Attachment B

Advice to the Department of Conservation and Land Management on the report:

"Towards Ecologically Sustainable Forest Management in Jarrah Forests of Western Australia"

A Review of Silviculture Guideline 1/02

by

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1. Introduction

A review of the draft Silviculture Guideline for the jarrah forest (1/02) has recently been prepared for the Conservation Commission by a panel consisting of N. Burrows, P. Christensen, S. Hopper, J. Ruprecht and J. Young (Burrows *et al.* 2002). The report provided advice to the Commission on how well the draft guidelines provide for regeneration adequacy, salinity constraints and habitat and biodiversity. It also provides advice on several related issues.

These comments have been prepared for the Department of Conservation and Land Management in response to the Panel report with the following terms of reference

> *examine the report and prepare technical advice for the A/Director Sustainable Forest Management on those aspects and recommendations of direct relevance to the draft silvicultural guideline; in particular on the technical justification, feasibility or implementation difficulties of the recommendations.*

The Panel had previously reported (Burrows *et al.* 2001) to the Department of Conservation and Land Management on the same issue as a basis for the Department's report to the Environmental Protection Authority on compliance with Ministerial Condition 11. The draft Silvicultural Guideline 1/02 took into account the recommendations of the Panel in that report. The author met with the Panel on the 26th October 2001 and discussed the amendments that would be incorporated to accommodate the concerns of the Panel. The panel indicated their satisfaction with the proposed amendments. Issues relating to structural goals were not included in this discussion because they were considered to be a planning issue and outside the scope of the Silvicultural Guidelines.

A contract was in place between the Conservation Commission and the author to provide assistance and silvicultural advice to the Panel in the preparation of their Part 2 report but the Panel did not avail themselves of this service.

The comments that follow relate to the recommendations and the discussion that forms the basis of the recommendations. Comments are made under the same main headings as the Panel report. Direct quotes from the Panel report are indicated in italics.

2. General Comments on revised Silvicultural Guideline 1/02

2.1.1. Emphasis and coverage of the guidelines

The panel has expressed concern at the emphasis on tree growing in the Guidelines with the inference that this implies a lack of interest or appreciation of the importance of forest management in the broadest sense and a failure to recognise what they describe as a paradigm shift from timber production to ecosystem management. Resolution of this seems to be largely a matter of perspective and the administrative arrangements that the Department of Conservation and Land Management wishes to put in place for the packaging of its various policies, guidelines and instructions. The following points are of some relevance.

Although the term Ecologically Sustainable Forest Management is relatively new in policy statements, the recognition of the importance of managing for all forest values has a long history in WA and as such the latest policies represent a further stage of development and interpretation rather than a paradigm shift. These changes have been particularly apparent since the 1970's and the elements of the so-called 'new forestry' were in practice in the jarrah forest several years before the term was coined in the United States. The issue is therefore not one of recognition of other values but their relative weightings and how they are expressed and promulgated.

The brief for the revision of the Silvicultural Guidelines required a revision of a specific set of existing guidelines. The guidelines were prepared primarily to provide guidance to operations staff (most of whom are employed by the Forest Products Commission) to achieve their task of harvesting timber in a way that satisfied the requirements of future timber production so far as was possible within the limitations imposed by the protection of other values according to recognised objectives. To that extent other values take precedence over timber production. They are intended to cover the silvicultural practices to be employed on the areas identified for timber production. Issues relating to the areas unavailable for harvest (informal reserves etc), level, spatial arrangement and timing of harvests are dealt with at the planning stage prior to the application of the guidelines. In the interests of brevity, background policy and scientific bases were kept to a minimum. There was no intention to attempt the preparation of a comprehensive Manual of forest management.

The panel is correct in suggesting that the draft guidelines are a technical upgrade of existing guidelines. They are intended to provide guidance for the silvicultural aspects of timber production, with the measures necessary to protect other values that may be impacted by those activities. The objectives and strategies for other values are provided as a framework, but not dealt with in the guidelines where they are covered in other manuals or instructions. If the silvicultural guidelines do not adequately cover the protective measures necessary for non-wood values then that is a concern and must be rectified; these issues are raised later in the report and are responded to at that stage.

Silvicultural guidelines are a component of the Environmental Management System (in preparation) which contains reference to other management activities. These include activities such as planning, landscape management, road construction, logging operations, fauna prediction, disease management and fire management. The components of harvesting and associated silviculture covered by the guidelines are summarised in section 1.5 of the guidelines. The guidelines were prepared in the expectation that the objectives, priorities, weightings and policies for the full range of ESFM values would be set out in the Forest Management Plan or supporting documents similar to that prepared for the last plan (CALM 1992) once they have been agreed. Regrettably these were not available at the time of preparation of the draft and when they are the guidelines will need to be amended accordingly. Explicit conservation objectives are still not finalised.

The framework of setting biodiversity objectives proposed by Burrows *et al* (2001) were not included in the guidelines because they were presented as a basis for discussion at that time; there has been no agreement of it at this stage. The proposed prescription to achieve it that was put forward in the Panel report has also not been agreed and has been amended in the stage 2 report, but in any event it did not affect silviculture at the site level; it impacted on planning which is covered in a separate process.

With respect to silviculture for other values, the principal conservation strategy adopted by the Department of Conservation and Land Management to the present time is essentially one of maintaining the *status quo.* There are few examples of the use of silviculture (in the broadest sense) to positively manage for or enhance non-wood values, as opposed to simply protecting them. The exceptions to this are regeneration of tuart (without wood production) but specifically excluded from this brief, fox control, the use of fire for vegetation management (newly proposed but yet to be implemented), thinning for water production (applied on one occasion to the Manjimup water supply catchment, currently under examination by the Water Corporation for Metropolitan catchments but not practiced), thinning to enhance aesthetics (occasionally applied adjacent to recreation sites). Should these policies change then the strategies and prescriptions required to achieve them should be included in guidelines with appropriate prominence.

The Panel suggest that *a new conceptual framework is needed. ……which focuses on maintaining the ecological integrity of forest ecosystems. The central axiom of ecosystem management is that*

any manipulation of a forest ecosystem should emulate the known or inferred (from knowledge of ecological processes) natural disturbance patterns of the region prior to 'industrial' manipulation such as timber harvesting. This is a philosophy that has been promoted in recent years often as a dogma of faith. The principal difficulty with it is that 'ecological integrity' has different meanings to different people, and it presumes that there are no other objectives of management. If the objective is to manage forest as close as possible to their perceived 'natural' condition, then it is appropriate, but it may not be possible to achieve other objectives within what is perceived to be a natural regime. Timber production is not a 'natural' activity, and has certain requirements for its achievement; as such, forests used for timber production might be expected to change to some degree. For example, regeneration can be achieved in quite small gaps, but if that regeneration is then smashed by the felling of trees in the future then such a system is not satisfactory for timber production. The real question is whether the multiple management objectives can be achieved in the one area over time, not whether change has occurred. For that reason it is critical to evaluate trade-offs and set objectives for all of the various management objectives involved, and design systems to achieve those objectives (Bradshaw 1992). The vagueness and lack of agreement of objectives has been the principal difficulty with the advancement of so-called ecosystem management.

Despite the initial statement, the Panel appear to agree with the approach described above in a later part of the discussion: *disturbances such as logging ..... are unprecedented so could be expected to have some adverse impacts on biodiversity. If this is recognised, then appropriate measures can be taken to offset or minimise these impacts. Similarly, soil disturbance and compaction have no natural analogue so could be expected to have some negative consequences on forest soils that are highly weathered and low in fertility. Again, measures can be taken to minimise adverse impacts.* And later they express the need for *clear definition of priority objectives and of acceptable trade-offs.*

Increasing the coverage and content of the Silvicultural guidelines to provide a more comprehensive treatment of policies, objectives, strategies and prescriptions for all aspects of forest management relevant to ESFM such as landscape, flora, fauna, heritage, fire, timber, soil and water management is an administrative issue rather than a technical one but the following comments may be useful.

Advantages

- In would provide a 'one stop' reference source of all information relevant to forest management
- Its preparation would provide an opportunity to resolve contradictions and resolve trade-offs before policies are promulgated.
- It would provide an appearance of equal emphasis of various values
- It would provide the background philosophy to all aspects of management

Disadvantages

- Such a document would be of encyclopaedic proportions,
- It would be difficult to write for a wide range of audience and it is likely to lose its value as a field guide.
- It would be logistically impractical to have all relevant components prepared and approved to the same deadline without significant delays,
- The same delays would occur with updates so that it would almost always be out-of-date. This will be exacerbated by the increasing complexity of the approval process.

2.1.2. Budget constraints

**The panel notes that priorities for treatments as stated on page 29 of the guideline may be foreshadowing anticipated budgetary constraints.*

Budget limitations have not been a constraint on silvicultural treatment for a number of years. Shortfalls in the program that have occurred have usually been due to other operational constraints. Application of funding to silviculture has generally been better under the Business Unit than it was prior to that time. Setting priorities for treatment is appropriate regardless of where constraints may come from. These priorities have not been set in anticipation of budget constraints though that may well be an issue for the immediate future during the period of silvicultural treatment of areas harvested under a higher level of cut but with a lower projected budget from current harvesting. This should settle down after the transition period.

