GOVERNMENT OF WESTERN AUSTRALIA

Conservation Commission of Western Australia

Forest Management Plan 2004–2013

End-of-term audit of performance report

30 March 2012

Conservation Commission of Western Australia

Contents

1. Executive summary 3
2. Introduction 11
3. Biological diversity 14
4. Productive capacity 21
5. Ecosystem health and vitality 35
6. Soil and water 41
7. Global carbon cycles 47
8. Natural and cultural heritage 50
9. Socio-economic benefits 53
10. Plan implementation 57

Appendix A 65

1. Executive summary

The Conservation Commission of Western Australia (Conservation Commission), the Department of Environment and Conservation (the Department) and the Forest Products Commission (FPC) are responsible for seeking to achieve the objectives of the *Forest Management Plan 2004–2013* (FMP).

This document is the Conservation Commission's end-of-term audit of performance report of the FMP submitted to the Environmental Protection Authority (EPA) for assessment with that authority subsequently providing advice to the Minister for Environment. The submission of an end-of term audit of performance report is a Ministerial requirement contained in the FMP.

The end-of-term audit report aims to report on progress in implementing the FMP and to contribute to the development of the draft Forest Management Plan 2014–2023.

Table 1 below is a summary of performance against targets for the key performance indicators of the FMP reported in this end-of-term audit report.

Table 1 Summary of performance against key performance indicator targets

KPI No.	Abbreviated KPI name	Achievement of performance target
1	Ecosystem representation in formal reserves	Y
2	Status of species and communities by listing	Y
3	Status of selected species subject to mgt	N
4	Area of native forest and plantations	N
5	Removal compared to sustained yield	In part
6	Area of forest cut over annually	NA
7	Removal of non-sawlog timber	Y
8	Presence of *Sirex* in softwood plantations	Y
9	Time to regenerate harvested areas	In part
10	Effectiveness of regeneration	Y
12	Achievement of early thinning schedules	N
13	Direct and indirect industry employment	NA
14	Access for apiculture	NA
15	Wildflowers and seed picking	NA
16	Risk posed by wildfire	In part
17	Severity and status of weeds and pests	NA
18	Effectiveness of dieback hygiene	N
19	Stream salinity	Y
20	Aquatic biodiversity	N
21	Soil damage	N
22	Water production	N
23	Cultural heritage identification and protection	N
24	Aboriginal consultation and involvement	Y
25	Heritage places protection in reserves	Y
26	Availability of recreation and tourism	Y
27	Basic raw material supply	NA

28	Adaptive management	Y
29	Public involvement	Y
30	Human resource skills	Y
31	Scientific understanding	NA
32	Environmental management system	N
33	Operational control	N

Y = Yes
N = No
NA = No target or not possible to report against target
In part = One or more but not all of multiple targets met
KPI – Key Performance Indicator

The following is a summary of the key findings on implementation of the FMP and considerations for future management relevant to each of the chapters of the FMP.

Biological diversity

Key findings on FMP implementation

- The area within formal conservation reserves increased significantly in the early years of the FMP. However, little progress has been made in establishing conservation reserves since the mid-term audit report. Forty-seven per cent (by number) of land category changes proposed in the FMP have been achieved, which represents 88 per cent of the area proposed to be reserved when fully implemented. Impediments to full establishment of conservation reserves are outside the control of the Department and Conservation Commission.
- Considerable resources have been allocated to identifying and protecting old-growth forest and significant areas of previously unmapped old-growth forest have been identified. Over 2,500 ha of forest has been nominated by the public for assessment as old-growth. Approximately 900 ha of this area has been identified as meeting the requirements for old-growth.
- A number of species of flora and fauna moved to a higher category of threat, but none of these changes is attributed to the FMP's management activities. The population of woylies has dramatically reduced in the wild, and the Department has made a significant investment of resources to protect the species and research the cause, which is thought to be predation and disease.
- Formal reserves, informal reserves, fauna habitat zones and habitat elements in harvest areas have been well protected from inappropriate disturbance activities.
- The FORESTCHECK biodiversity monitoring program represents best practice and showed that timber harvesting resulted in few significant impacts and most species groups were resilient to the disturbances imposed. The imprint of harvesting 40 years or more earlier on species composition had become indistinguishable from that on plots never harvested. The results also show that the representativeness of the formal reserve system is well founded as the pattern of occurrence of a broad range of biodiversity groups is strongly related to the vegetation systems used for reserve design.

Key considerations for future management

- While the move to a higher category of threat for 21 species is not attributed to the FMP's management activities, it is a reflection of a range of pressures impacting biodiversity in the region and the strategies and resources to conserve biodiversity warrant reconsideration.

- The procedures used to identify, protect and manage the information associated with fauna habitat zones could be more cost effective and warrant review.

Productive capacity

Key findings on FMP implementation

- Considerable work has been undertaken to address issues identified in the mid-term audit report including the FPC seeking markets for under-utilised wood resources, stratification of forest to assist with harvest planning and yield scheduling, improvements to silvicultural recording, work to facilitate calculation of sustained yield for the Forest Management Plan 2014–2023, an amendment to the FMP in respect of karri non-sawlog material and a more consistent approach to the management of public firewood collection.
- There have been major losses in plantations through fire, drought and land-use change and a reduction in the area of native forest through infrastructure development.
- Lack of markets for non-sawlog quality wood has constrained the achievement of desired silvicultural outcomes.
- An amendment to the FMP was approved by the Minister for Environment on 3 October 2011. The amendment allowed for an increase in the available volume of karri bole logs other than first and second grade sawlog.
- Karri sawlog removals have been consistently high and the Forest Products Commission, in consultation with the Department, is working to ensure the target for the 10-year period of the plan is not exceeded.
- The total area cut-over each year is approximately 1.1 per cent of the native forest available for wood production.
- A significant proportion of the public firewood removed was not covered by an authority to remove firewood or was inconsistent with the conditions for access stated on the authority.
- The time to undertake regeneration treatments for jarrah did not meet the performance target. This related to the difficulties in the timing and completion of the silvicultural burns.
- The target for the time to undertake regeneration treatments for karri was met for the period since the mid-term audit report and the performance target for effectiveness of karri and jarrah regeneration was achieved.
- The jarrah, karri and wandoo silvicultural guidelines were amended in line with the FMP, and an expert panel has reviewed and provided advice on silvicultural practices which will be used to inform the development of the draft Forest Management Plan 2014–2023.

Key considerations for future management

- There may be opportunities to address the decline in the area of native forest. The decline in the area of plantations requires policy direction.
- The dominance of regeneration establishment and selective cut silvicultural outcomes and the lack of thinning as a part of timber harvesting in jarrah forest requires further consideration and monitoring to determine if the most appropriate silviculture is being implemented.

- The potential impact of climate change on growth and sustained wood yield will need to be monitored and incorporated into the calculation of future sustained yields. Other supporting information and systems need to be updated to support calculation of sustained yield.
- The incomplete compliance by the public with the requirements for taking firewood requires ongoing management attention. Options for the future provision of this resource should be considered.
- There has been a delay in thinning of jarrah stands and a relative dominance of selective cut silvicultural outcomes as a result of lack of markets for non-sawlogs quality wood. The Forest Products Commission should pursue markets for this material.

Ecosystem health and vitality

Key findings on FMP implementation

- The Department continued to implement weed and pest management practices and control programs, including the *Western Shield* program, the control of feral pigs, rabbits, arum lily, bridal creeper, blackberry and other declared and priority environmental weeds. However, despite these efforts the impact of pests is significant and distribution of weeds continues to increase because of the high level of resourcing that would be required to implement full control.
- A number of weed species were reported as having adverse impacts. Pest animals also had adverse impacts, with the European red fox and cats being the most serious and widespread.
- In respect of fire management, the area of forest by fuel age shows general conformance with the performance target at the whole-of-forest scale but not for some Landscape Conservation Units.
- *Phytophthora cinnamomi* was introduced or potentially spread in some disturbance operations in both conservation reserves and State forest. There was inconsistent application of the dieback policy and subsidiary guidance documents across operations.

Key considerations for future management

- Dieback management may be improved by a renewed focus and resources to address updating of guidance documents, awareness and training, clarification of the roles and responsibilities, risk assessment, and ongoing monitoring of management effectiveness, together with improvement in the management of records of disease mapping and the broader application of hygiene management plans.
- There are some emerging weeds and the potential for increased impacts from weeds, pests and diseases associated with climate change. There is a need to assess this matter in more detail and develop an asset-based prioritisation process with an increased capacity to monitor and respond to emerging threats.

Soil and water

Key findings on FMP implementation

- The extended period of below average rainfall had a major impact on water availability in the FMP area and meant that the overall objective of the plan to protect water resources has not been achieved.

- The target to maintain streamflow was not achieved and annual streamflow declined by 12 to 50 per cent compared to 1975–2003. The decline was greatest in the northern jarrah forest. Declining rainfall is considered to be the main reason for reduced streamflow.
- The target of no site with aquatic fauna significantly different to reference condition was not achieved. Rainfall and stream flow strongly influences aquatic macro-invertebrate communities.
- Streams in all fully forested catchments remained fresh with annual flow weighted mean salinity around 100 to 200 milligrams per litre. The salinity risk in Swan and South West regions has reduced because groundwater levels have declined.
- Both the Department and the FPC have invested substantial resources into planning and managing operations to reduce soil damage. This process has resulted in clear improvements in the protection of soil under the FMP. However, soil disturbance limits were exceeded at a small number of sites each year.

Key considerations for future management

- Declining rainfall has significantly impacted water availability in the FMP area and predicted future climate change is likely to lead to further impacts. Further declines in streamflow and impacts on aquatic environments are likely. The impact of climate change needs to be closely monitored with adaptive management strategies implemented that ameliorate the impacts of climate change.
- The risk to stream salinity from timber harvesting has declined as a result of declining groundwater levels and silvicultural settings that have been in place for the FMP and the previous management plan should be reviewed.

Global carbon cycles

Key findings on FMP implementation

- The Department commissioned reports on climate change and forest management planning, vulnerability to climate change and an expert review of silviculture practices made recommendations about adaptation to climate change. Understanding of the potential impact of climate change was also advanced by the work of the Indian Ocean Climate Initiative and collaborative research with the South African National Biodiversity Institute.
- The Department has commenced the development of carbon stock modelling for the FMP area.

Key considerations for future management

- The Conservation Commission and the Department should seek to identify mitigation and adaption opportunities in response to future climate change.
- Further work will be required to predict carbon stocks for the FMP area.

Natural and cultural heritage

Key findings on FMP implementation

- The *Conservation Legislation Amendment Act 2011* requiring protection for Aboriginal cultural and heritage values was passed by State Parliament. Draft regulations to support the implementation of changes under the Act are being developed.
- The Department has a formal Memorandum of Understanding with the South West Aboriginal Land and Sea Council, which is the native title representative body for the FMP area.
- The majority of registered Aboriginal and non-aboriginal heritage sites have not been disturbed. However, the target of no disturbance of a registered site without formal approval was not achieved as one non-aboriginal site was disturbed without that approval.

Key considerations for future management

- Considerable management emphasis and resources will be required to implement the *Conservation Legislation Amendment Act 2011*.

Socio-economic benefits

Key findings on FMP implementation

- There has been a general increase in visitation to recreation sites from 2004. Visitor response to surveys showed a high level of satisfaction with their experience.
- The Ministers for Environment and Tourism announced the implementation of recommendations from the Nature-Based Tourism Review that includes recommendations for longer term leases and licences, which will benefit the tourism industry and tour operators.
- The Munda Biddi Trail was built from Mundaring to Nannup.
- Mining companies have sought increased access to the area subject to the FMP, especially for new proposals for bauxite mining in eastern and southern forest areas.
- The condition of roads and bridges in the FMP area continues to deteriorate because of the age of the structures. The Department has made significant progress towards the development and adoption of road management guidelines to deal with this issue.

Key considerations for future management

- The population of the Perth to Bunbury area is predicted to increase significantly over coming decades and this is likely to lead to increasing demand for recreation facilities. The nature of recreation activities is also likely to change. New and innovative ways to manage the steady increase in visitation and the expectations of users of the FMP area is required.
- Increased focus on the provision and management of active recreation sites to reduce risks associated with un-managed off-road vehicle activity, and provide a safe and enjoyable alternative to illegal off-road vehicle activity in other State forest areas is required.

Plan implementation

Key findings on FMP implementation

- Adaptive management trials have been conducted on a range of issues relating to implementation of the FMP including; fire and biodiversity, control of *Armillaria*, cording and soil disturbance, structural diversity in karri forest and silvicultural treatment to increase streamflow.
- The Department has not developed an environmental management system to a standard suitable for certification. However, work progressed on incorporating these principles into aspects of the Department's management system.
- There has been a significant increase in knowledge in relation to sustainable forest management as a result of the publication of peer reviewed scientific papers with a total of 136 being published between July 2004 and June 2011. A further 11 peer reviewed scientific papers were published on the results of FORESTCHECK monitoring of the impacts of timber harvesting on biodiversity after June 2011.
- Both the Department and FPC continue to maintain Registered Training Organisation status.
- Of the guidance documents required by the FMP, seven have been finalised or reviewed, one is in interim form, one has been approved and held pending completion of a related document and six are in preparation.
- The Department has made important contributions to national environmental reporting through the *State of the Forests Report* and *State of the Environment Report*.
- Audits were undertaken by the Department, the FPC and Conservation Commission to facilitate improvements to practices and management systems. The Conservation Commission undertook and published the following performance assessments to assist it in assessing whether management was being undertaken in accordance with the plan:- The protection of informal reserves, the selection and management of fauna habitat zones, dieback management, protection of significant flora and understorey species, and prescribed burning and master burn planning.
- There has been a major improvement in the working relationship and definition of roles and responsibilities between the Department and the Fire and Emergency Services Authority for fire management, including collaboration with WA Police and Main Roads WA for road management.

Key considerations for future management

- Opportunities for adaptive management to address the impacts of predicted climate change should be considered for the period of the next forest management plan.
- Commitment to demonstrating conformity with an environmental management system appropriate to the scale and impact of the activities associated with the FMP, including provisions for performance review and a commitment to continuous improvement, should be considered.
- An increase in public reporting of compliance monitoring, incident management and responses generated should be implemented.
- Information should be provided to the public on the systems and processes used to calculate sustained wood yields o inform discussion of the draft Forest Management Plan 2014–2023.
- Improvements to regulatory compliance need to be considered in the development of the draft Forest Management Plan 2014–2023.
- A review of silviculture practices has been undertaken by an expert panel and their recommendations should be considered during the development of the draft Forest

Management Plan 2014–2023. The panel's report should be made publicly available to inform discussion of the draft Forest Management Plan 2014–2023.

- The Key Performance Indicators (KPI) used to assess the performance of the FMP should be reviewed to inform an improved set of KPIs for the Forest Management Plan 2014–2023.

2. Introduction

The Conservation Commission of Western Australia (Conservation Commission), the Department of Environment and Conservation (the Department) and the Forest Products Commission (FPC) are responsible for seeking to achieve the objectives of the *Forest Management Plan 2004–2013* (FMP).

This document is the Conservation Commission's end-of-term audit of performance report of the FMP submitted to the Environmental Protection Authority (EPA) for assessment with that authority subsequently providing advice to the Minister for Environment. The submission of an end-of term audit of performance report is a Ministerial requirement contained in the FMP. The end-of-term audit report was prepared by the Conservation Commission following provision of a draft report by the Department which coordinated collection of information for reporting on KPIs from within the Department, FPC and Department of Water. This report has been prepared in accordance with Ministerial Condition 2-2 (Ministerial statement no. 000641, 2003) which requires that:

> *The proponent shall submit the mid-term audit of performance report and the end-of-term audit of performance report to the Environmental Protection Authority by 31 December 2008 and 31 December 2012 respectively.*

This condition is reflected in Action 32.3 of the FMP:

> *The Conservation Commission will undertake comprehensive mid-term and end-of-term audits of the extent to which management of land to which the plan applies has been undertaken in accordance with the plan, which will include consideration of the extent to which all key performance indicator targets have been achieved.*

The *Forest Management Plan 2004–2013 Mid-term audit of performance report* (the mid-term audit report) was submitted to the EPA on 24 December 2008.

As the nominated proponent of the FMP, the Conservation Commission is responsible for the submission of this report. The Department and the FPC are responsible for implementing and complying with the provisions of the FMP.

The delivery of the end-of-term audit report, ahead of the 31 December 2012 deadline in clause 32.3, has been a joint decision by the Conservation Commission, the Department and the EPA to enable the findings from the end-of-term audit report to be considered in the development of the draft Forest Management Plan 2014–2023.

Some datasets used to report on the key performance indicators are collected by calendar year, others by financial year. This report is based on the most up-to-date datasets available at the time of preparation of this report.

It is expected that the timing of this end-of-term audit report will contribute to the objective of providing the EPA with advice regarding the extent to which management of land to which the plan applies has been undertaken in accordance with the plan. This will be achieved by:

- an assessment of implementation of the FMP in relation to how well implementation of the FMP is achieving ecologically sustainable forest management and the objectives of the FMP
- reporting on KPIs that are designed to assess implementation of the plan and the extent to which performance targets of the KPIs have been achieved
- reporting progress on actions and issues that were raised in the mid-term audit report, and the associated report prepared by the EPA.

It should be noted that where the performance targets identified in KPIs have not been achieved, hereafter termed 'target shortfall', this end-of-term audit report constitutes the

Department's and the Conservation Commission's formal response to the target shortfall as required under the FMP. This includes reporting to the Minister for Environment, who will be forwarded a separate copy of this report.

The FMP requires that protocols be prepared for each KPI, to identify the data to be collected and analysed and the responsible entities. The list of approved KPI protocols that have been prepared or reviewed since the submission of the mid-term audit report is shown in Table 2. The approved protocols are in the document *Protocols for Measuring and Reporting on the Key Performance Indicators of the Forest Management Plan 2004–2013,* which is available on the Department's website (www.dec.wa.gov.au).

Table 2 KPI protocols that have been prepared or reviewed since the completion of the mid-term audit report

KPI No.	Title	Action since mid-term audit	Date approved
5	Annual removal of wood products compared to sustained yield determined by the plan.	New protocol written	17/08/09
6	Area of forest cut over annually.	New protocol written	17/08/09
7	Removal of non-sawlog timber.	New protocol written	21/12/09
9	Time to regenerate harvested areas.	New protocol written	14/09/09
10	Effectiveness of regeneration of native forest and plantation.	New protocol written	14/09/09
13	Direct and indirect employment in the timber industries.	New protocol written	12/10/09
15	Wildflowers and seed picking.	Reviewed existing protocol	02/09/09
16	The risk to conservation, life, property and other forest values posed by wildfire.	New protocol written	10/05/10
17	The severity status of weeds and pests as determined by subjective survey.	New protocol written	12/10/09
19	Annual flow weighted mean salinity and trend for streams in fully forested catchments.	New protocol written	18/05/10
22	Water production.	New protocol written	18/05/10
23	The identification and protection of cultural heritage.	Reviewed existing protocol	18/05/10
27	Basic raw material supply.	Reviewed existing protocol	21/12/09
29	Provide for public involvement activities and public education, awareness and extension programs and make available forest-related information.	Reviewed existing protocol	21/12/09

The body of this report provides a summary of the key findings in relation to each KPI. Complete reporting of each individual KPI, including the relevant figures and tables, is provided in Appendix A.

In addition, the end-of-term audit report is to cover whole-of-plan outcomes with a view to informing the development of the draft Forest Management Plan 2014–2023. This commences with an overview of the assessment of the implementation of the FMP followed by an overview of considerations for future management. The subsequent chapters are structured according to the modified framework of the Montreal Criteria as used in the FMP. With respect to the individual criteria, the chapters provide information on:

- a summary of overall performance in relation to how the Conservation Commission, the Department and FPC have addressed the objectives of the FMP
- a summary of key findings for each KPI including response to target shortfalls where these are identified

- reporting on progress with actions and issues that were raised in the mid-term audit report, and the associated report prepared by the EPA
- considerations for future management so that these issues can be considered in the process of developing the draft Forest Management Plan 2014-2023.

The KPI reports, and on occasions the response to shortfall reports, refer to management activities or management actions that are provided for under the FMP. For the purposes of this report these are:

- timber harvesting and associated activities
- prescribed burning and bushfire suppression
- roading and firebreak construction and maintenance
- recreation site development and maintenance
- community recreational use
- firewood, craftwood and minor forest product collection
- wildflower and seed collection
- honey production
- extraction of basic raw materials
- weed, disease and feral animal control
- vegetation and animal management and recovery
- fenceline clearing and wood salvage
- research
- traditional hunting and gathering.

3. Biological diversity

Summary of performance

- The formal conservation reserve system expanded significantly over the early years of the FMP. However little progress has been made in establishing conservation reserves since the mid-term audit report.
- 306 land category changes were proposed in the FMP. Of these 144 have been gazetted (47 per cent by number), which represents 88 per cent of the area proposed to be reserved when fully implemented.
- The main impediments to completion of changes to land category of areas of proposed formal reserves are outside the control of the Department and the Conservation Commission. The impediments are:
  - opposition to the proposed land category changes by the Department of Mines and Petroleum on the basis that this may reduce the opportunity for mineral exploration
  - native title issues
  - the need to retain access for rights under State Agreement Acts
  - the uncertainty about the future requirements for land listed under the Commonwealth Register of the National Estate.
- Formal reserves, informal reserves and fauna habitat zones have been well protected from inappropriate disturbance activities.
- Habitat trees and other habitat elements have been marked and retained at the required rate in areas subject to timber harvesting.
- Significant resources have been allocated to identifying and protecting old-growth forest and significant areas of previously unmapped old-growth forest have been identified.
- Over 2,500 ha of forest has been nominated by the public for assessment as old-growth forest. Approximately 900 ha of this area has been identified as meeting the requirements for old-growth forest. For those areas of forest assessed under Action 3.2.1 of the plan (approximately 2,300 ha), 128 ha have been identified as old-growth forest.
- In it's assessment of the protection of significant flora and understorey species, the Conservation Commission found that the FMP requirements in relation to the protection of all the required significant flora values were recently enacted for native forest pre-harvest checks (2010), but not fully enacted other disturbance activities in the FMP area. There was also found to be some variation in the mapped representation of the areas of endemic, disjunct or relictual flora.
- The finalisation of fauna habitat zones has been progressively completed on a priority basis, with approximately 100 out of 283 having been finalised by February 2012. Guidelines for the selection of fauna habitat zones have been approved and consultation processes applied.
- A revised approvals process incorporating a planning checklist for disturbance activities has been approved and includes a broader range of biodiversity checks.
- A number of species of flora and fauna moved to a higher category of threat, but none of these changes is attributed to the FMP's management activities.

- The population of woylies has dramatically reduced in the wild, and the Department has made a significant investment of resources and staff time to protect the species and research the cause. Predation by foxes and cats is thought to be the reason for the decline in woylies and disease that renders them vulnerable to predation may also play a role.
- There has been maintenance of processes for protecting threatened species and ecological communities through the development and implementation of recovery plans and through the continued implementation of the *Western Shield* fox baiting program.
- A major achievement is the FORESTCHECK biodiversity monitoring program which is used to assess the impact of silvicultural practices on forest biodiversity. This program represents best practice and results showed that few significant impacts were evident and most species groups were resilient to the disturbances imposed by timber harvesting. The imprint of harvesting 40 years or more on species composition had become indistinguishable from that on plots never harvested.
- A major finding from FORESTCHECK beyond silvicultural practices is that the representativeness of the comprehensive, adequate and representative reserve system is well founded as the pattern of occurrence of a broad range of biodiversity groups is strongly related to the vegetation systems used for reserve design.
- Work associated with FORESTCHECK has also increased recognition of the value and current distribution of dead woody material on the forest floor (known as coarse woody debris).
- FORESTCHECK has led to major increases in knowledge regarding biodiversity across the FMP area, particularly in relation to previously undocumented macro-invertebrates and fungi.

Report on Key Performance Indicators

Summary information on KPIs is reported below. Further information is available in Appendix A.

KPI 1 The representation of forest ecosystems in formal reserves

Measure	*Area of each forest ecosystem by land category (existing and proposed separately).*
Target	*The Department and the Conservation Commission to complete all actions for which they are responsible in order to formally change the land category of areas proposed for the reserve system within 10 years after the commencement of the plan.*

- 306 land category changes were proposed in the FMP. Of these 144 have been gazetted (47 per cent by number), which represents 88 per cent of the area proposed to be reserved when fully implemented.
- As a result of the changes, most forest ecosystems are well represented and are close to target reservation levels in the gazetted conservation reserve system. Target reservation levels are 15 per cent of pre-European distribution for most forest ecosystem and 100 per cent of extant distribution for four forest ecosystems.
- Most of the changes to the conservation reserve system were made in the early years of the FMP. Little progress has been made in establishing conservation reserves since the mid-term audit report.
- A complex series of issues has resulted in the delay in implementing the proposed land category changes.

- The main impediments to completion of changes to land category of areas of proposed formal reserves are outside the control of the Department and the Conservation Commission. The impediments are:
    - opposition to the proposed land category changes by the Department of Mines and Petroleum on the basis that this may reduce the opportunity for mineral exploration
    - native title issues
    - the need to retain access for rights under State Act agreement areas
    - the uncertainty about the future requirements for land listed under the Commonwealth Register of the National Estate.

KPI 2 The status of (critically endangered, endangered, vulnerable, conservation dependent) forest-dwelling species and ecological communities as determined by listing

Performance measure	*List of species and ecological communities and their status that tracks movements of species between protection categories.*
Performance target(s)	*No species or ecological community will move to a higher category of threat as a result of management activities.*

- Since 2004, 12 flora species have moved to a higher category of threat, and a further three flora species that were already listed as threatened were recorded for the first time in the FMP area and therefore included in the list for this KPI.
- Six fauna species have moved to a higher category of threat in the same period.
- None of these changes are attributed to the consequences of management activities. Reasons include the translocation of a recovery population of a critically endangered flora species within the FMP area and an international review of the conservation status of the Australasian bittern.

KPI 3 The status of selected threatened or conservation dependent species that are the subject of management actions to protect them

Measure	*The trap success for animals at selected monitoring sites.*
Target(s)	*As per recovery plans.*

- The target capture rate for chuditch was met.
- The target capture rate for woylie was not met.

Response to target shortfall

- Predation by foxes and cats is thought to be the reason for the decline in woylies and disease that renders them vulnerable to predation may also play a role.
- A predator-proof enclosure has been established at Perup for an insurance population of woylies and for research.
- The number of woylies within this enclosure has doubled, supporting the suspected cause for decline.

Progress on actions identified in the mid-term audit report

Topic	Action[i]	Response
Addressing impediments to	The Conservation Commission to review the causes of delays to the	The causes of delays were reviewed by the Department and

achieving reserve targets	implementation of the proposed formal conservation reserves and publicly report to the Minister for Environment with recommended actions to address this issue. In the EPA's report on the mid-term audit it was noted that the EPA could see no clear timetable within the life of the FMP for the implementation of the remaining 339 areas as formal conservation reserves.	the Conservation Commission and were found to fall outside the responsibility of the Department. KPI 1 provides an update on reserve implementation since the mid-term audit report.
Further biological survey	The requirement of Action 9.1 for the Department to undertake further biological survey of priority areas within the FMP area determined in consultation with the Conservation Commission will be addressed by the establishment of additional FORESTCHECK monitoring sites.	In 2009 the Conservation Commission accepted a recommendation by the Department that Action 9.1 be undertaken using methodology and resources currently employed for the FORESTCHECK monitoring program. As part of this process, the Department is currently undertaking a comprehensive review of biological studies conducted in the FMP area to identify geographic areas where survey effort has been relatively low and the level of reservation is low.
KPI target shortfalls for KPI 2 and 3 and response by Conservation Commission	The Department to report to the Conservation Commission and to the Minister for Environment with respect to the move of the red-tailed black cockatoo to a higher category of threat (KPI 2). The Department will report to the Conservation Commission and to the Minister for Environment with respect to the decline in trap capture success rate of the woylie (KPI 3). The Conservation Commission to develop a response to the report findings for the brush-tailed phascogale, and likewise for the red-tailed black cockatoo. The Conservation Commission will evaluate the need for revision of management practices, in the context of its assessment and auditing function, in consultation	During 2009, 2010 and 2011 the Conservation Commission received supplementary advice and briefings from the Department with respect to the shortfalls identified for KPI 2 and KPI 3. The Conservation Commission is satisfied that the reporting requirements for red-tailed black cockatoo, the brush-tailed phascogale and the woylie have been met. As part of the reporting the Department identified management actions that had been implemented to address declines. The Conservation Commission is satisfied that changes in taxonomic status for the brush-tailed phascogale and the red-tailed black cockatoo are not a reflection of the implementation of the FMP and that the declines in woylie populations are not limited to those areas covered by the

	with the Department.	FMP and are not a result of management activities. The Conservation Commission has not requested changes to management practices beyond those proposed by the Department. Further detail is provided in the reports for KPI 2 and 3.
Completion of guidelines	The Department to finalise *Guidelines to Protect the Values of Informal Reserves and Fauna Habitat Zones*, *Fauna Distribution Information System* and *Guidelines for the Selection of Fauna Habitat Zones*. The Department to finalise *Goals for Understorey Structural Diversity*. Conservation Commission to finalise the *Interim Guidelines for the Preparation of Terrestrial Conservation Reserve Management Plans*. In the EPA's report on the MTA they noted that it was of concern that the final *Guidelines for the Selection of Fauna Habitat Zones* were yet to be completed by the Department.	*Guidelines to Protect the Values of Informal Reserves and Fauna Habitat Zones* were completed and approved by the Minister for Environment in October 2009. *Guidelines for the Selection of Fauna Habitat Zones* were completed and approved by the Minister for Environment in November 2010. The Fauna Distribution Information System was endorsed for use. Guidance documentation is under review. Work on *Goals for Understorey Structural Diversity* has commenced but not yet been completed. The Conservation Commission completed a position statement related to the Preparation of Terrestrial Conservation Reserve Management Plans. Detail on this topic is provided in the report on KPI 33 l.
Criteria for FHZ selection	In providing its advice on the *Guidelines for Selection of Fauna Habitat Zones*, the Conservation Commission will clarify its expectations and criteria for fauna habitat zone selection.	The Commission clarified its expectations for selection criteria for fauna habitat zones and provided its advice to the Department during the development of the guidelines.
The capacity of Fauna Distribution Information System to generate an effective management response	The Conservation Commission to consider the final report on the Fauna Distribution Information System by 31 March 2009 and then work with the Forest Products Commission and the Department during 2009 to address concerns about whether Fauna Distribution Information System has the capacity to	The Conservation Commission considered the final report on FDIS and in July 2009 endorsed the use of Fauna Distribution Information System for the Forest Products Commission and the Department's operations planning. The Conservation Commission considered that the effective

	generate an effective management response.	implementation of Fauna Distribution Information System is an operational matter for the Department to consider and recommended that the points raised by the independent experts be considered in that process. Significant progress has been made in reviewing documentation for Fauna Distribution Information System and for the development of procedures for updating and maintaining currency of data and the Fauna Distribution Information System database. Ongoing maintenance of Fauna Distribution Information System is planned.
Old-growth demarcation procedure	The Department to finalise the old-growth demarcation procedure and consult the Conservation Commission on its content.	The Department has refined its procedure for demarcation of old-growth forest and is applying this on-ground, however the Conservation Commission has not yet been consulted on the content.
Plantation access	The Department to clearly define the planning and approvals system for the Forest Products Commission access to plantations.	The planning checklist is being used in some plantation areas on a risk-based approach to improve planning and approvals for access.
Planning checklist for disturbance activities	The Department to finalise the revised planning checklists.	The planning checklist has been finalised and is used in the planning and approvals process for timber harvesting operations and associated activities, e.g. roading. It is increasingly being applied in the planning process for other disturbance activities such as utilities infrastructure work on State forest and timber reserves. It is not currently used for mining operations or for fire planning.
Improve planning timeframes for FHZs	The Conservation Commission, the Department and the FPC will work together to improve planning timeframes to ensure that this problem (access to harvest areas during fauna habitat zone finalisation) does not recur.	As part of the finalisation of the guidelines, the administrative process for finalising fauna habitat zones was streamlined and additional resources were dedicated to shorten the planning timeframes. These steps have improved this issue.

Considerations for future management

- While the move to a higher category of threat for 21 species is not attributed to the FMP's management activities, it is a reflection of a range of pressures impacting biodiversity in the region and the strategies and resources to conserve biodiversity warrant reconsideration.
- The procedures used to identify, protect and manage the information associated with fauna habitat zones could be more cost effective and warrant review.
- The Department to develop an old-growth forest demarcation procedure in consultation with the Conservation Commission.
- The Department to develop Goals for Understorey Structural Diversity.
- The revised planning checklist for disturbance activities (SFMDEC019) to be applied in the planning process for all disturbance activities.
- Maps of areas of high flora species richness, centres of endemic flora, centres of relictual flora and centres of disjunct flora and associated data-bases to be updated to better reflect the status of current understanding of these values.
- Review FORESTCHECK so that it:
    - monitors delivery of practices under the *Forest Management Plan 2014–2023*
    - is used to fill gaps in the biological survey information
    - is able to be used as a base to monitor the impacts of climate change on biodiversity
    - is considered as a source of information for a KPI in the *Forest Management Plan 2014–2023*.

4. Productive capacity

Summary of performance

- Considerable work has been undertaken to address issues identified in the mid-term audit report including the FPC seeking markets for under-utilised wood resources, stratification of forest to assist with harvest planning and yield scheduling, improvements to silvicultural recording, work to facilitate calculation of sustained yield for the *Forest Management Plan 2014–2023*, an amendment to the FMP in respect of karri non-sawlog material and a more consistent approach to the management of public firewood collection.
- There has been a loss of plantation area from 59,000 hectares to 52,000 hectares because of fire, drought and land use change.
- There has been a reduction in area of native forest of approximately 940 hectares which is associated with construction of new roads, infrastructure corridors or the widening of existing easements.
- The volume of jarrah first and second grade sawlogs removed within each consecutive three-year period to 2010 has been consistently less than the target.
- The volume of karri first and second grade sawlogs removed each year has been consistently high, and has exceeded the annual and rolling three-year performance target in several instances. The FPC, in consultation with the Department, is working to ensure the target for the 10-year period of the plan is not exceeded.
- The available volume of karri non-sawlog material has been amended since the publication of the mid-term audit report and now provides for an average of up to 160,000 cubic metres per year.
- The removal of wandoo, blackbutt and sheoak sawlogs has remained well below the allowable removal specified in the FMP.
- The total area of forest cut over each year has averaged 9,290 hectares, which constitutes approximately 1.1 per cent of the native forest available for wood production under the FMP. The predominant silvicultural objectives in jarrah harvesting have continued to be to establish regeneration (shelterwood), selection cut in dieback affected forest and selective harvesting. Silvicultural follow-up treatments were not applied to all eligible areas during this period, due to factors such as the proximity of areas to scheduled bauxite mining, the retention of non-merchantable trees due to an absence of markets and the capacity to achieve post-harvest burn programs.
- A significant proportion of the public firewood removed was not covered by an authority to remove firewood or was inconsistent with the conditions for access stated on the authority.
- The time to undertake regeneration treatments in jarrah continued to not meet the performance target. This has been investigated since the mid-term audit report and found to be predominantly related to the difficulties in the timing and completion of the silvicultural burns.
- The target for the time to undertake regeneration treatments in karri was met for the period since the mid-term audit report.
- The performance target for effectiveness of karri and jarrah regeneration was achieved.

- The jarrah, karri and wandoo silvicultural guidelines were amended in line with the FMP, and an expert panel has reviewed and provided advice on silvicultural practices which will be used to inform the development of the draft Forest Management Plan 2014–2023.
- The thinning in young regrowth karri stands has consistently met or been ahead of schedule. However, the scheduled early thinning program for jarrah regrowth stands was not achieved.
- There has been an increased focus on management activities to reduce the impact of *Armillaria* in karri regrowth stands.
- Rolling three-year indicative harvest plans have been produced by the Department to facilitate forward planning by FPC for access to State forest. The plans have been made publicly available and consider the requirements of other industries, such as bauxite mining, and activities, such as the prescribed fire program. The FPC has prepared annual indicative timber harvest plans and these have been made publicly available.
- Employment in the timber industry has declined during the life of the FMP.
- There has been a small decrease in the number of available apiary sites during the life of the FMP due to a range of reasons outlined in the report on KPI 14 below.
- There has been a significant reduction in the number of wildflower pickers and the amount of wildflowers harvested within the FMP area believed to be linked to the availability of wildflowers from cultivated stands on private land.

Report on Key Performance Indicators

Summary information on KPIs is reported below. Further information is available in Appendix A.

KPI 4 The area of native forest and plantations

Measure	*Change in:* • *the area of native forest and plantation;* • *area of forest by land category;* • *area of forest cleared; and* • *area of forest rehabilitated.*
Target(s)	*No permanent loss of net area of forested land.*

Native forest

- Comparison of forest cover change between 2004 and 2011 indicates a permanent reduction in forest area of approximately 940 hectares. During this period there were some additions to the land area vested to the Conservation Commission, within the plan area, that would have offset this reduction, but the net difference was not able to be calculated. See the report on KPI 4 in Appendix A for further details.

- The reduction in forest cover was attributed to the permanent clearing of forests associated with the construction of new roads, infrastructure corridors or the widening of existing easements.

Plantation

- Over the period of the current FMP the area of pine plantation on land covered by the FMP has reduced from about 59,000 hectares to 52,000 hectares because of fire, drought and land use change.

Response to target shortfall

- The Conservation Commission and Department will continue to seek to minimise the net loss of forest through submissions to proposals to locate infrastructure on land that is subject to the FMP. This includes encouraging multiple infrastructure along a common alignment and seeking the replacement of forest areas permanently lost.
- Some rehabilitation of redundant roads and tracks in State forest areas has been undertaken during the life of the plan and the review of the Department's strategic road network has further progressed since 2008.
- Monitoring of the revegetation or recovery of areas where forest cover has been temporarily reduced will be an ongoing component of the forest health monitoring work.

KPI 5 Annual removal of wood products compared to the sustained yield determined by the plan

Measure	*Cumulative removals for jarrah and karri first and second grade sawlogs compared to the average annual sustainable yield.* *Annual removal of jarrah and karri sawlogs below first and second grade.* *Annual removal of all logs.*
Targets	*No more than 10 per cent more than the average annual yield of first and second grade sawlogs of each species to be removed in any one year.* *No more than 412,650 cubic metres of first and second grade jarrah sawlogs and 170,100 cubic metres of first and second grade karri sawlogs to be removed in any three consecutive years.* *No more than 1,310,000 cubic metres of first and second grade jarrah sawlogs and 540,000 cubic metres of first and second grade karri sawlogs to be removed over the 10-year life of the plan.* *Annual volume of jarrah and karri sawlogs other than first and second grade sold for value added products to show a positive trend.* *No more than 13,000 cubic metres of wandoo, 16,000 cubic metres of blackbutt and 19,000 cubic metres of sheoak sawlogs to be removed over the 10-year life of the plan.*

- The volume of jarrah first and second grade sawlogs removed each year has fluctuated, and, with the exception of 2008, has ranged from between six and 35 per cent below the annual target. Consequently, removals within each consecutive three-year period to 2010 have been consistently less than the target.
- The volume of karri first and second grade sawlogs removed each year has been consistently high, and in 2006 and 2008 the annual target was exceeded. Between 2006 and 2010 the volume of sawlogs removed in consecutive three-year periods was also higher than the performance target.
- The mid-term audit report identified that the annual level of production of karri other bole volume during the period 2004–2007 had exceeded the upper limit specified in the FMP. The cumulative total removals of karri other bole volume to the end of 2010 was seven per cent less than the target for this period. The FMP was amended and provides for an average annual volume of 160,000 cubic metres.
- After seven years, the cumulative volume of wandoo, blackbutt and sheoak sawlogs removed constitutes only 11, 35 and 11 per cent respectively of the total allowable volumes for the 10-year period of the FMP. The consistently low volumes removed each

year reflect variations in both the markets and the availability of these species from the mix of coupes within annual harvest plans.

Response to target shortfall

- The Department has advised the FPC of the trend in annual removals of karri first and second grade sawlogs.
- The FPC, in consultation with the Department, is working to ensure the target for the 10-year period of the plan is not exceeded.

KPI 6 Area of forest cut over annually

Measure	*Annual area of each forest type harvested according to each silvicultural objective.*
Target	*Not possible to set a realistic target for area cut over.*

- The total area of forest cut over each year has averaged 9,290 hectares, which constitutes approximately 1.1 per cent of the native forest available for wood production under the FMP.
- The area of jarrah forest cut over each year during the period 2004 to 2010 has averaged 7,730 hectares. This rate continues to be consistent with the range expected by the Department for the FMP.
- The predominant silvicultural objectives in jarrah harvesting have continued to be to establish regeneration (shelterwood), selection cut in dieback affected forest and selective harvesting.
- The area of karri forest cut over each year during the period 2004 to 2010 has averaged 1,480 hectares. This rate continues to be consistent with the range expected by the Department for the FMP, and comprises mostly thinning in younger regrowth forests.
- Silvicultural follow-up treatments were not applied to all eligible areas during this period, due to factors such as the proximity of areas to scheduled bauxite mining, the retention of non-merchantable trees due to an absence of markets and the capacity to achieve post harvest burn programs.

KPI 7 Removal of non-sawlog timber

Measure	*Total removals of firewood compared to the authorised removal through contract and licence.*
Target	*Authorised removals more than 70 per cent of estimated total removals based on survey information.*

- The amount of firewood removed to service FPC contracts of sale has been steady and consistently well below the amount authorised, suggesting that demand for firewood is generally stable and is less than the available supply.
- The trend in the number of authorities for firewood collection issued in the Swan Region indicates that there remains a strong demand for public firewood.
- Surveys of public firewood collection indicate that the amount taken is approximately double the authorised amount.
- Public firewood is often taken from outside designated areas or in breach of conditions of authorisation.
- Overall, the total removals through contract and licence meet the target. because the excessive public firewood removal was of a much smaller magnitude than the under utilisation of FPC contracts which dominate the authorised removal volumes.

KPI 8 The presence of *Sirex* in softwood plantations

Measure	*Evidence of Sirex in trap trees.*
Target	*No evidence of Sirex in trap trees.*

- Monitoring conducted from 2005 to 2011 did not detect the presence of *Sirex* wood-wasp in softwood plantations within the FMP area.

KPI 9 Time to regenerate harvested areas

Measure	*The time between completion of native forest harvesting of a coupe for regeneration and the completion of post-harvest regeneration treatment.*
Targets	*For karri and planted jarrah:* • *achieve more than 75 per cent of areas treated to be completed within 18 months; and* • *achieve 100 per cent of areas treated to be completed within 30 months.* *For other jarrah:* • *achieve 100 per cent of areas treated to be completed within 18 months.*

- Since the shortfall in time to undertake regeneration treatments in karri was reported in the mid-term audit report, the regeneration of karri has met the target.
- The target for time to undertake regeneration treatments in jarrah has not been met between 2004 and 2011.

Response to target shortfall

- Following the mid-term audit report, the Department and FPC investigated the cause for the delay in time to undertake regeneration treatments in jarrah.
- The ability to conduct timely silvicultural burns was identified as the main impediment to achieving the performance target.
- The Department and the FPC have since implemented key improvements, but the complexity of integrating multiple factors remains.

KPI 10 Effectiveness of regeneration of native forest and plantation

Measure	*The proportion of the sampled annual regeneration release program that does not meet the stocking standard set out in the Silviculture Guidelines.*
Target	*No more than five per cent of the area regenerated requiring remedial action.*

- The performance target for karri and jarrah was achieved every year from 2004 to 2009.
- The target for plantations was not achieved in 2004 and 2005. Sites that did not meet the target received remedial treatment. The response to the target shortfall was included in the mid-term audit report and further reporting is not required.

KPI 12 The achievement of early thinning schedules that underpin future yield

Measure	*Achieved thinning versus that prescribed in silviculture schedules.*
Target	*All stands thinned at the prescribed stand development stage.*

- The timing and extent of thinning in young regrowth karri stands has consistently met or been ahead of schedule.
- The rate of karri thinning will assist the reintroduction of strategic prescribed burning into these stands.

- In contrast, the scheduled early thinning program for jarrah regrowth stands was not achieved. The lack of a commercial market for the small logs produced during thinning of jarrah regrowth stands is the main reason that this has not been undertaken.

Response to target shortfall

- The Department will adjust the yield projections for the draft Forest Management Plan 2014–2023 to reflect the delay in commencing broad-scale early thinning in regrowth jarrah stands.
- The Department is progressing forest stratification and field surveys of stand structure, condition and tree size to refine the scheduling of thinning of young regrowth jarrah stands, particularly in the Warren Region.
- In 2011, the FPC commenced an Expression of Interest process for the processing of hardwood logs. The smaller logs potentially available from the jarrah thinning operations are included in the candidate resource for which processing options and markets are being sought.

