



Department of Agriculture
Government of Western Australia



**LAND-USE AND
VEGETATION IN
WESTERN AUSTRALIA**

**NATIONAL LAND AND WATER
RESOURCES AUDIT REPORT**

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October 2002



**RESOURCE MANAGEMENT
TECHNICAL REPORT 250**

Resource Management Technical Report 250

Land-use and vegetation in Western Australia

Project DAW27 – National Land and Water Resources Audit

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October 2002



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Research and collation of information presented in this report was undertaken with the financial assistance of the National Land and Water Resources Audit. The project was undertaken for this program under Project DAW27.

The views and opinions expressed in this report are those of the authors and do not reflect the views of the Commonwealth Government or the Ministers for the Environment or for Primary Industry.

This report may be cited as:

Beeston, G.R., Hopkins, A.J.M. and Shepherd, D.P. (2002). Land-use and vegetation in Western Australia. Department of Agriculture, Western Australia, Resource Management Technical Report 250.

Summary

This report details a project to compile detailed land-use data for Western Australia, on pre-European and present vegetation, and aspects of disturbance of the present vegetation. Metadata on botanical surveys throughout the State were also compiled.

Land-use data have been compiled at property scale for all land outside the boundaries of the Perth Metropolitan Region and all other cities and townsites in Western Australia. WA Land-use codes (WASLUC) were attributed to individual agricultural enterprises. Land-use has been attributed according to the principal economic activity for each enterprise. Enterprises with a common land-use were combined in the final product. A simplified coding scheme is used for the properties within the Metropolitan Region and city and town sites.

The pre-European type vegetation and extent dataset builds on the vegetation map database developed over the past 14 years by G.R. Beeston and A.J.M. Hopkins which is based on 1:250,000 scale mapping. Additional attributes have been compiled to the nationally-agreed National Vegetation Information System standards. The data for present vegetation extent for the South West Intensive Land-use Zone were developed through on-screen interpretation and digitising from up-to-date orthophoto coverages. Data for the remainder of the State were interpreted from the land-use dataset. Data on disturbances to native vegetation in the South West Intensive Land-use Zone were compiled through standardised interpretation of the orthophotos. Data on threats to individual patches of native vegetation in this Zone were generated through GIS analyses. For the Extensive Land-use Zone, areas of minimal disturbance have been identified from the land-use mapping in this project, and from other data sources, using GIS analyses.

Land-use in Western Australia is dominated by extensive grazing of livestock with an aerial coverage of 40% of the total area of 2.5 million square kilometres. Minimum intervention use, predominantly Unallocated Crown Land, occupies a further 31%. Other significant land-uses include conservation and managed resource protection at 10%, indigenous land-uses at 9% and cropping at 8%. Land set aside for forestry and conservation is also reported.

Detailed land-use data at the individual enterprise level are available for local use by arrangement with the custodian. Land-use is a dynamic process and arrangements should be made to update the attribution regularly using ancillary information such as AGSTATS maintained by the Australian Bureau of Statistics.

A total of 833 vegetation types are recognised in Western Australia. The NVIS Level 3 and 4 attributes compiled during this project are an important step toward edge-matching and comparing data from other States and Territories. However, the compilation of more detailed data – NVIS Level 5 - will be required to complete this process. These vegetation associations range from tall forests through a wide variety of forests and woodlands, shrublands and grasslands, mostly with an overstorey of trees. Tables show the original pre-European and current extent of each of these. Some of these vegetation associations have been substantially reduced by clearing over the past 30 years. A total of 119 associations have been reduced to below 30% of their pre-European extent and of these, 48 have $\leq 10\%$ remaining and two are presumed extinct. The vegetation extent dataset represents an important benchmark/baseline for managing issues such as land clearing and carbon accounting.

Around 40% of the vegetation patches in the Intensive Land-use Zone were assessed for disturbance. Of these, about 41% were found to have been disturbed significantly, mainly through partial clearing. Some 8% of the patches mapped are at risk from rising groundwater and associated salinisation. Land clearing is also considered a threatening process. Within the Extensive Land-use Zone, 48% of the State is likely to have been minimally disturbed. This is more than 70% of the land presently attributed as Unallocated Crown Land. The disturbance and threats dataset is considered preliminary, as time and financial constraints precluded on-ground evaluations.

A total of 602 metadata datasets relating to botanical surveys throughout Western Australia were compiled to ANZLIC standards. These have been loaded to the WA Land Information System metadata node where they are publicly available.

This project has resulted in the compilation and/or upgrading of substantial spatial data about Western Australia. These datasets will be distributed widely and will be available to planners, managers and decision-makers. They also provide an accurate baseline against which changes in land-use, vegetation extent and disturbance can be assessed. Some proposals for maintaining the currency of the data are included.

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1. Introduction

1.1 Background

The National Land and Water Resources Audit commenced in October 1997 under the Natural Heritage Trust to provide data, analytical and decision tools to facilitate improved decision-making on land, water, vegetation and natural resource management at the Commonwealth, State/Territory and regional level.

The Audit has developed seven key themes as the basis for its activities:

1. Surface and groundwater management - availability, allocation, use and efficiency of use;
2. Dryland salinity;
3. Vegetation cover, condition and use;
4. Rangelands monitoring;
5. Land-use change, productivity, diversity and sustainability of agricultural enterprises;
6. Capacity of and opportunity for farmers and other natural resource managers to implement change; and
7. Waterway, estuarine, catchment and landscape health.

The Western Australian project

The Western Australian Land Use and Vegetation Data Project was developed in recognition of the close inter-relationship between the data needs under the Land-use and Vegetation Themes. This led to development of a project that integrates work on both themes. The project provides spatial datasets on original (pre-1750) vegetation, present vegetation (extent), disturbance of native vegetation, and a land-use database. The strength of this integrated approach lies in the ability to cross-validate aspects of the vegetation theme data with land-use data and vice versa. It also ensures that derived datasets e.g. vegetation cover derived through intersecting vegetation map data with land-use and vegetation cover data are reliable. The cross-validation and intersection requires that the datasets be comparable in terms of scale and accuracy.

The work was designed to produce results that could be integrated with the land-use projects undertaken elsewhere in Australia (e.g. in terms of compatibility of land-use definitions), and work undertaken under the Rangelands Theme.

1.2 Project objectives

The objectives of *Land-use and Vegetation Mapping: Western Australia* were to:

- accurately map vegetation extent in the south-west agricultural area where much of the original vegetation cover has been removed for intensive agricultural activities;
- describe this vegetation, and that of the pastoral region outside the south-west, at the vegetation association level;

- describe the condition of a large sample of the vegetation in the south-west agricultural area in terms of the level of disturbance in individual patches;
- indicate which regions in the pastoral region have been subject to minimal disturbance from human activities over the long-term;
- describe land-use throughout Western Australia in terms of the dominant enterprise occurring on each property, or the type of purpose assigned to each parcel controlled by the Crown;
- relate the themes of land-use and vegetation in Western Australia in terms of the current status of vegetation and the potential for minimising further deterioration of native vegetation in the State.

The project was designed to have eight major outputs:

- a digital map of pre-1750 vegetation of the Western Australia attributed according to nationally agreed standards and at scales of 1:250,000 for the areas of intensive land-use and 1:1,000,000 for the areas of extensive land-use;
- a digital map of present vegetation of Western Australia attributed according to nationally agreed standards and at scales of 1:250,000 for the areas of intensive land-use and 1:1,000,000 for the areas of extensive land-use, derived from the intersection of the pre-1750 data with the land-use and vegetation extent data;
- a digital map of 1995 cover of deep-rooted perennial vegetation and other vegetation, throughout Western Australia, attributed according to a nationally agreed classification at scales of 1:250,000 for the areas of intensive land-use and 1:1,000,000 for the areas of extensive land-use;
- a digital map of estimated 1997 disturbance of natural vegetation throughout Western Australia, attributed according to a nationally agreed classification at scales of 1:250,000 for the areas of intensive land-use and 1:1,000,000 for the areas of extensive land-use;
- a digital land-use map for Western Australia that is accurate to the scale of 1:100,000 or better over the whole State compatible with nationally agreed standards for land-use mapping classes;
- a database with geocode for each agricultural enterprise related to an outer boundary, a broad classification of the enterprise and a land-use classification for individual parcels within each enterprise;
- metadata for all known vegetation, floristic and rangelands datasets; and
- project reports.

For the purposes of this project Western Australia has been divided into two zones. The Intensive Land-Use Zone (ILZ) describes the south-west agricultural area, dominated by intensive agricultural enterprises – mainly cropping and grazing with some horticulture, intensive livestock production and resource protection. The Extensive Land-Use Zone (ELZ) describes the remainder of the State, where land-use is dominated by grazing and mining activities. These zones are described in Figure 1.

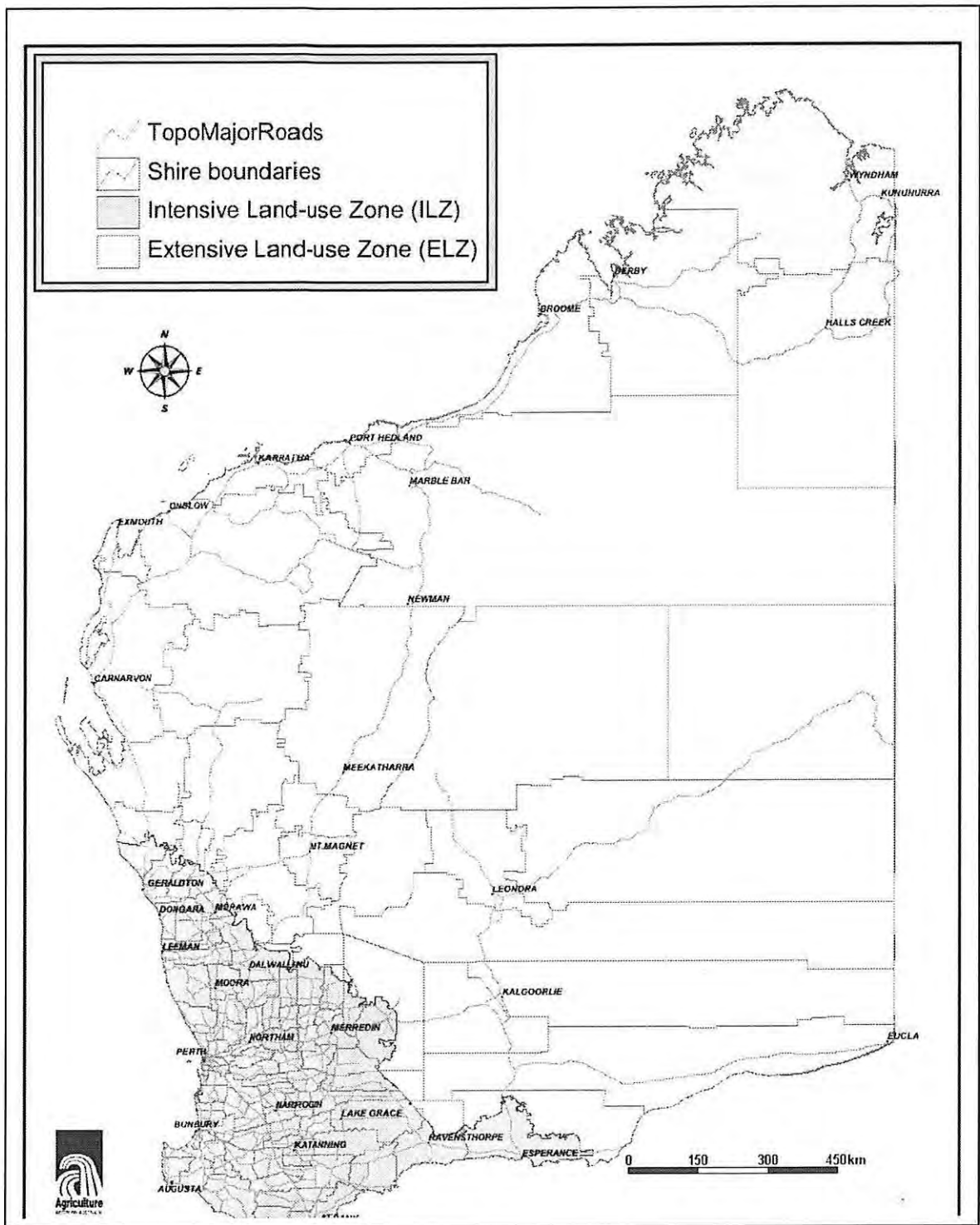


Figure 1. Land-use zones in Western Australia

2. Land-use

G.R. Beeston, D.P. Shepherd & N. Stephenson

2.1 Background

Accurate and reliable land-use data are now considered an important input into natural resource management and planning with the expanding use of integrated catchment planning processes. To meet these requirements, mapping techniques based on satellite remote-sensed data have been developed. However, sophisticated data processing techniques are required to compensate for the limitations in the accuracy of land-use mapping based on satellite imagery (Budyanto *et al.* 1998). Most previous land-use mapping projects relied on manual interpretation from aerial photography and/or on-ground survey. At commencement of this project, some generalised land-use mapping was available (Jarvis 1979, Plumb 1979) and more detailed data for limited areas from land-use change (Burvill 1979, Murray 1979).

The Audit project in Western Australia was able to take a more detailed approach largely because of the existence within the Department of Agriculture of an information system called Agricultural Property and Client System (AGPACS) which has now developed into the Client Retrieval Information System or CRIS (Peluso 1995, Beeston *et al.* 1999). This utilises the State's spatial cadastral database parcel information that is then integrated into properties using data gathering during normal activities. An agricultural property is thus defined as a series of contiguous cadastral parcels being managed as a single enterprise.

The CRIS database includes information about properties, owners and managers, addresses and information about the Department's dealings with agricultural properties. Other linked systems relate to treatment of disease and protection of agricultural land. These include livestock and disease information systems, stock brands registry and field reporting systems.

CRIS provides the technical infrastructure for efficient data storage and delivery of information in a variety of graphical and textual formats. In addition, CRIS data can be spatially represented and analysed with many spatial datasets because it is integrated with agency GIS. Delivery of all data and information products can be through stand-alone workstations or web-based applications.

2.2 Methods

2.2.1 Coding system

A system of land-use coding has existed in WA for many years – developed first for reporting uses for the 500,000 parcels of land in the Perth Metropolitan Region. This system has become the agreed Western Australian Land Information System (WALIS) standard. The Western Australian Land Use Codes (WASLUC) are described in WALIS (1998).

The land-uses in this study are listed with their WASLUC Codes in Appendix 1 with the matching Australian Land Use Management (ALUM) Classification (Bureau of Rural Sciences 2002) adopted for the Australia-wide Audit project (Stewart *et al.* 2001).

2.2.2 Data collection

Because of the size and complexity of the agricultural landscape, the land-use component was run as three sub-projects:

Zone 4 – Perth Metropolitan Area, south-western and forests region

Attribution of this area is based on interpretation of digital and hard-copy air photos acquired after 1996. Point source land-use data from the Water and Rivers Commission was used after verification with other sources, for attributing the peri-urban areas of Perth. Other data sources include information provided by industry bodies, personnel from Local Government Authorities (LGAs), Ministry for Planning (MfP) and the Department of Conservation and Land Management (CALM). The capture scale varies between 1:25,000 and 1:100,000.

South West Agricultural Region outside Zone 4

Agricultural land-use information in the ILZ was collected from several different sources. A significant proportion was provided by field officers from the Department of Agriculture and Community Landcare Offices through written descriptions on printed 1:25,000 cadastral maps. This text was later converted to WASLUC codes during data entry with primary, and sometimes secondary, land-use assigned. The assigned land-use was the field officer's estimation of the land-use providing the primary source of income for each cadastral block. ABS agricultural statistics for the agricultural census of 1997 were attributed to 10 km grids and compared with the land-use mapping for this project to check for gross misclassifications.

Pastoral and desert region referred to as the Extensive Land-use Zone (ELZ)

Pastoral properties were initially identified from lease information held by the Department of Land Administration (DOLA). Leases with common management are grouped into properties as part of CRIS system after verification by staff. Land-use on pastoral properties was derived primarily from lease data on the numbers and type of stock.

Extensive irrigation areas at Carnarvon were mapped at the local office of the Department of Agriculture. The Ord River irrigation area was mapped from South Perth from a digital colour photo mosaic acquired in 1993 and 1994 and updated from recent aerial photographs.

Conservation reserves in all zones were derived from the CALM Estate datasets (TENIS, see Bowen 1996). Other reserves, including Crown reserves and Unallocated Crown Land, were derived from the DOLA Land Tenure and Reserves databases. These have been attributed with WASLUC Codes. The final dataset was also checked against the CAPAD dataset.

An inventory of pastoral leases that have recently been placed under CALM management has been collated at the Department of Agriculture. These were attributed appropriately and added to the land-use dataset.

2.3 Results

The dataset was compiled according to the three regions described in Section 2.2. Adjacent polygons with common land-use were merged and those less than 1 hectare removed. These tiles were then amalgamated into a single dataset and delivered to the Audit through the

Bureau of Rural Science (BRS). The full dataset is included on a CD-ROM, which can be obtained from the authors. Draft versions were checked against Commonwealth data standards by the BRS. Some problems were experienced by BRS in using the dataset originally supplied in Shapefile format. To overcome this difficulty, the dataset was converted to Arc/Info coverage with the assistance of the Western Australian Land Information System.

The dataset includes 39,118 polygons that fall into 59 land-use codes in the Australian Land Use Management (ALUM) Classification. Land-use is dominated by extensive livestock grazing with an aerial coverage of 40% of the total of about 2.5 million square kilometres. Minimum intervention use, predominantly Unallocated Crown Land, occupies a further 31%. Other significant land-uses include conservation and managed resource protection at 10% and indigenous land-uses at 9%. Agricultural activities account for most of the remainder, but only the principal economic activity for each property was mapped for these land-use types. These data are not suitable for calculating the aerial extent of agricultural activities. Figure 2 shows primary land-use types according to the ALUM classification for Western Australia. Figure 3 shows primary land-use types mapped for the ILZ.

Table 1. Summary of land-use by area of Western Australia

Tertiary Land-Use Code	Description	Area (ha)
13	Minimum Intervention use	1,125
110	Nature Conservation	1,348,065
111	Strict Nature Reserve	6,788,046
113	National Park	5,408,568
115	Habitat/species Management Area	2,537,911
120	Managed Resource Protection	9,515,512
122	Surface Water Supply	42,138
123	Groundwater	24,053
125	Traditional Indigenous Use	21,972,143
130	Other Minimum Intervention use	23,469
133	Remnant Native Cover	2,977,793
210	Livestock Grazing	101,353,524
220	Production Forestry	1,758
310	Plantation Forestry	3,084
311	Hardwood Plantation	62,008
312	Softwood Plantation	17,623
330	Grazing - Improved Pastures	540,819
340	Cropping	21,486,238
341	Cereals	20,668
343	Hay & Silage	10,124
360	Seasonal Horticulture	69,403
400	Production from Irrigated Agriculture & Plantations	8,241
410	Irrigated Plantation Forestry	531

Table 1 (continued)

Tertiary Land-Use Code	Description	Area (ha)
412	Irrigated Softwood Plantation	2,631
422	Irrigated Windbreaks	27
430	Irrigated Improved Pastures	21,660
431	Irrigated Woody Fodder Plants	312
432	Irrigated Pasture Legumes	19
434	Irrigated Sown Grasses	3,370
443	Irrigated Hay & Silage	1,612
450	Irrigated Perennial Horticulture	13,559
451	Irrigated Tree Fruits	23,068
452	Irrigated Oleaginous Fruits	7,230
453	Irrigated Tree Nuts	900
454	Irrigated Vine Fruits	36,848
455	Irrigated Shrub Nuts Fruits & Berries	350
456	Irrigated Flowers & Bulbs	13,517
457	Irrigated Vegetables & herbs	20,827
460	Irrigated Seasonal Horticulture	21,334
464	Irrigated Vegetables & herbs	147
510	Intensive Horticulture	478
511	Shadehouse	1,093
513	Glasshouses (Hydroponic)	286
520	Intensive Animal Production	18,722
521	Dairy	99,735
522	Cattle	407
524	Poultry	3,578
525	Pigs	5,287
530	Manufacturing & Industrial	7,238
540	Residential	171,695
541	Urban Residential	1,131
542	Rural Residential	5,524
550	Services	8,224
553	Recreation & Culture	61,808
555	Research Facilities	14
570	Transport & Communication	987
580	Mining	12,000
631	Aquaculture	1,463
632	Water Storage & Treatment	270
Total area		174,780,197

Note: Area is the total area of parcels on which the land-use listed is the principal economic activity. For agricultural activities this is not the actual area of production.

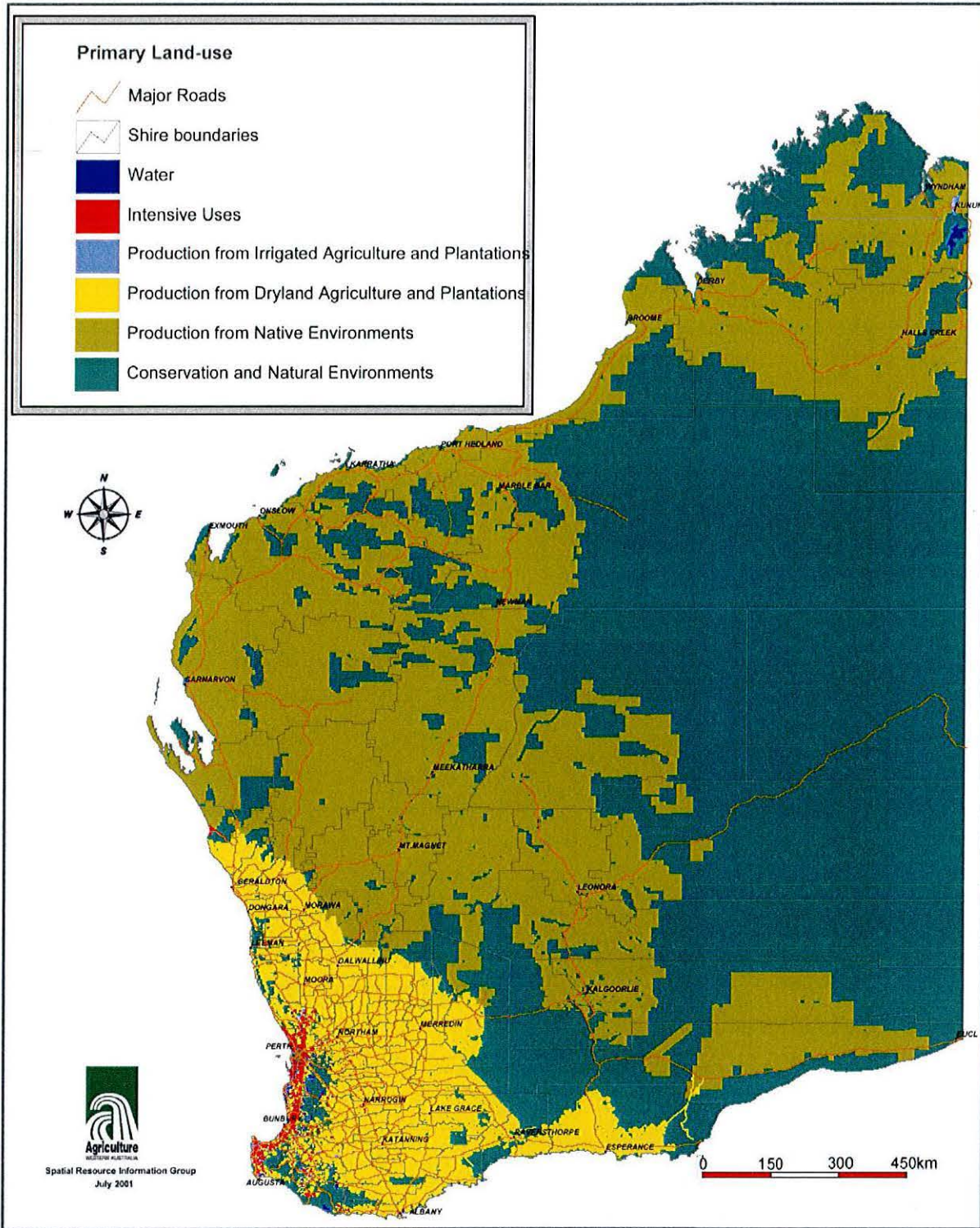


Figure 2. Primary land-use in Western Australia (Australian Land Use Management classification)

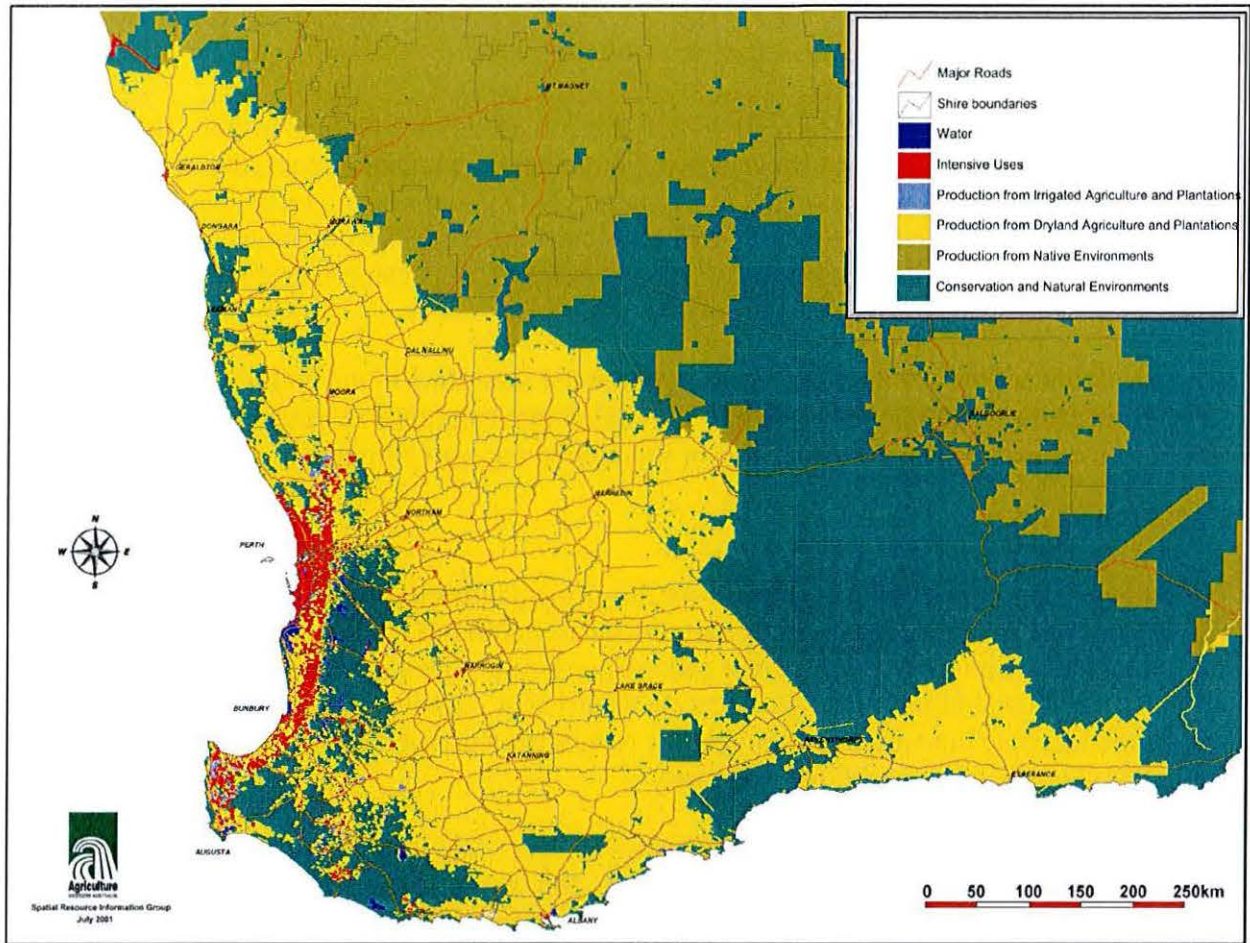


Figure 3. Primary land-use in the Intensive Land-use Zone of Western Australia (Australian Land Use Management classification)

2.4 Discussion

2.4.1 Data limitations

In preparing such a map, it must be realised that it is a snapshot at a particular time. In all areas not covered by perennial native vegetation or planted to perennial crops, the crop/pasture composition will vary on a yearly basis. No remote-sensing technique either using satellite data or aerial photography will enable the differentiation of annual or pasture types. Only field inspection or a census of agricultural producers can produce reliable figures on the areas of each crop.

For agricultural enterprises land-use has been attributed according to the dominant land-use for each enterprise, the principal economic activity on that enterprise or property. These data cannot be used to calculate the actual area of production for agricultural activities.

2.4.2 Data gaps

In most cases, land-use mapping compiled for this project indicates the principal economic activity for each property. For the most part, the dataset does not include land-use at a finer resolution than the property level (i.e. the paddock or field). The dataset does not include any attributes for other land-uses that may occur on a particular property. This dataset represents land-use for a single time period. Although this represents a useful baseline, it would be very useful to follow changes in land-use over time.

The development of a dataset with these attributes at finer scale would require considerable resources and was beyond the scope of this project. The current dataset will provide a base for the development of a more detailed dataset as a long-term objective. The tracking of changes in land-use at detailed scales represents a formidable challenge. Systems such as CRIS will facilitate the tracking of future changes in land-use through integration with other geocoded datasets. However, information on changes in historical land-use presents another challenge. A number of datasets are currently available which map changes in land tenure retrospectively. Land management may be implied, at least at a broad-scale, from these data, but little information is available on changes over time. Developing this information will require the combined use of remotely-sensed, historical records and statistical data.

2.5 *Summary and conclusions*

The land-use database developed through this project is very detailed. In Zone 4 of the ILZ, it contains information on production attributed to the cadastral parcel level. In the other zones, land-use is attributed at whole-of-property scale.

Using the ALUM Classification, Western Australia supports 59 land-uses, of which the most prominent are extensive livestock grazing (40% of total State), minimum intervention use predominantly Unallocated Crown Land (31%), conservation and managed resource protection (10%), indigenous land-uses (9%) and cropping (8%). This is an accurate snapshot of patterns of land-use at about 1997 – with some variability depending on data sources. This dataset will serve as a valuable benchmark in years to come.

This detailed land-use database is a considerable advance on previously available mapping that identified only five major land-uses. The database provides a solid foundation for planning and decision-making at all levels. It has seen immediate application in the recent locust control program, and has potential uses as the primary produce labelling and accreditation programs become more widespread. Further, it has considerable potential as a teaching and research tool in the field of geography. To develop these applications it will be necessary to identify and attribute other land-uses for each property and eventually the aerial extent of the major land-use activities for each property.

Maintenance of the currency of the land-use data will present some challenges in a time of limited resources in the public sector. We have attempted to address that issue in Western Australia through an agreement with the Australian Bureau of Statistics. Under this agreement, the Client Retrieval Information System (CRIS) is being matched with the Australian Bureau of Statistics business register so that after future agricultural census collection, the data will be geocoded and be capable of producing an updated land-use map.

Also the CRIS system has the potential to link with specific industry databases. This database can, then, be used to update particular sections of the database. Projects are already underway with the pig and wine industries to update the data both for the industry groups to service their members and for public sector agencies to better serve their clients.

No comparison has been made with the national map produced by the BRS project (Stewart *et al.* 2001) as the two projects use very different methodologies and produce products at completely different scales. For example, data from this project can be used in some areas be used at a scale of 1:25,000 for some areas whereas the national product should not be used below a scale of 1:1,000,000.

3. Vegetation type and extent

A.J.M. Hopkins, D.P. Shepherd, and S. Mazzilli

3.1 Background

Western Australia covers a large mass of land from 14 to 35° south latitude with a wide range of substrates exposed to many climates. These factors, coupled with the evolution of this part of the continent (e.g. Hopper *et al.* 1996), have produced an interesting and remarkably diverse biota. For example, the known vascular flora totals 11,000 species (Beard *et al.* in press b), and the South West Botanical Province is described as one of 25 Biodiversity Hotspots in the world (Meyers *et al.* 2000). The vegetation is a component and a reflection of that diversity.

In 1964, the Director of Kings Park and Botanic Garden, J.S. Beard initiated a project called the Vegetation Survey of Western Australia. The objective was an inventory of plant communities throughout the State as a necessary part of the basic scientific information required to develop native plants in horticulture. Over the next 17 years, Beard produced seven 1:1,000,000 scale maps of the vegetation, 24 1:250,000 maps for the south-west between Shark Bay and Esperance (all with explanatory text), together with a number of additional publications (see Beard *et al.* in press (a) for a comprehensive bibliography). All these maps attempted to depict the vegetation as it might have been at the time of settlement, prior to the extensive clearing for urban development and agriculture and the changes induced by pastoralism, depopulation by Aboriginal people and so on (i.e. it represents pre-European vegetation type and extent). Beard did not produce 1:250,000 scale maps of the extreme south west: these three map sheets were produced by F.G. Smith, based on a different mapping protocol. This gap has been filled recently by A.J.M. Hopkins (unpublished), so there is a complete, consistent coverage of vegetation mapping (Beard *et al.* in press a).

Since 1986, work has been underway to capture all of Beard and Hopkins' vegetation mapping to a Geographic Information System (GIS) and associated Relational Database Management System (ORACLE) as Phase 1 of a vegetation database for the State (Hopkins *et al.* in press). There is a seamless map coverage at the scale of 1:250,000 with a consistent nomenclature. The vegetation associations in the State-based database have been agglomerated in a systematic way to give more general units suitable for mapping at smaller scales (e.g. Beard *et al.* in press a).

The first inventory of the extent of remaining vegetation in the heavily-cleared agricultural region of south-western Australia was published by Beeston *et al.* (1996). This inventory was compiled predominantly from hard-copy airphotos acquired during the 1980s. The results have been used until recently to formulate guidelines for the assessment of land clearing applications by the Commissioner for Soil and Land Conservation and for numerous other land-use planning activities.