Nevertheless there are issues concerning priorities and funding for silvicultural work that requires clarification. These relate to issues where priorities and the standards required for conservation, long term yield and return on investment are not the same, and where the statutory obligations of the Conservation Commission and the Forest Products Commission are different.

2.1.3. Selection cutting

**Section 3.7 of the guideline for eastern forest states, "The final outcome is expected to be small groups of treated forest in a matrix of selectively cut forest with limited thinning in some areas". A case for selection cutting in some areas could be justified.*

The panel further suggests that a case for selection cutting could be justified in some areas, with a reference of market conditions. I do not understand this comment since the issue of markets is a factor in the use of selective cutting discussed in section 3.2 below.

Present practices include the entire range of silvicultural options available when the treemarking intent is combined with the various intensity of follow-up treatment. There are also a full range of silvicultural practices employed in past years (Bradshaw 1999). I would have thought that the description of the expected condition of the eastern forest is one example of a selection system. The issue of selection cutting is discussed further in section 7.1 below.

2.1.4. Employment of specialist staff

**It should be a condition of the NFMP that DCLM have a full time experienced silviculturalist and an experienced forest ecologist who jointly develop and improve silvicultural and other forest management guidelines.*

This is clearly an administrative matter but the following background may be useful.

If the Department of Conservation and Land Management is setting standards and guidelines for silvicultural practice then it must have access to silvicultural expertise and authority to ensure that its requirements are soundly based and achievable. Much of that specialist experience has been lost with the transfer of key staff to the Forest Products Commission. Ecological expertise within the Department of Conservation and Land Management remains unchanged.

The requirement for joint development of guidelines by a silviculturalist and an ecologist seems to stem from a misunderstanding of the objective of silviculture and the role of the silviculturalist or the inference that ecological issues have been ignored. The silviculturalist's role in the past has been, among other things, to prepare guidelines that implement the management objectives. It has essentially been a co-ordinating role between operations and research, and between all of the

various interests such as water, wildlife management, timber, landscape. Heritage values until now have received inadequate formal attention (Ferguson *et al.* 1997). Guidelines have been developed by the silviculturalist after considerable consultation with specialist and operational staff or by joint development. For example, the original habitat prescriptions were developed after consultation with a wide range of wildlife specialists and the karri guideline was developed by a group consisting of a landscape architect, an ecologist, a timber procurement officer and a silviculturalist. Issues related to catchment management have been developed over a number of years in association with the Water Authority and its successor. Correspondence on CALM files suggests general satisfaction with the process and the outcome. These guidelines then required endorsement by the Corporate Executive, which itself represented all of the various interests. It would probably be fair to say however that none of the participants was entirely happy with every aspect of the final result, but I would suggest that this is the price of multiple forest management objectives. There has also been a strong commitment to adaptive management in the preparation of the guidelines. I have been unable to think of a single example over the past couple of decades where changes to practice have not preceded the publication of relevant research results.

At the formation of the native Forest Business Unit, responsibility for silviculture was transferred to that group. This created an unfortunate impression of the dominance of timber of production over the broader responsibilities of silviculture. However despite the impression that may have been created, consultation with specialists continued to occur and be heeded as an examination of changes to wildlife management practice and landscape design will indicate.

While the engagement of an ecologist dedicated to the task of assisting to develop silvicultural guidelines may indeed provide for a more thorough consideration of those values, it follows that in the interests of balance, a landscape architect, hydrologist, timber procurement and heritage specialists should also be included on the same footing.

Regardless of the mechanism for the preparation of guidelines little improvement is likely without the development of a *clear definition of priority objectives and of acceptable trade-offs.* Even this is unlikely to result in satisfaction in every area of interest.

3. Regeneration adequacy

3.1. Strengths

**...consideration should be given to using dieback resistant strains of jarrah in all planting operations.*

I agree. The use of dieback resistant strains is used in reference to seeding but it should also be included in respect to planting. However I understand that current supplies are limited and devoted entirely to bauxite mining rehabilitation. There may need to be a review of priority useage.

3.2. Weaknesses

** selective harvesting is inadequately defined.*

The following statement appears in the guidelines under 'Treatment of gaps' and again under 'Treatment of shelterwood' - "Where the density of culls is high (>12m^2 /ha) treatment should be deferred until more produce has been removed. These patches will be regarded as 'selectively' cut and recorded as such". Under the section 'Culls to remove' the following statement appears "Where retained overwood of crop trees, habitat trees and culls is .....>17 m^2/ha – no culling is to be done – record as 'selective cut'. These statements are consistent, though they appear ambiguous. This should be clarified. A list of definitions may be useful.

** No reference is made to areas referred to as "extensively managed areas" in previous guidelines.*

All areas are now thinned, or cut to gap or shelterwood, selection cut or selectively cut as defined above, or (from now on) cut according to the 'eastern' forest prescription. There is no longer a need for the term 'extensive management' though it could be used in a generic sense to describe 'selective' cutting and the eastern forest prescription.

**..and this type of* (selective) *harvesting* (should be) *recorded annually.*

The area of selective cutting has been included in Department of Conservation and Land Management Annual Reports since the term was used in 1994, along with areas of other forms of harvesting and treatment.

** The panel believes that selective harvesting can be justified if it results in less short-term waste and options for future use of residues are retained.*

This is the case as mentioned above, but the Panel's statement appears to contradict the statement on page 11, viz.. *Jarrah gap creation should cease during the plan if funds are unavailable for adequate post harvest silvicultural treatments in specific forest types e.g., ... forests with a high proportion of culls to sawlogs.*

A harvested area is not left as 'selectively' cut because of lack of funds to remove culls, but because there would be excessive wastage if the necessary culling was carried out.

3.3. Recommendations

** The establishment of regeneration by direct seeding: This is a new initiative and should be trialed. Alcoa now favours direct seeding of jarrah over seedling planting as seedlings develop better form, they establish at stockings that favours good form, and root development is better than from planted stock.*

Direct seeded jarrah does produce better-formed saplings. However the only time artificial regeneration (planting or seeding) is required in native forest is when lignotubers are not present, usually because of excessive competition. The Panel elsewhere has expressed concerns about reducing that competition. Alcoa achieves successful regeneration from seed because they operate in an environment where the site is fully tilled and ripped, and where competition from established understorey is entirely absent. Jarrah seeding is used on landings in state forest where competition is also absent.

I do not believe that this would be a particularly fruitful line of research. A more productive avenue would be to determine ways in which planted stock may be managed for better form e.g. by the use of fire or coppice management.

** Documentation and analysis of regeneration survey data: A better understanding of the interactions between regeneration failure (and success) and factors such as dieback, seed availability and climatic and edaphic factors is needed. Progress could be accelerated if regional regeneration survey data already collected were analysed and published. The methods of analysis need further development and the panel understands that DCLM has already initiated some work in this area.*

Proposed changes to SILREC will facilitate the preparation of reports and summaries which will allow such analyses to be done.

** Adequacy and timing of post harvest regeneration surveys: With respect to infilling understocked patches it is stated in the guideline that, "It is important to attempt to identify the causes of poor regeneration so that steps can be taken to minimise these problems in the future". There must be a specific commitment to ensure that this does happen. It should also be noted that regeneration in areas cut to gaps and shelterwood during the 1993-2003 plan should be assessed during the next 5 years to ensure that prescriptions are adapted in a timely way if problems are identified.*

See above. The guidelines specify a survey of all shelterwood areas approximately 12 months after the establishment burn and a 5% sample of all gaps.

** Overstorey species mix: An assessment of the standards and a basis for monitoring overstorey species mix (jarrah:marri ratio) following harvesting are required. Relying on pre harvest surveys may be misleading, as in some cases jarrah (and marri) regeneration present prior to logging may be lost during harvesting and disturbance. We also recommended investigating ways of managing overstorey species composition associated with regeneration treatments to ensure biodiversity and production objectives are met in future forests.*

The potential impact of logging and burning on pre-harvest lignotuber stocking is acknowledged and is one of the purposes of the post-harvest survey of a minimum of 5% of the gaps. However there is a need for fully controlled before and after surveys to determine the extent of harvesting and burning impact on regeneration in terms of its affect on stocking and species mixture. The

results of such a study would provide guidance for the level and type of routine monitoring that may be required.

With respect to the second recommendation, it is not clear whether the overstorey mixture refers to the pre-regeneration condition or the mixture of the regeneration that follows. Where lignotubers and saplings are already established, the species mix of the next generation is largely pre-determined by that mixture The new guidelines do however provide for limited planting to increase the numbers of jarrah where necessary. Where seedlings need to be established, both marri and jarrah are usually present as the seed source though the preference is for jarrah, because of the tendency for a natural preponderance of marri in the regeneration. If the recommendation relates to the manipulation of species mixture within the regeneration, this matter is raised under section 3.4.

The Panel has expressed concern that *..Many decisions are being left to professional judgement, for example areas requiring post harvest monitoring of regeneration success in gaps.* In my view, when dealing with the management of biological processes there is a very important role for professional judgement. It is quite impossible to cover every conceivable possibility in a manual of instructions. However a more important issue that needs to be addressed now that there is a split of responsibilities between CALM and FPC, is the question of whose professional judgement. As I have pointed out in my letter that accompanied the draft guidelines, there are several matters left to the decision of the senior silviculturalist. These need to be clarified as to which of these issues is to dealt with by the CALM and which by the FPC senior silviculturalist.

