Environmental Protection Authority

Guidance for the Assessment of Environmental Factors

(in accordance with the Environmental Protection Act 1986)

Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia

No. 51

June 2004

Western Australia

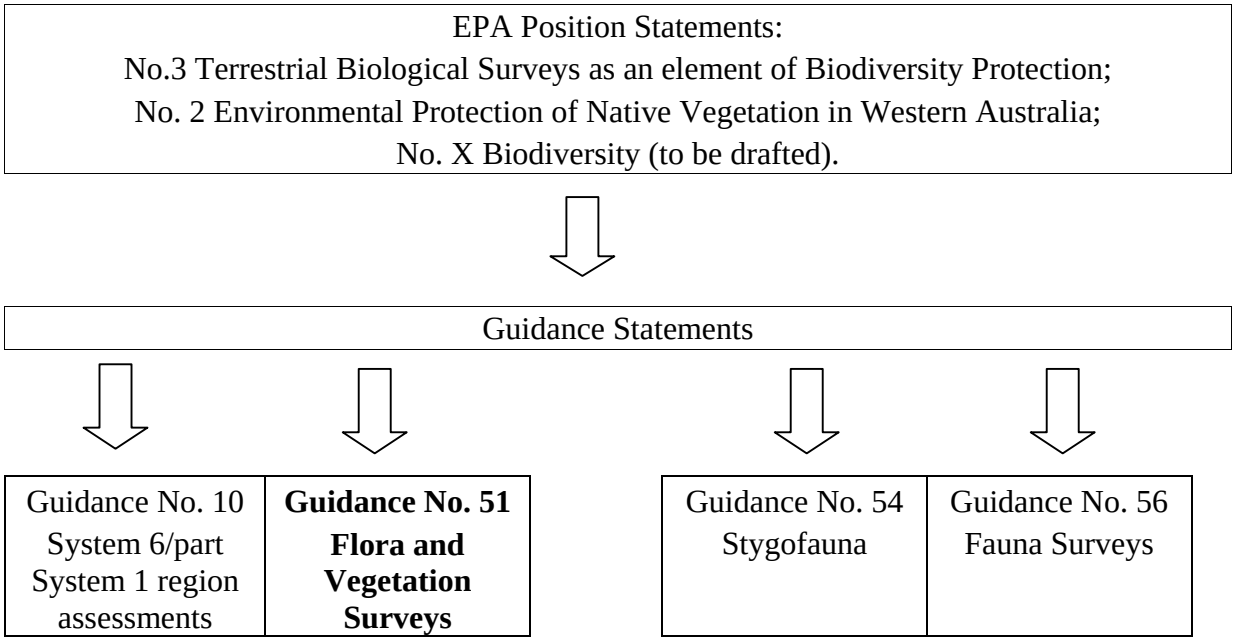
FOREWORD

The Environmental Protection Authority (EPA) is an independent statutory authority and is the key provider of independent environmental advice to Government.

The EPA's objectives are to protect the environment and to prevent, control and abate pollution and environmental harm. The EPA aims to achieve some of this through the development of environmental protection Guidance Statements for the environmental impact assessment (EIA) of proposals.

This document is one in a series being issued by the EPA to assist proponents, consultants and the public generally to gain additional information about the EPA's thinking in relation to aspects of the EIA process. The series provides the basis for EPA's evaluation of, and advice on, development proposals subject to EIA. The Guidance Statements are one part of assisting proponents in achieving an environmentally acceptable proposal. Consistent with the notion of continuous environmental improvement and adaptive environmental management, the EPA expects proponents to take all reasonable and practicable measures to protect the environment and to view the requirements of this Guidance as representing the minimum standards necessary to achieve an appropriate level of flora and vegetation survey for the assessment of environmental factors.

This Statement provides guidance on the standard of survey required to assist in collecting the appropriate data for decision-making associated with the protection of Western Australia's terrestrial flora and vegetation and their ecosystems. The flowchart below shows the relationship between Position Statements and this and other Guidance Statements.

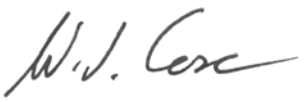


Whilst the EPA has provided this guidance to encourage best practice in flora and vegetation survey and reporting, it is conscious that the process has highlighted the need for complementary measures to promote such goals. In short, it is clear that the wider scientific community has a role to play in fostering skills and expertise. Firstly, the universities have a role to play in developing graduate skills in the areas of botany, taxonomy, biogeography, ecology and statistics, which are amongst the basic prerequisites in this line of endeavour. It is evident that there has been a shift away from these areas as society places more emphasis on areas such as biotechnology. Secondly, practising botanists and ecologists have a role to play, by mentoring recent graduates, and, perhaps most importantly, providing them with the opportunity to experience the breadth of the diversity at first hand. Thirdly, all practitioners have a role in developing a progressively better synthesis of the botany and ecology of the State. These matters are not specifically covered in this guidance.

While guidance is provided specifically in relation to the Western Australian *Environmental Protection Act, 1986*, proponents are reminded to ascertain any responsibilities they may have in regard to this issue under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*

This Guidance Statement has the status of "**Final**" which means it has been reviewed by stakeholders and the public. The EPA has signed off the Guidance Statement and published it although it will be updated regularly as new documents come to hand.

I am pleased to release this document which now supersedes the draft version.



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Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia

Key Words: biodiversity, biological diversity, biological surveys, IBRA, terrestrial flora, vegetation, plant species assemblages, Declared Rare and Priority Flora, significant flora

1 INTRODUCTION

1.1 Purpose

The primary purpose of this Statement is to provide guidance and information on expected standards and protocols for terrestrial flora and vegetation surveys to environmental consultants and proponents. The generic process for the writing of Guidance Statements is set out in Appendix 1.

This Guidance should be used when preparing documentation for referral of proposals, planning schemes and their amendments to the EPA, as well as for formal assessment and audit.

This Guidance Statement:

- provides the general standards and a common framework for terrestrial flora and vegetation surveys for environmental impact assessment (EIA) in Western Australia, the quality and quantity of information that should be derived from these surveys, and the consequent analysis, interpretation and reporting; and
- is primarily directed at the subset of biodiversity contained in all terrestrial vascular plants.

This Guidance will assist in the interpretation and application of the general principles outlined in the EPA's Position Statement No. 3, *Terrestrial Biological Surveys as an Element of Biodiversity Protection,* and Position Statement No. 2, *Environmental Protection of Native Vegetation in Western Australia.*

The EPA aims to promote survey work that is uniform and of sufficient rigour to contribute to a more systematic inventory of the State's biodiversity. This will result in a consolidated and readily accessible system of environmental information.

1.2 Policy context

1.2.1 State legislation

1.2.1.1 Environmental Protection Amendment Act 2003

Clearing of native vegetation on all land, except for exempt purposes, will soon be subject to the permit process defined under the *Environmental Protection Amendment Act 2003* (Government of Western Australia 2003a) and administered by the Department of Environment (DoE). The Act was assented to by the Governor on 20 October 2003. However, the clearing provisions cannot be proclaimed until regulations are tabled in the Legislative Assembly. These regulations have undergone extensive consultation with stakeholders and it is anticipated that they will be tabled in Parliament in the autumn session of 2004. All clearing of native vegetation in the State will require a permit, unless it is for an exempt purpose (detailed in Schedule 6 of the Act and in regulations).

Permit applications will be assessed against principles contained in the Act which consider impacts on: biodiversity, fauna habitat, rare flora, threatened ecological communities, level of remnant vegetation representation, watercourses and wetlands, land degradation, conservation areas, surface water quality, groundwater quality, and potential for flooding.

1.2.1.2 Other legislation in Western Australia

A range of other legislation is relevant to biodiversity conservation in Western Australia. This includes the *Environmental Protection Act 1986* (EP Act), the *Conservation and Land Management Act 1984*, and, in particular, the *Wildlife Conservation Act 1950*.

The Government proposes to replace the *Wildlife Conservation Act 1950* with a new Biodiversity Conservation Act. The new Act will provide for the protection and restoration of biodiversity, and the sustainable use of native plants, animals and other organisms.

1.2.2 Requirements for assessments which are accredited under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

Under the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), proposed actions which have the potential to have a significant impact on a matter of national environmental significance must be referred to the Commonwealth Minister for the Environment for a decision as to whether assessment is required under the provisions of that Act.

Provision has been made within the EPBC Act for State authorities to be accredited to undertake environmental assessments, either jointly with or on behalf of the Commonwealth, so as to meet the requirements for assessment under that Act. The

related requirements and arrangements for this are discussed in the EPBC Act itself and in the provisions of bilateral agreements being negotiated between State and Commonwealth governments. A bilateral agreement between Western Australia and the Commonwealth has been signed and came into effect on 20 October 2003, the date the EP Act amendments were assented to in the Western Australian Parliament.

Assessments must adequately address the potential impact on matters of national environmental significance in order to comply with the provisions of the EP Act and be accredited under the EPBC Act.

1.2.3 National policy context

The State has committed to an agreed framework, principles and objectives for the protection of biodiversity with the adoption of the *National Strategy for Ecologically Sustainable Development* (Commonwealth of Australia 1992) and subsequently *The National Strategy for the Conservation of Australia's Biological Diversity* (Commonwealth of Australia 1996). Western Australia was the first State to become a signatory to the latter, which followed from Australia's ratification of the United Nations Convention on Biological Diversity. In 2001 Western Australia endorsed the *National Objectives and Targets for Biodiversity Conservation 2001-2005* (Commonwealth of Australia 2001).

The EPA intends to ensure that, as far as possible, development proposals in Western Australia are consistent with, or do not conflict with, these principles, objectives and targets.

State of the Environment (SoE) reporting is now a legislative requirement at the Commonwealth level and has been adopted by Western Australia. SoE reporting aids environmental decision-making and enables assessment of progress towards ecological sustainability. It is important that environmental impact assessment reflects and reports on the "core" environmental indicators developed for SoE reporting, some of which are biodiversity indicators (ANZECC 2000).

Accordingly, the EPA is seeking to improve the consistency and the standard of flora and vegetation surveys to ensure that decisions relating to protection of biodiversity are based on appropriate information that accords with agreements between the State and the Commonwealth. These include:

- an increased level of emphasis placed on the protection of native biodiversity;
- some changes to nomenclature and definition; and
- an increase in the quality and quantity of information that the EPA needs for EIA, in order to report and make recommendations that are based on clear and meaningful information.