KPI 13 Direct and indirect employment in the timber industries

Measure	*The numbers employed in native timber harvesting, processing and downstream manufacture.*
Target	*No target, trends to be reported.*

- Employment figures show a continuing decline for the native forest timber industry from 2006 to 2011.

KPI 14 Access for apiculture

Measure	*The number of registered sites by land category.*
Target	*No target, trends to be reported.*

- There were over 1,100 registered apiary sites within the FMP area, more than three quarters of these are on State forest and timber reserves.
- There was a small decrease in the number of sites after 2008, mostly within national parks as a result of a range of reasons that are outlined in the report on KPI 14 in Appendix A.

KPI 15 Wildflowers and seed picking

Measure	*The level of activity measured by picking endorsements and returns.*
Target	*No target, trends to be reported.*

- There was a significant reduction in the number of wildflower pickers and the amount of wildflowers harvested within the FMP area. A possible explanation is that cultivated stands on private property have matured to a stage at which they are harvestable for the cut flora industry, resulting in less being sourced from Crown land.
- Seed picking amounts are variable and is attributed to changes in the demand for seed, coupled with variations in the seasonal availability of seed.

Progress on actions identified in the mid-term audit report

Topic	Action	Response
Insufficient markets for the quantity of lower grade jarrah and marri logs	The FPC to continue to develop markets for this component of the 'other bole volume' made available under the FMP.	Over the term of the FMP, the FPC has undertaken several processes to endeavour to increase the utilisation of non-sawlog material without a great deal of success. A greater uptake of bole sawlogs and third grade sawlogs has used some of this resource, but there is a still a substantial quantity for which there is no market. Market research and processing trials have been undertaken to identify prospective uses for currently under-used resources. These have included engineered strand lumber, plywood, particleboard and medium density fibreboard. Currently the FPC has an Expression of Interest process underway which will identify any prospective users for this resource. Market conditions have improved to suggest that there is a greater prospect of identifying new local processing options.
Harvest planning	Changes in the location of sawmills relative to the sawlog resource may necessitate variation to the relative proportion of sawlogs sourced from different regions, and require some revision of published three-year harvest plans. The Department and the FPC to progress the site quality and forest structure stratification of native forests to ensure appropriate information is available to assist harvest planning and (where necessary) to reschedule thinning treatments.	The Department has continued to expand site quality and forest structure stratification in native forests. This includes a program of interpreting forest height, structure and composition from high resolution digital aerial imagery for regrowth jarrah forests, and expanded field survey of both thinned and unthinned stands in regrowth karri. This work has been applied in the karri three-year harvest plans, the most recent being the 2011–2013 plan for Warren Region.

Jarrah silviculture training	The Department in consultation with the FPC to extend training programs on jarrah silviculture.	Jarrah silviculture training was provided to Department and FPC staff in November 2007 and November 2008. Additional jarrah silviculture training was provided to new Department staff in May 2009.
Silviculture recording	The Department and the FPC to place a renewed emphasis on the timely collation and verification of the extent and outcome achieved in the silvicultural treatments applied to the forest.	In 2009 and 2010 there was an increased effort by the FPC in supplying information to the Department on silvicultural treatments, however some discrepancies in the Department and the FPC datasets are still being progressively resolved. The capacity to improve records and verification of silvicultural outcomes using high resolution digital imagery was investigated. It was found that the use of this technology would be limited without enhancements to the field survey techniques. Work on improving collation of data and verification is ongoing.
Sustained yield (the Department)	To facilitate the next revision of the sustained yields, the Department will: • enhance the monitoring of silvicultural outcomes and sawlog utilisation in coupes • expand the approach to monitoring log grading standards • expedite the update of inventory and stratification projects recommended in the Ferguson report and the FMP • refine knowledge and adaptive strategies for climate-induced changes to long-term site productive capacity.	Monitoring of silvicultural outcomes and sawlog utilisation in utilisation plots was maintained through 2009 and 2010. An assessment of sawlog grades on landings at a sample of sawmills was introduced in 2010. A range of forest inventory and forest stratification projects in both the jarrah and karri forests has been progressed since 2009. An expert panel report on *Vulnerability of forests in south-west Western Australia to timber harvesting under the influence of climate change* was completed in 2009 (see www.dec.wa.gov.au). Knowledge of climate-induced impacts on forest are being refined through an ongoing drought mapping and site prediction study, dieback rate of spread study; research on physiological growth modelling of jarrah forests, hydrological monitoring (Kinal and Stoneman), and various CSIRO (Premiers Water Foundation) and Water Corporation studies (Wungong) related to water availability and long-term site productive capacity.

Sustained yield (the FPC)	To facilitate the next revision of the sustained yields, the FPC will: • confirm the magnitude of any changes arising from restructuring within the sawmilling sector of the timber industry that may affect the nature, quantity, or location of future available resource • secure sufficient markets for forest residue products to initiate thinning programs and undertake all scheduled silvicultural treatments • develop programs to address the backlog of regeneration treatments • ensure consistency in silvicultural and log grading activities with the sustained yield settings.	Sawlog grading has been adjusted in liaison with the sawmill industry to better reflect viable processing and markets. Additional markets have enabled additional thinning of karri regrowth in accordance with scheduled treatments. Markets have not enabled all scheduled thinning treatments to occur for jarrah regrowth.
Rehabilitation of clearfelled plantation areas to be returned to native vegetation	An inventory of those areas that are the FPC's responsibility should be completed and agreed to by the Department. A program of rehabilitation to be achieved by the relevant agency should be agreed between the FPC and the Department and rehabilitation works completed (at least 50 per cent in 2010 and the other 50 per cent in 2011).	A joint working group has been formed to address this issue and develop an agreed rehabilitation program.
Roading	An increased consideration by the FPC for the long-term potential use of roads and broadscale strategic planning for roads.	The FPC consults with the Department in seeking approval for roading works. Wherever practicable this is aligned to the Department's longer-term access requirements.

New log grading system	If a new log grading system is adopted, the Department and the FPC will need to ensure that the process of grading will be adequately monitored and that a new grading system may require the FMP's sustained yields to be recalculated to reflect the new grades.	A new log grading system was not introduced. From time to time, as a response to market conditions, there have been small variations in the log specifications that industry can affordably utilise. No amendments to FMP sustained yields are required as long as any changes in specification are converted to equivalent FMP sustained yield specifications for calculation and reporting purposes.
Additional volumes of karri other bole logs	The Department to provide the Conservation Commission with a detailed analysis of the causes for the greater volumes of karri other bole logs being produced.	In May 2009 the Department provided supplemental information to the Conservation Commission on the causes of additional volumes of karri other bole logs. The Conservation Commission provided advice to the EPA on options available to address the issue. The EPA considered that the plan had been assessed and approved and therefore must be complied with. The EPA noted that if there was a need to amend the FMP, then the process for amendment should follow the statutory processes under the CALM Act. The Conservation Commission endorsed an amendment to the FMP, carried out in accordance with Section 61 of the CALM Act. The amendment was approved by the Minister for Environment on 3 October 2011. The amendment allows for an increase in the available volume of karri bole logs other than first and second grade sawlog. This provides for an average annual availability of 160,000 cubic metres of karri other bole logs for the 10 years of the plan.

Forecast strategic timber yield versus actual timber yield.	The Department to provide the Conservation Commission with a detailed analysis of the causes for the actual versus predicted jarrah sawlog shortfall.	In May 2009 the Department provided supplemental information to the Conservation Commission on the reasons for differences between the realised and forecast yields of jarrah sawlog during 2004–2007. The Conservation Commission reviewed the information and provided advice to the Environmental Protection Authority. The Conservation Commission acknowledged that overall for the three forest regions, the revised data indicated a close conformity between the realised and forecast sawlog volume. The Conservation Commission advised the Environmental Protection Authority that, based on the supplementary advice it received from the Department, it was not necessary to adjust the sustained yield for jarrah sawlogs at this point in time. The Conservation Commission was, however, concerned with the clear trend of less volume being removed in the Swan Region relative to forecasts, and advised the Environmental Protection Authority that KPI 11 should be amended so that reporting on realised and forecast jarrah sawlog yields was undertaken annually from 2010 onwards. The Environmental Protection Authority supported the amendment to the reporting frequency under KPI 11. The Department advised that annual reporting based on the current number of jarrah inventory ground plots that were harvested would generate inconclusive results and resources would be better placed addressing higher priorities of the plan. This issue will be considered in the process of development of the next forest management plan.

Issues relating to domestic firewood demand	The Conservation Commission will discuss with the Department issues relating to domestic firewood demand and what actions can be taken to reduce the level of uncontrolled access and the illegal taking of firewood from conservation reserves.	The Department has commenced work to introduce a standard approach to the management of public firewood in the South West and Warren regions to bring them into line with the Swan Region for this and related issues will be considered in drafting the Forest Management Plan 2014-2023. This will involve a considerable effort towards management processes, followed by a period of public education and enforcement. Further information is available in the report on KPI 7.
Weeds, pests, diseases	Conservation Commission expects that weed species in plantation areas that impact on biodiversity values attract a high priority for control.	The Department has reviewed the planning checklist for disturbance activities to include the need for weed hygiene in the checklist. This topic of weed species and control is addressed in detail through KPI 17.
KPI 15 data availability	The data for 2006 and 2007 have not been supplied for the KPI report. The Conservation Commission will ask the Department to review the protocol for this KPI if data availability is likely to continue to be a problem.	The protocol for KPI 15 was reviewed and amended by the Department to enable improved reporting. Data on individual species remain difficult to collate and further refinement of the KPI may be required if ongoing reporting is intended.
The FPC review of timeliness of regeneration burns	With respect to the regeneration and rehabilitation of disturbed forest, the Conservation Commission supports the FPC in reviewing its performance and in requesting the Department to review its performance in conducting timely regeneration burns.	In 2009 the Department, in liaison with the FPC, undertook a review of performance and management practices associated with conducting timely regeneration burns. Changes to management practices were recommended in two key areas: revised requirements for approval of log stockpile locations and improved integrated planning practices.

Compliance with thinning schedules	The Conservation Commission was concerned with past performance in the areas of regeneration and rehabilitation of disturbed forest and compliance with thinning schedules when preparing the FMP. The Conservation Commission remains concerned with performance and will consider undertaking future specific performance assessments during the remainder of the plan's duration.	First thinning operations in young regrowth jarrah stands have continued to be delayed by a lack of commercial markets for the size and quality of the products that would be generated. The alternative of non-commercial thinning would require substantial funds to conduct. The potential for new markets and funding sources to conduct these operations has been the subject of ongoing investigations by the FPC, with a current Expression of Interest process underway. The thinning delays will be addressed by the Department in the preparation of yield regimes as part of the development of the next forest management plan. The Conservation Commission will consider scheduling a performance assessment for the next forest management plan on the compliance with thinning schedules.

Considerations for future management

- The decline in the area of native forest as a result of infrastructure could be addressed by conditions on approval for these activities requiring that the losses be offset. Within the FMP area there are opportunities for some offset of these losses through the rehabilitation of redundant roads and other areas not previously rehabilitated which are a result of historic activities.
- The decline in the area of plantations due to drought, fire and land use change and the likely further decline will require policy direction to ensure the estate is able to support the wood processing industry.
- The dominance of regeneration establishment and selective cut outcomes and the lack of thinning as a part of timber harvesting in jarrah forest requires further consideration and monitoring to determine if the most appropriate silviculture is being implemented.
- The potential impact of climate change on growth and sustained wood yield will need to be monitored and incorporated into calculation of future sustained yields.
- The incomplete compliance by the public with the requirements for taking firewood requires ongoing attention. Options for the future provision of this resource should be considered.
- Ongoing management is required to ensure timely treatments to provide for regeneration of harvest areas. If the KPI on time to regenerate harvested areas is to be retained then the performance target should be reviewed.
- Yield projections will need to be reviewed to reflect the delay in early thinning of regrowth jarrah stands and further work on stratification of the structure, condition and tree size of regrowth stands is required to improve scheduling of thinning and yield projections.

- Delay in thinning of jarrah stands and the relative dominance of selective cut silvicultural outcomes are a result of lack of markets for non-sawlogs quality wood. The FPC should pursue markets for this material.

5. Ecosystem health and vitality

Summary of performance

- In respect to fire management, the area of forest by fuel age shows general conformance with the performance target at the whole-of-forest scale. However, the fuel age distribution for some Landscape Conservation Units does not conform to the target distribution which generally relates to achieving a balance between the range of management objectives that are considered in burn planning as well as the impact of bushfires.
- A number of weed species were reported as having adverse impacts.
- Pest animals also had adverse impacts, with the European red fox and cats being the most serious and widespread.
- The Department continues to implement appropriate weed, pest and disease management practices and control programs, including, as part of the *Western Shield* program, fox baiting on over 2.13 million hectares within the area covered by the FMP, the control of feral pigs, rabbits, arum lily, bridal creeper, blackberry and other declared and priority environmental weeds.
- *Phytophthora cinnamomi* was introduced or potentially spread in some disturbance operations in both conservation reserves and State forest (see the report on KPI 18 in Appendix A). There was inconsistent application of the dieback policy and subsidiary guidance documents across operations.
- Disturbance operations associated with timber harvesting and mining in State forests had appropriately documented and generally well-managed hygiene planning processes in place. Other operations often lacked appropriate documentation, including hygiene management plans and the identification of protectable areas.
- The Department undertook a review of seed zones leading to improved management of rehabilitation.
- The Department has participated in a collaboration of government, research and industry partners supporting research into tree decline science and management in south-west Western Australia. An important collaboration addressed tuart decline and has increased knowledge about the contributing factors, however the number of forest declines and syndromes continues to increase.

Report on Key Performance Indicators

Summary information on KPIs is reported below. Further information is available in Appendix A.

KPI 16 The risk to conservation, life, property and other forest values posed by wildfire

Measure	*The area of forest by fuel age classification.*
Target	*General conformance with the theoretical distribution of time since fire for the whole-of-forest and for each Landscape Conservation Unit.*

- The area of forest by fuel age shows general conformance with the target at the whole-of-forest scale.

- The area of forest by fuel age also shows general conformance with the target for most Landscape Conservation Units. However, the fuel age distribution for some Landscape Conservation Units does not conform well.

Response to target shortfall

- The reasons for the fuel age distribution for some Landscape Conservation Units not conforming to the theoretical distribution generally relate to achieving a balance between the range of management objectives considered in burn planning as well as the impact of bushfires.
- Underlying limitations in the data (as explained further in Appendix A) are important to consider. These limitations mean that older fuels are under recorded.

KPI 17 The severity status of weeds and pests as determined by subjective survey

Measure	*List of important weeds and pests and their severity status that tracks movements of species between severity categories.*
Target	*No weed or pest to increase in severity status as a result of management actions.*

- A number of weed species were reported as having either a restricted or widespread distribution with adverse impacts.
- A number of serious weeds have emerged across the FMP area and some of these may in the future significantly affect conservation values.
- Pest animals have had adverse impacts, with the European red fox and cats being the most serious and widespread.

KPI 18 Effectiveness of dieback hygiene

Measure	*The number of sampled areas not infested with* Phytophthora cinnamomi *that remain uninfested following an operation with an approved hygiene management plan.*
Target	*No uninfested protectable area to become infested as a result of management actions.*

- The performance target was not achieved. *Phytophthora cinnamomi* (*Phytophthora* dieback) was introduced or potentially spread in some disturbance operations in both conservation reserves and State forest.
- There was inconsistent application of the dieback policy and subsidiary guidance documents across operations.
- Disturbance operations associated with timber harvesting and mining in State forest had appropriately documented and generally well-managed hygiene planning processes in place.
- Hygiene failures were evident in 25 per cent of the 85 protectable areas sampled within the harvest areas (see the report on KPI 18 in Appendix A). Fourteen per cent had new infestations or extensions, while 11 per cent had evidence of a breach in hygiene that put the area at potential risk of infestation.
- The total area put at risk from these hygiene failures was 0.4 per cent of the total protectable area of 10,171 hectares that was sampled. The small proportion was due largely to the hygiene failures occurring close to downslope diseased boundaries.
- In contrast, in both the formal conservation reserves and State forest those disturbance activities not associated with timber harvesting or mining often lacked appropriate documentation, including hygiene management plans and the identification of protectable areas.

- Within the non-harvest operations, 43 per cent of the sites were compromised. Twenty-nine per cent had confirmed infestations and 14 per cent had a hygiene breach that could lead to infestation. These results reflect a combination of diminished hygiene planning and management as well as the effectiveness of any hygiene tactics adopted during field operations.
- Availability of resources for management of dieback across many parts of the management system has contributed to performance.

Response to target shortfall

- The Department has established a *Phytophthora* Dieback Management Coordination Group (with senior representation across all operational divisions) to improve the delivery of planning and management for all operations on lands managed by the Department.
- Initiatives to provide increased awareness of the dieback policy and subsidiary guidance documents, improved focus on risk assessment in hygiene management planning, and revision of hygiene training, accreditation and manuals have either commenced or are in preparation.
- Ongoing monitoring of the effectiveness of hygiene management will be necessary to ensure continuous improvement in hygiene tactics and implementation standards.
- A review and risk-based prioritisation of the resources necessary for management of protectable areas in the long term will be necessary.
- The Department will examine options for the future access and management of public firewood collection in the development of the draft Forest Management Plan 2014-2023.

Progress on actions identified in the mid-term audit report

Topic	Action	Response
Risk from fire to native timber and plantation	The FPC to complete analyses of the risk from fire to native timber and plantation production resources as required by Actions 17.2 and 17.4.	The risk from fire has been addressed in the FPC's Integrated Forest Management System.
Working arrangements for fire management	Working arrangements for fire management between the Department and the FPC to be finalised and implemented.	Draft working arrangements on fire have been prepared, but remain the subject of consultation between the Department and the FPC.
Dieback	The Department to review Volume 1 of the *Phytophthora cinnamomi and Disease Caused by It Guidelines*.	Work has commenced on a review of documents relating to dieback management guidelines. A review of Volume 1 of the *Phytophthora cinnamomi and Disease Caused by It Guidelines* will occur as part of this process and outcomes of the process will be considered during the next FMP.

Dieback	The Department to review the interim *Phytophthora* dieback management policy endorsed by the Conservation Commission after a trial period of one year.	Review of the management policy is underway.
Dieback	The Conservation Commission to offer further advice to the EPA and the Minister for Environment on management of dieback after its performance assessment scheduled for 2009. The EPA noted in its report on the mid-term audit that disease in the forest was a key concern to it, the Conservation Commission and the community. The EPA said that it was prepared to work with the Conservation Commission and agencies to establish an appropriate framework that supports a whole-of-government approach to improved protection of the important but threatened flora of the state.	The Conservation Commission published its performance assessment of *Phytophthora* dieback management on lands vested in the Conservation Commission in February 2011. The review included a number of key findings and recommendations. The review, including the Department's response to the review recommendations, is available on the Conservation Commission website (www.conservation.wa.gov.au). The Department and the Conservation Commission will work with the EPA in the development of a State *Phytophthora* dieback management strategy if required.

Fire management	The Conservation Commission would like to see post-burn monitoring and review become part of the routine outcome of the Department's prescribed burns.	Each burn plan has a requirement for a post-burn evaluation that provides for an assessment of the degree to which the success criteria have been met. In areas that contain fire-sensitive species, ecosystems and habitats, these are monitored to ensure that the prescribed fire has achieved the stated objectives of protection, regeneration or fire exclusion. Logistical and resourcing constraints mean it is not feasible to monitor the effects of all prescribed burns on biodiversity. The expanding network of FORESTCHECK monitoring sites together with ongoing research is providing some on-ground monitoring capability and an increasing understanding of the effects of fire management on the forest biota. The Department acknowledges that if resources were not limiting, then increased levels of research and monitoring of fire management outcomes, including fire exclusion, would be desirable.
Fire – inadequate weighting to biodiversity	The Conservation Commission will maintain its performance assessment of fire management as a priority within its work program. The EPA supported the Commission's intention to maintain its performance assessment of fire management as a priority within its work program.	The Conservation Commission has scheduled a performance assessment of fire management to assist in the development of the draft Forest Management Plan 2014-2023.

Considerations for future management

- Dieback management may be improved by a renewed focus and resources to address:
  - updating of guidance documents
  - awareness and training to staff and others accessing the FMP area
  - clarification of the roles and responsibilities
  - risk assessment in planning and implementation
  - ongoing monitoring of management effectiveness, together with improvement in the management of records of disease mapping and hygiene management plans.
- There are some emerging weeds and the potential for increased impacts from weeds, pests and diseases associated with climate change. There is a need to develop an asset-based prioritisation process and increased capacity to monitor and response to emerging threats.

- There is a need to continue to improve the data on which fuel age distribution is based as the data currently under-represent the area of older fuels.
- Options for continuous improvement of monitoring of biodiversity outcomes with respect to fire management should be considered in the development of the draft Forest Management Plan 2014-2023.

6. Soil and water

Summary of performance

- The extended period of below average rainfall has had a major impact on water availability in the FMP area and meant that the overall objective of the plan to protect water resources has not been achieved. Two of the three KPIs used in the FMP to measure the protection of water resources showed a diminished condition due to reduced streamflow.
- The target of no site with aquatic fauna significantly different to reference condition was not achieved. Of the 51 sites sampled, 16 were classed as significantly impaired and eight were classed as severely impaired. All of the severely impaired sites were in jarrah forest. Rainfall and streamflow appeared to be strong influences on aquatic macro-invertebrate communities. Many sites that received a rating of significantly or severely impaired are in the northern part of the FMP area or in areas of low rainfall.
- The target to maintain streamflow was not achieved and annual streamflow declined by 12 to 50 per cent compared to 1975–2003. The decline was greatest in the northern jarrah forest. Declining rainfall is considered to be the main reason for reduced streamflow.
- Streams in all fully forested catchments remained fresh with annual flow weighted mean salinity around 100 to 200 milligrams per litre.
- In 2011, the Department published the results of long-term research of the hydrological impact of timber harvest and associated silviculture treatments in the jarrah forest. The study showed a low risk of stream salinity in the intermediate rainfall zones.
- Both the Department and the FPC have invested substantial resources into planning and managing operations to reduce soil damage. This process has resulted in clear improvements in the protection of soil under the FMP.
- A soil dryness index, two-stage approvals process, operational controls and monitoring protocols were introduced to manage the risk of soil damage according to seasonal conditions, soil type and operation type.
- A manual, tool and field guide have been developed for the management of surface water supported by training of officers and contractors to Certificate II or III level in Conservation and Land Management.
- FPC officers and their contractors apply a risk-based combination of visual surveillance triggers and formal survey techniques to monitor operations and suspend the movement of heavy vehicles before soil damage limits are exceeded.
- An adaptive management trial investigated the use of cording and matting to reduce soil compaction and rutting under moist soil conditions, leading to improvements in guidance documents and operational practices.
- Soil disturbance limits were exceeded at a relatively small number of sites each year. Tracks created by harvest vehicles accounted for the majority of occurrences where limits were exceeded. Factors that influence the ability to remain below allowable limits are forest type, vehicles used for harvest, topography, dimensions of harvest area and hygiene requirements.
- The Department and the FPC have continued to recognise and protect water quality and aquatic ecosystems through planning, approvals and monitoring. Key elements of this

process include demarcation and protection of stream reserves, management of salt-sensitive and high salt risk areas, spills management for pesticides and/or hydrocarbons, the location, design and drainage of roads, identification and management within acid sulphate soil risk zones and operational controls associated with public drinking water source areas.

Report on Key Performance Indicators

Summary information on KPIs is reported below. Further information is available in Appendix A.

KPI 19 Annual flow weighted mean salinity and the trend for streams in fully forested catchments

Measure	*Annual flow weighted mean salinity and the trends for selected gauging stations.*
Target	*Salinity trends to be neutral.*

- The target for salinity trends to be neutral for fully forested catchments was achieved.
- Streams in all fully forested catchments remained very fresh with annual flow weighted mean salinity around 100 to 200 milligrams per litre.
- Some catchments with small amounts of permanent clearing in the lower slopes were not fresh and had more variable stream salinity.
- Changes in groundwater level and flow regime (see KPI 22) appeared to be influencing salinity trends.

KPI 20 The percentage of water bodies (e.g. stream kilometres, lake hectares) with significant variance of biodiversity from the historic range of variability

Measure	*The diversity of aquatic macro-invertebrate fauna at a selected number of monitoring sites.*
Target(s)	*No sites with fauna significantly different from the reference condition.*

- A model that predicts aquatic macro-invertebrate richness (AusRivAS) was used to compare 51 stream sites to minimally disturbed reference sites.
- The target of no sites with fauna significantly different to reference condition was not achieved.
- Of the 51 sites, 16 were classed as significantly impaired and eight sites were classed as severely impaired. All of the severely impaired sites were in jarrah forest.
- Rainfall and streamflow appeared to be strong influences on aquatic invertebrate communities. For example, 18 of 51 sites were dry in 2010 and only three were in the reference condition. Almost half of the sites were dry on at least one sampling occasion.
- At all sites, macro-invertebrate communities varied annually and no site had the same AusRivAS band rating for all six years. Even reference sites received a rating of significantly impaired in at least one year.
- Many sites that received a rating of significantly or severely impaired are in the northern part of the FMP area (north of Dwellingup) or in the lower rainfall zone. Others are naturally saline or naturally acidic. For these sites, the model may have over-estimated expected richness.
- Some fully forested sites in the high rainfall area, which are not saline or acidic, also received a significantly impaired rating.

Response to target shortfall

- The reasons for aquatic fauna to be significantly different from the reference condition were unclear, although most cases of apparent impairment seem to be related to low rainfall and to shortcomings in the AusRivAS model.
- Drier conditions have resulted in many streams flowing for a shorter period which may have reduced the survival of aquatic macro-invertebrates.
- While the AusRivAS model provides a good benchmark against which to judge the degree of disturbance in stream, the model has some shortcomings. There are very few AusRivAS reference sites located on small seasonal streams or in the south east lower rainfall areas, which means sites in these areas may be rated incorrectly and the model may not be robust to the impacts of climate change in terms of being able to identify the effects of other impacts.
- Several sites which are brackish, saline or acidic may fall outside the limits of the AusRivAS model as they have been compared to reference sites in the model with better water quality. Consequently, these sites have received an impaired rating even though observed richness may be close to natural for these sites.

KPI 21 The level of soil damage resulting from timber harvesting

Measure	*Soil damage by risk category as measured by survey.*
Target	*Soil damage not to exceed prescribed maximum levels.*

- The severe and highly visual forms of soil damage, such as rutting, puddling and mixing, were rarely seen in association with timber harvest operations.
- A major effort has gone into minimising compaction by undertaking surveys in harvest coupes.
- These surveys indicated that soil disturbance limits were exceeded at a relatively small number of sites in every year between 2005 and 2011.
- The limits were exceeded mainly in jarrah forest.
- Significant refinements and adjustments in operational practices, monitoring procedures and monitoring effort meant that it was not possible to directly compare results between years in order to look for trends over time.

Response to target shortfall

- Tracks created by harvest vehicles accounted for the majority of recorded disturbance at sites where allowable soil disturbance limits are exceeded.
- The Department investigated instances where allowable limits were exceeded and has recognised that there are sites where it is difficult to remain below the allowable limits, even with good application of machine harvesting.
- The factors that influence the ability to remain below allowable limits are forest type, vehicle, topography, cell dimensions and hygiene requirements.

KPI 22 Water production

Measure	*Streamflow of selected forest streams.*
Target	*Streamflow to be maintained.*

- The target to maintain streamflow was not achieved in all 15 main catchments monitored.
- Annual streamflow over the period 2004–2009 declined by 12 to 50 per cent, compared to the 1975–2003 average and the decline was greatest in the northern jarrah forest.
- The average period of the year for which streams flowed decreased by two weeks and the pattern of flow for a number of streams shifted from perennial to intermittent.
- The annual maximum flows decreased by around 20 per cent.

Response to target shortfall

- Declining rainfall is considered to be the main reason for streamflow decline.
- The rainfall decline caused declining groundwater levels and disconnection of groundwater systems from streams.
- Forest structure and density are considered to have exacerbated streamflow decline for some catchments where timber harvesting prior to the 1930s led to regrowth forests which have relatively high leaf area and relatively high water use.

Progress on actions identified in the mid-term audit report

Topic	Action	Response
Dieback hygiene during moist soil harvesting	The Department to review planning and operational procedures during 2009–2010 to ensure that dieback hygiene during timber harvesting in moist soil conditions is properly considered.	Dieback hygiene continues to be addressed as a matter of importance in the planning, approval and monitoring of timber harvesting operations during moist soil conditions. Dieback hygiene risk is specifically addressed in both strategic and feller's block level approvals for operations under most soil conditions.
Soil damage in plantations	The Department to define damaged soil and specify rehabilitation standards for soils that have been damaged in plantation areas.	Commenced, not completed.
Soil damage limits	The Department to report to the Minister for Environment on the cause of soil damage exceeding maximum prescribed levels.	The Department provided this report in April 2009. An update on the status of KPI 21 was subsequently provided to the Minister in December 2010.

Topic	Action	Response
Machine harvesting and soil disturbance	The FPC to provide the Conservation Commission with a response to the Conservation Commission's concern that the trend to increased use of machinery for timber harvesting will lead to further shortfalls in the area of soil disturbance. The EPA noted in its report on the mid-term audit that it was clear that operators in the forest, particularly those employed through contractors, must have the necessary skills and knowledge of relevant prescriptions applying in the forest. This is an increasingly important matter as failure to follow these prescriptions should be subject to clear management action.	The FPC provided the Conservation Commission with a report on machine harvesting in June 2009. The report is available on the Conservation Commission's website (www.conservation.wa.gov.au). Since the mid-term audit report, the FPC has implemented an Integrated Forest Management System which captures the requirements of the Environmental Management Standard ISO 14001 and the Australian Forestry Standard. The Integrated Forest Management System is independently audited annually to ensure it is managed according to these standards. A component of the Integrated Forest Management System requires all the FPC personnel operating in the forest, including FPC contractors' personnel, be provided with an induction into the requirements of the Integrated Forest Management System before commencing operations. In addition to this, operations are monitored by the FPC staff to ensure standards are maintained and both internal and external audits of operations are undertaken.
Consultation between departments/ agencies on water issues	A greater level of cooperation and consultation between the Conservation Commission, the Department, the FPC, the Department of Water and the Water Corporation regarding the potential conflict between actions specified in the FMP and the requirements of water source protection plans, particularly in relation to fire and recreational use.	This issue will be considered in the process of development of the draft Forest Management Plan 2014-2023.
Water quantity	Government as a whole should address the question of whether it is reasonable to expect that forests can, or should, be managed to maintain or enhance water supply in the current drying climate.	Results of trials undertaken during this plan period relating to water quantity will be evaluated and this information will be considered in the process of development of the draft Forest Management Plan 2014-2023.

Considerations for future management

- Declining rainfall has significantly impacted water availability in the FMP area and predicted future climate change is likely to lead to further impacts. Further declines in streamflow and impacts on aquatic environments are likely. Opportunities for adaptive management to ameliorate the impacts of climate change should be considered during the term of the next FMP.
- The risk to stream salinity from timber harvesting has declined as a result of declining groundwater levels and settings that have been in place for the FMP and the previous management plan should be reviewed. Predicted future climate change is likely to lead to further decreases in groundwater levels, and thus possibly lower salinity risk in the FMP area over time.
- Soil disturbance limits were developed prior to the widespread application of machine harvesting. Monitoring under the current plan has identified circumstances where current soil disturbance limits are difficult to achieve even with the application of good practices in machine harvesting and the allowable limits should recognise this.
- Ongoing monitoring of soil and water values through KPIs based on those used in the FMP is required. However, each of the KPIs requires review to improve the data collected, the methods of analysis and assist interpretation of achievement of the objectives of the FMP.

7. Global carbon cycles

Summary of performance

- The Department commissioned a consultancy report on *Best Practice in Incorporating Climate Change into Forest Management Planning*, which was completed in 2008. A report on *Vulnerability of Forests in South-West Western Australia to Timber Harvesting Under the Influence of Climate Change* was completed in 2009. The expert review of silviculture practices also examined the impact of climate change and made recommendations about adaptation to climate change.
- The Department has commenced the development of a carbon stock modelling project for the FMP area.
- The Department has been involved in initiatives to advance understanding of, and response to, climate change. These include the Indian Ocean Climate Initiative which is working to generate better regional climate change information, and a collaborative research project with the South African National Biodiversity Institute to investigate the potential impacts of climate change on Western Australian ecosystems. Through the Indian Ocean Climate Initiative the understanding of the factors driving climate change in the south-west of Western Australia has improved substantially.
- The Department is participating in an ARC research project relevant to granite outcrops as refugia.

Report on Key Performance Indicators

There are no KPIs for this chapter.

Progress on actions identified in the mid-term audit report

Topic	Action	Response
Climate change	The Conservation Commission to prepare a paper to identify and scope the issues that need to be canvassed via Government, relevant agencies and stakeholders for a wide-ranging and public discussion of forest management under a changing climate. An indication of the Conservation Commission's current thinking is that the following matters need to be included: • the adequacy of the conservation reserve system and its management under a changing climate • the adequacy of the formal and informal reserve and fauna habitat zone system in establishing a sufficiently	Not complete. Where relevant these issues were considered in the review of silviculture practices. The report is available on the Department's website (www.dec.wa.gov.au). This issue, with options for how it might be addressed, will be considered in the process of development of the draft Forest Management Plan 2014-2023.

	connected landscape-scale network • the range of values and uses that the forest can support under a changed climate, e.g. whether timber harvesting can continue under the present Silviculture Guidelines across the entire State forest estate outside of the informal reserves and fauna habitat zones, or whether some areas of forest will no longer be able to support timber harvesting either generally or in terms of some silvicultural treatments • the quantity and quality of water for human and ecosystem use that can be provided by forest environments under a drying climate. Competition for water between the terrestrial and aquatic components of the ecosystem, compounded by demands for human use, requires a whole-of-government resolution. Access for recreation has become an issue of public concern in recent times, and could be considered in this process • the need to review the management of weeds, pests and disease so as to reduce the threats that the forest is subject to, as an adaptation strategy to build ecosystem resilience • the need to review the impact of fire, both planned and unplanned, on forest and community values, and to consider whether current practice will remain appropriate as the climate dries and temperatures increase. In its report on the mid-term audit, the EPA acknowledged and supported the concern of the Conservation Commission on the critical and difficult issue of climate change.	

	The EPA noted that it has serious doubts that continued logging in the low rainfall zone and adjoining medium rainfall zone in the eastern portion of the forest would be capable of meeting ecologically sustainable forest management objectives and that this would be a key matter for consideration in the development of the next forest management plan.	
Climate change	The Conservation Commission requested that the Department give greater weight to climate change whenever it makes management decisions.	The Department has incorporated design preferences for landscape connectivity, topographic aspects (south-facing slopes) and perennial water sources in the *Guidelines for the selection of fauna habitat zones.* In 2009 an expert panel was formed and reported on *Vulnerability of forests in south-west Western Australia to timber harvesting under the influence of climate change.* Advice from the panel has informed the preparation and review of the subsequent three-year harvest plans and the review of silviculture practices. The report is available on the Department's website (www.dec.wa.gov.au).
Carbon balances	The Conservation Commission is aware of significant work being undertaken across the country in terms of carbon balances in native forests and encourages the Department to develop similar work programs to inform the preparation of the next plan.	The Department is undertaking work on carbon stores as part of development of the draft Forest Management Plan 2014-2023.

Considerations for future management

- The Conservation Commission and the Department should seek to identify mitigation and adaption opportunities in response to future climate change.
- Further work will be required for carbon stock prediction for the FMP area.
- The issue of whether the low rainfall zone and adjoining medium rainfall zone in the eastern portion of the forest would be capable of meeting ecologically sustainable forest management objectives will be considered in the development of the draft Forest Management Plan 2014-2023.

8. Natural and cultural heritage

Summary of performance

- The majority of registered heritage sites have not been disturbed. However, the target of no disturbance of a registered site without formal approval was not achieved as one registered heritage site was disturbed without approval.
- The Department has a formal Memorandum of Understanding with the South West Aboriginal Land and Sea Council which is the native title representative body for the FMP area.
- The *Conservation Legislation Amendment Act 2011* has passed through Parliament and provides for joint management of land between the Department and others, including traditional owners, and expands the range of customary activities that can be undertaken on lands and waters managed by the Department.
- The Department has drafted supporting regulations for the *Wildlife Conservation Amendment Regulations 2012, the Conservation and Land Management Amendment Regulations 2012* and the *Forest Management Amendment Regulations 2012.*
- The Department has increased the delivery of cross-cultural awareness to Departmental staff.

Report on Key Performance Indicators

Summary information on KPIs is reported below. Further information is available in Appendix A.

KPI 23 The identification and protection of cultural heritage

Measure	*The number of existing and new heritage sites identified in management planning and the number protected.*
Target	*No disturbance of a registered place without formal approval.*

- The target of no disturbance of a registered site without formal approval was not achieved as one site was disturbed without formal approval.
- The majority of registered heritage sites have not been disturbed.
- Nine registered heritage sites were disturbed with approval for the purpose of maintaining or improving the values of these sites.

Response to target shortfall

- The Department investigated the unauthorised disturbance related to removal of bridge timbers at the Shannon River Bridge on the old Chesapeake Road, but was unable to determine the time, date or persons involved in this unauthorised activity.

KPI 24 Consultation and involvement of Aboriginal people in forest management

Measure	*Establishment of the Nyoongar working group.* *Issues addressed by the Nyoongar working group.* *Statutory referrals required under native title legislation.*
Targets	*Nyoongar working group to be established by 31 December 2004.* *All statutory referrals made.*

- The Department has a formal Memorandum of Understanding with the South West Aboriginal Land and Sea Council, the native title representative body for the FMP area.
- Within the South West Aboriginal Land and Sea Council there are various working parties with which the Department has an established relationship to identify, interpret, protect and manage significant cultural sites.
- The *Conservation Legislation Amendment Act 2011* allows for joint management of land between the Department and others, including traditional owners, and expands the range of customary activities that can be undertaken on lands and waters managed by the Department.

KPI 25 The protection of heritage places through representation in reserves

Measure	*Representation of heritage values in the existing and proposed formal and informal reserve system.*
Target	*The Department and the Conservation Commission to complete all actions for which they are responsible in order to formally change the land category of areas proposed for the reserve system within 10 years after the commencement of the plan.*

- There has been a large increase in the number of Aboriginal sites indentified on land managed by the Department, leading to a higher number within the formal and informal reserve system.
- There has been a reduction in the number of Heritage Council sites on the register from 2008 to 2011.
- The overall effect of these changes means that there are now a lot more heritage places in the reserve system than reported in the mid-term audit report. See the report on KPI 25 in Appendix A for further details.
- Overall, there has been little progress on implementing proposed land category changes since the mid-term audit report due to impediments outside the control of the Department and the Conservation Commission (see report on KPI 1 for further information).

Progress on actions identified in the mid-term audit report

Topic	Action	Response
Consultation and involvement of Aboriginal people	The Department will report to the Minister for Environment with respect to the alternative arrangements established for consultation and involvement of Aboriginal people in forest management.	Not completed. This process has been overtaken by negotiations with the South West Aboriginal Land and Sea Council and progress towards a comprehensive native title settlement. Refer to KPI 24 for further information.
KPI 23 The identification and protection of cultural heritage	The Conservation Commission requests the Department to collate statistics on the number of existing and new heritage sites identified in planning and the number protected for the next KPI report. The Department to review the protocol for this KPI if data availability continues to be a concern.	The protocol was reviewed by the Department and a revised protocol was approved in May 2010. The revised protocol can be found on the Department's website (www.dec.wa.gov.au) in the document; *Protocols for measuring and reporting on the KPIs of the Forest Management Plan 2004–2013*.

Considerations for future management

- Implementation of the *Conservation Legislation Amendment Act 2011* requirements including:
    - development of guidance documents
    - implementation of the South West Native Title Settlement Agreement
    - progressive survey of Aboriginal heritage values
- Implementation of the supporting regulations for the *Wildlife Conservation Amendment Regulations 2012,* the *Conservation and Land Management Amendment Regulations 2012* and the *Forest Management Amendment Regulations 2012*.
- Options to improve the analysis and documentation of heritage places needs to be considered in the development of the draft Forest Management Plan 2014-2023. There currently appear to be inconsistencies in the identification and mapping of heritage sites.

9. Socio-economic benefits

Summary of performance

- National parks were the main focus for recreation within the FMP area but State forest also offered opportunities and facilities for recreation. There has been a general increase in visitation to recreation sites from approximately five million in 2003/04 to approximately seven million in 2010/11. Visitor response to surveys showed a high level of satisfaction with their experience.
- The Department has continued to manage the increasing demand for recreational activities on land managed by the Department through the issuing of leases, licences and permits for commercial tourism uses.
- Procedures for the management and rehabilitation of basic raw material pits were reviewed and revised. In 2010, the vast majority of basic raw material was extracted from State forest and timber reserves and the FPC was the main user of basic raw materials.
- The Ministers for Environment and Tourism announced the implementation of recommendations from the Nature-Based Tourism Review on 7 December 2011. This includes longer-term leases (up to 99 years subject to amendment of the *Conservation and Land Management Act 1984* (CALM Act)) and longer term licences (up to 15 years in total), which will benefit the tourism industry and tour operators. This has been well received by local tourism organisations, particularly in the south-west.
- The Department has established a public off-road vehicle area at Pinjar and is continuing to improve the facilities, trails, maintenance and management of the area to reduce risks associated with un-managed off-road vehicle activity, and provide a safe and enjoyable alternative to illegal off-road vehicle activity in other areas.
- The first stage of the Munda Biddi Trail, from Mundaring to Collie, was opened in 2004, and by 2008 the trail had been extended to Nannup. The Department is continuing to extend the trail through to Albany.
- The Bibbulmun Track was completed in 1998 and in 2008 it was estimated that the track generated approximately $39 million of expenditure per year in the towns and regions that it passes through.
- Mining companies have sought increased access to the FMP area, especially for new proposals for bauxite mining in eastern and southern forest areas.
- The condition of roads and bridges in the FMP area continues to deteriorate because of the age of the structures. The Department has made significant progress towards the development and adoption of road management guidelines to deal with this issue.
- The Department has published the following policy documents related to its Parks and Visitors Services that apply to the FMP area:
  - Policy Statement 18 – *Recreation, Tourism and Visitor Services* (2006)
  - Policy Statement 62 – *Identification and Management of Wilderness and Surrounding Areas* (2004)
  - Policy 69 – *Acknowledgment of Aboriginal traditional custodians* (2011)
  - Policy 69 – *Guidelines for Acknowledgment Statements and Welcome to Country procedures* (2010).

- There has been major improvement in the working relationship and definition of roles and responsibilities between the Department and the Fire and Emergency Services Authority for fire management including collaboration with WA Police and Main Roads WA for road management.

Report on Key Performance Indicators

Summary information on KPIs is reported below. Further information is available in Appendix A.

KPI 26 Number, range and use of recreation/tourism activities available by proposed land category in the plan area

Measure	*Type and number of recreation and tourism facilities available in the plan area (e.g. picnic sites, campsites, toilets, visitor centres, walking trails, or major tourism developments).* *The number of visits to selected recreation areas.* *The satisfaction visitors express with their experience.*
Target	*Visitor satisfaction maintained at high levels.*

- National parks were the main focus for recreation within the FMP area but State forest also offered opportunities and facilities for recreation.
- There has been a general, significant increase in visitation to recreation sites from approximately five million in 2003/04 to approximately seven million in 2010/11.
- Visitor response to surveys showed a high level of satisfaction with their experience.

KPI 27 Basic raw material supply

Measure	*The number of notices of entry served to the Department under the Local Government Act.*
Target	*No target, trends to be reported.*

- The Department has undertaken a review of procedures for the management and rehabilitation of basic raw material pits allowing volumes of material removed across land categories and by agency to be reported for the first time.
- In 2010, the majority (97 per cent) of basic raw material was extracted from State forest and timber reserves, with the remainder from national parks.
- The FPC was the main user of basic raw material with gravel being the main resource accessed.

Progress on actions identified in the mid-term audit report

Topic	Action	Response
Access to basic raw materials	The Department and the FPC should develop a process to provide access to basic raw materials for the FPC's roading requirements associated with timber harvesting in State forest, which is within the current institutional framework.	This work was completed and arrangements between the Department and the FPC were signed in August 2011.
Adventure activities	The Conservation Commission will work with the Department to develop a policy for adventure activities and events on land vested in the Conservation Commission.	In September 2009 the Conservation Commission endorsed the Department's draft Management of Organised Group Activities Policy. The policy incorporates improvements to planning, assessment and approval of competitive events and events in high biodiversity risk areas, consideration of management plan actions when assessing applications and limits to activities that can take place in nature reserves.
KPI 27	The Conservation Commission will discuss with the Department the opportunity to develop a system that captures basic raw material extraction by the Main Roads Department, the FPC and the Department	The Department undertook a review and revision of procedures for the management and rehabilitation of basic raw material pits. Work on an improved data capture system was completed in July 2011. Documentation provided to Main Roads WA and Shires to authorise access to Department-managed land for the purpose of extracting basic raw material has been updated to include the requirement for extraction returns for each pit.

