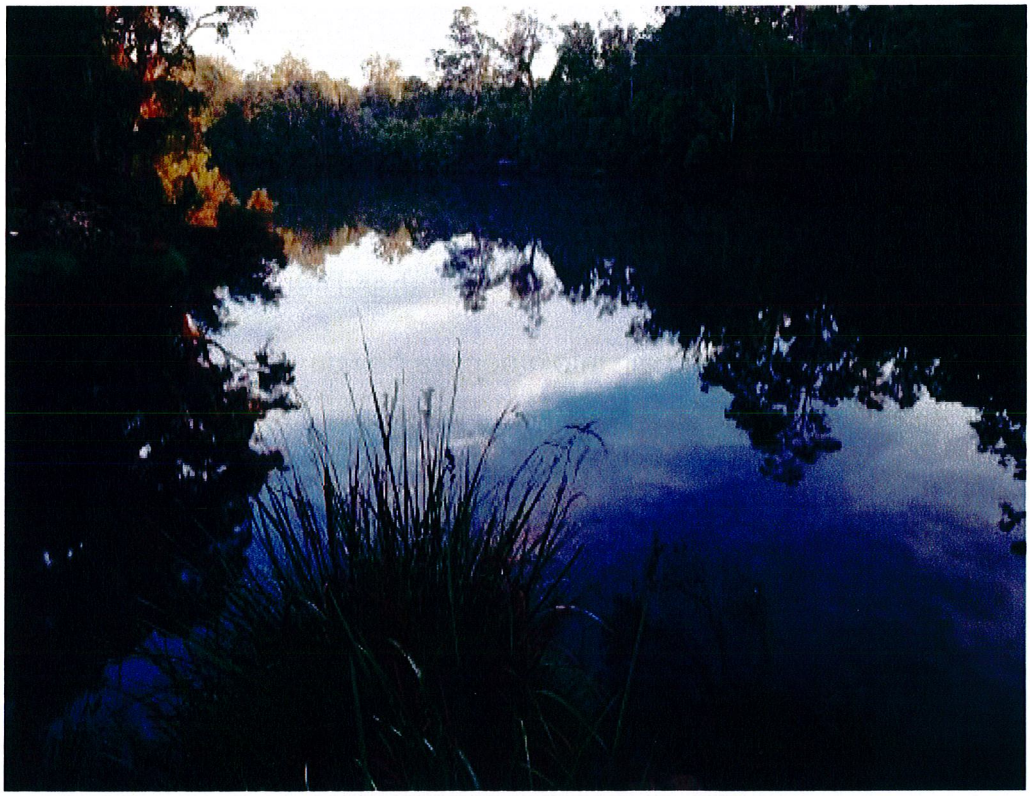
Soil and Water Conservation Guideline



Sustainable Forest Management Series

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Cover photograph: Blackwood River, fringing vegetation and jarrah forest.
(Taken by Chris Garnett)

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1 Framework for this guideline

1.1 Purpose

The purpose of this document is to provide guidance for the protection of soil and water values in areas subject to timber harvesting and associated activities in native forest in accordance with Action 20.1.2 of the *Forest Management Plan 2004-2013* (FMP). This guideline provides a proactive approach to the management of soil and water values as sought by the FMP.

1.2 Scope

This guideline applies to State forest, timber reserve and freehold land that contains indigenous vegetation and which is held in the name of the CALM Act Executive body. It covers the geographic area of the Swan, South West and Warren regions of the Department of Environment and Conservation, other than marine waters. This guideline applies to timber harvesting and associated activities unless there is an authority that overrides the provisions of the CALM Act or the FMP. Timber harvesting means the cutting, felling and gathering of forest timber. Associated activities are those which are related directly to harvesting and includes pre-harvest activities such as the demarcation of boundaries, scrub rolling of understorey, treemarking, gravel pit establishment and the extraction of basic raw materials, and road construction and maintenance. Associated activities also includes post-harvest activities such as the installation and maintenance of surface water management structures, seed collection, silvicultural burning, rehabilitation of extraction tracks, landings and gravel pits, silvicultural treatments including coppicing, notching and the mechanical removal of cull trees, seeding and planting for regeneration or rehabilitation. The guideline also provides for fire regimes to manage understorey structure and density to be used to enhance the quantity of surface and groundwater reservoirs.

1.3 Context

This guideline provides the framework for operational practices which meet requirements for the protection of soil and water provided in the FMP. Action 20.1.2 of the FMP requires the Soil and Water Conservation Guideline to provide for the manner in which the requirements of Appendix 6 of the FMP for soil protection are to be met and to further define visible soil disturbance. Once approved by the Minister, the measures in this guideline and subsidiary guidance documents will take effect and supersede Appendix 6. Collectively, this guideline together with SFM Manual No. 1 *Manual of Procedures for the Management of Soils Associated With Timber Harvesting in Native Forests* and SFM Manual No. 3 *Manual for the Management of Surface Water* fulfil the requirements of Action 20.1.2. In addition, SFM Technical Report No. 4 *Reference Material for the Conservation of Soil and Water Values* provides background information. The guideline provides guiding principles, rationale and strategies. The manuals provide detail regarding operational practices including further definition of visible soil disturbance and the reference material provides background information.

In accordance with Action 20.1.2 (soil) and 21.1.2 (water) of the FMP, the Department of Environment and Conservation (DEC) and the Forest Products Commission (FPC) are required to conduct their operations in accordance with the Soil and Water Conservation Guideline.

1.4 Custodianship and management of this guideline

This guideline is a controlled document. The custodian is the Manager of the Forest Policy and Practices Branch of the Sustainable Forest Management (SFM) Division of DEC.

This document has been prepared by DEC with public consultation, advice from the Conservation Commission and approval of the Minister for Environment.