In the particular case at issue here (post harvest monitoring) the guideline says: "The purpose of this survey is to monitor success of regeneration in coupes which appear to have been least successful. For all areas subject to regeneration release (gap creation), undertake at least a 5% survey by District in February following either the spring or autumn regeneration release burn. The area for survey is to be subjectively determined from visual inspection and is to be completed in those areas that appear to be the most poorly stocked. All areas where full stocking is considered doubtful are to be surveyed. This may result in more than a 5% survey." The Panel considers that this is too ambiguous.

The process of selection is a form of list sampling, but directed at a particular part of the population for the purpose of improving the understanding and knowledge about possible problem areas. A more statistically sound method of determining success would be achieved by a random 5% sample. However, experience has shown that almost all stands cut to gaps are satisfactorily stocked, and that a random sample would almost certainly produce an outcome of 'satisfactory stocking', but it would throw no light on the small percentage of gaps that were a problem.

I recommend that the proposed method of selection be maintained at least until the results of the controlled surveys described above are known. If the problem is one of perceptions of objectivity then you may wish to leave the selection to CALM staff. However it is unlikely that such a person will have a very good knowledge of on-the-ground detail. A compromise might be to have CALM endorse the selection. Presumably Audit Branch or the Conservation Commission auditor will use its own form of independent sampling.

** Stocking standards: The basis of the revised stocking standards in the guideline has not been adequately explained. We recommended that there be a mechanism to review and establish stocking standards for different forest types during the life of the next plan and following an analysis of survey data.*

I agree. However a thoroughly objective analysis of this issue is a major undertaking that has been engaging the attention of the Indigenous Forest Research Working Group for some years (Lutze 2001) and which is being pursued as part of the Montreal criteria.

** Review of seedling planting: Over the last 10 years nursery raised jarrah seedlings have been planted beneath jarrah in some shelterwood areas. The survival and success of such regeneration should be reviewed and findings published in the first half of the next plan.*

There are also a number of planting trials established in jarrah gaps by the Science Division which were de-activated some years ago. Several of these could be resurrected.

** Alternative regeneration strategies: The use of relatively frequent (3-5 years) summer/autumn fire coincident with a viable canopy-stored seed crop should be trialed as an alternative to a) shelterwood cutting and b) subsequent mechanical soil disturbance and reduction of understorey competition to establish an adequate pool of regeneration on some shelterwood cut sites..... Unpublished data from long term fire ecology plots in jarrah forests have shown that regular autumn burning at 3-4 year intervals in unlogged forest has substantially increased the density and stocking of jarrah and marri seedlings compared with other fire treatments.*

The following explanation of the issue of competition is repeated from the guidelines:

"In natural forest development, jarrah seedlings will germinate following a fire that disturbs the understorey and exposes the soil, provided that there is seed in the crowns when the fire occurs. Many seeds will be consumed by small mammals or ants and most of the seedlings that germinate will die in the first year or two as a consequence of moisture stress, exacerbated by the recovery of the understorey and the overstorey following the fire. Some seedlings will survive, and as they grow a lignotuber will form at the base of the stem, those on ashbeds growing faster than those on normal soil. Once a lignotuber has formed the jarrah plant has a very high capacity to survive the removal of the above ground shoot by insects, animal browsing and fire. However the formation of a lignotuber does not provide immunity from water stress and drought deaths may still occur until the roots have penetrated to a more permanent sub-soil water resource. Recruitment of this 'advance growth' may occur over several regeneration events, gradually increasing the size of the 'lignotuber (or advance growth) pool'..... On the majority of the jarrah forest there is usually a large pool of lignotubers at any one time but on some sites the lignotuber pool may be quite small. These are sites where the competition for resources is most severe and are commonly found in the drier eastern forest, in sandy sites with low nutrition, on sites with a dense understorey of root stock species, under thickets of banksia and sheoak and in some virgin stands with a high overstorey density especially when associated with dense understorey."

….. "Understorey competition develops on all sites until an equilibrium is maintained by mortality, so that all sites with established understorey present severe competition for new seedlings. To establish jarrah regeneration in these circumstances requires a temporary reduction in competition to allow it (jarrah) to establish along with new understorey seedlings rather than competing with already established understorey. Sometimes fire alone is sufficient to do that e.g. where the competition is mainly from seed stock and where ashbed is produced which not only kills some of the root stock competition but also provides good conditions for seedling development. On other sites, dominated by rootstock species, moderately intense fire will not kill it (e.g. established banksia, or sheoak) or it will only kill the above ground portion (e.g. ti-tree) and the understorey will re-shoot. Jarrah has no capacity to establish under this form of competition and in these cases the competition must be mechanically removed. Jarrah then has the opportunity to become established along with new germinants of understorey, thereby improving its competitiveness."……." Autumn burning is required to achieve successful regeneration probably because of excessive seed predation that occurs over summer after spring burning."

The use of autumn burning for seedling establishment is already acknowledged, however all of the evidence available suggests that their subsequent survival and development into lignotubers is severely inhibited or prevented in the presence of dense overstorey and/or dense understorey on harsh sites. Both survival and growth of the advance growth have been shown to be poorer under canopy (van Noort 1960, Stoneman *et al.* 1993, 1994) as they are in many other eucalypt species

(Stoneman 1994). The very fact that the lignotuber pool is small is principally an indication of competition rather than lack of opportunity for establishment.

The benefit of attempting to establish a lignotuber pool before partial harvesting (shelterwood) under extremely difficult conditions of competition rather than afterwards when overstorey competition problems have been reduced, is difficult to understand.

So far as understorey competition is concerned it is acknowledged above that in some circumstances fire alone will reduce competition sufficiently for jarrah seedlings to become established on 'an equal footing'. In these circumstances mechanical site disturbance is not required. However a fire regime that established jarrah under these circumstances would almost certainly result in at least a temporary reduction in the abundance of competing species, the avoidance of which is the apparent object of the exercise. However under thickets of large understorey (banksia, sheoak) and dense root stock species (ti-tree) fire alone is not sufficient, either before or after partial harvesting. In those circumstances, site disturbance is considered necessary. In most circumstances relating to banksia and sheoak, the density of those species is a consequence of inadequate regeneration on a previous occasion and it represents a restoration closer to the original status. Areas where this treatment is considered inappropriate, such as thickets of sheoak that previously did not contain jarrah, or areas that are extremely difficult to regenerate (Appendix 2 of the guidelines), are excluded from harvesting.

These recommendations appear to have been made in the expectation of a continuation of large areas of shelterwood harvesting in the future. Application of the draft guidelines will significantly reduce the area of shelterwood, to be replaced in the eastern forest with a system that relies more heavily on coppice development and with lower acceptable stocking standards. Its use in the southern forest will also reduce because the level of harvest in those areas will reduce to about a quarter of previous levels, future harvesting will be in previously-harvested forest where shelterwood is less commonly required, and because of the greater use of planted jarrah in some marri dominant sites.

I therefore do not believe that such a line of research would be productive. Even if successful in part, the dependence on the use of frequent autumn burning in the current climate of opposition to burning, means that it is unlikely to be operationally feasible. However research to elucidate the significance of competition and the dynamics of the understorey would provide useful information on which to improve the management of both reserves and multiple use forest.

The new guideline restricts regeneration burning to autumn. Because of the limited window of opportunity for autumn burning, there would be considerable operational benefits in being able to extend the period to other seasons. Research is required to determine the relative efficacy of spring, summer and autumn burning for the successful establishment of jarrah regeneration under shelterwood.

3.4. Uncertainties and Research Needs

** Competition control and seedbed preparation: These issues have the capacity to become sensitive as the trade-offs between tree establishment and growth and the maintenance of biodiversity values are considered further. There is evidence of changes in native plant species abundance/cover as a result of excessive disturbance to the topsoil (scarification) and mechanical control of understorey competition. Jarrah seedling establishment is favoured by practices that reduce competition from other species. Further research is required into jarrah seedling establishment and soil/site types that prove to be a problem should be defined. The importance of applying DAP fertilizers to boost survival should also be assessed and environmental impacts, if any, assessed. Alternative techniques of establishing regeneration, including the use of fire should be trialed on some sites (as discussed above).*

These issues have been discussed above. The soil/site types which are likely to have a low lignotuber pool are already defined sufficiently well in my view (section 1.3.1 and Appendix 2 of the guidelines). For application of appropriate treatment at the site level, direct estimates of lignotuber stocking is more effective than mapping soil and site and then making inferences about stocking.

** Monitoring of species mixes and dealing with marri dominance: On some sites, marri tends to dominate the regrowth. Where this occurs, there is some uncertainty about whether the imbalance should be corrected and if so, how. From a commercial wood production perspective, this is a problem that may be exacerbated if higher proportions of marri are left standing in the absence of a marri woodchip market. The effect of overstorey species mix on biodiversity is not well understood. As habitat trees, there is no species preference shown by birds or arboreal mammals, although marri tends to develop more hollows than jarrah, is usually a prolific flower and the fruits are an important food source for species such as cockatoos. Ways of manipulating species composition particularly in areas where a shift to marri is believed to be occurring should be researched. Ferguson et al. (2001) noted that early non-commercial crown release has the potential to improve jarrah dominance in these (jarrah-marri) stands but this has yet to be evaluated because there are few stands of suitable age available. This should be done in the next plan period. Thinning trials should be conducted to determine whether jarrah's dominance status could be improved on some southern forest site types.*

I agree.