1.2.4 Related policies of the Environmental Protection Authority

1.2.4.1 Position Statement No. 2 on the protection of native vegetation

Position Statement No. 2, *Environmental Protection of Native Vegetation in Western Australia* (EPA 2000), outlined EPA policy on the protection of native vegetation in Western Australia, particularly in the agricultural area. It identified basic elements that the EPA should consider when assessing proposals that impact on biological diversity. These include the following: comparison of all proposal options; avoidance of species and community extinctions; an expectation that implementing the proposal will not take a vegetation type below the "threshold level" of 30%; and that proponents should demonstrate that on- and off-site impacts can be managed.

1.2.4.2 Position Statement No. 3 on terrestrial biological surveys

In March 2002, the EPA published Position Statement No. 3 entitled *Terrestrial Biological Surveys as an Element of Biodiversity Protection.* In that document the EPA discussed the range of International, National and State agreements and policies currently influencing the future protection of biodiversity in Western Australia and the need to review and improve the quality and quantity of information required for EIA.

Position Statement No. 3 indicated that the EPA adopted the definition of Biological Diversity and the Principles as defined in the *National Strategy for the Conservation of Australia's Biological Diversity* (Commonwealth of Australia 1996); that the quality of information and scope of field surveys should meet standards, requirements and protocols as determined and published by the EPA; and the Interim Biogeographic Regionalisation of Australia (IBRA) should be used as the largest unit for EIA decision-making in relation to the conservation of biodiversity. The IBRA has identified 26 bioregions in the State (Figure 1) which are affected by a range of different threatening processes and have varying levels of sensitivity to impact. Terrestrial biological surveys should provide sufficient information to address both biodiversity conservation and ecological function values within the context of proposals and the results of surveys should be publicly available.

Following a workshop in July 2000 on the draft Position Statement No. 3, the EPA decided that because of the diversity of ecosystems, separate guidance statements were warranted to address the range and complexity of issues pertaining to biological surveys.

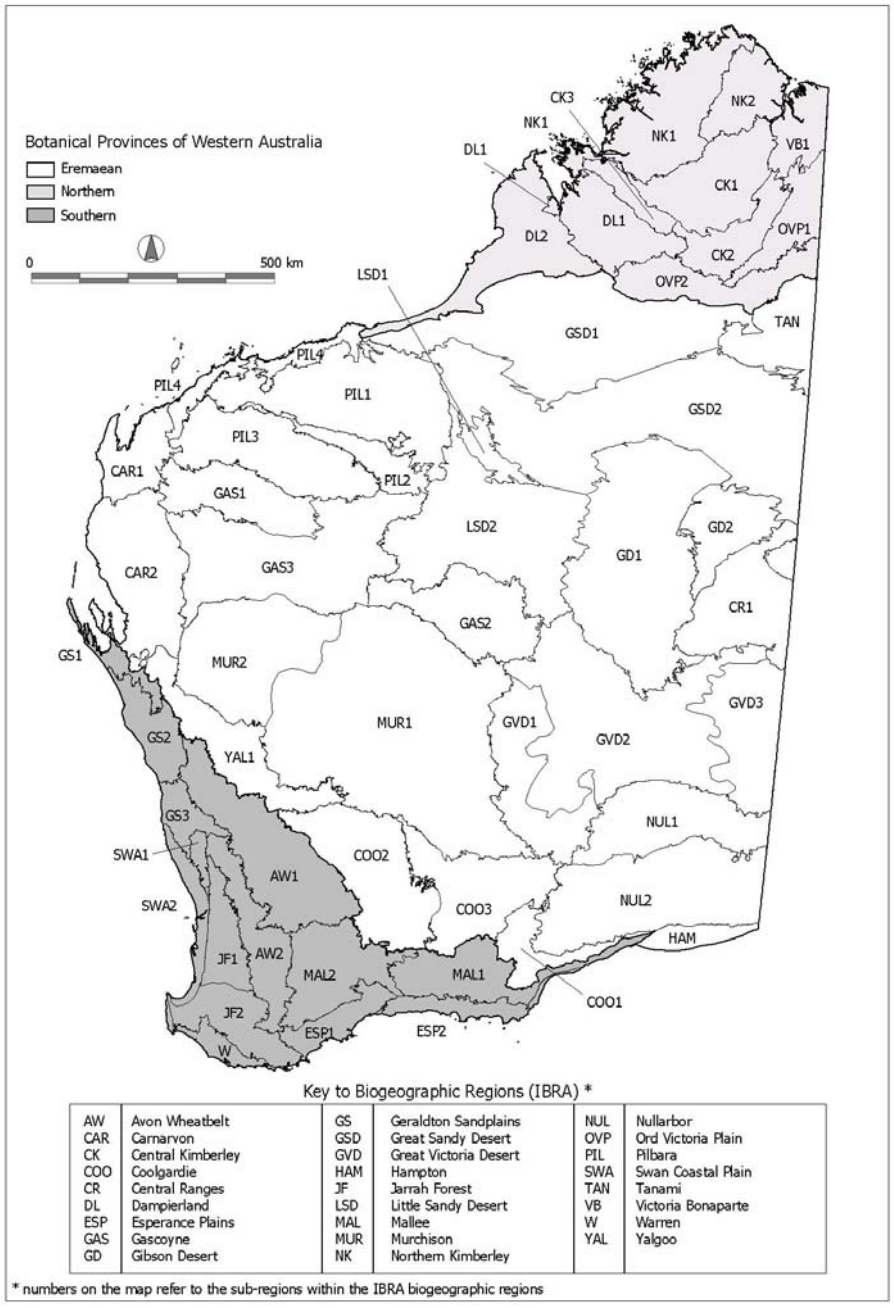

Figure 1: A Map of Western Australia showing the Botanical Provinces[1] (after Beard 1980), the IBRA bioregions (Environment Australia 2000) and the IBRA subregions (McKenzie et al. 2000).

[1] The Coolgardie and Yalgoo bioregions are here placed in the Eremaean Botanical Province (see Section 2.3). However, while their biotic composition is intermediate between the Eremaean and the South-West Provinces they are more closely allied with the South-West Province (GJ Keighery pers. comm. 2004).

Issues and survey types under consideration for incorporation in a series of guidance statements related to terrestrial biological surveys include:

- terrestrial flora and vegetation surveys (this Guidance);
- terrestrial fauna surveys (Guidance 56);
- subterranean fauna in groundwater and caves (Guidance 54);
- karst environments;
- data acquisition and submission; and
- threatening processes.

Therefore this Guidance Statement forms part of a series in response to Position Statement No. 3, and is intended to be read in conjunction with that document and other guidance statements that form part of the series.

1.3 Limitations of this guidance

This Guidance Statement is:

- confined to matters relating to flora and vegetation survey for EIA, and the treatment of associated data, and does not address more proposal-specific issues, which is the preserve of proposal-specific guidelines or approved scoping documents;
- the contemporary view of the EPA until such time as this document is subject to review;
- not an instrument for predicting outcomes of deliberations by the EPA; and
- intended to apply to proposals yet to come before the EPA.

2 DIVERSITY OF THE FLORA AND VEGETATION

2.1 The high diversity and endemism of the flora and vegetation

Flora

Australia's biota is one of the top 12 most diverse in the world (Common and Norton 1992, Mummery and Hardy 1994). One of the key parts of this diversity is the terrestrial flora of the South-West (Myers 1990).

Western Australia has high diversity and endemism of vascular plants. The progressive total of known species was 9803 in the year 2000 (Table 3 in Paczkowska and Chapman 2000); this was nearly half the national total (Hopper 1996). Overall, about 62% of plant species are endemic to the State, particularly the South-West (Paczkowska and Chapman 2000). The South-West, for example, holds 75% of the world's triggerplants (James 1979), and all *Actinostrobus* species (Marchant *et al.* 1987). In the wider part of the State endemism is less, at about 30% (Hopper 1996).

Vegetation

The high flora diversity is reflected in the vegetation. The State's 26 IBRA bioregions have been divided into 52 natural sub-regions which contain many vegetation units. This reflects the large number of different plants in each sub-region, which may occur together in a range of distinct combinations and habitats (e.g. Lyons *et al.* 2000, Gibson *et al.* 1994 and Keighery *et al.* 2000).

Other patterns that are evident with respect to the diversity of the flora, and particularly the vegetation, include:

- marked change in species complement from place to place; most intense in species rich areas (Griffin *et al.* 1990);
- patchiness or mosaic patterns of distribution, which are linked to the ancient, decayed, landscape (Hopper *et al.* 1996);
- refuges, or outposts, where organisms that are poorly suited to the current environment persist in isolated pockets of still suitable habitat (Hopper *et al.* 1996).

2.2 Developing the state of knowledge of the flora and vegetation

Due to the high diversity and the large size of the State, the short history of investigation, and limits to investigative resources, knowledge of the flora and vegetation of the State is still developing. Knowledge of species and their distribution is still in an exploratory phase. Thus frameworks to help understand patterns in vegetation are also still being developed.

There has been a steady increase in the number of taxa collected, examined and placed into their family groups (Paczkowska and Chapman 2000). A major rise since the 1970's probably reflects more systematic flora and vegetation survey, and taxonomic study (Figure 2). As this trend has not yet plateaued, it is clear that all future surveys, including those for EIA, can play a role in improving our knowledge of plant diversity.

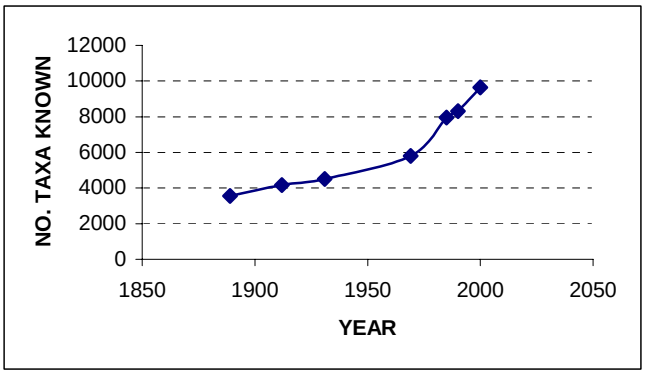

Figure 2: ***Historic rise in the number of vascular plant species found and recognized in Western Australia*** (from Paczkowska and Chapman 2000).
Note: Naturalised alien species are not part of the 1969 values.