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2 Legislative requirements

The legislative controls in relation to soil and water in Western Australia are found in the relevant State and Commonwealth Acts and regulations. The following table summarises the State government legislation.

Title of Act or Regulation	Relevance of legislation	Responsible agency
Agricultural and Veterinary Chemicals (Western Australia) Act 1995	Covers the use and control of pesticides, including the requirement to use pesticides in accordance with label requirements or 'off label' permits for unregistered pesticide. Regulations related to pesticide application will be covered through compliance with the Department of Agriculture and Food Bulletin 4648 *Code of Practice for the use of agricultural and veterinary chemicals in Western Australia.*	Department of Agriculture and Food
Conservation and Land Management Act (CALM Act)	DEC's activities are exempt from requiring a clearing permit where the management is in accordance with the CALM Act. This exemption applies to all land within the FMP area that is managed in accordance with an approved management plan.	Department of Environment and Conservation
Contaminated Sites Act (2003)	Provides for the identification, recording, management and remediation of contaminated sites. If any soil or water has been contaminated with hydrocarbons, fertilisers or pesticides it will fall within this Act. Contaminated sites do not include areas where fertiliser or pesticide are applied correctly.	Department of Environment and Conservation
Country Areas Water Supply Act (1947) (CAWS Act)	This Act together with the ***Metropolitan Water Supply, Sewerage and Drainage Act (1909)*** and associated by-laws are used to proclaim Public Drinking Water Source Areas (PDWSA). These may be referred to as water reserves, catchment areas or underground water pollution control areas. All operations in PDWSA are required to comply with the Department of Water (previously Water and Rivers Commission) Statewide Policy No. 2 *Pesticide use in Public Drinking Water Source Areas.* In PDWSA proclaimed under the CAWS Act, the removal of indigenous undergrowth and trees is controlled. Proponents that work on DEC land who remove indigenous undergrowth and trees are required to obtain a licence from the Department of Water.	Department of Water
Environmental Protection Act (1986) (EP Act)	Relates to the prevention, control and abatement of pollution and environmental harm. It is to ensure the conservation, preservation, protection, enhancement and management of the environment, and may relate to any contamination caused by hydrocarbons from machinery and pesticides from treatment of jarrah stands and weeds on firebreaks.	Department of Environment and Conservation
Forest Products Act (2000) (FP Act)	Clearing of vegetation maintained, or established and maintained, under the FP Act, or under a production contract or road contract, is exempt from the EP Act clearing permit requirements.	Forests Products Commission
Health Act (1911)	Applicable to any pesticides used by the crown within a PDWSA. The restrictions on pesticide use are specified in the Department of Health Public Service Circular 88 *Use of herbicides in catchment areas.*	Department of Health

Title of Act or Regulation	Relevance of legislation	Responsible agency
Metropolitan Water Supply, Sewerage and Drainage Act (1909) (MWSSD Act)	This Act and the CAWS Act and their associated by-laws are used to proclaim Public Drinking Water Source Areas (PDWSA). These may be referred to as water reserves, catchment areas or underground water pollution control areas. There are also requirements that relate to the use of pesticides in PDWSA. All operations in PDWSA are required to comply with the Department of Water (previously Water and Rivers Commission) Statewide Policy No.2 *Pesticide use in Public Drinking Water Source Areas*.	Department of Water
Rights in Water and Irrigation Act (1914) (RIWI Act)	Makes provision for the regulation, management, use and protection of water resources, to provide for irrigation schemes and related purposes. This Act has proclaimed Groundwater Management Areas and Surface Water Management Areas. While DEC may sustainably take water from land to which the FMP applies, it must obtain a licence from the Department of Water if it falls within the proclaimed areas. This Act covers water courses and wetlands together with their beds and banks. Activities that could lead to interference, obstruction or destruction of the water resources within the proclaimed areas may need to obtain approval from the Department of Water before commencing.	Department of Water
Soil and Land Conservation Act (1945)	Provides for the conservation of soil and land resources. It includes the mitigation of the effects of erosion, salinity and flooding. This Act covers crown land. The Commissioner may advise a Government department or public authority in regard to the care or use of Crown lands which have lead to land degradation.	Department of Agriculture and Food
Waterways Act (1976)	Provides for defined management areas. There are a number of specific controls that may require approval from the relevant management authority. These involve any activities that put mud, earth, gravel, litter or other matter into any waters or use design drainage that discharges directly or indirectly into any waters.	Department of Water

3 Summary of guiding principles for the conservation of soil and water values

The FMP has an overall aim to protect soil and water values and to adopt a proactive approach to management. The following principles have been identified to guide the management of timber harvesting and associated activities in native forest to achieve this aim. Application of the principles described below achieves the precautionary and risk management approach to ecologically sustainable forest management on which the FMP is based. Ecologically sustainable forest management is defined in various ways. In relation to this guideline it is considered to be a management system that seeks to sustain ecosystem integrity, while continuing to provide ongoing social and economic benefits to the community through the sustainable access to wood and non-wood forest resources and enjoyment of other forest values. The guiding principles below recognise that the conservation of soil and water is an important part of the conservation of biodiversity and sustaining the productive capacity and health and vitality of forest ecosystems. They also recognise that forest soils play an important role in regulating surface and groundwater flow and that the interaction of soil and water plays an important role in the health of rivers, streams and wetlands.

Guiding principles for the conservation of soil and water values contained in this guideline are summarised below. The following sections provide the objectives for the conservation of soil (Section 4) and water (Section 5) values together with the rationale and strategies associated with each of the guiding principles.

In this guideline the following terms are used:

- guiding principles are a statement of the desired outcome that is used to guide the formulation of strategies, actions and operational practices;
- rationale describes the logical basis or fundamental reasons behind the guiding principle;
- a strategy is a long-term plan of action designed to achieve a particular outcome; and
- tactics are the planned actions adopted to achieve a specific outcome.