** Regeneration in the Eastern Jarrah forest: Further research is required into understanding the flowering phenology, seed production and natural recruitment strategies of jarrah to increase the likelihood of successful seedling establishment. Ongoing work to ensure that post harvest burn prescriptions will give satisfactory results is also required. This issue could escalate given the potential for decreasing rainfall (hence productive capacity) associated with global warming.*

This is discussed above. Application of the eastern forest prescription will significantly reduce the reliance on seedling establishment. I am of the view that rather than more research, which will be very long term and the results are likely to have low repeatability because of harsher climatic conditions, a better outcome would result from attempts to undertake more of the future burns in autumn and at a time to coincide with a seed year. This will gradually build up the lignotuber pool over time but its establishment is not critical in the immediate future. Improved predictions of seed crops would be generally beneficial across the whole of the jarrah forest.

** Dieback: Although many aspects of dieback caused by Phytophthora cinnamomi have been well researched in the northern jarrah forest, the rate of spread and impact of the pathogen on some other vegetation types is poorly understood. One area of uncertainty is whether the pathogen affects seedling establishment and survival on some sites under particular conditions. The ongoing production of jarrah may be compromised with impacts on the sustainability of the industry. The analysis of regional regeneration survey data may assist with assessing specific impacts of dieback on regeneration.*

I agree.

** Use of Vegetation Complexes: Use of the Mattiske and Havel (1998) vegetation complexes is incorporated in the dieback section of the guideline. While there are benefits in developing this approach, there are also some constraints that need to be over come. An important benefit is in recognising that the jarrah forest is not homogenous and that different management approaches may be required in different ecosystems (landform, soils, climate and vegetation). A constraint is that very few people are familiar with the vegetation complexes. This can be overcome by training in the recognition of key indicator species and the development of simple field keys that help in the*

identification of assemblages. The concept of linking vegetation complexes with ecological vegetation systems, fauna habitats, fire management and silviculture is a good one and should be progressed.

I am concerned about what I consider to be an excessive expectation of the operational value of maps depicting vegetation complex or ecological vegetation system. While it is true that there are few staff who are adequately trained to recognise these complexes, the principal problem is that they frequently do not reflect differences that are relevant to a particular task and they often do not accurately reflect what is on the ground. It needs to be recognised that maps of vegetation complex or ecological vegetation system are based on landform with an inference on the vegetation that is generally expected to be found within those landforms. They do not directly map the vegetation that is on the ground. The actual correlation, even with overstorey vegetation, is often relatively poor (see attached maps in the Appendix).

Nevertheless they have been used in this guideline to identify areas of high impact for dieback management. While I am advised that these differences are reflected at the Vegetation Complex level, and can therefore be identified from existing maps, I believe that the sites should be monitored as operations progress. If Vegetation Complexes are inadequate and site vegetation types are required (Havel 1975a, b, McCutcheon 1980, Strelein 1988) they will need to be mapped on the ground directly from the vegetation that is present, rather than inferred. For consistency this would need to be done by (re-trained) dieback interpreters.

EVS has also been used to define 'eastern jarrah forest'. However following a closer inspection of these areas after the preparation of the draft, I believe that this will need to be applied with qualification. The reason for this is that EVS Ip3 (or Veg Complex D4), which is included as 'eastern forest' represents a transition zone between east and west of about 70,000 ha. Within that zone there are significant areas that are typical western and typical eastern forest. These are readily identified in the field but not reflected at the VC or EVS level. There will therefore need to be an amendment to the guidelines to allow for a departure from the standard prescription where it is clearly necessary to do so. This can only be done by direct observation in the field and professional judgement.

These comments are in no way meant to diminish the value of EVS and VC mapping for a variety of purposes, but merely to inject a note of caution to avoid their too-ready acceptance for purposes for which they are not suitable or in situations where other indicators are more efficient.

4. Salinity constraints

4.1. Weaknesses

** The definitions of concepts such as salt sensitive and high salt risk areas are unclear in the document.*

I agree, this should be rectified.

** There needs to be either a section on management practices to mitigate salinity impacts or a separate document that is specifically focused on the salinity issue.*

This relates to my earlier comments on the intended coverage of the guidelines. The guidelines presently do not include issues related to the selection of areas set aside from harvesting. This has been seen to be included in the planning framework and documentation. Salinity issues are dealt with by exclusion as informal reserves and management practice in harvested areas. Where salinity may be affected by field practice it is included in the guideline e.g. phased harvesting and intensity of thinning (summarized in Appendix 1 of the guidelines). A separate section should be included in the guidelines to deal with high salt risk catchments

** The management objective for water does not include other water quality aspects such as turbidity, particularly adjacent to water supply reservoirs. The importance of maintaining water quality in forests within water supply catchments needs to be strongly emphasised.*

All streams are buffered to levels accepted by the Waters and Rivers Commission (subject to review) and are therefore not subjected to harvesting activity. There are limitations on activity near to the reservoir which has been overlooked and should be included. Issues of erosion are dealt with in the Manual of Management Guidelines for Timber Harvesting in Western Australia.

** Insufficient attention is given to aquatic biota in the Water and Biodiversity objectives. There needs to be a more explicit recognition of biodiversity values encompassing the structural composition and functional integrity of aquatic ecosystems.*

I agree. Specific mention should be made in the conservation objectives and strategies.

** There is inconsistency between management objectives as specified in the guideline and those expressed in the Forest Management Plan.*

There were no revised objectives available at the time of preparation of the guidelines. The guidelines will need to be amended in line with agreed objectives that reflect agreed trade-offs.

** The specific requirements for stream buffers are not referred to. The planning, design and operational requirements for stream buffers are not explicit. Given the importance of stream buffers, the guideline must make it very clear that diligent placement and protection of the integrity of stream buffers is paramount if water quality and the riparian zone vegetation is to be protected.*

These are planning issues dealt with elsewhere – see comment above. Breaches of the rules for buffer width etc are included in the FPC EMS and presumably will be reflected in the CALM EMS.

** Roads are recognised as a major source of turbidity, but the guidelines make no mention of the importance of well-constructed and well-engineered roads for protecting water quality.*

Road construction is covered in the Manual of Management Guidelines for Timber Harvesting in Western Australia (1999) and includes measures to prevent or minimise turbidity. Similar guidelines are required for roading activities not associated with harvesting and these will presumably be contained in the new EMS for the Department of Conservation and Land Management. Nevertheless a section dealing specifically with environmental protection should be included in the guidelines.

** Application of chemicals such as fertiliser, pesticides and herbicides needs to be undertaken in such a manner as to ensure it does not affect water quality.*

Fertiliser and pesticides are not routinely used. Herbicide application is controlled by legislation and internal instructions are contained in the Herbicide Manual.

** Prescribed burning for silvicultural reasons needs to take into account of the potential impact on water quality, particularly where burns are high intensity and burn out riparian vegetation and humus layers to expose the soil.*

No high intensity burns are planned for any stream buffer and only occurs as an unintended wildfire. Decisions to burn or not burn stream buffers in association with silvicultural burns is made on a case by case basis and is influenced by the risk of escape and the potential damage of a severe wildfire relative to a controlled fire in the buffer. These are included in individual burning prescriptions.

4.2. Recommendations

** Adaptive management: Review the need to change stream buffer prescriptions based on the results of research currently under way and on the results of monitoring. As a minimum standard, maintain current salinity and water quality guidelines with respect to retention of stream buffers and leaf area index (basal area) unless there is sound scientific reasons for change.*

It would have been useful for the Panel to have addressed the issue of whether the same basal area retention is required in the low rainfall area as in the intermediate rainfall zone.

** Stream zone protection: Consistent with adaptive management, strong consideration should be given to the recommendation in 3.3.4 below, which recommends the retention of mature forest habitat zones incorporated into stream zones. A representative sample of these should be monitored to assess their added effectiveness with respect to protecting water quality and stream ecology.*

This seems to be covered by the recommendation above.

** Research and Monitoring: The DCLM catchment study currently under way in the northern jarrah forest intermediate rainfall zone (IRZ) should continue and be expanded to incorporate aquatic biota. Water quality should be monitored at selected gauging sites within and downstream from areas of forest subject to logging. Automated gauging could measure flow-weighted and event-related salinity, turbidity and nutrients. From a water supply viewpoint, water quality should remain within guidelines for potable water while, from an ecological viewpoint, criteria for salinity, turbidity and nutrients should be developed as recommended in the ANZEEC guidelines and account for known tolerance of local fauna. Monitoring water quality would be a way of measuring the adequacy of logging and buffer prescriptions.*

It would seem unlikely that expansion of the study in one catchment would be the most appropriate way to address aquatic biota. I suggest that quality standards be developed within the framework of the Montreal criterion.

** Biomonitoring has been shown to provide much more useful information about ecological condition of ecosystems than chemical monitoring. There is a range of methods for monitoring biological health of aquatic communities. The recent development of AusRivAS models, as the result of the national Monitoring River Health Initiative, provides a cost-effective method, with standardised methodology, for measuring the ecological health of streams. Monitoring ecological condition provides another measure of the adequacy of logging and buffer prescriptions.*

No comment.