In 1996 the Commonwealth coordinated State agencies through the Bureau of Rural Sciences in the Australian Land Cover Change (ALCC) project. This used Landsat TM satellite imagery to study gross change in vegetation cover in the intensive agricultural regions of Australia between 1990 and 1995. Results were released in September 2000 (Barson *et al.* 2000). The project also produced vegetation cover mapping current to 1995/96. However,

the resolution of the Landsat TM-derived datasets is less than previous work undertaken using airphotos, and there was a problem with the mis-classification of vegetation types that did not have a substantial tree cover e.g. open woodlands and the many shrubland and heath vegetation types that are widespread in south-western Australia. The opportunity was taken therefore to substantially enhance and update present vegetation extent datasets using aerial photography.

In the present project, the pre-European vegetation type and extent datasets and the present vegetation extent dataset were substantially upgraded to agreed national standards, and these two datasets were intersected to produce a coverage of present vegetation type and extent.

The availability of comparable datasets for pre-European vegetation type and extent, and present vegetation type and extent, provides the opportunity to quantify the impacts of land clearing on individual vegetation types in relation to emerging criteria. The most specific articulation of native vegetation clearing criteria is that of the Western Australian Environmental Protection Authority (EPA 2000), which are based on the Australian and New Zealand Environment and Conservation Council's *National Framework for the Management and Monitoring of Australia's Native Vegetation* (ANZECC 2000):

From a purely biodiversity perspective and taking no account of any other land degradation issues, there are several key criteria now being applied where clearing is still occurring:

- the threshold level below which species loss appears to accelerate exponentially at an ecosystem level is regarded as being at a level of 30% of the pre-clearing extent of the vegetation type;
- a level of 10% of the original extent is regarded as being a level representing "endangered". (EPA 2000 page 6).

Similar criteria were applied in the Comprehensive Regional Assessments for the various forest regions in southern Australia (JANIS 1997, C&WARFASC 1998), with $\leq 30\%$ of original extent remaining vegetation type being referred to as 'vulnerable', and the $\leq 10\%$ of original extent remaining type as endangered. The recent conservation assessment of Queensland's bioregional ecosystems (Satler and Williams 1999) has also used the 10% and 30% criteria, and the terminology of 'endangered' and 'of concern'. It is anticipated that the 10% and 30% threshold levels will be applied in developing criteria for nation-wide assessment when the Environmental Protection and Biodiversity Conservation Act 1999 (Cwlth) becomes fully operational.

In mid-1998, work commenced on developing a framework for auditing and compiling data and information on Australia's vegetation as part of Task 1 of the Audit's Theme 3 Vegetation Cover Condition and Use work plan. The National Vegetation Information System (NVIS) was developed from this framework. During project DAW27 the Commonwealth coordinated development of the National Vegetation Information System (NVIS) in collaboration with State agencies (National Land and Water Resource Audit 2000a). In Western Australia the opportunity was made to link the activities of these projects. NVIS seeks to develop a nationally consistent vegetation information system to support the State, Territory and Commonwealth requirements for vegetation information. For example, it is anticipated that the national NVIS database and associated spatial data will be used as a primary dataset for environmental assessments, monitoring and reporting at both regional and continental scales. The long-term coordination for the NVIS database is a joint responsibility for Environment Australia and Bureau of Rural Science (BRS). Arrangements have been agreed for the maintenance of the NVIS Stage 1 database to be co-ordinated through

Environment Australia and the BRS. Data will be available through the custodian or through a national node of the Australian Spatial Data Directory. Products will be served-up through the Audit's Natural Resource Atlas (www.environment.gov.au/atlas).

3.2 Methods

3.2.1 Pre-European vegetation

The pre-European type and extent vegetation dataset builds on the vegetation map database developed over the past 14 years by G.R. Beeston and A.J.M. Hopkins (Hopkins *et al.* in press). This is based on 1:250,000 scale mapping by J.S. Beard and A.J.M. Hopkins.

During the current project the pre-European database was modified to remove a number of inconsistencies in the original mapping between 1:250,000 scale map sheets. Some detail was added for particular vegetation types where new information is available. Finally, additional attributes were compiled to the nationally-agreed National Vegetation Information System (NVIS) standards. These attributes have been loaded to the NVIS data compiler (National Land and Water Resource Audit 2000b) and delivered, with spatial datasets, to the Commonwealth through the Bureau of Rural Sciences.

3.2.2 Present vegetation extent

The starting point for developing the '*present vegetation extent datasets*' for the Intensive Land-use Zone (ILZ) was the Australian Land Cover Change (ALCC) data. These data were derived from 1995 Landsat TM satellite imagery, with substantial checking, during the ALCC project (Shepherd *et al.* 1999, Barson *et al.* 2000). The ALCC mapping has been corrected and improved using digital aerial photography (orthophotos) acquired from 1996 to 1999. The most extensive corrections were made to chenopod-dominated vegetation in the broad saline valley floors of the South West Agricultural Region (Figures 4 and 5). These contain sparse, low but substantial vegetation that was poorly defined in mapping derived from Landsat imagery. Substantial corrections were also made to heath shrublands in the Agricultural Region, including extensive areas within the Geraldton and Esperance Sandplains Bioregions, and open woodlands throughout the Agricultural Region.

Orthophotos were not available for some areas. Here, vegetation extent was checked and corrected using un-rectified digital aerial photography and a Landsat TM image base. These areas will be less-reliably mapped than those for which orthophotos were available. The methods used to map various areas of the ILZ are illustrated in Figure 6.

The ELZ is presumed to carry native vegetation cover except for the major irrigated areas at Kununurra and Carnarvon. These irrigated areas have been removed from extent mapping for the ELZ using the land-use dataset developed during this project.

3.2.3 Present vegetation extent by type

The pre-European vegetation type and present extent datasets were intersected in order to develop a surrogate dataset for present vegetation type and extent. Plantations were derived from CALM's State Plantations dataset for those areas managed by CALM and from the State Sharefarm Inventory dataset currently held by Transport Western Australia for areas under private ownership. These have been combined for the current project in the land-use dataset.

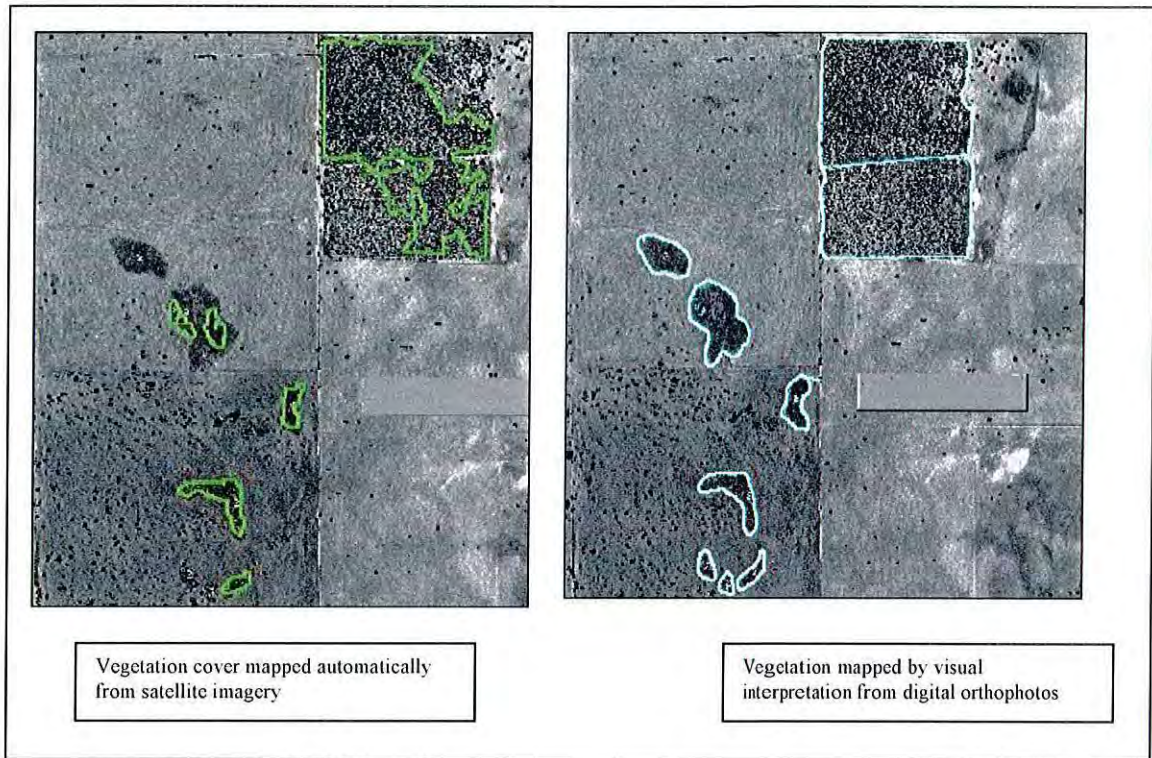


Figure 4. Comparison of vegetation mapping from satellite imagery and digital orthophotos – open woodland and heath

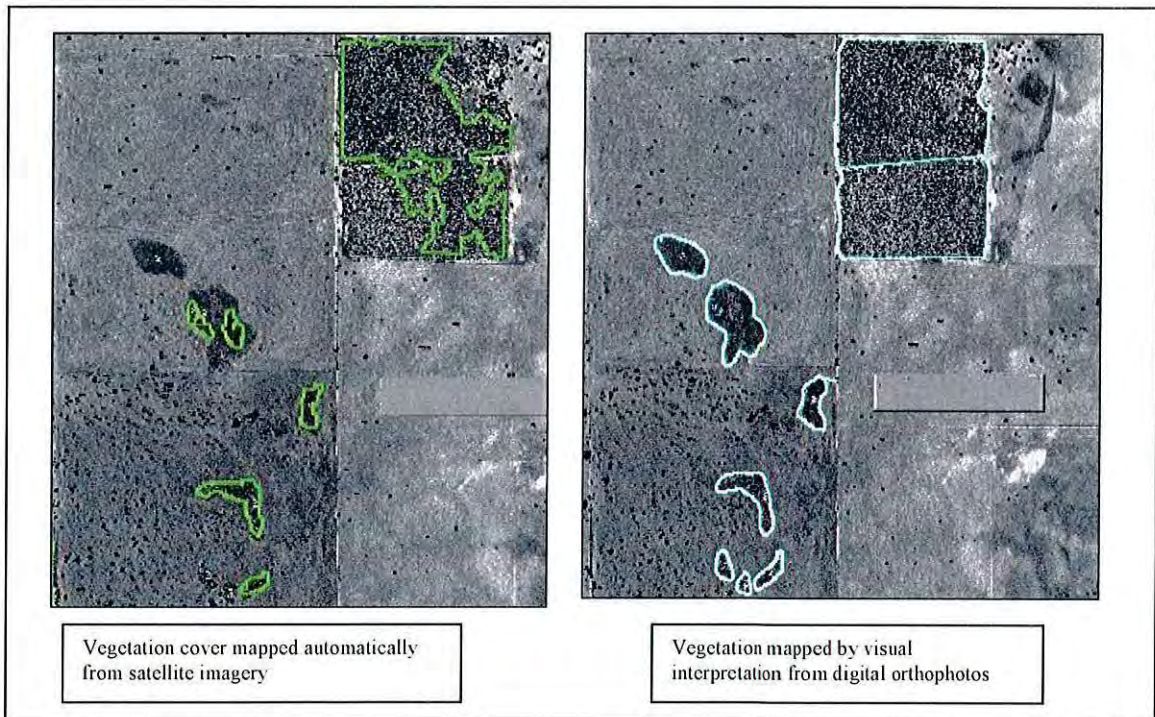


Figure 5. Comparison of vegetation mapping from satellite imagery and digital orthophotos – saline valley floors

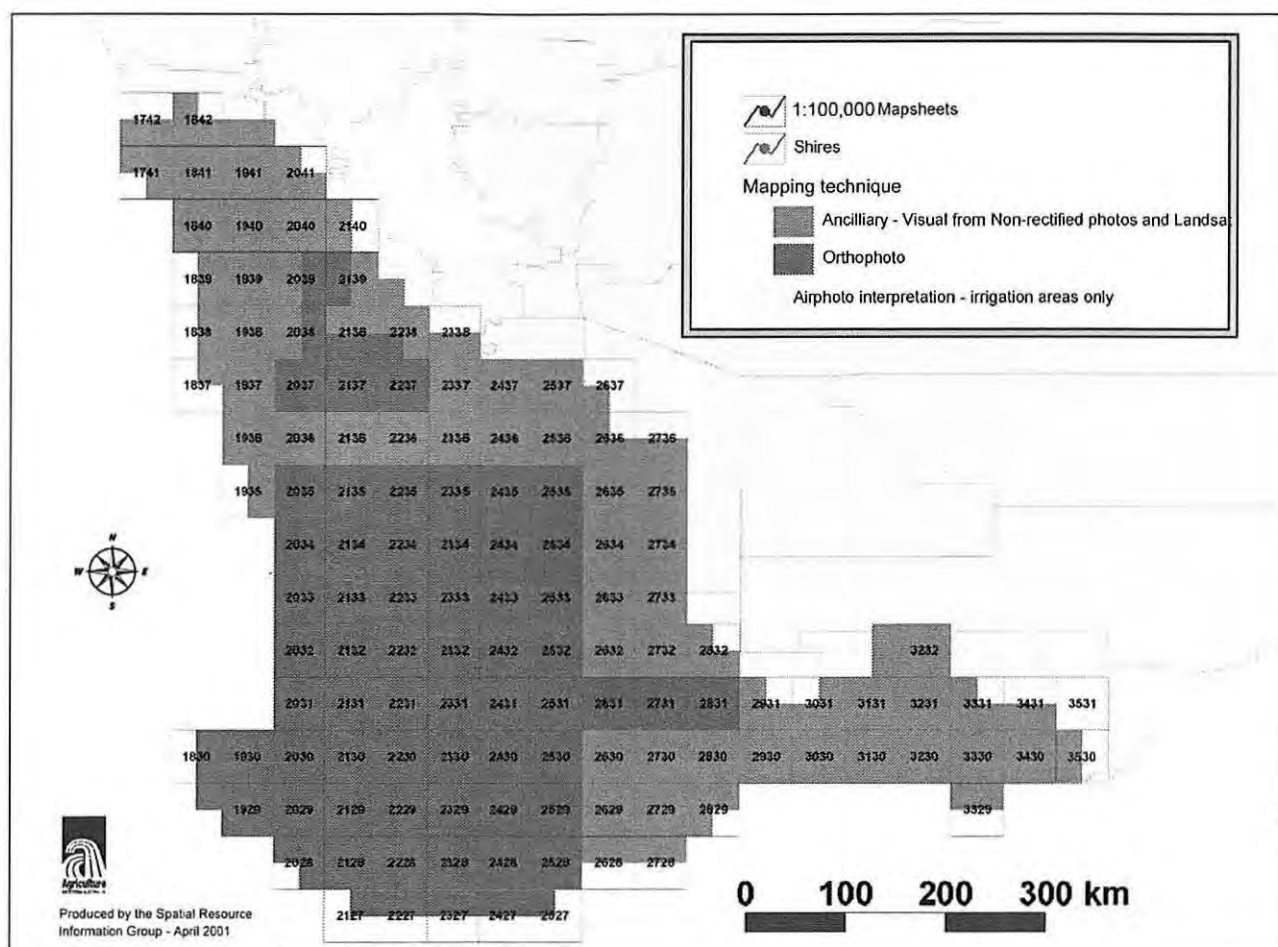


Figure 6. Methods used to update vegetation extent mapping

3.2.4 Contributions to development of the NVIS – Stage 1

State representatives attended a workshop to refine NVIS attributes 5-8 July 1999. The outcome was a refined set of attributes for NVIS that coincides with those being collected for project DAW27. A draft version of the NVIS data entry tool was also discussed.

State agencies in Western Australia received a working version of the NVIS data entry tool or compiler in October 1999. During November and December 1999 State collaborators compiled NVIS attributes for the pilot project areas from the existing pre-European digital dataset derived from J.S. Beard's original mapping (Hopkins *et al.* 1996) and some additional information from J.S. Beard's published map memoirs. The state data compiler and associated digital spatial datasets were then forwarded to the BRS in January 2000.

Details for map units loaded to the data compiler are based on an existing ORACLE database developed in a GIS environment over the past 14 years by G.R. Beeston and A.J.M. Hopkins (see above, and Hopkins *et al.* in press). Its development is described in Figure 7.

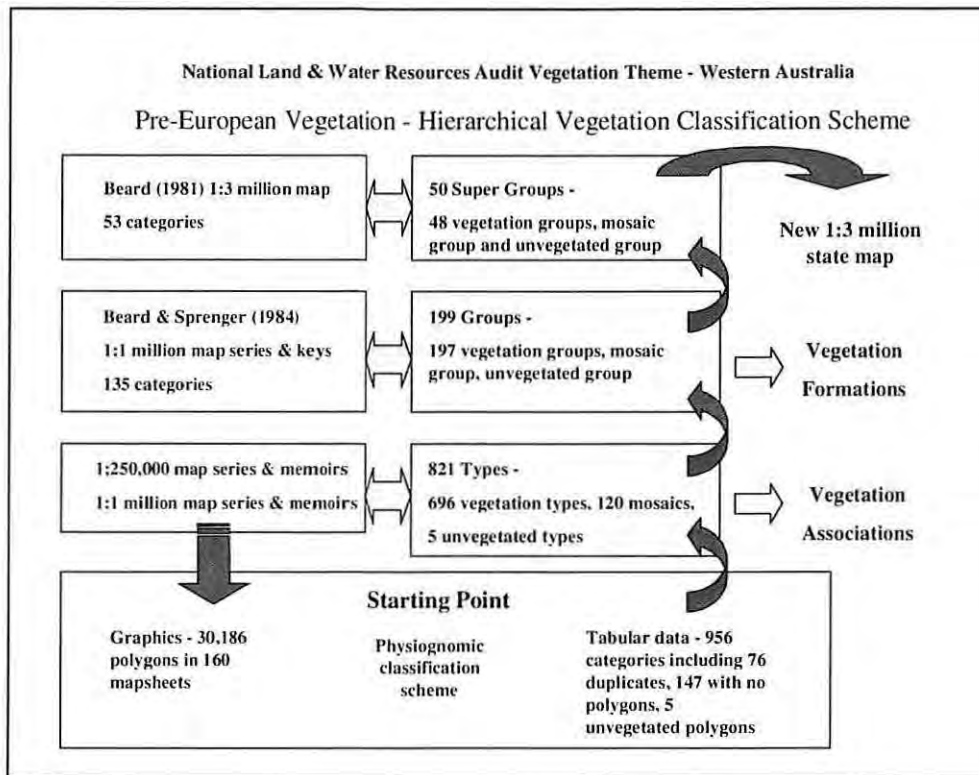


Figure 7. Development of the hierarchical classification scheme for vegetation in Western Australia

Figure 7 shows three levels of attribution in the Western Australia database in order of increasing complexity: 1:3 million, vegetation formation, and vegetation association. The Australian Vegetation Attributes V5.0 (NLWRA 2000a) describe six levels of classification for vegetation data. These are (in order of increasing complexity): class, structural formation, broad floristic formation, sub-formation, association and sub-association. These units are described in Table 2 derived from NLWRA (2000a).

The NVIS Information Hierarchy (derived from NLWRA 2000a)

Hierarchical Level	Description	NVIS structural/floristic components required
I	Class	Dominant growth form for the ecologically dominant stratum
II	Structural Formation	Dominant growth form, cover and height for the ecologically dominant stratum.
III	Broad Floristic Formation	Dominant growth form, cover, height and broad floristic code usually dominant land cover genus for the upper most or dominant stratum.
IV	Sub-Formation	Dominant growth form, cover, height and broad floristic code usually dominant Genus and Family for the three traditional strata. (i.e. Upper, Mid and Ground)
V	ASSOCIATION	Dominant growth form, height, cover and species (3 species) for the three traditional strata. (i.e. Upper, Mid and Ground)
VI	Sub-Association	Dominant growth form, height, cover and species (5 species) for all layers/strata

During compilation of data for NVIS we considered the vegetation association from the Western Australian database to be equivalent to Level 5 – Association – in the NVIS structure. Unfortunately, the floristic data required to describe fully describe these units to NVIS Level 5 does not currently exist in the native Western Australian database and is time consuming to derive from the source, most of which was compiled by J.S. Beard. Some

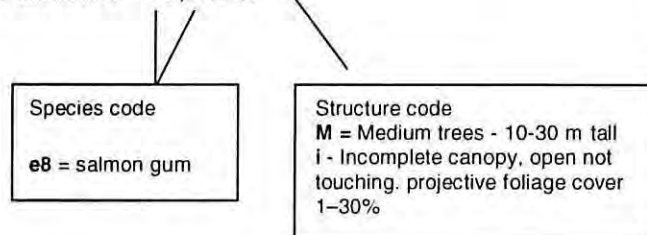
detailed information has been compiled over a number of years for the 50 or so units in the 1:3 million-scale map of vegetation. However, we did not consider it practical to compile this level of information for all 833 associations mapped in WA for NVIS Stage 1. For the purposes of NVIS Stage 1 attributes have been compiled to NVIS Level 3 or 4. Consequently there is an information gap in the current attribution of the NVIS Stage 1 dataset.

Most of the polygons in the pre-European vegetation dataset are based on those mapped originally by J.S. Beard during the 1970s and 1980s. The boundaries between vegetation types mapped at this scale are not likely to have changed appreciably between when the vegetation boundaries were mapped and the NVIS baseline of 1997. Rather, the change has been in the extent of native vegetation remaining. This is where most work in vegetation mapping for the current project was undertaken.

For the purposes of compilation to the NVIS data compiler the native Western Australia ORACLE vegetation database was output to an Access database and an abbreviated version the structure of the NVIS database duplicated. NVIS attributes were then derived from coded information in the native vegetation database. The following is an example:

Map Unit 8 - Medium woodland; salmon gum (*E. salmonophloia*) & gimlet (*E. salubris*)

Vegetation code from native WA database - e8,34Mi



The NVIS vegetation attribute framework specifies the dominant stratum through ecological dominance. Species in this stratum can be derived directly from these codes. The dominant species in other strata are also often included in this code and could be derived directly for the NVIS database. Other information on the structure and composition of each strata had to be collated from the published memoirs of J.S. Beard. Some unpublished information had also been collated during the development of the native WA vegetation database and was used to derive NVIS Levels 1 to 4.

In February 2000 a second workshop was held in Brisbane to discuss the results of the first collation of State datasets for NVIS. The main issues discussed were resolution of differences between mapping across State borders, enhancements to the NVIS compiler software and planning for information products to be developed from NVIS. At a second workshop in February 2000 technical issues relating to the resolution of differences in mapping across State borders and development of NVIS attributes and the data compiler were discussed.

A technical workshop was held in February 2001 to discuss the presentation of datasets delivered to the NLWRA through NVIS and resolve any outstanding technical issues relating to vegetation mapping by the States. This was followed by the final NVIS Stage 1 workshop in March 2001 at which agreement from State representatives was sought on the format and content of the final NVIS report to the NLWRA. At these workshops the Commonwealth indicated that the long-term coordination for the NVIS database (version 1) is a joint responsibility for EA and BRS. Arrangements have been agreed for the maintenance of the

NVIS Stage 1 database to be co-ordinated through Environment Australia and the BRS. Data will be available through the data custodian or through a national node of the Australian Spatial Data Directory. Products will be served up through the Audit's Australian Natural Resource Atlas (www.environment.gov.au/atlas)

3.3 Results

3.3.1 Pre-European vegetation

A total of 833 vegetation types are recognised in Western Australia after development of the NVIS dataset. Of these, 127 are mosaics consisting of one or more of the individual units. Eleven individual units are included that occur only as components of mosaics, and five sparsely vegetated units such as bare ground and granite rock that are considered to support unique vegetation but in relatively limited amounts. The units have been entered into the NVIS Data Compiler (see Section 3.3.4).

Some 30,186 polygons are incorporated into the graphics database. The polygons range from 0.0005 to 1,644,239 ha, with the predominance of larger polygons occurring in the Little Sandy, Great Sandy and Gibson Deserts, and parts of the Nullarbor. Many of these large polygons represent vegetation mosaics of dune and swale vegetation. There is greater level of detail and discrimination in the ILZ. Despite this variation, we treat all the vegetation units as equivalent within the classification hierarchy: they are all attributed as associations.

3.3.2 Present vegetation extent

The ELZ describes the region in which the land-use is dominated by grazing and mining activities. Although the extent of native vegetation region remains largely intact, the structure and floristics have been substantially altered since European settlement by grazing by introduced animals such as sheep, cattle, goats and rabbits, and by altered fire regimes. Vegetation extent in Western Australia is illustrated in Figure 6.

The ILZ has been extensively cleared for intensive agricultural activities – principally cropping and grazing on improved pastures, intensive animal production and horticulture. Only the jarrah, marri and karri forests of the extreme south-west remain largely intact. The Swan coastal plain, wheatbelt and mallee regions have been largely cleared and only patches of the original vegetation remain. Vegetation extent in the ILZ is illustrated in Figure 7.

A total of 236,108,924 ha of native vegetation was mapped - 93% of the State. This comprises 228,447,741 ha in the ELZ (99.9%, Figure 4) and 7,668,183 ha in the ILZ (30.3%).

3.3.3 Present vegetation extent by type

Appendix 2 lists the pre-European and present aerial extents of each vegetation association. These associations are based on the original WA descriptions rather than the NVIS units. Many associations have been substantially reduced by clearing over the past 170 years. A total of 119 associations have been reduced to below 30% of their pre-European extent and, of these, 48 have $\leq 10\%$ remaining and two are probably extinct. These are listed in Table 2.

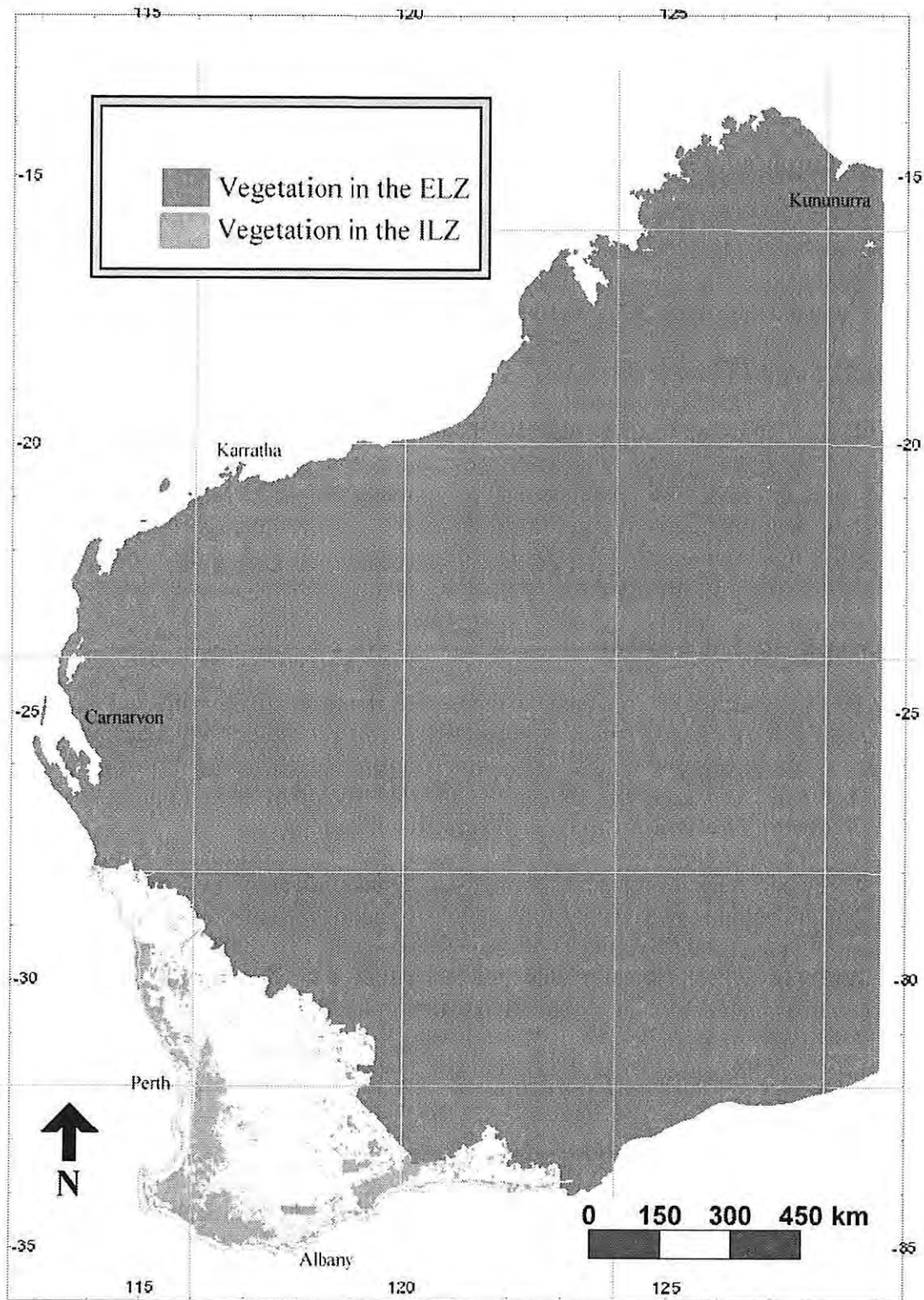


Figure 8. Present vegetation extent in Western Australia

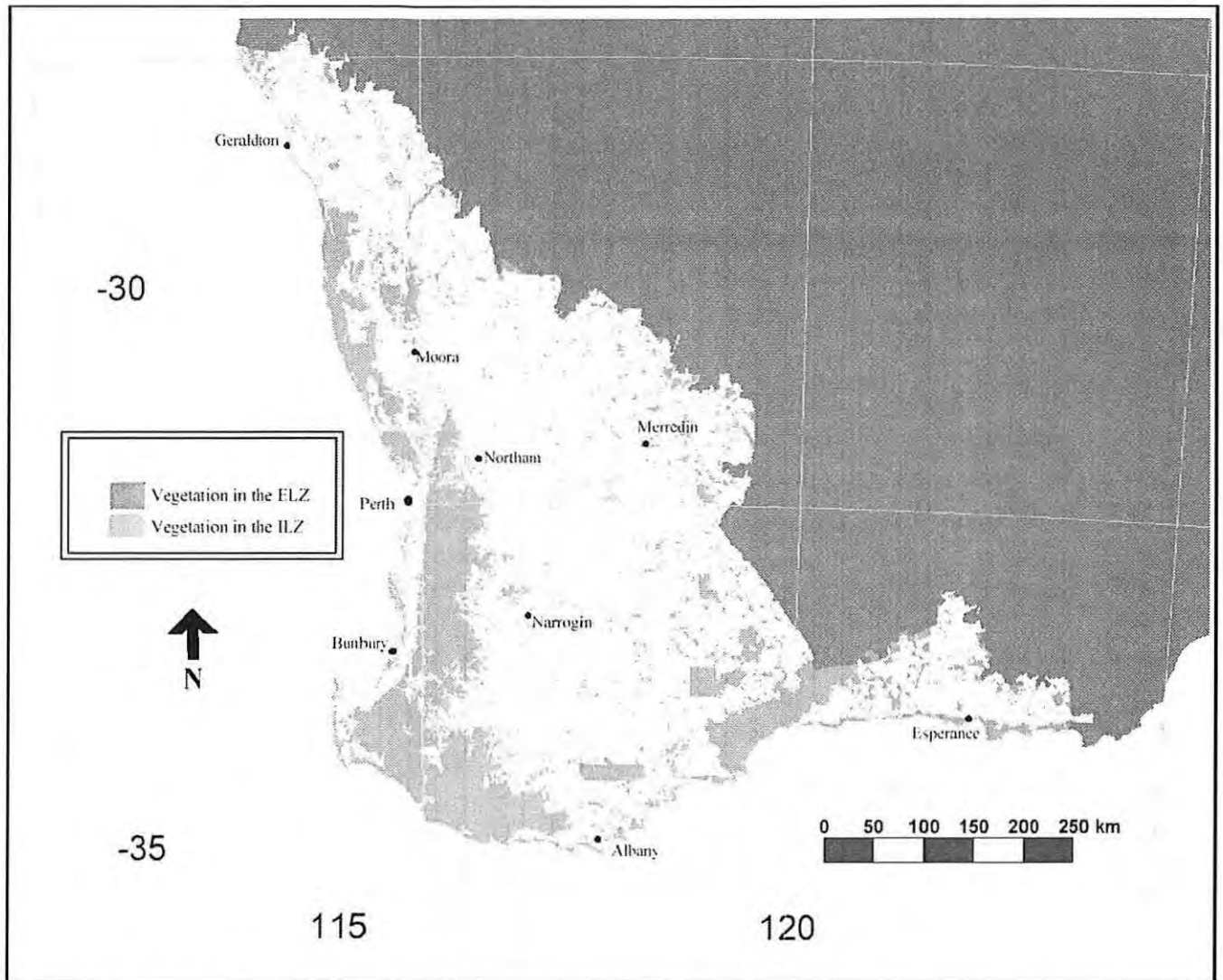


Figure 9. Present vegetation extent in the Intensive Land-Use Zone of Western Australia

A total area of 236,108,924 ha of native vegetation was mapped or 93% of the State. This comprises 228,447,741 ha (99.9%) in the ELZ (see Figure 4) and 7,668,183 ha (30.3%) in the ILZ (see Figure 5).

The results of the detailed present vegetation extent mapping from the current study were compared with those from the ALCC project (Barson *et al.* 2000). For all the agricultural shires in the ILZ, the present extent of native vegetation is 7,477,552 ha (from the current study). This is 487,741 ha, or 6.5% greater than for the ALCC project. The difference is primarily due to differences in mapping techniques between the studies. The ALCC study is based on an automated classification from Landsat satellite imagery whereas the current study is based on visual interpretation of digital aerial photography by skilled operators.