For the purpose of this guideline, key tactics have been included together with strategies where this is considered to enhance understanding of how the guiding principles are to be achieved. The subsidiary guidance documents which provide further detail regarding strategies and tactics are referenced where appropriate to point the reader to the source of further detail at the operational level.

Guiding principles for the conservation of soil values	
1	The extent of soil disturbance caused during timber harvesting will be minimised by planning and managing the location of the landing and the minimum extraction track network required for efficient operation.
2	The severity of soil disturbance will be controlled using a risk management approach coupled with restrictions on access to the forest.
3	Landings will be planned and managed to minimise the area affected, to minimise the severity of disturbance and to provide for successful rehabilitation.
4	Where protective treatments are applied to minimise the severity of soil disturbance, they will be planned and applied prior to the commencement of disturbance operations.
5	Surface water management structures will be installed and maintained to reduce the likelihood and severity of soil erosion, waterlogging and the contamination of rivers, streams and wetlands.
6	Monitoring of soil disturbance will be conducted to ensure allowable limits are not exceeded and to facilitate progressive improvement in practices. Harvesting will cease if limits are exceeded or likely to be exceeded
7	Visual triggers will be used to identify localised risk to soil values and to change or cease operations if values are threatened.
8	Where severe or very severe soil disturbance occurs, it will be identified, mapped and rehabilitated as soon as possible after the completion of timber harvesting.
9	Silvicultural treatments will be conducted in a manner that maximises the effectiveness of treatment and minimises the risk of unnecessary soil disturbance or soil damage.
10	Soil will be protected from contamination.

Guiding principles for the conservation of water values	
1	Aquatic biodiversity will be protected by minimising disturbance to the bed, banks and fringing vegetation of rivers, streams and wetlands.
2	Aquatic biodiversity will be protected by managing the risks to water quality.
3	Water quantity and flow regime for environmental purposes will be maintained or enhanced.
4	In Public Drinking Water Source Areas the risks to water quality will be managed in accordance with the relevant Public Drinking Water Priority Classification.
5	Silvicultural treatments and fire regimes may be used to enhance the quantity of surface and groundwater reservoirs.

4 Guiding principles for the conservation of soil values

Overall Objective

Minimise the extent and severity of disturbance to soil values that occurs as a result of timber harvesting and associated forest management activities.

The FMP has an overall aim to protect soil values, and seeks to adopt a proactive approach to reduce the occurrence of damage to soils as a result of compaction, puddling and mixing. The following principles address this aim together with the aims of rehabilitating damaged soil and protecting soil from erosion, waterlogging and contamination.

Guiding principle 1

The extent of soil disturbance caused during timber harvesting will be minimised by planning and managing the location of the landing and the minimum extraction track network required for efficient operation.

Rationale

The extent of soil disturbance during timber harvesting is managed by minimising the area that is impacted by the movement of vehicles. Compaction is the most common form of soil disturbance and most compaction occurs during the first few vehicle passes. An operation where many vehicle passes are confined to a small number of tracks is preferred to one with many tracks with a small number of vehicle passes. Harvest operations where the landing and extraction track network is carefully planned and managed will minimise the extent of soil disturbance caused during timber harvesting.

Note: The term extent is used to describe the amount or proportion of area that is covered.

Strategies

The following strategies will be used to manage the extent of soil disturbance to ensure that it remains within the limits specified in Appendices 1 and 2 of this guideline. These limits are further explained in the *Manual of Procedures for the Management of Soils Associated With Timber Harvesting in Native Forests*:

- identify and plan to use areas where the soil was disturbed by previous operations such as old roads, extraction tracks and landings in preference to creating new disturbance;
- plan the extraction track network and mark this in the field prior to commencement of timber harvest operations;
- confine machinery to the marked extraction tracks;
- avoid the creation of parallel, duplicate and criss-crossing tracks; and
- ensure that machine operators are trained and their activities are monitored so that operations can be corrected if required.

Guiding principle 2

The severity of soil disturbance will be controlled using a risk management approach coupled with restrictions on access to the forest.

Rationale

Soil disturbance is a term used to describe the act of altering or moving soil particles or layers so that they are not in their normal arrangement or position. The level of soil disturbance that occurs during timber harvesting will be determined according to visible disturbance categories that range from undisturbed through to very severe. Soil disturbance categories are defined in the *Manual of Procedures for the Management of Soils Associated With Timber Harvesting in Native Forests.* Severe or very severe disturbance is considered as damage.

A risk management approach addresses risks that can be managed by applying appropriate strategies or tactics. The application of protective treatments and the use of machines that carry rather than drag logs when soils become wet are examples of risk management approaches.

Access restriction for the prevention of soil damage is generally used where risks are high and management options are either difficult to implement or not highly effective. Ceasing work on soil types known to have limited trafficability in wetter months is an example of an access restriction.

Risk management and access restrictions are applied to minimise unnecessary soil disturbance and to prevent soil disturbance escalating to the point at which it becomes soil damage.

Strategies

Risk periods are determined in relation to soil moisture using the Trafficability Index $_{SDI}$ as defined in the *Manual of Procedures for the Management of Soils Associated With Timber Harvesting in Native Forests.* Timber harvesting activities will be evaluated to assess the risk posed by compaction, mixing and rutting of the soils according to risk periods. Proposed harvest operations in higher risk periods will undergo more thorough planning and evaluation prior to approval and commencement than during lower risk periods. The following strategies will be used:

- risk periods will be defined by Trafficability Index $_{SDI}$;
- soils which are more susceptible to damage will be protected or excluded from operations when the risk period is Medium to high or greater;
- the permissible management activities will be limited according to the risk period;
- forest management and timber harvesting activities will be considered, individually assessed and may have increased precautions applied to the movement of machines as the risk period increases;
- monitoring will be based on the visible soil disturbance categories as defined in the *Manual of Procedures for the Management of Soils Associated With Timber Harvesting in Native Forests*; and
- monitoring of operations will be increased as the risk period increases from Low through to High.