** Monitoring should also occur with respect to compliance with buffer prescriptions. Existing evidence from the south-west and elsewhere suggests that the current buffer prescriptions are likely to be adequate to protect the water quality and ecology of most forest streams. However, it should be acknowledged that this has not been thoroughly tested. Problems appear to be mostly the result of non-compliance with prescriptions, although data on the frequency of non-compliance are lacking. The extent of compliance with prescriptions should be monitored. The prescription may also need to be better defined to account for some of the confusion in definition of buffer extent.*

Buffer width compliance with respect to harvesting can be monitored from routine photography of harvested areas. I understand that any breaches are recorded and investigated. Experience to date suggests that in most cases the buffers retained in the field are wider than specified. The FPC EMS has a system for recording reported breaches. I assume this will have a counterpart in the CALM EMS when it is developed. Non-compliance should be reported.

4.3. Uncertainties and Research Needs

** The major uncertainty remains the appropriate width of stream buffers. A recent review of the buffer prescriptions by Water & Rivers Commission identified some major changes. These recommended changes to the buffer width prescription for different stream types need to be evaluated. Operational-scale trials to examine the effectiveness of varying stream buffer widths on water quality and stream ecology should be implemented as part of this evaluation.*

I understand that there is already some data available on this issue. I would expect that there is a wide range of buffer widths already in existence that could be used in the evaluation.

5. Habitat and Biodiversity Conservation

5.1. Proposed Biodiversity Conservation Objectives

The enunciation of conservation objectives at a variety of scales is an important step forward. I consider this version to be an improvement on those in the earlier report of the Panel. However I believe that there are several areas that require some amendment.

** **At the landscape scale**: A definition of a landscape:*
"A mosaic where the mix of local ecosystems and landforms is repeated in a similar form over a kilometers-wide area. Several attributes, including geology, soil types, vegetation types, local flora and fauna, climate and natural disturbance regimes tend to be similar and repeated across the whole area" (adapted from Forman 1995). Scale is usually tens of thousands of hectares.

Forest landscape units (FLUs) have been recently described and mapped by Mattiske & Havel (2002) based on their vegetation complexes (Mattiske & Havel 1998).

***Landscape scale conservation objectives:** Take all reasonable measures to:*
- *Maintain viable populations of native species throughout their natural range.*
- *Ensure a diverse representation of forest structures, habitat elements and seral stages through time and space.*
- *Protect ecologically sensitive communities and niches such as riparian zones, aquatic ecosystems, wetlands, granite outcrops and other non-forested complexes.*
- *Ensure maintenance of water quality.*

While the objective to maintain viable populations throughout the range is sound, some qualifications will be required in monitoring performance since many areas do not meet these criteria at the present time, including reserve areas.

** At the forest management unit (block) scale: A definition of a forest block:*

A spatial or administrative element within a landscape. It could be a (sub) catchment or an administrative management unit such as a forest block. It could contain a representation of landforms and ecosystems (or vegetation assemblages) common to the landscape unit. Scale is usually several thousand hectares.

I agree that there is a place for a sub-unit of a landscape. However I see no logic in simply adopting an administrative unit that does not respond in any way to the makeup of the landscape and has no biological relationship in terms of location of scale. A decision on the boundaries of these should be deferred until it has been given more thought and discussion of alternatives. There is no indication that the issues raised in the report on Structural Goals has been considered here (Bradshaw 2002). The Landscape Units recently developed by Mattiske and Havel would appear to provide a sound framework for sub-division, especially if it also adopted as a basis for fire management objectives. However there may be others that should be considered eg Allison *et al* (1993).

Forest block scale conservation objectives: To take all reasonable measures to:

- *Ensure that no species declines to irretrievably low levels or to levels such that they are classified as threatened or vulnerable.* Agree, but extensive baseline monitoring across all tenures must be done to determine if the objective is being met. Many areas (reserves included) do not meet the criterion at present.

- *Ensure that the capacity of the forest block to provide the range of habitat elements that it provided before timber harvesting is not permanently compromised due to timber harvesting.* Disagree with forest block as discussed above. Should also be broadened to cover all forest activities. The present emphasis on timber harvesting appears to presume that reserve management is satisfactory and that open-cut mining is exempt. Suggest "Ensure that the capacity of the landscape unit (?) to provide the range of habitat elements that it originally provided is not permanently compromised by management activities."
- *Ensure that an adequate proportion of the forest block retains mature or old growth overstorey structural characteristics or is within close proximity of a formal reserve that contains mature or old growth characteristics.* Suggest remove "or is within close proximity of a formal reserve that contains mature or old growth characteristics" to make it generic for all tenure; comments for block as above.
- *Minimise soil damage and rehabilitate damaged areas such as landings.* Suggest replace by "Maintain the productive capacity of the soil."
- *Prevent the introduction and spread of dieback.* Agree but change to minimize.
- *Minimise the introduction and spread of weeds and other aliens such as foxes and rabbits.* Suggest add "and undertake control measures necessary to meet conservation objectives."

***At the forest patch scale**: A definition of a patch:*
A discrete area of forest to which a single silvicultural treatment has been applied including a gap, an area cut to shelterwood or thinned. Scale may vary from a few hectares to several hundred hectares. The scale of these patches by design and definition varies from 2 x tree height ie 0.2 ha upwards. At least the first two objectives below are not feasible at fine scale.

***Forest patch scale conservation objectives**: To take all reasonable measures to:*

- *Ensure that the capacity of the patch to provide the range of habitat elements that it provided before timber harvesting is not permanently compromised due to timber harvesting (or other management activity).*
- *Retain adequate habitat trees and potential habitat trees and other critical habitat elements.*
- *Prevent soil erosion*
- *Maintain the productive capacity of the soil by minimising soil damage (compaction, profile-mixing, and puddling).*

I recommend that the patch objectives be dispensed with. These issues are really strategies to achieve the block objective and may vary from site to site. eg in karri areas, maintaining habitat trees on every patch may be inappropriate, but the 'block' objective must still be met; open cut mining cannot retain habitat trees on every patch, but the 'block' objective should still be met.

**** Threatened, listed and vulnerable species and communities**: These are defined according to various State and Federal legislation. Take all reasonable measures to:*
Protect (retain at viable levels) <u>all</u> populations of threatened, listed and vulnerable species and communities.

I suggest that 'protect' be made more positive (to 'manage' perhaps) to overcome the situation where protection in the sense of maintaining the *status quo* is the reason why the species is threatened.

5.2. Strengths

** The new jarrah forest silvicultural guideline has incorporated a number of recent findings from the Kingston Project and the Burrows et al. (2001) Part 1 report including:*
...Advance burning to protect riparian vegetation and habitats from high intensity fires associated with post-logging (silvicultural) burns.

There should not be an expectation that this will always occur. Advance burning is preferred from a silvicultural perspective but is not obligatory. It often conflicts with dieback mapping and other management practices.

The guidelines also recommended an increase in the retention rate of habitat trees to 6/ha. This will be discussed in reference to a later issue.

5.3. Weaknesses

5.3.1. Soil disturbance and damage

** It is important that local species are used in the revegetation* (of landings etc).

I agree. I understand the current list was based on expert advice and was not thoroughly checked.

** Burrows et al. (2001) made several recommendations directed at reducing soil damage including avoiding wet soils, or winter logging, smart design and layout of snig tracks and landings to minimise machine traffic and disturbance and the evaluation of machinery with lower ground pressures..... soil conservation during logging operations is not addressed in adequate detail in other documents.*

Recommendations have been made elsewhere to the effect that consideration be given to requiring dry soil logging only. The substantial reduction in harvest levels in the south, where the problem is greatest, should make the achievement of this more likely. Experience has shown that other measures have minimal impact of alleviating the damage if the soils are wet.

** ..the "Code of practice for timber harvesting" (CALM 1997) deals superficially and somewhat ambiguously with soil conservation. The "Manual of logging specifications" (CALM 1990) provides slightly more detail and guidance, but requires updating and expansion in the light of new information. It is also unclear to the panel as to whether the 1997 code of practice supersedes the 1990 manual.*

The documents referred to by the Panel have been superseded by The Manual of Management Guidelines for Timber Harvesting in Western Australia (1999) and the Code of Practice of similar date. The manual defines soil damage, sets maximum limits, defines rehabilitation requirements and provides a standard assessment method. It does not include instruction on methods to minimise damage. Research data to date is unfortunately somewhat ambiguous on the question of the significance of soil damage.

I suggest that what is included in various manuals depends somewhat on who is responsible for them. Experience has shown that the most effective improvements in mitigating soil damage was when CALM specified the allowable limits, assessment methodology and penalty and left it to the contractors to find ways of achieving the required result. Under current administrative

arrangements I would suggest that the same practice apply, with FPC determining the most appropriate methodology to achieve the result. i.e. methods of achievement may appear in an FPC manual but not in a CALM manual. The greatest single impediment to improving practice in this area however has been the absence of a practical, objective measure of damage, and meaningful data on the impact of damage on growth. Visual determination of soil damage is suitable for some purposes but has severe limitations for control purposes. There is a need to re-visit the standards of acceptable damage and this will need to be reviewed again when national standards are developed as part of the Montreal Process. However, dry soil logging will reduce the significance of these issues.