Table 2. Vegetation associations with less than 30% of their original distribution remaining in Western Australia
 (Descriptions are derived from the Western Australian vegetation database and are not NVIS descriptions)

Vegetation Association	Pre-European Extent	Current Extent	% Remaining	Description
16	3,463	253	7.3	Low forest, bushy yate (<i>E. cornuta</i>) & Bald Is. marlock (<i>E. lehmanni</i>)
1154	45,176	3,306	7.3	Shrublands, Acacia thicket with patches of heath
939	142	10	7.3	Succulent steppe with woodland, yorkgum, sparse teatree scrub & samphire
1093	9,924	759	7.6	Succulent steppe with open woodland & thicket, eucalypts & <i>Allocasuarina obesa</i> over teatree & samphire
960	190,026	15,215	8.0	Shrublands, mallee scrub, redwood & black marlock
948	1,707	139	8.1	Medium woodland, York gum & river gum
1044	1,678	137	8.2	Mosaic, Medium woodland, York gum & salmon gum / Shrublands, <i>Melaleuca thyioides</i> thicket
1136	68,762	6,048	8.8	Medium woodland; marn with some jarrah, wandoo, river gum and casuarina
1024	854,342	77,984	9.1	Shrublands; mallee & casuarina thicket
48	57,809	5,484	9.5	Shrublands; scrub-heath
371	37,651	3,703	9.8	Low forest, <i>Acacia rostellifera</i>
956	29,772	2,930	9.8	Shrublands, <i>Allocasuarina campestris</i> thicket with scattered wandoo
1156	1,996	197	9.9	Shrublands, <i>Allocasuarina campestris</i> thickets with scattered jam & casuarina
7	287,299	28,838	10.0	Medium woodland, York gum (<i>E. loxophleba</i>) & wandoo
35	213,685	21,972	10.3	Shrublands, jam scrub with scattered York gum
1055	148,790	15,924	10.7	Shrublands, York gum & <i>Eucalyptus sheathiana</i> mallee scrub
1021	1,458	158	10.8	Mosaic, Medium open woodland, wandoo / Shrublands, dryandra heath
999	275,380	32,451	11.8	Medium woodland; marn
25	10,747	1,287	12.0	Low woodland, <i>Allocasuarina huegeliana</i> & York gum
961	37,131	4,604	12.4	Mosaic, Shrublands, scrub-heath (SE Avon) / Shrublands, <i>Allocasuarina campestris</i> thicket
698	13,115	1,772	13.5	Mosaic, Shrublands, scrub-heath <i>Dryandra-Calothamnus</i> assoc. with <i>B. prionotes</i> on limestone in the northern Swan Region / Sparse low woodland; wandoo & powderbark wandoo
1057	127,479	18,251	14.3	Mosaic, Shrublands; Medium woodland; salmon gum & gimlet / York gum & <i>Eucalyptus sheathiana</i> mallee scrub
4801	70,176	10,182	14.5	Shrublands, heath with scattered <i>Nuytsia floribunda</i> on sandplain
1056	24,475	3,570	14.6	Shrublands, thicket, acacia & <i>Allocasuarina campestris</i>
953	11,519	1,718	14.9	Succulent steppe with thicket, teatree over samphire (m5?)
952	70,253	10,575	15.1	Shrublands, dryandra heath
352	874,652	133,255	15.2	Medium woodland, York gum
6048	135,614	20,728	15.3	Shrublands, banksia scrub-heath on sandplain in the Esperence Plains Region
954	6,846	1,052	15.4	Shrublands, thicket, Jam & <i>Allocasuarina huegeliana</i>
1053	16,300	2,587	15.9	Shrublands; <i>Melaleuca uncinata</i> thicket with scattered York gum
1098	21,730	3,469	16.0	Mosaic, Medium sparse woodland, salmon gum & morrel / Succulent steppe, samphire
1048	13,393	2,192	16.4	Mosaic, Shrublands, melaleuca patchy scrub / Succulent steppe, samphire
1038	1,999	333	16.7	Medium open woodland, eucalypts (e2?), with low woodland, <i>Banksia attenuata</i> & <i>B. menziesii</i>

3.3.4 Contributions to development of the NVIS

Comma delimited (.CSV) files for each NVIS tables – MapUnit, Strata, GrowthForm, Taxon and TaxonList - were output from a temporary access database. Problems were experienced in using .DBF files as these tended to truncate fields. The .CSV files were then loaded to the NVIS data compiler using the automatic loading facility. Some formatting errors were identified as the .CSV files were automatically loaded to the compiler. Unfortunately, these formatting errors were not flagged until all .CSV files had been loaded to the compiler. It would be useful to be able to correct formatting errors in the compiler as the data is loaded.

On completion of the import of .CSV files the remaining fields for the database record were completed. These are predominantly metadata for the dataset. The completed compiler was then forwarded to BRS with the corresponding spatial data in ArcView Shapefile format.

Upon receipt of these data the BRS combined the Western Australian compiler data with datasets from other states. Some editions were requested by the BRS and the Western Australian data was recompiled and a second copy forwarded to BRS. The second copy of the compiler data was used by BRS as the basis of the final dataset but editions were made by BRS in consultation with collaborators in WA to ensure the dataset was compatible with datasets from the other states. The details of these editions are discussed in section 3.4.

Some problems in using the Shapefile format files were also experienced by BRS. A request was made by BRS to supply the data in Arc/Info export files (.e00). As there are no facilities at the Department of Agriculture to produce data in this format, they were re-processed at the Information Management Branch of the Department of Conservation and Land Management (CALM). The Arc/Info export files for the pre-European and Extant vegetation datasets produced by CALM were verified against the original datasets at the Department of Agriculture and then forwarded to the BRS.

The Map Units in the NVIS dataset for Western Australia range from tall forests, through a wide variety of forests and woodlands to shrublands and grasslands, mostly with an overstorey of sparse trees. Level 2 Structural Formation in the NVIS hierarchy is dominated by Hummock grasslands with 117 units; medium woodlands - 101 units; and tall shrublands - 96 units. At Level 2 there are also 46 low woodland units; 41 open-hummock grassland units; 39 tussock grassland units; 32 tall mallee shrubland units; and 30 tall-closed shrubland units. At Level 3 Broad Floristic level in the NVIS hierarchy, there are 136 *Triodia* grassland units, 148 eucalypt woodland units and 101 acacia shrubland units. A full list of the associations is provided in Appendix 2.

3.4 Discussion

The information in the Western Australian Vegetation datasets for pre-European Vegetation and Current Vegetation by Type were entered into the NVIS Data Compiler as Associations. Since the vegetation mapping is consistent in methodology over the State, the mosaic units are also considered to be association-level units. The sparsely vegetated units are also referred to as vegetation associations for ease of discussion. During compilation of data for NVIS it was believed that this level of standardisation would be satisfactory for edge-matching and comparing data from other States and Territories. Unfortunately, there were differences in the classification schemes used by Western Australia and the other States.

In Western Australia the Beard-Webb System has been used, while the other States use the Specht System. In the Specht System, the diagnostic layer is the tallest layer. In contrast, the Beard-Webb System focuses on the ecologically dominant layer - the layer which, because of height or density or both, is considered to have a controlling effect on other layers. It can be observed that dense canopies of trees or shrubs suppress the layers beneath them, but open canopies may not, and so the understoreys become fully developed. In this latter case, the understoreys can be considered dominant and are used to classify the vegetation.

The significance of the difference between the Specht and Beard-Webb Systems becomes apparent when considering such vegetation types as shrublands and grasslands with very sparse emergent trees. Using Specht these would be classed as open-woodlands whereas Beard-Webb classes them as shrublands or grasslands.

An interim solution to this problem has been developed by re-classifying some of the Western Australian Map Units – in particular Savannah Woodland units in the Kimberley region (re-classified to grasslands). NVIS Major Vegetation Groups were also been developed by Environment Australia to facilitate the production of maps with a consistent vegetation classification across Australia for NVIS Stage 1.

It has been proposed by the BRS that, as a high priority for NVIS Stage II, the NVIS partners should aim to seek agreement on a definition of ecological dominance. A plan needs to be developed on how data custodians in all States might proceed to recode the datasets that they have supplied to the Audit using this agreed definition of ecological dominance.

3.4.1 Data limitations

It should be noted that the present vegetation extent data were derived through air photo interpretation without on-ground checking; therefore there may be minor errors in the data. The dataset is represented as 1997 vegetation extent. However, the mapping was derived from orthophotos acquired between 1995 and 1998, so that, in practice, there may be minor inconsistencies. It is recommended that the current extent dataset not be used at scales finer than 1:25,000. The dataset will require regular updating at periods not more than five years to remain reliable. In areas where vegetation is still being cleared, mainly the Perth metropolitan and urban-rural fringes the mapping should be updated at more regular intervals.

The authors also note the difference in scales and reliability between the pre-European vegetation mapping (type and extent) and the present mapping (extent only). The type and extent mapping should be used at scales no finer than that of the pre-European mapping, 1:250,000.

Attribution of vegetation types – the description of vegetation structure and floristic composition - is based on vegetation in a pristine or undisturbed state. In much of the ILZ and a large proportion of the ELZ, vegetation has been significantly disturbed through human activities and the vegetation structure and composition altered from the original state.

3.4.2 Data gaps

There is now complete spatial coverage for pre-European and extent vegetation in Western Australia. The pre-European dataset has been compiled at a scale of approximately 1:250,000. The actual level of detail capture varies between the Intensive and Extensive Land-use Zones. The pre-European dataset was compiled primarily from the mapping by J.S. Beard.

This was published between 1973 and 1984. Beard mapped vegetation types from air-photos and ground traverses and used a combination of geological and soil mapping to interpolate the original vegetation cover in areas where it has been removed. This mapping shows the vegetation cover likely to have existed at the time of European settlement in Western Australia in 1829. This mapping has been re-worked and incorporated into a GIS (Hopkins *et al.* in press) – see Section 2.1 – to form the current pre-European vegetation dataset. During the current project, these data were incorporated into the NVIS. Spatial data and attributes were translated to NVIS Level 3 or 4. However, digital data available at the time of the translation was insufficient to derive NVIS Level 5 attributes and an information gap remains in the dataset.

At the 1:250,000 or vegetation association scale of mapping, the vegetation is complex and varied, comprising 833 units mapped in about 30,000 polygons. At larger scales, a great deal more complexity and variation is revealed. For example, the 1:100,000 scale vegetation mapping of the 500 km² Dongolocking study area in the Western Australian wheatbelt identified nine vegetation types at the association level, where the 1:250,000 scale mapping showed only three associations (Beecham *et al.* 1998). The 1:250,000 scale mapping is more generalised, and some diversity is concealed within units that are referred to as mosaics, where two or three distinct vegetation mapping units are lumped into a single polygon.

Also noticeable is variation in the level of detail and discrimination in the attribution of vegetation units, and in the linework where the ILZ shows a greater level of detail and discrimination than the ELZ. Although Beard considered all of his mapping to be at association level, the fact that he published the work at different scales may have had an influence. The vegetation mapping of the ILZ was published at 1:250,000 as well as at 1:1,000,000 scales, whereas the ELZ was published only at 1:1,000,000.

3.5 *Summary and conclusions*

Clearing of native vegetation is very pronounced in the ILZ, where only 30% remains. More than 20% is in contiguous forested land managed by the Department of Conservation and Land Management. All of the vegetation associations that are cleared to the point of concern i.e. ≤30% remaining, are in the ILZ – predominantly in the area known as the wheatbelt, along the Swan Coastal Plain and in the Blackwood Plateau/Leeuwin-Naturaliste/Scott Plain area.

The vegetation database, with both pre-European and present extent of each vegetation association, is a potentially powerful tool for land-use planning and management at regional or catchment scale. At this scale, the database can be used to identify priorities for acquisition for conservation and for management across the landscape. Protocols for using the database have been developed, and are now being used in the acquisition of land for conservation e.g. McNamara *et al.* (2000), unpublished reports by A.J.M. Hopkins (1998-2001), and for catchment management (Hopkins *et al.* 2000). In addition, the vegetation data have been intersected with data on the spatial extent of saline components of the landscape in the South West Agricultural Region to identify vegetation types at risk from rising watertables and associated salinisation (Hopkins 2000) to provide further assessment of threat. Further applications of the vegetation database await development.

The limitations of the 1:250,000 scale mapping have become very apparent through the development of the applications referred to above, and the Dongolocking project (Beecham *et*

al. 1998). At the scale of the individual parcel of land in the South West Agricultural Region, for example, existing mapping is too general to provide accurate and reliable data on the vegetation present. This creates a dilemma: there is an urgent need for vegetation mapping at a scale relevant to the individual land parcel in this region, for example, for planning the communities response to rising groundwater and salinisation; the data are not available, so the small scale data are used. Where the data are used naively, the inevitable outcome appears to be poor planning, and criticism of the data as inaccurate.

The project has highlighted the values of the vegetation mapping data compiled thus far and, at the same time, the limitations of the existing data. The apparent demand for vegetation mapping that is accurate at the land parcel scale will need to be addressed – it is clear that a program of large-scale vegetation mapping is required if land-use planning and management is to progress. The process of considering such a program will raise the question, what is the appropriate scale for mapping reliable the vegetation of individual land parcels? Experience at Dongolocking (Beecham *et al.* 1998) and elsewhere in the Intensive Land-use Zone e.g. Tutanning Nature Reserve (Hopkins 1985) indicates that 1:50,000 scale mapping is required. It is practical to map vegetation on individual land parcels at this scale, and to develop from that mapping (and other sources) a 1:100,000 coverage of presumed pre-European mapping at the sub-association level, as was achieved for Dongolocking.

Another priority for improving the vegetation datasets in Western Australia was identified through involvement in NVIS Stage 1. This is to improve the level of NVIS attribution in existing datasets. Extant and pre-European datasets supplied to the NVIS through the Audit are currently attributed to at least NVIS level III, with some attribution to level IV. Existing data sources identified through metadata compilation during this project (see section 5 of this report) could be used to compile NVIS level V attributes for these datasets.

The project has developed a map coverage on the ILZ of present native vegetation that is considerably more accurate and reliable than pre-existing mapping. The dataset will be released by the joint custodians as the first authorised digital data on present native vegetation extent and date-stamped 2000. Questions of data maintenance i.e. custodial duties, and of maintaining the currency of the data will need to be addressed.

4. Disturbance of and threats to native vegetation

D.P. Shepherd, S. Mazzilli and A.J.M. Hopkins

4.1 Background

The issue of vegetation quality or condition has been identified as high priority for future management of native vegetation in Australia. The increasing level of interest is illustrated by the recent development of Partnership Agreements between State and Federal Governments and in the National Framework for the Management and Monitoring of Australia's Native Vegetation (ANZECC 2000).

Despite this level of interest there is still a lack of agreement at the national level as to what constitutes vegetation condition. Underlying this dilemma of how to measure and/or describe condition of vegetation are issues of values that have yet to be addressed, so the nationally agreed protocol remains elusive.

At least three approaches can be identified for assessing vegetation condition:

- Defined in terms of the current state compared with a baseline state. For example, one might assess condition of native vegetation by comparing its structure and composition with some notional pre-European state, and expect that this will have some meaning for its biodiversity conservation values.
- Defined in terms of the functionality of the vegetation eg vegetation that prevents erosion might be regarded as being good condition irrespective of its composition;
- Defined in terms of potential to be productive in an agricultural sense e.g. vegetation that has good pastoral values might also be regarded as being in good condition regardless of composition.

Given the range of these requirements for condition assessments it is unreasonable to propose a single assessment that will satisfy all client requirements given the disparate nature of the value systems that underpin these needs for condition.

A compromise approach is to measure and report on the extent of various types of disturbances and threatening processes to the notional vegetation baseline. However, agreement on what types of disturbances and threatening processes need to be considered will also be determined by the client's objectives. These objectives will in turn define the attributes to be collected or measured for a condition assessment. Using this approach provides one means for identifying which attributes need to be collected but not how these attributes might be combined and described. Agreement on what might constitute an index of condition is yet to be discussed and agreed to at a national level.

In the absence of a nationally agreed classification or protocol for vegetation condition, we have chosen to proceed with this component of the Western Australian Audit project by collecting attribute data for individual disturbance types and threatening processes separately, for each parcel of native vegetation.

Using this approach the attribute data that are collected and maintained as separate spatial coverages at any future time can be combined in any particular combination based on the

requirements of the user and/or the relevant classification or protocol once developed. This Western Australian project can be regarded as a pilot project in the development of one or more condition classification(s) and/or protocol(s) for Australia.

4.2 *Methods*

Within the ILZ, three disturbance types were assessed for a sample of vegetation patches:

1. clearing of native vegetation within a patch – either directly or through grazing, although these are not separately defined
2. presence of infrastructure within a patch, including roads, dams, and buildings
3. clearing for mining activities within a patch, including mineral sand and gold.

Two types of threatening processes were assessed for all patches of remnant native vegetation:

1. potential risk to native vegetation within a patch from rising watertables and associated salinisation
2. potential risk to each vegetation type as a consequence of clearing at the broad landscape level.

The disturbances to patches of remnant native vegetation in the ILZ were mapped from the digital orthophotos used to develop the present vegetation extent dataset. A simple four-tier rating system was used to describe the extent and intensity of each of the disturbance types (Figure 10). Level 1 indicates the disturbance is light and localised within the patch of vegetation, level 2 indicates a light but widespread disturbance, level 3 describes a heavy and localised disturbance, and level 4 indicates a heavy and widespread disturbance.

The risks to individual patches of native vegetation in the ILZ associated with were determined by intersecting the present vegetation extent-by-type data with mapping of soil landscapes with saline components >10% (N. Schoknecht, pers. comm.).

The risk from salinisation was assessed using different criteria than that used for the Salinity Theme. In Western Australia the same base dataset has been used based on proportional mapping of soil and landscape components within a soil-landscape. Each map unit within a system has a proportion of properties assigned to the soils and landscape position. Thus a proportion of map units within a system with a particular property – for example saline soils - can be identified from the dataset. For this project vegetation patches at risk from salinisation were defined as those occurring on soil-landscape systems with saline components representing >10% of an individual system. Vegetation patches with at least 5% of their area falling on such a system were tagged as being at risk from salinisation. It should be noted that whole vegetation patches are tagged as being at risk, rather than just the portion within the soil-landscape system.

For the Salinity Theme, the soil-landscape system dataset was combined with data on watertable trends from bore sites to identify areas at risk from rising watertables. Trends in watertable rises at bore sites were used to project salinity risk (Short and McConnell 2001).

Only one aspect of land clearing as a threat was examined. The percentage of each vegetation association remaining in the ILZ was determined by comparing its present type (based on the Western Australian description, not the NVIS-derived description) and extent with its pre-

European type and extent. The results of this comparison were assessed against emerging criteria of endangerment of vegetation types. In summary, a vegetation type is considered 'of concern' when $\leq 30\%$ of its original aerial extent remains, and 'endangered' or 'vulnerable' when $\leq 10\%$ remains (ANZECC 2000, EPA 2000). We have identified vegetation types that are $\leq 30\%$ remaining with those with $\leq 10\%$ remaining as a subset.

For the ELZ, areas have been identified which are not likely to have to be disturbed directly by human activities. The remainder of the ELZ is considered highly likely to have been directly affected by post-settlement activities, including grazing by sheep, cattle and goats. It should be noted that these ratings are only indicative - additional areas will be in good to excellent condition, and there are small areas within the zone attributed as undisturbed which have actually been disturbed directly, e.g. by mining exploration activities. It is important to note too that the areas attributed as undisturbed in the ELZ are likely to have been at least indirectly affected by post-settlement activities - mainly through altered fire regimes.

Areas unlikely to have been directly affected by human activities in the ELZ were derived primarily from the land-use dataset. Areas attributed with minimum intervention land-use (value 1.3.0 in the ALUM Classification) were selected from the land-use dataset. A buffer of 2 kilometres was generated around transport routes and grazing areas and these areas were subtracted from this minimum intervention theme. Small areas adjacent extensive areas of grazing were removed as probable artefacts of processing, and areas known to be subject to grazing by feral goats through recent aerial survey were also removed. These potentially little disturbed areas remaining were compared with NOAA NDVI data processed to identify areas where vegetation cover has remained relatively stable over at least 10 years.

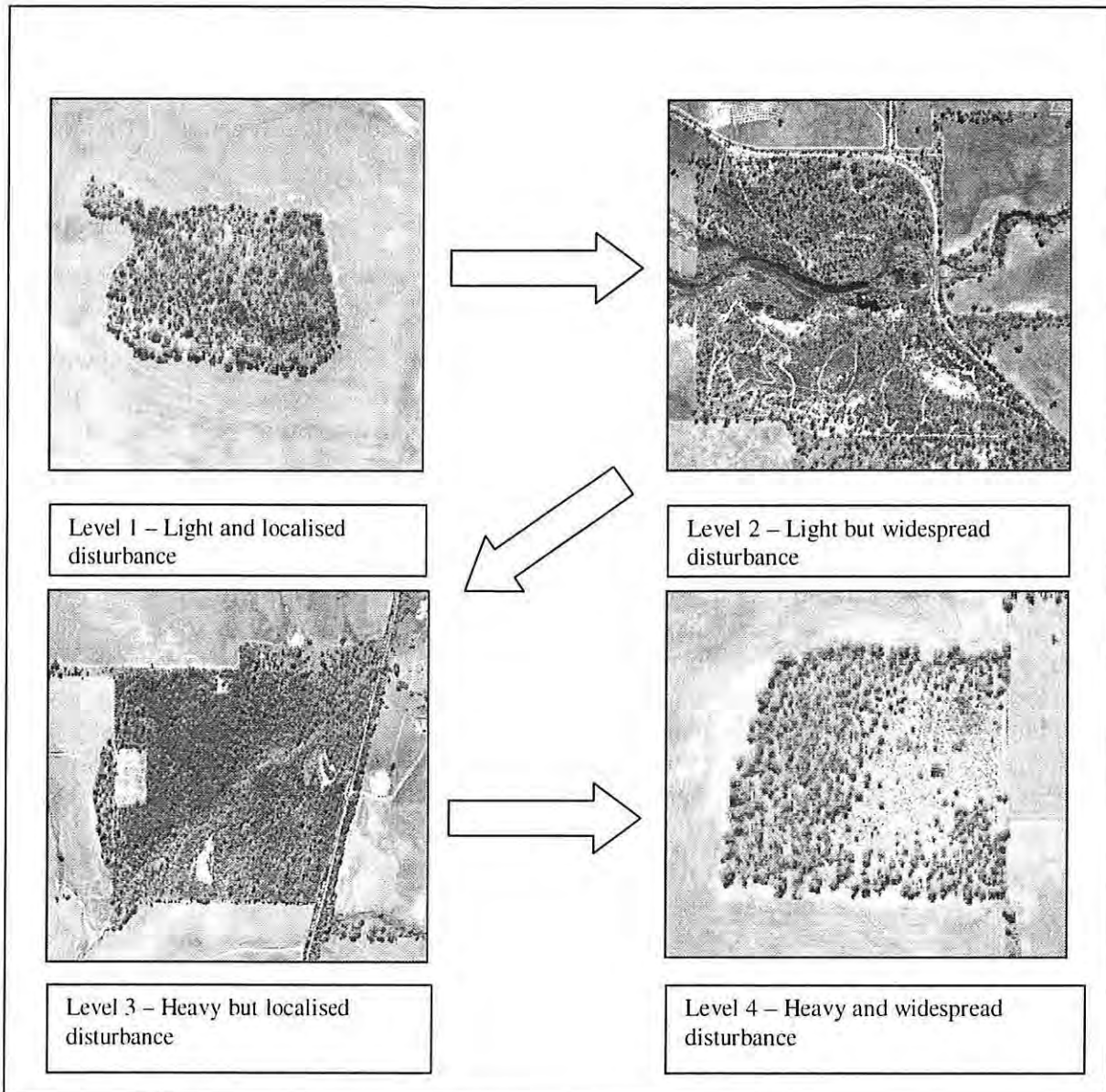


Figure 10. Rating scale for disturbance attributes

4.3 Results

Within the ILZ, more than 400,000 discrete patches of native vegetation have been mapped. All have been assessed for their potential to be threatened by salinisation. The vegetation associations were also assessed for extent of clearing against endangerment criteria: patches of native vegetation with the associations identified through this process have been attributed accordingly.

Within the ILZ, 193,542 patches of vegetation were assessed for disturbance. This represents 40.4% of the total number mapped in the ILZ. Of these patches, some level of disturbance was recorded in 79,250, or 41% of those assessed.

A total of 44,727 patches (23% of those assessed) were disturbed to some extent by clearing activities; 21,553 patches (11%) were disturbed by construction of infrastructure, including tracks, roads or buildings; and 286 patches (0.015%) were directly affected by mining. These

were mainly mineral sands mining on the Swan Coastal Plain and some gold mining in the central eastern part of the ILZ.

All areas of native vegetation in the ILZ were assessed for risk from salinisation. A total of 37,094 patches (8%) were to be at risk. The patches of native vegetation considered to be at risk are all in the heavily cleared parts of the South West Agricultural Region.

Table 3 lists the vegetation associations that are considered threatened by clearing. These are based on Western Australian descriptions rather than NVIS-derived descriptions. A total of 119 have been reduced to below 30% of their pre-European extent and, of these, 48 have $\leq 10\%$ remaining and two are potentially extinct. The extant, threatened vegetation associations are attributed to particular polygons of present native vegetation extent in the relevant dataset.

Within the ELZ, 121,929,760 ha, or 53% may be considered potentially undisturbed. This is 48% of the State. More than 70%, or 86,976,286 ha of the potentially undisturbed land is Unallocated Crown Land. These areas are coded Minimum Intervention land-use in the Land-use dataset. The remainder of the potentially undisturbed land is National Park and conservation reserves. Potentially undisturbed areas in the ELZ are illustrated in Figure 11.

Table 3. Assessment of disturbance of vegetation in the ILZ by 1:100,000 scale mapsheet

Map sheet number	Number of disturbed patches present				Total assessed	Total in Map sheet	% Assessed
	Clearing	Infrastructure	Mining	Salinity			
1741	163	132	0	0	884	2,119	41.7
1742	47	38	0	0	342	3,226	10.6
1830	0	0	0	0	0	27	0.0
1837	0	0	0	0	0	158	0.0
1838	0	0	0	0	0	124	0.0
1839	176	100	0	0	719	1,218	59.0
1840	495	13	0	0	1,553	5,594	27.8
1841	1632	7	0	238	3,394	5,549	61.2
1842	815	741	0	9	2,198	6,665	33.0
1929	12	0	0	0	1,074	1,622	66.2
1930	0	0	17	0	3,263	4,668	69.9
1935	10	3	0	0	37	590	6.3
1936	173	172	45	0	1,046	1,591	65.7
1937	238	231	0	0	1,966	3,919	50.2
1938	501	417	0	151	1,696	2,609	65.0
1939	98	75	0	2	376	2,249	16.7
1940	110	16	0	317	1,633	2,976	54.9
1941	7	3	0	37	120	3,357	3.6
2028	13	0	0	0	94	991	9.5
2029	18	0	0	0	756	2,510	30.1
2030	46	0	70	0	1,694	3,718	45.6
2031	0	0	20	0	737	5,196	14.2
2032	0	0	28	0	535	3,266	16.4
2033-2034	0	0	0	0	0	4,780	0.0
2035	299	122	0	0	805	5,127	15.7
2036	354	308	0	190	3,456	5,762	60.0
2037	522	411	0	456	1,437	2,037	70.5
2038	1115	990	0	958	3,661	3,929	93.2
2039	1032	789	0	157	2,336	4,805	48.6
2040	809	764	0	464	1,778	5,185	34.3
2041	1	1	0	57	58	943	6.2
2128	0	0	0	0	409	1,153	35.5
2129	122	9	0	0	670	5,014	13.4
2130	1068	1	15	0	3,244	3,988	81.3
2131	43	0	68	0	313	1,253	25.0
2132	206	35	18	0	583	857	68.0
2133	0	0	3	0	4	1,383	0.3
2134	896	382	0	0	1,809	7,653	23.6
2135	2687	1044	0	58	3,045	5,204	58.5

Map sheet number	Number of disturbed patches present				Total assessed	Total in Map sheet	% Assessed
	Clearing	Infrastructure	Mining	Salinity			
2136	3,539	1,243	0	969	5,834	8,495	68.7
2137	2,643	1,310	0	1,116	3,690	4,373	84.4
2138	1,329	1,074	0	584	2,997	4,133	72.5
2139	499	423	0	279	1,228	5,460	22.5
2140	144	144	0	71	269	792	34.0
2227	0	0	0	0	0	292	0.0
2228	10	0	0	0	454	1,334	34.0
2229	945	102	0	0	2,607	6,225	41.9
2230	2,623	0	0	33	5,769	6,220	92.7
2231	1,362	0	0	176	5,667	6,790	83.5
2232	1,170	0	0	0	3,228	7,313	44.1
2233	0	0	0	76	296	3,326	8.9
2234	0	0	0	0	395	3,695	10.7
2235	0	0	0	0	152	2,163	7.0
2236	198	76	0	0	641	2,983	21.5
2237	877	314	0	274	2,366	2,628	90.0
2238	7	5	0	359	396	2,289	17.3
2327	0	0	0	0	58	242	24.0
2328	0	0	0	0	57	3,124	1.8
2329	128	0	0	0	918	9,195	10.0
2330	1	0	0	1,284	2,897	10,133	28.6
2331	250	248	0	1,606	1,933	7,724	25.0
2332	2,033	1,163	0	266	4,110	8,490	48.4
2333	776	209	0	0	1,044	3,573	29.2
2334	6	0	0	0	756	1,396	54.2
2335	79	4	0	0	798	1,228	65.0
2336	18	0	0	0	217	3,791	5.7
2337	20	18	0	0	195	4,169	4.7
2338	17	7	0	0	243	469	51.8
2427	35	4	0	0	405	1,248	32.5
2428	0	0	0	0	712	5,763	12.4
2429	145	0	0	0	2,096	5,304	39.5
2430	0	0	0	1,017	2,554	6,832	37.4
2431	53	35	0	1,111	1,336	4,902	27.3
2432	139	98	0	751	1,138	3,987	28.5
2433	824	824	0	0	1,074	3,625	29.6
2434	293	127	0	0	1,162	3,141	37.0
2435	333	0	0	0	4,107	14,520	28.3
2436	332	332	0	0	1,047	3,090	33.9
2437	25	20	0	0	142	3,393	4.2
2527	0	0	0	0	0	25	0.0
2528	8	1	0	0	987	4,770	20.7
2529	141	48	0	0	788	4,180	18.9
2530	3	2	0	1078	1,524	5,458	27.9

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Map sheet number	Number of disturbed patches present				Total assessed	Total in Map sheet	% Assessed
	Clearing	Infrastructure	Mining	Salinity			
2531	581	427	0	823	1,979	4,059	48.8
2532	876	876	0	0	1,447	3,410	42.4
2533	24	24	0	0	491	4,129	11.9
2534	257	44	0	0	1,782	4,209	42.3
2535	339	102	0	0	1,455	3,238	44.9
2536	388	388	0	0	2,210	4,081	54.2
2537	48	48	0	0	584	1,635	35.7
2628	112	58	0	0	617	801	77.0
2629	39	23	0	118	269	4,249	6.3
2630	62	11	0	2,429	2,504	3,682	68.0
2631	235	222	0	0	2,225	4,832	46.0
2632	202	199	0	0	1,609	2,977	54.0
2633	155	143	0	0	1,740	2,504	69.5
2634	431	108	0	0	1,639	2,124	77.2
2635	283	183	1	0	2,419	2,829	85.5
2636	86	86	0	0	1,639	2,353	69.7
2729	0	0	0	0	0	1,474	0.0
2730	18	2	0	945	983	1,971	49.9
2731	0	0	0	0	90	4,980	1.8
2732	353	352	0	0	2,594	5,181	50.1
2733	275	274	0	0	1,298	1,835	70.7
2734	746	684	0	0	1,935	4,560	42.4
2735	1,323	1,136	0	0	2,526	5,121	49.3
2736	75	75	0	7	378	1,126	33.6
2829	0	0	0	0	0	32	0.0
2830	109	61	0	1,159	1,949	3,803	51.2
2831	21	0	0	1,353	3,076	6,578	46.8
2832	41	41	0	0	703	3,006	23.4
2930	18	18	1	210	337	3,819	8.8
2931	89	89	0	49	1,077	2,971	36.3
3030	333	154	0	199	1,855	3,950	47.0
3031	52	30	0	628	1,845	1,877	98.3
3130	10	10	0	13	767	1,876	40.9
3131	89	50	0	1,134	2,515	3,997	62.9
3230	0	0	0	13	102	7,973	1.3
3231	477	34	0	2,330	3,652	3,951	92.4
3232	7	0	0	1,188	1,674	2,827	59.2
3330	695	346	0	809	7,143	10,343	69.1
3331	0	0	0	6,301	6,309	7,712	81.8
3430	1,165	620	0	1,646	8,008	11,206	71.5
3431	0	0	0	0	506	7,966	6.4
3530	0	0	0	0	3	21	14.3
3531	0	0	0	1,596	1596	2,505	63.7
Total	44,727	21,553	286	37,094	193,542	479,071	40.4

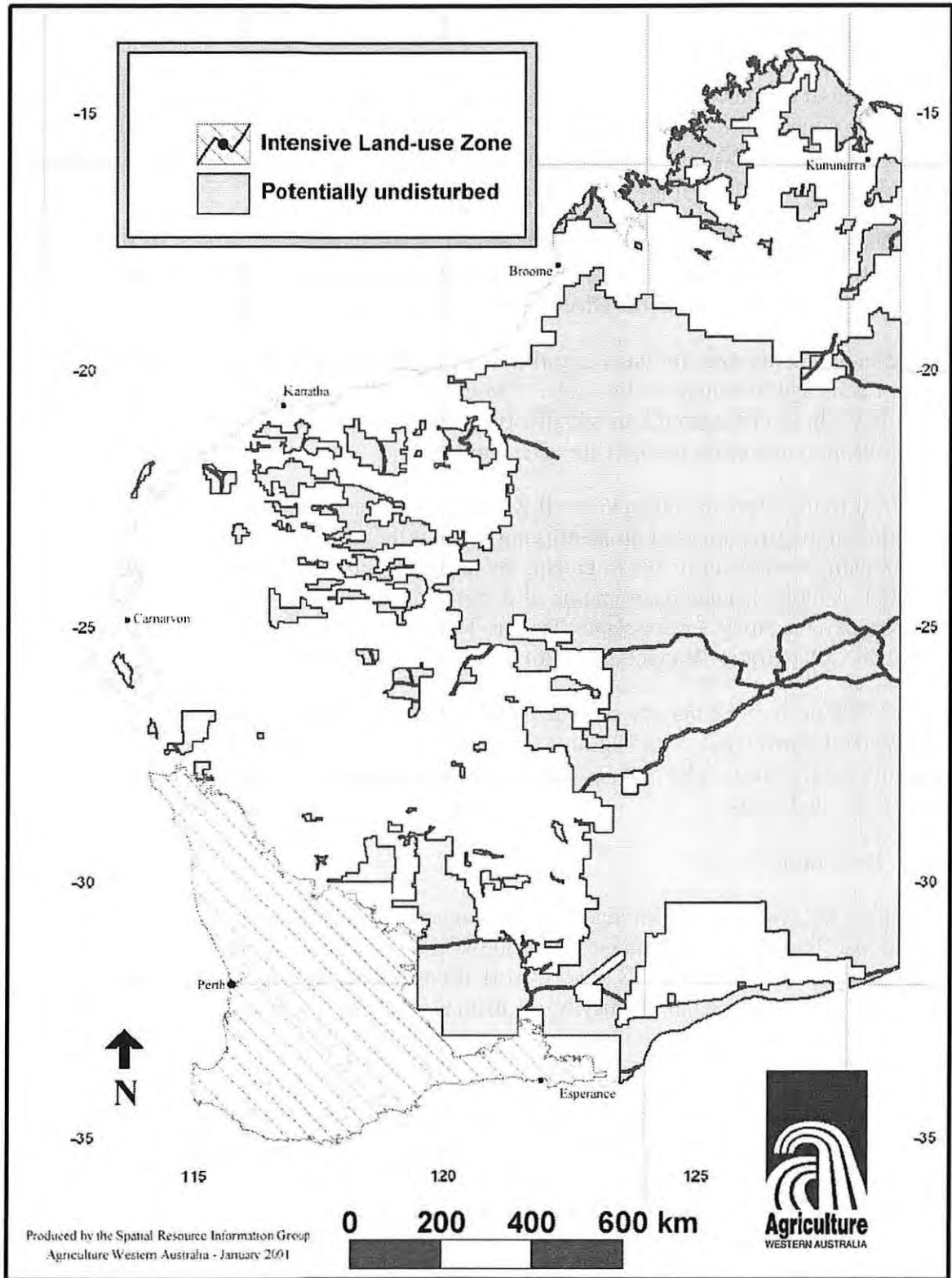


Figure 11. Potentially undisturbed areas in the Extensive Land-use Zone of Western Australia

4.4 Discussion

Around 40% of the patches of native vegetation assessed showed some level of disturbance. These were concentrated in the wheatbelt, so the level of disturbance there is likely to be considerably higher. Salinisation threatens 8% of the patches of native vegetation of the ILZ – these too are concentrated mainly in the wheatbelt.