The knowledge of the flora within bioregions is variable, and every bioregion (even the most studied) still has a suite of poorly known or recently found taxa.

2.3 Vegetation classification and mapping

The regionalisation of Western Australia based on vegetation and flora dates back to the 1860's with the recognition of south-western Australia's unique diversity and endemism by von Mueller 1867. In 1944 the state botanist, C. A. Gardner, used von Mueller's work, together with work by another German botanist (Diels 1906), to delineate three Botanical Provinces in Western Australia:

- the South-West Province, that is, south-western Australia;
- the Eremaean Province of the dry interior and coast; and
- the Northern Province in the tropical and semi-tropical north.

While both Diels and Gardner recognised districts within the provinces, subdivisions of the provinces are generally based on mapped vegetation types after Beard (1974-1981). Beard traversed the State to produce a series of maps, amalgamated at a broadscale (1:1 000 000). These mapping categories have been subdivided into sub-categories with associated text. Apart from the coarse scale of this mapping, there are other constraints in some sections of the State such as:

- there is generally only a summarised description of vegetation; and
- there have been changes to many plant names since Beard's publications.

Beard's mapping has remained the basis for the more recent regional maps: the National Land and Water Resources Audit (1998) vegetation maps and the natural regions identified in the IBRA project. Much of the base data set of the National Land and Water Resources Audit (1998) is at the broadscale, with some reference to a 1:250 000 scale for the South-West. This mapping, modified to reflect more recent information and unified across State borders, used the same underlying data as was utilised for delineating the IBRA natural regions in WA. However, the IBRA natural regions took into account geology, vegetation, flora and fauna.

The extent to which vegetation has been examined and categorised and/or mapped at finer scales in each of the three Botanical Provinces and/or regions is highly variable. In general, the most detailed approaches are linked to specific projects, and have very localised, scattered and limited coverage. In a few areas, such as regions in the South-West Province, there is better coverage at intermediate to broad levels of detail.

For example, mapping at scales in the vicinity of 1:250 000 to 1:100 000 are Heddle *et al.* (1980) and Mattiske and Havel (1998). Examples of vegetation plot based classification include Gibson *et al*. (1994), Department of Environmental Protection (1996), Markey (1997) and Keighery *et al.* (2000).

At State and regional levels there has been a mixed application of approaches to vegetation classification and mapping based on landform, species composition and vegetation structure. This mix of approaches has been recognised across Australia with the development of the National Vegetation Information System (NVIS) framework (Executive Steering Committee for Australian Vegetation Information 2003). NVIS has been developed to work towards providing Australia-wide comparable and consistent data. Consultants should be aware of this and, where possible, information should be collected so that it is compatible with NVIS protocols. There have also been various approaches to vegetation classification and mapping at the site/locality scale. This variation consequently means that all work does not systematically contribute to the development of regional frameworks.

For the purposes of this Guidance, the Provinces, regions and subregions, as delineated in Figure 1, are recognised as the basis for regional comparisons. The limitations of the knowledge base in these regions, broadly outlined above, should be noted.

2.4 Diversity and ecological function

A broad consideration of the ecological processes that influence sites and their ecological functions is required; statutory lists of Declared Rare and Priority Flora are only a small sub-set of biodiversity. Proponents should ensure that flora and vegetation surveys provide sufficient information to address both biodiversity conservation and ecological function values within the context of the type of proposal being considered and the relevant EPA objectives for protection of the environment (Environmental Protection Authority 2002a). This will enable an assessment of impacts on the conservation values and status of the site in a regional and local context.

This will help ensure that components and interactions of ecosystems are more effectively considered, leading to improvements in decision making and outcomes that are more ecologically sustainable.

3 THE GUIDANCE

3.1 EPA's objectives and their application to environmental impact assessment

3.1.1 The environmental objectives

The objectives of this Guidance Statement are to ensure that:

- there is clarity for proponents on the scale of flora and vegetation survey appropriate for different areas (see 3.2.5);

- the flora and vegetation survey, analysis, interpretation and reporting undertaken for EIA is of a suitable quality and consistent methodology to enable the EPA to judge the impacts of proposals on flora and vegetation;
- the environment, in particular significant flora and vegetation biodiversity, is identified and protected;
- WA's knowledge base of flora and vegetation biodiversity and biogeography is developed and enhanced over time, (particularly at the local scale) to the benefit of future decision-making; and
- survey data are capable of underpinning long-term observation and measurement for later compliance and audit purposes (especially as this pertains to completion criteria for projects).

3.1.2 Environmental factors and EPA objectives for each factor

Section 44 of the EP Act requires the EPA to report to the Minister for the Environment on the environmental factors relevant to proposals and planning schemes which it formally assesses under Part IV of the Act. The environmental factors are described in the scoping document (for proposals under Section 38) or instructions (for Schemes and their amendments under Section 48A) for the required environmental review document. The EPA's objective for each environmental factor and the investigations that will be undertaken by the proponent (proposals) or is required of the responsible authority (schemes and their amendments) to evaluate whether these objectives can be achieved is also defined in the scoping document or instructions.

The initial identification of factors should be undertaken by the proponent during the preparation of referral and scoping documents, see Section 3.1.3.

3.1.3 Application of the guidance to environmental impact assessment

This Guidance will apply when preparing documentation for referral of proposals, planning schemes and their amendments to the EPA for formal assessment and audit where vegetation is likely to be impacted as a result of implementation. Additional or special requirements for individual projects may be identified in the scoping document or instructions or in other advice provided via correspondence with the proponent or the responsible authority. Scoping documents or instructions should normally be consistent with this Guidance. However, in certain circumstances there may be a need to vary requirements to suit the particular case, and this would be set out in the scoping document or instructions.

3.2 Planning and design of flora and vegetation surveys

All proposals, planning schemes and their amendments where vegetation will be impacted as a result of implementation of the proposal, scheme or amendment should report fully on natural values, potential impacts, cumulative impacts, and options to minimise impacts. Documentation should identify the degree to which

the advice and approach provided in this Guidance Statement has been followed. Divergence from these standards should be highlighted in sections dedicated to limitations, see Section 3.3.1.

The EPA has provided below, guidance on what needs to be considered when surveys are being undertaken to provide information about flora and vegetation surveys relevant to a proposal.

3.2.1 Approaches, resources and standards required

The State's flora and vegetation is vast, complex and only partially known, and appraisal of it is a highly technical and skilled process. Therefore it is expected that for flora and vegetation survey:

- there will be adequate provision of resources for the survey and documentation of the flora and vegetation. It is anticipated that resources will be commensurate with the complex nature of the subject and the scope of the task being undertaken. For the process as a whole it is expected that:
  - the intensity of sampling (the number of sites, their spacing, and their area) is attuned to the complexity of the flora and vegetation of the proposal;
  - adequate resources are directed to plant specimen processing, identification, and subsequent lodgement (including allowance for a possible lag due to demand on botanists from multiple surveys and the availability of taxonomic specialists); and
  - adequate resources are directed to data analysis, mapping and interpretation (including allowance for a lag due to demand on surveyors from multiple surveys);
- there will be a high degree of rigour in reporting, not only to describe current vegetation and flora, but also to facilitate subsequent EPA assessment and auditing; and
- there will be a requirement for standardisation of techniques and terminology. It is important that the survey methods are given minimum standards so that future work on the flora and vegetation is comparable.

3.2.2 Stage of proposal when surveys should be commissioned

For any proposal, the timing of fieldwork is critical to the whole process of survey and reporting on flora and vegetation. It is the first part of a process, and the natural fluctuation in seasonal rainfall often delays fieldwork. A significant lead-time is required as it may be necessary to undertake surveys at various times of the year depending on the nature of the communities and species in the subject area. Survey over multiple years may be required where a single year's data is not adequate to address the environmental factors.

There may also be a lag time due to appropriate botanical expertise being unavailable. Botanists who meet demands for surveys at optimal times from more than one source, are likely to generate a lag due to having to sequentially process sample material and data from each survey. Proponents should make allowance for

this lag in project planning, as it is a consequence of best practice. Consequently, the EPA urges proponents to commission flora and vegetation surveys as early as practicable in the planning/site selection phase of a development or scheme to avoid potential for delays in project approvals.

For environmental management, it is essential that flora and vegetation surveys have been conducted before monitoring or completion criteria are decided prior to topsoil movement, and before local seed provenance determination and collection are undertaken.

3.2.3 Who should lead and undertake flora and vegetation surveys

Flora and vegetation surveys should be coordinated and led by botanists who have had training, mentoring and experience in flora and vegetation survey. It is expected that they will have specific training and/or experience in ecology and taxonomy of the Australian flora and would normally have had a wide exposure to WA's flora and vegetation, preferably with knowledge and experience in the region being surveyed.

It is recognised that some surveys may be done by survey teams that include members with less experience. These members should be supervised and mentored by the specialists mentioned above. This is seen as useful in training new practitioners.

3.2.4 When flora and vegetation surveys should be conducted

In most cases, the timing of a flora and vegetation survey is the key to providing the EPA with adequate information so that it can effectively assess the related environmental factors. Appropriate timing ensures that the majority of the plant species in an area are flowering, fruiting and have foliage that allows identification. This is particularly important where ephemeral or cryptic species of interest may occur (e.g. geophytes, orchids).

In general, the primary flora and vegetation survey should be conducted following the season which normally contributes the most rainfall in the bioregion. The relevant windows of time for sampling are dictated by the bioregion and can be ascertained from the growth and reproductive responses of all species to climate.

Northern Province	Eremaean Province	South-West Province
Main rain in summer	Main rain sporadic	Main rain in winter

In order to sample the majority of the flora and vegetation, it will be necessary to time additional surveys:

- according to secondary peaks in rainfall and/or the flowering period for additional suites of species or significant flora or plant communities; and

- to take into account short-term climatic fluctuation (such as drought or deluge) on the number of species present at the time of sampling. In periods of below average rainfall, there may also be justification for supplementary sampling in succeeding years to compensate for low diversity recorded during a survey (especially of ephemerals). This will be highly desirable in cases where drought is prolonged, or there are unusual circumstances such as possible pockets of significant flora and vegetation, or in the absence of a range of species or significant flora that might normally be expected in the environment.