Considerations for future management

- Continued liaison with Main Roads WA and local government is required to manage the expected increasing demand for basic raw materials from land managed by the Department for use on both public infrastructure and Departmental roads.
- An improved database is desirable for the recording and management of areas from which basic raw materials have been extracted. Development of plans and works programs for the rehabilitation of these areas are also required.
- Implementation of the findings of the *Nature-Based Tourism Review* (2011) including legislative change to facilitate longer-term leases.
- The population of the Perth to Bunbury area is predicted to increase significantly over coming decades and this is likely to lead to increasing demand for recreation facilities. The nature of recreation activities is also likely to change. New and innovative ways to manage the steady increase in visitation and the expectations of users of the FMP area will be required.

- Increased focus is required on the provision and management of active recreation sites to reduce risks associated with un-managed off-road vehicle activity, and provide a safe and enjoyable alternative to illegal off-road vehicle activity in other State forest areas.

10. Plan implementation

Summary of performance

- Audits were undertaken by the Department, the FPC and Conservation Commission to facilitate improvements to practices and management systems. Over the course of the FMP the Conservation Commission undertook and published the following performance assessments to assist it in assessing whether management was being undertaken in accordance with the plan:- The protection of informal reserves, The selection and management of fauna habitat zones, Dieback management, Protection of significant flora and understorey species, and Prescribed burning and master burn planning.
- The Department has not developed an environmental management system to a standard suitable for certification. However, work progressed on incorporating these principles into aspects of the Department's management system.
- Adaptive management trials have been conducted on a range of issues relating to implementation of the FMP. The topics addressed include fire and biodiversity, control of *Armillaria*, cording and soil disturbance, structural diversity in karri forest and silvicultural treatment to increase streamflow.
- The Department continues to publish and make publicly available information on forests and forest management including activities, programs, forums and invitation for public comment on draft management plans and guidance documents.
- There has been a significant increase in knowledge in relation to sustainable forest management as a result of the publication of peer-reviewed scientific papers, with a total of 136 being published between July 2004 and June 2011. Publications relating to biological diversity and ecosystem health and vitality were the most common. A further 11 peer-reviewed scientific papers were published after June 2011 on the results of FORESTCHECK monitoring of the impacts of timber harvesting on biodiversity.
- Both the Department and FPC continue to maintain Registered Training Organisation status. The Department maintains an active training program to address recognised performance gaps and to provide for career development of staff. Training programs are available for a wide range of subject areas including fire management, silviculture, field operations, flora and fauna conservation, occupational health and safety and organisational leadership. The FPC had 56 staff members complete its recruit training program.
- Of the guidance documents required by the FMP, seven have been finalised or reviewed, one is in interim form, one has been approved and held pending completion of a related document and six are in preparation.
- The Department has made important contributions to national environmental reporting through the *State of the Forests Report* and *State of the Environment Report*.

Report on Key Performance Indicators

Summary information on KPIs is reported below. Further information is available in Appendix A.

KPI 28 Adaptive management

Measure	*The number and topic of formal adaptive management trials.*
Target	*Within five years, trials will be held into at least two separate issues detailed in the plan's action statements.*

- Adaptive management trials have been conducted on a range of issues relating to implementation of the FMP. Some of the topics addressed by adaptive management trials include:
    - the potential biodiversity benefits resulting from fine-grained fire mosaics
    - practical options and methods for control of *Armillaria* root disease in karri regrowth forest
    - the use of cording to reduce soil disturbance during timber harvesting operations
    - an alternative approach to improving structural diversity in the karri forest subject to timber harvesting
    - increasing streamflow by silvicultural treatment of native forest and rehabilitated bauxite pits.

KPI 29 Provide for public involvement activities and public education, awareness and extension programs and make available forest-related information

Measure	*Compilation of programs for public involvement, education, awareness and extension programs.*
Targets	*Available programs and numbers of the community exposed to programs increases over time.*

- Volunteers made a strong contribution to projects in the FMP area providing around 40,000 hours of work per year.
- The Department continued to offer EcoEducation opportunities which are popular and showed an increased level of interest with 10,000–15,000 participants each year.
- The Department provided the community with culturally significant educational opportunities relating to the FMP area.
- Public information on forest management that is available on the Department's website showed continued interest through the level of visitation.
- The Department published and made publicly available information on forests and forest management including activities, programs, forums and invitations for public comment on draft management plans and guidance documents.

KPI 30 Develop and maintain human resource skills across relevant disciplines

Measure	*The extent to which the Department demonstrates the capacity and commitment to develop and maintain the essential skills of staff.*
Target	*Persons responsible for undertaking key tasks on average meet 80 per cent of the competency requirements for key tasks indicated in the environmental management system.*

- Both the Department and FPC continue to maintain Registered Training Organisation status.
- Since initiation of a training program for recruits in 2004, 56 staff members from the FPC completed this program.

- The Department has maintained an annual financial commitment of at least $250,000 into training staff employed in the FMP area (records are incomplete). In addition, a range of scholarships and development opportunities is offered each year.

KPI 31 Development of scientific understanding of ecosystem characteristics and functions

Measure	*Expenditures on research and development related to ecologically sustainable forest management;* *Person years of scientific research, by ecosystem or disciplinary area of study, in the field of ecologically sustainable forest management; and/or* *Number of peer-reviewed articles published annually on ecologically sustainable forest management.*
Target	*No target.*

- The Department continued to invest resources into improving scientific understanding of forest ecosystems. This investment is characterised by an annual expenditure of between $2.5 million and $3.2 million with a staff of about 20.
- A total of 136 peer-reviewed scientific papers was published from mid-2004 to mid-2011. Publications relating to biological diversity and ecosystem health and vitality were the most common. Subsequent to mid-2011, 11 peer reviewed scientific papers were published on the results of FORESTCHECK monitoring of the impacts of timber harvesting on biodiversity.

KPI 32 Environmental management system

Measure	*Development of a Departmental environmental management system (EMS) to a standard suitable for accreditation.*
Target	*EMS developed by December 2005.*

- The Department has not developed an environmental management system to a standard suitable for certification. However, work progressed on incorporating these principles into aspects of the Department's management system.

Response to target shortfall

- Given the significant cost of developing an environmental management system to a standard suitable for certification and competing priorities for resources, the Department decided to develop work processes and systems in line with the principles of an environmental management system.
- Work progressed on incorporating these principles into aspects of the Department's management system.

KPI 33 Operational control

Measure	*The extent to which guidance documents have been prepared / reviewed and management modified to improve ecologically sustainable forest management.*
Target	*All guidance documents referred to in the Actions proposed by the plan to be prepared/reviewed by mid-term.*

- The target of all guidance documents prepared/reviewed by mid-term was not achieved because resources were applied to higher priorities and the response to shortfall was reported in the mid-term audit report.
- Of the guidance documents required by the FMP, seven have been finalised or reviewed, one is in interim form, one has been approved and held pending completion of a related document and six are in preparation.

- Silvicultural guidelines to reflect the requirements of the FMP were approved by early 2005.
- The three key guidance documents identified as a priority for completion in the mid-term audit report were approved.
- Manuals and a field guide to support the Soil and Water Conservation Guidelines were approved.
- The Fauna Distribution Information System was endorsed for use.

Response to target shortfall

- The main reasons for the delay, relative to the target dates in the FMP, in finalising guidance documents since the mid-term audit report are:
    - the level of resources available and the competing priorities, particularly whole-of-State priorities and, in the FMP area, the continued implementation of the plan
    - emerging new priorities that the Department was required to service such as the response to the mid-term audit report through 2009 and 2010 and commencing development of the next forest management plan
    - involvement in fire emergencies which has seasonally impacted to a significant extent on works programs.

Progress on actions identified in the mid-term audit report

Topic	Action	Response
Public understanding of sustained yield	The Conservation Commission, in consultation with the Department, will investigate accessing the services of a scientific communicator for making information relating to sustained yield statistics and models available to the public.	The Department provided detailed briefing sessions in 2009 to representatives of voluntary conservation groups and the timber industry. The Department has commenced a project to publish web-based information in relation to sustained yields and models. This is intended to be available during the public comment period for the draft Forest Management Plan 2014–2023 to assist the public in understanding the methods used to calculate sustained yields.
Environmental Management System	The Conservation Commission finds the Department's statement that development of the EMS is considered a lower priority a matter of concern and will discuss options with the Department to resolve this shortfall.	Not completed. Refer to the report on KPI 32 for further details.
Environmental Management System (KPI 30)	The Conservation Commission notes that the FPC has an established EMS and expects that they	Not completed.

	will report on the performance target of the KPI by 31 July 2009.	
KPI protocols	The Conservation Commission requests that the Department and the FPC complete those KPIs for which they are responsible by 31 July 2009. For KPIs which require other agencies involvement, the Conservation Commission will work with the Department to finalise the protocols by 31 December 2009. The Conservation Commission also notes that there may need to be a revision of KPIs where data availability will continue to be an issue.	Four protocols were reviewed, revised and approved following the mid-term audit report, 10 protocols were prepared and approved for those KPI that did not previously have a protocol and there remain three KPIs for which there is not an approved protocol.
WINs and MLs	The FPC to provide a more timely response to Works Improvement Notices and Management Letters.	The Department has worked with the FPC staff to reduce the backlog of Works Improvement Notices and Management Letters requiring action and to improve the link between the Works Improvement Notices and Management Letters system and the FPC's environment management system. It is expected that further improvements will occur during the development and implementation of the next forest management plan.
Working arrangements	The Department and the FPC to finalise a Working Arrangement between the Department and the FPC as a matter of priority.	Working arrangements have been prepared, but not finalised. Both agencies operate in accordance with the draft arrangements.
Legislative clarity of the Department's relationship with proponents	With respect to the inadequate legislative clarity of the Department's relationship with proponents and how they operate on Department-managed land, the Conservation Commission offers the Department support in seeking appropriate powers under the CALM Act.	A review has been conducted with a view to improving the governance and operating arrangements. A number of changes and improvements to provide clearer regulation, division of responsibilities, accountabilities and transparency are intended. An implementation program arising from this review will be considered in the process of the developing the draft Forest Management Plan 2014-2023.

Legislative clarity of the Conservation Commission's relationship with the Department	Provide advice to the Minister for Environment concerning amendments to the CALM Act to create a statutory duty for the Conservation Commission to provide advice to the Minister for Environment, and for its tabling in Parliament, when substantial non-compliance with the FMP leading to serious environmental consequences appears likely. This matter was also addressed by the EPA in 2003. The EPA recommended that the Minister for Environment consider whether the Conservation and Land Management Act and the Forest Products Act should be amended to permit the Conservation Commission to require compliance with the approved plan where there has been a breach of compliance. If the proposed amendment was to proceed, it would go some way to addressing the previously stated concern of the EPA in relation to governance.	Not completed. This issue will be considered in the process of development of the draft Forest Management Plan 2014-2023.

Subsidiary guidelines	The Conservation Commission considers the lack of timely attention to subsidiary management guidelines by the Department to be unsatisfactory and requests that those guidelines listed in Appendix C be completed by 31 July 2009 (*Guidelines to Protect the Values of Informal Reserves and Fauna Habitat Zones*; *Guidelines for the Selection of Fauna Habitat Zones*; *Soil and Water Conservation Guidelines*). The EPA noted in their report that it supports the Commission's comments about the capacity of the Department to complete the actions in the FMP. Of particular concern is the lengthy delay in finalising a number of the key subsidiary documents that underpin the FMP and its implementation. The EPA reiterates its concern that many of these documents have yet to be approved.	*Guidelines to Protect the Values of Informal Reserves and Fauna Habitat Zones* were completed and approved by the Minister for Environment in October 2009. *Guidelines for the Selection of Fauna Habitat Zones* were completed and approved by the Minister for Environment in November 2010. The *Soil and Water Conservation Guidelines* were completed and approved by the Minister for Environment in December 2009. Further information on this topic is provided in the report on KPI 33 Operational control.
Operationalising the requirements of the FMP	The Conservation Commission's future performance assessments will continue to focus attention on the importance of having policy incorporated at the operational level.	The Conservation Commission's performance assessments routinely assess the implementation of policy at the operational level. Performance assessment reports can be found on the Conservation Commission's website (www.conservation.wa.gov.au).

Action 34.1.4	The Department and the Conservation Commission will initiate an independent expert review of silvicultural practices and their impacts on biodiversity during the second half of the life of the plan. The review will have regard to the results from FORESTCHECK and other research monitoring, audits, and adaptive management trials of these practices (in year 8 and end of year 9).	The review has been completed and recommendations by the expert panel will be considered as part of the process for the development of the draft Forest Management Plan 2014–2023.

Considerations for future management

- While a number of adaptive management trials have been undertaken since 2004, the opportunity to learn through operational scale experiments could be enhanced. For the period of the next forest management plan, opportunities for adaptive management to address the impacts of predicted climate change should be considered.
- Commitment to demonstrating conformity with an environmental management system appropriate to the scale and impact of the activities associated with the FMP, including provisions for performance review and a commitment to continuous improvement, should be considered.
- An increase in public reporting of compliance monitoring, incident management and auditing.
- The Department should consider providing information to the public on the systems and processes used to calculate sustained wood yields so as to inform discussion of the draft Forest Management Plan 2014–2023.
- Improvements to regulatory compliance need to be considered in the development of the draft Forest Management Plan 2014–2023.
- A review of silviculture practices has been undertaken by an expert panel and their recommendations should be considered during the development of the draft Forest Management Plan 2014–2023, and the panel's report should be made publicly available to inform discussion of the draft Forest Management Plan 2014–2023.
- The KPIs used to assess the performance of the FMP should be reviewed to inform an improved set of KPIs for the Forest Management Plan 2014–2023.
- The Department to develop Forest Monitoring Guidelines.

Appendix A

Report on Key Performance Indicators

The basis for reporting of the KPIs in this report is the *Protocols for Measuring and Reporting on the Key Performance Indicators of the Forest Management Plan 2004–2013*.

Biological diversity

Three KPIs are reported below in relation to biological diversity.

KPI 1 The representation of forest ecosystems in formal reserves

Performance measure	*Area of each forest ecosystem by land category (existing and proposed separately).*
Performance target(s)	*The Department and the Conservation Commission to complete all actions for which they are responsible in order to formally change the land category of areas proposed for the reserve system within 10 years after the commencement of the plan.*
Reporting	*Biennially on progress.*
Response to progress shortfall	*The Department to investigate lack of progress and report to the Conservation Commission and to the Minister for the Environment. The Department to address those impediments within its control and the Department and the Conservation Commission to advise the Minister for the Environment on measures to address other impediments.*

Objective of KPI 1

To assess the success of the implementation of the FMP in achieving its targets for representation of forest ecosystems in conservation reserves, through tracking the progress in the establishment of formal reserves.

Results and explanatory notes

As of June 2011 144 (47 per cent by number) of the 305[1] individual land parcels have been gazetted (Figure 1.1). This is a small increase from the 142 land category changes reported in the mid-term audit report. As of June 2011, 571,000 of the proposed 802,800 hectares proposed had been achieved (Table 1.1 and Figure 1.2).

Table 1.1 shows that reservation is 88 per cent of the area proposed to be reserved when the plan is fully implemented. Most forest ecosystems are well represented and are close to target reservation levels. Jarrah north east, Western wandoo forest and Western wandoo woodland are the ecosystems that are furthest from target levels due to impediments to progressing the proposed reservations (Table 1.2).

[1] This figure was reported at 306 in the mid-term audit but one parcel, ID 248, was found to have been wrongly included in the FMP as it was gazetted as a national park in 1957.

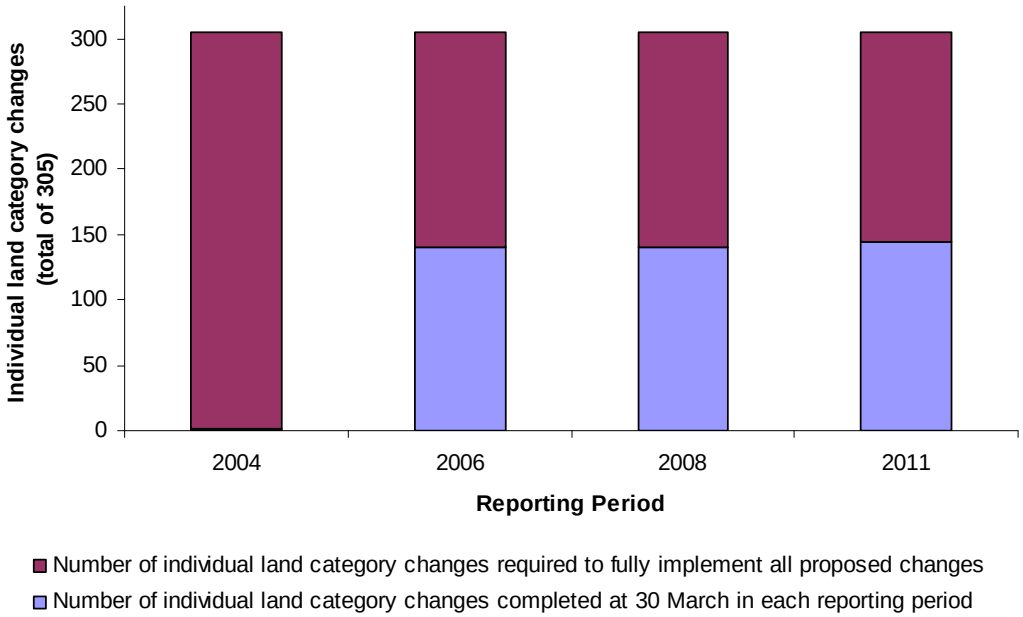


Figure 1.1 Number of proposed land category changes that have been fully implemented by reporting period

Table 1.1 Area (ha) by established land category for formal conservation reserves in the area of FMP for each reporting period

Land category	Area (ha) implemented for each reporting period				Total area proposed under the FMP
	2004	2006	2008	2011	
Nature reserves	0	58,300	58,300	58,300	97,500
National parks	200	499,100	499,200	499,300	606,700
Conservation parks	200	13,100	13,100	13,100	90,100
CALM Act section 5 (1) (g) & (h) reserves	0	900	900	900	8,500
Total	**400**	**571,300**	**571,400**	**571,600**	**802,800**

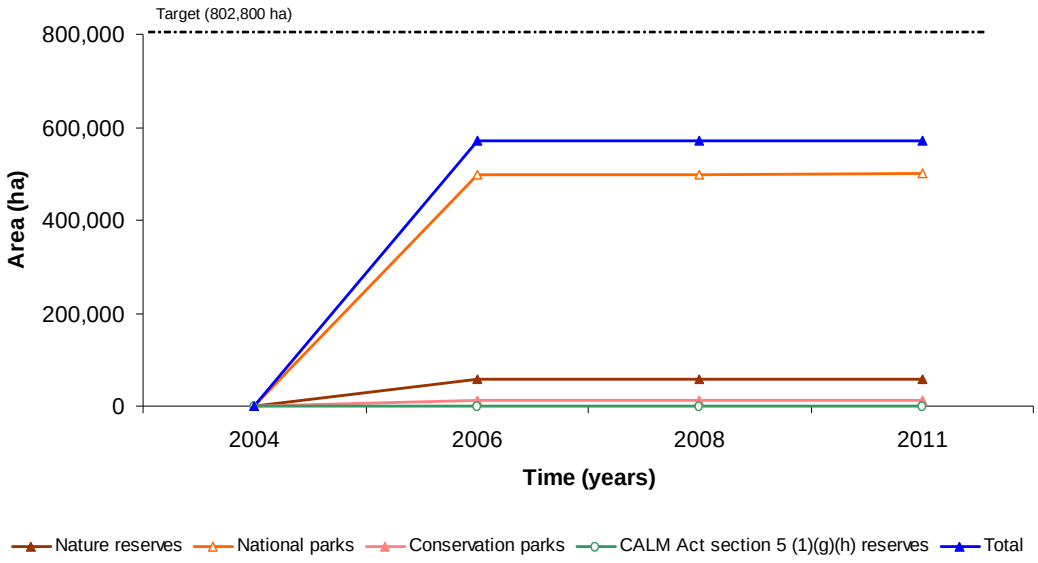


Figure 1.2 Area (ha) of formal conservation reserves by land category that have been established since 2004 in the FMP area to 30 March in each reporting period

Table 1.2 Representation of each forest ecosystem in formal conservation reserves for each reporting period in relation to the per cent that will occur when all reserves established

Forest ecosystem	Ecosystem representation in formal reserves (per cent of pre-1750 extent)				
	Gazetted at reporting period				All gazetted and proposed reserves (FMP)
	2004	2006	2008	2011	
Jarrah dominant	%				
Jarrah Blackwood	2.4	22.0	22.0	22.0	23.6
Jarrah Leeuwin	4.6	13.6	13.6	13.7	14.1
Jarrah Mt Lindesay	1.2	14.4	14.4	14.4	14.4
Jarrah North East	4.4	6.9	6.9	6.9	15.5
Jarrah North West	7.6	12.4	12.4	12.4	13.6
Jarrah Rate's Tingle	65.9	77.1	77.1	77.1	77.1
Jarrah Red Tingle	41.1	64.2	64.2	64.2	65.1
Jarrah Sandy	8.0	16.5	16.5	16.5	22.4
Jarrah South	9.4	40.0	40.0	40.0	40.4
Jarrah Unicup	6.4	18.7	18.7	18.9	19.4
Jarrah Woodland	11.0	22.0	22.0	22.0	26.0
Jarrah Yellow Tingle	15.2	65.3	65.3	65.3	65.5
sub total	***6.3***	***18.8***	***18.8***	***18.8***	***22.0***
Karri dominant					
Karri Main Belt	19.2	35.7	35.7	35.7	36.2
Karri Rate's Tingle	71.6	71.6	71.6	71.6	71.6
Karri Red Tingle	68.3	71.5	71.5	71.5	72.6
Karri West Coast	27.0	28.5	28.5	29.1	31.8
Karri Yellow Tingle	15.3	71.0	71.0	71.0	71.1
sub total	***21.2***	***38.9***	***38.9***	***39.0***	***39.6***

Wandoo dominant					
Western Wandoo forest	7.4	11.8	11.8	11.8	17.9
Western Wandoo woodland	8.4	12.5	12.5	12.5	20.5
sub total	***7.7***	***12.0***	***12.0***	***12.0***	***18.7***
Other					
Bullich and Yate	53.8	53.8	53.8	53.8	77.1
Darling Scarp	4.7	8.0	8.0	8.0	9.7
Peppermint and Coastal Heath	66.9	67.9	67.9	68.9	73.3
Rocky Outcrops	16.9	28.5	28.5	28.5	31.4
Sand Dunes	97.8	98.7	98.7	98.7	99.9
Shrub, Herb and Sedgelands	21.8	48.8	48.8	48.8	49.6
Swamps	33.7	39.4	39.4	39.4	40.7
sub total	***28.7***	***49.2***	***49.2***	***49.3***	***50.8***
Total native ecosystems	***10.5***	***23.4***	***23.4***	***23.4***	***26.7***

Most of the changes to the conservation reserve system were made in the early years of the FMP. Little progress has been made in establishing conservation reserves since the mid-term audit report. The Department and Conservation Commission have not been able to set a timeframe for completion of the outstanding FMP proposals due to circumstances outside their control. The key issues remain those set out in the mid-term audit report:

- Resolution of native title over the south-west since conversion or reservation of any Crown land with no vesting history is deemed a future act under the Commonwealth *Native Title Act 1993*.
- The Department of Mines and Petroleum's requirements for access to proposed conservation reserves for exploration and mining resulting in a lack of support for the tenure changes put forward in the FMP.
- The rights of State Agreement Act mining lessees, including the removal of three areas within their leases from the now defunct Register of the National Estate, before new conservation reserves within the leases could be created. The Commonwealth Register became defunct in February 2012, but the process to remove listed areas remains unclear.

KPI 2 The status of (critically endangered, endangered, vulnerable, conservation dependent) forest-dwelling species and ecological communities as determined by listing

Performance measure	*List of species and ecological communities and their status that tracks movements of species between protection categories.*
Performance target(s)	*No species or ecological community will move to a higher category of threat as a result of management activities.*
Reporting	*Annually with the review of the lists.*
Response to target shortfall	*The Department to investigate the cause of a change to a more threatened category and report to the Conservation Commission and to the Minister for the Environment. The Conservation Commission to evaluate the need for revision of management practices, in the context of its assessment and auditing function, in consultation with the Department.*

Objective of KPI 2

To assess the success of the implementation of the FMP in achieving its targets through monitoring the status (protection category) of threatened flora, fauna and ecological communities, so that ecosystem management activities can be assessed and appropriate actions to better achieve the objective can be identified.

Context

The Department maintains lists of taxa[2] which are threatened with extinction (Declared Rare Flora and Threatened Fauna) and taxa that may be rare or threatened but for which there are insufficient survey data to accurately determine their status, or are regarded as rare but are not currently threatened (Priority flora and fauna). A list is also maintained for threatened and priority ecological communities. An explanation of the conservation codes for Western Australia can be found on the Department's website.[3]

New species are added to the Declared Rare Flora and Threatened Fauna lists, species are removed from the lists, and listed species are re-ranked for their threat status, as information becomes available and recommendations of the Threatened Species Scientific Committee are agreed by the Minister for Environment.

Changes in species listing occur for a number of reasons including:

- sufficient information has been compiled to support a nomination (this does not directly correlate to a current decline in the conservation status of the species, but may reflect a natural situation or historical effects)
- there has been a change to the taxonomic classification of the species
- there is sufficient evidence that the species has suffered a decline in population size, extent or condition
- new evidence has become available that indicates a change in the status of a listed species.

[2] www.dec.wa.gov.au/content/view/852/2010/
[3] www.dec.wa.gov.au/content/view/852/2010/1/1/

Results and explanatory notes

Species with populations identified in the FMP area elevated to a higher category of threat between January 2004, when the FMP came into effect, and December 2011 are listed in Table 2.1 together with explanations for all changes in threat status.

Explanations are made below for those species raised to a higher category of threat since the mid-term audit report. The mid-term audit report provides information on species raised to a higher category of threat from January 2004 to December 2008. Further information is provided below on those taxa where the mid-term audit reported that it was uncertain if the elevated threat was related to management activities.

Flora

Four species of flora within the FMP area have been moved to a higher category of threat since January 2009. A further three species that were already listed as threatened were recorded for the first time in the FMP area and therefore are also listed in Table 2.1. One of these species, *Grevillea maccutcheonii*, is a population translocated within the FMP area.

Of the four species that moved to a higher threat category, three are new additions to the list and one was moved from Vulnerable to Critically Endangered.

The Department found no evidence to suggest that the three newly listed species had been elevated to a higher category of threat as a consequence of management activities, but rather the additional level of survey and available information for these species supported their listing as declared rare flora. This listing will ensure that the protection and management attention for these species is a priority. Additionally, the species re-ranked from Vulnerable to Critically Endangered, *Trithuria occidentalis,* was the result of a taxonomic review and re-definition of the previously listed species *Hydatella dioica*. Table 2.1 provides more detail of the reason why a species was listed or elevated in threat category.

These listings do not represent a shortfall in regard to the performance target for KPI 2, but reflect ongoing investigations into the conservation status of flora. Effective implementation of actions proposed in the FMP to manage activities in the FMP area, such as recreation and native forest timber harvesting, the appropriate use of fire, identification and control of priority weeds, pests and diseases will be important for conservation of these species.

Fauna

Botaurus poiciloptilus (Australasian bittern) was re-ranked in 2010 from Vulnerable to Endangered following an international review of its conservation status. Decline in the species is associated with degradation of its wetland habitat due to drought. This has been especially marked in the eastern part of its range (in the Murray Darling Basin), but reduced rainfall in the south-west of Western Australia also impacted the quality of the wetland habitat for this species. The effects are due to changing climate patterns, and potentially climate change, and not related to management activities. There is thus no performance shortfall as a consequence of this re-ranking.

The mid-term audit reportidentified the change in threat status for the red-tailed black cockatoo (*Calyptorhynchus banksii naso)*, brush-tailed phascogale (*Phascogale tapoatafa*) and woylie (*Bettongia penicillata)*, but stated that it was uncertain if the changes related to management activities.

The Department provided advice to the Conservation Commission and Minister for Environment on the reasons for category changes for the brush-tailed phascogale in March 2008, with further advice provided to the Conservation Commission in January 2011. Advice on the conservation status of the red-tailed black cockatoo and woylie was also provided to the Conservation Commission at this time. The Conservation Commission, at its August 2011 meeting, accepted the Department's January 2011 letter, supplementary advice and briefings as satisfying the reporting requirements for these species under KPI 2.

Investigation into the brush-tailed phascogale revealed apparent widespread decline across its range in the south-west. As such, there is no clear evidence to suggest that the subspecies' conservation status decline is due to management activities. In its advice to the Conservation Commission the Department also provided clarification on the brush-tailed phascogale's taxonomy, and confirmed that the Western Australian population is a distinct taxon and not identical to the subspecies in eastern Australia. The subspecies' status is therefore dependent on populations in this state.

The red-tailed black cockatoo's nomination for listing as a threatened species was made prior to the FMP coming into effect (although listed within the timeframe of the FMP) and should not be taken as a reflection of the implementation of the plan. The nomination recommended implementation of strategies to prevent illegal shooting and control of feral bees. The Department is implementing a community awareness and enforcement program to reduce illegal shooting and has developed a feral bee control method. Implementation of this methodology is still awaiting regulatory approvals. Silviculture guidelines and informal reservation strategies were also included in the FMP to maintain habitat for this species within forest areas.

The Department remains of the view the change in the conservation status of the woylie was not related to management activities and is therefore not a shortfall in relation to the performance target for this KPI. Research and recovery planning continues on the conservation of woylie populations and details of this research can be found on the Department's website. A further explanation for the decline in woylie populations and the possible factors contributing to this decline are provided as part of reporting on KPI 3, Status of selected threatened or conservation dependent species subject to management action to protect them.

Threatened ecological communities

There has been no change to the conservation status of threatened ecological communities from January 2009 to December 2011.

Table 2.1 List of species elevated to a higher category of threat

Species	Category	New category	Reasons why elevated	Due to management activities
Flora				
2004				
No species elevated to higher category in 2004				
2005				
No species elevated to higher category in 2005				
2006				
Andersonia annelsii	New addition	CR	Sufficient information compiled to support a nomination for listing based on the occurrence from a single known population. Potential threats identified in the nomination include fire, drought and *Phytophthora cinnamomi*.	No
Laxmannia grandiflora	P2	VU	Sufficient information compiled to support a nomination for listing based on occurrence from only four known populations following thorough searching.	No
Reedia spathacea	P4	EN	Sufficient information compiled to support a nomination for listing based on inability to locate additional populations despite extensive survey, and the decline of two populations known to exist a decade earlier. This species is dependent on groundwater seepage and may be adversely affected by recent trends of lower rainfall. Drier conditions may also lead to peat swamps, where this species occurs, becoming more vulnerable to fire. Some populations are being disturbed by feral pigs.	No
Stylidium semaphorum	New addition	CR	Sufficient information compiled to support a nomination for listing based on the occurrence from a single known population. Potential threats identified in the nomination include successive fires and weeds.	No
2007				
No species elevated to higher category in 2007				
2008				
Cryptandra congesta	P	VU	Sufficient information compiled to support a nomination for listing based on the occurrence from a single known population at Mt Lindesay, within a national park established under the FMP. Key threatening processes include *Phytophthora cinnamomi*, inappropriate fire regimes and drying habitat conditions. Feral pig activity and incidental recreational activities such as motorbike riding and bushwalking also have the potential to contribute to population decline.	No
Eremophila glabra subsp. chorella,	P	CR	This species is known from two populations, one being in the Mogumber Nature Reserve which is within the area covered by the FMP. The second population is within the metropolitan area and is subject to development pressure.	No

Species	Category	New category	Reasons why elevated	Due to management activities
Goodenia arthrotricha	P	EN	This species is known from six populations, the largest of which is located on private property. Populations have declined at one site due to railway maintenance activities, and due to grazing and mining activities at a second site.	No
Grevillea fuscolutea	P	VU	Sufficient information compiled to support a nomination for listing based on the occurrence from a single known population in the Mt Lindesay area within a national park established under the FMP. Survey data indicate that this population has declined in size and condition compared with earlier surveys a decade or more ago. Key threatening processes having the potential to reduce the extent of the population include *Phytophthora cinnamomi,* inappropriate fire regimes and drying habitat conditions. Feral pig activity and incidental recreational activities from motorbikes and walkers also have the potential to contribute to population decline.	No
2009				
No species elevated to a higher category of threat for 2009				
2010				
Caladenia lodgeana	New addition	CR	The species has been searched for by competent persons for the past five years and it is believed, on the basis of limited numbers of plants, significant threats through mining, housing development and lack of adequate reservation, that the species is in imminent threat of decline and possible extinction without formal protection as rare flora.	No
Diplolaena andrewsii	New addition	VU	Only known from two locations which are severely fragmented, consisting of around 600 plants. The extent of occurrence is approximately 17km^2 and the area of occupancy 0.04km^2. The extent and quality of available habitat reported to be in decline where *D. andrewsii* occurs.	No
Grevillea corrugata	New addition	VU	*G. corrugata* is only known from three locations which are severely fragmented, consisting of around 330 plants. The area of occupancy is likely to be less than 1km^2. Only one sub-population of *G. corrugata* occurs on land reserved for conservation, and one population on State forest managed for conservation (Julimar block). The other sub-populations are on road verges and private property, of which area, extent and quality of available habitat reported to be in decline.	No

Species	Category	New category	Reasons why elevated	Due to management activities
Trithuria occidentalis (previously listed as *Hydatella dioica*)	VU	CR	A recent taxonomic revision of the family Hydatellaceae has resulted in *Hydatella dioica* (Vulnerable) being recognised as a taxonomic synonym of *Trithuria occidentalis*. As a result of the revision this species now meets Critically Endangered (CR) B1ab(iii)+2ab(iii) based on an extent of occurrence being less than 100km, the species being known from a single locality (in a conservation reserve) and there being a continuing decline in the quality of its habitat. The reserve is on the Swan Coastal Plain. Decline is due to weed and hydrological impacts.	No
Grevillea maccutcheonii	CR	CR	This species was not previously recorded within the FMP area. A recovery population (translocation) was established for this species within the FMP boundary.	No
Synaphea stenoloba	CR	CR	This species was not previously recorded within the boundaries of the FMP. A new population was found which occurs within the FMP.	No
Verticordia plumosa var. pleiobotrya	VU	VU	This species was not previously recorded within the FMP area. A new population was found which occurs within the FMP boundary.	No
2011				
No species elevated to a higher category 2011				
Fauna				
2004				
No species elevated to higher category in 2004				
2005				
Calyptorhynchus banksii naso (red-tailed black cockatoo)	P3	VU	Status of this species was increased to vulnerable because of concerns about the limited availability of nesting sites, and the loss of known nesting sites monitored by the WA Museum. Nesting sites have been lost due to cumulative habitat loss associated with competition from feral bees and other birds, and to loss of mature trees resulting from bushfires and associated fire suppression operations, compounding historical habitat loss through clearing for agriculture in the early 1900s.	No
Calyptorhynchus baudini (Baudin's black cockatoo)	VU	EN	The species' range has not contracted since original listing in 1996 but it is now faced with an increasing range of threats from competition for nest hollows from feral bees and native ducks that are both increasing. Recent survey has indicated that two of 12 nests located since 1995 have been lost to bees. Illegal shooting continues to pose a threat. Survey also indicates that while the population remains at 10,000–15,000 birds only 10 per cent of the population is breeding age birds. Retention of marri is required to maintain these important food and nest trees in State forest.	No
2006				

Species	Category	New category	Reasons why elevated	Due to management activities
Atrichornis clamosus (noisy scrub-bird)	VU	EN	Status of this species was elevated to Endangered on a precautionary approach recognising that areas of core habitat in and adjoining the Two Peoples Bay Nature Reserve may be subject to increased fire frequency as a result of climate change. These reserves are not within the FMP area. Recommendation included a requirement to review the status after five years to determine whether in fact the species had continued to decline.	No
Phascogale tapoatafa subsp. WAM M434) (brush-tailed phascogale)	P3	VU	This species is now recognised as a Western Australian sub-species. Population sizes have declined across the range of the species and appear to be amongst the lowest on record. Populations are known to fluctuate widely, and the species is difficult to survey except when abundant.	No
2007				
No species elevated to higher category in 2007				
2008				
Bettongia penicillata (woylie)	Conservation dependent	EN	Re-listed as Endangered following declines in population size (>50 per cent) across the range of the species, within both State forest and conservation reserve.	No
2009				
No species elevated to a higher category 2009				
2010				
Botaurus poiciloptilus (Australasian bittern)	VU	EN	Increased threat status a result of national (and international) review of the status, and is reflective of changes in wetland condition, especially in the Murray-Darling Basin. Reduced rainfall in the south-west of Western Australia implicated in state decline.	No
2011				
No species elevated to a higher category 2011				

KPI 3 The status of selected threatened or conservation dependent species that are the subject of management actions to protect them

Performance measure	*The trap success for animals at selected monitoring sites.*
Performance target(s)	*As per recovery plans.*
Reporting	*Annually.*
Response to target shortfall	*The Department to investigate the cause and report to the Conservation Commission and to the Minister for the Environment. The Conservation Commission to evaluate the need for revision of management practices in the context of its assessment and auditing function, in consultation with the Department.*

Objective of KPI 3

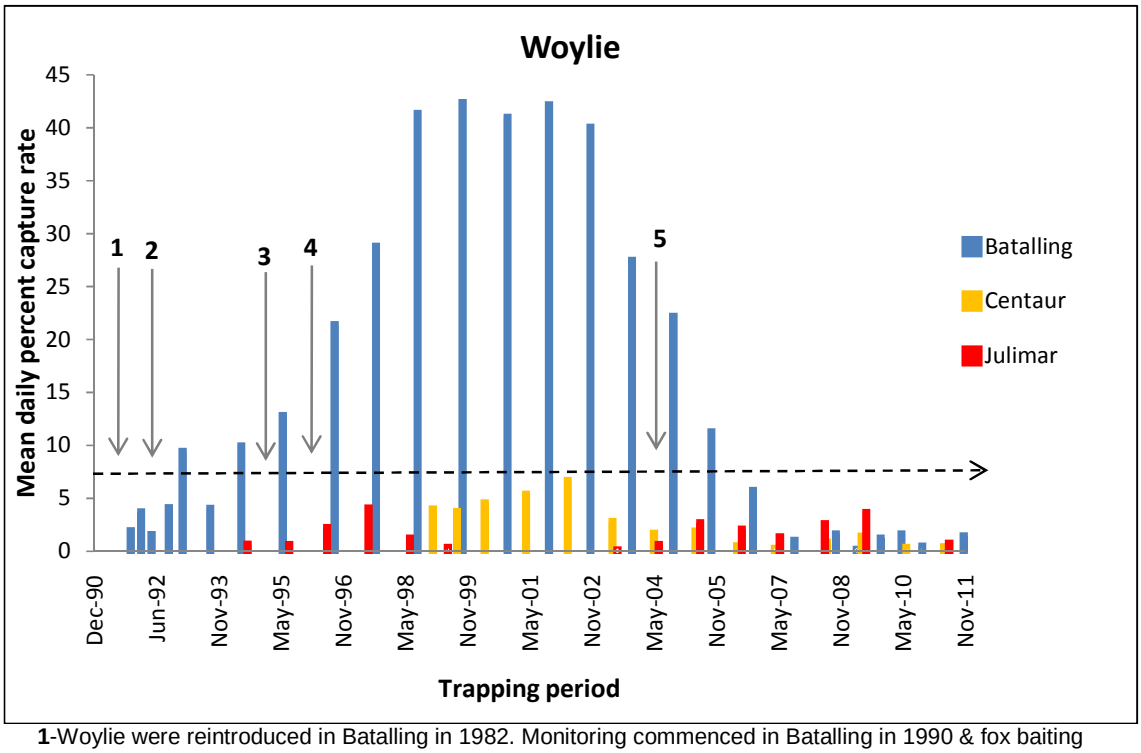
To assess the success of the implementation of the FMP in achieving its targets for conservation of biodiversity through protecting and assisting the recovery of threatened and conservation dependent species of fauna.

Results and explanatory notes

Data relevant to KPI 3 are provided by the *Western Shield* program. *Western Shield* monitoring sites have been established to provide information about population trends of fauna in the critical weight range (35–5,500 gram) in response to fox control by 1080 baiting. Survey methodology is intended to measure population changes at a landscape level. Data presented here relate to the woylie (*Bettongia penicillata*) and the chuditch (*Dasyurus geoffroii*) as both species have target capture rates defined in recovery plans. The sites of Batalling, Centaur, Julimar and Noggerup fall within the FMP area and data from these are used to report on KPI 3.

Woylie

The Woylie Recovery Plan (Start *et al.* 1995) established a capture rate of 7.5 per cent at monitoring sites as one of the criteria for successful recovery. Woylies were re-introduced to Batalling in 1982 when the site was first baited for fox control, but baiting was not maintained. In February 1991 quarterly fox baiting was introduced at Batalling and woylie capture rates consistently exceeded 7.5 per cent until 2005 (Figure A3). Capture rates began to decline in 2003 and since 2006 have been below the 7.5 per cent criteria for successful recovery. Woylies were also re-introduced at Julimar and Centaur and while these populations have persisted, capture rates have always been below 7.5 per cent. For the woylie, the trap success rate is below the target specified in the recovery plan and therefore the performance target of this KPI is not achieved. A response to target shortfall is provided below.

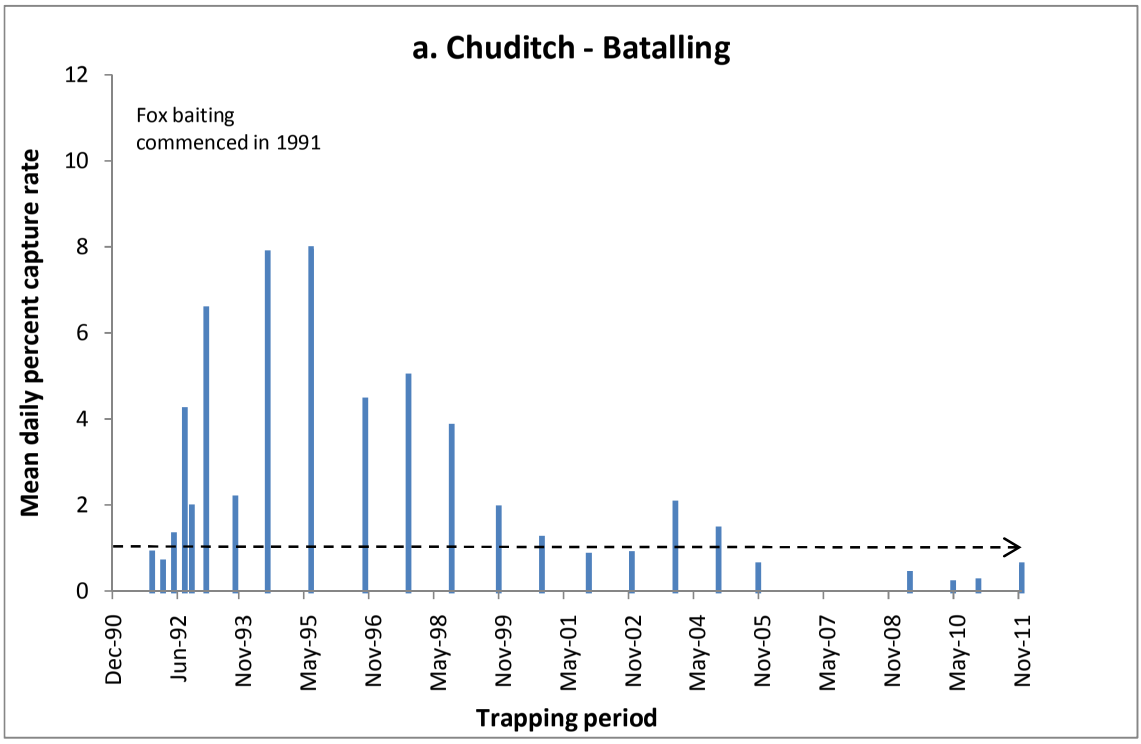


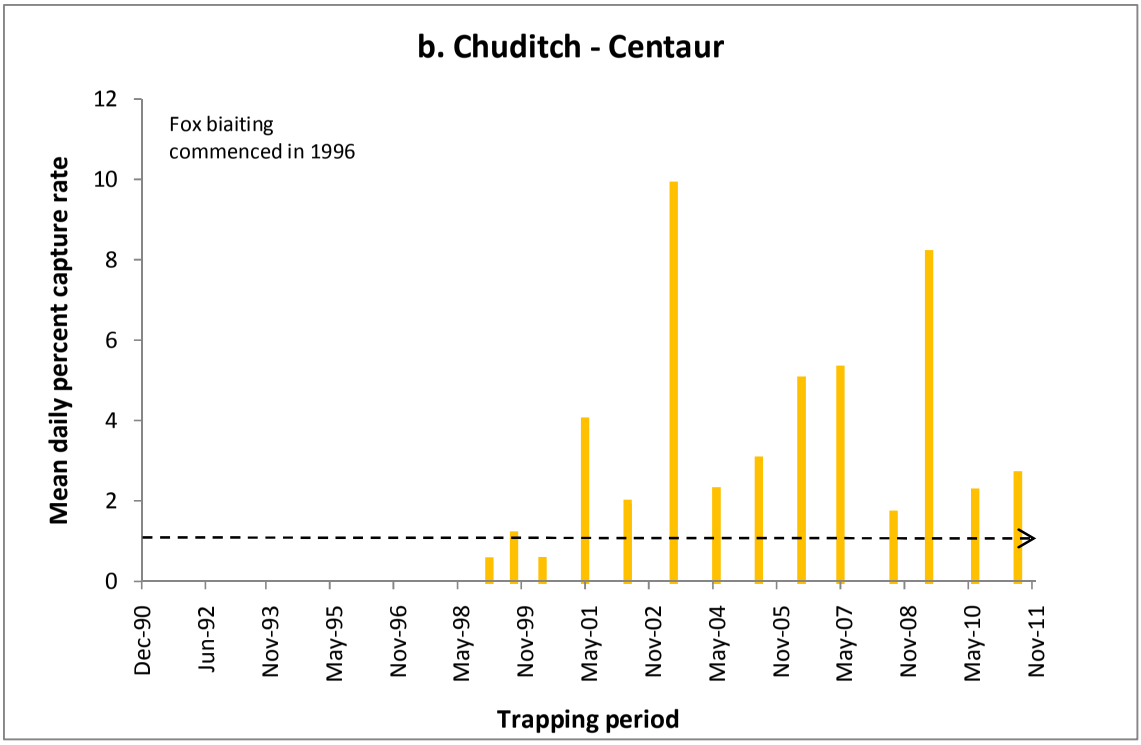
1-Woylie were reintroduced in Batalling in 1982. Monitoring commenced in Batalling in 1990 & fox baiting commenced in 1991; **2**-Monitoring and fox baiting commenced in Julimar in 1992; **3**-Woylie reintroduced in Julimar 1995; **4**-Fox baiting commenced in Centaur 1996 and monitoring commenced in 1999; **5**-Restocking commenced in Julimar 2004.