Land clearing is another major threat in the ILZ: 199 vegetation associations there retain ≤30% of their original extent. These occur predominantly in the wheatbelt, as well as along the Swan Coastal Plain and in the Blackwood Plateau/Leeuwin-Naturaliste/ Scott Plain area.

The individual data layers for each disturbance type and for the two threatening processes have not been agglomerated at this stage. The data from the pilot project are in a format where they can be considered individually, or agglomerated when the national classification(s) and/or protocol(s) are determined.

In contrast to the approach taken in the ILZ, the assessment of disturbance to native vegetation in the ELZ focused on identifying potentially little disturbed areas. The precise level of disturbance, mainly due to grazing by ungulates, in the remainder of the ELZ was not evaluated. A more detailed examination of disturbance in some Rangelands areas has been made through the Audit's Rangelands Theme. This assessment will continue through the Australian Collaborative Rangelands Information System (ACRIS).

Around 53% of the ELZ may be considered potentially undisturbed: most of this is Unallocated Crown Land, with National Parks and conservation reserves also making an important contribution. The remainder is disturbed to some degree by grazing, mainly by sheep, cattle and goats.

4.4.1 Data limitations

The dataset is considered preliminary, due to time and financial constraints on-ground evaluations. Interpretation of disturbances in the ILZ were made on-screen from digital air-photos whereas traditionally, this kind of work is carried out using stereo-photographs. Omissions or misinterpretations may result from using this rapid assessment technique.

4.4.2 Data gaps

Disturbance was assessed for 40% of vegetation patches mapped in the ILZ for this pilot project. These assessments were made using air-photos and the same rapid assessment methodology. It includes many of the larger patches of vegetation. However, for regionally-based assessments and comparisons of vegetation condition it will be necessary to compile a more complete dataset which includes disturbance attributes for thousands of smaller patches of vegetation. In areas with a long history of agricultural development, most of these smaller patches are likely to be heavily disturbed.

Disturbance attributes have been collected for three disturbance types in the ILZ. Two of these disturbance types – clearing and infrastructure – may be generated by a number of activities. For example, infrastructure includes the presence of roads and tracks, buildings, dams and gravel pits. These are not separately identified and represent disturbances common

in the agricultural areas. A number of other types of disturbances may also occur and include flooding, plant disease and erosion.

Attributes have been collected for two threatening processes in the ILZ – salinity and broad-scale clearing. Other threatening processes may also occur in this region and include weed invasion, weed seed, fertiliser and herbicide drift, lowered watertables from groundwater extraction, risk from plant pathogens, and isolation.

Disturbance has been recorded for only one time interval in the ILZ. This will provide a useful baseline, but will need to be re-assessed at regular intervals. Aerial photography is re-flown at intervals of not more than five years. It would be useful to re-assess vegetation disturbance at this time interval, at least for those areas under pressure from urban or intensive agricultural development.

It may also be possible to compile disturbance attributes retrospectively for some vegetation using information from previous vegetation surveys. Section 5 describes the compilation of metadata for historical vegetation surveys in Western Australia. This dataset facilitates access to this information and indicates the level of information collected for each survey. Historical survey information will provide an insight into long-term changes in the condition of vegetation not possible from other means.

Disturbance to vegetation in the ELZ has been attributed only at a very broad-scale during this project. Only areas which are likely to remain relatively undisturbed are mapped for this region and the causes of disturbance have not been individually defined. The preparation of a more detailed condition/disturbance dataset for the ELZ would require considerable resources.

One possible approach to this problem is to examine condition in areas in which threatening processes occur. An example of this approach is the work in the Gascoyne-Murchison Region. This work is being conducted by the Departments of Conservation and Land Management and Agriculture as part of the Gascoyne-Murchison Strategy. A system has been developed which identifies sites of high biodiversity and uses a rapid assessment technique to identify processes threatening this biodiversity (H. Pringle, pers. comm.).

4.4.3 Benefits and outcomes of the pilot project

The dataset on disturbance of, and threats to, remaining native vegetation in Western Australia is preliminary only. There is scope to enhance the data considerably through the completion of the assessment in the ILZ and inclusion of additional datasets for the whole State. At some stage, on-ground assessment for verification of the methodology, and for gathering data directly, will be necessary.

Arrangements in place with three of the catchment management groups in the South West Agricultural Region to provide disturbance data derived through on-ground sampling in exchange for access to the accurate vegetation extent data.. There is potential for arrangements of this kind to provide the detailed, reliable on-ground observational data for the whole of the ILZ within a reasonable time.

The rapid assessment methodology developed for this pilot project was discussed with personnel from a range of organisations involved in the assessment and management of vegetation in Western Australia during a workshop in Perth in May 2001. Attendees indicated that such methodology could provide a useful surrogate for vegetation condition

assessments where more detailed field-based data has not been collected. Arrangements have been made with two shire-based surveys to further test this methodology.

The challenge remains to develop an index of condition based on the attributes collected through this methodology and apply this to specific vegetation management systems. Although a more complete dataset will be required to address this issue, work currently underway at catchment and shire levels in South Western Australia will provide an opportunity to develop a practical condition index in the near future.

4.4.4 Recommendations for future assessments of disturbance to vegetation

The greatest difficulties in the accurate assessment of disturbances to vegetation during this pilot project were found in the assessment of the effect of disturbance in lower vegetation strata in forest and some woodland vegetation types, and differentiation of disturbance types in areas of complex land-use.

The types of disturbance assessed are usually severe enough, and cover a sufficient area, to be identified from aerial photography. However, in forest and some woodland areas it is possible that some disturbances are obscured by the upper strata and were omitted. This problem will be more acute if more subtle disturbances are assessed using this methodology, e.g. weed and feral animal infestation. We recommend that the rapid assessment methodology be combined with field observations for the assessment of disturbances likely to affect only lower strata in forest and woodland vegetation types.

Differentiation between types or causes of disturbance can be difficult in areas of complex land-use. This pilot project was conducted as part of a combined land-use and vegetation mapping project and the land-use mapping was used to inform the disturbance mapping. The land-use component of this work is useful to a scale of approximately 1:100,000. However, in areas of complex land-use, such as the peri-urban fringe of Perth, more detailed land-use mapping would be useful to more effectively identify disturbance types.

4.5 Summary and conclusions

As acknowledged, the issue of vegetation quality or condition has been identified as high priority for future management of native vegetation in Australia. The disturbance assessment component of this project was conceived as a pilot, to develop methodologies and protocols for condition assessment in different regions of Western Australia, with potential for their application elsewhere in Australia.

This pilot project has demonstrated the practicality of rapidly developing a disturbance dataset for vegetation over a large area by utilising expert observation in a GIS environment. In just a few months a dataset was created which covers a large proportion of vegetation in a highly fragmented environment. In a dedicated project a complete dataset could be developed over a similar time period.

The compilation of individual disturbance attributes produces a transparent methodology that is, as far as possible, an objective assessment of the status of a patch of vegetation. These disturbance ratings could be combined to produce a condition assessment. As long as the formula for combining the individual ratings is structured logically and is explicitly stated, the derived condition assessment is repeatable and can be compared between regions.

This approach to disturbance and condition assessment was discussed at a Western Australian NVIS stakeholders' workshop in June 2001. A wide cross-section of the biological science community was represented at the workshop. There was general agreement among attendees that this methodology offered a useful approach to disturbance and condition assessment and, if developed further (along the lines discussed under Section 4.4.4), would be particularly useful in combining field observations with assessments from high resolution remote sensing such as digital airphotos.

5. Metadata

A.J.M. Hopkins, D.P. Shepherd and K. Brooks

5.1 Background

The advent of readily available and powerful computers has increased enormously the storage of environmental data in digital form. This phenomenon has included spatial (mapped) data, and has facilitated the development of Geographical Information Systems (GIS). It is primarily the coincidence of these two factors that has given rise to protocols to report on issues such as projection of spatial data, so that the data can be shared without losing data quality. These data reporting protocols are now known as metadata.

Metadata statements are now recognised as a standard requirement for spatial datasets. Unfortunately, there are few metadata statements available, or at least collated in a modern format, for historical datasets. This project provided the opportunity to generate standard metadata statements for important biological information collected in Western Australia over the past few decades. Metadata for these studies, some of which has been collected for locations that remain otherwise described poorly, will be invaluable for land-use and environmental planning.

The Australia New Zealand Land Information Council (ANZLIC) is the peak inter-governmental council responsible for the coordination of land and geographic information in Australia and New Zealand. Metadata collation has been identified as an important tool in facilitating its objective of maximising community access to land and geographic information with due regard for issues of privacy and confidentiality (ANZLIC 1996). The metadata standards set by ANZLIC are widely used in Australia, and metadata collated for this project were described using these standards.

5.2 Methods

Metadata were compiled using the ANZLIC metadata tool. Metadata for ANZLIC Page 0 were collated as a minimum, but most metadata also include Page 1. Database fields specifically relating to biological data were added to the standard Page 1 metadata – these additional fields were developed by officers of the Bureau of Rural Science (BRS) in collaboration with the authors of this paper.

In the initial phase of metadata collation, the libraries of the Department of Conservation and Land Management (Woodvale Research Centre), Department of Agriculture, University of Western Australia and Murdoch University were visited to validate references known to project staff, and to locate other useful references. Metadata for these references were made in-situ using the metadata tool, and printed copies of any maps or spatial references were made. Co-ordinates for these references were then obtained by comparing hard copies of maps and other relevant material with spatial resource information in a GIS environment at the Department of Agriculture.

Contact was also made with consultants involved in biological surveys throughout Western Australia. Several private biological consultants were approached for metadata but we found this is seldom prepared during the collation of datasets by these consultants. It was necessary,

therefore, to provide assistance to the consultants in order to capture and verify metadata for their datasets. Due to time constraints, we concentrated on collating data from the largest private sources of biological data.

Visits were arranged to the offices of these consultants, and metadata were compiled for relevant studies with the assistance of those consultants. Permission to release metadata relating to privately commissioned studies was obtained from companies that commissioned the work by the consultants.

Metadata were also compiled for major spatial datasets held by the Department of Agriculture including the pre-European and current vegetation extent databases.

5.3 Results

A total of 602 datasets were collated: 300 records from a wide range of sources at academic institutions; and 302 from Matiske Consulting Pty Ltd. The spatial coverage of metadata records compiled for this project is illustrated in Figures 12 and 13.

Some 309 metadata records relate to site-based botanical surveys conducted for environmental impact assessment. These include all of those from Matiske Consulting. A total of 145 records relate to floristic surveys, mainly of existing or proposed nature reserves. Some 70 records describe full biological surveys including flora and fauna; 28 metadata records describe vegetation mapping projects; 15 records for flora checklists and 7 records for reconnaissance vegetation surveys. The remaining 28 metadata records relate to other biological assessments, mainly natural resource surveys with a biological component.

These metadata will be available to the public through the WALIS INTERRAGATOR software on CD-ROM, and through the Western Australian Australian Spatial Data Directory (ASDD) node via the internet.

5.4 Discussion

Metadata collated for this project will provide:

- An important source of information for agencies and scientists involved in biological research, surveys, environmental impact assessment and related activities such as land-use planning.
- Ready access to information about recent and historical survey work throughout Western Australia, and relevant methodological details. The collation of this datasets will compensate to some degree for the loss of corporate memory that has occurred in State Government Departments and Agencies as a consequence of re-structuring and retirements.
- A useful guide for assessing gaps in current knowledge, determining where and how new information needs to be collected, planning further research and for guiding environmental consultants involved in Environmental Impact Assessment.

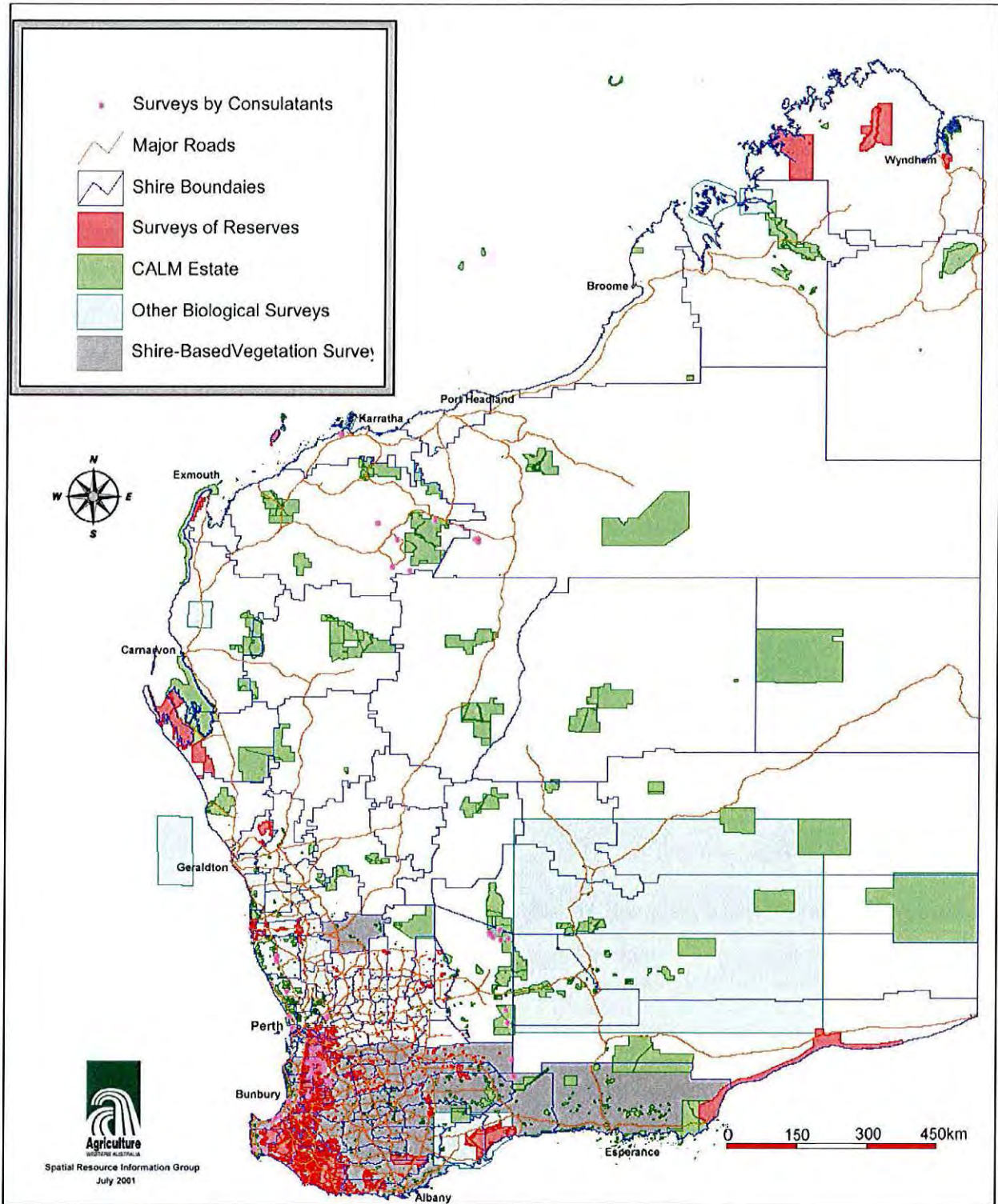


Figure 12. Spatial extent of metadata records compiled for NLWRA Project DAW27

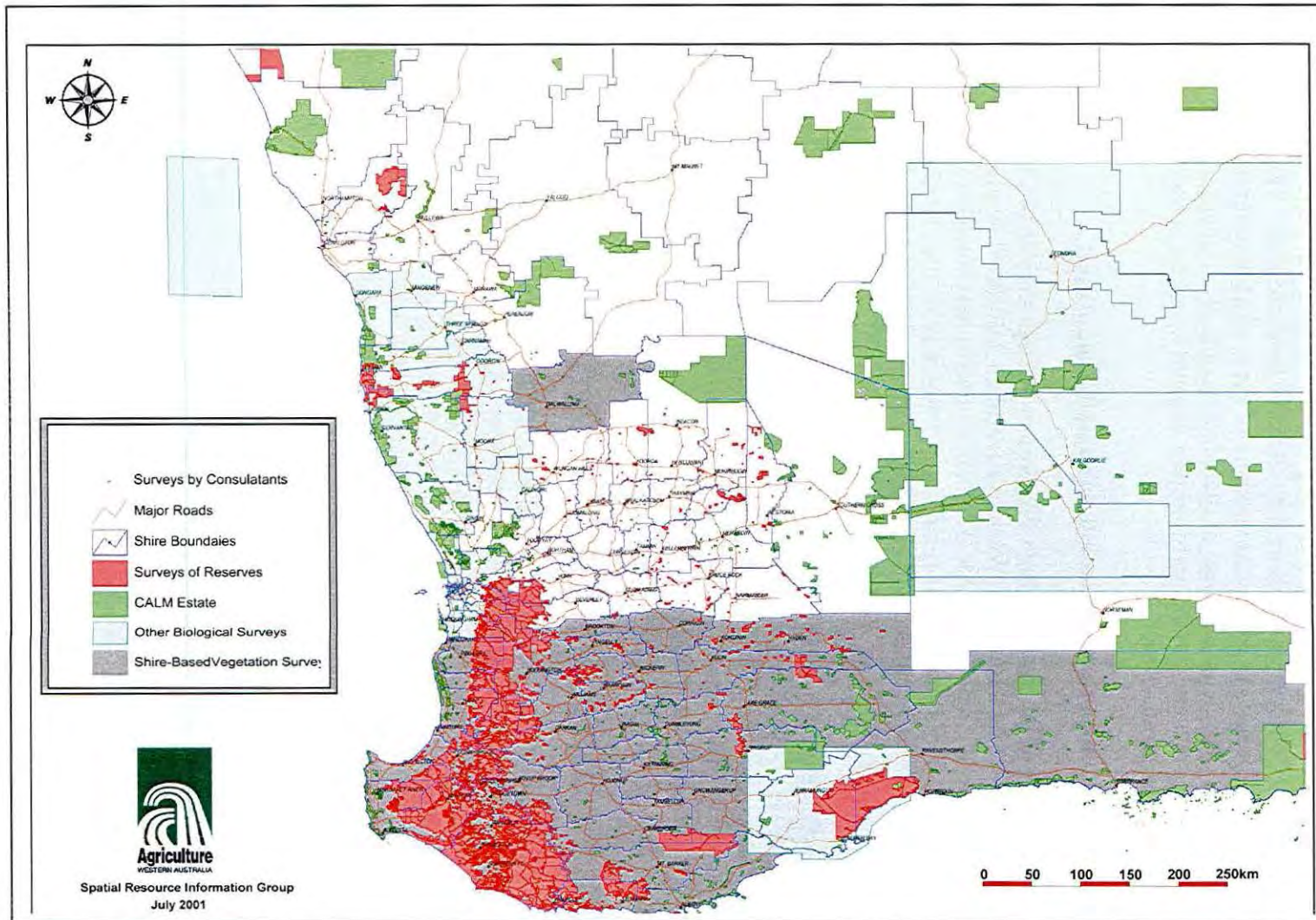


Figure 13. Spatial extent of metadata records compiled for NLWRA Project DAW27 – Intensive Land-use Zone

5.4.1 Gaps and data limitations

During this project it has been possible to collate metadata for the major botanical datasets in Western Australia. It was also possible to collate data for many smaller published studies made by various government agencies. Over half the metadata records collated were derived from studies made by a single private biological consultant in Western Australia. This seems to indicate that a large collection of data lodged with other private organisations remains to be described.

Following the work for this project, gaps in the spatial coverage of metadata remain predominantly in the Conservation lands of the Extensive land-use zone. There are currently no metadata records for surveys conducted on many of the CALM reserves and National Parks in this region. Gaps in the coverage of metadata records also remain in some areas of the ILZ. These gaps are mainly in the north-eastern wheatbelt and for conservation lands in the south-eastern wheatbelt.

5.4.2 Benefits and outcomes of the metadata compilation project

The ready availability of the metadata from this project through the WALIS INTERRAGATOR software on CD-ROM, and through the Western Australian Australian Spatial Data Directory (ASDD) node via the internet will aid ANZLIC's objective of maximising community access to land and geographic information. . It is anticipated that making the metadata collated during this project publicly available will encourage wider participation in metadata collation by other biological consultants in Western Australia.

The database is being used, and enhanced, at present by consultants commissioned to develop a metadata database of all survey work and related environmental data relating to the Pilbara region of Western Australia. This is a precursor to the planning phase for a major biological survey of the region. This step-by-step process is a valuable model for survey, environmental assessment and planning. It is clearly facilitated by the availability of some metadata, and the availability of a standard tool to compile and present additional datasets.

5.4.3 Recommendations for future metadata audit projects

The gaps in the metadata that have been identified through this project will need to be addressed in a systematic manner by Government and consultants. A major improvement could be made by requiring a metadata statement as part of every survey report henceforth. However, some issues of data quality would need to be addressed for this approach to be entirely successful. And the issue of the large number of historical datasets would remain.

Developing metadata statements for these historic datasets will also require commitment from the relevant Australian Government Departments and Agencies.

5.5 *Summary and conclusions*

During this project, metadata has been prepared for the major botanical datasets in Western Australia. Metadata for many smaller published studies by government agencies have also been collated. This dataset forms the core of a dataset that provides an important source of information for agencies and scientists involved in biological research, surveys, environmental impact assessment and related activities such as land-use planning.

The dataset provides ready access to information about recent and historical survey work throughout Western Australia, and relevant methodological details. It has also made preliminary assessment of gaps in current knowledge possible, determining where and how new information needs to be collected, planning further research.

The gaps in the metadata that have been identified through this project will need to be addressed in a systematic manner by all stakeholders - Western Australian Government Departments and agencies and consultants. A major improvement could be made by requiring a metadata statement as part of every survey report henceforth. A large number of historical datasets also remain to be described. Developing metadata statements for these valuable datasets will also require commitment from the relevant Australian Government departments and agencies.

6. Conclusions

G.R. Beeston, A.J.M. Hopkins and D.P. Shepherd

This land-use and vegetation mapping project has been a major collaborative undertaking by the two State agencies with custodial responsibilities in these areas: the Departments of Agriculture and Conservation and Land Management. Senior partners in the project have been working co-operatively on data management and analysis projects for over a decade and this relationship was fundamental to designing the project and seeing it through to completion.

This project was founded on the view that there would be efficiencies in producing land-use and vegetation datasets in tandem, because of the relationships between the two datasets. This view has been vindicated by the experience gained during the project – the two datasets overlap considerably, and there has been considerable advantage in having access to one dataset whilst preparing the other. For example, the land-use data have been a primary source of information for estimating condition of native vegetation in the Extensive Land-use Zone (see Section 4.2). As another example, the patches of remnant native vegetation mapped throughout the Intensive Land-use Zone have been incorporated into the land-use attribution for individual agricultural enterprises in this zone.

Four datasets have been generated or substantially upgraded through the land-use and vegetation mapping project:

- a land-use map for Western Australia that is accurate to individual agricultural enterprises
- a map of pre-European vegetation type and extent at the scale of 1:250,000
- a map of the present extent of native vegetation throughout Western Australia that is accurate to a scale equivalent of 1:50,000 in the ILZ and 1:100,000 in the ELZ
- results of a preliminary assessment of disturbance to native vegetation throughout the State.

A particularly important innovation is the linking of the cadastre from the land-use map with data produced by the Australian Bureau of Statistics, allowing the land-use map to be updated as often as relevant statistics are collected (every four years for the Census, presently every two years for AGSTATS).

While the data have been generated in response to an opportunity provided by the National Land and Water Resources Audit, the two Western Australian agencies involved have contributed significantly to the work. Agriculture in particular saw the potential for the land-use database to contribute to improved decision-making and management of the State's agricultural lands. The benefits of this investment were realised during the recent locust plague, as incoming hatching data could be accurately databased, and control measures planned and negotiated with full knowledge of land-use and ownership of the relevant land parcels. And it was recognised that the detailed land-use map database would be an essential component of planned primary produce labelling and accreditation programs. CALM has continued to invest in the vegetation map database because it is seen as critical for conservation planning in the State.

Collaboration in the development of the NVIS, and in the preparation of NVIS Level 1 through four attributes was an important step toward edge-matching and comparing data between States and Territories. These data have already proved useful in reporting on the extent and distribution of vegetation types across Australia and comparing the status of similar suites of vegetation between regions. However, the compilation of more detailed data – NVIS Level 5 - will be required to complete this process. We believe that the further development of NVIS as a distributed system between jurisdictions will serve a critical role in a national approach to native vegetation management.

The first three of the four datasets listed above have been prepared with meticulous attention to detail and issues of accuracy. They should be regarded as benchmark datasets by which changes in land-use and related activities such as clearing and revegetation, establishment of plantations can be evaluated and reported. It is anticipated that these three datasets will be released to the public and to other agency users as datasets authorised by the custodians.

The vegetation disturbance dataset should be regarded as preliminary only. The data have been compiled on a pilot project basis, to investigate methodological issues in data collection and analysis. Once there is agreement nationally on classifications and/or data protocols for vegetation condition, these preliminary data can be built on to the relevant standards.

There is scope to enhance the data on vegetation condition considerably through the completion of the assessment in the Intensive Land-use Zone and through inclusion of additional datasets for the whole State. At some stage, on-ground assessment for verification of the methodology, and for gathering data directly, will be necessary. Arrangements are in place with three catchment management groups in the South West Agricultural Region for those organisations to provide disturbance data derived through on-ground sampling in exchange for access to the accurate vegetation extent data. There is potential for arrangements of this kind to be organised for the whole of the Intensive Land-use Zone.

It is anticipated that the datasets will form a cornerstone for decision-making in the area of natural resource planning and management, including for nature conservation. An earlier version of the vegetation database has been used over the past five to six years for land acquisition for nature conservation in the State (e.g. McNamara *et al.* 2000). Assessment of nature conservation values in a major Natural Resource Management (NRM) Region, the South West Catchments Region, based to a substantial degree on the present extent of native vegetation, has recently been undertaken (Hopkins *et al.* 2000).

The role for the land-use database in planned programs for primary produce labelling and accreditation has already been noted. The vegetation datasets (pre-European type and extent, present type and extent, and disturbance and threats) will be essential and basic components of the biodiversity database that CALM plans to develop over the next few years. And all four datasets have considerable potential to become important teaching tools in the fields of geography, environmental science, conservation biology and environmental management.

Finally, we note there are major issues related to data custodianship that need to be addressed by Western Australian Government Departments and Agencies on completion of this land-use and vegetation mapping project.

These are issues of maintaining currency of the data, further enhancement of the individual datasets, and on-going database management.

1. Arrangements are now in place to allow the land-use dataset to be updated regularly following censuses and surveys of agricultural enterprises by the Bureau of Statistics. This is very important cross-linking of data. There will be a need for Government to invest in this process over time.
2. The dataset of pre-European vegetation type and extent at the 1:250,000 scale will shortly be signed off as a final and complete product, requiring little further input. However, we note that there are many existing larger scale vegetation map datasets for areas of the south west particularly that could contribute to improved land-use planning and management which are not available digitally. There is potential to bring these into the vegetation database, as it was deliberately structured to allow for the inclusion of such data. There is scope, therefore, for on-going development of the vegetation database, but this will require a commitment from the relevant Government departments and agencies.
3. It has become clear during our work with the vegetation data over the past decade that higher resolution vegetation mapping ie 1:50,000 to 1:100,000 scale is essential to answer the kinds of questions being asked in the planning and management of patches of remnant vegetation, catchments and entire landscapes throughout the South West Agricultural Region (the Intensive Land-use Zone). We note that all other States have on-going vegetation mapping programs (Victoria has a modest program because most of the State is now mapped at 1:100,000 scale), whereas Western Australia has no formal or even informal program of large scale vegetation mapping. This gap in vegetation mapping data will have to be addressed by Western Australian Government Departments and Agencies in the near future, since there would be a considerable lead-time to completing the necessary gap-filling work.
4. The coverage of present vegetation extent that we have prepared though this Audit project is based on aerial photography acquired from 1995 to 1998. The coverage is to be date stamped 1997. This dataset will require regular up dating at periods of not greater than five years, if it is to remain reliable. For the South West Agricultural Region, this can be achieved at minimal cost through the on-going aerial photography program for the region, with effective control and scheduling. However, there will need to be a commitment from Government to cover costs of databasing and data management.
5. The coverage of vegetation disturbance and threats that we have prepared through this Audit project, as a pilot project for the vegetation condition component of the Vegetation Theme, is incomplete. Further, the individual attributes have not been agglomerated to give an estimate of vegetation condition, because the relevant protocols have not yet been agreed nationally. We have noted too that there is scope to include additional data types, such as on-ground observations provided by community groups. Further work will be needed if Western Australia is to have a statewide data coverage relevant to the condition of native vegetation. This additional work will require support from the relevant Government Departments and Agencies.
6. Established data custodial obligations impose a requirement for the data custodian to maintain the dataset and provide on-going access to users who request copies. This responsibility is not without cost. To date, we have met these costs through project

budgets in the course of developing the datasets. However, as noted for the pre-European vegetation type and extent dataset, the project phase is now over. For that dataset and the other three, costs associated with meeting custodial obligations will have to be provided in future years by the relevant Government Departments and Agencies.

7. The datasets that we have developed or improved through this project, particularly those on vegetation, have value to the community – for a whole variety of reasons, community groups and even the public as a whole want or need to know about the country in which they live. Further, there are ways in which the community can contribute constructively to the on-going development of the datasets. Indeed, we have arrangements in place for three catchment management groups to provide on-ground verification and observational data. It is apparent that there are very real potential benefits for the environment from community involvement in recording observations about the environment and having them interpreted within a consistent framework. But there is also a cost, including training, data management and supervision/quality control. If this process of community involvement is to become more widely adopted, there will need to be an acceptance at high levels of Government of such an involvement, and a commitment to support the relevant programs.

A detailed list of issues raised in the WA NVIS stakeholder workshop held in June 2001 are provided in Appendix 3. This list includes further recommendations for development of vegetation datasets in Western Australia and on-going commitment to the development of the NVIS.

7. Acknowledgements

We thank all those people who assisted during this complex project, including the many botanists who willingly assisted our metadata databasing efforts, and the scientists and technicians who helped with the data entry and data management. Particular credit goes to Tony Leeming, Gabriela Seredeneco, Anna Hopkins, and Palenque Blair.

Robyn Wilson and staff from the Information Management Branch at Conservation and Land Management, and Anne Robertson from the WALIS office provided assistance in converting datasets for use by Commonwealth Agencies.

We acknowledge the financial support provided by the National Land and Water Resources Audit, and the very considerable in-kind support provided by Department of Agriculture, Western Australia and the Department of Conservation and Land Management. We have enjoyed our interactions with Audit personnel, particularly Colin Creighton, Warwick McDonald, Ian Cresswell and Maria Cofinas.

We have also enjoyed collaboration with Audit and Bureau of Rural Sciences (BRS) staff and other State agencies through the development of the National Vegetation Information System (NVIS), which occurred during the project. Particular thanks go to Richard Thackway and Sabrina Sonntag of the BRS for assistance with issues related to the implementation of NVIS.

Funding for the projects that are documented in this report was provided jointly by the Audit, AFFA and the Western Australian Government.