Guiding principle 3

Landings will be planned and managed to minimise the area affected, to minimise the severity of disturbance and to provide for successful rehabilitation.

Rationale

Landings are subjected to high levels of soil disturbance because they support a high traffic load. It is recognised that some level of soil damage is unavoidable on landings. The key to landing management is to pro-actively manage to prevent the landing becoming larger than is necessary and to limit the severity of damage so that successful rehabilitation can be achieved.

Factors influencing the size of a landing include the harvesting system and type of equipment used, the number, size and volume of products that are produced during timber harvesting and the room required for safe operations. Factors influencing rehabilitation success on landings include management of the topsoil, the application of protective treatments, the management of surface water, the soil moisture conditions during which the landing is active and the level of storage and rate of throughput of logs.

Strategies

The planning, establishment and management of landings will be conducted according to soil type, operation type and likely soil moisture conditions at the time of harvest. The following factors will be considered, and management strategies applied where appropriate based on risk assessment prior to establishment and during the operation of all landings:

- ensure that location of the landing is on the appropriate site and soil type;
- ensure that topsoil is removed and stockpiled where required;
- ensure the landing is effectively drained to minimise the amount of water running on to it; and
- ensure that landings are no larger than the size limits defined in Appendix 1 of this guideline and further explained in the *Manual of Procedures for the Management of Soils Associated With Timber Harvesting in Native Forests* unless this is required for operator safety or for small or narrow cells where the prescribed limits are not practically achievable.

Guiding principle 4

Where protective treatments are applied to minimise the severity of soil disturbance, they will be planned and applied prior to the commencement of disturbance operations.

Rationale

Protective treatments such as cording, matting and brushing are applied to spread the ground pressure of machinery and to separate the soil surface from the tyres or tracks of vehicles to reduce compaction, rutting, puddling and soil mixing. The treatments are generally applied to extraction tracks and landings. While the treatments may help to reduce compaction, they are most effective at reducing rutting, puddling and mixing, but only if applied before soil disturbance occurs. The use of these treatments does not negate the need for rehabilitation of the underlying soil if soil damage occurs.

Strategies

Protective treatments will be considered and applied where appropriate, subject to:

- identification of the intention to use treatments is to be approved as part of the harvest planning process;
- application of the treatments will occur prior to the commencement of disturbance operations;
- application and maintenance of treatments will be to the correct standards; and
- treatments will be effectively removed and disposed of prior to the commencement of rehabilitation of the underlying soil as defined in SFM Advisory Note 1 *Rehabilitation of Landings and Extraction Tracks that have been Corded or Matted.*

Guiding principle 5

Surface water management structures will be installed and maintained to reduce the likelihood and severity of soil erosion, waterlogging and the contamination of rivers, streams and wetlands.

Rationale

Surface water management is the process of managing the overland flow of water in a way that protects resources and environmental values. Surface water management is particularly important where the natural land surface is altered in a way that decreases the interception or infiltration of rainfall, increases the velocity of surface flow, restricts natural flow or makes the land surface less stable. Examples of instances where this occurs include the removal of vegetation following timber harvesting or fire, the compaction of the soil on extraction tracks, and the construction of roads.

Where surface water management structures are not installed or incorrectly constructed, the potential on-site impacts are minor sheet and rill erosion from surface flows, gully and major erosion of soils, ponding and water-logging. Potential off-site impacts are deposition, flooding and reduced water quality through turbidity, contamination or sedimentation of rivers, streams, wetlands and water supplies.

The purpose of surface water management is to protect the soil surface by moving water to a more stable surface before erosion or waterlogging is caused due to accumulated volume or velocity of water flow. Further information and specifications for the application of surface water management in timber harvesting and associated activities is provided in SFM Manual No. 3 *Manual for the Management of Surface Water.*

Strategies

The management of surface water will be applied to roads, landings and extraction tracks in all timber harvesting operations through:

- assessment of risks including slope, soil erodibility, rainfall intensity, catchment area and vegetation cover;
- choice of appropriate structure according to factors such as trafficability, anticipated service life, catchment condition, safety and maintenance requirements;
- use of appropriate standards for planning and design of structures for surface water management;
- construction and maintenance of structures to appropriate standards; and
- inspection and monitoring following construction and during the period until the vegetation recovers or the site stabilises.

Guiding principle 6

Monitoring of soil disturbance will be conducted to ensure allowable limits are not exceeded and to facilitate progressive improvement in practices. Harvesting will cease if limits are exceeded or likely to be exceeded.

Rationale

Operators in the forest are responsible for managing soil disturbance within the allowable limits that are specified in Appendices 1 and 2 of this guideline and further explained in SFM Manual No. 1 *Manual of Procedures for the Management of Soils Associated With Timber Harvesting in Native Forests*. Monitoring will be conducted during the course of operations to prevent unnecessary disturbance occurring, and will also be conducted at the completion of operations to check and report on compliance with allowable limits.

Strategies

The type and timing of monitoring will be determined according to assessed risk of unnecessary soil disturbance using the following strategies:

- a range of monitoring techniques will be used from visual surveillance to more detailed transect surveys;
- monitoring will be conducted at the most appropriate time to achieve the aim of either managing operations or reporting compliance;
- the frequency of monitoring of soil disturbance will increase as risk increases;
- appropriate written records will be created and retained for all monitoring of soil disturbance;
- harvesting will cease if limits are exceeded or likely to be exceeded; and
- analysis of monitoring results will be used to facilitate continual improvement by identifying the causes of problems and addressing them.