If the initial botanical survey is undertaken in non-optimal times, e.g. drought, supplementary surveys must be undertaken at optimal times.

For surveys conducted for formal environmental assessments, the scoping document or instructions may specify survey requirements. In other cases (such as where the survey is carried out prior to referral of a proposal) advice on significant flora or communities may be sought from relevant conservation agencies.

3.2.5 Determining the extent and level of survey required

The extent and level of flora and vegetation survey must ensure the information is sufficient for the EPA to assess potential impacts.

The scope of flora and vegetation survey may be set out in the EPA's scoping document or instructions. The scoping document or instructions should be consistent with this Guidance. In the absence of specific direction, the following steps should be addressed.

1) Extent
   The EPA encourages the early and comprehensive definition of the boundaries of the proposal. In terms of impacts this means considering the potential:
   a) zone of direct impacts which only affect the site or locality (e.g. clearing);
   b) zone of indirect impacts which spread from the site or locality (e.g. drainage, hydrological change, dust, weeds and pathogens); and
   c) zone of wider interest (e.g. alternative sites, the extent of vegetation).

   Each proposal will be expected to consider the following aspects of flora and vegetation.

   - Flora
     Significant taxa (usually species or their sub-divisions) should be considered at all scales. It is expected that advice will be sought from CALM and the relevant experts on significant taxa in the study area and the appropriate region. To adequately address significant taxa a comprehensive listing of flora is necessary.

- Vegetation
  Vegetation should be addressed below the regional to sub-regional scale, e.g. vegetation complexes, alliances and formations, and land systems. Mapping at the population or community level is preferable. However, in larger areas this may not be feasible.

The level of detail required for information on vegetation and flora for the wider zones of influence, under (b) and (c) above, will vary on a case by case basis. Much will depend on what information is already available and the level of risk and potential consequences of indirect impacts. However, in general, it is likely that information will be required at a similar scale as that for the locality, but at a decreasing level of intensity for zones (b) and (c). This information and mapping is particularly important where the zone of direct impact is a narrow linear shape, for example, a road, rail, powerline or pipeline easement.

When flora of interest are found, it is essential that surveys for these taxa extend on a local or regional basis (if data is not available) to facilitate a conservation assessment of the taxa and the potential impact of the proposal.

2) Level of Survey
A simplified outline indicating the levels of flora and vegetation survey expected is given in Appendix 2. Table 3 in Appendix 2 provides guidance on a range of characteristics that will influence the scale and nature of the impact. Appendix 2 is also intended to indicate issues that need to be considered during survey and reporting. It is not exhaustive, and practitioners may well find other ecological values that need to be assessed.

3) Review of Extent and Scope
In some cases the objective and scope of the flora and vegetation survey may need to be reviewed as a response to the findings of the initial stages of the investigation.

3.2.6 Determining survey sampling design and intensity

Sampling design and intensity needs to be considered at two levels: regional and area specific.

The EPA considers the IBRA regions or sub-regions as the most appropriate level for assessing regional significance. At times, these may be subdivided to take into account other natural and/or administrative boundaries.

In determining sampling design and intensity, the following need to be addressed:
- landform - scale, heterogeneity, rarity;
- habitat - scale, heterogeneity, rarity;
- vegetation structure, diversity and seasonality;

- potential for Declared Rare, Priority and other significant flora to occur, based on habitat analysis;
- results of reconnaissance investigations and preliminary sampling for the specific investigation (e.g. species/area curves, species and ecosystem diversity and heterogeneity); and
- information on adjacent areas, including herbarium records and previous surveys.

Some general trends evident in each of the three botanical provinces in Western Australia, which influence survey methodology, are illustrated here:

Northern Province	Eremaean Province	South-West Province
Main rain in summer	Main rain sporadic	Main rain in winter
Plant species at low/moderate densities	Plant species at low densities	Plant species at moderate/high densities

Survey methodology that includes point based sampling is preferable as the sample sites can be located on a map and used over time for standard locatable reference points. The minimum number of sample sites that would be expected per vegetation unit would be two (unless the unit is confined to a small area of about sample site size). Where a unit is widespread, there would need to be sampling at representative points throughout its range. Stratified transects and targeted sampling may also be appropriate.

Most importantly, the sampling design should be adequately explained and justified in the methods.

3.3 Presentation and reporting

3.3.1 Identifying the limitations of the survey

Every flora and vegetation survey report should contain a section describing the methods used and a sub-section identifying the limitations of these methods. The survey limitations are important and their influence on findings should be incorporated into the conclusions.

Listing survey limitations assists by:

- promoting consideration by the author of any:
  - factors which may have compromised results;
  - omissions from the survey; and
  - issues which could not be addressed within the survey scope;
- clearly signposting any compromising factors in a way that should indicate the capacity of the survey and its report to address issues; and
- providing insurance to the practitioner against being perceived to have made false claims.

Limitations may cover constraints such as:

- sources of information and availability of contextual information (i.e. pre-existing background versus new material);
- the scope (i.e. what life forms, etc., were sampled);
- proportion of flora collected and identified (based on sampling, timing and intensity);
- completeness and further work which might be needed (e.g. was the relevant area fully surveyed);
- mapping reliability;
- timing, weather, season, cycle;
- disturbances (fire, flood, accidental human intervention etc.);
- intensity (in retrospect, was the intensity adequate);
- resources;
- access problems; and
- experience levels (e.g. degree of expertise in plant identification to taxon level).

3.3.2 Requirements for data presentation

As far as possible, data collected should be presented in quantitative form. The information to support the key results should be in a stand-alone format, which would allow an appropriately qualified third party to evaluate them. Once these components are in place, the discussion and conclusions can be used to make more qualitative statements.

Requirements for data presentation include:

- location map/s which place the project in the regional and local context;
- Vegetation
  - a description of the vegetation units and their key component species referenced to specific sites described in a standardised format with a key to any codes used. GPS coordinates should be given for the sampling sites;
  - a map showing the vegetation units, preferably orthogonally corrected and with a scale bar. The map should show roads and tracks, the location of sampling sites and/or the degree to which the area was traversed;
  - a map of the vegetation condition (the condition rating should be referenced); and
  - data on each site location, characteristics, (e.g. landform, soil, geology) vegetation layer/s cover and height, dominant species cover and height and list of all species present.
- Flora
  - a species list by Family using the nomenclature of the WA Herbarium for known taxa. It is preferable that the list is in the form of a table indicating presence in vegetation types/plots. Conservation significant and introduced species should be indicated;
  - an estimate of what proportion of the total flora was found (given the coverage and the timing of sampling);

  - a description of Declared Rare and Priority Flora and/or significant flora, with an estimate of their numbers at the survey site, regional abundance and distribution. The data should be presented in a standard CALM Rare Flora Report Form to facilitate entry into the computerised database maintained by CALM;
  - the collection numbers of specimens vouchered in the WA Herbarium as part of the survey should be included in an appendix;
- consideration of disturbance, focussing on the number of native species compared to weed species, the proportion of native species present compared with that expected in an intact plant community of the same type and on the condition of the described units of vegetation;
- to define vegetation categories where the scope is large, in terms of number of vegetation types, area, and/or multiple locations, a form of multivariate analysis of the data is likely to be warranted. At intermediate scales, or in the absence of the resources for such analysis, a site/species matrix may be used to group sites on the basis of like suites of the most common/indicator species;
- multivariate analysis should include, as a minimum, presence/absence data, and perennial species;
- a table of the area of each vegetation type, the percentage affected by the project area (both at the locality and in the region), the categories of vegetation and their environmental values (which may include near pristine, unique, limited extent, extensively cleared, significant flora present); and
- general observations and other qualitative information on the site.

Data presented should be interpreted in a regional and local context. Biodiversity conservation includes all ecosystem components (biotic and abiotic) and their relationships. Understanding biotic and abiotic relationships is integral to the appraisal of ecosystem function.

3.3.3 Preparation of flora and vegetation survey reports

The person/s involved in planning and conducting the flora and vegetation survey should be responsible for preparing these reports. In some cases, there may be a need for quality endorsement by more experienced persons. However, as set out in Section 3.2.3, these persons should also be qualified to undertake surveys.

3.3.4 Setting the context for survey design and reporting

Aspects of ‘context’ will include, but not be limited to:

- review and appraisal of existing knowledge (including literature search, metadata search, CALM database searches to identify Threatened Ecological Communities, Declared Rare, Priority and significant flora that are known to occur in the vicinity);
- characteristics of the site at the international, national, State, regional, local level as appropriate;
- objective of the survey; and

- what specific areas of information will be investigated (e.g. biogeographical, landform, conservation status, threatening processes).

3.3.5 Format of survey reports and data

The findings of the survey should be submitted in two ways:

1) As a stand-alone report, which may also appear whole as an appendix of an environmental review document:
   - To the EPA
     In hard copy (including any original colour maps) and electronic form (with mapped data in a digital format)
   - To the public
     Available in hard copy from the proponent at a cost no greater than that of the main environmental review document (the specific location of Threatened and Priority flora may need to be removed from public documents. Such information disclosure is exempted under Freedom of Information legislation).
2) As an overview within the environmental review document
   A clear overview of survey findings on biodiversity, conservation values, and associated impacts should be included in the review document. It is imperative that the overview accurately and directly represents the discussion, conclusions, recommendations, summary and limitations of the survey report. The findings and impacts should also be evident in the summary and conclusions of the review document. The parts of the review document which refer to flora and vegetation should be an accurate representation of the survey report. Ensuring that this occurs is the responsibility of the review document author.

   The EPA encourages the flora and vegetation survey report author to present their results, discussion, conclusions, recommendations, summary and limitations in a form that can be transferred intact into the overview document.

3.3.6 Public availability of flora and vegetation survey reports submitted for EIA

The EP Act stipulates that the EPA [Section 39(1)(a)(b) and 39(5)] and proponents [Section 40 (2)(a)(4)(a)(b)] make information publicly available as part of the environmental review process.

The EPA considers that:

- the public availability of information on biodiversity is fundamental to the environmental review process and good decision making;
- all survey work on flora and vegetation should contribute to the sum total of knowledge for the State; and
- any disclaimer within an environmental review or survey document must recognise that the work is primarily for the purposes of environmental impact

assessment under the EP Act, is consequently publicly available, and is subject to the limitations outlined in the methods of the survey document.