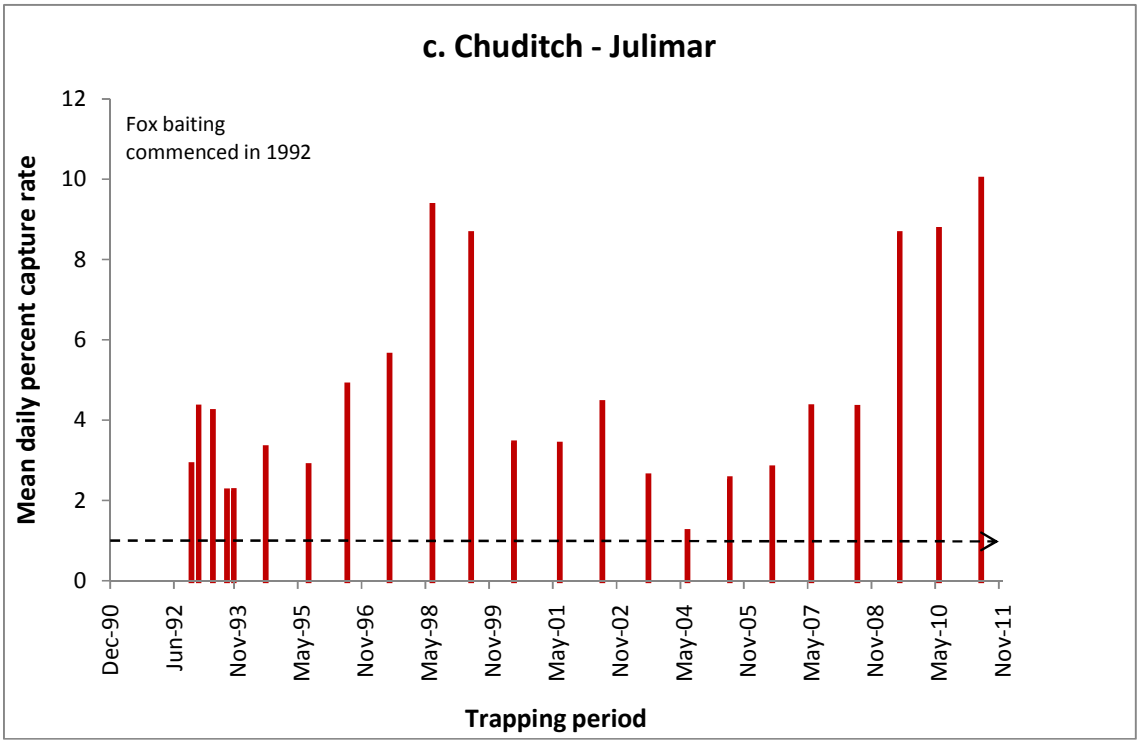
Figure 3.1 Capture rates for woylie at selected monitoring sites within the area of the FMP

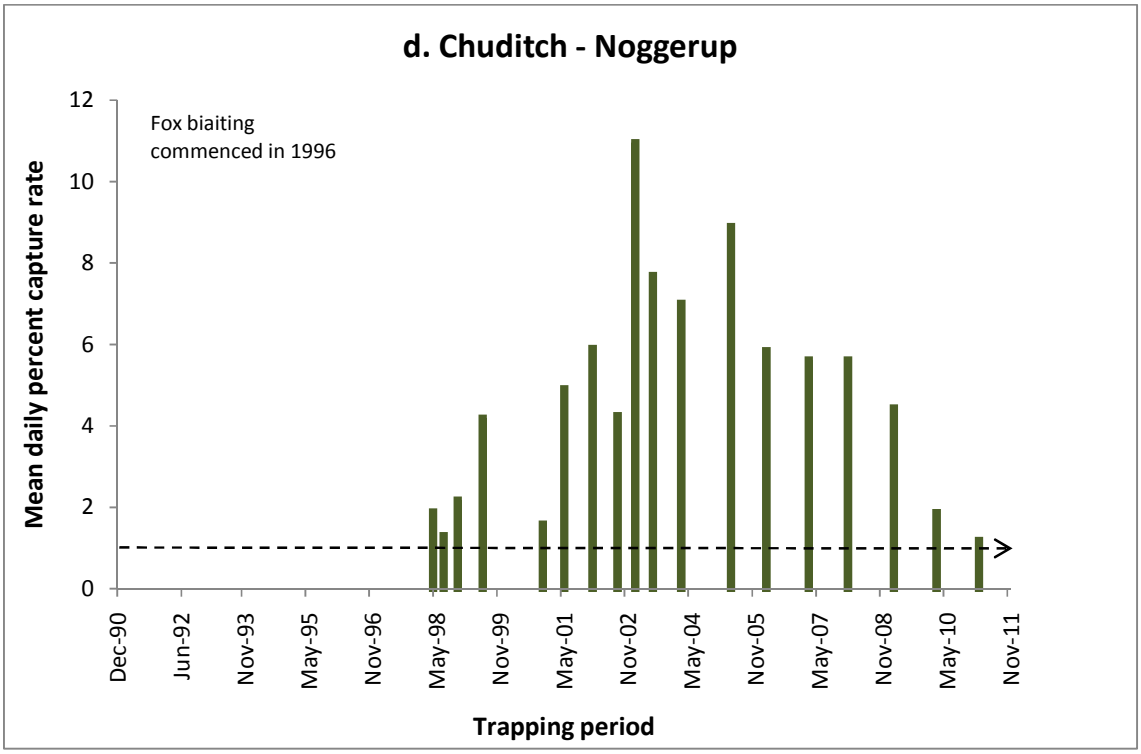
Chuditch

The Chuditch Recovery Plan (Orell and Morris 1994) established a capture rate of one per cent at monitoring sites as one of the criteria for successful recovery. Capture rates from the monitoring sites at Batalling, Julimar, Centaur and Noggerup have been sustained at or above one per cent within three years of quarterly baiting being implemented (Figures 3.2a–d). Capture rates exceeding eight per cent indicate very high densities of chuditch. Capture rates at Batalling dropped after woylie capture rates reached 20 per cent and this is likely due to competition for traps, with woylies being more likely to enter a trap to the exclusion of chuditch. Chuditch were not recorded at Batalling from 2006 to 2008 and the reason for this has yet to be established. Chuditch were captured at Batalling in 2009 and 2010 indicating that they are still present in the area.


a. Chuditch - Batalling
Fox baiting
commenced in 1991
Mean daily percent capture rate
12
10
8
6
4
2
0
Dec-90
Jun-92
Nov-93
May-95
Nov-96
May-98
Nov-99
May-01
Nov-02
May-04
Nov-05
May-07
Nov-08
May-10
Nov-11
Trapping period


b. Chuditch - Centaur
Fox biaiting
commenced in 1996
Mean daily percent capture rate
12
10
8
6
4
2
0
Dec-90
Jun-92
Nov-93
May-95
Nov-96
May-98
Nov-99
May-01
Nov-02
May-04
Nov-05
May-07
Nov-08
May-10
Nov-11
Trapping period





Figures 3.2a.–d. Capture rates for chuditch at selected monitoring sites within the FMP area

Response to target shortfall

Population declines have been observed throughout the range of the woylie, affecting both extant natural populations and re-introduced populations. A paper reviewing the relisting of the woylie as a threatened species was published in 2010 (Groom 2010). The Department has initiated a major research project involving a number of partner agencies to investigate potential causes of the decline. Results to date indicate that the decline in woylie populations is unlikely to be driven by habitat loss or fragmentation, fire or other direct human intervention. The hypothesis proposed to explain the decline is that woylie populations are being affected by a disease that renders them vulnerable to predation, with cats and foxes the most significant predators. In response to the decline, a 420-hectare predator-free enclosure was built in the state's south-west (construction was completed in 2010) and 40 woylies were released into the fenced area to establish an insurance population. Woylie populations inside and outside the enclosure are monitored. Monitoring of the enclosure population in October 2011 indicated that there were more than 83 woylies, a doubling of the population in less than one year. This indicates that predation is playing a major role in limiting the recovery of the woylie.

Results of population monitoring at *Western Shield* sites Batalling, Centaur and Julimar are presented in Figure A3. Although capture rates continue to be low, it is encouraging that woylies are present at all three sites, and in particular that woylies were captured at Julimar in 2011 after no captures in 2010.

Both Julimar and Centaur have a moderately high abundance of chuditch which is a known predator of the woylie, and it is possible that predation by chuditch may have contributed to the lack of recovery success at these sites.

A new woylie recovery plan is currently being prepared.

References

Groom, C. (2010). Justification for continued conservation efforts following the delisting of a threatened species: A case study of the woylie, *Bettongia penicillata ogilbyi* (Marsupialia: Potoroidae). *Wildlife Research.* **37**: 183-193.

Orell, P. and Morris, K. (1994). Chuditch Recovery Plan. Western Australian Wildlife Management Program No. 13. Department of Conservation and Land Management, Como, Western Australia.

Start, T., Burbidge, A. and Armstrong D. (1995). Woylie Recovery Plan. Western Australian Wildlife Management Program No. 16. Department of Conservation and Land Management, Como, Western Australia.

Productive capacity

Eleven KPIs are reported below in relation to productive capacity.

KPI 4 The area of native forest and plantations

Performance measure	*Change in:* • *the area of native forest and plantation;* • *area of forest by land category;* • *area of forest cleared; and* • *area of forest rehabilitated.*
Performance target(s)	*No permanent loss of net area of forested land.*
Reporting	*After each five years*
Response to target shortfall	*The Department to investigate the cause and report to the Conservation Commission and to the Minister for the Environment.*

Objective of KPI 4

To assess the success of the implementation of the FMP in achieving its targets through tracking any change in the area of native forest and plantations.

Context

Native forest

Maintaining the area of forested lands vested in the Conservation Commission is a prerequisite for sustaining all conservation and productive objectives in the FMP.

The forest area can be permanently reduced through clearing to locate essential infrastructure such as roads, powerlines, pipelines, dams or recreation facilities. Forest cover can also be reduced in the long term if areas that have had temporary removal of forest arising from such activities as mining, harvesting (landings), or fire tracks are not rehabilitated after use. Longer-term losses of forest cover can also arise naturally through poor recovery of the vegetation following natural disturbances such as drought, frequent intense bushfires, and salinisation or acidification of soil.

Plantations

The establishment and management of plantations on State forest and privately held land has been a key government strategy for more than 50 years. As a result of these policies about 59,000 hectares of pine plantation on land governed by the FMP were established. These formed the central resource that supplied local processors and the housing and construction industries.

Maintaining the productivity of plantations is threatened from several directions, in particular:

- Drought – the summer and autumn of 2011 saw extensive drought being expressed in the northern plantations. This was the result of the previous three years being the driest on record and an extended dry spell in March 2011. Around 70 per cent of the northern plantation area was affected.
- Fire – the prevalence of fire in plantations has been unprecedented in recent years. Several large and destructive fires have damaged plantation assets since 2004.

- Erosion of the plantation land base – plantation lands are seen as a desirable area to locate public infrastructure. Approximately 380 hectares of plantation have been excised for gas, power and water utility infrastructure in recent years.
- Land use change – unresolved changes in land use where access to existing plantation timber is restricted or the future access to the land for plantation production is unclear. This has occurred at Gnangara, Ludlow and Murray Valley plantations where the FMP is unclear about the intentions for land use.

Together, these events limit the capacity of the FPC to supply plantation timber into the future. The State has long-term resource commitments, including three State Agreement Acts for the supply of softwood timber. These commitments last until 2032 and contain options to continue the arrangements for further terms.

Results and explanatory notes

Native forest

The available data suggest the performance target for this KPI is unlikely to have been met.

Measuring the net change in forest area requires complete, detailed datasets to be maintained over time of the extent of forest types, tenure and causal factors for the change. It is further complicated by potential additions to the forest area arising from changes in tenure such as the acquisition of private property for conservation purposes. Detailed information on all these contributing factors is not maintained by the Department in a manner that could be readily collated for precise calculation of this KPI. Consequently, an indirect approach was adopted of using remote sensing records over time to quantify vegetation cover change since 2004 and then attributing causal factors from available information. The figures therefore provide an indication of the relative magnitude of changes, but require ongoing refinement.

Comparisons of the annual time series of LANDSAT TM from 2004 to 2011 were used to define forest areas in January 2004 for which a subsequent reduction in forest cover had not recovered by 2011. The cause of the change, and whether it was permanent or likely to recover over time was attributed by overlay with areas separately recorded as mined, harvested, new recreation sites, road alignments or other.

A permanent reduction in forest area of approximately 940 hectares since 2004 was attributed to the construction of new roads, infrastructure corridors or the widening of existing easements. This included permanent clearing associated with the construction of the Forrest Highway and major powerline upgrades. It was not possible to determine whether an equivalent area of forest had been acquired by DEC during this period, as a final tenure dataset to 2011 was still in compilation at the time of report preparation.

There were a number of reductions in forest cover arising from disturbances which were uncertain or presumed to be temporary including mining, drought and disease. The area of these changes was approximately 24 000 hectares. The rate and extent of vegetation recovery from bushfire, drought and other natural processes will vary and requires ongoing monitoring.

Plantations

Current situation

- Since 2004, the area of pine plantation on tenures covered by the FMP has reduced from about 59,000 hectares to 52,000 hectares.
- Severe wildfires have occurred in Southampton, Ferndale, Yanchep and Beraking plantations over the period of the FMP. The FPC is still dealing with the backlog of areas to be salvaged and replanted following these fires.
- It is expected that plantations on the Gnangara mound will be removed and replaced with other land uses.
- Drought in the northern plantations has damaged large areas of plantation. The level of this impact is being assessed.
- There is uncertainty over the future of Murray Valley plantation, Ludlow plantation and other smaller plantations that now fall within conservation reserves.
- The level of future supply of plantation timber will reduce as a result of the above impacts and land use changes. It is not known to what extent this will affect current plantation processing capability in Western Australia.
- The Government policy to discontinue its program of planting on farmland has placed greater emphasis on the need to achieve production outcomes on State forest and freehold land held by the Department.

Rehabilitation

Significant areas of unrehabilitated land exist where plantations are not being re-established following clearfelling of the existing crop, for example, the area of fallow ground in Gnangara plantation is approximately 5,000 hectares. A joint working group has been formed to address this issue and develop an agreed rehabilitation program.

Response to target shortfall

The Department will continue to seek to minimise the permanent reduction in forest area arising from submissions to locate infrastructure on, or alienate lands vested in, the Conservation Commission.

The Department will work towards streamlining the collation of records necessary to report on this KPI.

The Department will continue to monitor the recovery of areas with temporary reductions in forest cover.

KPI 5 Annual removal of wood products compared to the sustained yield determined by the plan

Performance measure	*Cumulative removals for jarrah and karri first and second grade sawlogs compared to the average annual sustainable yield.* *Annual removal of jarrah and karri sawlogs below first and second grade.* *Annual removal of all logs.*
Performance target(s)	*No more than 10 per cent more than the average annual yield of first and second grade sawlogs of each species to be removed in any one year.* *No more than 412,650 cubic metres of first and second grade jarrah sawlogs and 170,100 cubic metres of first and second grade karri sawlogs to be removed in any three consecutive years.* *No more than 1,310,000 cubic metres of first and second grade jarrah sawlogs and 540,000 cubic metres of first and second grade karri sawlogs to be removed over the 10-year life of the plan.* *Annual volume of jarrah and karri sawlogs other than first and second grade sold for value-added products to show a positive trend.* *No more than 13,000 cubic metres of wandoo, 16,000 cubic metres of blackbutt and 19,000 cubic metres of sheoak sawlogs to be removed over the 10-year life of the plan.*
Reporting	*Annually.*
Response to target shortfall	*The Forest Products Commission to advise the Conservation Commission how it will manage removals to be under the end of plan target. The Conservation Commission to evaluate the need for a revision of harvesting levels in the context of its assessment and auditing functions, in consultation with the Department.*

Objective of the KPI

To report on the level of production of jarrah and karri sawlogs relative to the sustained yield determined for the period of the FMP.

Context

The yield from the jarrah and karri forests is regulated on the basis of sawlogs, so this KPI focuses on sawlog removals over annual and three-year rolling periods to monitor removals. Small annual variations in removals may be necessary in response to market and operational factors.

All log products removed from harvest coupes by FPC contractors are tracked for accounting purposes in a computer database known as the Logging Operations Information System (LOIS). The data from the suite of harvest coupes in each year were aggregated for reporting in this KPI.

A wide range of sawlog and other log categories continued to be removed from the forests. Since the mid-term audit report the FPC has advised the Department of several variations to the specifications of sawlogs accepted by some customers. Accordingly, adjustments have been made to the raw LOIS data so that the KPI monitoring is standardised to the specification defined for the sustained yield calculations.

The annual volume figures reported in this KPI will differ from those published in annual reports because the figures for this KPI are collated and reported by calendar years for direct comparison with the basis of the FMP sustained yield calculations and planning period (2004 to 2013).

Results and explanatory notes

Jarrah first and second grade sawlogs

The performance target (of not more than 10 per cent more than the average annual yield to be removed in any one year) has been met each year except in 2008 (Table 5.1). In 2008 the target was exceeded by four per cent, although this was relative to annual undercuts of between six and 35 per cent in other years. The three-year periodic removals have all been within the performance target.

Table 5.1 Jarrah first and second grade sawlog removals during 2004 to 2010 relative to the 131,000 cubic metre annual sustained yield

Jarrah first and second grade sawlog volume (cubic metres)							
Annual volumes				Cumulative volumes			
Year	KPI upper limit	Annual removals	Variation	Period	KPI upper limit	Periodic removals	Variation
2004	144,100	120,251	- 23,849				
2005	144,100	135,677	- 8,423				
2006	144,100	120,507	- 23,593				
2007	144,100	122,598	- 21,502				
2008	144,100	149,309*	+ 5,209				
2009	144,100	116,586*	- 27,514				
2010	144,100	94,008*	- 50,092				
				2004 to 2006	412,650	376,435	- 36,215
				2005 to 2007	412,650	378,782	- 33,868
				2006 to 2008	412,650	392,414	- 20,236
				2007 to 2009	412,650	388,493	- 24,157
				2008 to 2010	412,650	359,903	- 52,747

* Figure incorporates an adjustment to the raw delivery data to reflect a change in the minimum sawlog specifications that was accepted by customers.

Karri first and second grade sawlogs

In 2006 and 2008 the annual removal of karri first and second grade sawlogs exceeded the prescribed target (of no more than 10 per cent more than the average annual yield in each year) by two and seven per cent respectively (Table 5.2). Nevertheless, the three-year periodic out-turn has exceeded the performance target for the last three periods by between two and five per cent. The Department advised the FPC of the emerging trend, and the FPC has taken steps since 2008 to adjust karri sawlog removals to 2013 so as to remain within the overall limit set by the FMP.

Table 5.2 Karri first and second grade sawlog removals during 2004 to 2010 relative to the 54,000 cubic metre annual sustained yield

Karri first and second grade sawlog volume (cubic metres)							
Annual volumes				Cumulative volumes			
Year	KPI upper limit	Annual removals	Variation	Period	KPI upper limit	Periodic removals	Variation
2004	59,400	51,986	- 7,414				
2005	59,400	53,691	- 5,709				
2006	59,400	60,325	+ 925				
2007	59,400	55,151*	- 4,249				
2008	59,400	63,342*	+ 3,942				
2009	59,400	54,763*	- 4,637				
2010	59,400	56,261*	- 3,139				
				2004 to 2006	170,100	166,002	- 4,098
				2005 to 2007	170,100	169,167	- 933
				2006 to 2008	170,100	178,818	+ 8,718
				2007 to 2009	170,100	173,256	+ 3,156
				2008 to 2010	170,100	174,366	+ 4,266

* Figure incorporates an adjustment to the raw delivery data to reflect a change in the minimum sawlog size that was accepted by customers during 2007 to 2010.

Annual volume of jarrah and karri sawlogs below first and second grade

The annual volume of logs below first and second grade is included in the figures reported below for 'other volume'. It is not possible to calculate the volume sold for value added products, as the ultimate processing and product recovery from separate categories of lower-grade logs is not recorded in existing information systems.

Annual volume of other sawlog products and species

Table 5.3 Wandoo sawlog volume (cubic metres)

Year	Annual removals	Cumulative total removals	KPI cumulative limit
2004	308	308	
2005	13	321	
2006	637	958	
2007	214	1,172	
2008	80	1,252	
2009	91	1,346	
2010	99	1,442	
2004–2013			13,000

The cumulative total removal of wandoo sawlog to the end of 2010 was 1,442 cubic metres, which constitutes 11 per cent of the total allowable volume over the 10 years of the FMP.

Table 5.4 Blackbutt sawlog volume (cubic metres)

Year	Annual removals	Cumulative total removals	KPI cumulative limit
2004	170	170	
2005	478	648	
2006	668	1,316	
2007	766	2,082	
2008	1,285	3,367	
2009	501	3,868	
2010	1,747	5,615	
2004–2013			16,000

The cumulative total removal of blackbutt sawlog to the end of 2010 was 5,615 cubic metres, which constitutes 35 per cent of the total allowable volume over the 10 years of the FMP.

Table 5.5 Sheoak sawlog volume (cubic metres)

Year	Annual removals	Cumulative total removals	KPI cumulative limit
2004	404	404	
2005	355	759	
2006	310	1,069	
2007	98	1,167	
2008	156	1,323	
2009	33	1,356	
2010	645	2,001	
2004–2013			19,000

The cumulative total removal of sheoak sawlog to the end of 2010 was 2,001 cubic metres, which constitutes 11 per cent of the total allowable volume over the 10 years of the FMP.

The comparatively lower volumes of wandoo, blackbutt and sheoak sawlogs sold to date are due to a combination of factors, including market fluctuations for the various products and the variable availability of these species within the suite of coupes that has been available on annual harvest plans.

Table 5.6 Jarrah other volume (cubic metres)

Year	Annual removals	FMP average annual availability	Cumulative total removals	FMP average annual cumulative quantity	Cumulative variation (Actual – FMP)
2004	132,432	534,000	132,432	534,000	- 401,568
2005	201,804	534,000	334,236	1,068,000	- 733,764
2006	150,349	534,000	484,585	1,602,000	- 1,117,415
2007	160,996	534,000	645,581	2,136,000	- 1,490,419
2008	166,796	534,000	812,377	2,670,000	- 1,857,623
2009	136,678	534,000	949,055	3,204,000	- 2,254,945
2010	128,574	534,000	1,077,629	3,738,000	- 2,660,371

The annual and cumulative volumes of jarrah other bole material removed to the end of 2010 are significantly less than the average levels specified in Table 4 of the FMP. This reflects an ongoing absence of markets for some of the lower grades of log material produced during integrated harvesting operations, and the lack of thinning operations in young regrowth stands. The removals figures do not include that portion of the non-sawlog volume made available but retained either standing or felled within the operations.

Table 5.7 Karri other volume (cubic metres)

Year	Annual removals	Amended FMP average annual availability	Cumulative total removals	FMP average annual cumulative quantity	Cumulative variation (Actual – FMP)
2004	143,504	160,000	143,504	160,000	- 16,496
2005	147,252	160,000	290,756	320,000	- 29,244
2006	170,249	160,000	461,005	480,000	- 18,995
2007	148,727*	160,000	609,732	640,000	- 30,268
2008	163,575*	160,000	773,307	800,000	- 26,693
2009	111,243*	160,000	884,550	960,000	- 75,450
2010	155,793*	160,000	1,040,343	1,120,000	- 79,657

* Figure incorporates an adjustment to the raw delivery data to reflect a change in the minimum sawlog size (and hence proportion sold as other bole volume) that was accepted by customers.

The level of karri other bole volume permitted to be removed over the period of the FMP was amended on 1 November 2011 to 1.6 million cubic metres, or an average annual availability of 160,000 cubic metres. The volume of karri other bole volume removed each year has generally been less than this amended average volume. The cumulative total removals to the end of 2010 are seven per cent less than the averaged FMP quantity for this period.

Table 5.8 Marri all logs volume (cubic metres)

Year	Annual removals	FMP upper limit	Cumulative total removals	FMP cumulative limit	Cumulative variation (Actual – FMP)
2004	8,889	196,000	8,889	196,000	- 187,111
2005	7,326	196,000	16,215	392,000	- 375,785
2006	18,212	196,000	34,427	588,000	- 553,573
2007	25,989	196,000	60,416	784,000	- 723,584
2008	12,340	196,000	72,756	980,000	- 907,244
2009	5,239	196,000	77,995	1,176,000	- 1,098,005
2010	17,441	196,000	95,436	1,372,000	- 1,276,564

The volume of marri logs (all bole volume) removed each year to the end of 2010 has been substantially less than the upper limit specified in Table 4 of the FMP. The total cumulative removal to the end of 2010 is only seven per cent of the allowable yield. This reflects an absence of markets for lower grades of marri log material produced during integrated harvesting operations, and a delay of thinning operations in young jarrah regrowth stands. The figures do not include that portion of the non-sawlog volume made available but retained either standing or felled within the operations.

Response to target shortfall

The level of annual removals of karri first and second grade sawlogs has been consistently high during the period to 2010. While exceeding an annual or three-year target level is of interest to the Department, the purpose of this KPI is to alert both the Department and the FPC to the need for corrective action during the period of the FMP to ensure the total level of removals during the period of the plan are within the sustained yield limits. In this regard the Department advised the FPC of the emerging trend, and the FPC has been taking steps since 2008 to adjust the level of sawlogs supplied each year for the remainder of the FMP to ensure removals stay within the 10-year limit.

The FPC has advised that a current Expression of Interest process for resource including the marri logs has received strong interest from a range of potential new processors.

KPI 6 Area of forest cut over annually

Performance measure	*Annual area of each forest type harvested according to each silvicultural objective.*
Performance target(s)	*Not possible to set a realistic target for area cut over.*
Reporting	*Annual publication of areas cut over.*
Response to reporting	*The Conservation Commission to evaluate the need for revision of management practices in the context of its assessment and auditing function, in consultation with the Forest Products Commission and the Department.*

Objective of the KPI

To assess the success of the implementation of the FMP by reporting trends in the total area harvested for each silvicultural objective in the context of the total forest area available for timber production.

Context

Monitoring the area of forest cut over each year to the various silvicultural objectives provides a general indication of the rate of harvest across that portion of the forest that is available for timber production.

Records of the location, extent and silvicultural objective for each area of forest cut over are sourced from a combination of ground survey and aerial photography, and maintained in a departmental database named SILREC (Silvicultural Recording System). Mining records are combined with the areas harvested by the FPC to generate an annual snapshot.

Variation between years in the area of each forest type cut over and the mix of silvicultural objectives is expected, and can arise for several reasons. These include fluctuations in the mix of forest types and structure within the coupes made available in annual and three year harvest plans, the variable markets for some wood products (such as wandoo sawlog or marri chiplogs), and the fluctuating level of clearing associated with mining activities or specific infrastructure projects. For example, since the mid-term audit report there has been some escalation of the area cleared for bauxite mining and a short-term decline in the availability of wandoo coupes in annual harvest plans.

Results and explanatory notes

During the period 2004 to 2010, the total area of native forest cut over each year averaged 9,290 hectares (Table 6.1). This constitutes 1.1 per cent annually of the total area of native forest available for timber production under the FMP, which is the same percentage that applied at the time of the mid-term audit report.

The relative proportion of the annual area cut over within each forest type has also remained steady, with an average of 7,750 hectares of jarrah (or one per cent of available) and 1,480 hectares (or 2.5 per cent) of karri forest cut over. Only a small area of wandoo forest (averaging 60 hectares per year) has been cut.

However, while the overall averages for the period 2004 to 2010 have been steady, there was a significant reduction in the area of jarrah cut over in 2010 associated with the temporary closure of the Deanmill sawmill. A significant reduction in the area of karri thinned in 2008 arose from a temporary reduction in the demand for woodchips.

The proportion of each forest type cut to the various silvicultural objectives has fluctuated across the reporting period. Over half of the area of jarrah forest cut over each year was cut to an objective to establish regeneration (shelterwood) or single tree selection (dieback). Areas cut to release regeneration (gap) contributed the least proportion of the total annual cut.

In the karri forest the predominant silvicultural objective was thinning – mostly in the young regrowth stands to promote the growth of future sawlogs on the retained trees. There were no areas of wandoo dominant forest recorded as harvested during the period 2008 to 2010, although some wandoo products (see KPI 5) were sourced from mixed jarrah/wandoo forests.

The figures reported in Table 6.1 do not directly indicate whether a particular silvicultural objective as applied in the field was the most appropriate choice for the stand structure and composition, nor do they represent the final outcome of follow-up silvicultural treatments, such as removal of culls or regeneration burns. The mid-term audit report identified the need to improve the reporting of silvicultural outcomes within the areas harvested to the various silvicultural objectives. The Department and the FPC examined the use of high resolution digital photography captured after silvicultural treatments to improve the accuracy of reporting. However, factors such as the high proportion of marri retained in many operations produced imprecise results, and the development of improved ground survey and reporting processes remain a priority.

Table 6.1 Annual area (hectares) of native forest cut over to each silvicultural objective

Forest type	Silvicultural objective	Area cut over[#^] (ha)							
		2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**Ave.**
Jarrah	Promote growth on retained trees (thinning)	470	570	1,070	440	610	600	620	630
	Release regeneration (gap)	480	220	690	370	410	710	180	440
	Establish regeneration-eastern jarrah (shelterwood)	780	720	1,090	500	90	660	140	570
	Establish regeneration-western jarrah (shelterwood)	3,040	2,210	1,690	2,340	2,450	2,760	1,110	2,230
	Single tree selection (retention in dieback areas)	1,420	1,620	2,120	2,030	1,520	2,040	1,330	1,730
	Selective[*]	1,460	520	1,080	1,180	1,330	1,900	1,140	1,230
	Other (mining and clearing for utilities)	930	920	650	940	730	990	1,250	920
	Jarrah total	**8,580**	**6,780**	**8,390**	**7,800**	**7,140**	**9,660**	**5,770**	**7,750**
Karri	Establish jarrah/karri regeneration	70	30	60	30	40	90	30	50
	Establish regeneration (clearfall karri)	170	480	350	440	360	640	370	400
	Establish regeneration (partial karri clearfall)	120	10	0	100	0	0	0	30
	Promote growth on retained trees (thinning)	930	1,140	1,140	1,000	660	910	1,210	1,000
	Karri total	**1,290**	**1,660**	**1,550**	**1,570**	**1,060**	**1,640**	**1,610**	**1,480**
Wandoo	Establish regeneration	0	0	90	20	0	0	0	20
	Promote growth on retained trees (thinning)	0	30	220	40	0	0	0	40
	Wandoo total	**0**	**30**	**310**	**60**	**0**	**0**	**0**	**60**
	All forest types total	**9,870**	**8,470**	**10,250**	**9,430**	**8,200**	**11,300**	**7,380**	**9,290**

* Stands that have been cut over and retain a high proportion of cull (unmerchantable trees), and in which limited silvicultural treatments have been applied.

These statistics will vary slightly from figures published in the mid-term audit report and previous Departmental and FPC annual reports due to rounding, the subsequent updating of some objectives following later silvicultural treatments, and data refinements arising from updates of final treatment and informal reserve boundaries. For example, in some years there has been a reallocation of significant areas from gap to selective following the overlay of later cull treatment records.

^ The areas reported are the net area cut over, which is equal to the entire coupe area LESS the area of informal reserves and other uncut patches within the coupe.

KPI 7 Removal of non-sawlog timber

Performance measure	*Total removals of firewood compared to the authorised removal through contract and licence.*
Performance target(s)	*Authorised removals more than 70 per cent of estimated total removals based on survey information.*
Reporting	*After each five years.*
Response to reporting	*The Department to investigate the cause and report to the Conservation Commission and to the Minister for the Environment. The Conservation Commission to evaluate the need for revision of management practices in the context of its assessment and auditing function, in consultation with the Department.*

Objective of KPI 7

To assess the success of the implementation of the FMP in achieving its targets through tracking any change in the supply of firewood from the forest.

Context

This KPI reports on firewood, which is a type of non-sawlog timber classed as forest produce. The FMP has an objective for forest produce to be removed in a manner that, so far as is practicable and sustainable, satisfies public demand for that produce. There are two different ways in which firewood removal from the FMP area occurs: by public firewood collection and under contract of sale by the FPC to commercial suppliers.

Public firewood collection provides for the gathering of forest produce for home heating and other domestic uses, and is a form of recreation in the forest enjoyed by many people each year. The Department currently provides for public firewood collection from State forest and timber reserves. In the Swan Region, where there is strong demand from the public, the Department issues members of the public with a licence to collect firewood. The licence is a conditional authorisation that requires collectors to take firewood from within a public firewood collection area, not to collect within three days following rainfall (to prevent spreading dieback) and to take no more than one cubic metre of firewood. The numbers of licences for public firewood collection issued recently in the Swan Region were 1,706, 4,566 and 5,271 in 2008, 2009 and 2010 respectively.

Firewood removed under contract of sale is generally a by-product of timber harvesting conducted for sawlog timber. These operations are integrated into sawlog operations conducted by contractors and managed by the FPC. The amount of firewood removed under contract of sale is around 10 times that which is removed via authorised public firewood collection. The FPC administers around 40 individual contracts, each supplying between 200 and 8,000 tonnes per year.

Results and explanatory notes

Survey of firewood collected under Departmental authorisations in the Swan Region

In 2005 and 2010, the Department conducted firewood collection surveys to gain a perspective in forests surrounding the Perth and Mandurah metropolitan areas. The surveys focused on the amount of collection and the level of compliance with the system used to authorise the removal of domestic firewood. The results from both surveys were very similar.

The surveys found that around half of the vehicles recorded as carting firewood were not associated with a valid authority and around one-third of collectors removed firewood from outside of areas designated for public firewood collection. Around one-third of the firewood removed was transported within three days following rainfall, one-fifth of collectors carted more than the authorised volume and 10 per cent took more than one load. These findings suggest that the amount of firewood being removed from forest areas is in excess of the authorised amount and the performance target for removal of firewood by the public was not met. Table 7.1 below summarises the results of these surveys. SFM Technical Report No. 6 (Cullen and Hagan 2011) provides a more detailed description of the survey technique and findings.

Table 7.1 Survey of firewood removals from Swan Region

Record type	**All vehicles recorded**		**Vehicles from public firewood collection areas**		**Vehicles from outside public firewood collection areas**	
	Number of vehicles [% of total]	Volume of firewood [% of total]	Number of vehicles [% of total]	Volume of firewood [% of total]	Number of vehicles [% of total]	Volume of firewood [% of total]
2005						
Authority	165 [47]	160 [51]	147 [58]	143 [64]	18 [18]	18 [20]
No authority	189 [53]	154 [49]	106 [42]	82 [36]	83 [82]	72 [80]
Total	354	314	253	224	101	90
2010						
Authority	127 [41]	105 [41]	122 [54]	101 [53]	5 [6]	4 [6]
No authority	186 [59]	152 [59]	103 [46]	90 [47]	83 [94]	62 [94]
Total	313	257	225	191	88	66

Volume of firewood sold under contract by the FPC

The total volume of firewood removed to service contracts of sale by the FPC was steady and consistently well below the amount authorised. The most likely explanation is that the market for firewood is driven by demand, which is relatively stable and less than the available supply. Table 7.2 below shows the volume removed compared to contracted volume from 2004 to 2010.

The number of contracts has been stable, with small variations due to termination, reassignment or issue of minor production contracts. The volume of firewood removed has been steady except for depressed volumes in 2007. The lower volumes in 2007 could be due to a number of reasons. From a supply point of view, contracts tendered from 2005 included green firewood, which had to be stockpiled and dried before being ready for sale in 2007. There may also have been an increase in the use of residue such as mill ends and offcuts from an increased amount of available bole saw logs. There is currently no way of measuring how much this source contributes to supply. From a demand point of view, the lower figures in 2007 may be related to incentives to replace wood fires with gas heating which were on offer in the 2006/07 season. Since 2007 there has been a gradual rise in demand, possibly due to increased use of firewood in outdoor pizza ovens and braziers, or due to wood merchants making wood more convenient in bagged or boxed form.

Table 7.2 Summary of firewood sales and removals by FPC

Component	Year						
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
No. of contract of sale	42	45	41	44	39	32	45
Contract volume	51,300	87,200	88,000	83,400	84,400	78,600	82,600
Removed volume	50,800	55,600	54,000	32,300	41,200	45,500	47,300
% removal	99	64	61	39	49	58	57

There is not a target shortfall overall because estimated removals are well below the authorised volume through contracts and licences. The reason the overall target is achieved is because the authorised volumes are dominated by FPC contracts which were not fully utilised.

Despite the KPI target being achieved, the management of public firewood collection is problematic. The potential environmental consequences arising from collection outside of designated firewood collection areas and under moist soil conditions are of more concern to the Department than the volume of firewood removed. Potential issues associated with unauthorised collection include rubbish dumping, spread of weeds or dieback (see the report on KPI 18), felling of standing trees and/or removal of coarse woody debris, with potentially adverse biodiversity impacts, particularly in areas where legacy elements are already depleted.

Anecdotal evidence from the Department's district staff suggests the inconsistent use of the current public firewood collection system could be due to cultural or economic reasons that may include:

- firewood collectors may not be aware of the requirement to have an authority
- the inconvenience of having to travel to purchase an authority or reach a public firewood collection area
- an unwillingness to collect and stockpile wood over summer
- a lack of awareness of the environmental impacts of indiscriminate collection.

Since the 2005 study, the Department's website has been updated with more information regarding firewood collection and the requirements for authorisation (see www.dec.wa.gov.au/content/view/3065/1830/). However, this does not appear to have translated to an improvement in the 2010 survey results.

The Department conducts weekend patrols primarily for the purposes of public education, but also at times for enforcement relating to environmental breaches. DEC is currently reviewing processes for public access to firewood so as to achieve consistency across regions and to facilitate effective reporting.

Reference

Cullen, G and Hagan, R P (2011) Firewood collection from forests close to Perth – 2005 Study. Department of Environment and Conservation, Western Australia, Sustainable Forest Management Series, SFM Technical Report No. 6, 21 pp.

KPI 8 The presence of Sirex in softwood plantations

Performance measure	*Evidence of Sirex in trap trees.*
Performance target(s)	*No evidence of Sirex in trap trees.*
Reporting	*Annually.*
Response to target shortfall	*The Forest Products Commission to initiate a control program.*

Objective of KPI 8

To assess the success of the implementation of the FMP in achieving its target of not allowing *Sirex* to become established in plantations, and thus minimising the impact of *Sirex* on the productive capacity of pine plantations in the plan area.

Context

Sirex noctilio is a wood wasp species native to Europe that infests pine trees. It was accidentally introduced into New Zealand in 1945 and has since been discovered in Australia where outbreaks have been recorded in Tasmania, Victoria, New South Wales and South Australia. *Sirex* kills pine trees by introducing a wood-rotting fungus into the tree. The fungus is introduced by the female wasp and spreads throughout the tree providing food for the burrowing larvae. If *Sirex* were to become established in plantations within the FMP area, the potential losses in production would be significant.

Results and explanatory notes

Prior to 2007, trap trees were used as the method for detecting the presence of *Sirex*. During the period 2005/06 to 2007/08, 115 trap trees across 19 sites did not detect the presence of the wasp. In 2007, the use of static traps was introduced in preference to trap trees. The benefits of using static traps include reduced variability, ability to detect earlier, at low numbers and before the insects reach plantations.

Since 2007, the FPC has conducted an annual trapping program during the *Sirex* flight season which occurs between December and April. Four sites were established in the 2007/08 season, and the number of sites was expanded to 10 in subsequent years. The monitoring is summarised in Table 8.1 below and up to 2011 shows no evidence of *Sirex* in any of the static traps.

Table 8.1 Number of *Sirex* detected in static traps from 2007 to 2011

Plantations assessed	Number of *Sirex* detected			
	2007/08	2008/09	2009/10	2010/11
Gnangara	Nil	Nil	Nil	Nil
McLarty		Nil	Nil	Nil
Myalup	Nil	Nil	Nil	Nil
Dardanup (Wespine)		Nil	Nil	Nil
Wilcock	Nil	Nil	Nil	Nil
Baudin		Nil	Nil	Nil
Maidment		Nil	Nil	Nil
Napier (Albany)	Nil	Nil	Nil	Nil
Albany Town		Nil	Nil	Nil
Esperance		Nil	Nil	Nil

KPI 9 Time to regenerate harvested areas

Performance measure	*The time between completion of native forest harvesting of a coupe for regeneration and the completion of post-harvest regeneration treatment.*
Performance target(s)	*For karri and planted jarrah:* • *achieve more than 75 per cent of areas treated to be completed within 18 months; and* • *achieve 100 per cent of areas treated to be completed within 30 months.* *For other jarrah:* • *achieve 100 per cent of areas treated to be completed within 18 months.*
Reporting	*Annually.*
Response to target shortfall	*The Forest Products Commission to advise the Department how it will rectify the shortfall. The Department to determine the need for a revision of management practices, in consultation with the Conservation Commission.*

Objective of KPI 9

To assess the success of the implementation of the FMP in achieving its targets in regard to the time taken to regenerate harvested areas.

Context

Completing regeneration treatments following harvesting operations is essential in maintaining the long-term productive capacity, flora composition and structural attributes of native forests. Time delays between harvesting and regeneration reduce the ability to achieve prescribed burn outcomes and may lead to site degradation. Ensuring that areas are regenerated within target timeframes increases the likelihood of achieving effective regeneration and potentially reduces the time taken for biodiversity to return to pre-disturbance levels.

Time taken to harvest an individual coupe will vary according to a number of factors including volume of product to be harvested and seasonal access restrictions. The date that harvesting is considered complete is when all fellers' blocks within the coupe have been certified as complete. Further transportation of timber products from landings to customers can continue after this date.

Regeneration of harvested areas involves the completion of a sequence of tasks including harvesting, post-harvest treatment, burn preparation, burning and in some cases planting. The date of the last operation in the sequence of regeneration treatment is seen as the date regeneration treatments were completed.

Results and explanatory notes

The performance target for jarrah was not met in the sample of coupes harvested during the first eight years of the FMP for which data are available (Table 9.1). A response to this target shortfall is provided below.

Table 9.1 Jarrah – Percentage of sampled jarrah harvest coupes in various categories of time between harvest completions of regeneration treatments

Year harvested complete	Completed in less than 18 months	Completed in less than 30 months	Completed in greater than 30 months	Not completed in greater than 30 months	Total
2004	13% (1)	51% (4)	38% (3)	13% (1)*	100% (8)
2005	29% (2)	86% (6)	0% (0)	14% (1)*	100% (7)
2006	50% (8)	56% (9)	6% (1)	38% (6)*	100% (16)
2007	84% (10)	84% (10)	8%(1)	8% (1)#	100% (12)
2008	23% (5)	37% (8)	4% (1)	59% (13)#	100% (22)
2009	43% (6)	50% (7)	0% (0)	50% (7)#	100% (14)
2010	50% (5)	50% (5)	0% (0)	50% (5)#	100% (10)
2011	0% (0)	50% (1)	0% (0)	50% (1)#	100% (2)
Total	41% (37)	55% (50)	7% (6)	38% (35)#	100% (91)
Target	100%				

* - Not regenerated at 30/06/2008 as reported in the mid-term audit report.
\# - Not regenerated at 30/06/2011.
- The sample covers coupes in which harvesting was completed during the period 2004–2011, in which regeneration was not based on planting of seedlings and hence where the performance target is 100 per cent of areas treated to be completed within 18 months.
- Numbers in parentheses refer to the number of coupes contributing data for that year.