Guiding principle 7

Visual triggers will be used to identify localised risk to soil values and to change or cease operations if values are threatened.

Rationale

Saturated soils are highly prone to soil mixing, puddling and compaction, and consequently to a rapid escalation of the level of soil disturbance. When it is raining, or free water is present on the soil surface in the harvest area, this is a visual trigger that is used to indicate that soil is likely to be saturated. The onset of rutting is a visual trigger indicating that soil strength is beginning to fail due to soil moisture conditions. The aim of using visual triggers is to recognise the potential for an escalation in soil disturbance and to prevent unnecessary soil disturbance or for disturbance to increase to a level where it becomes soil damage.

Note: Visual triggers are readily observable occurrences that relate to underlying processes that in conjunction with the use of heavy vehicles may threaten soil values.

Strategies

Visual triggers will be used to assess operations and guide management in order to prevent unnecessary soil disturbance. This will be achieved through the use of the following strategies:

- the presence of free water will be used as a trigger to cease the off-road and off-landing use of heavy vehicles;
- when it is raining, this will be a trigger to cease heavy vehicle movement off-road or off-landing. (One exception exists for machine harvest of first thinning of karri on sites that are adequately corded, matted or brushed);
- the onset of rutting will be used as a trigger to:
  a) investigate whether allowable soil disturbance limits are being approached;
  b) assess current operational tactics in relation to the risk period; and
  c) determine whether a change in tactics will allow the operation to proceed without threatening allowable limits of soil disturbance; and
- harvesting will cease if limits are exceeded or likely to be exceeded.

Guiding principle 8

Where severe or very severe soil disturbance occurs, it will be identified, mapped and rehabilitated as soon as possible after the completion of timber harvesting.

Rationale

When soils are disturbed, they may lose some of their natural physical or chemical structure and level of biological activity. Soils that are lightly disturbed can repair themselves over the medium term (decades) through processes facilitated by biological activity. Soils that are severely or very severely disturbed (damaged) cannot naturally repair themselves in the medium term and require the application of mechanical techniques to ameliorate physical damage.

Rehabilitation does not immediately repair damaged soil. It should aim to remove severe physical or chemical limitations to plant growth or biological activity, and to create the conditions required for longer term restoration through biological action. In disturbed areas where rootstock, residual seed or natural seed fall is insufficient for rehabilitation, such as on landings, seeding or planting may be required to facilitate regeneration.

Strategies

To facilitate the repair of severe or very severe soil disturbance, rehabilitation will be conducted so that:

- the proponent will identify and map damaged soil;
- operations do not further damage the site;
- earthworks are undertaken during appropriate soil moisture conditions;
- construction of earthworks is monitored to ensure appropriate standards are achieved;
- rehabilitated areas are protected from erosion;
- seed collected locally or plants propagated from seed collected locally are to be used for regeneration or rehabilitation operations. The proposed seed mix for all areas to be revegetated is to be approved by DEC as described in SFM Guideline No 1 *Silvicultural Practice in the Jarrah Forest* and SFM Guideline No. 3 *Silvicultural Practice in the Karri Forest*;
- rehabilitation success is monitored; and
- rehabilitation treatments are re-applied to areas that do not meet rehabilitation standards until the required standard is achieved.

Guiding principle 9

Silvicultural treatments will be conducted in a manner that maximises the effectiveness of treatment and minimises the risk of unnecessary soil disturbance or soil damage.

Rationale

A range of silvicultural treatments involving the use of heavy vehicles are conducted following the completion of harvesting to facilitate the establishment of seedlings and to improve growth of advance growth and retained trees. These treatments include ripping to facilitate planting of seedlings in harvested coupes using a bulldozer, rough heaping of post-burn log debris, re-heaping or bumping up of debris, shallow scarification to facilitate seedling establishment and machine push-down of cull trees. These operations should be undertaken at a time and under soil moisture conditions that are conducive to the required outcome and compatible with an acceptable risk of unnecessary soil disturbance. Soil disturbance may be required to facilitate regeneration establishment, and this should be carefully implemented to prevent soil damage.

Strategies

To ensure post-harvest silvicultural treatments do not result in severe or very severe soil disturbance, treatments will be conducted so that:

- ripping operations are undertaken when the subsoil is dry so that soil shatter is achieved to the required standard;
- ripping operations are planned to reduce the risk of subsequent soil erosion;
- unnecessary and unplanned scalping and mounding of topsoil is avoided;
- heaping and cull removal operations are undertaken during appropriate soil moisture conditions in order to reduce compaction;
- heaps do not contain significant amounts of soil; and
- scarification to remove competing rootstock may be used up to limits defined in SFM Guideline No 1 *Silvicultural Practice in the Jarrah Forest.*

Guiding principle 10

Soil will be protected from contamination.

Rationale

Soils may be contaminated by spills or inappropriate use of hydrocarbons, pesticide, fertiliser or other substances. Contamination at point sources most commonly occurs as a result of spills due to mechanical failure or during refuelling. The management of spills includes both preventative and remedial actions. Soil values may be affected to a lesser degree but over a broader area compared to point sources if broad scale treatments such as the application of pesticides or fertilisers are not conducted appropriately. Factors to consider when assessing the risk of contamination of the soil include the type of product, and rate, method and timing of application, the prevailing weather conditions and the experience of the operators.

Soils may be contaminated by the disturbance of their natural status such as the activation of acid sulphate soil processes. Acid sulphate soil is the term used to describe a group of naturally occurring sediments and soils containing iron sulphides. The exposure of the sulphide in these soils to oxygen by drainage, excavation or disturbance will lead to generation of sulphuric acid. The resulting acid can release other substances including heavy metals into the surrounding environment, and may cause on-site or off-site effects. Forest management activities that may impact on acid sulphate soils are disturbances such as construction of roads, extraction of basic raw materials, construction of water points, drainage works or any activities that lower the water table.