The EP Act provides for particular and limited protections on confidential information [Section 39(2)(3)(a)(b)(4) and Section 120]. The *Freedom of Information Act 1992* also applies.

3.3.7 Use of terminology

Terminology should be clear and standardised, preferably using those terms listed in Section 6 of this Guidance. Vegetation categorisation tends to be the most variable area of terminology. When there is doubt about the application of vegetation terms, it is recommended that reference be made to absolute scales, densities, and extent of vegetation. When using the generic term "vegetation unit" it should be qualified to indicate whether each unit is fine-scale (intra-locality), intermediate-scale (locality or inter-locality) or broad-scale (local to region).

3.3.8 Acknowledgement of contributors and attribution of all sources of data

Scientific and technical documents should appropriately acknowledge all contributions and authorship (this includes Environmental Review documents). This is important to the process of properly valuing all work and promoting basic standards.

Flora and vegetation survey reports should list the names of all persons involved in the survey and the preparation of the report and briefly state their role. Acknowledgements should also extend to any other contributors including external expertise sought.

Other sources of data should be fully attributed and referenced to the original source. This includes metadata (including GIS), maps, figures and tables copied or adapted from other sources.

3.3.9 Record keeping for the purpose of audit

It is highly desirable that the source data from flora and vegetation surveys be maintained by the proponent (or the consultant on behalf of the proponent, but the responsibility for this is with the proponent) in a readily available format for a minimum period (7 years) following the survey so that:

- subsequent supplementary, time-sequence or monitoring surveys can be adequately designed;
- survey limitations are transparent to data users; and
- the surveys themselves are verifiable and auditable by a third party.

Accordingly, the base data collected in surveys (including details of sample timing, precise location, etc.) should be retained in the form originally collected, and electronically, for a minimum of 7 years after the survey is completed.

The EPA advises that there may be random audits of flora and vegetation surveys (and/or related reports). In some cases flora and vegetation survey reports (and related data) may be subject to peer review by an independent botanist.

3.4 The role of the surveyor in increasing biodiversity knowledge

As a result of the limited amount of detailed flora and vegetation survey data available for Western Australia, much of the flora survey work conducted is of an exploratory nature and there is significant potential for new discoveries or findings which may challenge conventional understanding of the distribution or abundance of flora and vegetation.

The EPA would expect that persons engaged in flora and vegetation surveys will act as scientific advocates and bring to the scientific, government and public arenas, new information arising from surveys.

In addition to Threatened and Priority Flora, other significant taxa should be highlighted in the survey report, vouchered in the State Herbarium and brought to the attention of relevant authorities (CALM, the EPA, etc.). These include plant specimens which are collected and not readily identifiable as common, or reflect taxonomic anomalies (new species, sub-species, varieties, hybrids), or are found to occur at the limit of, or beyond, the previously known range of a taxon. It is recommended that proponents consult with the staff of the State Herbarium and other experts, prior to the survey, for guidance on these significant taxa and whether the locality of the planned survey has been subject to previous survey and therefore whether vouchering of more common taxa may also be warranted.

Local-scale vegetation categories which may be scarce, unknown, refugia, key habitat or at extremes of distribution, should also be noted.

3.5 Auditing or peer reviewing surveys

The EPA does not have the resources to undertake systematic review of all flora and vegetation surveys or reports. To ensure that the methods and standards applied in surveys are of a standard that is adequate to ensure quality environmental assessment by the EPA, a proportion of projects may be selected at random for the audit process. In such cases, selected parts of the survey and the related report (i.e. a sample of the work) may be audited.

Peer review may be warranted for some EIA surveys. Such review must be undertaken by experienced and suitably qualified professionals (Section 3.2.3). Unless there are matters in dispute, the peer review would normally be conducted at the expense of the proponent. The EPA will normally seek to inform the proponent

of the likely requirement for a peer review in the project-specific guidelines or approved scoping document.

Core elements of the peer review process in science are that:

a) the choice of reviewer/s is made by a body independent of the author and the report commissioners (in this case, the EPA is the independent body);
b) the reviewers are qualified and experienced professionals, with levels of relevant experience and expertise at least equivalent to those of the people they are reviewing;
c) the reviewers are clear as to the scope and the limitations of the review (general limitations are considered);
d) the reviewers can remain anonymous; and
e) there is an opportunity to re-submit work after revision.

4 APPLICATION

4.1 Area

This Guidance Statement applies throughout the State of Western Australia and will apply to all new proposals, planning schemes and amendments to schemes.

Position Statement No. 3 indicates that the EPA intends to use IBRA as the largest unit for decision making in relation to maintenance of biodiversity. Proponents will, as a minimum, be required to demonstrate that their proposal can meet objectives which are framed in the context of conservation within the applicable bioregion/s. In some areas, such as the Swan Coastal Plain, the developing framework of biogeographical knowledge and policy may provide a more detailed context (EPA Guidance Statement No. 10 and Government of Western Australia 2000a and b).

4.2 Duration and Review

The duration of this Guidance Statement is for five years, unless circumstances require it to be reviewed earlier.

5 RESPONSIBILITIES

5.1 Environmental Protection Authority responsibilities

The EPA will apply this Guidance Statement when assessing any proposals, planning schemes or amendments where flora and/or vegetation are identified, as relevant factors, prior to or during the assessment.

5.2 Department of Environment responsibilities

The DoE, through the EPA Service Unit (EPASU), will assist the EPA in applying this Guidance Statement in environmental impact assessment and in conducting its functions under Part IV of the EP Act.

The DoE, through the EPASU, will provide more specific advice to proponents and environmental consultants, as required, in relation to detailed interpretation of aspects of this guidance and in relation to specific assessments, within available resources.

5.3 Proponent responsibilities

Assessment is likely to be assisted if proponents demonstrate to the EPA that the requirements of this Guidance Statement are incorporated into proposals.

As outlined in Section 3.3.5 the EPA expects that proponents will ensure that the findings of the original survey report/s appear in an unaltered form in the main text of any review document, and that a copy of the whole survey report will appear as an appendix of the review document.

5.4 Environmental practitioner (including botanical consultant) responsibilities

Environmental practitioners should exercise due professional diligence in the conduct of flora and vegetation surveys and the authorship of flora and vegetation survey reports. Environmental review documents and flora and vegetation survey reports should contain an acknowledgment that the EPA's EIA process is one of the specific purposes for which the document or report has been prepared and that the document is suitable for this purpose. Documents and/or reports that do not do so will not be accepted by the EPA for the purposes of EIA.

It is essential that the standards for survey outlined here are met or exceeded. The EPA urges practitioners to ensure that they fully understand the inherent context and level of meaning of terms before they apply them. Particular use should be made of this document in this regard.

A full and frank statement of impacts is expected at all levels of survey and environmental assessment documentation.

6 DEFINITIONS AND ACRONYMS

6.1 Definitions

Assemblage (compare with community, which is similar) - A collection of co-occurring populations (Lewis 1977).

Biological diversity/biodiversity – is the variety of all life forms - the different plants, animals and microorganisms, the genes they contain, and the ecosystems of which they form a part. It is not static, but constantly changing; it is increased by genetic change and evolutionary processes and reduced by processes such as habitat degradation, population decline, and extinction (Commonwealth of Australia 1996).

Biodiversity has two key aspects:

- its intrinsic value at the genetic, individual species, and species assemblages levels; and
- its functional value at the ecosystem level.

Two different species assemblages may have different *intrinsic* values but may still have the same *functional* value in terms of the part they play in maintaining ecosystem processes.

o **Genetic diversity** – is the variety of genetic information contained in all of the individual plants, animals and microorganisms that inhabit the earth (Commonwealth of Australia 1996). In any given area it is the variety of genetic material contained in all organisms.

Genetic diversity occurs within and between the populations of organisms that comprise individual species as well as among species (Commonwealth of Australia 1996).

Due to a lack of research regarding the genetic range of endemic species, there has been, and will continue to be, difficulty in addressing protection of biodiversity specifically at the genetic level.

However for many species some information is available on the phenotypic expression of genetic variation through the recognition of different taxa at the sub-species or variety level. These may be significant in terms of exhibiting varying distribution and levels of rarity. The protection of species throughout their range and on the variety of sites may therefore serve as a surrogate for protection of genetic diversity in the absence of specific information. This issue needs to be considered in the design/collection and interpretation of data obtained in flora and vegetation surveys.

o **Species diversity** – the variety of species on the earth (Commonwealth of Australia 1996). In any given area it is the variety of species, or a measure of that variety (Lewis 1977; Jones *et al.* 1990).

While diversity can be measured in many ways, *Most simply it is measured as the species richness of ... an area, though it provides a more useful measure ... when it is combined with an assessment of the relative abundance of species present. Diversity within ecosystems has been equated classically with stability and climax communities* (Allaby 1992).

Species diversity is conceptually different from genetic diversity because:

- in general, the recognition of species is based on physical features (a taxonomic approach of recognising, describing, naming and classifying);
- a species is a concept, rather than a clear unit in nature. This can mean that the amount of genetic variation within one species may be markedly different from another species. To accommodate such inconsistencies, sub-divisions such as sub-species, varieties and hybrids may be recognised.

Species diversity is usually the default in biodiversity assessment, which means it becomes a surrogate for the underlying genetic diversity. Species diversity becomes a progressively better estimate of the full range of genetic diversity when it considers the range of variation within a species (including sub-species, varieties, and hybrids), a species' entire range, and the range of habitat in which a species occurs.

Declared Rare and Priority flora are only one subset of species diversity. The scope of formal listings is limited by the extent and intensity of sampling in any area, by how well a surveyor recognises all different organisms in an area, by whether all known occurrences are registered (i.e. whether specimens were submitted), and by the current progress in naming species groups. Since these processes are ongoing, it is clear that survey for environmental impact assessment has a role in extending knowledge. Consequently, consultants are encouraged to check specimens which have no known match, or appear anomalous, and which may be new.