The performance target for karri of 75 per cent within 18 months was met each year except 2004, 2005 and 2007 in the sample of karri coupes assessed. A response to this target shortfall was provided in the mid-term audit report. The performance target for karri of 100 per cent within 30 months was met in all years (Table 9.2).

Table 9.2 Karri – Percentage of sampled karri harvest coupes in various categories of time between harvest and completion of regeneration treatments

Year harvested complete	Less than 18 months	Less than 30 months	Total
2004	50% (2)	100% (4)	100% (4)
2005	70% (7)	100% (10)	100% (10)
2006	100% (7)	100% (7)	100% (7)
2007	33% (1)	100% (3)	100% (3)
2008	80% (12)	100% (15)	100% (15)
2009	100% (21)	100% (21)	100% (21)
2010	100% (22)	100% (22)	100% (22)
2011	100% (3)	100% (3)	100% (3)
Total	88% (75)	100% (85)	100% (85)
Target	75%	100%	

* - Not regenerated at 30/06/2008 as reported in the mid-term audit report.
- The sample covers coupes in which harvesting was completed during the period 2008–2010, in which regeneration was based on planting of seedlings and hence where the performance target is 75 per cent of areas treated to be completed within 18 months and 100 per cent of areas treated to be completed within 30 months. Numbers in parentheses refer to the number of coupes contributing data for that year.

Response to target shortfall

The FPC has advised the Department that the shortfall for jarrah is due to a number of factors, most of which relate to the capacity to conduct regeneration burns in a timely manner including:

- the need to coincide burning with maturation of seed crops given that burns often comprise a mix of silvicultural outcomes
- restricted opportunities to undertake burning due to seasonal conditions
- precedence of townsite and community protection burns over silviculture burns
- inability to complete silviculture burns which are likely to affect grape growers, with impacts on silviculture burns in both karri and southern jarrah fuel types
- availability of resources to complete all burns during suitable conditions.

Further delays were also identified in planning processes. Coupe boundaries often did not coincide with management boundaries suitable for use as the post-harvest burn boundary, and a separate burn boundary usually needed to be established. When burn boundaries are not included as part of the disturbance area identified during the harvest planning process, a second disturbance checklist needs to be completed and the area needs to be revised for flora surveys and dieback mapping. This process may delay regeneration by several months to a year. The Department has worked with the FPC to have the silviculture burn boundary identified and included in the disturbance planning for the coupe.

To achieve silvicultural objectives in areas cut to shelterwood, the silviculture burn must be timed to coincide with a suitable seed crop. In many coupes where shelterwood is the predominant outcome, harvesting is completed without a seed crop being available. The burn must then be postponed until seed conditions are suitable. This contributes to long delays which could be avoided if seed forecasts were completed and harvest timed to occur just prior to seed maturity.

Large jarrah coupes often take a number of years for harvesting to be completed. This results in substantial regeneration establishment and growth in the initial fellers' blocks, prior to the post-harvest burn. This can cause difficulties in achieving the regeneration requirements, especially when coupled with the need to provide for multiple outcomes. Department staff are working with harvest planners to try to reduce the size of coupes to assist with timely completion, and also to introduce target harvest completion times.

Since the mid-term audit report, the Department in liaison with the FPC has reviewed performance and management practices associated with conducting timely regeneration burns. Key changes to management practices have been implemented as a result:

- revised requirements for approval of log stockpile locations
- identification of the perimeter of silvicultural burns earlier in the planning and approvals process
- a review of Silvicultural Guideline 1-97 *Fire as a silvicultural tool in the jarrah forest* to provide additional clarity and flexibility, leading to a revised document that was approved for implementation in November 2011.

These changes address impediments to achieving the performance targets, but the complexity of integrating multiple factors remains.

KPI 10 Effectiveness of regeneration of native forest and plantation

Performance measure	*The proportion of the sampled annual regeneration release program that does not meet the stocking standard set out in the Silviculture Guidelines.*
Performance target(s)	*No more than five per cent of the area regenerated requiring remedial action.*
Reporting	*Annually.*
Response to target shortfall	*The Forest Products Commission to advise the Department how it will rectify the shortfall. The Department to determine the need for a revision of management practices, in consultation with the Conservation Commission.*

Objective of KPI 10

To assess the success of the implementation of the FMP in achieving its targets in regard to the effective regeneration of forest and plantation areas.

Context

In order to maintain productive capacity and to provide for a range of other forest values, forest and plantation areas are regenerated after harvesting. Regeneration surveys are conducted to determine whether success criteria have been achieved. Infill planting is required when success criteria have not been met.

Results and explanatory notes

The performance targets for karri and jarrah forest were achieved in every year from 2004 to 2009 as shown in Tables 10.1 and 10.2. The performance target for regeneration success in plantation areas was not achieved in 2004 and 2005 as shown in Table 10.3.

The plantation areas that did not meet stocking targets have received remedial treatment. The performance from 2006 to 2010 indicates there is no systematic deficiency in achieving the required performance target. The higher percentages requiring remedial action (infill planting) for the 2009 and 2010 establishment years resulted from below average rainfall leading to drought deaths. Insect infestations in the Harvey coast plantations also contributed to the higher remedial requirements.

Table 10.1 Annual area of karri forest regenerated that was surveyed and required remediation to achieve stocking density standards specified in the Silviculture Guidelines

Year	Area (ha) regenerated in previous year	Area (ha) surveyed	Area (ha) understocked	Area requiring remedial treatment (% of area surveyed)
2004	1,409.6	1,381.5	8.4	0.6
2005	1,323.0	1,314.6	5.9	0.4
2006	737.5	731.6	1.0	0.1
2007	674.5	673.5	4.0	0.6
2008	564	522	0	0
2009	497	438	10	2.2

Table 10.2 Annual area of jarrah forest regenerated that was surveyed and required remediation to achieve stocking density standards specified in the Silviculture Guidelines

Year	Area (ha) regenerated in previous year	Area (ha) surveyed	Area (ha) understocked	Area requiring remedial treatment (% of area surveyed)
2004	1,614.7	952.1	0	0
2005	962.6	512.2	0	0
2006	287.7	222.4	0	0
2007	302.9	173.8	0	0
2008	427	194	0	0
2009	253	197	0	0

Table 10.3 Annual area of plantation (pine) forest regenerated that was surveyed and required remediation to achieve stocking density standards specified in the Silviculture Guidelines

Year	Area (ha) regenerated in previous year	Area (ha) surveyed	Area (ha) understocked	Area requiring remedial treatment (% of area surveyed)
2004	1,418.1	1,418.1	105.0	7.4
2005	1,455.8	1,455.8	143.0	9.8
2006	1,432.7	1,432.7	45.0	3.1
2007	1,511.5	1,511.5	52.0	3.4
2008	1627.0	1627.0	23.8	1.46
2009	2106.2	2106.2	95.0	4.51
2010	570.0	570.0	28.2	4.95

KPI 12 The achievement of early thinning schedules that underpin future yield

Performance measure	*Achieved thinning versus that prescribed in silviculture schedules.*
Performance target(s)	*All stands thinned at the prescribed stand development stage.*
Reporting	*Two years after commencement of the plan and each two years thereafter.*
Response to target shortfall	*The Forest Products Commission and the Department to investigate the cause and report to the Conservation Commission. The Conservation Commission to evaluate the need for revision of management practices in the context of its assessment and auditing function in consultation with the Department.*

Objective of KPI 12

To assess the implementation of the FMP through tracking the area of regrowth jarrah and karri forests that have received a first thinning, relative to the area provisionally scheduled in the calculation of sustained yields.

Context

The sustained yield projections in the FMP assume that regrowth jarrah and karri stands are periodically thinned to promote sawlog growth, and to maintain forest health and vigour. Achievement of early (first) thinnings is particularly important in jarrah because extended delays over years can lead to an overstocked condition and markedly slower growth rates.

This KPI compares the area of young regrowth forest provisionally scheduled to be thinned against the area recorded as cut over in the Department's SILREC database (see KPI 6). The young regrowth stands are predominantly those regenerated since the 1970s.

The mid-term audit report identified the need to progress the site quality and forest structure stratification of the forests to assist harvest planning and (where necessary) to reschedule thinning treatments. A substantial project commenced in 2010 to map the height and structure of the regrowth jarrah forest using high resolution digital imagery. This ongoing project is progressively improving the information available for scheduling stands for both harvest planning and sustained yield purposes.

Following the mid-term audit report the Department provided supplemental advice to the Conservation Commission concerning the causes for the higher levels of karri other bole volume produced during 2004–2007. This detailed analysis also confirmed that for regrowth karri the silvicultural schedules and areas thinned were consistent with the settings adopted for the FMP.

Results and explanatory notes

The area of regrowth karri thinned to December 2009 indicates that the thinning program is progressing on or ahead of the schedule (Table 12.1). The total area provisionally scheduled for thinning averaged up to 1,260 hectares per annum (2,520 hectares per biennium) over the period of the FMP, with a higher proportion of the area scheduled to be thinned in the latter period of the plan (2009–2013). In the first four years of FMP, thinning has progressed at a higher rate, but remains within the overall range expected by the

Department for the FMP. The faster rate of thinning will not impact future sawlog sustained yields.

Table 12.1 Area (hectares) of regrowth karri and jarrah provisionally scheduled and actually thinned during the period 2004 to 2009. The figure for the scheduled karri area includes provision for an expanded first thinnings program as provided for in the FMP.

Species	Operation period	Area provisionally scheduled for first thinning (hectares)	Area thinned[#] (hectares)	Variation (hectares)
Karri	2004–2005	1,448	2,070	+ 622
	2006–2007	2,108	2,140	+ 32
	2008–2009	2,108	1,570	- 538
Jarrah*	2004–2005	0	0	0
	2006–2007	900	0	- 900
	2008–2009	900	0	- 900

* Approximately 170 hectares of early thinning was recorded during this period within two-tiered and pole stands (not the young regeneration reported in this KPI).
[#] These statistics will vary slightly from figures published in the mid-term audit report due to rounding and the subsequent updating of datasets.

Factors contributing to the larger program of karri thinning include the persistence of a strong commercial market for small karri logs, the ready availability of stands at the suitable development stage for thinning, and the availability of appropriate stratification and planning systems.

In contrast, no thinning was recorded in young regrowth jarrah stands to December 2009. Broadscale thinning operations have not commenced in these young stands because there is currently no market for the very small logs generated.

The FMP provisionally scheduled approximately 450 hectares per annum, commencing in the stands regenerated between 1974 and 1984 in the Warren Region. Field inspections of candidate areas by the FPC suggest that improved stratification and survey may be required in some areas, as some of these stands were not yet suitable for a thinning. Factors contributing to the delayed development include delayed establishment and the impact of frost events and insect damage.

Response to target shortfall

The cumulative delay of several years in commencing thinning operations in the young regrowth jarrah stands will require modification to the yield regimes applied to these stands in the calculation of sustained yields for the next FMP. The Department will ensure this is undertaken as part of the routine work to update relevant datasets in the sustained yield modelling. Such updates will also include the refinement of forest stratification datasets being generated from the new interpretation project.

The FPC has continued to pursue markets for the small jarrah and marri logs generated from first thinning operations. In December 2011 the FPC invited Expressions of Interest from companies interested in processing up to 800,000 tonnes a year of low grade hardwood logs. The jarrah and marri logs scheduled to be made available from first thinnings are included in this process.

KPI 13 Direct and indirect employment in the timber industries

Performance measure	*The numbers employed in native timber harvesting, processing and downstream manufacture.*
Performance target(s)	*No target, trends to be reported.*
Reporting	*Forest Products Commission to report biennially.*
Response to target shortfall	*The Department to investigate the cause and report to the Conservation Commission and to the Minister for the Environment.*

Objective of KPI 13

There is no specific objective in the FMP dealing with employment, however this KPI will enable changes in the level of employment and employment categories to be recognised and investigated if required.

Results and explanatory notes

The 2004 FMP saw a sharp decline in the available quantity of log material available from State forest. With respect to sawlogs, there was also a general decline in size. The initial result was a major restructuring of the native forest sector. Those sawmills that maintained access to the native forest resource, particularly the larger mills, struggled to maintain operating viability with the lower quality logs.

As a consequence of this restructure there has been a continuing decline in the native forest industry as seen in the employment figures from 2006 to 2011 in Table 13.1, notably with Gunns operations closing at Yarloop and Manjimup.

Table 13.1 The number of persons employed directly in native forest management, harvesting and sawmilling

Year	2006	2008	2011
Number of persons employed	1,571	1,307	1,278

Source: Dare and Schirmer (2012).
Note: The data do not include manufacturing or indirect employment.
Note: Where data categories in Dare and Schirmer (2012) encompass both native and plantation forests, the categories have been allocated pro-rata based on known employment by sector.

More recently there appears to be some restored confidence in the native forest industry with the reopening of the Deanmill complex at Manjimup by Auswest, an existing player in the Western Australian native forest industry. This should see employment numbers in the industry increase in 2012.

It should be noted that there is an increasing worldwide demand for resources, including timber, with heightened interest in the FPC's uncommitted lower grade native forest resource. This has seen a number of overseas parties exploring options to develop local processing of this resource.

Interest in new investment in the native forest industry however is currently dampened by the expiry of the FMP at the end of 2013 and uncertainty surrounding the available resource to be provided by the next forest management plan in 2014.

Reference

Dare, M. and Schirmer, J. 2012. Western Australia Forest Industry Survey, unpublished data. CRC for Forestry, Hobart.

KPI 14 Access for apiculture

Performance measure	*The number of registered sites by land category.*
Performance target(s)	*No target, trends to be reported.*
Reporting	*Biennially.*
Response to target shortfall	*The Department to investigate the cause and report to Conservation Commission and to the Minister for the Environment. The Conservation Commission to evaluate the need for revision of management practices in the context of its assessment and auditing function, in consultation with the Department.*

Objective of KPI 14

To assess the success of the implementation of the FMP through the management of the production of honey by providing information on the number of apiculture sites.

Context

A significant proportion of Western Australia's honey production comes from apiary sites within the FMP area. The FMP seeks to provide access for the field placement of hives, and to reduce the likelihood of unintended impacts from spread of dieback, weeds or damage to approved sites. The Department manages access to apiary sites across a range of tenures within the FMP area using a permit system. Changes in access may occur through prescribed removals from new or revised area management plans. Changes in numbers of registered sites or movement of sites may also occur due to seasonal conditions or trends in the honey production industry.

Results and explanatory notes

The Department continues to provide access for apiculture within the FMP area. The number of registered apiary sites by land tenure at March 2008 and November 2011 are shown in Table 14.1. In October 2011 there were 1,136 registered apiary sites, 100 fewer than the number of hives reported in the mid-term audit report. There was a reduction in the number of hives in national parks, and an increase in the number of hives in conservation parks.

The small overall reduction since the mid-term audit report may be attributed to a number of different causes:

- An increase in apiary rental fees in September 2010 from $60 per year to $84 per year. Some beekeepers have rationalised their sites, cancelling those less productive or economical.
- Drought has caused some areas to decline and be less productive. Some beekeepers have cancelled sites in such areas.
- Some sites have been cancelled because they are within active mining areas.
- The criteria introduced for assessing apiary sites in area management plans have reduced the number of sites in some national parks and reserves in which the criteria have been applied.
- A small number of sites have had to be cancelled following a determination that they had been issued too close to other beekeepers' sites. Beekeepers must be at least 2.7 kilometres from another beekeeper's site but there is no distance restriction between sites held by the same beekeeper.

- A small number of sites were cancelled because they were within 200 metres of the Bibbulmun Track and Munda Biddi Trail. (Some are still in the process of being relocated or cancelled.)
- Some sites were cancelled or relocated because they were found to be issued within the two-kilometre reservoir protection zone around drinking water catchments. This issue is still ongoing.

Table 14.1 Number of apiary sites on each land category in the FMP area

Land category	Number of sites in FMP area	
	March 2008*	**October 2011**
State forest, timber reserve	849	827
Nature reserve	47	44
National park	295	197
Conservation park	45	101
CALM Act section 5(1)(g) & (h) reserve	Not reported as a separate category in 2008	52
Total for FMP area	1,236	1,136

*Figures adjusted from the mid-term audit report in line with the KPI protocol, e.g. seven sites in unvested reserves reported previously have been excluded and State forest and timber reserve totals have been combined.

DEC consults formally with the beekeeping industry twice a year (usually in May and November) through the Beekeeping Consultative Committee. Issues that have been discussed with industry since the mid-term audit report that could impact on the lands dealt with under the FMP include:

- development of the revised Draft Beekeeping Policy and Policy Guidelines
- removal of apiary regulations in the Forest Management Regulations 1993 and introduction of new regulations for apiary sites in the Conservation and Land Management Regulations 2002 in September 2010
- the Department agreeing to the trading of apiary sites
- the development of the Feral Bee Strategy
- clearing permits for beekeepers in relation to the vegetation growing at or near apiary sites
- unlawful placement of hives on Crown land
- proposed development of a Conditions Booklet and Beekeepers Handbook
- beekeepers affected by the closure of tracks within forest areas
- apiary sites affected by area specific management plans
- dieback hygiene.

KPI 15 Wildflowers and seed picking

Performance measure	*The level of activity measured by picking endorsements and returns.*
Performance target(s)	*No target, trends to be reported.*
Reporting	*Annually.*
Response to target shortfall	*The Department to investigate the cause and report to Conservation Commission and to the Minister for the Environment. The Conservation Commission to evaluate the need for revision of management practices in the context of its assessment and auditing function, in consultation with the Department.*

Objective of KPI 15

To assess the success of the implementation of the FMP in seeking to sustain the productive capacity of the forest through monitoring the removal of wildflowers and seed.

Context

The FMP has an objective to manage the removal of forest produce, other than sawlogs and residue logs, in a manner that, so far as is practicable and sustainable, satisfies public demand for that produce. The Department manages wildflower harvesting in accordance with *Policy Statement 13 – Commercial Flora Harvesting* (1993), and *Management of Commercial Harvesting of Protected Flora in Western Australia 1 July 2008 – 30 June 2013* (2008).

Since the mid-term audit report, the protocol for this KPI has been reviewed by the Department and updated to enable improved reporting. The revised protocol was approved by the Conservation Commission in September 2009.

Results and explanatory notes

Registration and harvest statistics for wildflower pickers from 2004 to 2010 are shown in Table 15.1 below. There has been a 33 per cent reduction in the number of wildflower pickers within the plan area, from a reported 454 in 2004 to 305 in 2010. This has led to a significant reduction in the amount of wildflowers harvested within the plan area, with a drop from around 10 million stems in 2004 to four million in 2010. This represents a reduction of around 60 per cent in the harvest. After a steady reduction from 2004 to 2008, harvest levels have been relatively constant from 2008 to 2010.

The availability of detailed information at a species level continues to be difficult and time consuming to collate and analyse. Cultivated stands on private property have matured to a stage at which they are harvestable for the cut flora industry. This has resulted in a significant amount of the wildflower harvesting now occurring on private property, instead of being sourced from Crown land.

Table 15.1 Registration and harvest statistics for wildflower pickers for 2004–2010

Wildflower harvesting	2004*	2005*	2006	2007	2008	2009	2010
Number of grid reference** squares in which wildflowers were harvested	15	15	16	17	15	14	16
Number of registered# wildflower pickers	454	412	347	374	394	335	305
Number of registered# wildflower pickers who submitted a value return^	191	156	153	127	129	117	111
Number of registered# wildflower pickers within the FMP grid reference* squares who submitted a value return^	160	127	124	118	112	101	93
Total number of wildflowers harvested (number of stems) within the FMP grid reference* squares	10,328,670	9,502,362	8,667,680	6,493,230	4,768,136	4,700,672	4,237,221

* Figures adjusted from the mid-term audit report in line with the receipt of late returns from pickers and the revised KPI protocol.

** Data is not available for 'forest blocks' so data were analysed on the basis of the statewide 'grid reference' squares. The following grid reference squares were used to encompass the south-west forests of Western Australia (1811, 1812, 1813, 1814, 1911, 1912, 1913, 1914, 2004, 2011, 2012, 2013, 2014, 2102, 2111, 2112, 2113, 2114, 2123)

\# This is the total number of Commercial Purposes licensees for the calendar year, i.e. any Commercial Purposes licensee is able to take seed/wildflowers if they obtain the correct permissions/endorsements. Applicants specify these details on an application form, but these data are not reflected on their licence.

^ A return on which a value was given for stem/seed picked for that year. Therefore this number does not include those licensees who harvested but did not submit their return, or those licensees who submitted a 'Nil' return.

Registration and harvest statistics for seed pickers from 2004 to 2010 are shown in Table 15.2 below. There is significant variation in the level of harvest from a peak of around 20 tonnes in 2008, to a low of around five and a half tonnes in 2006. The Department attributes the variation to the changing demand for seed, coupled with variations in the availability of seed in dry years.

Table 15.2 Registration and harvest statistics for seed pickers for 2004–2010

Seed collection	2004*	2005*	2006	2007	2008	2009	2010
Number of grid reference** squares in which seed was harvested	15	15	15	15	14	14	13
Number of registered# seed pickers	454	412	347	374	394	335	305
Number of registered# seed pickers who submitted a value return^	141	130	146	155	204	173	173
Number of registered# seed pickers within the FMP grid reference* squares who submitted a value return^	78	90	91	111	149	126	135
Total amount of seed collected (kg) within the FMP grid reference* squares	15,743.63	5,597.37	5,407.07	10,332.99	20,363.46	9,648.52	12,653.00

* Figures adjusted from the mid-term audit report in line with the receipt of late returns from pickers and the revised KPI protocol.

** Data is not available for 'forest blocks' so data were analysed on the basis of the statewide 'grid reference' squares. The following grid reference squares were used to encompass the south-west forests of Western Australia (1811, 1812, 1813, 1814, 1911, 1912, 1913, 1914, 2004, 2011, 2012, 2013, 2014, 2102, 2111, 2112, 2113, 2114, 2123)

This is the total number of Commercial Purposes licensees for the calendar year, i.e. any Commercial Purposes licensee is able to take seed/wildflowers if they obtain the correct permissions/endorsements. Applicants specify these details on an application form, but these data are not reflected on their licence.

^ A return on which a value was given for stem/seed picked for that year. Therefore this number does not include those licensees who harvested but did not submit their return, or those licensees who submitted a 'Nil' return.

In summary, there appears to be a trend in wildflower harvesting from south-west forests from cut flora to seed, possibly due to an increased focus on the need to collect seed for use in rehabilitation for mining.

Reference

Management of Commercial Harvesting of Protected Flora in Western Australia 1 July 2008 – 30 June 2013 (2008), Department of Environment and Conservation, Perth.

Ecosystem health and vitality

Three KPIs are reported below in relation to ecosystem health and vitality.

KPI 16 The risk to conservation, life, property and other forest values posed by wildfire

Performance measure	*The area of forest by fuel age classification.*
Performance target(s)	*General conformance with the theoretical distribution of time since fire for the whole-of-forest and for each Landscape Conservation Unit.*
Reporting	*Annually.*
Response to reporting	*The Department to evaluate high-risk areas and incorporate into fuel reduction planning for subsequent years.*

Objective of KPI 16

To assess the success of the implementation of the FMP in achieving its targets in relation to the management of fire by providing information on the temporal diversity of 'time since fire' within each Landscape Conservation Unit.

Results and explanatory notes

Overall fuel age distribution in the south-west forest regions

The frequency distribution of fuel ages across the entire FMP area (Figure 16.1) gives an indication of the understorey structural diversity and therefore habitat diversity at that level. The degree to which the fuel age distribution conforms with the theoretical negative exponential curve gives an indication of how well the Department's fire program is achieving the fire objectives of the FMP at an all-of-forest scale.

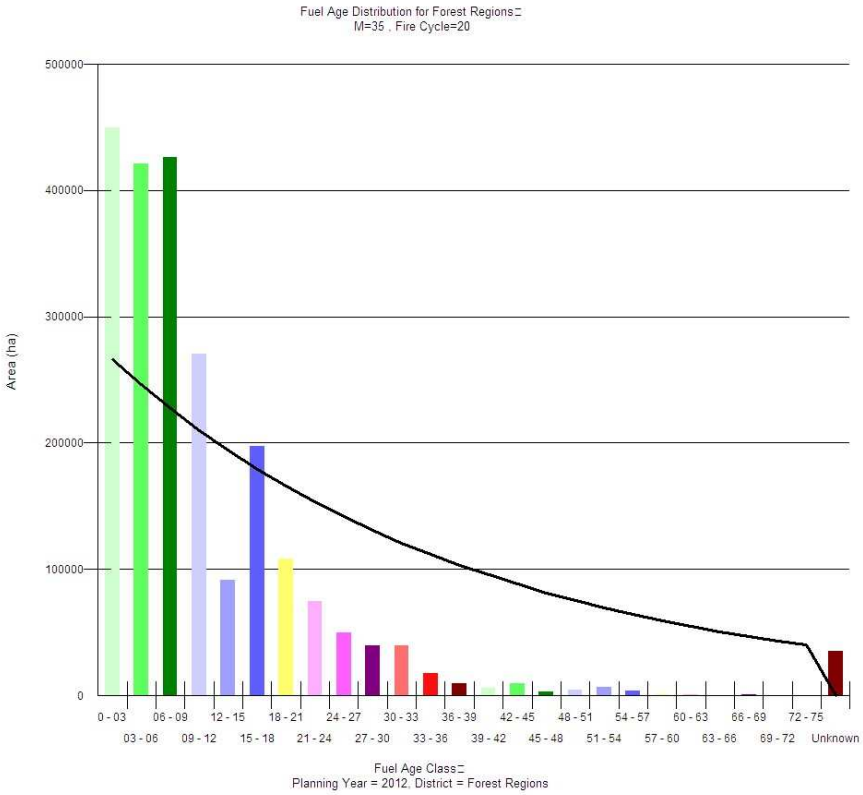


Figure 16.1 Proportion of areas according to fuel age classes for the area of the FMP

The graph shows a strong correlation with the desired negative exponential curve indicating that vegetation structural diversity is highly probable at an all-of-forest scale. This must be considered in the context of the data limitations discussed below.

The unknown fuel age category relates to small parcels of land on the forest periphery or other areas recently incorporated into the forest estate for which fuel age records do not exist. It also includes areas where fuel is not present, such as lakes and sand sheets.

Major Landscape Conservation Units

The major Landscape Conservation Units (LCU) reported in Table 16.1 below are large and contiguous and were reported on in the mid-term audit report. Other LCUs occur in areas that are on the fringe of the forest belt and contain land managed by the Department that is small in area and fragmented.

Table 16.1 Conformance of fuel age classes at a LCU level with a negative exponential distribution

Landscape Conservation Unit	***Comments on conformance with negative exponential curve***
Blackwood Plateau	Generally conforms with the curve
Central Blackwood	Generally conforms with the curve
Central Jarrah	Generally conforms with the curve
Central Karri	Higher fuels in the 15–33-year-old categories due to karri regrowth
Collie-Wilga	Generally conforms with the curve
Monadnocks, Uplands and Valleys	Large area included in 9–12-year-old fuels due to the 2003 Mt Cooke fire
North Jarrah	Generally conforms, but with some younger fuels due to the 2005 Perth hills bushfire
North Karri	Higher fuels in the 15–24-year-old categories due to karri regrowth
Northern Sandy Depressions	Affected by the large 2005 Perth hills bushfire
Northern Upper Collie	Some younger fuels due to recent burns in large forest blocks
South Eastern Uplands	A mix of adjoining land tenures requires strategic protection burning
Southern Dunes	Generally conforms with the curve
Southern Hilly Terrain	Large area of 9-year-old fuel due to a 2003 bushfire
Southern Karri	Generally conforms with the curve
Southern Swampy Plains	Largely inaccessible with several large burns in recent years
Strachan-Cattaminup Jigsaw	Generally conforms, but with high younger fuels due to strategic protection imperatives
Yornup Wilgarup Perup	Generally conforms, but with high younger fuels due to post-harvest burning

Generally, the majority of LCUs conform to the shape of the negative exponential curve indicating that fire management is effective for those areas. However, in a similar manner to that reported in the mid-term audit report, some of the LCUs do not conform well to the shape of the negative exponential curve.

Response to target shortfall

Where there are significant deviations from this guiding curve the reasons generally relate to achieving a balance between other management objectives as well as unplanned fire events.

The limitations of the underlying data must also be appreciated. An area's fuel age is recorded as the time since the last fire occurred within that area. The entire area that is treated with prescribed fire or the entire area within the boundary of a bushfire is considered to be burnt for the purposes of record keeping.

In reality, significant areas within a prescribed burn boundary (in the order of 10 per cent to 30 per cent) and even within a bushfire boundary remain unaffected by fire. These unburnt areas continue to accumulate fuel until they are burnt at some future time. No recognition is given to the mosaic of fuel ages within these areas.

This limitation of the data means that there are significant areas of older fuels within areas recorded as being burnt recently and assigned a young fuel age. This results in the fuel age

distribution curves significantly under-representing the true quantum and extent of older fuel ages and over-representing the quantum and extent of younger fuel ages.

It may be possible to rectify this deficiency in the data over coming decades as more detailed records are collected using improved remote sensing technologies. These future advances should allow the fine scale differentiation of burnt and unburnt areas within a prescribed burn or bushfire.

In addition, prescribed fire is applied in LCUs for a range of purposes including biodiversity conservation, catchment management, strategic bushfire risk management, research and silviculture. For example, fuel age in the Yornup Wilgarup Perup LCU reflects burning for silvicultural purposes. Similarly prescribed fire is also withheld for various strategic reasons, and bushfire activity also affects LCUs at different spatial and temporal scales.

A number of LCUs such as North Karri and Central Karri contain extensive areas of karri regrowth which is susceptible to fire until about 25 years old. Prior to that, some bole damage can be expected. Burn programs are planned accordingly to manage this situation over time and in the context of surrounding areas and fuels. Seasonal variability and unfavourable weather can affect program implementation in some years.

Significant areas were affected by bushfires in recent years leading to an over-representation of some younger fuel ages. These areas include the Monadnocks, Uplands and Valleys, North Jarrah, Southern Hilly Terrain and the Northern Sandy Depressions. The Master Burn Planning process is used for program planning at different scales to take account of these bushfires and to adjust fuel age distributions over time through prescribed burning.

A number of LCUs such as the South Eastern Uplands, Central Jarrah and Strachan-Cattaminup Jigsaw have adjoining land tenures and uses that require burning to be tailored to strategic protection and fuel management requirements. Central Blackwood has this imperative as well, plus some fragmentation. This is evident in the proportion of younger fuels in these LCUs and is indicative of the requirement to manage forest fire regimes for multiple objectives.

KPI 17 The severity status of weeds and pests as determined by subjective survey

Performance measure	*List of important weeds and pests and their severity status that tracks movements of species between severity categories.*
Performance target(s)	*No weed or pest to increase in severity status as a result of management actions.*
Reporting	*Every five years.*
Response to target shortfall	*The Department to investigate the cause and report to Conservation Commission and to the Minister for the Environment. The Conservation Commission to evaluate the need for revision of management practices in the context of its assessment and auditing function, in consultation with the Department.*

Objective of KPI 17

To assess the success of the implementation of the FMP through tracking the severity status of weeds and pests so that management activities can be assessed and appropriate actions to better achieve the objective can be identified.

Context

A new protocol for this KPI was approved by the Conservation Commission in October 2009 which uses a list of major weed species likely to be found in the south-west of Western Australia and provides a numerical severity impact score against which each species can be rated. Each region is encouraged to add additional species to this list as new information becomes available and where the distribution of impact is considered to be significant.

Weed invasion is a major threat to natural ecosystems and the native species within them. Weeds threaten biological diversity by disrupting ecosystem processes and functions. In 2008, the Department commenced a weed risk management project that will prioritise weeds within each of the Department's nine regions. The results presented in this KPI represent an interim step towards achieving the full weed risk management process across land managed by the Department.

The invasion of ecosystems by pest animals can pose a major threat to the native species within them, and has been a major contributing factor to many species extinctions and increase in vulnerability status in Western Australia.

Results and explanatory notes

Results of the subjective survey into the severity status of weeds and pests for each region are shown in Tables 17.1 (Swan), 17.2 (South West) and 17.3 (Warren).

Weeds

Significant species for each region are highlighted as follows:

Swan Region

- The species having adverse impacts across multiple tenure throughout the region are – *Acacia* sp. not native to Western Australia, bridal creeper, Paterson's curse, perennial veldgrass, African love grass, narrowleaf cottonbush, cape tulip, Victorian tea tree,

blackberry, South African onion weed, watsonia, arum lily, tree lucerne and Geraldton carnation weed.

- An area of concern is the emerging aquatic weeds in the Canning Regional Park. Distribution is currently limited with minimal impact but these species have the potential to become widespread and have adverse impacts.

South West Region

- The species having adverse impacts across multiple tenure throughout the region are – *Acacia* sp. not native to Western Australia, asparagus fern, Dolichos pea, perennial veldgrass, African love grass, Montpellier broom, narrowleaf cottonbush, cape tulip, Victorian tea tree, Pinaster pine, Radiata pine, blackberry, variegated thistle, apple of sodom, South African onion weed, bulrush, watsonia and arum lily.
- DEC is cooperating with the Department of Agriculture and Food and landowners to create and maintain a blackberry-free buffer zone to enhance the effectiveness of new rust strains on the European subspecies of blackberry. The northern (American) and southern (European) infestations will be separated by controlling blackberry along the Brunswick and Collie rivers and all infestations in an approximately 10-kilometre-wide strip between them.

Warren Region

- The species having adverse impacts across multiple tenures throughout the region are – *Acacia* sp. not native to Western Australia, bridal creeper, Dolichos pea, Montpellier broom, Victorian tea tree, blackberry, variegated thistle, bullrush, watsonia and arum lily.

The spread of weeds continues to be a problem across all tenures. While data are not yet available to quantify movement of species between severity classes, local and anecdotal reports indicate there appears to have been a gradual increase in the severity status of a number of weed species across the three forest regions.

Pest animals

- The European red fox and feral cat are having widespread serious affects in all regions and are continuing to be the focus of major control programs and research.
- Feral pigs are widespread and continuing to have adverse impacts in all regions.
- Rainbow lorikeets have been a developing problem in the Perth hills since 2004 and have shown a significant increase over the period of the FMP.
- Feral bees have been added as a species of concern by the Swan Region. They are reported to be widespread and having an adverse impact across the region. The bees are an introduced competitor for hollows, and are considered to be affecting a wide range of bird and mammal species that rely on tree hollows.
- European house borer is another species of concern in the Swan Region. This species occurs in plantations in the greater Perth area, and while it does not appear to be a conservation threat, it has consumed considerable time and resources. Borers are the subject of an ongoing intensive management program involving the Department of Agriculture and Food, the FPC and the Department to restrict the spread of the pest.

Table 17.1 Survey of severity impact status of weed and pest occurrence in the Swan Region (Perth Hills/Swan Coastal districts)

Common names	Severity impact score by tenure category						Comments
	Sf & Tr		NR	CP	NP	51g &h	
	NF	Pltn					
Aquatic weeds							
Hydrocotyle	0/0	0/0	0/0	0/0	0/0	-/2	Low distribution, emerging weed in Canning River Regional Park.
Leafy elodea	0/0	0/0	0/0	0/0	0/0	-/2	Low distribution, emerging weed.
Parrots feather	0/0	0/0	0/0	0/0	0/0	-/2	Low distribution, emerging weed.
Sagittaria	0/0	0/0	0/0	0/0	0/0	-/2	Low distribution, emerging weed.
Salvinia	0/0	0/0	0/0	0/0	0/0	-/2	Low distribution, emerging weed.
Terrestrial weeds	0/0	0/0	0/0	0/0	0/0		
Acacia not native to WA	1/0	3/0	1/3	1/0	1/2	2/0	
Bridal creeper	0/0	1/1	2/5	2/0	2/5	2/0	
Saffron thistle	0/0	1/0	0/0	0/0	0/0	0/0	
African corn-flag	0/0	0/0	1/0	0/0	0/0	0/0	
Pampas grass	1/0	1/1	1/0	0/0	0/0	1/0	
Dolichos pea	0/0	0/0	2/0	2/0	0/0	3/0	
Paterson's curse	1/0	0/4	2/5	0/4	0/4	0/0	
Perennial veldgrass	0/0	0/5	5/0	3/0	3/0	2/0	
Doublegee	0/0	0/1	0/0	0/0	0/0	0/0	
African lovegrass	0/0	0/5	5/5	5/5	5/5	0/0	
Narrow cottonbush	1/0	1/3	5/5	0/0	5/5	0/0	Mostly south of the river.
Cape tulip	0/0	0/3	3/5	3/5	3/0	0/0	
Victorian tea tree	1/5	1/5	2/3	0/0	0/3	0/0	
Pinaster pine	2/4	0/4	2/2	0/0	2/2	3/0	
Radiata pine	2/4	0/4	2/0	0/0	2/0	3/0	As above.
Blackberry	3/0	3/0	5/5	3/0	3/0	3/0	Waterways.
Apple of sodom	0/0	0/0	0/2	0/2	0/3	0/0	
S African onion weed	0/0	0/0	0/5	0/5	0/5	0/0	
Bullrush	0/0	0/0	1/3	1/3	1/3	0/0	Wetlands.
Watsonia	3/1	3/1	6/6	6/5	6/5	6/0	
Arum lily	0/2	3/2	3/5	3/5	3/5	3/0	
Fig	1/0	0/0	3/0	0/0	0/0	0/0	
Tree lucerne	0/0	0/3	3/3	3/3	3/3	0/0	
Geraldton carnation weed	0/0	0/0	0/6	0/6	0/6	0/0	Increasing trend.
Invasive Species							
Feral goat	0/2	0/2	3/0	0/0	3/1	0/0	
Deer all ssp.	2/0	2/0	2/0	0/0	2/0	0/2	SC-Regional Park.
Cat	6/6	6/2	6/6	6/6	6/6	6/0	
Rabbit	3/2	5/2	5/6	5/6	5/6	5/0	
Feral pig	6/5	6/0	6/5	6/5	6/5	6/0	
Fox	6/6	6/6	6/6	6/6	6/6	6/0	
Rainbow lorikeet	1/5	0/0	1/5	0/5	1/5	0/0	A developing problem since 2004.
European house borer	0/0	6/5	0/0	0/0	0/0	0/0	
Feral bee	6/5	6/5	6/5	6/5	6/5	6/5	

Severity impact score	Description
0	No data, or not known to be present.
1	Reported present but not problematic.
2	Occurs but restricted distribution, has little impact.
3	Restricted distribution and adverse impact.
4	Widespread distribution but having minimal impacts.
5	Widespread distribution and having adverse impacts locally.
6	Very widespread and having widespread adverse impact.

Table 17.2 Survey of severity impact status of weed and pest occurrence in the South West Region (Blackwood/Wellington districts)

Common names	Severity impact score by tenure category						Comments
	Sf & Tr		NR	CP	NP	51g &h	
	NF	Pltn					
Terrestrial weeds							
Acacia not native to WA	6/4	2/2	6/2	6/2	3/2	6/2	
Bridal creeper	2/2	0/2	0/5	0/2	2/2	0/3	
Asparagus fern	0/0	0/0	0/0	0/0	3/0	0/0	
Saffron thistle	2/0	2/0	0/0	0/0	2/0	2/0	
African corn-flag	0/0	0/0	3/0	0/0	0/0	0/0	
Pampas grass	3/0	3/0	2/0	0/0	2/0	2/0	
Dolichos pea	5/0	0/0	0/5	0/0	5/3	0/0	
Paterson's curse	0/0	4/0	3/0	0/0	0/0	0/0	Populations persist at low density under plantation and display explosive regrowth after clearfelling.
Perennial veldgrass	5/3	4/0	0/3	0/4	5/0	0/0	
Doublegee	2/0	4/0	2/0	0/3	4/0	0/0	
African lovegrass	5/0	4/0	5/0	5/0	5/0	0/0	
Montpellier broom	3/0	3/0	3/0	3/0	3/0	0/0	This should also include *Genista linifolia*.
Narrow cottonbush	5/2	5/5	5/4	0/4	0/3	0/3	
Cape tulip	3/2	0/2	3/2	0/2	3/2	0/2	
Victorian tea tree	3/3	3/0	0/0	0/0	5/0	0/2	
African boxthorn	0/0	0/0	0/3	0/0	0/0	0/0	
Pinaster pine	5/0	0/0	3/0	5/0	5/0	0/0	
Radiata pine	5/3	0/0	3/3	5/0	5/3	0/0	
Blackberry	6/4	6/5	6/3	6/4	6/4	6/3	Wellington has blackberry-free buffer zone.
Weeping willow	0/0	0/0	0/0	0/0	0/0	1/0	CALM Exec Body Freehold (Golden Valley).
Variegated rhistle	2/3	6/3	0/0	0/0	2/3	2/0	
Apple of sodom	3/3	5/4	0/0	0/0	3/3	0/3	
S African onion weed	0/0	0/0	0/0	0/5	0/2	0/2	
Bullrush	3/0	0/0	5/5	0/5	2/3	0/5	Wellington – Mining voids and dams.
Watsonia	5/5	2/5	5/5	5/5	5/3	5/5	
Arum lily	3/2	5/2	6/3	5/5	6/3	6/5	
Invasive species							
Deer all ssp	0/2	0/2	0/1	0/0	0/2	0/0	
Cat	6/5	6/5	6/5	6/5	6/5	6/5	
Rabbit	6/2	6/2	6/3	6/3	6/3	6/3	
Feral pig	6/5	6/5	6/4	6/4	6/4	6/4	
Fox	6/6	6/6	6/5	6/5	6/5	6/5	

Severity impact score	Description
0	No data, or not known to be present.
1	Reported present but not problematic.
2	Occurs but restricted distribution, has little impact.
3	Restricted distribution and adverse impact.
4	Widespread distribution but having minimal impacts.
5	Widespread distribution and having adverse impacts locally.
6	Very widespread and having widespread adverse impact.

Table 17.3 Survey of severity impact status of weed and pest occurrence in the Warren Region (Frankland/Donnelly districts)

Common names	Severity impact score by tenure category						Comments
	Sf & Tr		NR	CP	NP	51g &h	
	NF	Pltn					
Terrestrial weeds							
Acacia not native to WA	3/3	-/0	3/3	-/3	3/3	0/0	Mainly *A. longifolia* / *A. dealbata* / *A. melanoxylon*. *A. mearnsii* is a major issue on road reserves in Donnelly District.
Bidgee widgee	0/3	-/0	0/0	-/0	0/0	0/0	
Bridal creeper	2/5	-/2	3/2	-/5	3/2	0/0	
African corn-flag	0/0	-/0	0/0	-/0	0/2	0/0	Mainly Sir James Mitchell NP.
Pampas grass	0/2	-/0	0/0	-/0	2/0	0/0	Outside Walpole townsite.
Dolichos pea	3/3	-/3	3/0	-/0	3/0	0/0	
Paterson's curse	0/0	-/2	0/0	-/0	0/0	0/0	
Perennial veldgrass	0/0	-/0	0/0	-/0	0/3	0/0	
Doublegee	0/0	-/2	0/0	-/0	0/0	0/0	
African lovegrass	4/1	-/1	4/0	-/1	4/0	0/0	
Montpellier broom	2/5	-/5	0/3	-/5	2/3	0/0	An emerging problem across the region.
Cape tulip – all sp.	0/0	-/0	0/2	-/0	2/2	0/0	Potential identification issue.
Victorian tea tree	3/2	-/0	3/2	-/0	3/5	0/0	Control program in D'Entrecasteaux NP.
Pinaster pine	2/2	-/0	0/0	-/0	3/0	0/0	
Radiata pine	2/2	-/2	0/1	-/1	3/1	0/0	
Blackberry	5/5	-/5	5/2	-/5	5/5	0/0	
Weeping willow	1/0	-/0	0/0	-/0	0/0	0/0	
Variegated thistle	0/0	-/3	0/0	-/0	0/0	0/3	
South African onion weed	0/2	-/0	2/0	-/0	2/2	0/0	
Bullrush	2/1	-/1	3/3	-/0	3/3	0/0	
Gorse	0/0	-/0	0/0	-/0	0/0	0/0	
Watsonia	3/5	-/1	3/3	-/1	3/1	0/0	
Arum lily	3/5	-/5	3/2	-/2	3/5	0/0	Larger areas located since 2009, in Owingup NR (Frankland District).
Invasive species		-		-			
Dingo/wild dog	0/1	-/0	0/1	-/0	0/1	0/0	
Feral goat	0/2	-/0	0/0	-/0	0/2	0/0	
Deer all ssp.	2/4	-/4	2/5	-/4	2/4	0/0	Donnelly – primarily east of Manjimup.
Cat	6/5	-/0	6/5	-/5	6/5	6/0	
Rabbit	4/1	-/1	4/1	-/1	4/1	4/0	
Feral pig	6/5	-/4	6/5	-/4	6/5	6/0	
Fox	6/5	-/5	6/5	-/5	6/5	6/5	
Rainbow lorikeet	0/0	-/0	0/0	-/0	1/0	0/0	
English blackbird	0/2	-/0	0/0	-/0	0/0	0/0	Controlled.
Plague locust	0/1	-/0	0/1	-/0	0/1	0/0	

Severity impact score	Description
0	No data, or not known to be present.
1	Reported present but not problematic.
2	Occurs but restricted distribution, has little impact.
3	Restricted distribution and adverse impact.
4	Widespread distribution but having minimal impacts.
5	Widespread distribution and having adverse impacts locally.
6	Very widespread and having widespread adverse impact.