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Appendix 1. Land-use map datasets and conversion table of WASLUC codes to Australian Land Use Management Classification (ALUMC)

Primary	Description	Secondary	Description	Tertiary	Description	ABS Level 1	Description	Grouped Description	ABS Level 2	Description	ALUMC
1	RESIDENTIAL	1									540
1		1		1	HOUSING UNITS						540
1		1		2	GROUP QUARTERS						540
1		1		3	OTHER LODGINGS						540
1		1		9	OTHER RESIDENTIAL						540
2	MANUFACTURING	2									530
2		2		1	FOOD, BEVERAGES & TOBACCO						530
2		2		3	TEXTILES MANUFACTURING						530
2		2		4	CLOTHING AND FOOTWEAR MANUFACTURING						530
2		2		5	WOOD, WOOD PRODUCTS & FURNITURE						530
2		2		6	PAPER, PAPER PRODUCTS & FURNITURE						530
2		2		7	CHEMICAL, PETROLEUM & COAL PRODUCTS						530
2		2		8	NON-METALLIC MINERAL PRODUCTS MANUFACTURING						530
2		2		9	BASIC METAL PRODUCTS MANUFACTURING						530
3	MANUFACTURING	3									530
3		3		1	FABRICATED METAL PRODUCTS MANUFACTURING						530
3		3		2	TRANSPORT EQUIPMENT MANUFACTURING						530
3		3		3	OTHER MACHINERY AND EQUIPMENT MANUFACTURING						530
3		3		4	MISCELLANEOUS MANUFACTURING						530
4	TRANSPORTATION COMMUNICATION UTILITIES	4									570
4		4		1	RAILWAY TRANSPORTATION.						573
4		4		2	MOTOR VEHICLE TRANSPORTATION						572
4		4		3	AIRCRAFT TRANSPORTATION						571
4		4		4	MARINE CRAFT TRANSPORTATION						574

Primary	Description	Secondary	Description	Tertiary	Description	ABS Level 1 Description	Grouped Description	ABS Level 2	Description	ALUMC
4		4		5	HIGHWAY AND STREETS					572
4		4		6	AUTOMOBILE PARKING					570
4		4		7	COMMUNICATION					575
4		4		8	UTILITIES					570
4		4		9	OTHER TRANSPORTATION, COMMUNICATION & UTILITIES NEC					570
5	COMMERCE	5								551
5		5		1	WHOLESALE TRADE					551
5		5		2	RETAIL TRADE - BUILDING MATERIALS, HARDWARE & FARM EQUIPMENT					551
5		5		3	RETAIL TRADE - GENERAL MERCHANDISE					551
5		5		4	RETAIL TRADE - FOOD					551
5		5		5	RETAIL TRADE - AUTOMOTIVE, MARINECRAFT, AIRCRAFT & ACCESSORIES					551
5		5		6	RETAIL TRADE - APPAREL AND ACCESSORIES					551
5		5		7	RETAIL TRADE - FURNITURE, HOME FURNISHINGS & EQUIPMENT					551
5		5		8	RETAIL TRADE - EATING AND DRINKING					551
5		5		9	OTHER RETAIL TRADE NEC					551
6	SERVICES	6								551
6		6		1	FINANCE, INSURANCE AND REAL ESTATE SERVICES					551
6		6		2	PERSONAL SERVICES					551
6		6		3	BUSINESS SERVICES					551
6		6		4	REPAIR SERVICES					551
6		6		5	PROFESSIONAL SERVICES.					551
6		6		6	CONSTRUCTION SERVICES					551
6		6		7	GOVERNMENTAL SERVICES					552
6		6		8	EDUCATIONAL SERVICES					552
6		6		9	MISCELLANEOUS SERVICES					551
7	ENTERTAINMENT RECREATION	7								553
7		7		1	CULTURAL ACTIVITIES					553
7		7		2	PUBLIC ASSEMBLY					553

Primary	Description	Secondary	Description	Tertiary	Description	ABS Level 1	Description	Grouped Description	ABS Level 2	Description	ALUMC
7		7		3	AMUSEMENTS						553
7		7		4	RECREATIONAL ACTIVITIES						553
7		7		5	RECREATIONAL ACCOMMODATION AND GROUP CAMPS						553
7		7		6	PARKS						553
7		7		7	NATURE EXHIBITIONS						553
7		7		9	OTHER CULTURAL, ENTERTAINMENT & RECREATIONAL ACTIVITIES NEC						553
8	RURAL AND PRIMARY INDUSTRY	1	AGRICULTURE					AGRICULTURE			300
8		1	AGRICULTURE	1	PREDOMINANTLY FIELD CROPS			PREDOMINANTLY FIELD CROPS			340
8		1	AGRICULTURE	1	PREDOMINANTLY FIELD CROPS	1	WHEAT GROWING	WHEAT GROWING			341
8		1	AGRICULTURE	1	PREDOMINANTLY FIELD CROPS	2	OTHER CEREAL CROPS (GRAIN)	OTHER CEREAL CROPS (GRAIN)			341
									1	OATS	341
									2	BARLEY	341
									3	CEREAL RYE	341
									4	BUCKWHEAT	341
									5	GRAIN SORGHUM	341
									6	MAIZE	341
									7	MILLET	341
									8	RICE	341
									9	TRITICALE	341
									10	OTHER CEREALS FOR GRAIN	341
		1	AGRICULTURE	1	PREDOMINANTLY FIELD CROPS	3	OTHER GRAIN CROPS	OTHER GRAIN CROPS			341
		1	AGRICULTURE	1	PREDOMINANTLY FIELD CROPS	4	CEREAL CROPS - HAY	CEREAL CROPS - HAY			343
		1	AGRICULTURE	1	PREDOMINANTLY FIELD CROPS	5	FODDER PRODUCTION - GREEN FEED AND SILAGE	FODDER PRODUCTION - GREEN FEED AND SILAGE			430
				1	PREDOMINANTLY FIELD CROPS	6	PASTURES FOR HAY	PASTURES FOR HAY			443
									1	Lucerne (pure) - area at 31 March	432

Primary	Description	Secondary	Description	Tertiary	Description	ABS Level 1	Description	Grouped Description	ABS Level 2	Description	ALUMC		
8	RURAL AND PRIMARY INDUSTRY			1	PREDOMINANTLY FIELD CROPS	6	PASTURES FOR HAY	PASTURES FOR HAY	2	Pasture legumes (excl lucerne) - area at 31 March	432		
									3	Sown grasses - area at 31 March	434		
										4	Native or naturalised pasture at 31 March	330	
										5	Mix of perennial grasses & legumes - area at 31 March	433	
										6	Mix of annual grasses & legumes - area at 31 March	433	
				1	AGRICULTURE	1	PREDOMINANTLY FIELD CROPS	7	PASTURES FOR SEED	PASTURES FOR SEED			340
				1	AGRICULTURE	1	PREDOMINANTLY FIELD CROPS	9	MIXED CROPS	MIXED CROPS			
											1	ALOE VERA	457
											2	MUNG BEANS	457
											3	OTHER FIELD BEANS	457
											4	SOYBEANS	457
											5	BROOM MILLET	457
											6	COTTON	446
											7	COTTON	446
											8	HOPS	457
											9	LAB LAB PURPUREUS	457
											10	FENNEL	457
											11	LAVENDER	457
											12	LINSEED	457
											13	LUPINS	457
											14	OIL POPPIES	457
									15	PEANUTS	457		
									16	LEGUMES	457		
									17	FIELD PEAS	457		
									18	PIGEON PEAS	457		
									19	CHICK PEAS	457		
									20	COFFEE	457		
									21	POPCORN	457		

8

Primary	Description	Secondary	Description	Tertiary	Description	ABS Level 1	Description	Grouped Description	ABS Level 2	Description	ALUMC
		1	AGRICULTURE	1	PREDOMINANTLY FIELD CROPS	9	MIXED CROPS	MIXED CROPS	22	CANOLA	457
									23	SAFFLOWER	457
									24	SESAME	457
									25	SILAGE/GREEN FEED	443
									26	Sugar cane cut for crushing - area	445
									27	Sugar cane cut for plants - area	445
									28	Sugar cane (standover) - area	445
									29	Sugar cane (newly planted) - area	445
									30	SUNFLOWER	457
									31	TOBACCO	457
									32	VETCH	457
									33	LENTILS	457
									34	CORIANDER	457
									35	GINGER	457
									36	FABA BEANS	457
									37	MUSTARD	457
									38	TURF	434
									39	PYRETHRUM	457
									40	PEPPERMINT	457
8	RURAL AND PRIMARY INDUSTRY	1	AGRICULTURE	1	PREDOMINANTLY FIELD CROPS	9	MIXED CROPS	MIXED CROPS	41	Crops (excl cereals) cut for hay - area	440
									42	Crops (including cereals) cut for hay - area	440
									43	OTHER NON-CEREAL CROPS	440
									44	Nurseries - area	456
									45	Cut flowers - area	456
		1	AGRICULTURE	2	STOCK CROPS AND STOCK RAISING	5	FODDER PRODUCTION OTHER GRAIN CROPS/ HAY AND SHEEP - GREEN FEED AND SILAGE				330

Primary	Description	Secondary	Description	Tertiary	Description	ABS Level 1	Description	Grouped Description	ABS Level 2	Description	ALUMC
8		1	AGRICULTURE	2	STOCK CROPS AND STOCK RAISING	6	PASTURES FOR HAY	FODDER CROPS/HAY AND SHEEP			330
8		1	AGRICULTURE	2		7	PASTURES FOR SEED	FODDER CROPS/HAY AND CATTLE			330
8		1	AGRICULTURE	2		9	FLORA CONSERVATION AREA NEC	GRAZING/FODDER CROPS NEC			330
8		1	AGRICULTURE	3	PREDOMINANTLY SHEEP/CATTLE RAISING			PREDOMINANTLY SHEEP/CATTLE RAISING			520
8		1	AGRICULTURE	3	PREDOMINANTLY SHEEP/CATTLE RAISING	1	WHEAT GROWING	SHEEP			522
8		1	AGRICULTURE	3		2	OTHER CEREAL CROPS (GRAIN)	CATTLE			522
8		1	AGRICULTURE	3		3	OTHER GRAIN CROPS	SHEEP FOR WOOL			523
8		1	AGRICULTURE	3		4	CEREAL CROPS - HAY	SHEEP FOR MEAT			523
8		1	AGRICULTURE	3		5	FODDER PRODUCTION - GREEN FEED AND SILAGE	CATTLE FOR DAIRY			521
8		1	AGRICULTURE	3		9	FLORA CONSERVATION AREA NEC	LIVESTOCK MIXED			520
8	RURAL AND PRIMARY INDUSTRY	1	AGRICULTURE	4	PREDOMINANTLY OTHER LIVESTOCK			PREDOMINANTLY OTHER LIVESTOCK			520
8				4		1	WHEAT GROWING	PIGS			525
						2	OTHER CEREAL CROPS (GRAIN)	GOATS			520
						3	OTHER GRAIN CROPS	HORSES			520
						4	CEREAL CROPS - HAY	DEER			520
	Y					5	FODDER PRODUCTION - GREEN FEED AND SILAGE	POULTRY HATCHING			524
8				4		6	PASTURES FOR HAY	POULTRY FOR MEAT			524
				4		7	PASTURES FOR SEED	POULTRY FOR EGGS			524
				4		8	MIXED CROPS	OTHER LIVESTOCK			520
				5	PREDOMINANTLY HORTICULTURAL CROPS			PREDOMINANTLY HORTICULTURAL CROPS			460

Primary	Description	Secondary	Description	Tertiary	Description	ABS Level 1	Description	Grouped Description	ABS Level 2	Description	ALUMC
8	RURAL AND PRIMARY INDUSTRY	1		5	PREDOMINANTLY HORTICULTURAL CROPS	1	WHEAT GROWING	POTATOES			464
									1	Potatoes - for seed - area	464
									2	Potatoes - early/spring - harvest before 31 March - area	464
									3	Potatoes (main/autumn) harvested after 31 March - area	464
		1	AGRICULTURE	5	PREDOMINANTLY HORTICULTURAL CROPS	2	OTHER CEREAL CROPS (GRAIN)	VEGETABLES AND GROUND CROPS (EXCEPT POTATOES)			464
									1	Beans french & runner - for seed - area	464
									2	Carrot seed - area	464
									3	Cabbage (chinese) for seed - area	464
									4	Cauliflower seed - area	464
									5	Onion seed - area	464
									6	Peas green - for seed - area	464
									7	Pumpkins - for seed - area	464
									8	Radish seed - area	464
									9	Vegetable seed - other (not elsewhere classified) - area	464
									10	Artichokes - area	464
									11	Asparagus - total area	464
									12	Broad beans - area	464
									13	French and runner beans (processing) - area	464
									14	French and runner beans (fresh market) - area	464
									15	Beetroot - area	464
									16	Broccoli - area	464
									17	Brussel sprouts - area	464
									18	Cabbages - area	464

Primary	Description	Secondary	Description	Tertiary	Description	ABS Level 1	Description	Grouped Description	ABS Level 2	Description	ALUMC
		1	AGRICULTURE	5	PREDOMINANTLY HORTICULTURAL CROPS	2	OTHER CEREAL CROPS (GRAIN)	VEGETABLES AND GROUND CROPS (EXCEPT POTATOES)	19	Chinese cabbage (Buckchoi and Wombak) - area	464
									20	Capsicum chillies and peppers - area	464
									21	Carrots - area	464
									22	Cauliflower - area	464
									23	Celery - area	464
									24	Chokos - area	464
									25	Cucumbers - area	464
									26	Eggplant - area	464
									27	Witloof chicory (french endive) - area	464
									28	Fennel (sweet) - area	464
									29	Garlic - area	464
									30	Gherkins - area	464
									31	Herbs - lemon grass etc - area	464
									32	Horse radish - area	464
									33	Leeks - area	464
									34	Lettuce - area	464
									35	Marrows and squashes - area	464
									36	Zucchini - area	464
									37	Marrows squashes and zuchinis - area	464
									38	Melons rock (incl cantaloupe) - area	464
									39	Melons water - area	464
									40	Melons (not elsewhere classified) - area	464
									41	Melons bitter (gourd) - area	464
									42	Mushrooms - area	464
									43	Okra - area	464

Primary	Description	Secondary	Description	Tertiary	Description	ABS Level 1	Description	Grouped Description	ABS Level 2	Description	ALUMC					
8	RURAL AND PRIMARY INDUSTRY	1	AGRICULTURE	5	PREDOMINANTLY HORTICULTURAL CROPS	2	OTHER CEREAL CROPS (GRAIN)	VEGETABLES AND GROUND CROPS (EXCEPT POTATOES)	44	Onions spring (incl shallots) - area	464					
		45		Onions white and brown - area		464										
		46		Parsley - area		464										
		47		Parsnips - area		464										
		48		Peas green (for processing) - area		464										
		49		Peas green (for fresh market) - area		464										
		50		Peas snow - area		464										
		51		Pumpkins triambles trombones etc. - area		464										
		52		Radish - area		464										
		53		Rhubarb - area		464										
		54		Silver beet and spinach - area		464										
		55		Sprouts (alfalfa mung bean etc.) - area		464										
		56		Sweet corn - area		464										
		57		Sweet potatoes - area		464										
		58		Tomatoes (processing) - area		464										
		59		Tomatoes (fresh market) - area		464										
		60		Swedes - area		464										
		61		Turnips (white) - area		464										
		62		Vegetables other (not elsewhere classified) - area		464										
8		RURAL AND PRIMARY INDUSTRY		1		AGRICULTURE			5	PREDOMINANTLY HORTICULTURAL CROPS	3	OTHER GRAIN CROPS	VINES GROWING			454
				4					CEREAL CROPS - HAY		ORCHARD FRUIT GROWING - CITRUS FRUIT		461			

Primary	Description	Secondary	Description	Tertiary	Description	ABS Level 1	Description	Grouped Description	ABS Level 2	Description	ALUMC
8	RURAL AND PRIMARY INDUSTRY	1	AGRICULTURE	5	PREDOMINANTLY HORTICULTURAL CROPS	4	CEREAL CROPS - HAY	ORCHARD FRUIT GROWING - CITRUS FRUIT	1	Oranges trees under 6 years	461
									2	Oranges trees 6 years and over	461
									3	Grapefruit trees under 6 years	461
									4	Grapefruit trees 6 years and over	461
									5	Lemon and lime trees under 6 years	461
									6	Lemons and limes trees 6 years and over	461
									7	Mandarins trees under 6 years	461
									8	Mandarins trees 6 years and over	461
									9	Tangelos trees under 6 years	461
									10	Tangelos trees 6 years and over	461
									11	Citrus fruit other (NEC) - trees under 6 years	461
									12	Citrus fruit other (NEC) - trees 6 years and over	461
8	RURAL AND PRIMARY INDUSTRY	1	AGRICULTURE	5	PREDOMINANTLY HORTICULTURAL CROPS	5	FODDER PRODUCTION - GREEN FEED AND SILAGE	ORCHARD FRUIT GROWING - POME FRUIT	1	Apples trees under 6 years	461
									2	Apples trees 6 years and over	461
									3	Pears (excluding Nashi) trees under 6 years	461
									4	Pears (excluding Nashi) trees 6 years and over	461
									5	Quinces - trees under 6 years	461

Primary	Description	Secondary	Description	Tertiary	Description	ABS Level 1	Description	Grouped Description	ABS Level 2	Description	ALUMC
8	RURAL AND PRIMARY INDUSTRY	1	AGRICULTURE	5	PREDOMINANTLY HORTICULTURAL CROPS	5	FODDER PRODUCTION - GREEN FEED AND SILAGE	ORCHARD FRUIT GROWING - POME FRUIT	6	Quinces - trees 6 years and over	461
									7	Nashi trees under 6 years	461
									8	Nashi trees 6 years and over	461
									9	Pome fruit (NEC) trees under 6 years	461
									10	Pome fruit (NEC) trees 6 years and over	461
						6	PASTURES FOR HAY	ORCHARD FRUIT GROWING - STONE FRUIT			461
									1	Apricots trees under 6 years	461
									2	Apricots trees 6 years and over	461
									3	Avocados trees under 6 years	461
									4	Avocados trees 6 years and over	461
									5	Carambola trees under 6 years	461
									6	Carambola trees 6 years and over	461
									7	Cherries trees under 6 years	461
									8	Cherries trees 6 years and over	461
									9	Custard apples trees under 6 years	461
									10	Custard apples trees 6 years and over	461
									11	Dates trees under 6 years	461
									12	Dates trees 6 years and over	461
									13	Jackfruit trees under 6 years	461

Primary	Description	Secondary	Description	Tertiary	Description	ABS Level 1	Description	Grouped Description	ABS Level 2	Description	ALUMC
8	RURAL AND PRIMARY INDUSTRY	1	AGRICULTURE	5	PREDOMINANTLY HORTICULTURAL CROPS	6		ORCHARD FRUIT GROWING - STONE FRUIT	14	Jackfruit trees 6 years and over	461
									15	Figs trees under 6 years	461
									16	Figs trees 6 years and over	461
									17	Guava trees under 6 years	461
									18	Guava trees 6 years and over	461
									19	Loquats - trees under 6 years	461
									20	Loquats - trees 6 years and over	461
									21	Lychees - trees under 6 years	461
									22	Lychees - trees 6 years and over	461
									23	Mangoes trees under 6 years	461
									24	Mangoes trees 6 years and over	461
									25	Nectarines trees under 6 years	461
									26	Nectarines trees 6 years and over	461
									27	Olives - trees under 6 years	461
									28	Olives - trees 6 years and over	461
									29	Longans - trees under 6 years	461
									30	Longans - trees 6 years and over	461
									31	Peaches - trees under 6 years	461
									32	Peaches - 6 years and over	461
									33	Peacharines - trees under 6 years	461

Primary	Description	Secondary	Description	Tertiary	Description	ABS Level 1 Description	Grouped Description	ABS Level 2	Description	ALUMC
8	RURAL AND PRIMARY INDUSTRY	1	AGRICULTURE	5	PREDOMINANTLY HORTICULTURAL CROPS	6	ORCHARD FRUIT GROWING - STONE FRUIT	34	Peacharines - trees 6 years and over	461
								35	Persimmons - trees under 6 years	461
								36	Persimmons - trees 6 years and over	461
								37	Plums - trees under 6 years	461
								38	Plums - trees 6 years and over	461
								39	Prunes - trees under 6 years	461
								40	Prunes - trees 6 years and over	461
								41	Rambutan trees under 6 years	461
								42	Rambutan trees 6 years and over	461
								43	Stone fruit (NEC) trees under 6 years	461
								44	Stone fruit (NEC) trees 6 years and over	461
								45	Orchard fruit NEC - trees under 6 years	461
								46	Orchard fruit NEC - trees 6 years and over	461
						7	PASTURES FOR SEED TROPICAL FRUIT GROWING			461
								1	Babacos not yet bearing area	461
								2	Babacos bearing area	461
								3	Bananas - not yet bearing area	461
								4	Bananas - bearing area	461
								5	Kiwi fruit / zespri - not yet bearing area	461
								6	Kiwi fruit / zespri - bearing area	461

Primary	Description	Secondary	Description	Tertiary	Description	ABS Level 1 Description	Grouped Description	ABS Level 2	Description	ALUMC										
8	RURAL AND PRIMARY INDUSTRY	1	AGRICULTURE	5	PREDOMINANTLY HORTICULTURAL CROPS	7	PASTURES FOR SEED	TROPICAL FRUIT GROWING	7	Papaws / Papaya - not yet bearing area	461									
									8	Papaws / Papaya - bearing area	461									
									9	Passionfruit not yet bearing area	461									
									10	Passionfruit bearing area	461									
									11	Pepinos not yet bearing area	461									
									12	Pepinos bearing area	461									
									13	Pineapples - not yet bearing area	461									
									14	Pineapples - bearing area	461									
									15	Rosella not yet bearing area	461									
									16	Rosella bearing area	461									
									17	Tropical fruit (NEC) -not yet bearing area	461									
									18	Tropical fruit (NEC) - bearing area	461									
									8	RURAL AND PRIMARY INDUSTRY	1	AGRICULTURE	5	PREDOMINANTLY HORTICULTURAL CROPS	8	MIXED CROPS	BERRY FRUITS GROWING			461
																		1	Black currants - area not yet bearing	461
																		2	Black currants - bearing area	461
																		3	Blueberries not yet bearing area	461
																		4	Blueberries bearing area	461
																		5	Gooseberries area not yet bearing	461
6	Gooseberries bearing area	461																		
7	Loganberries not yet bearing area	461																		
8	Loganberries bearing area	461																		

Primary	Description	Secondary	Description	Tertiary	Description	ABS Level 1	Description	Grouped Description	ABS Level 2	Description	ALUMC
8	RURAL AND PRIMARY INDUSTRY	1	AGRICULTURE	5	PREDOMINANTLY HORTICULTURAL CROPS	8	MIXED CROPS	BERRY FRUITS GROWING	9	Raspberries - not yet bearing area	461
									10	Raspberries - bearing area	461
									11	Strawberries - not yet bearing area	461
									12	Strawberries - Bearing area	461
									13	Berry and other small fruit (NEC) not yet bearing area	461
									14	Berry and other small fruit (NEC) - bearing area	461
									8	RURAL AND PRIMARY INDUSTRY	1
1	Almonds trees under 6 years	462									
2	Almonds trees 6 years and over	462									
3	Cashews trees under 6 years	462									
4	Cashews trees 6 years and over	462									
5	Chestnuts trees under 6 years	462									
6	Chestnuts trees 6 years and over	462									
7	Filberts hazelnuts & cobnuts trees under 6 years	462									
8	Filberts hazelnuts & cobnuts 6 years and over	462									
9	Macadamia trees under 6 years	462									
10	Macadamia trees 6 years and over	462									
11	Pecans trees under 6 years	462									
12	Pecans trees 6 years and over	462									

Primary	Description	Secondary	Description	Tertiary	Description	ABS Level 1	Description	Grouped Description	ABS Level 2	Description	ALUMC								
8	RURAL AND PRIMARY INDUSTRY	1	AGRICULTURE	5	PREDOMINANTLY HORTICULTURAL CROPS	9	FLORA CONSERVATION AREA NEC	NUTS GROWING	13	Pistachios trees under 6 years	462								
									14	Pistachios trees 6 years and over	462								
									15	Walnuts trees under 6 years	462								
									16	Walnuts trees 6 years and over	462								
									17	Nuts (NEC) trees under 6 years	462								
									18	Nuts (NEC) trees 6 years and over	462								
												6	MIXED HORTICULTURE AND HORTICULTURE N.E.C.			MIXED HORTICULTURE AND HORTICULTURE N.E.C.			360
												6	MIXED HORTICULTURE AND HORTICULTURE N.E.C.	1	WHEAT GROWING	HORTICULTURAL CROPS NEC			360
												6		9	FLORA CONSERVATION AREA NEC	MIXED HORTICULTURE			360
												7	MIXED ENTERPRISE			MIXED ENTERPRISE			300
												7	MIXED ENTERPRISE	1	WHEAT GROWING	MIXED AGRICULTURE - LIVESTOCK,CROPS & HORTICULTURE			300
												9	OTHER AGRICULTURAL ENTERPRISES			OTHER AGRICULTURAL ENTERPRISES			300
												9		1	WHEAT GROWING	SEED PRODUCTION,PLANT NURSERIES (OPEN AIR NOT RETAIL)			450
			9	OTHER AGRICULTURAL ENTERPRISES	2	OTHER CEREAL CROPS (GRAIN)	FLOWERS AND ORNAMENTAL PLANTS (OPEN AIR) (NOT RETAIL)			456									
			9		3	OTHER GRAIN CROPS	GLASS-HOUSE OR SHADE-HOUSE PLANT PRODUCTION (NOT RETAIL)			510									
			9		4	CEREAL CROPS - HAY	APIARY			520									
8	RURAL AND PRIMARY INDUSTRY	1	AGRICULTURE	9	OTHER AGRICULTURAL ENTERPRISES	9	FLORA CONSERVATION AREA NEC	OTHER RURAL ACTIVITY NEC											
									2	AGRICULTURAL AND RELATED ACTIVITIES									
									2		1	PREDOMINANTLY FIELD CROPS			AGRICULTURAL PROCESSING		530		
									2		1		1	WHEAT GROWING	GRAIN MILLING SERVICES		551		

Primary	Description	Secondary	Description	Tertiary	Description	ABS Level 1	Description	Grouped Description	ABS Level 2	Description	ALUMC
		2		1	PREDOMINANTLY FIELD CROPS	2	OTHER CEREAL CROPS (GRAIN)	CORN SHELLING,HAY BALING & THRESHING SERVICES			551
		2		1	PREDOMINANTLY FIELD CROPS	3	OTHER GRAIN CROPS	GRAIN HANDLING GRADING			551
		2		1	PREDOMINANTLY FIELD CROPS	4	CEREAL CROPS - HAY	WOOL HANDLING,SHEEP SKIN,WOOL CLASSING			551
		2		1	PREDOMINANTLY FIELD CROPS	5	FODDER PRODUCTION - GREEN FEED AND SILAGE	CONTRACT SORTING,GRADING & PACKAGING SERVICES (FRUIT & VEG)			551
		2		1	PREDOMINANTLY FIELD CROPS	6	PASTURES FOR HAY	SHEEP SHEARING			551
		2		1	PREDOMINANTLY FIELD CROPS	7	PASTURES FOR SEED	SEED CLEANING			551
		2		1	PREDOMINANTLY FIELD CROPS	8	MIXED CROPS	LIVESTOCK DIPPING,DRAFTING & TAILING SERVICES			551
		2		1	PREDOMINANTLY FIELD CROPS	9	FLORA CONSERVATION AREA NEC	OTHER AGRICULTURAL PROCESSING SERVICES NEC			551
		2		9	OTHER AGRICULTURAL ENTERPRISES			OTHER AGRICULTURAL RELATED ACTIVITIES NEC			300
		2		9	OTHER AGRICULTURAL ENTERPRISES	1	WHEAT GROWING	HORTICULTURAL SERVICES			551
		2		9	OTHER AGRICULTURAL ENTERPRISES	9	FLORA CONSERVATION AREA NEC	OTHER AGRICULTURAL RELATED ACTIVITIES NEC			300
		3	FORESTRY ACTIVITIES AND RELATED SERVICES					FORESTRY ACTIVITIES AND RELATED SERVICES			120
		3		1	PREDOMINANTLY FIELD CROPS			COMMERCIAL FORESTRY PRODUCTION			310
		3		1	PREDOMINANTLY FIELD CROPS	1	WHEAT GROWING	SOFTWOOD PRODUCTION			312
		3		1	PREDOMINANTLY FIELD CROPS	2	OTHER CEREAL CROPS (GRAIN)	HARDWOOD PRODUCTION - PREDOMINATELY FOR SAW LOGS			311
8		3		1	PREDOMINANTLY FIELD CROPS	3	OTHER GRAIN CROPS	HARDWOOD PRODUCTION - PREDOMINATELY FOR CHIP LOGS			311
8		3		1	PREDOMINANTLY FIELD CROPS	4	CEREAL CROPS - HAY	TIMBER PRODUCTION - FIREWOOD			120
8		3		1	PREDOMINANTLY FIELD CROPS	5	FODDER PRODUCTION - GREEN FEED AND SILAGE	TIMBER PRODUCTION - POLES AND PILES			120

Primary	Description	Secondary	Description	Tertiary	Description	ABS Level 1	Description	Grouped Description	ABS Level 2	Description	ALUMC
8		3		1	PREDOMINANTLY FIELD CROPS	6	PASTURES FOR HAY	TIMBER PRODUCTION - SANDALWOOD			120
8				1	PREDOMINANTLY FIELD CROPS	9	FLORA CONSERVATION AREA NEC	COMMERCIAL FORESTRY PRODUCTION NEC			120
8				2	STOCK CROPS AND STOCK RAISING			FORESTRY SERVICES			551
		3				1	WHEAT GROWING	FOREST NURSERIES.			120
						9	FLORA CONSERVATION AREA NEC	OTHER FORESTRY SERVICES NEC			551
8	RURAL AND PRIMARY INDUSTRY	4	FISHING ACTIVITIES AND RELATED SERVICES					FISHING ACTIVITIES AND RELATED SERVICES			551
		4		1	PREDOMINANTLY FIELD CROPS			FISHERIES AND MARINE PRODUCTS			620
		4		1	PREDOMINANTLY FIELD CROPS	1	WHEAT GROWING	OCEAN AND COASTAL FINFISH FISHERIES			620
		4		1	PREDOMINANTLY FIELD CROPS	2	OTHER CEREAL CROPS (GRAIN)	INLAND FINFISH FISHERIES			620
		4		1	PREDOMINANTLY FIELD CROPS	3	OTHER GRAIN CROPS	OCEAN AND COASTAL SHELLFISH FISHERIES			620
		4		1	PREDOMINANTLY FIELD CROPS	4	CEREAL CROPS - HAY	INLAND SHELLFISH FISHERIES			620
		4		1	PREDOMINANTLY FIELD CROPS	9	FLORA CONSERVATION AREA NEC	OTHER FISHERIES AND MARINE PRODUCTS NE			620
		4		2	STOCK CROPS AND STOCK RAISING			FISHERY SERVICES			631
		4				1	WHEAT GROWING	FISH HATCHERIES			631
		4				9	FLORA CONSERVATION AREA NEC	OTHER FISHERY SERVICES NEC			631
9	NATURAL AND MISCELLANEOUS USES	9									100
9		9		1	NATURE CONSERVATION AREA						110
9		9		2	ENVIRONMENTAL PROTECTION AREAS						110
9		9		3	FOREST AREAS - NON COMMERCIAL						110
9		9		4	SCENIC GEOGRAPHIC FEATURES						124
9		9		6	WATER AND WATER RELATED AREAS						120

Primary	Description	Secondary	Description	Tertiary	Description	ABS Level 1	Description	Grouped Description	ABS Level 2	Description	ALUMC
9		9		8	VACANT FLOOR AREA						130
9		9		9	UNUSED LAND AND WATER AREAS						130

Appendix 2: Aerial extent of vegetation in Western Australia by type

Association	Current extent (ha)	Pre-European extent (ha)	Remaining (%)	Description
1	57,208	74,626	76.66	Tall forest; karri (<i>Eucalyptus diversicolor</i>)
2	2,454	3,155	77.79	Tall woodland; tuart (<i>E. gomphocephala</i>)
3	1,860,865	2,707,678	68.73	Medium forest; jarrah-marri
4	276,471	1,127,124	24.53	Medium woodland; marri & wandoo
5	26,091	61,873	42.17	Medium woodland; wandoo & powderbark (<i>E. accedens</i>)
6	22,168	67,429	32.88	Medium woodland; tuart & jarrah
7	24,624	256,576	9.60	Medium woodland; York gum (<i>E. loxophleba</i>) & wandoo
8	631,867	1,096,450	57.63	Medium woodland; salmon gum & gimlet
9	244,735	244,735	100	Medium woodland; coral gum (<i>E. torquata</i>) & Goldfields blackbutt (<i>E. le souefii</i>) (also some e10,11)
10	147,632	153,995	95.87	Medium woodland; red mallee group
11	35,944	35,944	100	Medium woodland; coolabah (<i>E. microtheca</i>)
12	8,725	8,725	100	Medium woodland-tropical; stringybark (<i>E. tetrodonta</i>) & woollybutt (<i>E. miniata</i>)
13	4,606	7,766	59.31	Medium open woodland; wandoo
14	72,747	114,694	63.43	Low forest; jarrah
15	0	2,791	0	Low forest; cypress pine
16	210	2,878	7.31	Low forest; bushy yate (<i>E. cornuta</i>) & Bald Is. marlock (<i>E. lehmanni</i>)
17	53,568	76,761	69.79	Shrublands; <i>Acacia rostellifera</i> thicket
18	22,029,557	22,029,557	100	Low woodland; mulga (<i>Acacia aneura</i>)
19	4,428,494	4,428,494	100	Low woodland; mulga between sandridges
20	1,336,850	1,336,850	100	Low woodland; mulga mixed with <i>Allocasuarina cristata</i> & <i>Eucalyptus</i> sp (e6?)
21	79,317	79,317	100	Low woodland; waterwood
22	3,210	4,339	73.98	Low woodland; <i>Agonis flexuosa</i>
23	33,108	41,148	80.46	Low woodland; jarrah-banksia
24	266,665	266,665	100	Low woodland; <i>Allocasuarina cristata</i>
25	1,130	10,710	10.55	Low woodland; <i>Allocasuarina huegeliana</i> & York gum
27	98,194	135,605	72.41	Low woodland; paperbark (<i>Melaleuca</i> sp.)
28	317,397	317,397	100	Open low woodland; mulga
29	7,015,905	7,015,905	100	Sparse low woodland; mulga, discontinuous in scattered groups
31	724	2,860	25.30	Shrublands; <i>Melaleuca thyooides</i> thicket with scattered York gum
32	33,389	33,389	100	Shrublands; pindan; acacia shrubland with scattered low trees over <i>Plectrachne</i> sp. & <i>Triodia</i> spp.
34	2,948	2,948	100	Shrublands; acacia scrub with scattered mulga
35	19,224	187,165	10.27	Shrublands; jam scrub with scattered York gum
36	157,048	315,743	49.74	Shrublands; thicket, acacia-casuarina alliance ?species
37	23,393	40,073	58.38	Shrublands; teatree thicket
38	2,693	2,875	93.67	Shrublands; thicket, mixed
39	4,856,768	4,856,768	100	Shrublands; mulga scrub
40	415,165	550,752	75.38	Shrublands; acacia scrub, various species
41	187,306	204,859	91.43	Shrublands; teatree scrub
42	296,289	323,485	91.59	Shrublands; mallee & acacia scrub on south coastal dunes
43	187,661	225,819	83.10	Low forest; mangroves (Kimberley) or thicket; mangroves (Pilbara)
45	358,099	358,099	100	Shrublands; mallee scrub (Great Victoria Desert)
46	456,973	456,973	100	Shrublands; mallee scrub (e=?)