Strategies

Spills will be managed through:

- compliance with procedures that prevent spills occurring;
- development of emergency plans for activities that may result in soil contamination;
- enactment of emergency plans for activities that result in soil contamination;
- lessening the impact of the spill if it does occur; and
- reporting of spills to enable the timely review of current practices.

All operators who apply pesticides, fertilisers or other substances will:

- be appropriately trained;
- consider and manage prior to application for potential off-target consequences;
- use products according to the uses and conditions specified on the label;
- apply at the appropriate rate, timing and method of application;
- continually assess the application in relation to prevailing conditions; and
- comply with the Department of Agriculture and Food Bulletin 4648 *Code of practice for the use of agricultural and veterinary chemicals in Western Australia.*

The risk to soil values from the activation of acid sulphate soils will be minimised by:

- ensuring that planning identifies the risk zone associated with acid sulphate soils for the operation;
- managing operations in areas identified as having the potential to disturb acid sulphate soil in accordance with DEC Guideline *Treatment and management of soils and water in acid sulfate soil landscapes* and ensuring these guidelines are followed to mitigate the impact if acid sulphate soils are activated; and
- ensuring that the scale of any proposed disturbance in susceptible sites is reduced to the smallest possible extent.

5 Guiding principles for the conservation of water values

Overall Objective

Protect or enhance the quantity and quality of water for environmental purposes and water for consumption purposes through timber harvesting and associated forest management activities.

The FMP has an overall aim to protect water values, and proposes to protect the ecological integrity and quality of streams, wetlands and their associated vegetation and increase the flow of water to surface and groundwater reservoirs. Many of the principles to protect soil values outlined in Section 4 above also serve to protect water values. The following additional principles will be used to guide the management of timber harvesting and associated forest management activities in native forest to protect water values.

Guiding principle 1

Aquatic biodiversity will be protected by minimising disturbance to the bed, banks and fringing vegetation of rivers, streams and wetlands.

Rationale

In protecting aquatic biodiversity, the bed and banks of aquatic ecosystems are important areas where disturbance should be avoided. If disturbance is unavoidable, it should be done applying risk management principles. Changes to the bed and banks of aquatic systems can seriously degrade aquatic habitat by changing the velocity, volume or timing of flow, by altering the depth, temperature and substrate of pools and channels, by reducing stability or by restricting the movement of aquatic fauna.

The protection of undisturbed vegetation adjacent to streams is widely recognised as an effective method of protecting aquatic ecosystems from the potential impacts of land management occurring in their catchment area. This vegetation is often described as fringing vegetation. It is habitat for both aquatic and terrestrial fauna, provides a linkage between aquatic and terrestrial ecosystems and acts as a wildlife corridor. Overhanging vegetation regulates light availability and temperature in the water body, intercepts and filters nutrients, pollutants and sediments from the catchment and helps to stabilise embankments from erosion and subsidence.

Strategies

To ensure timber harvesting and forest management activities do not result in unacceptable impacts on aquatic biodiversity, operations will be conducted so that:

- rivers and streams are included in the informal reserves system as specified in Appendix 3 of the FMP, and managed in accordance with SFM Guideline No. 4 *Guidelines for Protection of the Values of Informal Reserves and Fauna Habitat Zones*;
- the number of existing and new stream crossings or structures is minimised;
- new or retained stream crossings or structures are constructed and maintained to the appropriate standard to ensure minimal changes to the movement of aquatic fauna, water flow, shape of the bed and banks;
- drainage from roads, tracks and landings will be managed to ensure that sediment is captured before it can alter the structure or composition of the bed of rivers, streams and wetlands; and
- significant risks to aquatic values from the installation of structures in or adjacent to rivers, streams or wetlands will be identified and addressed.

Guiding principle 2

Aquatic biodiversity will be protected by managing the risks to water quality.

Rationale

The quality of water affects aquatic biodiversity. Water quality can be negatively impacted by inputs to rivers, streams and wetlands that occur as a result of land management practices. Inputs that reduce water quality include salt, contamination, turbidity and acidity. A recognised strategy to reduce the likelihood and consequences of these inputs occurring is to have operational controls applied to land based activities.

Salt input into streams can occur when the leaf area of a forest is reduced if a saline groundwater is close to the soil surface and groundwater rises to the extent that it makes a significant contribution to streamflow. Operational controls that are effective in managing salt risk during timber harvesting are to not log all the area at once (phased logging), to control the level of cut (basal area limitations) and to protect stream zones from timber harvesting. The high rainfall zone (> 1100 mm per year) has a low risk of stream salinity because the storage of salt in the soil profile is low. The intermediate rainfall zone (1100 – 900 mm per year) has a higher risk of stream salinity due to the groundwater level which may be in reach of the soil surface following timber harvesting and where salt storage in the soil is moderate. The low rainfall zone (< 900 mm per year) has a lower risk of stream salinity than the intermediate rainfall zone, despite the high salt storage in the soil profile, because the groundwater is too deep to reach the soil surface following timber harvesting and regeneration.

Contamination of water can occur through spillage or inappropriate use of pesticides, fertilisers and other substances. The best approach to managing these is a sequence of considerations designed to help manage impacts, which includes (in order of preference) avoid, minimise, rectify, reduce and offset.

Turbidity occurs when fine particles of soil become suspended in water which is flowing over the ground surface. Roads and recently disturbed areas are common sources of turbid water. The risk of turbidity entering aquatic ecosystems can be managed by reducing the volume and velocity of water flowing over the land, and by moving turbid water to a stable surface where it can dissipate and suspended sediments can fall out prior to the water entering a stream, river or wetland.

If acid sulphate soils are activated, drainage from these areas can reduce surface and groundwater quality by altering pH or increasing the level of harmful elements such as heavy metals.