KPI 18 Effectiveness of dieback hygiene

Performance measure	*The number of sampled areas infested with* Phytophthora cinnamomi *that remain uninfested following an operation with an approved hygiene management plan.*
Performance target(s)	*No uninfested protectable area to become infested as a result of management actions.*
Reporting	*After five years. Results for State forest and timber reserves, and conservation reserves to be reported separately.*
Response to reporting	*The Department to investigate the cause and report to Conservation Commission and to the Minister for the Environment. The Conservation Commission to evaluate the need for revision of management practices in the context of its assessment and auditing function, in consultation with the Department.*

Objective of KPI 18

To assess the success of the implementation of the FMP in managing disturbance activities to minimise the spread of *Phytophthora* dieback.

Context

This KPI has not been previously reported because of the lengthy period required to reliably detect disease introduction or spread following an operation, and the need to build a sufficient sample size of areas.

The FMP seeks to minimise the impact of pathogens and their associated diseases on the health and vitality of forest ecosystems. A plan objective is "to protect from infestation, those areas currently free from *Phytophthora cinnamomi*".

The FMP requires the Department and the FPC to conduct their activities in accordance with the policy *Management of Phytophthora and Disease Caused By It* (Department of Environment and Conservation, 1998). This policy seeks to progressively identify uninfested 'protectable' areas, and to protect them by minimising human access and managing hygiene on entry into them. The policy requires the preparation and approval of Hygiene Management Plans for all disturbance activities.

Protectable areas are defined as an area, including areas of high conservation and/or socio-economic value (e.g. a small uninfested area which contain a known population of a susceptible species of threatened flora) within the vulnerable zone that are:

- Situated in zones receiving > 600 mm per annum rainfall or are water gaining sites (e.g. granite outcrops, impeded drainage or engineering works which aggregate rainfall) in the 400-600 mm per annum rainfall zone.
- Not calcareous soil (e.g. not a Quindalup dune system).
- Determined to be free of the *P. cinnamomi* by a qualified Disease Interpreter (all susceptible indicator plant species are healthy, no plant disease symptoms normally attributed to *P. cinnamomi* are evident).
- Positioned in the landscape and are of sufficient size (e.g. > 4 ha with axis > 100m) such that a qualified Disease Interpreter judges that *P. cinnamomi* will not autonomously engulf them in the short term (a period of a few decades).
- Where human vectors are controllable (e.g. not an open road, private property).

This KPI aims to evaluate the success of the overall planning and management systems rather than simply adherence to the Hygiene Management Plans. Consequently, three important metrics were measured:

- The occurrence of any new infestations or extensions of disease associated with a disturbance operation. The causal factors were ascertained or inferred (such as the standard of *Phytophthora* dieback interpretation, choice of hygiene tactics, level of activity monitoring, failure of measures and breaches of plan provisions) rather than simply recording the number of new infestations or extensions that resulted from an activity.
- The frequency of breaches of hygiene (such as vehicles moving between infested and uninfested areas without appropriate washdown). Breaches can compromise the future disease status of protectable areas, although it may take several years for new infestations to become evident.
- The protectable area put at risk as a consequence of any new infestation or potentially put at risk from a breach.

Measuring this KPI involved sampling a selection of disturbance operations conducted after 2004. The operations represented a range of types, season of activity, geographic location and hygiene tactics. Field inspection of the sites was undertaken several years after the operations finished to allow for any subsequent disease expression. However, the sample was compromised by inadequate documentation and records for those operations conducted outside timber harvesting and mining activities. Operations for non-harvest activities generally lacked appropriate documentation and were managed through less rigorous protocols that often did not provide for the preparation of hygiene management plans and the identification of protectable areas. This meant that the KPI was limited to reporting by operation types grouped into 'harvest' and 'other'.

During the monitoring period of this KPI the Conservation Commission conducted a performance assessment of *Phytophthora* dieback (*Performance assessment of Phytophthora Dieback management on lands vested in the Conservation Commission of Western Australia*, 2010), and the results from this KPI informed the Department's response to that report.

Results and explanatory notes

The performance target for this KPI was not achieved.

Across the three forest regions, 85 protectable areas comprising 10,171 hectares were assessed. Twenty-one other sites (not associated with timber harvest or mining activities) with no determined protectable areas were also assessed.

Twelve of the 85 (or 14 per cent) of the protectable areas sampled in harvest areas had new infestations or vectored extensions confirmed. A further nine areas (or 11 per cent) had been compromised (Table 18.1). While these breaches could potentially introduce the disease, no symptoms were evident at any of the sites. The total area infested or potentially put at risk in these operations was 44.9 hectares or 0.4 per cent of the total 10,171 hectares sampled. This small area is partly a consequence of most of the new disease sites being in close proximity to the downslope disease boundary, which limited the distance until the extension coalesced with an already infested area.

Within the other 21 sites, six sites (or 29 per cent) had new infestations or extensions associated with soil disturbance activities, and a further three sites (or 14 per cent) had been compromised. Ten of the 21 sites were in formal reserves, with one site exhibiting a

new infestation and another site showing two instances where the disease-free area had been compromised.

Breaches in hygiene were mostly attributed to extensive illegal entry into protectable areas following an operation, particularly for public firewood collection. In some instances illegal access for firewood collection had resulted in unauthorised tracks being pushed into protectable areas.

Availability of resources for management of dieback across many parts of the management system has contributed to performance.

Table 18.1 Number, area and proportion of protectable areas sampled that had new infestations/extensions confirmed or compromised within each forest region

	Swan		South West		Warren		Total	
	Operation type							
	Harvest	Other*	Harvest	Other	Harvest	Other	Harvest	Other
Number of protectable areas sampled	39	8	24	7	22	6	85	21
Total protectable area (ha)	5,183		4,301		687		10,171	
Number of new infestations/extensions confirmed	2	0	4	3	6	3	12	6
Proportion of new infestations / extensions confirmed as a percentage of total number of areas sampled	*5*	*0*	*17*	*43*	*27*	*50*	*14*	*29*
Number of protectable areas compromised	2	0	2	2	5	1	9	3
Proportion of protectable areas compromised as a percentage of total number of areas sampled	*5*	*0*	*8*	*29*	*23*	*17*	*11*	*14*
Total area of new infestations / extensions (ha)	0.15		1.97		14.0		16.1	
Total area put at risk from new infestations/extensions (ha)	4.0		6.5		18.3		28.8	
Combined new infestations / extensions area + area put at risk (ha)	4.15		8.47		32.3		44.9	
Combined impact (new infestations / extensions + area put at risk) as a percentage (%) of the total area sampled	*0.08*		*0.2*		*4.7*		*0.44*	

*****The 'Other' operation type refers to sites inspected where protectable areas had not been defined, and it was therefore not possible to calculate the protectable area or area put at risk.

Response to target shortfall

The low percentage of area put at risk from hygiene breakdown in harvesting and mining operations suggests that in most cases the planning and implementation of hygiene has been effective in minimising the risk of *Phytophthora* dieback introduction. Further analysis was undertaken of the relative frequency of new and potential infestations (in approximately one-quarter of the harvested protectable areas and almost half of the other sites assessed).

The approach to collecting data for this KPI enabled the factors contributing to the new infestations or disease extension to be inferred. These factors included an inconsistent approach to the application of the Department's dieback policy and procedural guidelines; an inconsistent approach to the assessment of the risk and consequences of disturbance activities introducing *Phytophthora* dieback to protectable areas; variation in the standards of implementing hygiene tactics such as the closure of access roads and landings after harvesting operations have been completed; and a lack of awareness and training within some workgroups. The data also suggest that relying solely on particular hygiene tactics

(such as ‘Clean on Entry’) to ensure areas remain uninfested in the long term is higher risk than a combination of tactics and post-operation monitoring.

In response to the shortfall in KPI 18 and as part of the response to the Conservation Commission’s *Phytophthora* dieback performance report, the Department established a *Phytophthora* Dieback Management Coordination Group (with senior representation across all operational divisions) to improve all aspects of disease management across the Department. The group has planned or commenced the following actions to address the shortfall in KPI 18:

- An immediate awareness raising program on dieback policy and a review of training requirements for all personnel responsible for, or involved in, soil disturbance activities on Departmental land in the *Phytophthora* dieback vulnerable zone (which includes all the FMP area). Priority is focused on delivery of training to personnel managing non-harvest related activities.
- Clarification of the roles and responsibilities for disease planning, management and monitoring within the Department.
- Preparation of guidance for managers to assist them in prescribing appropriate levels of protection for different threat and biodiversity asset categories when preparing hygiene management plans.
- Ongoing monitoring of the effectiveness of hygiene management to ensure continuous improvement in tactics and implementation standards.
- Consideration and risk-based prioritisation of the resources available for management of the protectable areas in the long term.
- Investigation of the resources required to progressively identify protectable areas on lands subject to high levels of non-timber harvesting disturbance or visitation.
- Improvement in the management of records of disease mapping and hygiene management plans for all soil disturbance operations.
- The Department will examine options for the future access and management of public firewood collection in the development of the next FMP.

Soil and water

Four KPIs are reported below in relation to soil and water.

KPI 19 The annual flow weighted mean salinity and the trend for streams in fully forested catchments

Performance measure	*The annual flow weighted mean salinity and the trends for gauging stations of selected forest streams.*[4]
Performance target(s)	*Salinity trends to be neutral.*
Reporting	*Every five years subject to information being provided by the Department of Water.*
Response to target shortfall	*The Department to investigate the cause and report to the Conservation Commission and to the Minister for the Environment. The Conservation Commission to evaluate the need for revision of management practices in the context of its assessment and auditing function, in consultation with the Department.*

Objective of KPI 19

To assess the success of the implementation of the FMP in maintaining the low concentration of salinity in streams of forest catchments.

Context

Since the 1970s, forest managers in the south-west of Western Australia have been aware that clearing or excessive reduction in vegetation cover may cause rising groundwater, mobilisation of soil salts, and discharge of these salts into streams. Over the past three decades, a significant amount of research has increased knowledge about causes and effects of stream salinity and this was used to develop operational controls within the FMP. These controls limit the intensity and extent of timber harvesting according to the risk of causing stream salinity.

Catchments used in this analysis were selected according to the availability of long-term continuous records aiming to have almost no permanent clearing and be greater than 15 square kilometres in size. In the context of this KPI, areas of forest that have been harvested and regenerated, or areas that have been mined and rehabilitated are not considered to have been permanently cleared. Catchments with two per cent or less of their area permanently cleared are considered to be fully forested. A low concentration of salinity or 'fresh' is defined as close to 500mg/L. A change in salinity between forest management plans of less than 30mg/L was considered 'no change'.

The availability of good quality data was an issue in reporting on this KPI. Although continuous data are required for the best determination of flow weighted-salinity, discrete data (a series of 'one off' measurements) were used due to the lack of continuous data. Due to the scarcity of good salinity records, some catchments were included that contained greater than two per cent permanently cleared areas, or were less than 15 square kilometres in size.

[4] The selected forest streams differ from those listed in the protocols document due to suitability and availability of data.

Results and explanatory notes

The low salinity in streams within fully forested catchments has been maintained, meeting the target for salinity trends to be neutral. Figure 19.1 shows that these streams are fresh with salinity well below 500mg/L. Although statistically significant trends exist, the magnitude of these is negligible with differences between the FMP and the historical period generally less than 40mg/L. All streams that were consistently fresh at the start of monitoring remained fresh for the duration of the monitored period. Although all the catchments have a history of timber harvesting spanning over 100 years, there is no detectable impact of timber harvesting or other forest management activities on stream salinity for the fully forested catchments.

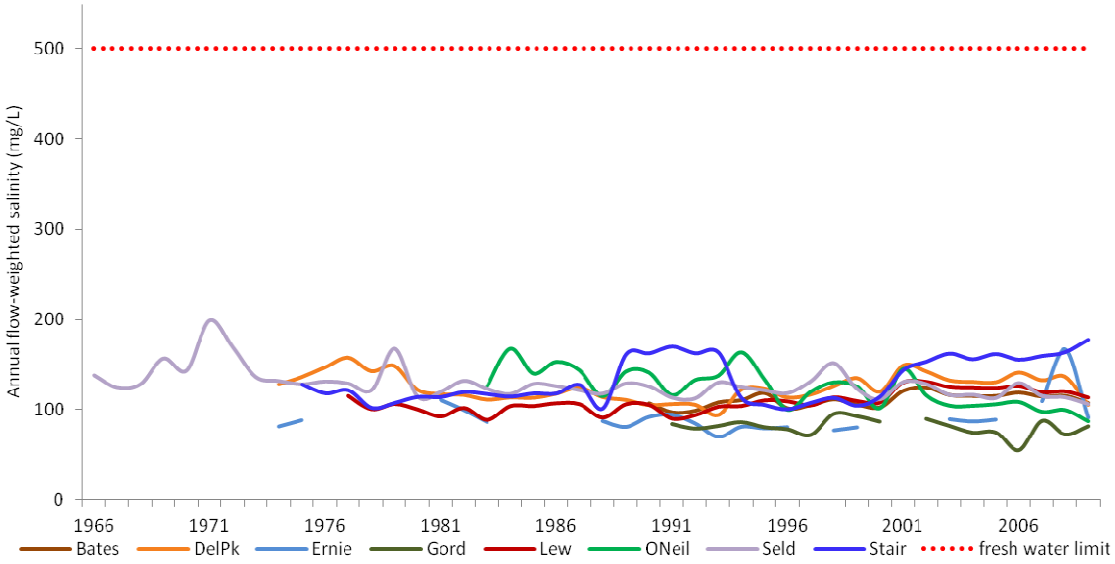


Figure 19.1 Annual flow-weighted salinity for catchments with less than two per cent permanently cleared

In streams where more than two per cent of the catchment area was permanently cleared, the salinity is often higher (Table 19.1) and more variable (Figure 19.2). Catchments where clearing has occurred in the lower slopes (even only a small percentage of total catchment area) have higher stream salinity. In contrast to the fully forested catchments which have stream salinity around 100–200mg/L, some of these catchments have stream salinity greater than 200mg/L ranging up to 2,000mg/L. The salinity is due to the mobilisation of salts in the soil through rising groundwater. The variability is most likely to be related to seasonal to decadal changes in whether these salts are being accumulated or flushed from the catchment. Palmer catchment, which is five per cent cleared, has oscillated around the freshwater limit for most its record, but has been well below this limit since 2002. The two most northern catchments, Ngangaguringuring and Poison Lease, have had marginal to brackish stream salinities for most of their recorded histories. These catchments are both approximately six per cent cleared, and extend east into the low rainfall zone where stored salts in areas of wandoo vegetation in the lower slopes are very high. The salinity at Poison Lease catchment appears to have stabilised in the recent decade. Salinity at Ngangaguringuring catchment steadily increased in recent decades, but appears to have stabilised and may even be decreasing in recent years.

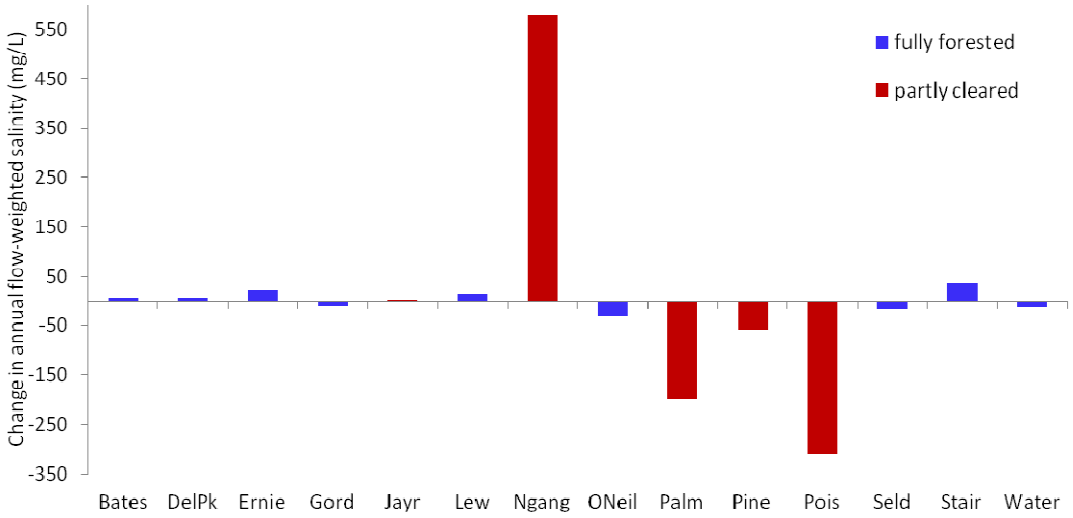


Figure 19.2 Change in average flow-weighted salinity under the current FMP compared to the 1975–2003 average

In catchments where stream salinity is decreasing, this is considered to be the result of decreasing groundwater level caused by decades of below average rainfall. When the groundwater level falls below the stream, the contribution of saline groundwater to streamflow is reduced or ceases.

In catchments where stream salinity has increased, this may be due to a decline in the dilution of saltier groundwater because of a faster decline in fresher surface flow and interflow.

Table 19.1 Percentage of catchment permanently cleared, stream salinity and possible reasons for salinity trends

Catchment	Percentage permanently cleared	salinity 1975–2003; (mg/L)	salinity 2004–2009; (mg/L)	Salinity change between FMPs mg/L	Comments
Jayrup	4	76	76	0	Short period of record, streamflow appears to follow rainfall variation.
Bates	0	109	114	+5	LAI increased.
Del Park	0	123	129	+6	
Gordon	0	84	75	-10	
Waterfall Gully	7	128	116	-11	Declining groundwater. Streamflows follow rainfall variation.
Seldom Seen	2	131	116	-15	Declining groundwater.
Lewis	1	106	121	+15	Mining. Note salinity decreasing since 2001, soon after rehabilitation began.
Ernies	0	86	109	+23	Unreliable trend, many no flow years.
O'Neil	0	131	100	-31	Possible disconnecting groundwater. This catchment was recently mined.

Staircase Road	1	126	162	+36	
Pine Plantation	4	246	188	-58	Possible declining groundwater. Streamflows follow rainfall variation.
Palmer	5	408	208	-200	Clearing in stream zones may have increased surface flows, increasing groundwater dilution.
Poison Lease	6	1153	843	-310	Possible declining groundwater.
Ngangaguringuring	6	1563	2143	+580	Affected by clearing in the catchment, which increased groundwater levels prior to 2000 (groundwater levels have decreased since 2001).

KPI 20 The percentage of water bodies (e.g. stream kilometres, lake hectares) with significant variance of biodiversity from the historic range of variability

Performance measure	*The diversity of aquatic macro-invertebrate fauna at a selected number of monitoring sites.*
Performance target(s)	*No sites with fauna significantly different from the reference condition.*
Reporting	*Every five years.*
Response to target shortfall	*The Department to investigate the cause and report to the Conservation Commission and to the Minister for the Environment. The Conservation Commission to evaluate the need for revision of management practices in the context of its assessment and auditing function, in consultation with the Department.*

Objective of KPI 20

To assess the success of the implementation of the FMP in achieving its targets in regard to protecting the ecological integrity and quality of streams.

Context

This KPI uses an approach called biomonitoring which assesses the response of biota to change in the environment. Biomonitoring is widely regarded as a more direct and integrative indicator of the ecological condition of a river or stream than chemical measurements. In 1994 the Australian Government funded a biomonitoring program for rivers and streams in Western Australia as part of the Australian River Assessment Scheme (AusRivAS). The AusRivAS model (which was developed using data from minimally disturbed streams) provides a benchmark against which to judge the degree of disturbance in streams.

Aquatic macro-invertebrates and water quality were monitored at 51 sites throughout the south-west forests in spring each year (unless they were dry). Eight of these are reference sites that were used to build the AusRivAS models, although some timber harvesting and planned burning have occurred in the catchments of these sites. Forty sites are in 'fully forested' catchments (more than 80 per cent on land managed by the Department), three sites are located immediately below dams and eight catchments contain less than 20 per cent private land ('not fully forested'). Generally, these sites are downstream of, rather than within, areas subject to timber harvesting and planned burns, as the aim is to monitor broader effectiveness of forest management rather than local impacts.

Standard AusRivAS field methods were used to sample macro-invertebrates and water chemistry and to score habitats at the sites (Halse *et al.*, 2001). These data were run through the AusRivAS model produced for stream channel habitat in south-western Australia (http://ausrivas.canberra.edu.au/). The AusRivAS model predicts macro-invertebrate communities that would be expected to occur in the absence of an impact. The model then compares the macro-invertebrate families predicted to occur at a test site (E: those families expected to occur with >50 per cent probability at the equivalent reference sites) with those actually collected (O: observed). This gives an O/E score, which is an indicator of the ecological condition of the site. If O/E = 1, the test site is assumed to be equivalent to reference condition. If O/E < 1, some families have probably been lost and the site is assumed to be degraded to some extent. Sites with O/E scores between 0.54–0.84 are classed as band B ('significantly impaired'), sites with scores between 0.24–0.54 are classed as band C ('severely impaired') and sites with <0.24 are classed as band D ('extremely impaired'). Sites that are more biologically diverse than the reference sites are

rated as band X. The use of the terms ‘significantly’ or ‘severely’ impaired follows the AusRivAS terminology (Halse *et al.*, 2001).

While the AusRivAS model provides a reasonable and widely used benchmark against which to judge the degree of disturbance in the streams, the model has some limitations. In particular, there were very few reference sites in the lower rainfall areas, which means the model predictions may not be as useful for such areas. Also, when calculating the O/E score the model only uses family data, and only considers families with a probability of occurring at a reference site at least 50 per cent of the time. For this reason, the model has limited ability to detect subtle changes in community structure: it is meant to be a rapid bioassessment tool. Further, some families recorded in this project are not included in the AusRivAS model, so presence/absence of some families is not reflected in model outputs. Additional biodiversity measures (such as taxonomic distinctness and functional groups) could be used in the future.

Results and explanatory notes

Almost half (20) of the sites were dry for at least one sampling occasion, nine were dry for two or more sampling occasions and three were dry for four or more sampling occasions. The O/E scores for each year were averaged to give an overall score for each site for the period 2005 to 2010. Of the 51 sites, 16 were classed as significantly impaired (band B) and eight sites were classed as severely impaired (band C). Some sites were scored as extremely impaired (band D) in some years, but no site received an overall D banding. All of the severely and extremely impaired samples were collected from jarrah forest sites. Banding derived from the average scores is shown on Figure 20.1.

Figure 20.1 shows that many sites that received a B or C band rating are in the lower rainfall areas or the northern part of the FMP (north of Dwellingup). All sites to the east of the ≤725mm isohyet received C bands and all sites east of the ≤850mm isohyet received B or C bands. Streams in these areas are likely to be more seasonal than streams further south and west and therefore more likely to have naturally lower invertebrate diversity. This is not well accounted for in the AusRivAS model as most model reference sites in the northern area are larger streams and there is a lack of AusRivAS reference sites in the low rainfall area south east of Collie.

At all sites the macro-invertebrate communities varied annually. Almost all sites moved between two or three AusRivAS bands over the six-year monitoring period. Even reference sites (which on average received an A band) received a rating of significantly impaired (band B) in at least one year. This is not surprising as there is natural variability in macro-invertebrate communities. Family richness was generally lower in years with a dry winter and sometimes also the year following. In 2010, 18 sites were dry and only three sites received an A band rating.

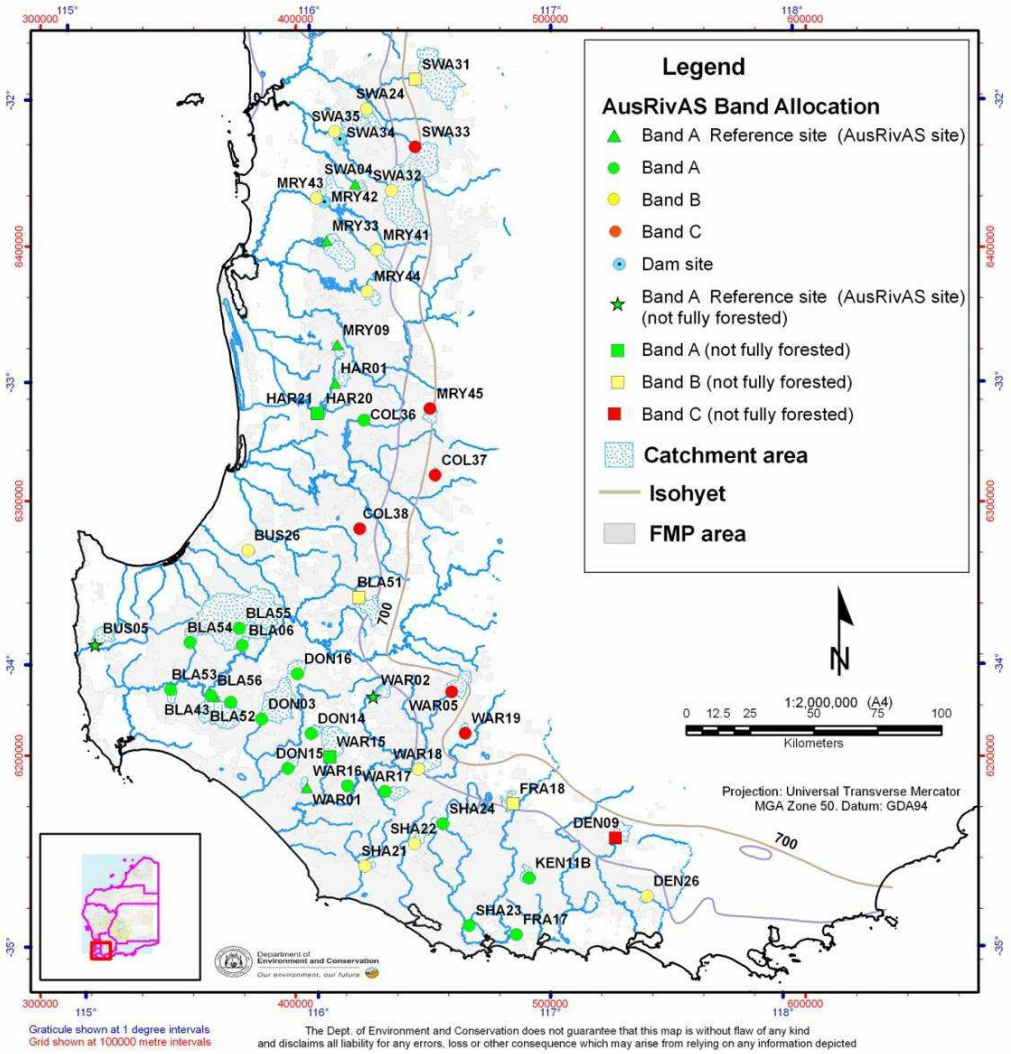


Figure 20.1 Map showing the bands derived from average AusRivAS score for each site sampled over the 2005–2010 period

Six of 16 sites which received a significantly impaired rating (band B), had an average O/E score >0.8 which means the sites have lost less than 20 per cent of the families expected to occur at an AusRivAS reference site. Each of these sites also received at least three A bands or an X band during monitoring, indicating that they are only marginally impaired, and are likely to have AusRivAS scores in the A or X bands in the future providing conditions in the streams do not degrade. Continued monitoring of these sites is recommended to determine if their condition remains relatively high.

Several of the sites which received an impaired rating (B or C bands) are naturally saline or acidic and have been compared to reference sites in the AusRivAS model with more benign water quality. Therefore, they have received a lower O/E score even though observed richness may be close to natural for these sites. Continued monitoring of these sites is recommended to determine whether they have naturally lower richness or whether conditions at these sites are declining. Further refinement of the model to include reference sites with these environmental conditions would improve the scope of the AusRivAS model.

A few fully forested sites occur in the >850mm rainfall zone and are not acidic or saline, but nonetheless received a significantly impaired average rating (band B) and never scored a reference condition banding in any year. These sites are SWA35, MRY44, MRY41 and COL38. SWA35 is downstream of a dam which may be influencing the ecological condition of this site, but further investigation is needed at these sites.

Additional catchment data beyond the AusRivAS set have been collected and analysed to investigate reasons for low AusRivAS scores at some sites. These data include forest type, fire management and timber harvest history, dieback presence and other stream disturbances such as presence of major dams. Additional macro-invertebrate biodiversity indices have been calculated to supplement the AusRivAS index. These are family richness, chironomid (non-biting midge) species richness, EPT richness (number of species of mayflies (Ephemeroptera), stoneflies (Plecoptera) and caddisflies (Trichoptera)) and total taxa richness. Multivariate analyses of community composition were also carried out. Details of these additional analyses, plus summaries of each catchment, are provided in Pennifold and Pinder(2011) and briefly summarised as follows:

- While almost half of the sites appeared to be impaired based on the AusRivAS scores, the level of impairment was not clearly related to the proportion of the catchment subject to timber harvesting or burning.
- Some differences were found between sites with a greater versus lesser proportion of the catchment harvested or burned. However, the differences were not consistent across sites.
- Over the period 2005 to 2008 there were no significant correlations between biodiversity measures and the proportion of jarrah or karri catchments harvested and/or burned. Time since the last fire or timber harvesting event was also uncorrelated with biodiversity measures.
- Some of the variation in biodiversity measures over time may be related to rainfall. In particular, the lower richness at most sites in 2007 may have been the result of reduced survival and reproduction in the dry 2006 season, with subsequent low recruitment in 2007.
- Macro-invertebrate diversity was higher in streams with higher maximum flow and lower conductivities. The most south-easterly streams had highest salinities and particularly low macro-invertebrate diversity.
- Stream macro-invertebrate communities differed between jarrah and karri forests, with karri forests generally having a higher number of mayflies, stoneflies and caddisflies (EPTs). Results to date suggest that EPT taxa are the most sensitive and are proving to be a valuable measure of disturbance.
- There were no significant differences in most richness measures between sites immediately downstream of dams and undisturbed sites. However, low O/E family scores at the dam sites indicate that fewer of the families included in AusRivAS models are found in streams below dams than one would expect to find at reference sites.
- Wildfires occurred at two jarrah forest sites just prior to initial sampling in 2005. Even though there were no pre-wildfire measures of macro-invertebrate diversity, the richness of species and families at these sites was well below those of undisturbed jarrah streams for 2005. By 2008 (four years after the wildfires) biodiversity measures (except EPTs) at both sites were similar to undisturbed jarrah sites.
- Overall, stream biodiversity measures in catchments affected by dieback disease caused by *Phytophthora cinnamomi* were not significantly different to those in catchments unaffected by dieback. However, in the jarrah forest all measures (except for chironomid richness) were positively correlated (albeit weakly) with the proportion of

the catchment affected by dieback. There was no such relationship in karri forest communities. Dieback may be influencing jarrah forest stream ecosystems by increasing the amount of debris, run-off and sediment entering streams.

Response to target shortfall

The FMP target of no sites with fauna significantly different to reference condition was not achieved. However, while almost half of the sites appeared to be impaired, based on the AusRivAS scores, the level of impairment was not clearly related to the proportion of the catchment subject to timber harvesting or burning. Most cases of apparent impairment seem to be related to low rainfall and to shortcomings in the AusRivAS model.

- Drier climatic conditions during the monitoring period, compared to the 1990s when the AusRivAs models were constructed, may have influenced the AusRivAS scores received by some sites. Even though most sites would have been influenced by the drier conditions, some sites were more severely affected, particularly those in northern jarrah forest. Almost half (20) sites were dry for at least one sampling occasion. All sites which have an annual average rainfall less than 725mm received an overall rating of severely impaired (band C).
- While the AusRivAS model provides a good benchmark against which to judge the degree of disturbance in the streams, the model has some shortcomings, with very few AusRivAS reference sites located in the lower rainfall areas, which may lead to an overestimate of the expected richness in streams of lower rainfall areas.
- At all sites, macro-invertebrate communities varied annually and no site had the same AusRivAS band rating for all six years. Even reference sites (which on average received an A band) received a rating of significantly impaired (band B) in at least one year. Six sites with an average B banding received at least three A and/or X band scores during the study period, indicating that they might be slightly impaired but are close to reference condition and certainly retain substantial resilience.
- Most sites which were saline, brackish or acidic received a B or C band rating, but this may be due to their natural environmental condition, rather than to impairment. The current south-west Western Australia AusRivAS model does not account for such environmental conditions.
- A few fully forested sites occur in the >850mm rainfall zone and are not acidic or saline, but nonetheless received a significantly impaired average rating (band B). These sites are SWA35, MRY44, MRY41 and COL38. SWA35 is downstream of a dam which may be influencing macro-invertebrate composition at this site, but further investigation is needed at these sites.
- Additional biodiversity indices have been analysed to further investigate ecological integrity of the streams. A detailed description and analysis of results including individual catchment summaries is provided in Pennifold and Pinder (2011).

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KPI 21 The level of soil damage resulting from timber harvesting

Performance measure	*Soil damage by risk category as measured by survey.*
Performance target(s)	*Soil damage not to exceed prescribed maximum levels (see Appendix 6).*
Reporting	*Annually.*
Response to target shortfall	*The Department to investigate the cause and report to the Conservation Commission and to the Minister for the Environment. The Conservation Commission to evaluate the need for revision of management practices in the context of its assessment and auditing function, in consultation with the Department.*

Objective of KPI 21

To assess the success of the implementation of the FMP in achieving its targets by providing information on the amount of soil damage as a result of timber harvesting.

Results and explanatory notes

The severe and highly visual forms of soil damage, such as rutting, puddling and mixing, were rarely seen in association with timber harvest operations under the FMP. This is due to the approvals process for harvest operations under moist soil conditions which requires operators to plan and conduct operations according to the risk of causing soil damage. Importantly, operations are required to cease as soon as these highly visual forms of damage are observed.

A major effort under the FMP has gone in to minimising compaction, which is not visually apparent, and measured by transect survey. The results of transect surveys for all operation types conducted between 2005 and 2011 are shown in Table 21.1 below. This table shows that the moderate and severe soil disturbance limits were exceeded for some operations each year. Results according to different operation types are shown in Tables 21.2 (jarrah), 21.3 (karri thinning) and 21.4 (karri clearfall). These tables show that jarrah operations were the type where limits were mostly exceeded and that limits were never exceeded in karri thinning operations and rarely exceeded in karri clearfall operations.

Table 21.1 The number of surveys conducted and number exceeding moderate and severe soil disturbance limits for all operations

All operations	**Number of surveys conducted**	**Number of surveys exceeding moderate soil disturbance limits**	**Number of surveys exceeding severe soil disturbance limits**
Year			
2005	37	9	6
2006	26	6	3
2007	20	3	6
2008	21	2	1
2009	17	3	3
2010	40	1	2
2011	21	3	7

Table 21.2 The number of surveys conducted and number exceeding moderate and severe soil disturbance limits for jarrah operations

Jarrah	Number of surveys conducted	Number of surveys exceeding moderate soil disturbance limits	Number of surveys exceeding severe soil disturbance limits
Year			
2005	21	9	6
2006	23	6	3
2007	17	3	5
2008	13	2	1
2009	7	3	3
2010	0	0	0
2011	15	3	7

Table 21.3 The number of surveys conducted and number exceeding moderate and severe soil disturbance limits for karri thinning operations

Karri thinning	Number of surveys conducted	Number of surveys exceeding moderate soil disturbance limits	Number of surveys exceeding severe soil disturbance limits
Year			
2005	11	0	0
2006	3	0	0
2007	3	0	0
2008	8	0	0
2009	3	0	0
2010	18	0	0
2011	5	0	0

Table 21.4 The number of surveys conducted and number exceeding moderate and severe soil disturbance limits for karri clearfell operations

Karri clearfell	Number of surveys conducted	Number of surveys exceeding moderate soil disturbance limits	Number of surveys exceeding severe soil disturbance limits
Year			
2005	5	0	0
2006	0	0	0
2007	0	0	0
2008	0	0	0
2009	7	0	0
2010	22	1	2
2011	1	0	0

The management approach to controlling soil disturbance has been consistently refined over the period of the FMP. Significant changes that have occurred in operational practices, monitoring procedures and monitoring effort mean that it is not possible to directly compare results between years in order to look for trends over time.

Response to target shortfall

A response to target shortfall for KPI 21 was reported in the mid-term audit report, and subsequently to the Minister for Environment in July 2009. Follow-up advice was then provided to the Minister for Environment in December 2010 after the Conservation Commission had considered a report on machine harvesting and soil disturbance by the FPC and the Department had provided an update on soil disturbance monitoring results.

The Department has continued to investigate instances where soil disturbance limits have been exceeded, and since the mid-term audit report has used GPS mapping to record and validate findings of why soil disturbance limits are exceeded. Essentially, the findings remain the same as those previously reported. That is that karri thinning and karri clearfell operations are consistently managed within allowable levels of soil damage. However, in every year since 2004, a relatively small proportion of mechanically harvested jarrah operations exceeded the allowable limits of soil disturbance. The main cause is the extent of tracks created by the heavy vehicles used to harvest and extract timber.

Soil disturbance limits were developed prior to the widespread application of machine harvesting. Monitoring under the FMP has identified circumstances (forest type, machinery, topography, cell dimensions and hygiene requirements) where soil disturbance limits are difficult to achieve even with good application of machine harvesting. In these cases it is not possible to conduct machine harvest operations without creating an extraction track layout below two per cent (very severe limit) or eight per cent (severe limit) of the area of the feller's block.

Occasionally, instances have been identified where an alternative approach may have allowed an operation to be conducted without exceeding allowable limits. The Department has concentrated on communicating and resolving these types of operational issues with the FPC and timber harvesting contractors.

KPI 22 Water production

Performance measure	*Stream flow of selected forest streams.*
Performance target(s)	*Streamflow to be maintained.*
Reporting	*Every five years subject to information being provided by the Water Corporation and the Water and Rivers Commission (linked to KPI 19).*
Response to target shortfall	*The Department and the water authorities to identify the reasons for the trend and the Department to report to the Conservation Commission and to the Minister for the Environment. The Conservation Commission to evaluate the need for revision of management practices in the context of its assessment and auditing function, in consultation with the Department.*

Objective

To assess the performance of the FMP in achieving its target to maintain the flow of water to surface reservoirs and to protect the ecological integrity of streams, wetlands and their associated vegetation.

Context

Rainfall has declined significantly in the south-west of Western Australia since the mid-1970s. This has resulted in declines in both groundwater levels and streamflow (Indian Ocean Climate Initiative (IOCI) 2002, Croton and Reed 2007), with the reduction in streamflow proportionately greater than the reduction in rainfall (Petrone et al 2010, Rogers and Ruprecht 1999). Over the period 2001–2009, rainfall declined by around five per cent for all areas apart from along the south coast, where it increased by around two per cent.

Results and explanatory notes

Fifteen primary catchments were used for this analysis; that is catchments that are fully or almost fully forested, have good streamflow records, and are greater than 15 square kilometres in size. A further 17 supplementary catchments were included to help explain trends and responses to climate and forest management.

Average annual streamflow during the period of the current FMP was 26 per cent and 37 per cent lower than in 1975–2003 in the primary and supplementary catchments respectively. The one exception is a small supplementary catchment (Hansens) which was extensively mined and thinned and where average annual streamflow increased by 29 per cent during the current FMP compared with the period 1975–2003. The target to maintain streamflow was not achieved and a response to this target shortfall is provided below.

Declines in average annual streamflow in the northern half of the northern jarrah forest were greatest, averaging 47 per cent, while declines in the southern half of the northern jarrah forest (Collie to just north of Waroona) were 29 per cent and declines in the Collie to South Coast area of the state and the south coast were 23 and 25 per cent respectively.

Average annual streamflow has varied considerably from decade to decade. Most catchments had relatively high annual streamflows in the pre-1975 period (where records exist), low flows in the relatively low rainfall years of the late 1970s and early 1980s and medium to high flows in the late 1980s to early 1990s, followed by low flows since the late 1990s and into the period of the current FMP. This widespread pattern emulates the pattern evident in the rainfall record and indicates that climate variability is, in most cases, the

dominant driver of streamflow variation and the recent streamflow declines (Figure 22.1). Groundwater levels mirrored the climatic pattern evident in streamflow records, and showed a decline in the recent decade.

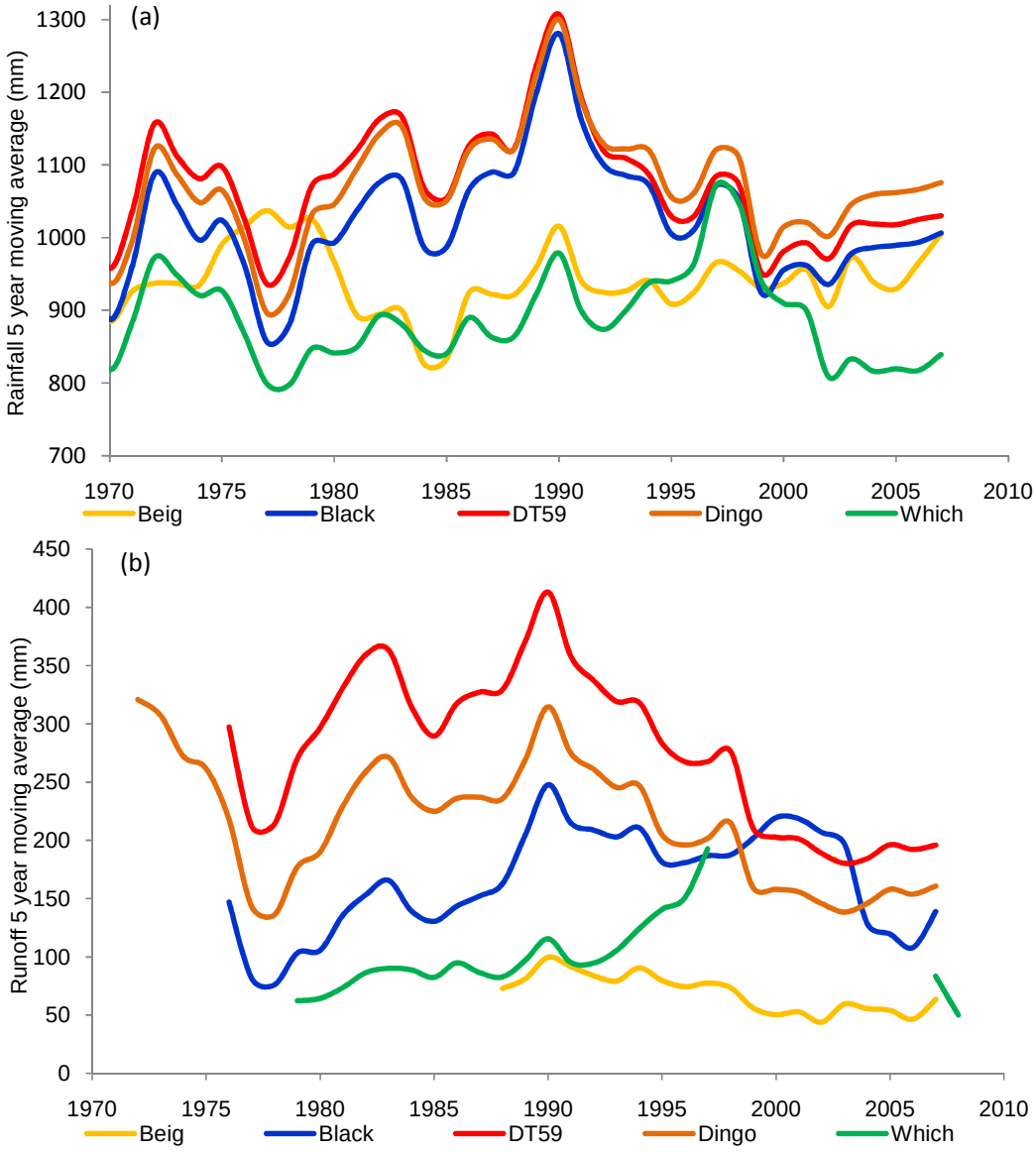

Figure 22.1 (a) Rainfall and **(b)** Streamflow moving averages for selected primary catchments

In many catchments, streamflows in the recent decade are the lowest recorded. While streamflows in the period of the current FMP are, in most cases, lower than the 1975–2003 average, a declining trend that is statistically significant (Table 22.1) cannot always be identified. This is because of the large variation in annual streamflow which, in turn, reflects large annual variation in rainfall.