Association	Current extent (ha)	Pre-European extent (ha)	Remaining (%)	Description
47	388,949	1,165,812	33.36	Shrublands; tallerack mallee-heath
48	5,157	50,568	10.20	Shrublands; scrub-heath
49	21,795	53,001	41.12	Shrublands; mixed heath
50	3,790	6,594	57.47	Shrublands; dwarf scrub on granite (South coast)
51	34,732	62,555	55.52	Sedgeland; reed swamps, occasionally with heath
52	203,185	203,185	100	Grasslands, high grass savanna woodland; bloodwood & stringybark over upland tall grass & curly spinifex
53	1,003,955	1,003,955	100	Mosaic: Grasslands/pindan; Medium woodland with mixed tree scrub over tall upland grass and plectrachne
59	145,071	145,071	100	Grasslands, high grass savanna sparse tree; bauhinia & coolabah over Mitchell, blue & tall upland grasses
60	167,483	167,483	100	Grasslands, tall bunch grass savanna woodland, grey box & cabbage gum over ribbon grass
61	136,256	136,256	100	Grasslands, tall bunch grass savanna woodland, coolabah over ribbon grass (<i>Crypsopogon</i> spp)
64	442,097	442,097	100	Grasslands, tall bunch grass savanna low tree; baobabs <i>Adansonia gregorii</i> , bauhinia & beefwood (<i>Grevillea striata</i> over ribbon grass
65	72,818	72,818	100	Grasslands, tall bunch grass savanna, sparse low tree, terminalia; mitchell grass (<i>Astrebla pectinata</i> & spp)
67	27,535	27,535	100	Grasslands, tall bunch grass savanna, sparse low tree; ribbon grass & paperbarks
72	270,930	271,288	100	Grasslands, short bunch grass savanna, grass; arid short grasses on dry plains
73	249,064	249,064	100	Grasslands, short bunch grass savanna, grass; salt water grassland (<i>Sporobolus virginicus</i>)
75	1,761,292	1,761,292	100	Grasslands, curly spinifex, low tree savanna woodland; gnaingar (<i>E. phoenicea</i>) & <i>Eucalyptus ferruginea</i> over <i>Plectrachne pungens</i>
77	419,862	419,862	100	Grasslands, curly spinifex & short grass low tree savanna; snappy gum over enneapogon & curly spinifex
78	670,485	670,485	100	Hummock grasslands, low tree steppe; eucalypts over soft spinifex soft spinifex
80	161,741	161,741	100	Hummock grasslands, low tree steppe; desert walnut over soft spinifex between sandridges
81	111,285	111,285	100	Hummock grasslands, low tree steppe; snappy gum over soft spinifex
82	2,687,751	2,687,751	100	Hummock grasslands, low tree steppe; snappy gum over <i>Triodia wiseana</i>
84	1,670,385	1,670,385	100	Hummock grasslands, open low tree & mallee steppe; marble gum & mallee (<i>Eucalyptus youngiana</i>) over hard spinifex <i>Triodia basedowii</i> between sandhills
85	2,760,337	2,760,337	100	Hummock grasslands, open low tree & mallee steppe; marble gum & mallee (<i>Eucalyptus youngiana</i>) over hard spinifex on sandplain
86	97,768	97,768	100	Hummock grasslands, open low tree steppe; mulga, <i>Allocasuarina cristata</i> & hard spinifex between sand ridges
91	453,009	453,603	100	Hummock grasslands, sparse tree steppe; snappy gum over soft spinifex
92	157,108	157,108	100	Hummock grasslands, sparse tree steppe; bloodwood over hard spinifex <i>Triodia basedowii</i>
93	3,134,772	3,134,772	100	Hummock grasslands, shrub steppe; kanji over soft spinifex
94	8,910	8,910	100	Hummock grasslands, shrub steppe; kanji over soft spinifex between sand ridges
95	1,240,331	1,240,331	100	Hummock grasslands, shrub steppe; acacia & grevillea over <i>Triodia basedowii</i>
96	1,054,822	1,054,822	100	Hummock grasslands, shrub steppe; acacia species (+grevillea) over <i>Triodia basedowii</i> often between sandridges
97	41,110	41,110	100	Hummock grasslands, shrub steppe; acacia species over <i>Plectrachne melvillei</i>

Association	Current extent (ha)	Pre-European extent (ha)	Remaining (%)	Description
98	477,182	477,182	100	Hummock grasslands, shrub steppe; kanji over soft spinifex & T. basedowii
99	532,217	532,217	100	Hummock grasslands, shrub steppe; Acacia coriacea & hakea over hard spinifex Triodia basedowii
100	59,722	59,722	100	Hummock grasslands, shrub steppe; Acacia delibrata over soft spinifex
101	1,244,744	1,244,744	100	Hummock grasslands, shrub steppe; Acacia pachycarpa over soft spinifex
102	957,624	957,624	100	Hummock grasslands, shrub steppe; Acacia pachycarpa over Triodia basedowii
103	593,926	593,926	100	Hummock grasslands, shrub steppe; snakewood over soft spinifex & T. wiseana
104	90,910	90,910	100	Hummock grasslands, shrub steppe; Grevillea refracta & hakea over soft spinifex soft spinifex
105	2,571	2,571	100	Hummock grasslands, shrub steppe; mulga over soft spinifex
106	431,038	431,038	100	Hummock grasslands, shrub steppe; hakea over soft spinifex soft spinifex
107	2,980,661	2,980,661	100	Hummock grasslands, shrub steppe; mulga and Eucalyptus kingsmillii over hard spinifex
109	978,095	978,095	100	Hummock grasslands, shrub steppe; Eucalyptus youngiana over hard spinifex
110	533,492	533,492	100	Hummock grasslands, shrub steppe; red mallee over spinifex Triodia scariosa
111	745,455	745,455	100	Hummock grasslands, shrub steppe; Eucalyptus gamophylla over hard spinifex
112	26,412	26,412	100	Hummock grasslands, shrub steppe; Acacia ligulata over Triodia plurinervata
116	118,520	118,520	100	Hummock grasslands, sparse low tree steppe; mixed low trees over Triodia wiseana
117	862,281	890,079	96.88	Hummock grasslands, grass steppe; soft spinifex
118	323	323	100	Hummock grasslands, grass steppe; spinifex Triodia wiseana, T. basedowii & Plectrachne pungens
120	479,504	479,504	100	Succulent steppe with open low woodland; mulga & sheoak
122	2,585,960	2,585,960	100	Succulent steppe with open low woodland; Acaia papyrocarpa over saltbush & bluebush,
123	9,186	9,186	100	Succulent steppe with open low woodland; sheoak over saltbush & bluebush
125	3,237,158	3,578,590	90.46	Bare areas; salt lakes
126	204,323	220,518	92.66	Bare areas; freshwater lakes
127	745,336	765,734	97.34	Bare areas; mudflats
128	302,558	503,092	60.14	Bare areas; rock outcrops
129	39,747	83,490	47.61	Bare areas; drift sand
131	24,755	235,184	10.53	Mosaic: Medium woodland; salmon gum & gimlet / Shrublands; mallee scrub, redwood & black marlock
133	49,235	49,235	100	Mixed short grass and spinifex
134	26,440,094	26,440,094	100	Mosaic: Hummock grasslands, open low tree steppe; desert bloodwood and feathertop spinifex (on) sandhills / Hummock grasslands, shrub steppe; mixed shrubs over spinifex
136	304,775	304,775	100	Hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills
137	203,729	203,729	100	Hummock grasslands, low tree steppe; desert walnut over (soft) spinifex/plectrachne on sandplain
138	1,017,437	1,017,437	100	Mosaic: Hummock grasslands, low tree steppe; eucalypts over feathertop between dunes / Hummock grasslands, patchy shrub steppe; Acacia pachycarpa over soft spinifex on lateritic rises

Association	Current extent (ha)	Pre-European extent (ha)	Remaining (%)	Description
139	7,224,836	7,224,836	100	Hummock grasslands, patchy shrub steppe; mulga over hard spinifexon laterite
141	236,898	580,105	40.84	Medium woodland; York gum, salmon gum & gimlet
142	266,619	967,983	27.54	Medium woodland; York gum & salmon gum
143	17,681	17,681	100	Medium woodland; York gum, salmon gum & Allocasuarina cristata
144	441,835	460,103	96.03	Medium woodland; wandoo, salmon gum, morrel, gimlet & rough fruited mallee
145	339	9,575	3.54	Mosaic: Medium woodland; York gum & salmon gum / Shrublands; thicket, acacia-casuarina-melaleuca alliance
147	24,500	30,791	79.57	Succulent steppe with scrub; acacia species over saltbush
148	23,065	23,065	100	Medium woodland; gimlet
151	190,207	190,207	100	Sedgeland; sedges with open low trees; coolabah over various sedges
152	306,589	306,589	100	Hummock grasslands, grass steppe; soft & hard spinifex soft spinifex
155	6,051,427	6,051,427	100	Hummock grasslands, low tree steppe; eucalypts over soft and feathertop spinifex between sandhills
157	500,420	501,139	100	Hummock grasslands, grass steppe; hard spinifex Triodia wiseana
158	165,325	165,325	100	Hummock grasslands, shrub steppe; kanji over Triodia basedowii
160	1,145,775	1,145,775	100	Shrublands; snakewood & Acacia victoriae scrub
161	63,004	63,004	100	Hummock grasslands, low open tree & shrub steppe; scattered eucalypts, Acacia pachycarpa over Triodia basedowii
162	546,330	546,330	100	Shrublands; snakewood scrub
163	641,389	641,389	100	Shrublands; eremophila and cassia dwarf scrub
165	539,081	539,081	100	Low woodland; mulga & snakewood (A. eremaea)
166	347,975	347,975	100	Low woodland; mulga & Acacia victoriae
167	120,446	120,446	100	Shrublands; Acacia victoriae & snakewood open scrub
168	56,304	56,304	100	Shrublands; mulga, Acacia victoriae & snakewood scrub
169	398,200	398,200	100	Shrublands; mulga & minnieritchie scrub
171	186,301	186,301	100	Hummock grasslands, low tree steppe; snappy gum over soft spinifex & T. brizioides
173	1,717,425	1,717,425	100	Hummock grasslands, shrub steppe; kanji over soft spinifex & T. wiseana on basalt
174	1,161,763	1,161,763	100	Hummock grasslands, shrub steppe; mixed shrubs over soft spinifex
175	518,102	518,102	100	Short bunch grassland - savanna/grass plain (Pilbara)
177	170,412	170,412	100	Hummock grasslands, sparse shrub steppe; Acacia bivenosa over hard spinifex Triodia brizioides
178	619,834	619,834	100	Hummock grasslands, grass steppe; hard spinifex Triodia basedowii
179	75,402	75,402	100	Hummock grasslands, shrub steppe; Acacia pachycarpa & A. victoriae over soft spinifex & T. wiseana
180	27,650	27,650	100	Shrublands; mulga open scrub
181	1,751,618	1,751,618	100	Shrublands; mulga & snakewood scrub
182	94,274	94,274	100	Low woodland; mulga & bowgada (A. ramulosa)
183	320,960	320,960	100	Low woodland; mulga, Acacia victoriae & snakewood
184	74,781	74,781	100	Shrublands; mulga & bowgada scrub
185	214,990	214,990	100	Sedgeland; sedges with medium woodland; sedges with coolabah over various sedges
186	20,947	20,947	100	Shrublands; Acacia sclerosperma & A. victoriae open scrub
187	4,318	4,318	100	Succulent steppe with open scrub; scattered Acacia victoriae & snakewood over various species
188	25,487	25,487	100	Shrublands; mulga & Acacia sclerosperma scrub

Association	Current extent (ha)	Pre-European extent (ha)	Remaining (%)	Description
190	169,401	169,401	100	Hummock grasslands, sparse shrub steppe; Acacia bivenosa & A. trachycarpa over hard spinifex Triodia wiseana, Very poor rocky country on gneiss
191	34,280	34,280	100	Hummock grasslands, low open tree & shrub steppe; sparse snappy gum, Acacia pachycarpa & A. victoriae over T.pungens & T. brizoides
192	276,406	276,406	100	Hummock grasslands, shrub steppe; kanji over Triodia pulchella & T. brizoides on basalt
194	59,253	59,253	100	Hummock grasslands, tree steppe; desert oak & hard spinifex between sandhills
196	87,603	87,603	100	Hummock grasslands, shrub steppe; kanji over Triodia wiseana on hills of dolerite and shale
197	56,545	56,545	100	Sedgeland; sedges with scattered medium trees; coolabah over various sedges & forbs
198	287,357	287,357	100	Hummock grasslands, low open tree & shrub steppe; sparse snappy gum, Acacia pachycarpa & A. victoriae over Triodia brizoides on chert
199	62,896	62,896	100	Hummock grasslands, shrub steppe; mulga over soft spinifex Triodia on rises
200	2,304	2,304	100	Mosaic: Low woodland over scrub; mulga over bowgada scrub / Shrublands; bowgada & grevillea scrub on sandhills
202	365,344	365,344	100	Shrublands; mulga & Acacia quadrimarginea scrub
204	208,644	208,644	100	Succulent steppe with open scrub; scattered mulga & Acacia sclerosperma over saltbush & bluebush
205	294,626	294,626	100	Shrublands; Acacia sclerosperma & bowgada scrub
206	21,088	21,088	100	Shrublands; bowgada & grevillea scrub
207	38,160	38,160	100	Hummock grasslands, shrub steppe; red mallee over hard spinifex
208	28,514	28,514	100	Mosaic: Shrublands; Acacia sclerosperma & bowgada scrub / Shrublands; bowgada & grevillea scrub
209	43,194	43,249	100	Shrublands; Acacia sclerosperma & minnieritchie scrub
214	495,208	495,208	100	Mosaic: Medium woodland; goldfield eucalypts / Succulent steppe with open low woodland; myoporium over saltbush
215	19,010	19,010	100	Low woodland; mulga on dolerite
216	272,861	272,861	100	Low woodland; mulga (?with spinifex) on rises
217	88,211	88,211	100	Hummock grasslands, steppe woodland; desert oak (Allocasuarina decaisneana & soft spinifex (soft spinifex)
218	1,878,159	1,878,159	100	Hummock grasslands, shrub steppe; corkwood (Hakea suberea) & acacia species over soft spinifex soft spinifex
219	61,065	61,065	100	Hummock grasslands, grass steppe; soft & hard spinifex & T. basedowii
221	58,600	58,600	100	Succulent steppe; saltbush
222	226,960	226,960	100	Sparse low woodland; mulga & Acacia victoriae in scattered groups
223	2,612	2,612	100	Succulent steppe with open scrub; scattered mulga over saltbush & bluebush
224	82,857	82,857	100	Shrublands; waterwood & Acacia victoriae scrub
225	9,861	9,861	100	Shrublands; snakewood & minnieritchie scrub
226	6,087	6,087	100	Mosaic: Shrublands; Acacia sclerosperma & bowgada scrub / Succulent steppe; samphire
228	10,840	10,840	100	Shrublands; Acacia quadrimarginea scrub
229	8,053	8,053	100	Mosaic: Shrublands; bowgada and associated spp scrub / Shrublands; bowgada & grevillea scrub
230	1,634,212	1,634,212	100	Mosaic: Medium sparse woodland; desert oak between sand dunes /Hummock grasslands, grass steppe; hard spinifex Triodia basedowii
233	133,653	133,653	100	Shrublands; Acacia bivenosa
234	15,482	15,482	100	Shrublands; Acacia ?cyperophylla scrub
236	1,674,263	1,674,263	100	Hummock grasslands, shrub steppe; mulga and mallee (marble gum) over hard spinifex

Association	Current extent (ha)	Pre-European extent (ha)	Remaining (%)	Description
239	5,245,077	5,245,077	100	Hummock grasslands, open medium tree & mallee steppe; marble gum (<i>E. gonglocarpa</i> & mallee (<i>Eucalyptus youngiana</i>) over hard spinifex <i>Triodia basedowii</i> between sandhills
240	119,006	119,006	100	Succulent steppe with open scrub; scattered <i>Acaia sclerosperma</i> & bowgada over saltbush & bluebush
242	2,373	2,373	100	Succulent steppe with scrub; snakewood over saltbush
243	115,010	115,010	100	Shrublands; bowgada & minnieritchie scrub
244	89,065	89,065	100	Shrublands; <i>Acacia sclerosperma</i> & <i>A. victoriae</i> scrub
245	2,175	2,175	100	Mosaic: Shrublands; bowgada & minnieritchie scrub / Succulent steppe; saltbush & bluebush
246	14,428	14,428	100	Hummock grasslands, low tree steppe; <i>Eucalyptus dongarraensis</i> & <i>E. foecunda</i> over <i>Triodia plurinervata</i>
248	37,406	37,406	100	Shrublands; bowgada scrub with scattered red mallee & <i>Eucalyptus</i> sp.
251	182,412	182,412	100	Low woodland; mulga & <i>Allocasuarina cristata</i>
252	145,318	145,318	100	Hummock grasslands, shrub steppe; mulga and mallee over soft spinifex
254	146	361	40.35	Shrublands; <i>Melaleuca uncinata</i> thicket with scattered wandoo and powderbark wandoo
255	2,973	3,164	93.96	Shrublands; mallee scrub, <i>Eucalyptus dongarrensensis</i>
256	67,890	67,890	100	Low woodland; York gum, and cypress pine (adjacent to e6pMLi)
260	19,198	19,198	100	Mosaic: Shrublands tree-heath between sandhills; <i>Banksia ashbyi</i> , <i>Grevillea gordoniana</i> , <i>Acacia</i> spp., <i>Melaleuca</i> and mallee / Shrublands; scrub-heath
261	8,858	8,858	100	Succulent steppe with low woodland; snakewood over saltbush & bluebush
262	6,093	6,093	100	Shrublands; acacia & other spp on Mt Augustus
264	839,386	839,386	100	Low woodland; <i>Acacia victoriae</i> & snakewood
265	21,895	21,895	100	Low woodland; <i>Acacia sclerosperma</i> & <i>A. victoriae</i>
266	135,152	135,152	100	Mosaic: Shrublands; bowgada scrub / Succulent steppe; saltbush & bluebush
267	32,200	32,200	100	Succulent steppe with open scrub; scattered <i>Acaia sclerosperma</i> & <i>A. victoriae</i> over saltbush & bluebush
268	15,506	15,506	100	Succulent steppe with open scrub; scattered <i>Acacia sclerosperma</i> over saltbush & bluebush
269	180,151	180,151	100	Low woodland over scrub; mulga over bowgada scrub
281	793	793	100	Shrublands; mulga & bowgada open scrub
282	12,043	12,043	100	Shrublands; <i>Acacia sclerosperma</i> & <i>A. victoriae</i> sparse scrub
283	71,325	71,325	100	Shrublands; <i>Acacia sclerosperma</i> , bowgada & <i>A. victoriae</i> scrub
284	50,287	50,287	100	Mosaic: Shrublands; <i>Acacia sclerosperma</i> & bowgada scrub / Shrublands; snakewood & <i>A. victoriae</i> scrub
285	14,922	14,922	100	Mosaic: Shrublands; <i>Acacia victoriae</i> & snakewood scrub patches / Scattered groups of succulents
288	6,065	6,065	100	Mosaic: Scattered low trees; mulga / Succulent steppe; sparse saltbush & bluebush on greenstone
289	104,343	104,343	100	Succulent steppe; saltbush & bluebush
300	1,928	1,928	100	Mosaic: Low woodland; mulga / Succulent steppe; saltbush & bluebush
301	115,020	115,020	100	Hummock grassland; shrub steppe; mixed scrub, hard spinifex (<i>Triodia basedowii</i>) with dwarf shrubs
303	104,848	104,848	100	Sparse succulent steppe; bluebush with very sparse snakewood shrubs
304	12,497	12,497	100	Sparse low woodland; <i>Acacia victoriae</i> & snakewood in scattered groups
305	7,231	7,231	100	Medium woodland over scrub; coolabah over bowgada

Association	Current extent (ha)	Pre-European extent (ha)	Remaining (%)	Description
306	164	164	100	Low woodland; Casuarina ?obesa (salt lake)
307	476,834	476,834	100	Low woodland; bowgada & Acacia subtressarogona
308	448,461	452,925	99.01	Mosaic: Shrublands; Acacia sclerosperma sparse scrub / Succulent steppe; saltbush & bluebush
311	577	577	100	Succulent steppe with open low woodland; mulga & Acaia sclerosperma with saltbush & bluebush
312	41,364	41,364	100	Succulent steppe with very open shrubs; very sparse mulga and Acacia sclerosperma over saltbush & bluebush
313	68,630	68,630	100	Succulent steppe with open scrub; scattered Acaia sclerosperma & A. victoriae over bluebush
314	7,487	7,487	100	Succulent steppe with open woodland; york gum over saltbush
320	7,512	7,512	100	Shrublands; bowgada & Acacia victoriae scrub
321	149,585	149,585	100	Mosaic: Shrublands; Acacia sclerosperma & bowgada scrub / Succulent steppe; saltbush & bluebush
323	5,652	5,652	100	Shrublands; Acacia sclerosperma, bowgada & snakewood scrub
325	55,812	64,719	86.24	Succulent steppe; saltbush & samphire
326	987,059	987,059	100	Low woodland over scrub; mulga over bowgada & minnieritchie scrub
327	31,133	31,133	100	Shrublands; mulga, bowgada, Acacia quadrimarginea & minnieritchie scrub
328	10,234	10,234	100	Succulent steppe with scrub; waterwood & Acacia sclerosperma over saltbush & samphire
329	26,759	27,451	97.48	Shrublands; dwarf waterwood (Acacia coriacea) shrubs on recent dunes
337	29,669	29,669	100	Mosaic: Shrublands; bowgada scrub / Hummock grasslands, mixed sandplain - open red mallee & mixed sparse dwarf shrubs over Triodia basedowii
338	98,352	98,352	100	Hummock grasslands, mixed sandplain; bowgada, sugarbrother, mallee, Triodia basedowii & T. ?sp
339	26,746	26,746	100	Hummock grasslands, mixed sandplain; bowgada, sugarbrother, mallee, Triodia scariosa & T. ?sp
340	2,495	2,495	100	Succulent steppe with scrub; bowgada scrub over various species
341	10,333	10,333	100	Low woodland over scrub; mulga over Acacia sclerosperma bowgada, A. victoriae & minnieritchie (A. grasbyi)
342	295,342	295,342	100	Mosaic: Low woodland; waterwood / Shrublands; Acacia sclerosperma & bowgada scrub
344	224,123	224,123	100	Mosaic: Shrublands; bowgada scrub and associated spp / Shrublands; Acacia sclerosperma, bowgada & A. victoriae scrub
345	57,121	57,121	100	Mosaic: Shrublands; Acacia sclerosperma & A. victoriae patchy scrub, barren / Succulent steppe; saltbush & bluebush
346	61,541	61,541	100	Mosaic: Shrublands; Acacia sclerosperma, A. victoriae & snakewood scrub / Shrublands; patches of low mixed scrub
347	69,885	69,885	100	Mosaic: Shrublands; Acacia sclerosperma, A. victoriae & snakewood scrub patches / Succulent steppe; bluebush
349	129,529	129,529	100	Mosaic: Shrublands; bowgada scrub with scattered mulga / Shrublands; bowgada & grevillea scrub
351	382	8,398	4.55	Shrublands; mallee & acacia scrub with scattered York gum & red mallee
352	128,959	844,713	15.27	Medium woodland; York gum
353	4,074	90,731	4.49	Shrublands; mallee & acacia scrub with scattered York gum
354	5,292	91,819	5.76	Shrublands; jam and Acacia rostellifera (+hakea?) scrub with scattered York gum
355	56,780	61,812	91.86	Shrublands; bowgada & jam scrub with scattered York gum & red mallee
356	2,024	4,335	46.70	Succulent steppe with open woodland; eucalypts over saltbush
357	36,495	36,926	98.83	Medium woodland over scrub; York gum over bowgada & jam (Acacia acuminata)

Association	Current extent (ha)	Pre-European extent (ha)	Remaining (%)	Description
358	58,896	58,896	100	Shrublands; bowgada & Acacia quadrimarginea on stony ridges
359	6,682	44,571	14.99	Shrublands; acacia & banksia scrub
360	240	240	100	Shrublands; bowgada scrub with scattered mulga
361	251,013	253,058	99.19	Shrublands; bowgada & minnieritchie scrub with scattered mulga
362	39,995	39,995	100	Mosaic: Shrublands; bowgada & minnieritchie scrub with scattered mulga / Scattered groups of saltbush/bluebush
363	247,652	247,652	100	Shrublands; bowgada scrub with scattered cypress pine
364	491,763	510,524	96.33	Shrublands; bowgada scrub with scattered eucalypts & cypress pine
365	46,925	55,495	84.56	Shrublands; bowgada & jam scrub with scattered York gum & red mallee
368	330,817	330,817	100	Shrublands tree-heath between sandhills; Banksia ashbyi, Grevillea gordoniana, Acacia spp., Melaleuca and mallee
371	1,149	32,912	3.49	Low forest; Acacia rostellifera
372	24,709	82,052	30.11	Mosaic: Shrublands; scrub-heath on deep sandy flats / Shrublands; thicket, acacia-casuarina alliance
374	4,863	7,731	62.91	Shrublands; bowgada scrub with scattered York gum
377	63,116	63,116	100	Mosaic: Shrublands; scrub-heath on limestone in the northern Swan Region / Sparse low woodland; illyarrie
378	59,230	95,106	62.28	Shrublands; scrub-heath with scattered Banksia spp E. todiana & Xylomelum angustifolium on deep sandy flats in the Geraldton Sandplain Region
379	112,551	549,394	20.49	Shrublands; scrub-heath on lateritic sandplain in the central Geraldton Sandplain Region
380	266,890	539,301	49.49	Shrublands; scrub-heath on sandplain
383	7,158	13,296	53.84	Shrublands; Acacia rostellifera scrub-heath
384	3,962	3,962	100	Shrublands; mallee & acacia thicket on ?coastal dunes (central west)
385	30,730	46,644	65.88	Shrublands; bowgada & jam scrub with scattered York gum
386	2,253	2,253	100	Low woodland; York gum
387	8,651	14,853	58.25	Shrublands; Melaleuca cardiophylla thicket
389	646,554	646,554	100	Succulent steppe with open low woodland; mulga over saltbush
391	1,566	3,091	50.68	Shrublands; Melaleuca uncinata thicket
392	1,356	3,046	44.52	Shrublands; Melaleuca thyioides thicket
393	4,386	5,051	86.83	Shrublands; Melaleuca thyioides thicket with scattered Casuarina obesa
395	102,425	102,425	100	Hummock grasslands, mixed sandplain; bowgada, mallee, heath and spinifex
400	192,391	192,391	100	Succulent steppe with open low woodland; mulga over bluebush
401	32,380	32,671	99.11	Mosaic: Shrublands; scrub-heath on coastal association on yellow sandplain / Shrublands; acacia patchy scrub
402	40,530	42,391	95.61	Shrublands; heath on coastal limestone
403	10,098	11,588	87.14	Shrublands; Acacia ligulata scrub-heath
404	194,540	202,127	96.25	Shrublands; bowgada & Acacia murrayana scrub
405	22,069	25,589	86.24	Shrublands; Acacia sclerosperma, bowgada & jam scrub
406	141,540	153,004	92.51	Shrublands; acacia, casuarina, Eucalyptus eudesmioides, Banksia ashbyi & other mixed species thicket
407	27,547	32,140	85.71	Low woodland over scrub; Allocasuarina heugeliana over jam scrub
408	124,373	337,505	36.85	Shrublands; scrub-heath on coastal association, yellow sandplain
411	44,262	44,262	100	Succulent steppe with open scrub; scattered bowgada & jam over saltbush
412	5,135	9,457	54.30	Succulent steppe with scrub; teatree (Melaleuca thyioides) & samphire
413	1,787	8,503	21.01	Shrublands; Acacia neurophylla & A. species thicket
414	46,340	46,340	100	Succulent steppe with open scrub; scattered bowgada & jam over saltbush & bluebush

Association	Current extent (ha)	Pre-European extent (ha)	Remaining (%)	Description
415	104,301	104,301	100	Succulent steppe with open scrub; scattered mulga & other wattle(s) over saltbush & bluebush
416	224,841	241,098	93.26	Low woodland; mulga mixed with cypress pine & york gum
417	20,962	20,962	100	Succulent steppe with open scrub; scattered wattles over saltbush
418	4,389	4,389	100	Low woodland; mulga, Casuarina cristata & cypress pine
419	290,915	313,543	92.78	Shrublands; bowgada, jam and Melaleuca uncinata thicket
420	704,710	737,536	95.55	Shrublands; bowgada & jam scrub
423	19,267	31,002	62.15	Shrublands; Acacia scrub-heath unknown spp
424	2,655	2,786	95.30	Shrublands; York gum mallee scrub
427	14,823	38,753	38.25	Shrublands; jam scrub with scattered Allocasuarina huegelliana & York gum
431	3,379	4,313	78.35	Shrublands; Acacia rostellifera open scrub
432	4,929	5,731	86.02	Shrublands; Acacia rostellifera & Melaleuca cardiophylla thicket
433	13,349	32,386	41.22	Mosaic: Shrublands; Acacia rostellifera & Melaleuca cardiophylla thicket / Sparse low woodland; illyarrie
434	1,386	1,386	100	Shrublands; Acacia quadrimarginea & jam scrub with scattered York gum & Allocasuarina huegelliana
435	914,483	1,185,145	77.16	Shrublands; Acacia neurophylla, A. beauverdiana & A. resinomarginea thicket
436	1,061	1,061	100	Shrublands; Acacia rostellifera open scrub
437	320,787	359,644	89.20	Shrublands; Mixed acacia thicket on sandplain
438	156	328	47.71	Shrublands; dodonaea scrub
440	2,058	5,844	35.21	Shrublands; Acacia ligulata open scrub
441	2,864,986	2,864,986	100	Succulent steppe with open low woodland; mulga & sheoak over bluebush
442	54,576	54,576	100	Low open woodland; mulga & Allocasuarina cristata
444	11,404	11,404	100	Hummock grasslands, open low tree steppe; mulga over Triodia scariosa
448	428,716	607,479	70.57	Succulent steppe; bluebush (in dongas)
449	975,872	975,872	100	Succulent steppe; bluebush with grassy depressions
460	4,822	4,822	100	Succulent steppe; bluebush with saltbush in depressions
461	781,926	781,926	100	Succulent steppe with open low woodland; Acaia papyrocarpa over bluebush
467	285,342	285,342	100	Mosaic: Medium woodland; salmon gum & gimlet / Hummock grasslands, mallee steppe; red mallee over spinifex Triodia scariosa
468	476,113	476,113	100	Medium woodland; salmon gum & goldfields blackbutt
479	35,287	36,102	97.74	Shrublands; mallee-heath (Nuytsland)
480	127,393	127,393	100	Succulent steppe with open low woodland; mulga & sheoak over saltbush
481	816,241	816,241	100	Mosaic: Medium woodland; salmon gum & red mallee / Hummock grasslands, mallee steppe; red mallee over spinifex Triodia scariosa
482	1,615,442	1,639,415	98.54	Medium woodland; merrit & red mallee
483	395,106	395,106	100	Hummock grasslands, mixed sandplain - open mallee over sparse dwarf shrubs with spinifex ; red mallee mallee & mixed sparse dwarf shrubs over Triodia basedowii
484	70,235	70,235	100	Shrublands; jam thicket
485	230,181	230,181	100	Hummock grassland, mixed sandplain - scattered low trees over sparse dwarf shrubs with spinifex; red mallee over mixed dwarf shrubs with Triodia basedowii
486	251,068	414,727	60.54	Mosaic: Medium woodland; salmon gum & red mallee / Shrublands; mallee scrub Eucalyptus eremophila
487	502,598	502,598	100	Medium woodland; redwood & red mallee (E. oleosa)