5.3.2. Post logging silvicultural treatments; removal/reduction of competition

** It is recognised that aggressive, 'pioneer' species such as Banksia grandis and Allocasuarina fraseriana can form (unnaturally) dense thickets in response to previous logging/disturbance, hence restricting the establishment, regeneration and growth of jarrah and marri. Where this is the case, there is a need to reduce the abundance of these species so that jarrah and marri can re-establish. However, this needs to be done sensitively and with more precision than is the current practice. As recommended by Burrows et al. (2001), clear and consistent definitions of what constitutes unacceptable competition (likely to prevent the establishment of regeneration) and how this should be treated are needed.*

As indicated earlier the very absence of jarrah lignotubers (which has had many decades of opportunity to establish) indicates that competition is excessive (for jarrah establishment). This may be due to overstorey or understorey or both. Reducing the density of overstorey combined with fire for regeneration will sometimes be sufficient. Where competition from root stock species is required, guidelines are given for its removal as follows:

- "Where regeneration is adequate in number but too small for immediate release, poison cull trees to reduce basal area to 8-10 m^2 /ha. No other treatment is necessary.
- Where regeneration is inadequate in number,
  - remove 80% of unmarked understorey such as mature *Banksia grandis* and sheoak by machine pushing. Concentrate pushing and disturbance in thickets of banksia rather than individuals. Pushing of banksia should not be done more than 12 months prior to the burn. Do not push thickets of sheoak where there are no jarrah stumps to indicate that it was previously a jarrah dominated site. Cull trees < 30 cm in dbh and malformed saplings are also to be pushed. The objective is to break these trees off at ground level, rather than push them out of the ground.
  - In areas where there is severe understorey rootstock competition, remove competing rootstock understorey in swathes at least 3 metres wide and not more than 10 metres apart. Preferably use a tracked machine with a rake blade. Do not establish swathes within 3 metres of retained trees. This work must only be done in dry soil conditions to ensure that a receptive seedbed results. Install erosion barriers at the appropriate intervals (See *Timber Harvesting in W.A.").*
- Where thickets of understorey do not appear to be an inhibitor to regeneration, do not use machine pushing but coppice all malformed stems < 30 cm diameter.

- Soil disturbance should be done in dry soil conditions immediately prior to the post harvest burn."

Given the current knowledge about the impact of competition and the realities of field operations, I do not believe that these guidelines can be made any more precise than the above. This should also be seen in the context of the much reduced in areas requiring shelterwood treatment as a result of the new guidelines and changes to harvest levels (see 5.3.3 below).

It is also acknowledged that post harvest burning intensity is generally higher than is necessary to achieve the objectives of regeneration and debris reduction. In the covering notes that accompanied

the draft guidelines it was recommended that checks be conducted to determine whether this was due to inappropriate prescriptions or incorrect application. Dr. Lachie McCaw is undertaking this review but I understand the results will not be known for some months.

** The new guideline is inconsistent. The practice of reducing/removing competition to favour the establishment and growth of commercial tree species, on some sites, highlights the conflict between timber production and biodiversity. Decisions about what value takes precedence must be guided by higher order settings of values and principles that determine acceptable trade-offs.*

I agree with the final sentence but I do not understand the issue of inconsistency. I do not consider that there is necessarily a conflict between timber production and biodiversity in this respect. Removal of competition to establish jarrah regeneration will inevitably result in a change in abundance of other species for a period. Jarrah regeneration, however established, will inevitably displace individuals of other species. Frequent autumn burning as proposed by the Panel, could only succeed if it did the same thing, and will change abundance of other species regardless of its success in regenerating jarrah.

The notion of conflict appears to come from the presumption that the abundance of individuals of understorey species as they exist at the time of logging is a constant and somehow 'correct' condition. This ignores the reality of change that will occur as a result of successional development that occurs after any form of disturbance (say regular fire) or no disturbance at all (Bell & Koch 1980). Under this criteria no form of management, or lack of it, would be satisfactory, whether it be in reserves or non-reserves. A more appropriate measure is that enunciated in the objectives defined by the Panel, viz: *Ensure that no species declines to irretrievably low levels or to levels such that they are classified as threatened or vulnerable.* The immediate measure would be aimed at determining if this was likely to occur rather than whether there had been a change from the *status quo.*

Furthermore abundance is not a particularly informative parameter on which to base a presumption of change since it does not take into account the distribution, the size or the site occupancy of the individuals in question. This is the reason why stocking, not abundance, is used for determining the adequacy of tree regeneration or occupancy (Lutze 2001). I would recommend that a similar approach needs to be developed for understorey before the impact of natural change or imposed disturbance can be properly evaluated.

5.3.3. Structural goals and retention of mature forest habitat refuges

While the general thrust of the intention of the Panel recommendations relating to structural goals and mature forest are in my view appropriate, it seems to have been developed against the background of an image of the forest which does not accord with the reality. This perspective has therefore influenced the detail and the emphasis of the recommendations that have followed. This is indicated by the following:

** Contemporary jarrah forest silviculture has the capacity to create even-aged patches of regrowth, particularly in areas cut to gap, which, over time, could apply to considerable areas of forest available for timber harvesting...*and*... oceans of regrowth forest.*

The following statistics may provide a better perspective on the impact of harvesting under current and future guidelines:

Since 1987 when the essential elements of the current guidelines were generally implemented: The proportion of the area harvested by different methods has been [1]:

- Gap 28%
- Shelterwood 26%
- Thinning 17%
- Selective 18%
- Selection 5%

The impact on the jarrah forest [2] was:

- Cut to gap 4.3% (69,000 ha) of the jarrah forest over the period
- Shelterwood 4.1% of the jarrah forest over the period
- Thinning, selective, selection 6.4% of the jarrah forest over the period

At the present time [3]:

- 60% of gaps are < 2 ha in size
- Average gap size is ~ 1.5 ha

In the future:

- Gap size is likely to be much the same as at present
- Total area cut to gaps is likely to be 500 – 1000 ha /ann [4] (~ 0.04% of the jarrah forest / ann)
- Shelterwood harvesting (currently 7000 ha /ann [5]) will reduce to a very low level because:
  - the allowable sawlog harvest will reduce by at least 50%,
  - The eastern forest prescription, relying principally on coppice management, will replace much of the shelterwood cutting and associated site disturbance,
  - Harvesting in southern forests will reduce to about one quarter of previous levels.
- All harvest areas will contain 6 habitat trees / ha, and most gaps > 2 ha will have ~ 10% crown cover.

At the same time:

- Annual area mined will be similar to the area cut to gap, with no limit to gap size and no habitat retention
- The largest single product removal is likely to be domestic firewood, most of it collected under limited control.

[1] Source: Updated from statistics in the response to the Codd report (CALM 2000) to 1998 with data from SILREC to 2001.
[2] Publicly owned jarrah forest in the south-west.
[3] Source: Derived from SILREC data for 2001, and including gaps too small to be mapped as such but included as part of 'mixed' harvesting.
[4] Source: Based on SILREC data for 2001, adjusted for estimated future levels of sawlog harvesting.
[5] Source: SILREC data for 2001

This impression of intensive impact is also emphasised by somewhat selective comparisons of the number of large trees retained in various types of stands.

* *The number of large trees (and potential habitat for some fauna) in a jarrah forest exposed to these treatments over time (*gap, shelterwood), *has effectively reduced from about 42 to less than 10 per hectare*,

While there is no question that harvesting reduces the number of large trees in the areas harvested for a number of years, the differences are grossly overstated. For example data derived from a sampling across a range of virgin jarrah forest indicates a much lower number of large trees as follows [6]: Boyup Brook (12 spha > 70 cm), Deanmill (28), Palgarup (11), Shannon (21), Tone River (14), Sunklands (17), Dwellingup (15). Harvesting from such areas as Shannon and Deanmill will be much reduced in the future.

Furthermore the fact that the number of habitat trees proposed to be left in the new guidelines has doubled is not acknowledged in the report. This is a concern since this increase was done in response to the Kingston findings, but now seems to be replaced by the concept of mature patches. Whether the increase is now required is uncertain. However if this increase is still considered necessary, gaps that will be cut in future will have a minimum of six such trees plus a number of culls, a possible total of about nine. In the future therefore, rather than the 88% reduction of large trees suggested in the report, the reduction is more likely to be 35% in the most intensively harvested areas, the extent of which is indicated above.

5.3.4. Retaining mature patches – Option A

* *"retaining mature (or old growth) patches of about 200 ha (minimum) in a matrix of regrowth forest on a forest block, preferably continuous or connected (eg, creek lines), should be considered until better information is available".*

Mature forest is characterised here as forest (as opposed to non-forested ecosystems) that meets the JANIS (1997) definition of old growth, or forest that has a mature overstorey (height and cover) and has a preponderance of trees in the larger diameter classes (for example, more than 15 trees per hectare >65 cm dbhob).