For some catchments, successive changes in forest structure and increasing leaf area index (remotely sensed) indicate that historical forest management practices may have

exacerbated climate-influenced streamflow decline. These catchments were generally harvested at high intensity early last century prior to regulatory controls introduced by the former Forests Department, and subsequently thinned in the 1960s or 1970s leaving a regrowth forest that is still in the immature to early mature stage of growth with relatively high leaf area and consequently relatively high water use (Macfarlane et al 2010).

Although most catchments experienced declining streamflow in recent times, and climate was considered to be the major driving influence, they did not respond uniformly to this influence, and the presence or strength of trends varied over time. To show the broad differences between the streamflow responses and suspected influences, the catchments are broadly grouped into categories shown in Table 22.1.

Table 22.1 Summary of flow trends and groupings for the study catchments

Primary catchments (15)	**Stream-flow 1975–2003 (ML)**	**No flow days 1975–2003**	**Stream-flow 2004–2009 (ML)**	**No flow days 2003–2009**	**Trend (direction, type*, significance)**	**Trend category**
Blackbutt	6,351	12	5,107	11	-, -, -	Climate pattern dominant – no overall streamflow trend.
Crouch Road	6,472	174	5,125	192	-, -, -	
Hairpin Bend	8,23	233	605	246	-, -, -	
Pine Plantation	3,255	216	2,300	232	-, -, -	
Wattle Block	2,182	144	1,930	139	-, -, -	
Beigpiegup	3,656	89	2,913	124	↓ -, -	Climate pattern dominant – streamflow decline visible.
Ordnance Road	41,085	46	34,208	48	↓ -, -	
Staircase Rd	7,119	0	6,231	0	↓ -, -	
Teds Pool	37,308	80	26,659	108	↓ -, -	
Worsley	5,132	63	3,576	100	↓ -, -	
Yarragil	1,615	181	911	212	↓ b, 0.05	
Dingo Road	30,882	3	23,459	3	↓ c, - -	Climate pattern present, streamflow decline possibly exacerbated by increasing vegetation cover.
Dee Tee 59	8,256	0	5,627	9	↓ abc, 0.1	Climate pattern present, streamflow decline exacerbated by increasing vegetation cover.
Slavery Lane	1,682	183	840	210	↓ b, 0.1	
Whicher	1,656	176	1,294	183	-, -, -	Further investigation required – unusual similarity rainfall – run-off relationship over time. Appears to follow rainfall pattern.
Supplementary catchments (17)						
Jayrup	770	241	539	256	-, -, -,	Climate pattern dominant – no overall streamflow trend.
Bates	429	0	204	<1	↓ abc, 0.01	Climate pattern dominant – streamflow decline visible.
Cobiac	322	204	181	242	↓ b, 0.01	
Ernies	14	327	7	333	↓ - , -	
Trew Road	755	217	564	237	↓ -, -	
Waterfall Gully	2,101	0	1,402	0	↓ ab, 0.1	
Del Park	231	53	120	139	↓ ab, 0.01	Climate pattern present, streamflow decline exacerbated by increasing vegetation cover.
Gordon	22	272	13	290	↓ -, -	
More Seldom Seen	702	18	165	183	↓ abc, 0.01	

Seldom Seen	1,619	0	599	11	↓ ab, 0.01	Follows rainfall variation.
Vardi Road	11,846	0	5,567	73	↓ ab, 0.01	
Hansens	135	29	174	0	↑ ab, 0.01	
Lewis	217	12	135	38	↑ a, 0.1	
Ngangaguringuring	1,755	0	1,273	0	-, -, -	Climate pattern present, clearing and/or intensive thinning have stabilised or increased streamflows.
O'Neil	4,571	211	3,211	238	-, -, -	
Palmer	5,447	232	4,902	234	-, -, -,	
Poison Lease	4,949	191	3,118	202	-, -, -,	

* a = significant trend detected by Mann-Kendall or Spearman's Rho tests.
b = significant step change, detected by Rank Sum or distribution-free CUSUM tests.
c = shift from perennial to intermittent flow observed
Note: based on past observations. Some catchments have recently been thinned or mined and their categorisation might change in coming years. Some of the catchments in which the climate trend is dominant have actually been thinned or otherwise significantly harvested, but these actions have had little extended impact on streamflows.

Several streams have experienced major changes in streamflow pattern. One primary stream shifted from perennial to intermittent in 2004–2009 (DeeTee59). A second primary stream, Dingo Road became intermittent in 2001 (prior to the current FMP). Another three supplementary streams shifted from perennial to intermittent flow during the current FMP (Bates, Seldom Seen, and Vardi Road), and another (More Seldom Seen) lost its perennial flow in 1998. Streams in one primary catchment (Pine plantation) and four supplementary catchments (Cobiac, Ernies, Gordon and Poison Lease) didn't flow at all in 2010, although this year was not included in the analysis due to the data for the full water year not yet being available. The period without streamflow increased by an average of about two weeks across the catchments, and average annual daily maximum flow decreased by 22 per cent.

Response to target shortfall

The target to maintain streamflow was not achieved in any of the catchments except for one of the supplementary catchments. Analysis indicates that climate (decreasing rainfall over the past three decades) is the dominant factor driving the observed streamflow declines and that the trend observed over the period of the current FMP is a continuation of the well documented overall trend which began in the mid 1970s. Under the current climatic regime, the catchments are all likely to be at different stages of groundwater-stream zone disconnection. This disconnection is a major factor implicated in streamflow decline and is supported by a growing body of scientific research and the available groundwater data. Groundwater connection to the stream zone is first lost high in the landscape which may explain the larger streamflow declines observed in the supplementary catchments in the northern jarrah forest which are generally first-order catchments high in the landscape.

After the dominant influence of rainfall, there is no other single factor that explains the patterns in streamflow that occurred over the period of the current FMP. It is important to note that streamflow generation is a complex process and for each catchment it is determined by a different combination of influences which include geology, topography, soil type, vegetation type, health, structure and management history.

Streams across the entire FMP area are showing declines in flow. The flow decline is evident regardless of location or management history, from Wattle block in the south which is almost entirely old-growth forest dominated by karri trees, to the jarrah forest in the north which has a history of disturbance from timber harvesting, mining and public access spanning more than a century.

In general, the streamflow decline is greater in the north of the FMP area and this is most likely due to a combination of factors which include the disconnection of groundwater systems from streams driven by declining rainfall and in some cases forest structure originating from past timber harvesting practices and mine-site rehabilitation. In the south of the FMP area, the rate of groundwater decline is less, evaporation is lower and there is generally a briefer and less intense history of timber harvesting. There is also some evidence that over the recent decade rainfall decline has continued to occur in the north of the FMP area, but the decline is not as great further south and there may have been an increase in rainfall along the south coast.

In addition to the gradient from north to south, there is also a gradient of increasing streamflow decline from higher rainfall areas in the west to lower rainfall areas further east. The mechanism driving this trend is considered to be the disconnection of streams from groundwater systems.

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Rogers, SJ and Ruprecht, JK 1999, *The effect of climate variability on streamflow in the south-west of Western Australia*, Surface Water Hydrology Series, unpublished report, SWH 25, Water and Rivers Commission, Perth.

Natural and cultural heritage

Three KPIs are reported below in relation to natural and cultural heritage.

KPI 23 The identification and protection of cultural heritage

Performance measure	*The number of existing and new heritage sites identified in management planning and the number protected.*
Performance target(s)	*No disturbance of a registered place without formal approval.*
Reporting	*Annually.*
Response to target shortfall	*The Department or the Forest Products Commission to investigate the cause and report to the Conservation Commission and in the case of the Department, to the Minister for the Environment. The Conservation Commission to evaluate the need for revision of management practices in the context of its assessment and auditing function, in consultation with the Department.*

Objective of KPI 23

To assess the success of the implementation of the FMP in achieving its targets by providing information on registered heritage sites identified in management planning and the adequacy of their protection during disturbance operations.

Context

In the mid-term audit report, it was reported that a formal database to capture statistics relevant to KPI 23 was in development. Following the mid-term audit report, the KPI protocol was updated to improve identification of registered heritage places. However, the proposed database has not been progressed.

Results and explanatory notes

Analysis of the data available from 2008 indicates that the majority of registered heritage sites were not disturbed. Table 23.1 shows registered heritage sites that were either not disturbed, disturbed with approval or disturbed without approval.

Table 23.1 Protection of registered heritage sites during disturbance operations since the mid-term audit report

	Registered heritage sites		
	Not disturbed	**Disturbed with approval**	**Disturbed without approval**
Disturbance operations managed by DEC	92	9	1
Disturbance operations managed by FPC	102	0	0
Disturbance operations managed by other proponents	102	0	0
Total	102	9	1

The one site that was disturbed without approval is the Shannon River Bridge on the old Chesapeake Road, where some of the decking of the bridge has been removed by persons unknown.

Disturbance to the nine registered sites that occurred with approval is related to management, maintenance and upgrade to maintain or enhance the values of these sites. Examples of these disturbance activities include:

- upgrade of access and day use facilities at Black Point
- establishment of a new day-use site including interpretation shelter and walk trail at D'arcy Lefroy's property (commonly known as the 100 year forest or the founder's forest)
- removal of exotic flora that had potential to impact on the exterior fabric of the Balganup (Bolghinup) Slab Hut and fire suppression activities to protect the hut from a bushfire in December 2010
- ongoing management activities such as road maintenance, prescribed burning and conservation works within the Yanchep cultural heritage precinct.

Response to target shortfall

An investigation by the Department has been unable to determine the time, date or persons involved in the unauthorised removal of bridge timbers at the Shannon River Bridge on the old Chesapeake Road.

KPI 24 Consultation and involvement of Aboriginal people in forest management

Performance measure	*Establishment of the Nyoongar working group.* *Issues addressed by the Nyoongar working group.* *Statutory referrals required under native title legislation.*
Performance target(s)	*Nyoongar working group to be established by 31 December 2004.* *All statutory referrals made.*
Reporting	*Annually.*
Response to target shortfall	*The Department or the Forest Products Commission to investigate the cause and report to the Conservation Commission and in the case of the Department, to the Minister for the Environment. The Conservation Commission to evaluate the need for revision of management practices in the context of its assessment and auditing function, in consultation with the Department.*

Objective of KPI 24

To assess the success of the implementation of the FMP through monitoring progress towards the establishment and performance of the Nyoongar working group.

Context

In the mid-term audit report, the Department reported that it had not established a formal Nyoongar working group and provided details on the alternative arrangements for consultation and involvement of aboriginal people. The Conservation Commission accepted that the approach adopted addresses the objective and the intent of the action.

Results and explanatory notes

The Department has a formal Memorandum of Understanding with the South West Aboriginal Land and Sea Council (SWALSC), the native title representative body for the plan area, for the purpose of seeking to work with Aboriginal people to identify, interpret, protect and manage significant cultural sites. The various native title claimant groups have established working parties (supported by SWALSC) to negotiate and facilitate interests in the claim area. In order to align with this preferred SWALSC structure, and to avoid establishing overlapping structures, the Department has an established relationship with the working parties. These working parties are able to provide more appropriate and specific cultural heritage advice than a Nyoongar wide working group. These working parties are able to provide direct advice on identifying individuals 'with authority and knowledge relating to Aboriginal cultural heritage', and have assisted the Department to undertake action 24.1.2 of the FMP.

The Aboriginal Heritage Act does not provide any set statutory referral process within the Aboriginal community for Aboriginal heritage sites. The Department and the FPC notify SWALSC for all disturbance activities that are likely to impact on Aboriginal values and proposed actions are often formally presented to SWALSC. The notification and protection process often includes field visits and site inspections with traditional owners and custodians with authority and knowledge relating to Aboriginal cultural heritage, Aboriginal monitors on site during earthworks and incorporation of cultural heritage messages and themes in onsite information. In liaising with local Aboriginal groups and custodians the Department ensures that sensitive information is protected from unnecessary disclosure. Aboriginal heritage site visits and consultations took place over proposed works in the following areas: Yellagonga Regional Park, Woodman Point Regional Park, Canning River

Regional Park, Tuart Forest National Park, Blackwood River National Park, Wellington National Park, Bramley National Park, Leeuwin-Naturaliste National Park, Leschenault Peninsula Conservation Park, D'Entrecasteaux National Park, Stirling Range National Park, and for the Munda Biddi Trail construction.

In circumstances that necessitate a registered Indigenous site to be disturbed, appropriate Ministerial consent is required; the proponent of the disturbance activity must apply to the State Aboriginal Cultural Heritage Materials Committee for approval to undertake the activity in the vicinity of the registered site.

All statutory referrals under the Native Title Act for management plans were made to seek input from native title parties into the management of the forest and protection of cultural heritage values.

The Department is committed to the protection and conservation of the value of the land to the culture and heritage of Aboriginal people, and in 2011 the CALM Act and *Wildlife Conservation Act 1950* were amended to allow for joint management of land between the Department and others, including traditional owners, and expand the range of customary activities that can be undertaken on lands and waters managed by the Department.

KPI 25 The protection of heritage places through representation in reserves

Performance measure	*Representation of heritage values in the existing and proposed formal and informal reserve system.*
Performance target(s)	*The Department and the Conservation Commission to complete all actions for which they are responsible in order to formally change the land category of areas proposed for the reserve system within 10 years after the commencement of the plan.*
Reporting	*Biennially on progress.*
Response to target shortfall	*The Department to investigate the lack of progress and report to the Conservation Commission and to the Minister for the Environment. The Department to address those impediments within its control and the Department and the Conservation Commission to advise the Minister for the Environment on measures to address other impediments.*

Objective of KPI 25

To assess the success of the implementation of the FMP in achieving its targets for the protection of heritage places/sites in the conservation reserve system.

Results and explanatory notes

Table 25.1 shows the representation of heritage places in the conservation reserve system. The 2011 analysis recorded an increase in Aboriginal sites when compared to previous years. This is attributed to an additional 4,613 sites added to the Aboriginal sites register between 31 December 2008 and 30 June 2011.

Conversely, the number of Heritage Council sites has decreased when compared to previous years. This is attributed to a decrease in sites on the register from 2008 to 2011.

The overall effect of these changes means that there are now a lot more heritage places in the reserve system than reported in the mid-term audit report.

Table 25.1 Representation of heritage places in the conservation reserve system

Reserve type	Heritage list	FMP proposed	Dec 04	Dec 06	Dec 08	Dec 2011
Informal	Heritage Council	n/a	7	10	11	6
	Aboriginal sites	n/a	286	282	338	417
Formal	Heritage Council	23	13	19	22	19
	Aboriginal sites	313	189	262	296	420
	Total	336	202	281	318	862
	% of end of FMP target		60	84	95	257

Overall, there has been little progress on implementing proposed land category changes due to impediments outside the control of the Department and the Conservation Commission (see report on KPI 1 for further information).

Socio-economic benefits

Two KPIs are reported below in relation to socio-economic benefits.

KPI 26 Number, range and use of recreation/tourism activities available by proposed land category in the plan area

Performance measure	*Type and number of recreation and tourism facilities available in the plan area (e.g. picnic sites, camp sites, toilets, visitor centres, walking trails, or major tourism developments).* *The number of visits to selected recreation areas.* *The satisfaction visitors express with their experience.*
Performance target(s)	*Visitor satisfaction maintained at high levels.*
Reporting	*Annually.*
Response to target shortfall	*The Department to investigate the cause and report to the Conservation Commission and to the Minister for the Environment. The Conservation Commission to evaluate the need for revision of management practices in the context of its assessment and auditing function, in consultation with the Department.*

Objective of KPI 26

To assess the success of the implementation of the FMP in achieving its targets through the provision of recreational opportunities and tourism.

Results and explanatory notes

Type and number of facilities

National parks continue to be the main focus for recreation within the FMP area but State forest also continues to offer opportunities and facilities for recreation, particularly overnight camping (Table 26.1). Day-use recreation sites are the most common site 'types' provided in national parks, State forest and nature reserves. Associated facilities**,** including barbecues, information displays, toilets and walk trails**,** are currently better provided for in national parks.

Comparison between 2004 and 2011 in Table 26.1 is problematic because of a greater uptake of data entry by districts, since 2008, into the Department's RecData application (recreational park infrastructure asset register) rather than a true reflection of an increase in the installation or construction of new facilities.

Table 26.1 Type and number of recreation and tourism facilities by proposed land category for the areas of the FMP in 2004 and 2011

Land category	Number of recreation facilities							
	Accommodation	*Camping*	*Day-use*	*BBQ*	*Info*	*Toilets*	*Bush walk*	*4WD*
			2004					
National park	3	37	121	61	38	138	89	41
Nature reserve	0	0	4	0	1	8	0	0
Conservation park	1	6	52	7	2	18	35	1
State forest, timber reserve	10	39	70	41	26	91	60	17
CALM Act section 5(1)(g)	0	12	10	9	5	42	13	5
Total	**14**	**94**	**257**	**118**	**72**	**297**	**197**	**64**
			2011					
National park	18	72 (71)	176	254	54	149	196	92
Nature reserve	0	0 (0)	3	2	3	4	0	1
Conservation park	0	7(10)	6	21	9	15	10	4
State forest, timber reserve	3	49 (55)	53	178	18	72	40	35
CALM Act section 5(1)(g)(h)	0	17 (21)	6	37	3	42	20	6
Total	**21**	**145 (157)**	**244**	**492**	**87**	**282**	**266**	**138**

Definitions

Accommodation: No. current sites with 'Accommodation' checked as a site type.
Camping: No. current sites with 'Camping' checked as a site activity (or site type).
Day-use: No. current sites with 'Day Use' checked as a site type.
Barbecues: No. current furniture facilities with 'Barbecue' selected as the furniture type.
Information: No. current buildings with 'Info shelter' selected as the building type.
Toilets: No. current buildings with 'Toilet' selected as the building type.
Bushwalking: No. current trail facilities with 'Walk' selected as the trail type (excludes Bibbulmun, Munda Biddi and Cape to Cape tracks).
4WD: No. current road facilities with '4WD' checked as the vehicle suitability.
Fees: No. current sites with boat tour, camping, caving, park entry or site entry fees.

Level of visitation

There has been a general increase in visitation to recreation sites over the period of the FMP from around five million in 2003/04 to around seven million in 2010/11 (Table 26.2). The changes and increases seen are due to more accurate reporting during the 2008/09 period but also follow the general trend in the statewide data of an increase in visitation to lands and waters managed by the Department.

As with previous periods, the increase in figures reported in 2009/10 and 2010/11 are the result of both changes in actual visitation trends and changes in monitoring methods during the period.

Table 26.2 Number of visits to selected recreation areas by proposed land category for the area of the FMP from 2004 to 2011

Recreation area	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11
National park	3,795,417	3,742,666	4,200,319	4,272,459	4,256,465	4,431,282	4,481,967	4,946,819
5G Reserve	435,764	545,157	600,409	602,490	631,588	648,609	1,180,121	1,159,127
State forest	410,742	343,334	332,159	363,248	418,809	490,476	495,046	518,057
Conservation park	104,663	118,215	125,955	139,228	155,079	150,107	119,441	150,602
Executive Director freehold	33,529	29,104	34,644	18,576	22,386	20,837	10,956	10,049
Nature reserve	17,360	16,688	16,688	18,674	16,688	16,688	78,388	81,200
Misc. reserve	12,284	13,000	12,528	12,709	18,049	19,329	21,138	21,006
Non-CALM Act	0	200	200	200	200	200	38,095	45,900
Total	**4,809,759**	**4,808,364**	**5,322,902**	**5,427,584**	**5,519,264**	**5,777,528**	**6,425,152**	**6,932,760**

Level of visitor satisfaction

Figure 26.1shows results from the Visitor Satisfaction Index (VSI), which has been adopted to compare visitor satisfaction levels each year and is averaged from visitor responses to surveys at selected parks, reserves and forest areas in the FMP area. The VSI figures reported below are indicative of a continuing high level of satisfaction with the respondents' visits.

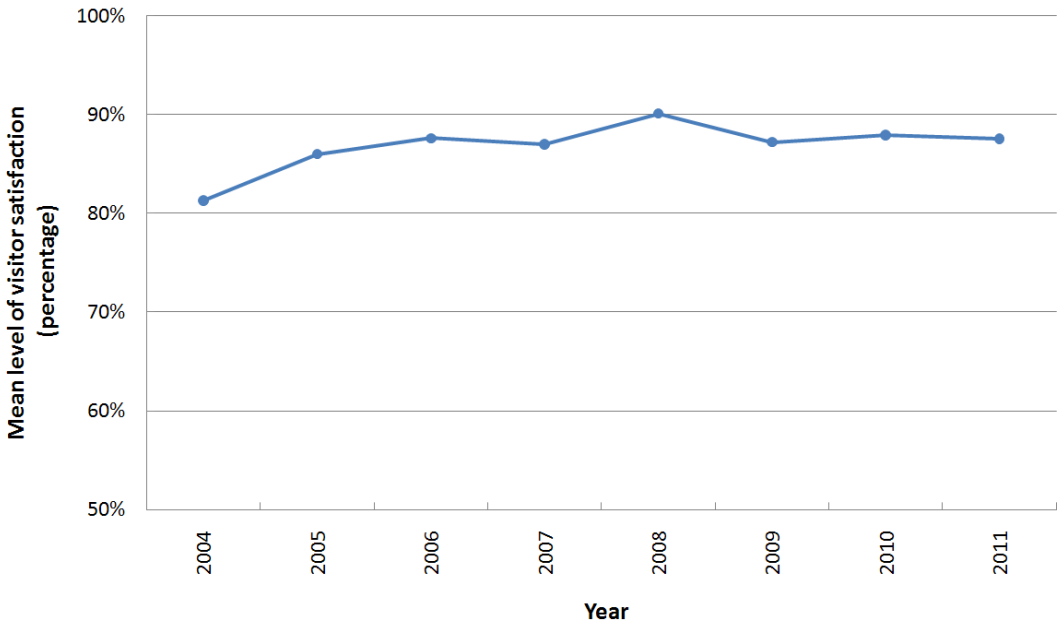


Figure 26.1 The level of visitor satisfaction recorded for recreation sites within the FMP area from 2004–2011

KPI 27 Basic raw material supply

Performance measure	*The number of notices of entry served to the Department under the Local Government Act.*
Performance target(s)	*No target, trends to be reported.*
Reporting	*Annually.*

Objective of KPI 27

To assess the success of the implementation of the FMP through the supply of basic raw materials (BRM).

Context

The Department manages the supply of BRM to local government and Main Roads Western Australia via a Notice of Entry system. BRM are also supplied to the FPC and extracted and used by the Department.

Since the mid-term audit report, the protocol for this KPI has been reviewed by the Department and updated to enable improved reporting. This was accompanied by a significant review and revision of procedures for the management and rehabilitation of BRM pits. The revised protocol was approved by the Conservation Commission on 21 December 2009. The collated return for 2010 provided in this report is the first time data on quantities of BRM removed by all users have been available.

Results and explanatory notes

Summaries of BRM extraction by land category for 2010 are shown in Tables 27.1 to 27.3. Around 97 per cent of the BRM was taken from State forest and timber reserves, with the remainder being sourced from national parks. The FPC was the main user of BRM, followed by local government or Main Roads and then the Department. Approximately two-thirds of the BRM sourced was gravel, with the remainder being shale (23 per cent) and sand (10 per cent).

Reference

Department of Environment and Conservation 2008, *Guidelines for the Management and Rehabilitation of Basic Raw Material Pits,* Department of Environment and Conservation. Perth.

Table 27.1 Summary of entries for extraction of basic raw materials by agent by land category for FMP area

Product extracted	Land categories in FMP Area*																					Total by product		
	State torest and timber reserves						Conservation lands									Other DEC-managed lands								
	Native forest			Plantation			Nature reserve			National park			Conservation park			CALM Act reserves - s5 (1) (g) & (h).			CALM Act CEO lands					
	No. of pits			No. of pits			No. of pits			No. of pits			No. of pits			No. of pits			No. of pits			No. of pits		
Agent	NOE	FPC	DEC	NOE	FPC	DEC	NOE	FPC	DEC	NOE	FPC	DEC	NOE	FPC	DEC	NOE	FPC	DEC	NOE	FPC	DEC	NOE	FPC	DEC
Shale			2																					**2**
Sand	1	3	1																			**1**	**3**	**1**
Clay																								
Gravel	2	20	6			1				1		3										**3**	**20**	**10**
Limestone			2																					**2**
Total by categories	**3**	**23**	**11**			**1**				**1**		**3**										**4**	**23**	**15**

* Land categories are as proposed in the FMP and as subsequently amended in line with the plan

Table 27.2 Summary of extraction of basic raw materials by volume by agent by land category for FMP area

Product extracted	Land categories in FMP Area*																						Total by product		
	State forest and timber reserves						Conservation lands									Other DEC-managed lands									
	Native forest			Plantation			Nature reserve			National park			Conservation park			CALM Act reserves - s5 (1) (g) & (h).			CALM Act CEO lands						
	Quantity removed			Quantity removed			Quantity removed			Quantity removed			Quantity removed			Quantity removed			Quantity removed			Quantity removed			
Agent	NOE	FPC	DEC	NOE	FPC	DEC	NOE	FPC	DEC	NOE	FPC	DEC	NOE	FPC	DEC	NOE	FPC	DEC	NOE	FPC	DEC	NOE	FPC	DEC
Shale		6,372	1,530																				**6,372**	**1,530**
Sand	3,000		120							492												**3,492**		**120**
Clay																								
Gravel	6,000	16424	45			60						690										**6,000**	**16,424**	**795**
Limestone		5,000																					**5,000**	
Total by categories	**9000**	**27796**	**1695**			**60**				**492**		**690**										**9,492**	**32,796**	**2,445**

* Land categories are as proposed in the FMP and as subsequently amended in line with the plan

Table 27.3: Summary of extraction of basic raw materials by land category for FMP area

Product extracted	Land Categories in FMP Area*						Total	
	State Forest and timber reserves		Conservation lands		Other DEC-managed lands			
	No. of pits	Quantity removed	No. of pits	Quantity removed	No. of pits	Quantity removed	No. of pits	Quantity removed
Shale	2	7,902					**5**	**7,902**
Sand	5	3,120	1	492			**3**	**3612**
Clay								
Gravel	33	22,529	3	690			**10**	**23,219**
Limestone	2	5,000						**5,000**
Annual total#	**42**	**38,551**	**4**	**1,182**			**18**	**39,733**

* Land categories are as proposed in the FMP and as subsequently amended in line with the plan

Plan Implementation

Six KPIs are reported below in relation to plan implementation.

KPI 28 Adaptive management

Performance measure	*The number and topic of formal adaptive management trials.*
Performance target(s)	*Within five years, trials will be held into at least two separate issues detailed in the plan's action statements.*
Reporting	*Five years.*
Response to target shortfall	*The Department to report to the Conservation Commission and to the Minister for the Environment on measures required to address achievement.*

Objective of KPI 28

To assess the success of the implementation of the FMP in achieving its targets through undertaking adaptive management trials aimed at improving forest management.

Results and explanatory notes

Adaptive management trials have been conducted to improve knowledge on a range of topics associated with implementation of the FMP. A brief summary of five of these trials is given below.

Walpole fire mosaic

The Walpole Fire Mosaic Project was initiated in 2003 as an adaptive management operational trial that aims to determine whether a fine-grained fire mosaic can be created by the frequent and targeted introduction of fire into the landscape (patch-burning), and whether this enhances biodiversity through space and time. It is a landscape-scale trial and the fire mosaic is being mapped using satellite imagery and the response of plants, animals and fungi is being monitored using a network of sampling grids. Monitoring is also being carried out at sites from which fire is excluded and sites experiencing fuel reduction burns. A fine-grained fire mosaic has been successfully developed in London block following three specially designed prescribed fire events. Monitoring biodiversity within the mosaic and analysing operational activities are currently in progress.

For further information see Burrows, N 2006. Burning for biodiversity: investigating fine grained fire mosaics in south-west Australia. Australian Plant Conservation 14: 5–6.

Armillaria root disease

As part of an extensive adaptive management trial to assess practical options and methods for control of Armillaria root disease in karri regrowth forest, operational stump pulling has been undertaken in Warren and Dombakup forest blocks. Stump pulling removes both existing and potential inoculum from the site and has the potential to reduce spread of disease through root-to-root contact between stumps and residual trees. The trial extends over 1,150 hectares of regrowth forest thinned between 2004 and 2006, in which 543 hectares were surveyed and all infected trees and stumps mapped. Within the surveyed area, all stumps within a 25-metre radius of an infection point were extracted using an excavator fitted with a specifically designed stump extraction head. The trial is designed to assess whether stump removal will reduce the incidence and impact of disease on retained trees.

For further information see Robinson, R 2012. Armillaria root disease in karri regrowth forests. Science Division Information sheet xx/2012

Cording to reduce soil disturbance during timber harvesting

The use of cording as a means of reducing soil disturbance during timber harvesting operations was examined in a series of adaptive management trials. The hypothesis being tested was that cording would reduce soil disturbance under moist soil conditions. Cording is the use of round or split log material that is closely and continuously laid across extraction tracks and log landing areas to distribute the machine load over a larger area. Cording provided a substantial reduction in rutting and associated soil mixing, together with a small but statistically significant reduction in soil compaction. The trials found that the impacts of harvesting operations conducted during moist soil conditions, and on soils with low gravel content can be reduced by cording. Operational learning that occurred during the trials allowed the FPC to gain an improved understanding of techniques for applying cording, cost of cording, and removal and rehabilitation of cording after completion of operations.

For further information see Science Division Information Sheet 43/2011 www.dec.wa.gov.au/content/view/3569/2103

Karri habitat retention

This trial examines an alternative approach to managing structural diversity to that outlined in the Department's Guideline No. 3 *Silvicultural Practice in the Karri Forest*, where the rationale for leaving only immature trees as habitat to grow into future habitat trees in clearfell areas was based on the fire-sensitive nature of mature karri trees and doubts about their survivorship following a hot broadcast burn. The trial was prompted by a change in the regeneration burning techniques used in the karri forest, largely stemming from a reduction in the market for marri (*Corymbia calophylla*) and the potential impact of smoke on grapes. These lower intensity burns offer more scope to retain mature habitat elements where they exist in clearfell coupes.

The broad aim of the trial is to provide a sound foundation on which to develop measures which maintain biological diversity that can be included in any revision of the silviculture guidelines. The trial involved harvesting an area of two-tiered forest and retaining mature trees with crown decline classes 4–8 as required by the jarrah guideline in lieu of the same number of potential habitat trees. The harvesting and burning has been completed, and the initial report is currently being prepared. It is expected that further monitoring to assess the survivorship of the trees to wind/exposure will continue to be undertaken as the regrowth develops.

Wungong catchment

The Wungong project was established to trial the harvesting and thinning of native forest and bauxite rehabilitation stands to increase streamflow over the projected flows resulting from current management practices under the prevailing rainfall. The project recognised three 'vegetation types' for different silvicultural treatments, which were regrowth jarrah forest, bauxite rehabilitation (pre-1988), and bauxite rehabilitation (post-1988). The Water Corporation prepared interim guidelines for the management of each of these types and trialled these guidelines in the Wungong catchment. The first phase of the project was reviewed in 2010, and found that the expected results had not been achieved. Current research, monitoring and hydrologic process modelling demonstrates that the treatments resulted in a retained leaf area greater than that required for sustained streamflow under the current climate regime. A proposal to continue the project with a thinning prescription based

on this latest knowledge for a smaller area closer to the Wungong Reservoir has been under consideration and development for the past 18 months.

For further information see www.watercorporation.com.au/w/wungong_index.cfm.

KPI 29 Provide for public involvement activities and public education, awareness and extension programs and make available forest-related information

Performance measure	*Compilation of programs for public involvement, education, awareness and extension programs.*
Performance target(s)	*Available programs and numbers of the community exposed to programs increases over time.*
Reporting	*Annually.*
Response to target shortfall	*The Department to investigate the cause and report to the Conservation Commission and to the Minister for the Environment.*

Objective of KPI 29

To assess the success of the implementation of the FMP in achieving its targets by tracking progress in the number of programs for public involvement and the numbers of the community exposed to forest-related programs.

Results and explanatory notes

Volunteers

Contribution to volunteer activities is increasing. This trend has been reflected in the statistics recorded for the FMP area for number of volunteers and hours provided (Figures 29.1 and 29.2). This was despite a drop in the number of projects recorded in the FMP area relative to an overall rise in new projects registered with the Department's Community Involvement Unit (Figure 29.3). The drop in the number of projects is thought to be due to consolidation or completion of ongoing projects.

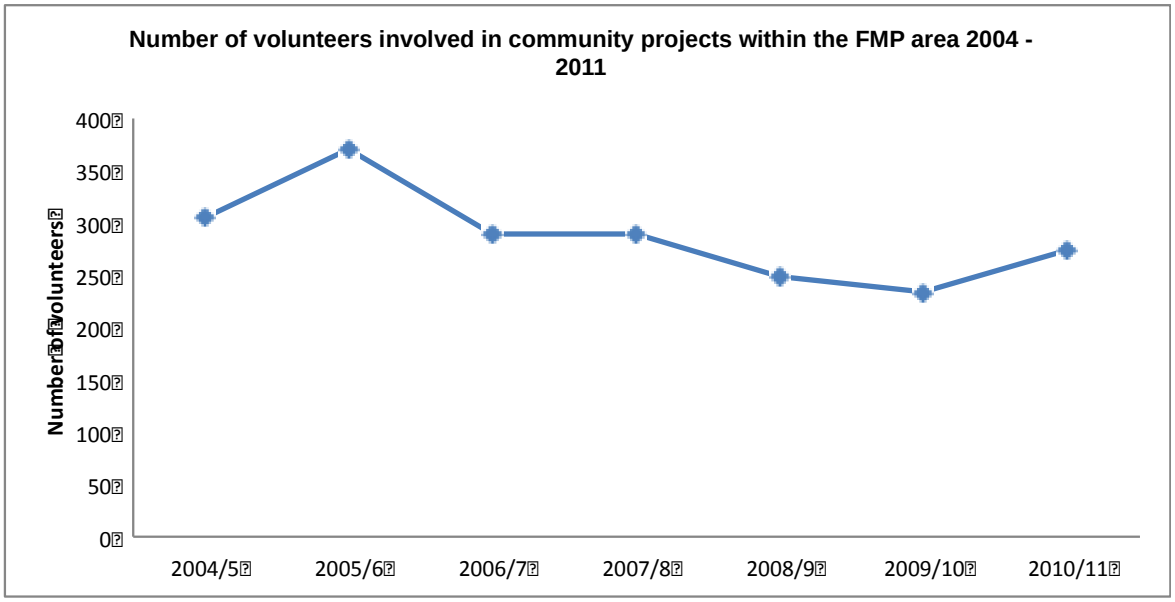


Figure 29.1 Number of volunteers involved in community projects within the FMP area for the period 2004–2011, excluding Bibbulmun Track volunteers and the Department's Bush Rangers program

Figure 29.2 Contribution of hours worked by volunteers in community projects within the FMP area for the period 2004–2011

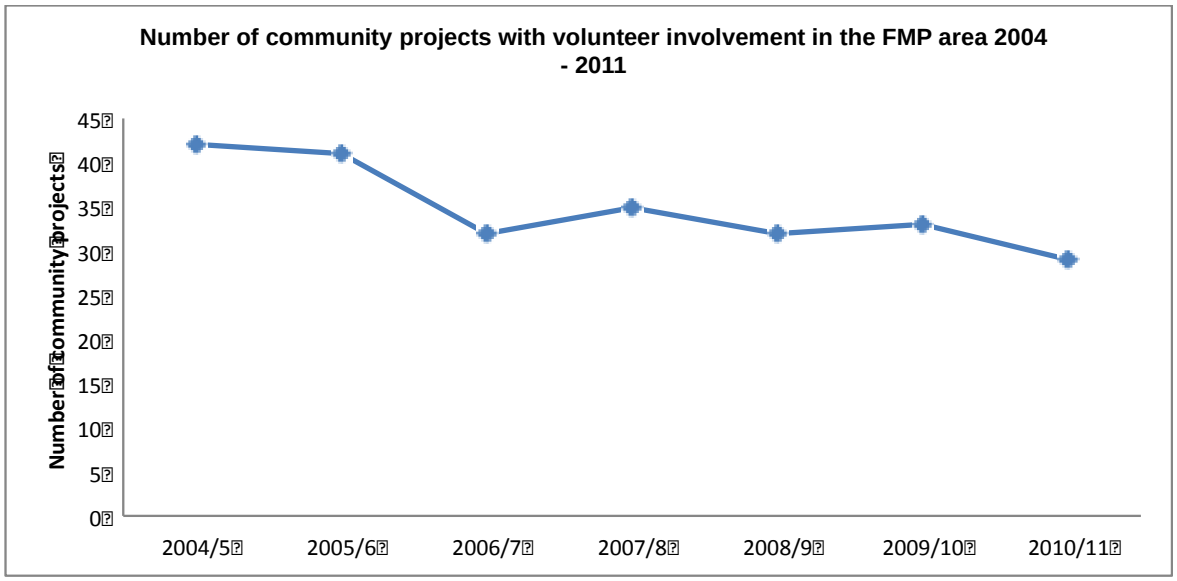


Figure 29.3 The number of community projects with volunteer involvement in the FMP area for the period 2004–2011

EcoEducation

The Department provides a range of forest education programs, focusing on the Perth Hills Centre in Swan Region, the Wellington Forest Discovery Centre and Wharncliffe Discovery Centre in South West Region and the Perup Forest Ecology Centre in Warren Region. The number of community participants in these programs since 2007/08 is shown in Figure 29.4 (consistent data are not available before 2007/08).

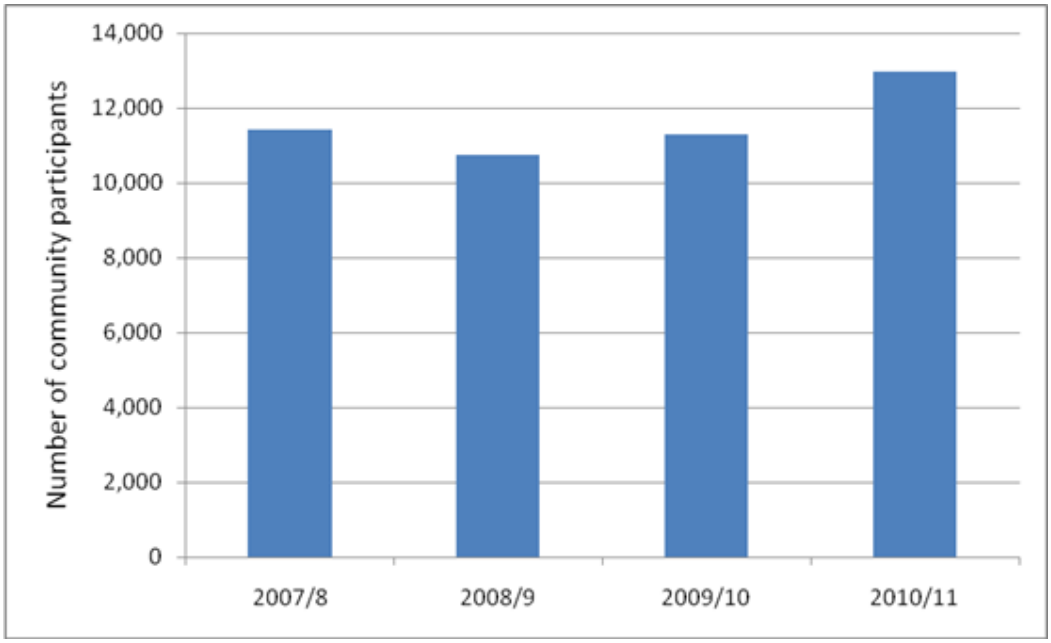


Figure 29.4 Community participants in the Department's EcoEducation programs from 2007/08 to 2010/11

EcoEducation also delivers curriculum-linked programs to help students understand sustainability concepts and achieve outcomes across a range of learning areas. Programs have three elements: professional learning for educators, classroom resources, and excursions or camp activities.

Interpretive information about forest management for visitors in State forest and national parks is provided primarily through signs and exhibits. A history of forest management and the timber industry is a component of the Swarbrick and Valley of the Giants Wilderness Discovery Centre sites in the Walpole Wilderness, and also at Harewood Forest near Denmark, and along the Total Forest Trail within Wellington Forest.

Aboriginal Heritage Unit

The Department's Aboriginal Heritage Unit develops and implements programs that seek to provide the community with culturally significant educational opportunities and information. The unit also has a role in training Departmental staff on cultural aspects of forest management. These programs and activities include:

- ongoing consultation and presentations in regard to customary activities and joint land management with the six working parties within South West Aboriginal Land and Sea Council (SWALSC)
- continuing to build on a positive working relationship with SWALSC through its memorandum of understanding with the Department
- continuing liaison with the Gnulla Maarnan Moort Boodjah men's group to progress joint land management initiatives with DEC
- providing the link for ongoing liaison between Department regional and district staff and the Aboriginal community.

The Aboriginal Heritage Unit conducts some 100 programs a year involving around 3,000 to 7,000 participants with no clear trends evident over time.

Publications produced by the Department

In addition to the peer-reviewed publications reported on in KPI 31, the Department publishes a range of reports, guidelines, books, brochures and magazine articles relating to the FMP area. Key publications produced over the past four years include:

2008
Forestry on private property – fact sheet
Common birds of the South West forests – Bush Book
Wandoo crown decline – brochure
EcoEducation programs 2009 – booklet
Tuart Dwellers – children's book
LANDSCOPE articles:

- 'Walpole Wilderness' (Winter 2008) and run-on (stand-alone reprint)
- 'Managing our stunning south-west corner' (Spring 2008)
- 'Hidden biodiversity: fungi and invertebrates' (Spring 2008)
- 'Down but not out: discovering the significance of dead wood' (Summer 2008–09)

2009
Leaf and branch (second edition) – book
EcoEducation programs 2010 – booklet
Lane Poole Reserves and Proposed Reserve Additions – draft management plan
Treasuring wandoo – such a marvellous tree – booklet
Wandoo Recovery Group Bulletin #6
LANDSCOPE articles:

- 'Lane Pool Reserve: into the future' (Winter 2009)
- 'Bushfires, fungi and biodiversity' (Spring 2009)
- 'Perth's trees and tall shrubs' (Summer 2009–10)

2010
Warren National Park – brochure
Vulnerability of forests in the South West of WA – report
EcoEducation programs 2011 – booklet
Guidelines for the protection of informal reserves and fauna habitat zones, SFM series – report
Soil and water conservation guidelines, SFM series – report
LANDSCOPE article:

- 'Walpole-Nornalup National Park: celebrating 100 years' (Spring 2010) and stand-alone run-on

2011
Wellington District – brochure
Karri Forest Explorer 2011 update – brochure
Proposed amendment to the Forest Management Plan 2004–2013 June 2011 – web information note
Lane Poole Reserves and Proposed Reserve Additions – management plan
Dryandra Woodland – management plan
EcoEducation programs 2012 – booklet
Three-year (2011–2013) indicative harvest plan – advertisement
Tuart Forest National Park – draft management plan
Tuart Forest National Park draft management plan invitation to comment – leaflet
LANDSCOPE articles with forest themes for the International Year of Forests:

- 'The jewel in the crown: Perup and the Upper Warren' (Autumn 2011)

- ‘Lessons learnt since the Dwellingup fires’ (Winter 2011)
- ‘Tuart Forest National Park’ (Spring 2011)
- ‘Dry times in the northern jarrah forest’ (Summer 2011–12)

Documents relating to forest management on the Department’s website

Key documents are available for the public to download and in some cases provide feedback or comments. Indicative levels of interest may be reflected by the number of visits, or ‘hits’, to the website received, which are shown in Table 29.1. The highest level of visitation is associated with the FMP and associated documents which received up to 17,000 hits. Maps for the three-year indicative timber harvesting plan are posted each year and also show a high level of visitation, receiving up to 6,000 hits. A number of items of general information about forest-related issues including tuart and wandoo decline, recovery plans and research working group reports continue to show high levels of visitation and have received around 5,000 to 10,000 hits.