Association	Current extent (ha)	Pre-European extent (ha)	Remaining (%)	Description
488	38,335	38,335	100	Mosaic: Medium woodland; gimlet / Shrublands; mallee scrub Eucalyptus eremophila
489	79,073	79,073	100	Mosaic: Medium woodland; Goldfields blackbutt & Dundas blackbutt/Shrublands; dodonaea scrub
491	67,365	67,365	100	Medium woodland; morrel & Dundas blackbutt (E. dundasii)
493	19,428	19,582	99.21	Medium woodland; salmon gum mixed with merrit & red mallee
494	2,596	2,596	100	Medium woodland; salmon gum mixed with merrit & desert bloodwood (Eucalyptus sp.)
495	8,517	8,517	100	Shrublands; thicket, Jam & Allocasuarina acutivalvis on ironstone
500	99,485	99,485	100	Mosaic: Medium woodland; merrit & red mallee / Shrublands; dodonaea scrub
501	47,731	47,731	100	Medium woodland; goldfields blackbutt
502	46,411	46,411	100	Medium woodland; goldfields blackbutt & red mallee
504	8,366	8,366	100	Low woodland; mulga & red mallee
505	7,894	7,894	100	Low woodland; Allocasuarina cristata & eucalypts
506	106,401	106,401	100	Succulent steppe with woodland; salmon gum & bluebush
507	8,479	8,479	100	Succulent steppe with woodland; salmon gum & saltbush
508	60,241	60,241	100	Succulent steppe with open scrub; scattered mulga over saltbush
509	146,503	146,503	100	Succulent steppe with woodland; gimlet & saltbush
510	3,207	3,207	100	Shrublands; Mt Ragged heath
511	227,738	440,916	51.65	Medium woodland; salmon gum & morrel
512	61,776	238,581	25.89	Shrublands; mallee scrub, Eucalyptus eremophila & Forrest's marlock (E. forrestiana)
513	16,039	16,039	100	Mosaic: Medium woodland; salmon gum & Dundas blackbutt / Shrublands; mallee scrub Eucalyptus eremophila
514	134,829	145,230	92.84	Shrublands; mallee scrub, white mallee (Eucalyptus cooperiana)
515	740,878	740,878	100	Shrublands; mallee scrub, blue mallee (Eucalyptus socialis)
516	540,610	1,473,105	36.70	Shrublands; mallee scrub, black marlock
518	662,657	662,657	100	Mosaic: Medium woodland; merrit & coral gum /Shrublands; mallee scrub Eucalyptus eremophila
519	1,119,196	2,021,134	55.37	Shrublands; mallee scrub, Eucalyptus eremophila
520	33,692	35,439	95.07	Shrublands; Acacia quadrimarginea thicket
521	122,020	123,694	98.65	Medium woodland; salmon gum & red mallee
522	676,324	676,324	100	Medium woodland; redwood (E. transcontinentalis) & merrit (E. floctoniae)
524	349,095	349,095	100	Medium woodland; Dundas blackbutt & red mallee
525	236,629	236,629	100	Mosaic: Medium woodland; salmon gum & gimlet / Medium woodland; merrit & red mallee
529	82,198	82,198	100	Succulent steppe with open low woodland; mulga & sheoak over bluebush
532	21,482	21,482	100	Hummock grassland, mixed sandplain - sparse low trees over sparse dwarf shrubs with spinifex; ?marble gum & red mallee mixed dwarf shrubs with Triodia scariosa & T. sp?
533	148,478	148,478	100	Low woodland; mulga & cypress pine
535	17,921	17,921	100	Medium woodland; rough fruited mallee on greenstone hills
536	11,595	19,973	58.05	Medium woodland; morrell & rough fruited mallee (E. corrugata)
537	587	702	83.62	Medium woodland; morrel (E. longicornis)
538	134,762	152,426	88.41	Shrublands; Acacia brachystachya scrub
540	163,291	163,291	100	Succulent steppe with open low woodland; sheoak over saltbush
542	4,919	4,919	100	Shrublands; mallee scrub marble gum (Eucalyptus gonglocarpa)
545	458	458	100	Hummock grasslands, sparse low tree-steppe; mulga over Triodia basedowii

Association	Current extent (ha)	Pre-European extent (ha)	Remaining (%)	Description
546	10,563	10,563	100	Succulent steppe with low woodland; mulga over samphire
547	40,007	40,007	100	Mosaic: Low woodland; mulga & bowgada / Succulent steppe; samphire
551	91,433	323,369	28.28	Shrublands; Allocasuarina campestris thicket
552	31,817	33,988	93.61	Shrublands; Casuarina acutivalvus & calothamnus (also melalueca) thicket on greenstone hills
554	1,038	1,038	100	Low woodland over scrub; Allocasuarina cristata over bowgada scrub
555	57,310	57,310	100	Hummock grasslands, mallee steppe; red mallee over spinifex Triodia scariosa
560	83,624	83,624	100	Mosaic: Shrublands; bowgada scrub / Succulent steppe; samphire
561	4,938	4,938	100	Succulent steppe with low woodland; mulga over saltbush
562	103,655	103,655	100	Mosaic: Low woodland; mulga in valleys / Hummock grasslands, open low tree-steppe; snappy gum over T. wiseana
563	924	924	100	Shrublands; acacia scrub (Acacia sp. unknown various locations)
565	144,154	144,154	100	Hummock grasslands, low tree steppe; bloodwood over soft spinifex
567	778,256	778,256	100	Hummock grasslands, shrub steppe; mulga & kanji over soft spinifex & T. basedowii
568	33,884	33,884	100	Hummock grasslands, shrub steppe; mulga & snakewood over Triodia wiseana
569	67,805	67,805	100	Hummock grasslands, low tree steppe; bloodwood over soft spinifex & T. wiseana
580	22,580	22,580	100	Mosaic: Shrublands; eremophila and cassia dwarf scrub / Hummock grasslands, grass steppe; hard spinifex Triodia wiseana
583	243,095	243,095	100	Hummock grasslands, sparse shrub steppe; kanji & Acacia bivenosa over hard spinifex Triodia basedowii & T. wiseana
584	721	721	100	Open low woodland; Eucalyptus sp. aff. aspera
585	145,532	145,532	100	Mosaic: Shrublands; snakewood & Acacia victoriae scrub / Hummock grasslands, shrub-steppe; kanji over soft spinifex & T. basedowii
587	581,685	581,685	100	Mosaic: Hummock grasslands, open low tree-steppe; snappy gum over Triodia wiseana / Hummock grasslands, shrub-steppe; kanji over T. pungens
588	86,942	86,942	100	Shrublands; Acacia victoriae scrub
589	788,970	788,970	100	Mosaic: Short bunch grassland - savanna / grass plain (Pilbara) / Hummock grasslands, grass steppe; soft spinifex soft spinifex
600	67,007	67,007	100	Sedgeland; sedges with open low tree sananna; Eucalyptus sp. aff aspera over various sedges
601	109,629	109,629	100	Mosaic: Sedgeland; various sedges with very sparse snakewood / Hummock grasslands, shrub-steppe; kanji over soft spinifex
603	56,665	56,665	100	Hummock grasslands, sparse shrub steppe; Acacia bivenosa over hard spinifex
604	15,681	15,681	100	Hummock grasslands, shrub steppe; kanji & snakewood over soft spinifex
605	99,816	99,816	100	Hummock grasslands, shrub steppe; Acacia pachycarpa & waterwood over soft spinifex
606	32,170	32,170	100	Hummock grasslands, shrub steppe; Acacia victoriae & snakewood over soft spinifex
607	120,693	120,693	100	Hummock grasslands, low tree steppe; snappy gum & bloodwood over soft spinifex & T. wiseana
608	313,487	313,487	100	Mosaic: Shrublands; Acacia victoriae & snakewood scrub patches / Short bunch grassland - savanna / grass plain (Pilbara)
609	74,226	74,226	100	Mosaic: Hummock grasslands, open low tree steppe; bloodwood with sparse kanji shrubs over soft spinifex / Hummock grasslands, open low tree steppe; snappy gum over Triodia wiseana
612	474	474	100	Low woodland; Eucalyptus sp. aff. aspera
619	106,129	106,260	100	Medium woodland; river gum (E. camaldulensis)
620	39,943	39,943	100	Hummock grasslands, shrub steppe; snakewood over soft spinifex

Association	Current extent (ha)	Pre-European extent (ha)	Remaining (%)	Description
624	89,244	89,244	100	Hummock grasslands, shrub steppe; mulga over soft spinifex & T. basedowii
625	16,163	16,163	100	Shrublands; mulga & minnieritchie sparse groups
626	116,507	116,507	100	Hummock grasslands, shrub-steppe; kanji over soft spinifex & T. brizoides
629	59,308	59,308	100	Mosaic: Short bunch grassland - savanna / grass plain (Pilbara) / Hummock grasslands, grass steppe; hard spinifex <i>Triodia wiseana</i>
631	40,279	107,999	37.30	Succulent steppe with woodland and thicket; york gum over <i>Melaleuca thyooides</i> & samphire
640	17,443	17,443	100	Sedgeland; sedges with scattered medium trees; coolabah & river gum over various sedges
641	36,031	36,031	100	Medium woodland; coolabah & river gum
644	27,045	27,045	100	Hummock grasslands, open low tree steppe; mulga & snakewood over soft spinifex & T. basedowii
645	84,534	84,534	100	Hummock grasslands, shrub steppe; kanji & snakewood over soft spinifex & T. wiseana
646	47,623	47,623	100	Hummock grasslands, shrub steppe; snakewood over <i>Triodia basedowii</i>
647	196,403	196,403	100	Hummock grasslands, dwarf-shrub steppe; <i>Acacia translucens</i> over soft spinifex
649	40,263	40,263	100	Sedgeland; Various sedges with very sparse snakewood
658	200,436	200,436	100	Shrublands; <i>Acacia sclerosperma</i> & snakewood scrub (also with some waterwood)
662	285,209	285,209	100	Hummock grassland; shrub steppe; mixed acacia scrub & dwarf scrub with soft spinifex & T. basedowii
663	29,016	30,334	95.65	Hummock grasslands, shrub steppe; waterwood over soft spinifex
664	83,991	83,991	100	Hummock grasslands, sparse tree-steppe; scattered bloodwood over soft spinifex & T. sp. indet. aff. <i>angusta</i>
667	18,555	22,806	81.36	Hummock grasslands, shrub-steppe; scattered shrubs over <i>Triodia wiseana</i> & T. sp. indet. aff. <i>angusta</i>
670	147,944	147,944	100	Hummock grasslands, shrub steppe; scattered shrubs over <i>Triodia basedowii</i>
674	3,244	3,244	100	Hummock grasslands, shrub steppe; bowgada & snakewood over <i>Triodia basedowii</i>
675	7,445	52,288	14.24	Shrublands; mixed thicket (<i>melaluca</i> & <i>hakea</i> ?)
676	1,888,961	1,907,938	99.01	Succulent steppe; samphire
678	5,980	5,980	100	Hummock grasslands, sparse shrub steppe; <i>Acacia bivenosa</i> over hard spinifex
680	90,436	90,436	100	Hummock grasslands, shrub steppe; <i>Acacia bivenosa</i> over <i>Triodia basedowii</i>
681	5,741	6,031	95.19	Shrublands; open dwarf scrub, waterwood (<i>Acacia coriacea</i>) on recent dunes
683	46,029	46,029	100	Succulent steppe with open scrub; scattered <i>Acacia sclerosperma</i> & snakewood over samphire
684	26,655	126,727	21.03	Mosaic: Shrublands; Shrublands; jam scrub with scattered York gum in the valleys / <i>Allocasuarina campestris</i> thicket
686	8,001	12,964	61.72	Medium woodland; York gum & red mallee
687	9,243	52,895	17.47	Shrublands; bowgada & jam scrub with scattered <i>Allocasuarina heugelliana</i> & York gum
691	35,707	52,015	68.65	Shrublands; <i>Dryandra quercifolia</i> & <i>Eucalyptus</i> spp. thicket
692	1,819	2,885	63.06	Shrublands; <i>casuarina</i> & <i>melaleuca</i> thicket
693	3,068	4,376	70.11	Mosaic: Low woodland: <i>Allocasuarina heugelliana</i> over mallee and acacia scrub / <i>Allocasuarina campestris</i> thicket
694	59,092	345,721	17.09	Shrublands; scrub-heath on yellow sandplain <i>banksia-xyloelum</i> alliance in the Geraldton Sandplain & Avon-Wheatbelt Regions

Association	Current extent (ha)	Pre-European extent (ha)	Remaining (%)	Description
695	46	660	6.94	Shrublands; Allocasuarina campestris scrub
696	1,107	3,052	36.29	Shrublands; casuarina & dryandra thicket with wandoo and powderbark wandoo
697	32,239	73,178	44.06	Shrublands; scrub-heath on lateritic sandplain in the southern Geraldton Sandplain Region
698	1,554	11,357	13.68	Mosaic: Shrublands; scrub-heath Dryandra-Calothamnus assoc. with B. prionotes on limestone in the northern Swan Region / Sparse low woodland; wandoo & powderbark wandoo
699	2,039,191	2,039,191	100	Shrublands, pindan; Acacia eripoda shrubland with scattered low bloodwood (E. dicromophloia) & E. setosa over soft & curly spinifex on sandplain
700	1,026,993	1,026,993	100	Shrublands, pindan; Acacia eripoda shrubland with scattered low bloodwood & Eucalyptus setosa over soft & curly spinifex between dunes
701	109,977	109,977	100	Hummock grasslands, shrub steppe; Acacia pachycarpa & grevillea over soft spinifex & T. intermedia on sandy plateau
702	24,488	24,488	100	Hummock grasslands, grass steppe; hard spinifex Triodia intermedia
703	107,095	107,095	100	Hummock grasslands, low tree steppe; snappy gum over Triodia intermedia
704	62,390	62,390	100	Grasslands, short bunch grass savanna low tree & sparse shrubs; bauhinia & Acacia eriopoda & A. impressa over Aristida brownii short grasses on river flats
705	101,060	101,060	100	Hummock grasslands, sparse tree steppe; snappy gum & bloodwood (E. dichromophloia) & Eucalyptus setosa over spinifex & T. intermedia
706	296,573	296,573	100	Grasslands, tall bunch grass savanna, mitchell & ribbon/blue grass
707	279,483	279,483	100	Grasslands, tall bunch grass savanna sparse low tree; bauhinia & coolabah over ribbon/blue grass on black soil
709	62,057	62,057	100	Hummock grasslands, shrub steppe; Acacia impressa over Triodia intermedia on stony laterite
710	25,983	25,983	100	Mosaic: Grasslands, tall bunch grass savanna low tree; baobabs, bauhinia & beefwood over ribbon grass / Hummock grasslands, grass steppe Triodia. pungens & Plectrachne pungens
712	247,643	247,643	100	Mosaic: Shrublands, pindan; Acacia eriopoda shrubland with scattered low bloodwood & Eucalyptus setosa over soft & curly spinifex / Grasslands, tall bunch grass savanna low tree
713	3,573,024	3,573,024	100	Mosaic: Hummock grasslands, open low tree steppe; bloodwood (Eucalyptus dichromophloia) over soft spinifex soft spinifex / Hummock grasslands, open low tree steppe; desert walnut
716	11,827	11,827	100	Mosaic: Grasslands, tall bunch grass savanna low tree; baobabs, bauhinia & beefwood over ribbon grass / Hummock grasslands, open low tree-steppe; snappy gum over spinifex
717	4,146	4,594	90.24	Low forest; mixed tropical deciduous forest
718	50,686	50,686	100	Grasslands, tall bunch grass savanna woodland, coolabah & ghost gum over ribbon grass
720	6,632	6,632	100	Grasslands, tall bunch grass savanna, mitchell & mitchell/blue grass
721	52,840	52,840	100	Hummock grasslands, sparse tree steppe; eucalypt & bauhinia over hard spinifex Triodia intermedia
722	21,660	21,660	100	Shrublands, pindan; Acacia pachycarpa & A. eriopoda shrubland with sparse low bauhinia (Lysiphylum cunninghamii) & bloodwood over ribbon & curly spinifex
724	12,605	12,605	100	Hummock grasslands, shrub steppe; Acacia pachycarpa & A. impressa over Triodia intermedia
725	124,094	124,094	100	Hummock grasslands, shrub steppe; Acacia pachycarpa & A. tumida over soft spinifex
726	74,592	74,592	100	Grasslands, tall bunch grass savanna low tree; baobabs, bauhinia & beefwood over mitchell & ribbon/blue grass on black soil

Association	Current extent (ha)	Pre-European extent (ha)	Remaining (%)	Description
727	117,294	117,294	100	Hummock grasslands, low open tree & shrub steppe; bloodwood, kanji (<i>A. pyrifolia</i>) over soft spinifex
728	8,888	8,888	100	Grasslands, short bunch grass savanna low tree & acacia thicket; bauhinia & <i>Acacia</i> sp & <i>A. impressa</i> over <i>aristida</i> short grasses on river flats
729	15,677	15,677	100	Hummock grasslands, low tree steppe; ?bauhinia & <i>Grevillea</i> ? <i>striata</i> over soft spinifex
730	16,107	16,107	100	Shrublands, pindan; <i>Acacia pachycarpa</i> & <i>A. eriopoda</i> shrubland with sparse low bauhinia & <i>Grevillea</i> over soft spinifex & <i>T. intermedia</i>
731	176,456	176,456	100	Hummock grasslands, low tree steppe; snappy gum over soft spinifex & <i>T. intermedia</i>
733	8,295	8,295	100	Hummock grasslands, shrub steppe; silver-leaved box over soft spinifex
735	40,737	40,737	100	Hummock grasslands, sparse medium tree steppe; <i>Adansonia gregorii</i> over open <i>T. wiseana</i> on limestone
736	608,520	608,520	100	Mosaic: Grasslands, curly spinifex, low tree savanna; snappy gum & <i>Eucalyptus perfoliata</i> over <i>Plectrachne pungens</i> / Grasslands; sparse low tree savanna; <i>Adansonia gregorii</i> over <i>Triodia</i>
737	36,777	36,777	100	Shrublands, pindan; <i>Acacia tumida</i> shrubland with scattered low bloodwood & <i>Eucalyptus setosa</i> over curly spinifex
738	515,904	515,904	100	Grasslands, curly spinifex, low tree savanna; snappy gum & bloodwood (<i>Eucalyptus dichromophloia</i>) over curly spinifex
739	2,042,125	2,042,125	100	Grasslands, high grass savanna woodland; grey box <i>Eucalyptus tectrifolia</i> & cabbage gum over white grass (<i>Sehima nervosum</i>)
740	97,202	97,202	100	Grasslands, curly spinifex, tree savanna woodland; snappy gum & bloodwood over curly spinifex on limestone plateau
741	68,998	68,998	100	Grasslands, tall bunch grass savanna woodland, grey box & cabbage gum over ribbon & blue grass
742	8,042	8,042	100	Medium woodland; river gum & <i>terminalia</i>
743	19,280	19,280	100	Grasslands, tall bunch grass savanna sparse low tree; <i>Acacia suberosa</i> & bauhinia over ribbon/blue grass on black soil
744	145,277	145,277	100	Grasslands, tall bunch grass savanna sparse low tree; <i>Acacia suberosa</i> & bauhinia over mitchell & ribbon/blue grass on black soil
745	237	237	100	Shrublands, pindan; acacia shrubland with scattered low trees over spinifex
746	135,504	135,504	100	Hummock grasslands, low tree steppe; bloodwood over <i>Triodia wiseana</i>
748	275	340	80.81	Shrublands; <i>Melaleuca thyoidea</i> thicket with scattered river gum
750	1,242,062	1,242,062	100	Shrublands, pindan; <i>Acacia tumida</i> shrubland with grey box & cabbage gum medium woodland over ribbon grass & curly spinifex
751	12,838	12,838	100	Shrublands, pindan; <i>Acacia eriopoda</i> & <i>A. tumida</i> shrubland with scattered low <i>Eucalyptus confertifolia</i> over curly spinifex
752	6,833	6,906	98.94	Hummock grasslands, shrub steppe; <i>Acacia tumida</i> over <i>Triodia intermedia</i>
754	198,356	198,356	100	Shrublands, pindan; <i>Acacia tumida</i> shrubland with woollybutt (<i>Eucalyptus miniata</i>) & cabbage gum (<i>E. grandiflora</i>) medium woodland over ribbon grass & curly spinifex (<i>Plectrachne pungens</i>)
755	19,141	19,141	100	Shrublands, pindan; <i>Acacia tumida</i> & <i>A. oimpressa</i> shrubland with scattered low bloodwood & <i>Eucalyptus setosa</i> over ribbon & curly spinifex
756	2,731	2,731	100	Medium woodland; river gum & <i>terminalia</i> mixed with coolabah & ghost gum (<i>E. papuana</i>)
757	16,280	16,280	100	Shrublands, pindan; <i>Acacia tumida</i> & <i>A. oimpressa</i> shrubland with scattered low bloodwood & <i>E. setosa</i> over ribbon & curly spinifex
759	54,145	54,145	100	Grasslands, tall bunch grass savanna woodland, coolabah over ribbon/blue grass (<i>Botriochloa</i> spp)
760	220,321	220,321	100	Shrublands, pindan; <i>Acacia tumida</i> shrubland with scattered low bloodwood & <i>Eucalyptus setosa</i> over ribbon & curly spinifex

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761	26,438	26,438	100	Hummock grasslands, shrub steppe; Acacia eriopoda & A. tumida over Triodia pulchella & T. intermedia sandplain
762	7,605	7,605	100	Hummock grasslands, shrub steppe; Acacia eriopoda over soft spinifex
764	558,683	558,683	100	Shrublands, pindan; Acacia eriopoda & A. tumida shrubland with scattered low bloodwood & Eucalyptus setosa over ribbon & curly spinifex
765	178,031	178,031	100	Hummock grasslands, shrub steppe; mulga and mallee over spinifex
767	572	572	100	Hummock grasslands, shrub steppe; Grevillea refracta over soft spinifex soft spinifex
770	837	1,020	82.05	Shrublands; Wattle thicket near Broome
771	36,013	36,013	100	Shrublands, pindan; Acacia tumida shrubland with ghost gum (Eucalyptus papuana) & E. setosa medium woodland over curly spinifex
772	4,396	4,871	90.23	Shrublands; Acacia lasiocarpa & Melaleuca acerosa heath
773	10,301	10,301	100	Grasslands, high grass savanna low tree; bloodwood (Eucalyptus dichromophloia) & grey box over white grass &/or upland tall grass
774	35,448	35,448	100	Grasslands, tall bunch grass savanna sparse low tree; Acacia suberosa over mitchell grass on black soil
800	279,310	279,310	100	Grasslands, high grass savanna woodland; stringybark & woollybutt over (upland tall grass &) curly spinifex
802	383,783	383,783	100	Grasslands, high grass savanna woodland; grey box & cabbage gum over mixed/white grass on basalt and dolerite
804	76,211	76,211	100	Grasslands, tall bunch grass savanna low tree; bloodwood (Eucalyptus dichromophloia) & cabbage gum over ribbon grass
805	6,230	6,230	100	Grasslands, curly spinifex, tree savanna woodland; snappy gum & bloodwood over curly spinifex on limestone plateau
806	141,522	141,522	100	Hummock grasslands, low tree steppe; snappy gum & Mt House box over soft spinifex on shale plains
807	2,002	2,002	100	Grasslands, tall bunch grass savanna sparse low tree; acacia over grass on black soil
808	1,354,293	1,354,293	100	Grasslands, curly spinifex, low tree savanna; snappy gum over curly spinifex
809	12,382	12,382	100	Grasslands, tall bunch grass savanna woodland, bloodwood (E. polycarpa) over aristida grass (Aristida browniana), riverine
810	96,628	96,628	100	Grasslands, high grass savanna woodland; ghost gum & Eucalyptus foelscheana over upland tall grass (Sorghum spp)& curly spinifex on basalt
811	99,758	99,758	100	Grasslands, high grass savanna low tree; Mt House box & bloodwood (Eucalyptus terminalis) over white grass on rolling basalt country
812	266,834	266,834	100	Grasslands, high grass savanna woodland; bloodwood & woollybutt over upland tall grass & curly spinifex
813	10,580	10,580	100	Grasslands, high grass savanna sparse tree; bauhinia & coolabah over blue & tall upland grasses on black soil plain
814	177,156	177,156	100	Hummock grasslands, low steppe woodland; silver-leaved box (E. prunosa) & melaleuca over plectrachne
815	50,141	50,141	100	Grasslands, tall bunch grass savanna, sparse low tree, terminalia; mitchell & blue grass on basalt
816	137,809	137,809	100	Grasslands, short bunch grass savanna, low tree, Mt House box (E. argillifera) & bloodwood over arid short grass (Enneapogon spp)
817	6,123	6,123	100	Grasslands, high grass savanna low tree; terminalia (Terminalia spp) over upland tall grass & blue grass
818	34,455	34,455	100	Hummock grasslands, low tree steppe; snappy gum over Triodia inutulis
819	60,937	60,937	100	Grasslands, tall bunch grass savanna low tree; cabbage gum & silverleaved box over aristida & ribbon grass on sandy plains

Association	Current extent (ha)	Pre-European extent (ha)	Remaining (%)	Description
820	61,586	61,586	100	Grasslands, high grass savanna sparse low tree; snappy gum (E. brevifolia) over upland tall grass & curly spinifex on granite
825	65,519	65,519	100	Grasslands, high grass savanna woodland; cabbage gum & Eucalyptus foelscheana over upland tall grass & curly spinifex on basalt
826	707	707	100	Hummock grasslands, low tree steppe; snappy gum over curly spinifex
827	90,039	90,039	100	Hummock grasslands, low tree steppe; terminalia over Triodia wiseana on limestone
829	12,308	12,308	100	Mosaic: Grasslands, short bunch grass savanna, low tree, Mt House box & bloodwood over enneapogon arid short grass / Grasslands; high grass savanna, white grass
830	173,777	173,777	100	Mosaic: Grasslands, short bunch grass savanna, low tree, Mt House box & bloodwood / Hummock grasslands, open low tree-steppe; snappy gum / Grasslands; high grass savanna
831	394,242	394,242	100	Hummock grasslands, sparse tree steppe; snappy gum over hard spinifex Triodia intermedia & T. inutilis
833	39,913	39,913	100	Grasslands, short bunch grass savanna sparse low tree; scattered snappy gum over arid short grass on plains
834	33,207	33,207	100	Grasslands, tall bunch grass savanna, mitchell & blue grass
835	122,077	122,077	100	Grasslands, high grass savanna woodland; grey box & Eucalyptus foelscheana over spinifex & white grass
837	178,449	178,449	100	Grasslands, short bunch grass savanna low tree; snappy gum over arid short grass on plains
838	14,473	14,473	100	Grasslands, high grass savanna woodland; ghost gum & bloodwood (Eucalyptus polycarpa) over spinifex & tall upland grass
839	9,184	9,184	100	Grasslands, high grass savanna low tree; Mt House box & bloodwood (E. terminalis) over upland tall grass.
840	38,051	38,051	100	Grasslands, tall bunch grass savanna, ribbon/blue grass
842	360,184	360,184	100	Mosaic: Grasslands, short bunch grass savanna, low tree, Mt House box & bloodwood over enneapogon short grass / Hummock grasslands, open low tree-steppe; snappy gum over Triodia
843	22,098	22,098	100	Hummock grasslands, grass steppe; curly spinifex Plectrachne pungens on shale
844	2,696	2,696	100	Grasslands, high grass savanna low tree; melaleuca over upland tall grass
846	94,509	94,509	100	Hummock grasslands, sparse low tree steppe; snappy gum (E. brevifolia) over soft spinifex (T. pungens) & T. intermedia
847	73,173	73,173	100	Hummock grasslands, sparse tree steppe; snappy gum & bloodwood (Eucalyptus terminalis) over soft spinifex soft spinifex
848	234,050	234,050	100	Hummock grasslands, low tree steppe; eucalypts over curly spinifex on laterite sand plains
849	497,552	497,552	100	Hummock grasslands, low tree steppe; snappy gum & bloodwood over soft spinifex
850	324,665	325,120	100	Grasslands, tall bunch grass savanna, mitchell & blue grass
851	113,423	113,423	100	Hummock grasslands, sparse tree steppe; snappy gum & bloodwood (E. terminalis) over hard spinifex Triodia wiseana & T. intermedia on basalt and dolerite
852	6,689	6,689	100	Grasslands, short bunch grass savanna low tree; snappy gum & bloodwood (Eucalyptus terminalis) over arid short grass on plains
854	56,582	56,582	100	Grasslands, tall bunch grass savanna low tree; baobabs, bauhinia & beefwood over ribbon & blue grass
855	4,298	4,298	100	Grasslands, tall bunch grass savanna low tree; mixed low trees over mitchell & ribbon/blue grass on black soil
856	3,501	3,501	100	Grasslands, tall bunch grass savanna low tree; mixed low trees over ribbon/blue grass on black soil

Association	Current extent (ha)	Pre-European extent (ha)	Remaining (%)	Description
858	324,507	324,507	100	Mosaic: Grasslands, curly spinifex, low tree savanna woodland; gnainger & Eucalyptus ferruginea over Plectrachne pungens / Grasslands, curly spinifex, low tree savanna woodland; snappy gum
861	116,504	116,504	100	Grasslands, tall bunch grass savanna low tree; grey box & bloodwood (Eucalyptus terminalis) over aristida & ribbon grass on sandy plain
862	39,091	39,091	100	Hummock grasslands, open low tree & mallee steppe; marble gum & mallee (E. kinismillii) over hard spinifex Triodia basedowii
863	56,048	56,048	100	Hummock grassland, mixed sandplain - sparse low trees over sparse dwarf shrubs with spinifex; red mallee over mixed dwarf shrubs with Triodia scariosa & T. sp?
864	25,025	25,025	100	Grasslands, tall bunch grass savanna low tree; bloodwood (Eucalyptus dichromophloia) over ribbon grass
865	64,231	64,231	100	Hummock grassland, mixed sandplain - scattered low trees over sparse dwarf shrubs with spinifex; red mallee over mixed dwarf shrubs with Triodia scariosa & T. sp?
866	27,727	27,727	100	Grasslands, tall bunch grass savanna sparse low tree; bauhinia & coolabah over ribbon grass on black soil
867	117,569	117,569	100	Grasslands, high grass savanna low woodland; grey box & cabbage gum over white grass &/or upland tall grass
868	237,074	237,074	100	Grasslands, curly spinifex & short grass low tree savanna; snappy gum & bloodwood (Eucalyptus dichromophloia) over enneapogon & curly spinifex on granite
869	10,016	10,016	100	Grasslands, tall bunch grass savanna low tree; bauhinia & coolabah over ribbon grass on black soil
870	11,314	11,314	100	Grasslands, tall bunch grass savanna low tree; snappy gum over ribbon grass
871	238,830	238,830	100	Mosaic: Grasslands, curly spinifex, low tree savanna; snappy gum over curly spinifex / Hummock grasslands, grass steppe; hard spinifex Triodia intermedia
872	3,468	3,468	100	Hummock grasslands, sparse tree steppe; snappy gum over hard spinifex Triodia wiseana & T. intermedia on basalt and dolerite
873	77,773	77,773	100	Mosaic: Grasslands, short bunch grass savanna low tree; snappy gum over enneapogon short grass on plains / Hummock grasslands, grass steppe: soft & hard spinifex
875	243,191	243,191	100	Mosaic: Hummock grasslands, open low tree steppe; snappy gum over soft spinifex soft spinifex / Hummock grasslands, grass steppe; hard spinifex Triodia intermedia on laterite
876	52,384	52,384	100	Hummock grasslands, shrub steppe; Acacia pachycarpa & A. tumida over Triodia pulchella & T. intermedia sandplain
877	49,039	49,039	100	Grasslands, tall bunch grass savanna low tree; snappy gum & bloodwood (E. dichromophloia) over ribbon grass
878	66,159	66,159	100	Hummock grasslands, sparse tree steppe; snappy gum & bloodwood (Eucalyptus dichromophloia) over soft spinifex & T. intermedia
879	66,556	66,556	100	Grasslands, short bunch grass savanna low tree; bauhinia over Aristida pruinosa short grasses on plains
881	24,728	24,728	100	Grasslands, curly spinifex, low tree savanna; bauhinia over Plectrachne sp.
882	36,451	36,451	100	Hummock grasslands, sparse tree steppe; snappy gum over hard spinifex Triodia intermedia
883	27,984	27,984	100	Grasslands, curly spinifex, low tree savanna; bloodwood (Eucalyptus dichromophloia) over curly spinifex
884	43,865	43,865	100	Grasslands, tall bunch grass savanna low tree; cabbage gum & bloodwood (Eucalyptus polycarpa) over ribbon & blue grass on sandy plains
887	45,038	45,038	100	Grasslands, high grass savanna woodland; grey box & cabbage gum over mixed/white grass
888	165,446	165,446	100	Grasslands, tall bunch grass savanna low woodland, grey box & cabbage gum over ribbon grass

Association	Current extent (ha)	Pre-European extent (ha)	Remaining (%)	Description
894	43,821	43,821	100	Sedgeland; sedges with low tree savanna woodland; coolabah & grey box over spinifex
895	103,590	105,418	100	Hummock grasslands, shrub steppe; mixed acacia over soft spinifex (Tanami)
897	2,749	2,749	100	Spinifex, mitchell grass & kangaroo grass (mapped as akGc, joins xHG1)
899	49,506	49,506	100	Mosaic: Grasslands, short bunch grass savanna low tree; snappy gum over enneapogon short grass on plains / Hummock grasslands, grass steppe; hard spinifex <i>Triodia intermedia</i>
901	4,716,886	4,716,886	100	Grasslands, high grass savanna woodland; stringybark & woollybutt over upland tall grass & curly spinifex
902	11,180	12,887	86.76	Hummock grasslands, low tree steppe; scattered low rare eucs in open curly spinifex
904	148,131	148,131	100	Medium woodland-tropical; stringybark & woollybutt with understory of palms (<i>Livistona eastonii</i>)
905	57,527	57,527	100	Grasslands, high grass savanna woodland; cabbage gum & ghost gum over mixed/white grass, riverine
906	8,388	8,388	100	Grasslands, high grass savanna woodland; bloodwood, stringybark & woollybutt over white grass & tall upland grass on sandstone (sometimes with p3)
907	10,885	10,885	100	Grasslands, high grass savanna woodland; ghost gum & bloodwood (<i>Eucalyptus polycarpa</i>) over ribbon & tall upland grass
908	8,391	8,391	100	Grasslands, high grass savanna low tree; terminalia & bauhinia over upland tall grass
909	288,847	288,847	100	Grasslands, high grass savanna woodland; bloodwood, stringybark & woollybutt over upland tall grass & curly spinifex on sandplain
911	42,760	42,760	100	Grasslands, high grass savanna woodland; bloodwood over upland tall grass & curly spinifex
914	51,444	51,444	100	Grasslands, high grass savanna woodland; grey box & <i>Eucalyptus foelscheana</i> over kangaroo (<i>Themeda australis</i>) & white grass
915	1,453	1,453	100	Mosaic: Grasslands, high grass savanna woodland; grey box, <i>E.confertifolia</i> & <i>E. foelscheana</i> over spinifex, white & tall upland grass / Grasslands, high grass savanna low tree; terminalia & bauhinia
916	78,447	78,447	100	Grasslands, high grass savanna woodland; grey box, <i>Eucalyptus confertifolia</i> & <i>E. foelscheana</i> over spinifex, white & tall upland grass on sandy plain on limestone
918	1,491	1,491	100	Hummock grasslands, low tree steppe; snappy gum over curly & ? spinifex (t14=?)
922	16,836	16,836	100	Hummock grasslands, low tree steppe; eucalypts (e23) over soft (t1?) & feather spinifex between sandhills
923	23,321	23,321	100	Hummock grasslands, grass steppe; spinifex <i>Triodia inutulis</i>
924	33,430	82,770	40.39	Shrublands; mallee scrub, <i>Eucalyptus eremophila</i> & red mallee
925	29,649	31,115	95.29	Shrublands; mallee scrub, red mallee
929	7,929	10,576	74.98	Low forest; moort (<i>E. platypus</i>)
931	13,854	37,152	37.29	Medium woodland; yate
934	54,908	69,180	79.37	Shrublands; mallee scrub <i>Eucalyptus nutans</i>
936	891,958	924,675	96.46	Medium woodland; salmon gum
938	15,749	92,567	17.01	Medium woodland; York gum & yate
939	9	139	6.23	Succulent steppe with woodland; yorkgum, sparse teatree scrub & samphire
940	107,279	315,711	33.98	Mosaic: Shrublands; mallee scrub, black marlock / Shrublands; tallerack mallee-heath
941	14,626	40,987	35.68	Mosaic: Medium woodland; salmon gum & morrel/ / Shrublands; mallee scrub, redwood
942	8,128	40,444	20.10	Mosaic: Medium woodland; yate / Shrublands; mallee scrub, black marlock