Strategies

To ensure timber harvesting and associated forest management activities do not result in unacceptable changes to water quality, rivers and streams will be included in the informal reserves system as specified in Appendix 3 of the FMP, and managed in accordance with SFM Guideline No. 4 *Guidelines for Protection of the Values of Informal Reserves and Fauna Habitat Zones.* In addition, operations will be conducted so that:

Salinity

- the requirements for managing salt risk are incorporated into the harvest planning and approvals process. These requirements are summarised in the SFM Specification *Summary of key requirements for managing salt risk.*

Contamination

- all operators have procedures to avoid, minimise, rectify, reduce and offset the impact of spills;
- the timing, rate and method of applying pesticides, fertilisers and other substances is managed to reduce the risk of contaminating water; and
- the use of some products or practices may be restricted in the vicinity of rivers, streams and wetlands.

Turbidity

- turbid water is managed so it does not enter a river, stream or wetland;
- the extent of roads is reduced, and their condition managed to protect water quality, and the rehabilitation of old roads, gravel pits and other disturbed land is conducted in a timely manner.

Acidity

- refer to Principle 10 in the conservation of soil values for strategies to manage acid sulphate soil.

Guiding principle 3

Water quantity and flow regime for environmental purposes will be maintained or enhanced.

Rationale

Water regimes influence the ecological values of water dependent ecosystems. Management of water regimes includes how much water is available for the environment together with the timing and volume of flow. The overall volume of water is important together with low flows, irregular flood events and links between groundwater and wetlands.

Flow regimes are important for aquatic fauna to access food, complete breeding cycles, avoid predators, access new habitats and for juvenile recruitment. This guiding principle includes activities conducted in the catchment areas that may have a significant influence on flow patterns including road construction, timber harvesting and prescribed burning.

Strategies

To ensure timber harvesting and associated forest management activities do not result in unacceptable changes to water quantity and flow regime:

- water collected from active sources such as rivers and streams should be taken from peak flows, and should not reduce environmental flow during periods of low flow;
- the construction of static sites such as natural or constructed holes to collect surface runoff or natural seepage should not act to drain the site or surrounding area;
- if groundwater is extracted, consideration must be given to the potential effect on adjacent wetlands or other groundwater dependant ecosystems;
- the downstream impacts of forest management activities in the catchment will be considered regarding the potential effects on water quantity and flow regime; and
- where required to maintain environmental flows, active catchment management may be applied including use of the strategies outlined in guiding principle 5 below.

Guiding principle 4

In Public Drinking Water Source Areas the risks to water quality will be managed in accordance with the relevant Public Drinking Water Priority Classification.

Rationale

The management of Public Drinking Water Source Areas is a risk-based approach in which potential threats to water quality are identified and managed. The emphasis of this approach is on the need to protect drinking water through a combination of catchment protection and treatment measures which is known as a multiple-barrier approach. The framework requires all potential hazards to the water source to be identified and assessed in terms of the level of risk each poses. Measures to counter the risks are applied using avoidance, minimisation or management.

In Public Drinking Water Source Areas there are three levels of water quality protection called priority classification areas 1, 2 and 3. In addition, there are two types of protection zones called Well Head Protection Zones and Reservoir Protection Zones. Public Drinking Water Source Areas may be harnessed or unharnessed. Harnessed catchments are those currently being used for consumption. Unharnessed catchments are not currently being used for consumption but may be used in the future.

The potential risks to water quality associated with activities in catchments include salinity, contamination by pathogens, pesticides or nutrients, turbidity, sedimentation and acidity.

Strategies

To prevent unacceptable changes to water quality in Public Drinking Water Source Areas, operations will be planned and conducted so that:

- rivers and streams are included in the informal reserves system as specified in Appendix 3 of the FMP, and managed in accordance with SFM Guideline No. 4 *Guidelines for Protection of the Values of Informal Reserves and Fauna Habitat Zones.*
- all proposed activities comply with requirements when operating in a Public Drinking Water Source Area, Well Head Protection Zone or Reservoir Protection Zone;
- activities occurring in Well Head Protection Zones and Reservoir Protection Zones are discussed with the Department of Water prior to commencement;
- activities are in accordance with Department of Water Statewide Policy No.2 *Pesticide use in Public Drinking Water Source Areas* and Department of Health Public Service Circular 88 *Use of herbicides in catchment areas*;
- the same management restrictions apply for both harnessed and unharnessed catchments. However the risk framework for the monitoring and management of turbidity and contamination requires greater attention in harnessed catchments.
- human waste is managed to minimise the risk of contamination to water supplies;
- new basic raw material pits are not established within Well Head Protection Zones and Reservoir Protection Zones;
- Public Firewood Areas are excluded from Well Head Protection Zones and Reservoir Protection Zones;
- roads adjacent to reservoirs are not used for timber harvesting and associated activities in a way or at a time when they are likely to contaminate the reservoir;
- vehicular access in water catchments is controlled to reduce potential vectors for contamination; and
- timber harvesting is conducted in accordance with approved silvicultural guidelines and subsidiary guidance documents.

Guiding principle 5

Silvicultural treatments and fire regimes may be used to enhance the quantity of surface and groundwater reservoirs.

Rationale

Forest management may be used to influence the quantity of surface water contributing to reservoirs and to groundwater aquifers. Small catchment studies conducted in the 1980's and 1990's demonstrated that reducing tree cover could substantially increase water yield. However, the effectiveness of silvicultural treatments at increasing water yield is less certain under modern silvicultural practices, at larger catchment scales and under prevailing climate conditions.