Table 29.1 Number of website visitation (hits and downloads), for a range of forest-related information available on the Department’s website

Category	Document name	Date published	Hits to 2008	Hits to Dec2011
Forest Management	Forest Industry Statement	January 2004	7,201	15,144
	Forest management Plan 2004–2013: KPI Protocols	July 2007 (updated Feb 2011)	7,019	15,192
	Forest Management Plan 2004–2013	January 2004	7,852	17,439
	Forest Management Plan 2004–2013 (Ministerial Conditions)	December 2003	7,322	14,363
	Guidelines for the management of Informal Reserves and Fauna habitat Zones Guidelines for Protection of the Values of Informal Reserves and Fauna Habitat Zones	March 2008 April 2010	2,038	 1,613
	Soil and Water Conservation Guideline (Draft) Soil and Water Conservation Guideline (Final)	March 2008 April 2010	1,282	5,350 1,516
	Protocols for Measuring and Reporting on the KPIs of the Forest Management Plan 2004–2013	December 2011		63
Timber harvesting plans	Indicative 3-year map – South-west	September 2007	1,731	5,929
	Indicative 3-year map – Swan	September 2007	2,135	6,981
	Indicative 3-year map – Warren	September 2007	1,894	6,132

Category	Document name	Date published	Hits to 2008	Hits to Dec2011
	South-west Region Coupe Listing (2008–2010)	September 2007	1,928	5,672
	Swan Region Coupe Listing (2008–2010)	September 2007	2,105	6,374
	Swan Region Coupe Listing (2010–2012)	December 2009		1,562
	Warren Region Coupe Listing (2008–2010)	September 2007	1,664	4,629
	Warren Region Coupe Listing (2010–2012)	December 2009		1,190
Conserving our Tuart	Conserving our Tuarts (Brochure)	July 2002	2,703	6,519
	Tools for Identifying Indicative High Conservation Tuart Woodland	March 2004	3,341	9,280
Strategies	Draft Tuart Strategy	December 2004	1,681	4,762
Reports	Tuart Conservation and protection Status Report	August 2002	1,693	4,536
Conserving our Wandoo	Surveying wandoo crown decline – a guide for assessors	March 2007	4,699	10,285
	Wandoo Crown Decline Action Pan	November 2006	4,623	9,945
	Wandoo Crown Decline Survey Sheet (incl. Crown Decline Diagrams)	April 2007	4,108	9,237
	Wandoo Distribution Map	February 2007	4,428	11,558
	Wandoo Research Strategy	March 2007	4,678	9,989
Wandoo articles	Comparison of changes to water levels in deep bores 1975-2004, Helena catchment	October 2004	2,979	7,175
	Healthy Ecosystems – Inland wandoo woodland case study, Wyalkatchem Nature Reserve	July 2006	2,950	7,131
	Wondering About Wandoo – LANDSCOPE Autumn 2005	March 2005	3,136	6,807
Wandoo Response Group Bulletins	Wandoo Response Group News Bulletin – issue 01	March 2007	3,086	7,197
	Wandoo Response Group News Bulletin – issue 02	March 2007	3,223	7,559
	Wandoo Response Group News Bulletin – issue 03	December 2005	3,026	7,130

Category	Document name	Date published	Hits to 2008	Hits to Dec2011
	Wandoo Response Group News Bulletin – issue 04	March 2007	3,161	7,338
	Wandoo Response Group News Bulletin – issue 05	March 2009		2,716
	Wandoo Response Group News Bulletin – issue 06	January 2011		754
	Assessment of Eucalyptus Wandoo (Wandoo) – Progress Report	April 2009	486	5,833
WRG Reports	Baselining Wandoo Crown – Preliminary report of wandoo crown decline surveys, 2006	June 2007	2,554	7,052
	Crown Decline in Wandoo: Observations from Wundabiniring Brook 1999–2005	July 2005	2,892	7,204
	Crown Decline in Wandoo: Observations from Wundabiniring Brook 1999–2006	July 2006	3,259	7,696
	Wandoo Crown Condition 2007	May 2008	409	4,518
	Wandoo Crown Condition 2008	March 2009		1,640
	Wandoo Crown Condition 2009	December 2009		1,089
	Wandoo Crown Condition 2010	January 2011		514
	Wandoo Crown Decline Situation Statement	July 2006	3,132	5,693
	Wandoo Crown Decline: Summary of Research	November 2006	2,963	5,802
	Wandoo Decline: A Forest Manager's Perspective	November 2006	2,883	5,385
Sustainable Forest Management Technical Reports	Review of factors Affecting Disturbance of Soils	May 2005	3,585	8,648

KPI 30 Develop and maintain human resource skills across relevant disciplines

Performance measure	*The extent to which the Department demonstrates the capacity and commitment to develop and maintain the essential skills of staff.*
Performance target(s)	*Persons responsible for undertaking key tasks on average meet 80 per cent of the competency requirements for key tasks indicated in the environmental management system.*
Reporting	*Annually.*
Response to target shortfall	*The Department and the Forest Products Commission to investigate the cause and report to the Conservation Commission and in the case of the Department, to the Minister for the Environment.*

Objective of KPI 30

To assess the success of the implementation of the FMP in achieving its targets by examining the extent to which the Department and FPC demonstrate the capacity and commitment to develop and maintain the essential skills of staff.

Context

Effective implementation of many of the actions identified in the FMP requires knowledge and understanding in relation to the range of forest values and systems for implementation of the plan. Formal skills development through training is one element of establishing competence. However, acknowledgement of other sources of skills development through experience and education is also important.

Results and explanatory notes

FPC

The FPC has two major components to its training programs for operational staff:

- training for existing experienced staff
- an Environmental Management System (EMS) that highlights areas of environmental risk and the training required to address these.

The FPC initiated a training program for recruits in mid-2004 and 56 staff have now completed this program. Training is conducted under the auspices of Great Southern TAFE which is a Registered Training Organisation and is responsible for ensuring that training and assessment meets the Australian Qualification Training Framework and aligns with the Forest Products Industry training package (FPI 05). On successful completion, recruits receive a Certificate 3 in Forest Growing and Management issued by Great Southern TAFE.

The FPC also has a 'skills recognition' program for existing Operations Division staff. The organisation has documented the skills and competencies needed by operations staff at each of the Government Officers Salaries, Allowances and Conditions Award levels 3, 4, and 5, then linked or mapped them to the FPI 05 training package. Level 3 equates to a Certificate 3 in Forest Growing and Management, Level 4 to a Certificate 4 in Forest Operations, and Level 5 to a Diploma in Forests and Forest Products. This training program is also provided through Great Southern TAFE to ensure Australian Qualification Training Framework requirements, standards and access to qualifications are met. Operations staff

commenced this program in early 2008. The training and assessment process enables experienced and competent staff to achieve a qualification at their existing level and responsibility, and will also highlight to the organisation areas or gaps where training is required. Since the program was introduced, 34 existing staff have completed a Cert 111 in Forest Growing and Management, 26 have completed a Cert IV in Forest Operations and 30 have completed a Diploma in Forest and Forest Products.

The FPC also gave staff the opportunity to gain skills in Business, Front Line Management, Management and Training and Assessment. Since 2009 the numbers of existing staff who have qualifications in these areas are as follows:

Business Cert III	13
Business Cert IV	14
Business Diploma	16
Front Line Management Cert IV	5
Training and Assessment	11

Note – Some staff have multiple qualifications.

It is not possible to put a complete dollar value on these qualifications as much of the training and assessment is done by FPC staff under an arrangement with Great Southern Institute of Technology. However, a standard enrolment cost for Recognised Prior Learning is $292 per enrolment and around $600 for a full course. For the existing staff (roughly half of FPC staff have left in the past 12 months) this would equate to $53,104 being spent on enrolment fees alone. Last year FPC assisted staff (current and those who have since left) to gain a total of 153 qualifications. This gives an enrolment value of around $44,676 in the past 12 months.

Meanwhile the EMS has highlighted the key training requirements of the five main operational areas, Nursery, Seed Technology, Plantations, South West Forests and Arid Forest. The Environmental Training Register nominates the training required to ensure each area's operational controls can be met.

Department of Environment and Conservation

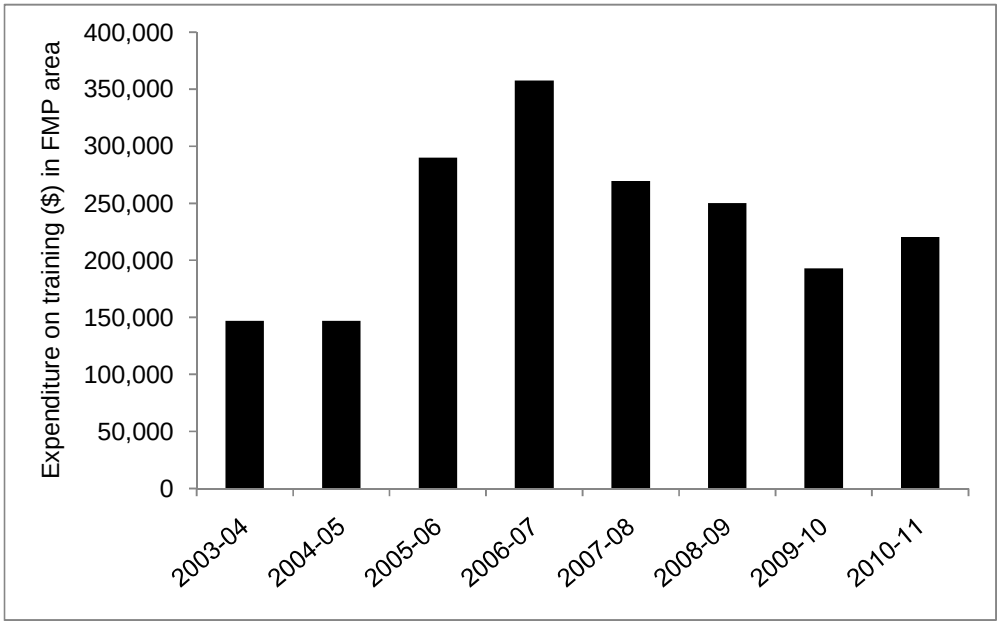
Implementation of the FMP by the Department is undertaken by many staff from different divisions within the agency. For a large number of staff, FMP implementation is one aspect of their job, which also involves work in other regions or on other aspects of environmental management and conservation. An indication of the level of resources provided for training within the three forest regions covered by the FMP is shown in Figure 30.1 below. The figure shows an annual expenditure of around $250,000 with an increase in the first three years of the plan. Some of this increase is attributed to training associated with new systems and processes, such as for the management and protection of soils. The peak around 2007 is also likely to be associated with the merge between the former Department of Conservation and Land Management and Department of Environment to form the Department of Environment and Conservation.

The Department's Training Centre continues to manage and maintain Registered Training Organisation status. Since 2004, 29 staff have achieved certificate II, 26 have achieved certificate III and 40 have achieved certificate IV in Conservation and Land Management. The Department also encourages staff to undertake further training and development, offering a range of scholarships and development opportunities each year. Four women working in regional districts within the FMP area participated in the 'Leadership Journey for Women' Program 2011. Each year between 2005 and 2011, between one and eight

regional staff members in the FMP area received scholarship funds to undertake further development. During this time, three regional staff members received funding scholarships to undertake international or interstate learning and development programs.

In 2009, the Sustainable Forest Management Division commenced a succession management project to identify key positions together with the associated knowledge and skills required to implement the FMP. This project seeks to maintain the skills, knowledge and experience to undertake sustainable forest management into the future.

Table 30.1: Annual expenditure by DEC on training within the FMP area



KPI 31 Development of scientific understanding of ecosystem characteristics and functions

Performance measure	*Expenditures on research and development related to ecologically sustainable forest management;* *Person years of scientific research, by ecosystem or disciplinary area of study, in the field of ecologically sustainable forest management; and/or* *Number of peer-reviewed articles published annually on ecologically sustainable forest management.*
Performance target(s)	*No target.*
Reporting	*Annually.*
Response to report	*The Conservation Commission to review the scientific effort in forests in relation to the total Departmental effort and discuss priorities with the Department.*

Objective of KPI 31

To assess the success of the implementation of the FMP through monitoring the development of scientific understanding in relation to sustainable forest management.

Context

Effective implementation of a number of the actions identified in the FMP requires improved knowledge and understanding of south-west forests. This KPI provides quantitative indicators of the level of effort committed to scientific research on sustainable forest management, and the output of scientific publications resulting from this effort.

Results and explanatory notes

The Department has continuously invested resources into improving scientific understanding of the forest ecosystems within the FMP area. Figure 31.1 shows the number of FTEs and expenditure on research relevant to sustainable forest management for the period 2005 to 2011. The number of FTEs has varied between 20 and 25 during this period, with a decline evident from 2008 to 2010. This decline resulted from the retirement of permanent staff who were not replaced. The increased FTE evident in 2011 reflects updated staff salary allocations that better align with the work requirements of individual staff within the Science Division, for example in the area of climate science.

Expenditure on research has remained relatively consistent at approximately $2.5 million with an increase to $3.2 million in the year ending 2011.

The number of publications on research relevant to sustainable forest management in peer reviewed scientific journals has varied from 11 in 2008 to 28 in 2011 (Fig. 2). Since 2009 the annual number of publications has exceeded 25. The total number of publications for the period is 136 (Table 31.1). Variation in the number of articles published each year is expected because the time required to conduct research, analyse data and prepare manuscripts for submission varies according to the type of research undertaken. The time between acceptance of scientific manuscripts and the eventual publication in journals is also variable.

Publications relating to biological diversity and ecosystem health and vitality have been the most common, with a small number of publications relating to productive capacity and soil and water. Publications relating to jarrah forest ecosystems have been the most frequent, followed by those dealing with matters at a whole-of-forest scale. The ratio of papers on

jarrah and karri forest ecosystems is broadly proportional to the areas of each forest ecosystem. A full list of papers is provided at the end of this section.

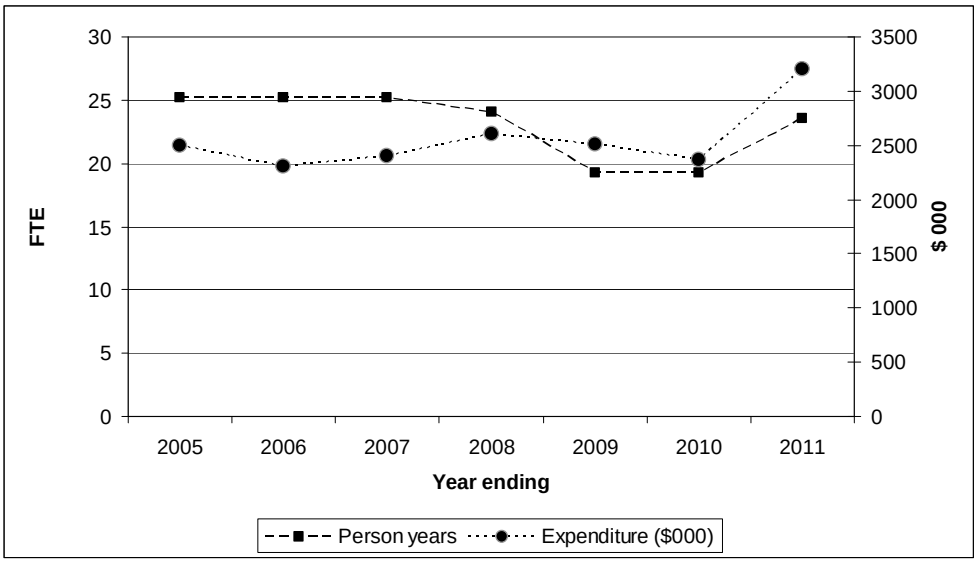


Figure 31.1 Number of FTEs and expenditure on research relevant to sustainable forest management for the period 2005 to 2011

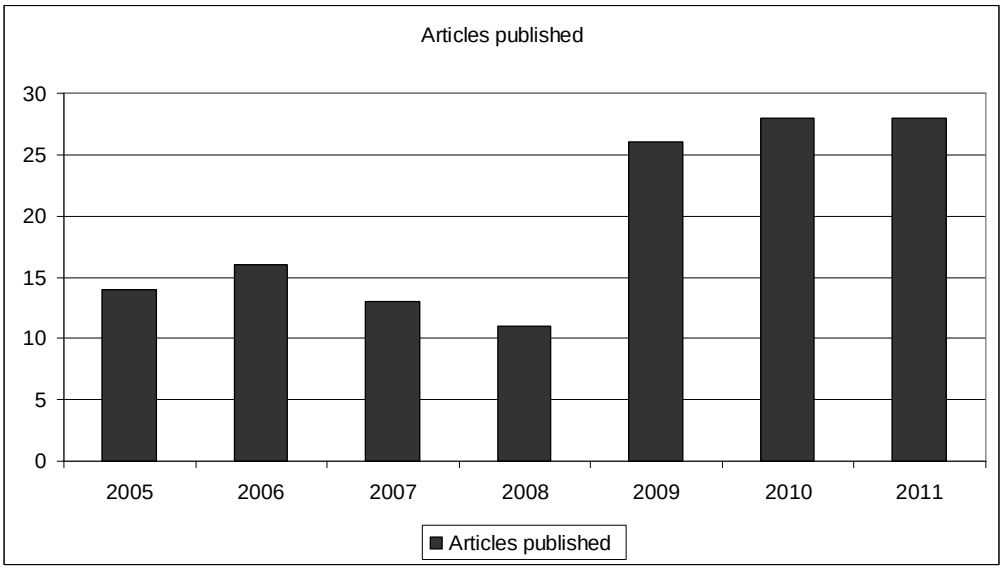


Figure 31.2 Annual number of articles relating to ecologically sustainable forest management published in peer reviewed scientific journals on which Departmental authors are included as senior or co-author

Table 31.1 Total number of articles relating to ecologically sustainable forest management published in peer reviewed scientific journals on which Departmental authors are included as senior or co-author during the period July 2004 to June 2011

Criterion	Ecosystem			Total
	Jarrah	Karri	Whole of forest[a]	
Biological diversity	48	5	16	69
Productive capacity	2	2	2	6
Ecosystem health and vitality	30	1	26	57
Soil and water	2	-	-	2
Natural and cultural heritage	-	-	-	-
Socio economic benefits	1	-	1	2
	83	8	46	136

[a] Also includes a small number of articles relating to forest types other than jarrah and karri dominant.

Eleven peer-reviewed scientific papers were published, after June 2011, on the results of monitoring of the impacts of timber harvesting on biodiversity. This was a package of papers on the five year review of results from FORESTCHECK.

Peer-reviewed papers are an important output from scientific research but are only one of a number of ways in which knowledge can be documented and communicated. Scientists in the Department are also encouraged to contribute through scientific conferences, field days and seminars and to make information available in a variety of formats that target the needs and interests of specific user groups. These include Science Information Sheets, web-based products and technical manuals. A comprehensive list of these outputs is provided in the Science Division Annual Research Activity Report.

List of peer reviewed articles on aspects of ecologically sustainable forest management published by Departmental authors between July 2004 and June 2011(Data sourced from Science Division Annual Research Acvtivity Report and contents of Nuytsia)

2004

Abbott I, Burrows N (2004) Monitoring biodiversity in jarrah forest in south-west Western Australia: the ForestCheck initiative. In *Conservation of Australia's Forest Fauna*. - 2nd ed. (ed. D Lunney), pp. 947-958. Royal Zoological Society of New South Wales, Sydney.

Barrett SR, Shearer BL, Hardy GE St J (2004) Phytotoxicity in relation to in plant concentration of the fungicide phosphite in nine Western Australian native species. *Australasian Plant Pathology* **33**, 521–528.

Cranfield R (2004) *Grevillea bipinnatifida* subsp. *pagna* (Proteaceae), a new subspecies from south-west Western Australia. *Nuytsia* **15**, 187–192.

Farr JD, Swain D, Metcalf F (2004) Spatial analysis of an outbreak of *Uraba lugens* (Lepidoptera: Noctuidae) in the southwest of Western Australia: does logging, vegetation type or fire influence outbreaks? *Australian Forestry* **67**, 101–113.

Hayward MW, de Tores PJ, Augee ML, Fox BJ, Banks PB (2004) Home range and movements of the quokka, *Setonix brachyurus* (Macropodidae: Marsupialia), and its

impact on the viability of the metapopulation on the Australian mainland. *Journal of Zoology* **263**, 219–228.

Lamont BB, Wittkuhn R, Korczynskyj D (2004) Turner review. No. 8: Ecology and physiology of grasstrees. *Australian Journal of Botany* **52**, 561–582.

Lee KM, Abbott I (2004) Precautionary forest management: a case study from Western Australian legislation, policies, management plans, codes of practice and manuals from the period 1919–1999. *Australian Forestry* **67**, 114–121.

McCaw L, Hamilton T, Rumley C (2004) Application of fire history records to contemporary management issues in south-west Australian forests. In *A Forest Conscienceness: Proceedings 6th National Conference of the Australian Forest History Society Inc., 12–17 September 2004, Augusta, Western Australia* (eds M Calver, H Bigler-Cole, G Bolton, A Gaynor, P Horwitz, J Mills, G Wardell-Johnson), pp. 555–564. Millpress Science, Rotterdam.

Meyer C, Beer T, Müller J, Gillett R, Weeks I, Powell J, Tolhurst K, McCaw L, Cook G, Marney D, Symons R (2004) Dioxin emissions from bushfires in Australia. Department of Environment and Heritage, Canberra. National Dioxins Program Technical Report 1

Smith JA, Wright LJ, Morris KD (2004) BiblioChuditch: the chuditch, Dasyurus geoffroii (Gould 1841): a Wildlife Science Library bibliography. *Conservation Science Western Australia* **5**, 6–19.

Stoneman G.L., Hagan, R. and Rayner, M.E. (2005) Evolution of silvicultural practice in the jarrah forest of Western Australia. In *A Forest Conscienceness – Proceedings of the 6th National Conference of the Australian Forest History Society Inc.*, M. Calver, H. Bigler-Cole, G. Bolton, J. Dargavel, A. Gaynor, P. Horwitz, J. Mills and G Wardell-Johnson (eds). Millpress, Rotterdam. pp. 693–706.

Whitford K, Stoneman G (2004) Management of tree hollows in the jarrah, *Eucalyptus marginata*, forest of Western Australia. In *Conservation of Australia's Forest Fauna*. - 2nd ed. (ed. D Lunney), pp. 807–829. Royal Zoological Society of New South Wales, Sydney.

Wills AJ, Burbidge TE, Abbott I (2004) Impact of repeated defoliation on jarrah (*Eucalyptus marginata*) saplings. *Australian Forestry* **67**, 194–198.

2005

Burrows N (2005) Effets de la diversité des feux sur un hotspot de la biodiversité en Australie (Fire diversity in a biodiversity hotspot). Forêt Méditerranéenne **26,** 243–250.

Burrows N (2005) Synthèse des connaissances sur les impacts du feu sur le biote des ecosystems de type forêt méditerranéenne dans le Sud-Oest australien (A summary of knowledge of the impacts of fire on elements of the biota of Mediterranean-type forest ecosystems of south-west Western Australia). Forêt Méditerranéenne **26,** 207–216.

Cranfield R and Keighery G (2006) *Logania wendyae* (Loganiaceae), a new species from south-west Western Australia. *Nuytsia* 16, 11–14.

D'Souza NK, Colquhoun IJ, Shearer BL, Hardy GE St J (2005) Assessing the potential for biological control of *Phytophthora cinnamomi* by fifteen native Western Australian jarrah-forest legume species. *Australasian Plant Pathology* **34**, 533–540.

Hayward MW (2005) Diet of the quokka (*Setonix brachyurus*) (Macropodidae: Marsupialia), in the northern jarrah forest of Western Australia. *Wildlife Research* **32**, 15–22.

Hayward MW, de Tores PJ, Augee ML, Banks PB (2005) Mortality and survivorship of the quokka (*Setonix brachyurus*) (Macropodidae: Marsupialia), in the northern jarrah forest of Western Australia. *Wildlife Research* **32**, 715–722.

Hayward MW, de Tores PJ, Banks PB (2005) Habitat use of the quokka, *Setonix brachyurus* (Macropodidae: Marsupialia) in the northern jarrah forest of Australia.

Journal of Mammalogy **86**, 683–688.
Hayward MW, de Tores PJ, Dillon MJ, Fox BJ, Banks PB (2005) Using faecal pellet counts along transects to estimate quokka (*Setonix brachyurus*) population density. *Wildlife Research* **32**, 503–507.
Wardell-Johnson G, Pullar D, van Neil K, Burrows N (2005) Towards a landscape conservation culture: anticipating change in the tingle mosaic, south-western Australia. *Australasian Plant Conservation* **14(2)**, 6–8.
Wayne AF, Cowling A, Rooney JF, Ward CG, Vellios CV, Lindenmayer DB et al. (2005) A comparison of survey methods for arboreal possums in jarrah forest, Western Australia. *Wildlife Research* **32**, 701–714.
Wayne AF, Cowling A, Rooney JF, Ward CG, Wheeler IB, Lindenmayer DB et al. (2005) Factors affecting the detection of possums by spotlighting in Western Australia. *Wildlife Research* **32**, 689–700.
Wayne AF, Rooney JF, Ward CG, Vellios CV, Lindenmayer DB (2005) The life history of *Pseudocheirus occidentalis* (Pseudocheiridae) in the jarrah forest of south-western Australia. *Australian Journal of Zoology* **53**, 325–337.
Wayne AF, Ward CG, Rooney JF, Vellios CV, Lindenmayer DB (2005) The life history of *Trichosurus vulpecula hypoleucus* (Phalangeridae) in the jarrah forest of south-western Australia. *Australian Journal of Zoology* **53**, 265–278.

2006

Abbott I (2006) Mammalian faunal collapse in Western Australia, 1875–1925: the hypothesised role of epizootic disease and a conceptual model of its origin, introduction, transmission and spread. *Australian Zoologist* **33**, 530–561
Burrows ND (2006) Burning for biodiversity: investigating fine grain fire mosaics in southwest Australia. *Australasian Plant Conservation* **14(4)**, 5–6.
Kinal J, Stoneman GL, Williams MR (2006) Calibrating and using an EM31 electromagnetic induction meter to estimate and map soil salinity in the jarrah and karri forests of southwestern Australia. *Forest Ecology and Management* **233**, 78–84.
Matthews S, McCaw WL (2006) A next generation fuel moisture model for fire behaviour prediction (ABSTRACT). *Forest Ecology and Management* **234S**, p. S91.
McCaw WL (2006) *Asplenium aethiopicum* recolonises karri forest following timber harvesting and burning. *Journal of the Royal Society of Western Australia* **89**, 119–122.
Robinson RM (2006) Varying fire regimes to promote fungal diversity across the landscape. *Australasian Plant Conservation* **14(4)**, 16–17.
Shearer BL, Fairman RG, Grant MJ (2006) Effective concentration of phosphite in controlling *Phytophthora cinnamomi* following stem injection of *Banksia* species and *Eucalyptus marginata*. *Forest Pathology* **36**, 119–135.
Wayne AF, Cowling A, Lindenmayer DB, Ward CG, Vellios CV, Donnelly CF et al. (2006) The abundance of a threatened arboreal marsupial in relation to anthropogenic disturbances at local and landscape scales in Mediterranean-type forests in south-western Australia. *Biological Conservation* **127**, 463–476.
Wheeler MA, Byrne M (2006) Congruence between phylogeographic patterns in cpDNA variation in *Eucalyptus marginata* (Myrtaceae) and geomorphology of the Darling Plateau, south-west of Western Australia. *Australian Journal of Botany* **54**, 17–26.

2007

Abbott I, Burbidge T, Wills A (2007) *Austromerope poultoni* (Insecta: Mecoptera) in south-west Western Australia: occurrence, modelled geographical distribution and phenology. *Journal of the Royal Society of Western Australia* **90**, 97–106.
De Tores PJ, Hayward MW, Dillon MJ, Brazell RI (2007) Review of the distribution, causes for the decline and recommendations for management of the quokka, *Setonix*

brachyurus (Macropodidae: Marsupialia), an endemic macropod marsupial from south-west Western Australia. *Conservation Science Western Australia* **6**(1), 13–73.
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Jayasekera AU, McComb JA, Shearer BL, Hardy GE St J (2007) *In planta* selfing and oospore production of *Phytophthora cinnamomi* in the presence of *Acacia pulchella*. *Mycological Research* **111**, 355–362.
Matthews S, McCaw WL, Neal JE, Smith RH (2007) Testing a process-based fine fuel moisture model in two forest types. *Canadian Journal of Forest Research* **37**, 23–35.
McCaw L, Marchetti P, Elliot G, Reader G (2007) Bushfire weather climatology of the Haines Index in south-western Australia. *Australian Meteorological Magazine* **56**, 75–80.
Meyer CP, Black RR, Tolhurst KG, McCaw L, Cook G, Symons R et al. (2007) An emission budget for dioxins from crop and bush fires in Australia. *Organohalogen Compounds* **69**, 2419–2422.
Meyer CP, Black RR, Tolhurst KG, McCaw L, Cook G, Symons R et al. (2007) Emission of dioxins from bush fires in Australia. *Organohalogen Compounds* **69**, 307–310.
Robinson RM, Tunsell V (2007) Preliminary list of macrofungi recorded in burnt and unburnt *Eucalyptus diversicolor* regrowth forest in the south-west of Western Australia: 1998–2002. *Conservation Science Western Australia* **6**(1), 75–96.
Shearer BL, Crane CE, Barrrett S, Cochrane A (2007) *Phytophthora cinnamomi* invasion, a major threatening process to conservation of flora diversity in the south-west botanical province of Western Australia. *Australian Journal of Botany* **55**, 225–238.
Shearer BL, Fairman RG (2007) A stem injection of phosphite protects *Banksia* species and *Eucalyptus marginata* from *Phytophthora cinnamomi* for at least four years. *Australasian Plant Pathology* **36**, 78–86.
Stoneman GL (2007) Ecological forestry and eucalypt forests managed for wood production in south-western Australia. *Biological Conservation* **137**, 588–566.
Stukely MJC, Crane CE, McComb JA, Bennett IJ (2007) Field survival and growth of clonal, micropropagated *Eucalyptus marginata* selected for resistance to *Phytophthora cinnamomi*. *Forest Ecology and Management* **238**, 330–334.
Stukely MJC, Webster JL, Ciampini JA, Kerp NL, Colquhoun IJ, Dunstan WA *et al*. (2007) A new homothallic *Phytophthora* from the jarrah forest in Western Australia. *Australasian Plant Disease Notes* **2**, 49–51.
Wardell-Johnson GW, Williams MR, Mellican AE, Annells A (2007) Floristic patterns and disturbance history in karri (*Eucalyptus diversicolor*: Myrtaceae) forest, south-western Australia. 2, origin, growth form and fire response. *Acta Oecologica* **31**, 137–150.

2008

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KPI 32 Environmental management system

Performance measure	*Development of a Departmental environmental management system (EMS) to a standard suitable for accreditation.*
Performance target(s)	*EMS developed by December 2005.*
Reporting	*December 2005.*
Response to target shortfall	*The Department to report to the Conservation Commission and to the Minister for the Environment on measures it proposes to complete the task and the completion date.*

Objective of KPI 32

To assess the success of the implementation of the FMP by providing information on the development of an EMS.

Results and explanatory notes

The Department has not developed and EMS to a standard suitable for accreditation.

Response to target shortfall

In the mid-term audit report, the Department indicated that it had decided to place priority on implementing key changes in policy and practice committed to in the FMP. As a result of resource constraints, competing priorities and increased expectations to service other requirements of the FMP, an EMS was deemed to be of lower priority.

This position was further reinforced in January 2010 when the Department reported to the Minister for Environment that in 2006 and 2007 it investigated the cost associated with achieving certification of forest management to the Australian Forestry Standard. It was estimated that this would cost the Department $1.7 million to establish with an ongoing annual cost of $400,000. Given the significant cost of developing an EMS and competing priorities for the Department's resources, the Department recommended development of work processes and systems in line with EMS principles while focusing resources on the operational implementation of the FMP. These improvements in work processes and systems have been steadily progressed since 2008 and include:

- implementing a system of document control for guidance documents
- developing an approvals matrix for disturbance operations on State forest and timber reserves
- providing consistent availability of operational approvals using the Department's intranet
- providing FPC staff access to the Department's intranet for document loading and sharing
- developing a values table for risk-based monitoring of proposed and current harvest areas
- updating the Planning checklist for disturbance activities (SFMDEC019) to include all required values.

KPI 33 Operational control

Performance measure	*The extent to which guidance documents have been prepared/reviewed and management modified to improve ecologically sustainable forest management.*
Performance target(s)	*All guidance documents referred to in the Actions proposed by the plan to be prepared/reviewed by mid-term.*
Reporting	*Annually.*
Response to target shortfall	*The Department to investigate the cause and report to the Conservation Commission and to the Minister for the Environment. The Conservation Commission to evaluate the need for revision of management practices in the context of its assessment and auditing function, in consultation with the Department.*

Objective of KPI 33

To assess the success of the implementation of the FMP in achieving its targets by ensuring that guidance documents maintain their currency.

Results and explanatory notes

The performance measure for KPI 33 required a suite of FMP guidance documents to be prepared or reviewed by December 2008. As this target was not achieved at the time the mid-term audit of performance was undertaken in December 2008 the department investigated the cause of delays in preparing these guidance documents. At the time of the mid-term audit the primary reason given for the shortfall were:

- the level of resources available to the department to implement the FMP
- the ramp-up in capacity required to develop guidance documents within relevant parts of the Department meant some deadlines had passed before an increased capacity was in place
- the difficulties that arose in implementing the FMP and hence the resources used in resolving these difficulties, with consequent impacts for work on implementing the FMP that otherwise would have progressed
- emerging new priorities that the Department was required to service, e.g. the Timber Industry Working Group in 2006 and 2007, with consequent impacts for work on implementing the FMP that otherwise would have progressed
- additional work to service the Conservation Commission beyond that required by the FMP, e.g. for field surveys of old-growth forest and procedures and consultation involved in finalising fauna habitat zones, with consequent impacts for work on implementing the FMP that otherwise would have progressed
- some initiatives in the FMP, such as soil management, have required substantially more resources than anticipated because of the increased complexity that has evolved (to develop the Trafficability Index system, undertake adaptive management trials, revise the soil management system on several occasions), with consequent impacts for work on implementing the FMP that otherwise would have progressed
- involvement in fire emergencies which has seasonally impacted to a significant extent on works programs, with consequent impacts for work on implementing the FMP that otherwise would have progressed.

As a consequence the Conservation Commission identified three key guidance documents (Appendix C mid-term audit report) which it considered a priority to finalised by 31 July 2009:

- *Guidelines for the Protection of the Values of Informal Reserves and Fauna Habitat Zones*
- *Guidelines for the Selection of Fauna Habitat Zones*
- *Soil and Water Conservation Guidelines*.

As at December 2011 the key guidance documents were completed and approved (Table 33.1 provides the approval dates). Each of these documents was finalised in accordance with the requirements of the FMP and were made available for public comment over an eight week period. The final approved guidelines are published to the Department's website[5].

The *Protocols for Measuring and Reporting on the Key Performance Indicators of the Forest Management Plan 2004-2013*.[6] have been updated since December 2008 to include a further 10 protocols and four revised protocols.

As required by Action 34.1.4 of the FMP, the Department undertook an independent expert review of silvicultural practices. A report was presented by the panel in December 2011.

Of the guidance documents required by the FMP:

- seven have been finalised or reviewed
- one is in interim form
- one has been approved, and held pending completion of a related document
- six are in preparation.

Table 33.2 outlines the status of proposed and existing guidance documents reported on in December 2008 and then in December 2011.

A number of advisory notes and an interim manual were developed as an interim measure to the completion of FMP guidance documents. These were developed to guide and support operations prior to the established formal arrangements and procedures between the Department and the FPC. A list of the documents is shown in Table 33.1, which also identifies a number of documents developed to meet specific operational matters as these arose in the course of implementing the FMP.

[5] www.dec.wa.gov.au/content/category/47/869/1827/
[6] www.dec.wa.gov.au/index.php?option=com_docman&task=doc_download&gid=6248

Table 33.1 Status of guidance documents required by the FMP

Guideline name	Date prepared	Date reviewed (progressive)	Status/comment as at December 2008	Status/comment as at December 2011
Proposed guidelines				
SFM Guideline No. 4 (2009) – Guidelines for the Protection of the Values of Informal Reserves and Fauna Habitat Zones. To be prepared by the Department by 31 December 2004 in accordance with Action 3.1.2 and 7.2.2.	October 2009		Draft for public comment released March 2008. Revised document submitted to the Conservation Commission for advice in October 2008	Finalised
SFM Guideline No. 6 – Guidelines for Selection of Fauna Habitat Zones. To be prepared by the Department by 31 December 2004 in accordance with Action 7.2.2.	November 2010		Draft for public comment substantially complete	Finalised
Goals for Understorey Structural Diversity. To be prepared by the Department by 31 December 2005 in accordance with Action 4.1.			In preparation	As for December 2008
Fauna Distribution Information System. To be prepared by the Forest Products Commission in accordance with Action 8.4. (No completion date set.)			Referred to the Conservation Commission August 2007	Finalised
Native Forest Timber Harvest Planning Guidelines. To be prepared by the Department by 31 December 2008 in accordance with Action 34.1.1.			In preparation	As for December 2008
SFM Guideline No. 5 (2009) – Soil and Water Conservation Guideline. To be prepared by the Department by 31 December 2005 in accordance with Action 20.1.2.	December 2009		Draft for public comment released March 2008	Finalised
Guidelines for the rehabilitation of plantation areas to be returned to native vegetation. To be prepared by the Department in accordance with Action 15.4.2. (No completion date set.)			Not commenced	In preparation

Guideline name	Date prepared	Date reviewed (progressive)	Status/comment as at December 2008	Status/comment as at December 2011
Proposed guidelines				
Forest Monitoring Guidelines. To be prepared by the Department by 31 December 2005 in accordance with Action 34.1.1.			Not commenced	In preparation
SFM Manual No. 2 (2011) – Protocols for Measuring and Reporting on the KPI of the Forest Management Plan 2004–2013. To be prepared by the Department in accordance with Action 32.6. (No completion date set.)	March 2007		Published (includes protocols for 20 of the 33 KPI)	Published (includes protocols for 30 of 33 KPIs)
Guidelines for the preparation of area management plans for conservation reserves. To be prepared by the Conservation Commission in accordance with Action 5.2. (No completion date set.)			Interim guidelines developed (see table A40). These will have broader application than the area covered by the FMP	Completed
Indigenous Heritage Management Guidelines. To be prepared by the Department in accordance with action 25.2. (No completion date set.)			Not commenced	In preparation
Non-indigenous Heritage Management Guidelines. To be prepared by the Department in accordance with action 25.2. (No completion date set.)	Draft Guideline April 2004		Further development constrained by resources and competing priorities	Reviewed in 2010. Final draft in preparation.
Existing guidelines				
Phytophthora cinnamomi and Disease Caused by it – Volume 1. Management Guidelines. To be reviewed by the Department by 31 December 2008 in accordance with Action 18.2.1.	January 1999 *			In preparation, substantial progress made to draft guidelines
SFM Guideline No. 1 (2004) – Silvicultural Practice in the Jarrah Forest. Reviewed by 31 December 2004		November 2004		Reviewed as per Action 34.1.4, December 2011
Silviculture Guideline No. 3 (2005) – Silvicultural Practice in the Karri Forest. Reviewed by 31 December 2004		January 2005		Reviewed as per Action 34.1.4, December 2011

Guideline name	Date prepared	Date reviewed (progressive)	Status/comment as at December 2008	Status/comment as at December 2011
Proposed guidelines				
Silviculture Guideline No. 2 (2004) – Silvicultural Practice in Wandoo Forest and Woodland. Reviewed by 31 December 2004.		November 2004		Reviewed as per Action 34.1.4, December 2011

* Date recorded as published to the Department of Conservation and Land Management intranet

Table 33.2 Other guidance and supporting documents that have been prepared

Guidance document name	Date prepared	Status/comment
SFM Advisory Note 1 – Rehabilitation of Landings and Extraction Tracks that have been Corded or Matted.	28/2/2005	To be superseded, at least in part, by guidelines
SFM Advisory Note 2 – Blade-up Access in Informal Reserves and other Protected Areas within State Forest and Timber Reserves.	23/6/2006	To be superseded, at least in part, by guidelines
SFM Advisory Note 3 – Management of Access in Informal Reserves and other Protected Areas within State Forest and Timber Reserves.	21/9/2006	To be superseded, at least in part, by guidelines
SFM Advisory Note 4 – Procedures for the Use of Work Improvement Notices and Management Letters.	21/11/2006	To be superseded, at least in part, by guidelines
SFM Advisory Note 5 – Salvage of Logs in Association with Informal Reserves.	1/3/2007	To be superseded, at least in part, by guidelines
SFM Manual No. 1 – Interim Manual of Procedures for the Management of Soils Associated With Timber Harvesting in Native Forests.	31/5/2005 13/6/2006 6/9/2006 31/5/2007	To be revised to support proposed Soil and Water Conservation Guideline.
Guidelines for the preparation of area management plans for conservation reserves. To be prepared by the Conservation Commission in accordance with Action 5.2. (No completion date set.)	March 2006	Completed. These have broader application than the area covered by the FMP
SFM Interim Guideline No. 1 – Interim Guideline for Silvicultural Practice in the Jarrah Forest of the Wungong Catchment.	13/11/2007	Will be used to guide operational practice on an initial trial basis. It is intended that the initial trial will be during 2007 and early 2008 and that the review of the Interim Guidelines will form part of the Water Corporation's first stakeholder project review for the overall Wungong project,

Guidance document name	Date prepared	Status/comment
SFM Interim Guideline No. 2 – Interim Guideline for the First Thinning of Bauxite Rehabilitation Areas Established After 1988 with Native Species in the Wungong Catchment.	23/5/2007	Will be used to guide operational practice on an initial trial basis. It is intended that the initial trial will be during 2007 and early 2008 and that the review of the Interim Guidelines will form part of the Water Corporation's first stakeholder project review for the overall Wungong project,
SFM Interim Guideline No. 3 – Interim Guideline for the First Thinning of Bauxite Rehabilitation Areas Established Before 1988 with Exotic Species in the Wungong Catchment	17/8/2007	Will be used to guide operational practice on an initial trial basis. It is intended that the initial trial will be during 2007 and early 2008 and that the review of the Interim Guidelines will form part of the Water Corporation's first stakeholder project review for the overall Wungong project,
Since January 2009 (post mid-term audit of performance)		
SFM Manual No. 1 – Manual of Procedures for the Management of Soils Associated with Timber Harvesting in Native Forests.	July 2009	Supporting document to the Soil and Water Conservation Guidelines
SFM Manual No. 3 — Manual for the Management of Surface Water	July 2009	Supporting document to the Soil and Water Conservation Guidelines
SFM Manual No. 4 – Jarrah Silvicultural Burning Manual	November 2011	
SFM Advisory Note 6 – Approvals Matrix for Operations on State forest, Timber reserves and Executive Director Land	July 2010	
Procedure DECSFM019 – Planning checklist for disturbance activities	October 2009	Revised to incorporated requirements of the FMP
Procedure DECSFM013 – Growing stock and habitat element assessment of damage and potential damage procedure	June 2010	
Procedure DECSFM015 – Treemarking monitoring procedure	June 2009	
NC Procedure – Use of *Phytophthora cinnamomi* free bridges in forest operations.	December 2010	
NC Procedure – *Phytophthora* dieback status of existing roads – implications for hygiene management.	September 2011	
SFM Field Guide No. 1 – Tables and formulae for the management of surface water field guide.	March 2010	Supporting document to the Soil and Water Conservation Guidelines
Approvals matrix for operations on CALM Act reserves and other lands and waters managed by DEC.	January 2011	
Management Guideline No. 1 – User Guide for Approvals matrix for operations on CALM Act reserves.	January 2011	
Management Guideline No. 2 – Necessary Operations: A Guide for Managers.	September 2011	
Corporate Guideline No. 3 – Reporting Illegal Activity.	September 2011	

Guidance document name	Date prepared	Status/comment
Corporate Guideline No. 4 – Nomenclature Guidelines.	September 2011	
Corporate Guideline No. 5 – Signing of Departmental Correspondence and Documents.	September 2011	
Corporate Guideline No. 6 – Reporting emergencies.	September 2011	
Corporate Guideline No. 7 – Piecework and Productivity Incentive Schemes	October 2011	
Corporate Guideline No. 8 – Procedural requirements for Access to Garden Island.	October 2011	
Corporate Guideline No. 9 – Administrative Boundary Guidelines.	October 2011	
Corporate Guideline No. 10 – Guidelines for Managing Temporary Control Areas.	October 2011	

Response to target shortfall

Six guidance documents have not been completed as at the timeframe required by the FMP and the date for the end of term audit. The main reasons for this performance shortfall are:

- the level of resources available to the Department to continue to implement the FMP
- emerging new priorities that the Department was required to service, e.g. the response to the mid-term audit report 2009 and 2010 commencing preparation of the next forest management plan, with consequent impacts for work on ongoing implementation of the FMP that otherwise would have progressed,;
- additional work to service the Conservation Commission, e.g. for field surveys of old-growth forest and procedures and consultation involved in finalising fauna habitat zones, with consequent impacts for work on implementing the FMP that otherwise would have progressed
- some initiatives in the FMP, such as soil management, have required substantially more resources than anticipated because of the increased complexity that has evolved (to develop the Trafficability Index system, undertake adaptive management trials, revise the soil management system on several occasions), with consequent impacts for work on implementing the FMP that otherwise would have progressed
- involvement in fire emergencies which has seasonally impacted to a significant extent on works programs, with consequent impacts for work on implementing the FMP that otherwise would have progressed.

[i] Actions refer to issues or actions that were identified in the mid-term audit of the FMP. The mid-term audit should be referred to for context on each action. Where relevant, the text includes the EPAs response from their report on the mid-term audit.