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945	8,635	219,646	3.93	Mosaic: Medium woodland; salmon gum / Shrublands; mallee scrub, redwood & black marlock
946	16,251	94,085	17.27	Medium woodland; wandoo
947	9,464	37,608	25.17	Medium woodland; powderbark & mallet
948	117	1,707	6.85	Medium woodland; York gum & river gum
949	88,844	220,744	40.25	Low woodland; banksia
950	190	597	31.79	Medium woodland; Casuarina obesa
951	8,330	28,999	28.73	Succulent steppe with sparse woodland & thicket; york gum & Kondinin blackbutt over teatree thicket & samphire
952	9,918	62,983	15.75	Shrublands; dryandra heath
953	1,726	11,895	14.51	Succulent steppe with thicket; teatree over samphire (m5?)
954	788	5,795	13.59	Shrublands; thicket, Jam & Allocasuarina huegeliana
955	10,231	140,001	7.31	Mosaic: Shrublands; scrub-heath (SE Avon)/ Shrublands; Allocasuarina campestris thicket
956	2,422	27,103	8.93	Shrublands; Allocasuarina campestris thicket with scattered wandoo
959	3,930	15,622	25.15	Succulent steppe with sparse woodland & thicket; yorrell & Kondinin blackbutt over teatree & samphire
960	13,678	188,643	7.25	Shrublands; mallee scrub, redwood & black marlock
961	4,263	29,645	14.38	Mosaic: Shrublands; scrub-heath (SE Avon)/ Shrublands; Allocasuarina campestris thicket
962	207	1,435	14.42	Medium woodland; mallet (E. astringens)
963	2,360	7,290	32.37	Medium woodland; yate & paperbark (Melaleuca spp)
964	1,477	4,109	35.95	Shrublands; mallee scrub, black marlock & Eucalyptus decipiens
965	5,029	10,575	47.55	Medium woodland; jarrah & marri
966	157	3,848	4.08	Succulent steppe with sparse woodland & thicket; salmon gum & morrell over teatree & samphire
967	32,104	262,508	12.23	Medium woodland; wandoo & yate
968	67,277	185,122	36.34	Medium woodland; jarrah, marri & wandoo
969	9,710	33,815	28.72	Mosaic: Medium forest; jarrah-marri / Low forest; jarrah
970	1,385	1,685	82.23	Low forest; jarrah & Eucalyptus decipiens
971	156	417	37.50	Shrublands; mallee scrub, Eucalyptus decipiens
972	9,261	28,523	32.47	Medium woodland; jarrah, marri, wandoo & yate
973	1,585	5,522	28.71	Low forest; paperbark (Melaleuca raphiophylla)
974	585	8,754	6.68	Medium woodland; York gum, salmon gum & morrell
975	15,567	19,976	77.93	Low woodland; jarrah
976	488	2,618	18.64	Succulent steppe with low woodland; myoporum over samphire
977	19,649	28,804	68.22	Low forest; teatree & casuarina
978	20,643	66,436	31.07	Low forest; jarrah, Eucalyptus staeri & Allocasuarina fraseriana
979	1,812	9,450	19.18	Mosaic: Medium forest; jarrah-marri / Low forest; jarrah & casuarina (probably Allocasuarina fraseriana)
980	78,910	212,504	37.13	Shrublands; jarrah mallee-heath
981	1,190	12,767	9.32	Medium woodland; wandoo, York gum & yate
982	638	1,942	32.85	Low woodland; Eucalyptus decipiens
984	18,399	18,399	100	Mosaic: Shrublands; acacia & melaleuca scrub / Succulent steppe; saltbush
986	15,255	36,469	41.83	Shrublands; mallee-heath (Stirling Ra.)
987	1,328	4,340	30.59	Medium woodland; jarrah & wandoo
988	22,230	99,139	22.42	Succulent steppe with thicket; Melaleuca thyoides over samphire
989	7,410	11,008	67.31	Shrublands; Albany blackbutt mallee-heath
990	13,483	18,353	73.47	Low forest: peppermint (Agonis flexuosa)

Association	Current extent (ha)	Pre-European extent (ha)	Remaining (%)	Description
991	255	374	68.06	Medium woodland; small wandoo patches surrounded by e2, 5Mi; e5, 7Mi
992	27,458	122,056	22.50	Medium forest; jarrah & wandoo (E. wandoo)
993	694	2,541	27.29	Medium woodland; York gum & Allocasuarina huegeliana
994	5,030	20,743	24.25	Low forest; jarrah & casuarina (probably Allocasuarina fraseriana)
995	3,053	3,923	77.81	Shrublands; mallee scrub, bushy yate & Bald I. marlock
997	1,322	3,455	38.28	Shrublands; melaleuca heath
998	17,332	48,946	35.41	Medium woodland; tuart
999	28,185	252,446	11.16	Medium woodland; marri
1000	28,844	109,798	26.27	Mosaic: Medium forest; jarrah-marri / Low woodland; banksia / Low forest; teatree (Melaleuca Spp.)
1001	16,758	64,799	25.86	Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina
1002	15,736	16,008	98.30	Medium open woodland; jarrah
1003	52,295	98,292	53.20	Medium forest; jarrah, marri & wandoo
1004	3,655	11,783	31.02	Mosaic: Medium open woodland; wandoo / Shrublands; mixed heath
1005	200	932	21.42	Low woodland; Allocasuarina huegeliana
1006	24,157	46,573	51.87	Medium woodland; jarrah, wandoo & powderbark
1007	4,233	32,366	13.08	Mosaic: Low woodland over scrub; mulga over bowgada scrub / Shrublands: bowgada and Grevillea scrub on sandhills
1008	825	4,575	18.03	Medium open woodland; marri
1009	2,281	7,490	30.46	Medium woodland; marri & river gum
1010	80	1,213	6.56	Medium open woodland; marri & tuart
1011	854	1,264	67.54	Medium open woodland; tuart
1012	145	509	28.39	Mosaic: Medium open woodland; tuart / Low woodland; banksia
1013	97	466	20.88	Mosaic: Medium open woodland; marri / Shrublands; teatree thicket
1014	22,072	41,154	53.63	Mosaic: Low woodland; banksia / Shrublands; teatree thicket
1015	5,452	19,512	27.94	Mosaic: Shrublands: scrub-heath on the Swan Coastal Plain / Shrublands: dryandra heath
1016	508	1,527	33.26	Mosaic: Low woodland; banksia / Shrublands; dryandra heath
1017	9,973	17,358	57.46	Medium open woodland; jarrah & marri, with low woodland; banksia
1018	3,173	14,085	22.52	Mosaic: Medium forest; jarrah-marri / Low woodland; banksia / Low forest; teatree / Low woodland; Casuarina obesa
1019	344	790	43.52	Medium sparse woodland; jarrah & marri
1020	1,799	5,608	32.07	Mosaic: Medium forest; jarrah-marri / Medium woodland; marri-wandoo
1021	135	1,245	10.83	Mosaic: Medium open woodland; wandoo / Shrublands; dryandra heath
1022	181	456	39.62	Succulent steppe with woodland; Casuarina obesa & samphire
1023	89,334	1,601,880	5.58	Medium woodland; York gum, wandoo & salmon gum (E. salmonophloia)
1024	67,054	732,522	9.15	Shrublands; mallee & casuarina thicket
1025	36	1,926	1.86	Mosaic: Medium woodland; York gum, salmon gum & morrel / Succulent steppe; saltbush & samphire
1026	70,090	70,090	100	Mosaic: Shrublands; Acacia rostellifera, A. cyclops (S) & Melaleuca cardiophylla (N) thicket / Shrublands; Acacia lasiocarpa & Melaleuca acerosa heath
1027	22,493	39,792	56.53	Mosaic: Medium open woodland; jarrah & marri, with low woodland; banksia / Medium sparse woodland; jarrah & marri
1028	310	1,125	27.60	Medium woodland; river gum
1029	54,095	71,022	76.17	Shrublands; scrub-heath Dryandra-Calothamnus assoc. with B. prionotes on limestone in the northern Swan Region

Association	Current extent (ha)	Pre-European extent (ha)	Remaining (%)	Description
1030	89,152	137,565	64.81	Low woodland; <i>Banksia attenuata</i> & <i>B. menziesii</i>
1031	94,910	269,381	35.23	Mosaic: Shrublands; hakea scrub-heath / Shrublands; dryandra heath
1032	6,691	8,310	80.52	Mosaic: Medium woodland; marri, wandoo, powderbark / Shrublands; dryandra heath
1033	497	594	83.64	Mosaic: Shrublands; <i>Acacia cyclops</i> thicket / Shrublands; <i>Acacia lasiocarpa</i> & <i>Melaleuca acerosa</i> heath
1034	1,107	1,821	60.78	Medium woodland; marri, wandoo & powderbark
1035	336	4,993	6.73	Mosaic: Medium open woodland; marri / Shrublands; dryandra heath
1036	31,928	86,372	36.97	Low woodland; <i>Banksia prionotes</i>
1037	2,157	2,372	90.93	Medium woodland; York gum & river gum (incl e6,18Mr?)
1038	285	1,710	16.67	Medium open woodland; eucalypts (e2?), with low woodland; <i>Banksia attenuata</i> & <i>B. menziesii</i>
1039	1,309	2,036	64.28	Shrublands; mallee with scattered York gum
1040	585	2,831	20.67	Medium woodland; York gum & <i>Casuarina obesa</i>
1041	1,164	4,769	24.40	Low woodland; <i>Allocasuarina huegeliana</i> & Jam
1042	12	269	4.35	Succulent steppe with low woodland; sheoak over samphire
1043	1,534	3,788	40.49	Mosaic: Medium open woodland; wandoo & powderbark wandoo / Shrublands; dryandra heath
1044	117	1,442	8.14	Mosaic: Medium woodland; York gum & salmon gum / Shrublands; <i>Melaleuca thyioides</i> thicket
1046	56	863	6.46	Succulent steppe with woodland; york gum & samphire
1047	81,018	221,882	36.51	Shrublands; <i>Eucalyptus incrassata</i> mallee-heath
1048	2	11,365	0.02	Mosaic: Shrublands; melaleuca patchy scrub / Succulent steppe; samphire
1049	16,684	645,392	2.59	Medium woodland; wandoo, York gum, salmon gum, morrel & gimlet
1051	4,149	17,679	23.47	Shrublands; teatree thicket with scattered wandoo & yate
1053	2,291	14,827	15.45	Shrublands; <i>Melaleuca uncinata</i> thicket with scattered York gum
1055	13,503	126,214	10.70	Shrublands; York gum & <i>Eucalyptus sheathiana</i> mallee scrub
1056	3,042	20,851	14.59	Shrublands; thicket, acacia & <i>Allocasuarina campestris</i>
1057	15,522	162,330	9.56	Mosaic: Shrublands; Medium woodland; salmon gum & gimlet / York gum & <i>Eucalyptus sheathiana</i> mallee scrub
1058	251	9,345	2.69	Shrublands; York gum & <i>Eucalyptus gonglocarpa</i> mallee scrub
1059	14	2,256	0.60	Mosaic: Medium woodland; salmon gum & gimlet / Shrublands; mallee <i>Eucalyptus longicornis</i> & <i>E. sheathiana</i> scrub
1061	12,370	42,619	29.02	Mosaic: Medium sparse woodland; salmon gum & yorrell / Succulent steppe; saltbush & samphire
1062	5,407	22,441	24.09	Succulent steppe with open woodland & thicket; york gum over <i>Melaleuca thyioides</i> & samphire
1063	114,963	126,692	90.74	Medium-Low woodland; York gum & cypress pine (<i>Callitris columellaris</i>)
1065	544	8,303	6.56	Mosaic: Shrublands; Medium woodland; wandoo & gimlet / York gum & <i>Eucalyptus sheathiana</i> mallee scrub
1067	13,398	15,303	87.55	Medium woodland; salmon gum, morrel, gimlet & rough fruited mallee
1068	120,882	249,503	48.45	Medium woodland; salmon gum, morrel, gimlet & <i>Eucalyptus sheathiana</i>
1071	841	966	87.05	Succulent steppe with scrub; acacia species over saltbush & bluebush
1073	6,008	21,176	28.37	Medium woodland; wandoo & mallet
1074	1,306	5,501	23.73	Succulent steppe with open woodland & thicket; wandoo & <i>Allocasuarina obesa</i> over teatree & samphire
1075	27,235	404,932	6.73	Shrublands; mallee scrub, <i>Eucalyptus eremophila</i> & black marlock (<i>E. redunca</i>)

Association	Current extent (ha)	Pre-European extent (ha)	Remaining (%)	Description
1076	11	13	83.60	Mosaic: Medium woodland; salmon gum & morrel / Shrublands; mallee scrub Eucalyptus eremophila & ?bloodwood E. dichromophloia
1077	1,185	3,066	38.65	Medium woodland; jarrah & river gum
1078	758	758	100	Medium woodland; salmon gum, redwood, merrit, gimlet & Eucalyptus sheathiana
1079	2,745	7,841	35.01	Mosaic: Medium open woodland; salmon gum & morrel / Succulent steppe; saltbush
1080	78	3,877	2.02	Succulent steppe with malle & thickets; Mallee and Melaleuca uncinata thickets on salt flats
1081	14	14	94.94	Shrublands; mallee scrub, Eucalyptus longicornis & E. sheathiana
1083	2,195	12,816	17.13	Succulent steppe with open woodland & scrub; wandoo, salmon gum & Allocasuarina obesa over teatree & samphire
1085	4,505	62,552	7.20	Medium woodland; wandoo & blue mallet (E. gardneri)
1087	298	899	33.14	Medium woodland; wandoo, morrell & blue mallet
1088	159	480	33.04	Medium woodland; mallet & blue mallet
1091	262	863	30.37	Low woodland; Banksia prionotes & Allocasuarina huegelianna
1092	5,224	93,990	5.56	Medium woodland; wandoo, York gum & morrell
1093	759	9,911	7.65	Succulent steppe with open woodland & thicket; eucalypts & Allocasuarina obesa over teatree & samphire
1094	4,130	87,386	4.73	Mosaic: Medium woodland; York gum & salmon gum / Shrublands; mallee scrub Eucalyptus eremophila & black marlock
1095	291	1,477	19.70	Medium woodland; York gum, yate & salmon gum
1096	177	425	41.75	Medium woodland; yate & salmon gum
1098	3,469	21,772	15.93	Mosaic: Medium sparse woodland; salmon gum & morrel / Succulent steppe; samphire
1099	50,018	52,973	94.42	Hummock grassland; shrub steppe; wattle scrub & heath Acacia ligulata x rostellifera
1100	35,871	37,272	96.24	Hummock grassland; dwarf shrub Steppe; mixed ericoid shrubs & spinifex
1101	18,437	19,182	96.12	Shrublands; Acacia ligulata x rostellifera thicket
1102	12,826	12,931	99.19	Mosaic: Shrublands; mixed heath / Shrublands; acacia patchy scrub
1103	17,209	17,209	100	Shrublands; Acacia & lamarchea thicket
1104	12,743	13,234	96.29	Mosaic: Shrublands; scrub-heath / Shrublands; Acacia rostellifera & Melaleuca cardiophylla thickets
1105	413	413	100	Hummock grasslands, grass steppe; spinifex Triodia plurinervata
1106	2,845	2,845	100	Mosaic: Shrublands; scrub-heath / Shrublands; acacia various species scrub
1107	703	703	100	Open low woodland; Eucalyptus oraria
1108	7,210	8,936	80.68	Shrublands; Acacia decipiens
1109	28,836	34,092	84.58	Shrublands; peppermint scrub, Agonis flexuosa
1111	691	803	86.13	Medium woodland; yate (E. occidentalis)
1112	10,296	10,701	96.22	Mosaic: Tall forest; karri / Tall forest; jarrah & marri
1113	5,830	7,850	74.27	Shrublands; Jacksonia horrida heath
1114	14,943	19,872	75.19	Shrublands tree-heath; paperbark over teatree thickets
1115	1,269	1,278	99.36	Medium woodland; marri & yate
1116	4,267	4,641	91.93	Tall forest; jarrah (E. marginata)
1121	22,909	22,909	100	Mixed short grass and spinifex with scattered coolabah
1125	65,302	65,302	100	Succulent steppe with scrub; Acacia victoriae & snakewood over saltbush & bluebush
1126	3,209	3,209	100	Low woodland; mulga & minnieritchie
1127	69,027	69,027	100	Mosaic: Saltbush & bluebush/samphire

Association	Current extent (ha)	Pre-European extent (ha)	Remaining (%)	Description
1128	18,651	18,651	100	Mosaic: Succulent steppe with open scrub; scattered Acacia sclerosperma & bowgada over saltbush & bluebush/Succulent steppe; samphire
1130	1,018	1,079	94.33	Tall forest; karri & red tingle (<i>E. jacksonii</i>)
1131	272	283	96.11	Medium forest; bushy yate (<i>E. cornuta</i>)
1132	238	276	86.26	Medium forest; marri
1134	34,120	38,096	89.56	Medium woodland; jarrah (south coast)
1136	6,071	57,110	10.63	Medium woodland; marri with some jarrah, wandoo, river gum and casuarina
1137	369	1,092	33.80	Shrublands; <i>Melaueca incana</i> , <i>Hakea tuberculata</i> , <i>Viminaria juncea</i> scrub on ironstone, south coast.
1138	524	691	75.83	Low forest; jarrah & marri
1139	14,131	15,077	93.73	Tall forest; karri & yellow tingle (<i>E. guilfoyleii</i>)
1140	760	760	100	Tall forest; karri & Rates tingle (<i>E. brevostylis</i>)
1141	749	11,071	6.77	Shrublands; jam, <i>Acacia rostellifera</i> & <i>Melaleuca megacephala</i> thicket
1142	778	3,418	22.77	Shrublands; <i>Acacia ligulata</i> & <i>Melaueca uncinata</i> dominated thicket on dark brown loamy soil
1143	4,150	65,569	6.33	Shrublands; <i>Allocasuarina campestris</i> thicket with patches of heath
1144	140,233	165,374	84.80	Tall forest; karri & marri (<i>Corymbus calophylla</i>)
1147	2,428	51,515	4.71	Shrublands; scrub-heath in the south-east Avon-Wheatbelt Region
1148	270,313	272,310	99.27	Shrublands; scrub-heath in the Coolgardie Region
1149	499	7,501	6.65	Shrublands; scrub-heath <i>Acacia-Ecdeiocolia</i> association in the south-east Geraldton Sandplain Region
1150	5,244	5,439	96.41	Tall forest; karri, red tingle & yellow tingle
1151	2,053	2,181	94.12	Medium forest; jarrah & red tingle
1152	7,303	7,354	99.31	Medium forest; jarrah & yellow tingle
1153	1,050	1,178	89.14	Medium forest; jarrah & Rates tingle
1154	2,859	39,088	7.31	Shrublands; <i>Acacia</i> thicket with patches of heath
1155	2,898	7,789	37.20	Mosaic: Medium woodland; York gum /Shrublands; <i>Allocasuarina campestris</i> thicket
1156	172	1,729	9.97	Shrublands; <i>Allocasuarina campestris</i> thickets with scattered jam & casuarina
1157	1,174	1,232	95.28	Tall forest; jarrah & marri
1158	97	98	98.28	Mosaic: Medium forest; jarrah & yellow tingle / Medium forest; jarrah & Rates tingle
1162	71,685	71,685	100	Hummock grasslands, grass steppe; hard spinifex <i>Triodia wiseana</i> & <i>T. basedowii</i>
1164	19	2,002	0.97	Mosaic: Shrublands; scrub-heath on sandplain (<i>banksia-xyloelum</i> alliance) in the Geraldton Sandplain & Avon-Wheatbelt Regions / Shrublands; <i>Allocasuarina campestris</i> thicket
1180	2,271	2,915	77.90	Shrublands; <i>Calothamnus quadrifidus</i> & <i>Hakea trifurcata</i> (Cape Naturaliste)
1181	9,388	19,329	48.57	Medium woodland, jarrah & <i>Eucalyptus haematoxylon</i> (Whicher Ra.)
1182	5,847	23,468	24.92	Medium woodland; <i>Eucalyptus rudis</i> & <i>Melaleuca raphiophylla</i>
1183	7,972	9,057	88.02	Medium woodland; <i>Eucalyptus rudis</i> & blackbutt with some bullich, jarrah & marri (fringing Blackwood R.)
1184	32,660	63,430	51.49	Medium woodland-fringing; jarrah, marri, <i>Eucalyptus rudis</i> & <i>Agonis flexuosa</i>
1185	13,368	15,164	88.16	Medium woodland; jarrah, marri & blackbutt
1195	362,485	362,485	100	Mosaic: Low woodland; mulga in valleys / Hummock grasslands, shrub steppe; acacia species over <i>Triodia basedowii</i>
1198	15,611	18,083	86.33	Mosaic: Succulent steppe with thicket; <i>Melaleuca thyiodes</i> over samphire / Shrublands; bowgada open scrub

Association	Current extent (ha)	Pre-European extent (ha)	Remaining (%)	Description
1200	9,322	150,091	6.21	Mosaic: Medium woodland; salmon gum & morrel / Shrublands; mallee scrub Eucalyptus eremophila & black marlock (E. redunca)
1217	86,287	86,287	100	Hummock grasslands, steppe woodland; desert oak & soft spinifex between sandhills
1239	2,033,120	2,033,120	100	Hummock grasslands, open medium tree & mallee steppe; marble gum & mallee (E. youngiana) over hard spinifex Triodia basedowii on sandplain
1241	4,913,332	4,913,332	100	Succulent steppe; bluebush
1271	87,333	87,333	100	Bare areas; claypans
1294	6,181	6,181	100	Medium woodland; coral gum
1322	245,450	245,450	100	Shrublands; Acacia sclerosperma, A. victoriae & snakewood scrub
1325	9,998	9,998	100	Succulent steppe with very open low trees; coolebah over saltbush & samphire
1413	1,328,653	1,981,503	67.05	Shrublands; acacia, casuarina & melaleuca thicket
1423	28,352	28,352	100	Shrublands; scrub-heath in Shark Bay Area, mainly Acacia spp.
1446	170,391	170,391	100	Succulent steppe with scrub; mulga over bluebush
1515	222,425	222,425	100	Shrublands; mallee scrub Eucalyptus gracilis
1516	55,299	127,085	43.51	Shrublands; mallee scrub, black marlock & Forrest's marlock
1519	3,151	3,315	95.03	Shrublands; mallee scrub, Eucalyptus eremophila & banksia
1550	1,562	2,312	67.57	Shrublands; dwarf scrub (Dirk Hartog I)
1601	128,766	128,766	100	Mosaic: Shrublands; snakewood & A. victoria scrub / Hummock grasslands; grass steppe, hard spinifex Triodia basedowii
1602	98,058	98,058	100	Mosaic: Shrublands; snakewood scrub / Hummock grasslands; grass steppe, hard spinifex Triodia basedowii & T. wiseana
1684	58,232	58,232	100	Succulent steppe with open scrub; scattered snakewood over bluebush
1967	5,693	31,041	18.34	Medium woodland; wandoo, yate & river gum
2003	43,102	50,147	85.95	Medium forest; jarrah & marri on laterite with blackbutt (E. patens) in vales, swampy bottomlands with bullich (E. megacarpa) and Agonis flexuosa
2009	57,135	57,135	100	Medium woodland; redwood & goldfields blackbutt
2016	0	430	0	Low forest; bushy yate
2041	435,988	435,988	100	Succulent steppe with scrub; teatree over saltflats
2047	1,057	1,441	73.36	Shrublands; tamma & dryandra thicket
2048	150,253	381,812	39.35	Shrublands; scrub-heath in the Mallee Region
2051	7,452	12,777	58.32	Sedgeland; sedges with low tree savanna woodland; paperbarks over & various sedges
2081	1,318,342	1,318,342	100	Shrublands; bowgada and associated spp. scrub
2093	4,459	11,138	40.03	Succulent steppe with open woodland & scrub; yate over teatree & samphire
2097	53,278	53,278	100	Mosaic: Hummock grasslands, open low tree steppe; desert bloodwood and feathertop spinifex (on) sandhills / Shrublands; teatree scrub
2121	124,305	124,305	100	Mosaic: Open low woodland; mulga / Succulent steppe; saltbush & bluebush on greenstone
2151	9,029	9,029	100	Low woodland; coolabah & paperbark (Melaleuca sp.)
2175	99,908	99,908	100	Grass savanna on clay plains (Tanami)
2245	1,313	1,313	100	Shrublands; mallee scrub (Nullabor) Eucalyptus socialis, E. cooperana & E. gracilis
2675	351,527	351,527	100	Hummock grasslands, low tree & shrub steppe; scattered eucalypts, kanji over Triodia pungens & T. basedowii
2685	58,409	58,409	100	Shrublands; Acacia quadrimarginea & jam scrub on greenstone
2736	79,787	79,787	100	Grasslands, curly spinifex, low tree savanna; snappy gum & Eucalyptus perfoliata over Plectrachne pungens

Association	Current extent (ha)	Pre-European extent (ha)	Remaining (%)	Description
2901	36,103	36,103	100	Mosaic: Medium woodland; Allocasuarina cristata & goldfields blackbutt Shrublands; Acacia quadrimarginea thicket
2902	938	938	100	Medium woodland; Allocasuarina cristata & goldfields blackbutt
2903	28,423	28,423	100	Medium woodland; Salmon gum, goldfield blackbutt, gimlet & Allocasuarina cristata
2904	54,152	54,152	100	Medium woodland; York gum, goldfield blackbutt, gimlet & Allocasuarina cristata
3003	44,370	66,353	66.87	Medium forest; jarrah & marri on laterite with wandoo in valleys, sandy swamps with teatree and Banksia
3041	1,284	18,564	6.91	Mosaic: Low woodland; Allocasuarina huegeliana & jam around granite rocks
3048	3,588	14,592	24.59	Shrublands; scrub-heath on the Swan Coastal Plain
3432	164,253	164,253	100	Mosaic: Low woodland; waterwood / Shrublands; Acacia sclerosperma, A. victoriae & A. subtressarogona scrub
4048	43,818	67,232	65.17	Shrublands; scrub-heath in the Esperance Plains incl. Mt Ragged scrub-heath
4621	52,095	52,095	100	Shrublands; mallee scrub, Eucalyptus eudesmioides
4623	237,699	237,699	100	Succulent steppe with low woodland; Acacia papyrocarpa over bluebush
4641	155,772	155,772	100	Succulent steppe with open woodland; salmon gum & gimlet over bluebush
4801	8,480	58,508	14.49	Shrublands; heath with scattered Nuytsia floribunda on sandplain
6048	17,229	113,042	15.24	Shrublands; banksia scrub-heath on sandplain in the Esperance Plains Region
7001	105,765	105,765	100	Shrublands, pindan; Acacia eripoda & A. tumida shrubland with scattered low cabbage gum & Eucalyptus setosa over ribbon & curly spinifex
7048	98,950	119,723	82.65	Shrublands; banksia scrub-heath on coastal plain in the Esperance Plains Region
8001	203,861	238,462	85.49	Grasslands, curly spinifex, low tree savanna; bloodwood (Eucalyptus dichromophloia) & woollybutt over curly spinifex on islands
8002	19,890	19,890	100	Grasslands, high grass savanna woodland; E. dichromophloia (bloodwood) & E. miniata (woollybutt) over upland tall grass & curly spinifex (T. bitextura) / Hummock grasslands, grass steppe
8003	117,463	117,463	100	Pindan A. eripoda; A. impressa shrubland with scattered low trees of Lysiphylum cunninghamii; Grevillea striata over grasses
Total	236,108,925	257,239,228		

Appendix 3. Western Australia NVIS Stakeholder Workshop

Department of Conservation and Land Management and Agriculture Western Australia - 5-6 June 2001

Issues and Actions arising

<i>WA Issues</i>	<i>Actions Required</i>
<p>1. At the State level WA portfolios do not have a whole of landscape approach to the surveying, mapping and compilation of vegetation data across the landscape, with perhaps the exception being small catchments in the ILZ (e.g. Blackwood catchment). These activities appear to be highly fragmented and lack overall coordination and the application of common standards.</p>	<p><i>Using the NVIS – Australian Vegetation Attributes - as a standard, together with locally relevant attributes, establish a cooperative arrangement between WA agencies to maintain vegetation extent mapping in Western Australia. A standard approach should also be developed for assessing the conservation value of patches of vegetation taking into account landscape context.</i></p>
<p>2. More work is needed to establish a ‘true’ extant vegetation map for the ILZ. It is mapped only from a Pre European perspective. (The attributes and the line work 1:250K and are circa 1975). Clearly more work is needed map the vegetation at a scale (:1:50K – 1:100K) that is relevant to the on ground needs of the land managers. WA wants support to assist them to:</p> <ul style="list-style-type: none"> • implement the Walker and Hopkins site-based protocol as the WA site-based protocol for vegetation surveying and mapping • develop and maintain support for the application of a consistent vegetation classification that meet the NVIS attribute standard 	<p><i>Capture digitally, existing detailed vegetation type mapping in Western Australia at scales of at least 1:100k, and apply the NVIS – Australian Vegetation Attributes - as a standard. Sources of detailed vegetation type mapping have been identified through the metadata audit conducted through the NLWRA project DAW27. Other important sources of polygon-based mapping are Historical Survey Maps and Forest Type Mapping from CALM.</i></p> <p><i>This work should be addressed through NVIS Stage II and gap-filling projects. For areas where polygon mapping is not available – point source datasets should be combined with detailed soil and landscape mapping to develop a polygon-based dataset at a scale of at least 1:100 k.</i></p>
<p>3. WA has identified a major problem is that of custodianship of the vegetation datasets in the ILZ. There is no Statewide Vegetation Mapping Program that coordinates / provides adequate resources across portfolios in that State.</p>	<p><i>Actions addressed under point 1. A cooperative arrangement between agencies should be developed under the leadership of the Department of Agriculture and CALM under the framework of the WA Land Information System (WALIS).</i></p>

<p>4. The map of 'present vegetation' is only a 1997 land cover change mask (1:50K-1:100K scale) i.e. a map of remnants of native vegetation that has been intersected with the Pre European 1:250K scale coverage. This does not make it an extant coverage. It only describes the present vegetation extent of the remaining Pre European. This has resulted in about 450,000 remnants in the ILZ. In reality this is an information product not an extant vegetation coverage.</p>	<p><i>Combine vegetation extent mapping with a more detailed dataset developed under point 2.</i></p>
<p>5. There are a further 28 suitable mapped vegetation datasets that were not included in the NVIS Stage I project in WA. It is not clear which of the 500 or so WA metadata records supplied to the Audit & BRS these 28 datasets refer to. Should these 28 datasets be included in NVIS Stage II and gap filling projects.</p>	<p><i>Actions addressed under point 2.</i></p>
<p>6. Vegetation attribute data supplied in the WA extant dataset indicated '0' for large areas of the ILZ. These '0s' relate to cleared and highly disturbed native vegetation. Data on whether it is a cropped area or a plantation are found in the land use coverage supplied to the Audit by WA. These data/information are required to create a whole of landscape view of vegetation for WA.</p>	<p><i>Polygons currently attributed as '0' in the vegetation mapping for the ILZ in WA should be re-attributed as 'Rotational Agriculture'.</i></p>
<p>7. Riparian vegetation surveys have been undertaken the Blackwood Shire for the River Health Commission. These have not been described in the metadata audit for NLWRA project DAW27. How might these data be included in the WA NVIS dataset?</p>	<p><i>These data should be incorporated into a more detailed extant vegetation type dataset described under point 2.</i></p>
<p>8. WA has an interest in revegetation data and information. The Dept of Agriculture has collected these data. How might these data be included in the WA NVIS dataset?</p>	<p><i>A more comprehensive survey of perennial revegetation in the ILZ of WA should be undertaken. These data should then be incorporated into a more detailed extant vegetation dataset described under point 2.</i></p>

<p>9. Community groups have been called on to provide assistance to State and regional government in WA to survey and map vegetation-related issues e.g. weeds and endangered species. The issue of quality control was raised but not resolved.</p>	<p><i>Feedback between community groups and state agencies responsible for maintaining vegetation data should be promoted. The NVIS – Australian Vegetation Attributes – should be used to ensure consistency of the information exchanged between community groups and state agencies.</i></p>
<p>10. WA use a definition of ecological dominance which differs from the definition of ecological dominance used by the other State and Territories. WA is reluctant to change the attributes they provided to NVIS to match the Walker and Hopkins or a modified Specht because of potential confusion to the users of the WA pre European map.</p>	<p><i>The NVIS was originally specified to identify ecological dominance in vegetation types. At the conclusion of NVIS Stage 1 - Western Australia is the only state to have described dominance ecologically. It has been proposed by the BRS that, as a high priority for NVIS Stage II, the NVIS partners should aim to seek agreement on a definition of ecological dominance. A plan needs to be developed on how data custodians in all States might proceed to recode the datasets that they have supplied to the Audit using this agreed definition of ecological dominance.</i></p> <p><i>An interim solution to this problem has been developed by re-classifying some of the Western Australian Map Units – in particular Grassland Savannah units in the Kimberley region (re-classified to woodlands). NVIS Major Vegetation Groups were also been developed by Environment Australia in collaboration with the States, to facilitate the production of maps with a consistent vegetation classification across Australia for NVIS Stage 1. A more robust, longer term solution needs to be developed to address this issue.</i></p>