This option has been discussed in my previous report on Structural Goals in which the impact of several options on timber production was considered. The new Panel report has clarified the intent to retain 200 ha of mature forest per forest block. The previous analysis suggested that to achieve this level of retention would require the effective reservation of an additional 4,250 ha of mature forest. However this analysis was based on a definition of forest with mature characteristics being one with >= 20% crown cover of mature trees. The definition used here is much more restrictive, and much of the old growth forest would not meet the criteria of 15 trees > 65 cm. (see the data for numbers of large trees above). If this definition is retained then the impact would be greater than the 4,250 ha because some the reserved areas contributing to the 200 ha would not qualify as mature forest and additional areas would need to be included. The extent of this is not known and it is difficult to see how it might be estimated or mapped. However, the Panel's definition may be based on the presumption that virgin forest has 42+ large trees / ha. If the 15 trees were intended to represent 30% of the original density of mature trees then the 20% crown cover previously used would be a reasonable equivalent. This needs to be clarified before the can be assessed.

[6] Source: Derived from summaries of basal area distribution by size class for a total of 939 plots established during the 1960s for Resource Level Inventory. Plots are based on stratified random sampling by block, previously summarised to localities based on historic 'permit' areas.

If the definition of mature forest is amended in the way described above then I believe that this option satisfactorily meets the needs of conservation and timber production in multiple use forest. While it is appropriate to use this criteria for planning purposes and for the management of blocks currently affected by harvesting and mining, I do not believe it should be adopted as a final solution. Apart from the uncertainties expressed by the Panel, I believe that the use of the forest block as the basic unit should be reviewed. While forest blocks are a useful and well recognised administrative unit, they have no biological foundation.

5.3.5. Retaining mature patches – Option B

** ...it is suggested that in areas of production forest, "remote" sections, say more than 5km from any area of formal reserve of not less than 200ha, provision is made to ensure that there is a continuing availability of mature forest elements.*

It is not clear to me why a formal reserve of 200 ha is regarded differently from an informal reserve of 200 ha. The Panel may be unaware that the recent additions of old growth to the reserve system are classified as 'informal' despite the fact that they may be quite extensive and be managed the same as other reserves. This option requires a greater degree of hands-on planning and design before its impact on timber production can be analysed and this has not been possible in the time available. However for the purposes of estimating the impact on yield its impact might be considered to be similar to Option A. If the anomaly related to some informal reserves is addressed then this option would also appear to be a satisfactory compromise of the various values involved. However my comments above relating to the use of forest blocks apply equally to this option.

It is not clear from the report which option is preferred from a conservation perspective.

5.4. Recommendations

** Soil conservation: The codes of practice with respect to soil conservation must be revised and referred to in the silviculture guideline. A revised code of practice should be based on best available knowledge, best practice and should at least clearly define a) the importance of protecting soil b) what constitutes soil damage c) acceptable physical and area limits to soil damage d) measures to minimise compaction, puddling and rutting and e) rehabilitation techniques.*

I agree with the intent of this recommendation but draw attention to the fact that items b, c and e are already addressed in the Manual of Management Guidelines for Timber Harvesting in Western Australia (1999). I am of the view that any decision to limit or stop wet soil logging to mimimise soil impacts, and limits of acceptable damage are decisions for CALM, while harvesting techniques are an issue for FPC.

** Understorey vegetation conservation: Alternative techniques for establishing jarrah and marri regeneration that do not involve significant (and permanent) changes to the understorey composition should be trialed over the life of the NFMP. These include use of fire under conditions conducive to the continuous establishment and growth of tree species over time in preference to soil scarification and physical reduction of understorey competition to create a pulse of regeneration in a short time.*

While further information and available options are always useful, I do not consider that this is likely to be particularly fruitful or high priority. Given the changes that have already been made in the guidelines and for other reasons discussed earlier. I suggest that a greater appreciation of the

background dynamics of vegetation change and a clearer enunciation of the objectives and trade-offs appropriate to multiple use forest should be addressed first.

** Structural goals: The existing FMP attempts to set structural goals for the forest. The extent to which these goals were met, the temporal and spatial appropriateness of these goals and the need to re-visit goals relevant to the NFMP should be progressed. Structural goals should then determine the pattern of timber harvesting over the life of the plan. Ensuring an ongoing availability of mature forest structures in forests available for timber harvesting is critical for habitat diversity and species diversity objectives (see recommendation below). How much should be retained and where will require further discussion and spatial analysis. This should involve analysis of the trade-offs with timber production and other values.*

I agree with this approach. However there is a need to address the basis for the selection of the landscape sub-unit and also the need to develop modelling capability so that these decisions can be better informed (Bradshaw 2002).

** Mature forest habitat refuges: Consistent with ESFM and with the forest conservation objectives proposed in section 3.3.1 above, mature forest habitat refuges should be retained at the forest block level in forests available for timber harvesting in addition to habitat trees retained in logged and regenerated forests. These should be incorporated into the stream reserves or as viable strips linking stream reserves. The area and distribution of mature forest habitat refuges needs further discussion and analysis incorporating the latest biological knowledge, the proximity and extent of mature forest in the formal reserve system and the impacts of retention on timber supply. Consistent with adaptive management, a range of options should be trialed over the life of the NFMP.*

I agree with the need for ongoing development of this issue, in particular the resolution of appropriateness of the forest block as the basic unit for landscape level structural goals. Clarification is required as to whether the increase to 6 habitat trees is required given that this change was not acknowledged by the Panel and subsequent recommendation are presumably made on the basis of fewer numbers.

** Silviculturalist and Forest Ecologist: In addition to silvicultural expertise, the Forest Management Branch of DCLM should include a forest ecologist to assist with development and implementation of silvicultural guidelines that reflect a shift to ecosystem management consistent with the principles of ecologically sustainable forest management.*

While the addition of expert staff will always be an advantage I do not agree with the premise on which the recommendation is made for the reasons discussed earlier. It would not seem to me to be necessary to specifically employ an ecologist within that section given that the Sustainable Management Division already has access to fauna and flora specialists elsewhere within the Department as it does to specialists in landscape, heritage and hydrological values. It can and should seek access to timber production specialists and other silviculturalists in the Forest Products Commission.

6. Additional Comments

6.1. Purpose of silvicultural guidelines

** Where silvicultural guidelines (and other guidelines) sit in relation to the broader planning framework, how they integrate and align with other planning processes and their purpose with respect to broader forest management objectives, needs to be explicit. ....An illustration of the forest planning framework showing the purpose of each plan (guideline/code of practice etc.), where it sits in the framework and the alignments and linkages, would be helpful for managers, planners and the public.*

I agree. I understand that internally, this will be indicated in the EMS, but a simpler illustration of the relationship would be valuable. There is also a need to indicate the differences in areas of responsibility for the Department of Conservation and Land Management and the Forest Products Commission.

** It is therefore important that agreed specific conservation objectives be stated clearly at the beginning of the document including the overriding objective that application of the ESFM system should deliver outcomes which mean the risks of environmental damage as a result of timber harvesting will be minimised. The document must remain focused on giving specific guidance to tree markers and staff responsible for ongoing protection of the forest and its values. Definitions used in all DCLM documents must be agreed and then adopted universally. Definitions used in the guideline differ from those adopted in the Discussion Paper. The objectives should also be complementary or consistent between key document such as the FMP and the silvicultural guidelines.*

I agree. Unfortunately the guidelines preceded the discussion paper but amendments are being made to ensure consistency. Clear conservation objectives and an understanding of trade-offs however are still not agreed and available to guide the silvicultural guidelines, as indicated by the Panel report itself. Ideally silvicultural guidelines or any other prescription (including those presented in Options A and B above) should not be developed until the objectives and trade-offs are clearly stated and agreed at the policy level.

6.2. Operational Safety and Economic Considerations

** ..the costs of all necessary operations should be reviewed relative to the income to be derived from the harvesting.*

I agree. However it is important to consider the returns in terms of the site potential as well as the return from the current operation. If this is not done then 'degraded' sites with high potential may not be given the attention or investment that they deserve and which they have 'earned' from previous yields. It also needs to be reviewed in the light of future yields eg non-commercial thinning.

** The panel notes that the revised guidelines for the eastern zone forests now prescribe that the trees to be retained should "contain a sawlog only if there is not other suitable seed trees available". It is assumed that such a direction is based on maximising the sawlog cut for economic reasons on the current pass. It is of concern that future removals of the retained low quality*

shelterwood trees may be compromised as the value of the trees will provide little incentive for their harvest.

This requirement applies to shelterwood everywhere. With the increase in the number of habitat trees (and some additional culls) it is virtually impossible in most areas to reduce the overstorey density sufficiently to achieve regeneration while at the same time leaving sufficient sawlog trees for a second commercial harvest – bearing in mind that there is a significant reduction in harvesting of high volume areas of the southern forest. The object is therefore to maximise the first harvest (and make it achievable in the first place) and have no expectations of a second commercial harvest. The odd individual that is retained can be left till the first commercial thinning. This practice will:

- reduce the area cut to shelterwood,
- improve the economics of harvesting,
- reduce the number of entries for logging,
- improve the certainty of access to the yield,
- have no adverse long term impact on yield, and
- have no adverse impact on conservation values.

6.3. Heritage and Environmental Protection

** Although the panel was not asked to address the issues of heritage and environmental protection these issues are inadequately dealt with in the guidelines.*

Heritage protection is the subject of a separate manual which I understand is still in draft form and yet to be approved. Environmental protection issues are also dealt with elsewhere including the Manual of Management Guidelines for Timber Harvesting in Western Australia (1999). The EMS provides guidance and referral.