In natural systems, species diversity varies from area to area and so is not a complete measure of the significance of a vegetation unit. Many communities with relatively few species, such as estuaries and mangrove forests, are highly productive and have an abundance of life but not a great variety of species. Similarly, for any species, its significance may come from values other than scarcity, or because it may be under threat. For example, a prolific species may be a key part of an ecosystem (e.g. in terms of bulk, productivity, or the provision of resources such as nest sites or nectar).

o **Ecosystem diversity** – in any given area, the variety of habitats, biotic communities and ecological processes (Commonwealth of Australia 1996).

Ecosystems are the basic functional ecological units. They comprise the diversity of all-living organisms and non-living components and their relationships within a given area. They can be defined at almost any nominated scale. Ecosystems include abiotic components, which include physical factors such as radiation, gases, the water cycle, geology, land and soil forming processes, and climate.

Ecological processes are the interactions, and changes or development processes, of the ecosystem over time.

Ecosystem diversity is harder to measure than species or genetic diversity because the boundaries of ecosystems (or component habitats and communities) are a matter of definition within a matrix. Provided a consistent set of criteria is used to define ecosystems, their number and distribution can be measured. It is therefore essential that scale/s and the basis for differentiation are defined and understood in any treatment of ecosystem diversity.

- **Other expressions of biodiversity** - Other expressions of biodiversity can be important. These include the relative abundance of species, the age structure of populations, the pattern of communities in a region, changes in community composition and structure over time, and ecological processes such as predation, parasitism and mutualism. It is often important to examine diversity in ecosystem structure and function as well as compositional diversity of genes, species and ecosystems (Environmental Protection Authority 2002a).

Community (compare with assemblage and ecological community) - A general term applied to any grouping of populations of different organisms found living together in a particular environment (Allaby 1992). Plant community - an assemblage of plants at any given locality Beard (1990).

The term ‘community’ has been applied at a range of scales in general use (as have ecosystem, habitat and vegetation). In this document ‘community’ is usually used to refer to all populations of all plant species at a locality. This is a detailed approach to plant diversity, with good resolution of the make-up of vegetation. Beard’s regional vegetation mapping was several levels coarser than this.

Completion criteria - Completion criteria apply to the required state of an area at the end of the natural life of a proposal that impacts on that area. Completion criteria are used to stipulate the natural values that should be rehabilitated or, preferably, restored (adapted from Tongway and Hindley 1995 and Tongway *et al.* 1997).

Declared Rare Flora - Species specially protected under the *Wildlife Conservation Act 1950*, as identified in the current listing. At time of printing the listing is Wildlife Conservation (Rare Flora) Notice 2003 (Government of Western Australia 2003b).

Ecological community - Naturally occurring biological assemblage that occurs in a particular type of habitat. Note that the scale at which ecological communities are

defined will often depend on the level of detail in the information source. Therefore no particular scale is specified (English and Blyth 1999).

An assemblage of native species that: a) inhabits a particular natural area; and b) meets the additional criteria specified in the regulations made for the purposes of this definition (EPBC Act 1999).

Ecosystem - A dynamic complex of plant, animal, fungal, and microorganism communities and the associated non-living environment interacting as an ecological unit (Commonwealth of Australia 1996). (That is, all living and non-living parts of a system and their interaction. Non-living factors include climate, atmosphere, and the geosphere.)

Ecosystem function/processes (compare to threatening processes) - Interconnected processes that sustain the biodiversity typical of a given ecosystem, and drive the self-directed development of that ecosystem. Such processes involve all components of ecosystems, living and non-living. One-off biological survey tends to reveal little about ecosystem processes without complementary investigations over time.

Environmental Impact Assessment (EIA) - an orderly and systematic process for evaluating a proposal, including its alternatives and its effect on the environment, and the mitigation and management of those effects. The process extends from the initial concept of the proposal through implementation to commissioning and operation and, where appropriate, decommissioning (Environmental Protection Authority 2002b).

Environmental review document – a document (used in environmental impact assessment) which describes a proposal or plan for human development activity, the pre-existing environment of the area to be affected and the potential environmental impacts of the proposal or plan (including impacts on flora and vegetation). The preparation of an environmental review document may precede or be required as a component of the formal EIA process under the EP Act.

Environmental Indicators of Biodiversity - Applied to State of the Environment (SoE) reporting at a national level (Saunders *et al.* 1998). Indicators most relevant to flora and vegetation survey reporting are listed below, with those of lesser relevance in brackets [thus]:

1 Pressure Indicators (SoE sense)
- extent and rate of clearing or major modification of natural vegetation ... (No. 2.1)
- location and configuration or fragmentation of remnant vegetation ... (No. 2.2)

2 Condition Indicators (SoE sense)
- number of sub-specific taxa (No. 9.1); applies to the number of distinct entities (such as sub-species; ecotypes; geographical, morphological, physiological, behavioural or chromosomal races) readily recognisable

within a species. Attention to the amount of variation within a species is applied as a surrogate means of estimating the genetic variation and monitoring any decline. It is not a perfect substitute. This indicator is more useful for widely distributed species, particularly if they are rich in such variation, cover a number of biogeographic regions or habitats, and have populations with a disjunct or fragmented distribution.

- population size, numbers and physical isolation (No. 9.2)
- number of species (No. 10.1)
- [estimated number of species] (No. 10.2)
- number of species formally described (No. 10.3)
- number of subspecies as a percentage of species (No. 10.5)
- number of endemic species (No. 10.6)
- conservation status of species (No. 10.7)
- [percentage of species changing in distribution] (No. 10.9)
- demographic characteristics of target taxa (No. 10.11)
- ecosystem diversity (No. 11.1)
- number and extent of ecological communities of high conservation potential (No. 11.2)

3 Response Indicators (SoE sense)

- Extent of vegetation type (No. 13.1)
- Proportions of bioregions covered by biological surveys (No. 14)

Factor - This word has two meanings in the contexts of EIA and ecology

1 environmental factor - [ecological definition]
Any component or aspect of the environment that may influence the observed state. Since these factors arise from the environment, they are revealed by impartial observation. They are not imposed. Rather, they are labelled as they manifest themselves. (In ecology, multi-variate analysis is employed in order to account for the influence of all factors other than the one in question, so that its influence clearly stands out).

2 environmental factor - [EPA definition]
Usually broad working divisions used to compartmentalise the environment for administrative purposes. Some of these definitions may have broad similarities with the ecological definitions at higher levels. Since these factors arise from an administrative need to compartmentalise, they are imposed *a priori* (before study). At lower levels, they may more closely approach environmental factors, such as within proposal-specific guidelines or approved scoping documents.

Flora (compare with vegetation) - All the vascular plant taxa (including species, subspecies, varieties, hybrids, and ecotypes) in a given area or epoch (after Collocott and Dobson 1975; Onions 1978; Lewis 1977; Delbridge 1987; Mueller-Dombois and Ellenberg 1974).

Flora and vegetation survey - A field-based investigation (including a review of established literature) of the biodiversity inherent in the flora and vegetation of an area. In terms of EIA or environmental management, the area is usually that of a

proposal or scheme to be reviewed by the EPA. Survey may also include sufficient surrounding areas to place the proposal or plan into local area and/or regional context.

Flora and vegetation survey report - A document describing the objectives, methods, limitations, data results and conclusions of a flora and vegetation survey.

Habitat - The natural environment of an organism or a community, including all biotic and abiotic elements; a suitable place for it to live (after Gilpin 1996; Jones *et al.* 1990; Lewis 1977; Onions 1978; Commonwealth of Australia 1996). The term 'habitat' has been applied at a range of scales in general use (as have community and vegetation). Vegetation can become a reasonable surrogate for outlining habitat when its main components, structure and the associated landform are also described.

Heterogeneity - Diverse in character, varied in content (Onions 1978).

Interim Biogeographic Regionalisation of Australia (IBRA) - the scheme for the division of the continent into natural regions.

- It is based on the assumption that it is the physical processes which drive ecological processes, which in turn are responsible for driving the observed patterns of biological productivity and the associated patterns of biodiversity (Thackway and Cresswell 1995).
- IBRA regions represent a landscape-based approach to classifying the land surface. Specialist ecological knowledge, combined with regional and continental scale data on climate, geomorphology, landform, lithology and characteristic flora and fauna were interpreted to describe these patterns.
- The resulting integrated regions were ascribed the term biogeographic regions. The developers of the IBRA acknowledged that, given the paucity of biophysical data in some parts of the continent, new information through time would modify our understanding of the regions, hence the term interim was used in the title of the IBRA.
- Currently the number has been revised from the original 80 to 85 regions. In addition, 354 **IBRA sub-regions** have been developed (Environment Australia 2000).

Natural Areas - naturally vegetated area or non-vegetated areas such as water bodies (generally rivers, lakes and estuaries), bare ground (generally sand or mud) and rock outcrops (EPA 2003).

Precautionary principle - Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:

- careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and

- an assessment of the risk-weighted consequences of various options.

(Intergovernmental Agreement on the Environment 1992).

This provides an approach for considering the environmental impacts of a proposal on biodiversity values where there is a lack of knowledge and lack of scientific certainty. A useful methodology for applying the precautionary principle is that of Deville and Harding (1997).

Priority Flora - Lists of plant taxa, maintained by the Department of Conservation and Land Management (Atkins 2003), that are either under consideration as threatened flora but are in need of further survey to adequately determine their status, or are adequately known but require monitoring to ensure that their security does not decline.

Proposal specific guidelines - See scoping documents.

Scoping document - A document prepared as part of the referral to the EPA of a Public Environmental Review or Environmental Review and Management Program. Scoping documents are used to outline the environmental factors to be examined as part of environmental impact assessment of a proposal. Scoping documents have replaced proposal-specific guidelines that formerly filled a similar role. This is outlined in the EP Act under Section 6.1 of the *Environmental Impact Assessment (Part IV Division 1) Administrative Procedures 2002.*

The EPA intends that this flora and vegetation guidance will apply to assessments where project-specific guidelines or approved scoping documents cover flora and vegetation survey, and that it will provide the context, standards and principles. Additional or special requirements for individual projects may be specified by the EPA in the proposal-specific guidelines or approved scoping documents or in other advice provided via correspondence with the proponent or consultant. Scoping documents should normally be consistent with this guidance. However, in certain circumstances, there may be a need to vary requirements to suit the particular case, and this would be laid out in the scoping document.