7. Research and Monitoring

7.1. Operational trials

** Alternative regeneration techniques: Current regeneration methods have some undesirable impacts on soils and understorey vegetation in forests cut to shelterwood to establish jarrah and marri regeneration. The role of frequent autumn fire, coincident with heavy seed years, and the absence of mechanical disturbance, should be trialed on a range of sites. The hypothesis being that over time regeneration can be established using natural processes with little adverse impact.*

I do not believe that this would be a productive line of research for the reasons given in section 3.3 above.

** Competition control to enhance regrowth: Examine the cost effectiveness of various levels and techniques of managing understorey competition, including no post-logging silvicultural treatments and intensive treatments on a range of sites. The hypothesis being that at some point, understorey does not constitute competition worth spending resources on.*

The difference between competition that can be influenced by fire and that which cannot has been discussed earlier. However, the significance of the areas that will be impacted in this way in the future needs to be evaluated before such a project should be considered for priority funding.

** Low impact logging: Continue trialing techniques to minimise the physical and area extent of impacts of logging on soils by trialing dry soil logging and different roading and extraction techniques. The hypothesis being that there are alternative cost-effective ways of reducing soil damage.*

This has been commented on under section 5.3.1 above. I suggest that a greater contribution could be made by developing more objective measures of determining damage and by further negotiation with FPC with the view of ending moist soil logging.

** Managing overstorey species mix: On sites where marri appears to be dominating the regrowth, disproportionately to its status prior to harvesting, early non-commercial crown release trails should be implemented to improve jarrah dominance in these stands.*

I agree.

** Effectiveness of stream buffers: Monitor the effectiveness of varying the width of stream buffers on water quality and stream ecology, especially in the intermediate rainfall zone. The hypothesis being that there is a point at which increasing buffer width does not provide water quality benefits.*

I agree, though I understood that this was reasonably well understood.

**Retention of mature forest habitat refuges: Vary the amount and spatial distribution of retained mature forest habitat refuges. Trial varying the retention rates of 'habitat trees' within regrowth forest as well as varying the size and distribution of patches of mature forest within regrowth forest. The hypothesis being that retention of mature forest in areas available for logging is important for sustaining viable populations of groups of fauna at the block scale.*

I agree, except that 'block scale' requires review. It is not clear how this will be evaluated.

** Varying the intensity of logging. For example in 100 ha, trial single tree or small group selection logging as against standard gap/shelterwood logging. The hypothesis being that the former is less intrusive.*

It is obvious that single tree selection is 'less intrusive' at the first pass than is harvesting to larger gaps. The real question is whether selection cutting meets timber production objectives and whether it satisfies the 'block' level conservation objectives any better than alternatives – in the long run. There is no need to establish new trials to consider this issue – there are many thousands of hectares cut to varying intensity (from 1870 to 2001) from which to choose (Bradshaw 1999) and where the type of cutting is known or can be readily deduced. I understand that this was meant to be part of the retrospective studies associated with the Kingston study.

** Diverse fire regimes: Vary the frequency, season and intensity of fire based on biological indicators. The hypothesis being that fire diversity promotes biodiversity.*

I take it that this reference does not apply to the use of fire for specific silvicultural purposes. If it is intended for broader application then I understand that new policies are being developed in that direction but have yet to be finalised.

8. Conclusion

There are a number of issues that have been highlighted in the Panel report that require clarification or some amendment to the guidelines and these have been noted in the text.

The main area of contention appears to be the coverage of the silvicultural guidelines. The issue of presentation of objectives, strategies, policies and instructions needs to be resolved at an administrative level so that guidelines for all activities can be designed to fit within the framework. There is a need for a comprehensive overview of how various values are catered for at the planning and operational level. I would recommend that this be include in the Forest management Plan itself rather than in subsidiary documents.

Some issues relate to different perceptions or interpretation of objectives, particularly conservation objectives. As I understand it, these and their associated trade-offs remain unresolved. Statements from the Conservation Commission suggests that many of these key issues will be put to government for resolution. Clarification of what interim objectives will be used is needed before the guidelines can sensibly be finalised.

Clarification of several key issues is required before a full assessment of the impact of the mature habitat retention options are considered. These include the definition of mature forest in Option A, the status of informal reserves in Option B, the application of the rules in blocks with both jarrah and karri, and the rules to be applied in the presence of open cut mining.

Further discussion is essential in respect to an appropriate choice of a landscape sub-unit to which the prescription for mature habitat retention should apply, though I do not recommend that any particular unit be 'cast in concrete' at this stage until there are further developments in modelling along the lines recommended in the report on Structural Goals.

I strongly recommend that any further development or formal reporting of these issues include a discussion phase with appropriate personnel to ensure that basic assumptions are correct and to provide opportunities to clarify intentions.

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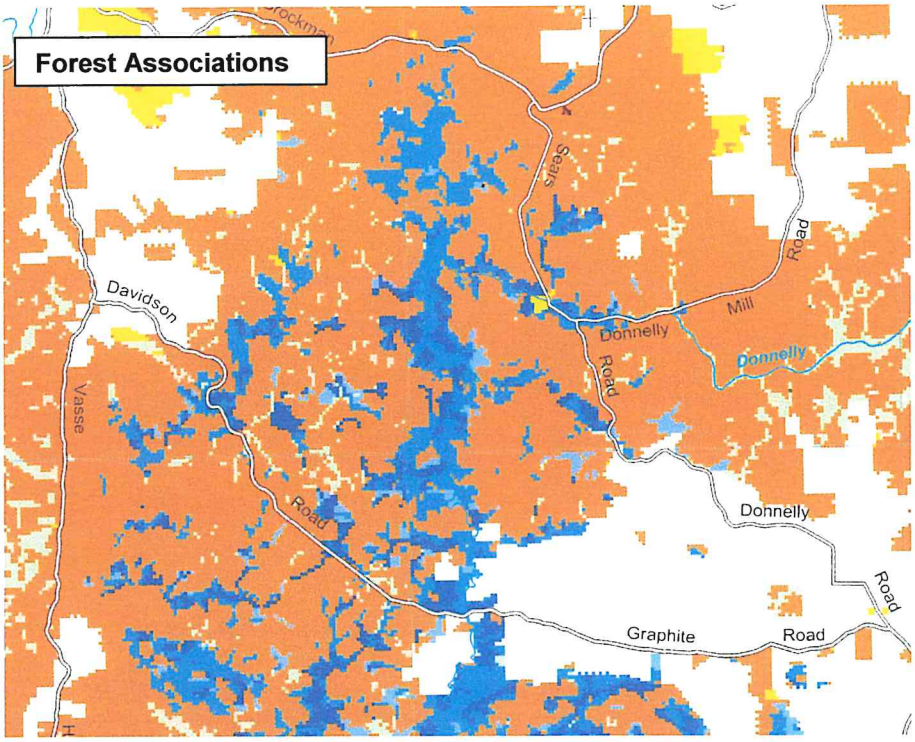
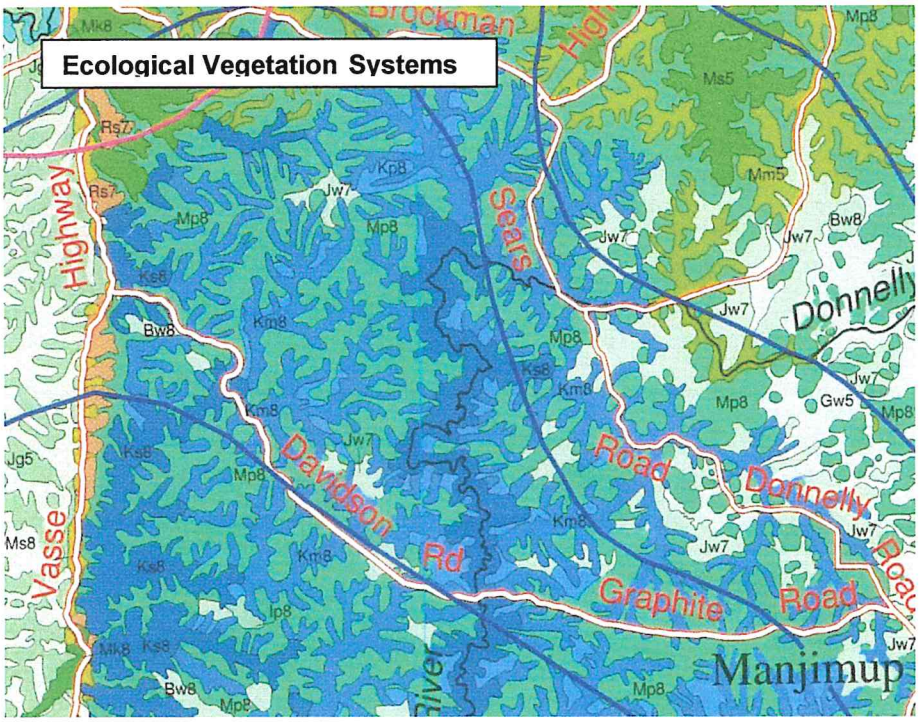
10. Appendix





The maps of the Donnelly Valley depicted above illustrate the difference that can exist between mapped overstorey species (Associations) and overstorey vegetation inferred from landform (EVS). The blue areas on the above maps indicate the actual or inferred presence of karri and karri/marri. It illustrates the importance of selecting maps or techniques that discriminate the elements appropriate to any particular task. The scale is approx 1:300,000.