Significant flora – Species, subspecies, varieties, hybrids, and ecotypes may be significant for a range of reasons, other than as Declared Rare Flora or Priority flora, and may include the following:

- a keystone role in a particular habitat for threatened species, or supporting large populations representing a significant proportion of the local regional population of a species;
- relic status;
- anomalous features that indicate a potential new discovery;
- being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- the presence of restricted subspecies, varieties, or naturally occurring hybrids;
- local endemism/a restricted distribution;

- being poorly reserved.

Significant vegetation - Vegetation may be significant for a range of reasons, other than a statutory listing as Threatened Ecological Communities or because the extent is below a threshold level, which may include the following:

- scarcity;
- unusual species;
- novel combinations of species;
- a role as a refuge;
- a role as a key habitat for threatened species or large populations representing a significant proportion of the local to regional total population of a species;
- being representative of the range of a unit (particularly, a good local and/or regional example of a unit in 'prime' habitat, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- a restricted distribution.

This may apply at a number of levels, so the unit may be significant when considered at the fine-scale (~intra-locality), intermediate-scale (~locality or inter-locality) or broad-scale (~local to region)

Species/area curve - Number of species versus area (Lewis 1977); usually depicted as a graph.

State of the Environment (SoE) reporting (see Environmental Indicators of Biodiversity)

Taxa (singular **Taxon) –** A taxonomic group. Depending on context, this may be a species or their subdivisions (subspecies, varieties etc), genus or higher group.

Threatened Ecological Community - Ecological communities that have been assessed through a procedure (co-ordinated by CALM) and assigned to one of the following categories related to the status of the threat to the community.

The categories are:

1 **Presumed Totally Destroyed;**
2 **Critically Endangered:** <10% of pre-European extent remains in an intact condition in the bioregion;
3 **Endangered:** 10 to 30% of pre-European extent remains;
4 **Vulnerable:** declining and/or has declined in distribution and/or condition, and whose ultimate security is not yet assured (it could move into a category of higher threat in the near future if threatening processes continue) (English and Blyth 1997, 1999).

One of the criteria used to determine the categories of threatened ecological community is an estimate of the geographic range and/or the total area occupied and/or the number of discrete occurrences reduced since European settlement.

Threatening Processes (compare ecosystem function/processes) - Any process or activity that threatens to destroy or significantly modify the ecological community and/or effect the continuing evolutionary processes within any ecological community (English and Blyth 1999). A process that threatens, or may threaten, the survival, abundance or evolutionary development of a native species or ecological community (ANZECC 2000).

Vegetation (compare with flora; and see significant vegetation) - The various combinations that all populations of all vascular plant species form within a given area, and the nature and extent of each combination (after Mueller-Dombois and Ellenberg 1974; Collocott and Dobson 1975; Lewis 1977; Onions 1978; Delbridge 1987). Note that this is a biodiversity approach, and that other approaches may be based on structure or appearance - approaches that describe lesser subsets of plant diversity. The term vegetation has been applied at a range of scales in general use (as have community and habitat). The joint influence of different approaches and levels that can be applied to vegetation has led to a range of terms which describe vegetation, with resulting confusion.

Vegetation unit - A general purpose term to apply to vegetation categories regardless of level, and with no level implied.

This is required because the most variable area of terminology is to do with vegetation and its categorisation at various levels of meaning. If practitioners have any doubt about the application of vegetation terms, it is recommended that they:

- refer to absolute scales, densities, and extent of vegetation as much as possible; and
- use only the generic term "vegetation unit" and qualify whether each unit is fine-scale (~intra-locality), intermediate-scale (~locality or inter-locality) or broad-scale (~local to region).

6.2 Acronyms

ANZECC	Australian and New Zealand Environment and Conservation Council
CALM	Department of Conservation and Land Management
DEP	Department of Environmental Protection
DoE	Department of Environment
DRF	Declared Rare Flora
EIA	Environmental Impact Assessment
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986*
EPASU	Environmental Protection Authority Service Unit
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
GIS	Geographic Information System
IBRA	Interim Biogeographic Regionalisation of Australia

NVIS	National Vegetation Information System
SoE	State of the Environment
TEC	Threatened Ecological Community

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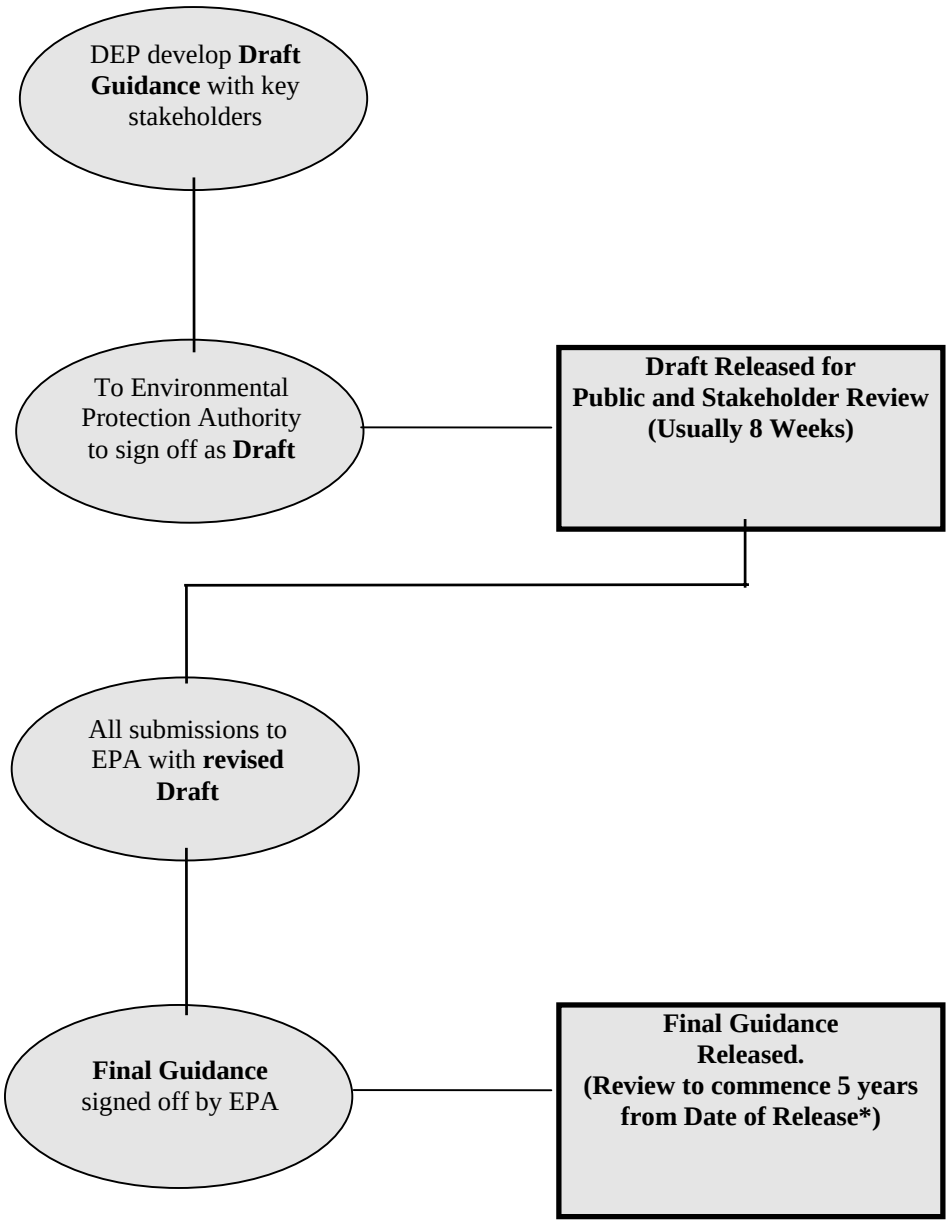
Appendix 1

GENERIC FLOW DIAGRAM FOR THE GUIDANCE STATEMENT PROCESS



* Guidance may be reviewed earlier if circumstances require it.

Appendix 2
GUIDE TO LEVELS OF FLORA AND VEGETATION SURVEY

Table 1: Levels of Flora and Vegetation survey
(adapted from EPA Position Statement No. 3)

Survey levels differ in the capacity of the survey work to provide detail of the conservation and functional values of the target area and its immediate context.	
Level 1 Surveys	**Background research or 'desktop' study** The purpose is to gather background information on the target area (usually at the locality scale). This involves a search of all sources of literature, data and map-based information. **Reconnaissance survey** The purposes are: i) to verify the accuracy of the background study; ii) to further delineate and characterise the flora and the range of vegetation units present in the target area; and iii) to identify potential impacts. This involves a target area visit by suitably qualified personnel to undertake selective, low intensity sampling of the flora and vegetation, and to produce maps of vegetation units and vegetation condition at an appropriate scale.
Level 2 Surveys	Incorporates **Background research** and **Reconnaissance survey** as preparation for more intensive survey that may range in form between detailed and comprehensive survey. **Detailed survey** The purpose is to enhance the level of knowledge at the locality scale. This applies where the general context is better known. This involves: i) one or more visit/s in the main flowering season and visit/s in other seasons; and ii) replication of plots in vegetation units, and greater coverage and displacement of plots over the target area. **Comprehensive survey** The purpose is to enhance the level of knowledge at the locality scale and the context at the local scale. In some cases sub-region survey may be required to provide wider context. This applies where there is only broad general context. This involves survey, at the intensity applied in detailed survey, of both the locality and parts of the local area. Such work is likely to be more structured with longer-term study and multiple visits.

Table 2: Indicative levels of flora and vegetation survey expected by the EPA in relation to the scale and nature of impact of proposals and the sensitivity of the receiving environment

(adapted from EPA Position Statement No. 3)

The bioregions have been grouped in Table 2 according to the existing degree of regional modification or loss of biodiversity, degree of threat and sensitivity to further loss. As a guide to the use of this table, it is very important to note that there will be areas of greater sensitivity within each bioregion that will require special consideration (e.g. wetlands, threatened ecological communities, heritage, geomorphological values, etc). Conversely, for areas with a high degree of pre-existing modification (such as cleared agricultural land) the investigation effort expected is likely to be reduced in comparison with areas supporting native vegetation.

Sensitivity of Environment (Bioregion Groups)	**Numbers indicate level of flora and vegetation survey expected (as defined in Table 1)**		
	Scale and Nature of Impact		
	High	**Moderate**	**Low**
Group 1	2	2	1
Groups 2 and 3	2	1 or 2*	1
Group 4	2	1	1

Bioregion Groups

- **Group 1: Warren, Avon Wheatbelt, Geraldton Sandplains, Esperance Plains, Mallee, Swan Coastal Plain** (bioregions of the South-West Botanical Province that are extensively cleared for agriculture).
- **Group 2: Gascoyne, Carnarvon, Yalgoo, Pilbara, Coolgardie, Murchison, Nullarbor, Hampton,** (bioregions of the Eremaean Botanical Province, native vegetation is largely contiguous but used for commercial grazing) **and Jarrah Forest** (this South-West Botanical Province bioregion is included here because the native vegetation remains extensive and largely contiguous but is used as a commercial forestry resource).
- **Group 3: Dampierland, Northern Kimberley, Central Kimberley, Ord-Victoria Plains, Victoria-Bonaparte** (bioregions of the Northern Botanical Province, native vegetation is largely contiguous but is used for commercial grazing).
- **Group 4: Great Sandy Desert, Gibson Desert, Great-Victoria Desert, Little Sandy Desert, Central Ranges, Tanami** (bioregions of the Eremaean Botanical Province, native vegetation is largely contiguous but is generally not used for commercial grazing).

Table 3: Consideration of the characteristics of proposal areas in defining the scale and nature of impacts on biodiversity (to be used in conjunction with Tables 1 and 2 to provide guidance on the level of flora and vegetation survey required for a proposal)

SITUATION I: The area and its immediate surrounds do not support native vegetation	
The area of the proposal and adjacent areas that could be impacted by off-site impacts from the proposal **do not** support native vegetation (see Keighery 1994). Areas that could be impacted are in a completely degraded condition (Keighery 1994).	**This Guidance Statement is not applicable** It is not expected that the proposal will need to address flora or vegetation factors. Any proposal submitted to the EPA for assessment of other environmental factors should include comprehensive photographs of the area which identify the nature and condition of any vegetation in the area. Depending on the area and nature of the development, it may be appropriate to consider some strategic revegetation or landscaping with local provenance native plant species to re-establish them in the area.

SITUATION II: The area and/or its immediate surrounds supports native vegetation	
If there is native vegetation in or adjacent to the proposal area that could be impacted, and that vegetation is not completely degraded, then background research and reconnaissance survey is required as a minimum. **Note: If the area supports native vegetation within a national park, nature reserve, conservation park, or other reserve formally protected or recommended for protection for a conservation purpose a comprehensive survey is required as a minimum.**	**This Guidance Statement is applicable** The following sections of this Table provide guidance as to the level of flora and vegetation survey expected.

AREA CHARACTERISTICS	EXPLANATION OF SIGNIFICANCE	SCALE AND NATURE OF IMPACT		
		HIGH	MODERATE	LOW
Degree of degradation or clearing within region				
Determine the level of alteration of the original vegetation. The extent of clearing in the district and bioregion is the simplest measure of change and of sensitivity to further change. However, less obvious factors can be measured that have also altered the vegetation and flora. Examples in the Eremaean Province include change in the balance of species under grazing, and associated invasion of introduced species (especially grasses). This is usually referred to as a change in vegetation condition.	This is a background factor in any region, with some regions having significantly higher cumulative degradation than others.	In either the local area or region: i) in fragmented ecosystems with less than 30% native vegetation or natural areas remaining; or ii) in more extensive ecosystems with less than 30% of vegetation in better condition.	In either the local area or region: i) in fragmented ecosystems with between 30-50% native vegetation or natural areas remaining; or ii) in more extensive ecosystems with between 30-50% of vegetation in better condition.	In either the local area or region: i) in fragmented ecosystems with more than 50% native vegetation or natural areas remaining; or ii) in more extensive ecosystems with more than 50% of vegetation in better condition.
Size/scale of proposal/impact				
The size of impact is important in determining the environmental significance of the proposal. This characteristic is not intended to imply relative natural values of bioregions. Rather it reflects the relative degree of disturbance in each group of bioregions.	Area of clearing/loss of native vegetation or habitat expected to result from the proposal.	>10 ha - Bioregion Group 1 >50 ha - Bioregion Groups 2-3 >75 ha - Bioregion Group 4	1-10ha - Bioregion Group 1 10-50ha - Bioregion Groups 2-3 20-75ha - Bioregion Group 4	< 1ha - Bioregion Group 1 <10ha - Bioregion Groups 2-3 <20ha - Bioregion Group 4
Rarity of vegetation				
Consider whether the proposal impacts on vegetation that is restricted or rare, either naturally or as a result of clearing. Threatened Ecological Communities (TEC's) may fit either of these categories. This may include vegetation unit/s, habitat type/s, or landform units.	Impact on **any** naturally rare or restricted vegetation unit or TEC is considered a high to moderate impact.	Vegetation that: i) naturally comprises less than **5%** in the local area (15 km radius) or the bioregion; or ii) is a Threatened Ecological Community.	Vegetation that naturally occupies from **5 to 10%** of the local area (15 km radius) or the bioregion.	Vegetation that is naturally more widespread than **10%** of local area (15 km radius) and the bioregion.

AREA CHARACTERISTICS	EXPLANATION OF SIGNIFICANCE	SCALE AND NATURE OF IMPACT		
		HIGH	MODERATE	LOW
Significant vegetation unit				
Consider whether the area supports vegetation units that have particular significance for ecological reasons; (in addition to Threatened Ecological Communties).	See Section 6 for definition of significance.	Significant vegetation units are known in the area or are found in the area during reconnaissance survey.	i) There are anomalous vegetation units in the area; and/or ii) the vegetation and area characteristics indicate that significant units may occur.	Significant vegetation units are not known from the area or found by reconnaissance survey.
Refugia				
Consider whether the area serves as an ecological refuge. These are more restricted environments that have been isolated for extended periods of time, or are the last remnants of such areas. They may be of high significance for plant taxa or vegetation units with very restricted distributions. Examples include isolated hills which are remnants of an ancient eroding surface, islands, permanent wetlands in arid areas, permanent damplands in wetter regions which may retain Gondwanic elements, patches of ancient palaeodrainage which have vegetation that is not yet affected by secondary salinity as a result of clearing (especially in agricultural areas), mound springs, etc.	For Gondwanic values see Main 1996, Hopper *et al.* 1996, and Horwitz 1994. Arid zone refuges may include taxa with preferences for stability/low seasonality, seclusion from fire, or for permanent water (e.g. Nix 1982); or rainforest elements, with mesic features (Truswell and Harrris 1982); or other derivatives that are now isolated (e.g. Keighery and Gibson 1993, Gibson and Lyons 1997).	Isolated, or disjunct populations and communities are known or are likely to be present. The presence of refuges indicates the potential impact is high.	The characteristics of the area indicate that it could serve as a refuge for some taxa.	Refugia are not known from the area or are not found by reconnaissance survey.

AREA CHARACTERISTICS	EXPLANATION OF SIGNIFICANCE	SCALE AND NATURE OF IMPACT		
		HIGH	MODERATE	LOW
Rare or Priority flora				
Consider whether statutory significant and Priority flora occur or may occur in the area.	Declared Rare Flora (DRF) and Priority flora.	i) DRF species are found in the area or in similar vegetation in its immediate vicinity during reconnaissance survey; and/or ii) the vegetation and area characteristics indicate that DRF species may occur. The presence of several Priority species may also raise the impact to high.	i) Priority species are found in the area or in similar vegetation in its immediate vicinity during reconnaissance survey; and/or ii) the vegetation and area characteristics indicate that Priority species may occur. Cumulative impact on the total number of populations should be considered.	DRF and Priority flora species are not found by reconnaissance survey, and are not likely to be found in the area or its immediate vicinity, on the basis of existing information. Generally, the area would be well known from one, and ideally more than one, well timed and structured survey.
Other significant flora				
Consider whether the area supports taxa that have particular significance for ecological reasons.	Taxa at the extremes of their range, or isolated outlying populations; taxa with anomalous features which may be new. See Section 6 for definitions of significance.	-	Significant species or taxa are found in the area or in similar vegetation in its immediate vicinity during reconnaissance survey.	Significant species or taxa are not found in the area or in similar vegetation in its immediate vicinity during reconnaissance survey.

AREA CHARACTERISTICS	EXPLANATION OF SIGNIFICANCE	SCALE AND NATURE OF IMPACT		
		HIGH	MODERATE	LOW
Size of remnant and condition/intactness of vegetation				
Determine whether the proposal impacts on a relatively large more or less intact remnant (e.g. Bioregion Group 1), or is an area of more or less intact vegetation in areas of extensively degraded landscapes (e.g. Bioregion Groups 2 and 3).	Large intact remnants are key biodiversity reservoirs in fragmented environments. In some cases even small, but intact, remnants may be highly significant. Areas of relatively intact vegetation in regions/districts where the vegetation is generally in poorer condition are also important for retention of biodiversity. Desktop study should seek to determine the size of remnants and/or vegetation condition relative to those in the local surrounds (≥15km radius).	Area is a relatively large compact remnant, or part of a large compact remnant in a district where native vegetation is fragmented by clearing and/or other degradation; or an area of native vegetation, which is more intact than typical for the local district or bioregion.	Area supports a remnant of less than average size and degree of intactness in the district; or the vegetation is not more intact than that in the district.	Area is not in a fragmented environment or an environment with extensive areas of otherwise degraded vegetation, such as some rangeland environments.
Ecological Linkage				
Determine the ecological linkage role of the area in the local and regional context.	Ecological linkages have important biodiversity conservation roles, therefore the values of these roles are highly sensitive to change.	The area is part of an ecological linkage at the regional or local scale.	The area is not directly connected to adjoining areas but is part of a minor ecological linkage.	The area is isolated with no ecological linkages.
Heterogeneity or complexity of the vegetation				
Determine the characteristics of remnants relative to those in the local surrounds through desktop and reconnaissance surveys.	The relative complexity of the area is expressed by the range of landforms/habitats/vegetation units and associated ecotones.	The area and/or its immediate surrounds are complex, with a wider range of component units relative to the character of the local and regional surrounds.	The area and/or its immediate surrounds have a similar range of component units relative to the characteristics at the local and regional scale.	The area and its immediate surrounds are less complex relative to the characteristics of the local and regional scale.