Strategies

Where forest management is undertaken to increase water yield for public supply, timber harvesting and associated forest management activities will be conducted in a manner that does not result in unacceptable changes to water quality or environmental values by ensuring that:

- timber harvesting operations will be conducted according to an approved set of silvicultural guidelines and subsidiary guidance documents;
- these guidelines and subsidiary guidance documents will consider local and regional requirements, age structure of stands within the catchment, opportunities and rate of conversion of mature forest to regrowth, rotation lengths and stand density;
- planning and approval processes will be used for all disturbance activities;
- specific fire regimes to manage understorey age and structure will be approved before they are applied; and
- sufficient monitoring will be conducted to enable the effectiveness and environmental impacts of vegetation management treatments to be objectively assessed.

6 Appendices

Appendix 1: Soil disturbance limits

Type of disturbance	Measure	Limit
Very severe soil disturbance Visual soil disturbance - defined as the subsoil removed and parent material exposed or subsoil mixed with parent material.	For all areas other than landings, the percentage of the total area impacted.	0 per cent
	For landings, the area of landings impacted as a percentage of the total harvest area.	1.5 per cent in jarrah
		1 per cent in karri thinning
		3.5 per cent in karri clearfall
		No soil mixing to occur
	For rutting, the depth and length of the rutting.	150 mm maximum depth for gravel and sand soils, 300 mm maximum depth for other soils; depths not to be exceeded over a cumulative length of 20 metres of extraction track for the feller's block.
	Erosion	Erosion control measures installed as per Contractors Timber Harvesting Manual for South West Native Forests and only minor erosion occurs and is limited to between erosion control measures.
Severe soil disturbance* Visual soil disturbance - defined as the topsoil completely removed and the subsoil exposed or the topsoil mixed with subsoil (B horizon), or the subsoil disturbed, or the subsoil mixed with parent material, or the subsoil partially removed.	For all areas other than landings the percentage of the total area impacted.	2 per cent in jarrah
		1 per cent in karri thinning
		1 per cent in karri pre-logging
		2 per cent in karri clearfall (including pre-logging)
	Landings, rutting and erosion.	As for the limits of the "very severe visible soil disturbance" category.
Moderate soil disturbance* Visible soil disturbance - defined as the topsoil mixed with subsoil (A horizon) or the topsoil partially removed.	For all areas other than landings the percentage of the total area impacted.	8 per cent in jarrah
		8 per cent in karri thinning
		5 per cent in karri pre-logging
		15 per cent in karri clearfall (including pre-logging)
	Landings, rutting and erosion.	As for the limits for the "very severe visible soil disturbance" category.

* Allowable limits are inclusive of those for higher levels of soil disturbance i.e. 8 per cent of moderate soil disturbance in jarrah is to include any occurrence of severe or very severe soil disturbance.

The Director, Sustainable Forest Management Division or a delegate will have the authority to set more specific rutting depth thresholds for particular soil types, and the Conservation Commission will be notified when this occurs.

Appendix 2: Summary of very severe soil disturbance thresholds

Type	Situation	Threshold
Rutting	Gravel and sand soils	A cumulative length of 20 metres of significant ruts on extraction tracks for an individual feller's block (Significant ruts are those with a maximum depth greater than or equal to 150 mm which occur over a length greater than or equal to 5 m).
	other soils	A cumulative length of 20 metres of significant ruts on extraction tracks for an individual feller's block (Significant ruts are those with a maximum depth greater than or equal to 300 mm which occur over a length greater than or equal to 5 m).
Erosion	Rill erosion: in harvest cell (excluding extraction track)	> 20 mm deep; and > 10 m in length; or > 100 m^2 in extent.
	Rill erosion: extraction tracks	> 50 mm deep; and > 15 m in length; or > 100 m^2 extent; or Erosion has breached the surface water management structures.
	Rill erosion: Roads, boundary tracks and table drains	> 10 cm deep that are not controlled, repaired or maintained
	Gully erosion: In coupe / extraction tracks	> 30 cm deep
	Gully erosion: Roads, boundary tracks and table drains.	> 30 cm deep
Deposition		A single deposition > 30 m^2 in extent; or any deposition from major erosion.
Turbid runoff		Where turbid runoff is not contained within the coupe, or within the stream reserve , and reaches the watercourse.
Scalping	Shallow scalping over an extensive area	Unauthorised removal of the topsoil over an area > 50 m^2
Hole from tree pulling or pushing		Repeated exposure of soil to a depth of > 50 cm caused by unauthorised pulling or pushing of a tree e.g. > 10 x per fellers block.

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Custodian: Manager, Forest Policy and Practices Branch
Approved by: Minister for Environment

7 References

Conservation Commission of Western Australia (2004). Forest management plan 2004-2013. Conservation Commission of Western Australia, Perth.

Department of Agriculture and Food (2005) Code of practice for the use of agricultural and veterinary chemicals in Western Australia. Bulletin 4648. Third Edition. Department of Agriculture and Food Western Australia.

Department of Conservation and Land Management (2004), Silvicultural Practice in the Jarrah Forest, Department of Conservation and Land Management, Sustainable Forest Management Series, SFM Guideline No. 1.

Department of Conservation and Land Management (2005), Silvicultural Practice in the Karri Forest, Department of Conservation and Land Management, Sustainable Forest Management Series, SFM Guideline No. 3.

Department of Conservation and Land Management (2005). Rehabilitation of Landings and Extraction Tracks that have been Corded or Matted, Department of Conservation and Land Management, Sustainable Forest Management Series, SFM Advisory Note No. 1.

Department of Environment and Conservation (2009). Manual of Procedures for the Management of Soils Associated With Timber Harvesting in Native Forests, Department of Conservation and Land Management, Sustainable Forest Management Series, SFM Manual No. 1.

Department of Environment and Conservation (2008) Summary of key requirements for managing salt risk Department of Environment and Conservation, Sustainable Forest Management Series, SFM Specification.

Department of Environment and Conservation (2009). DRAFT Treatment and management of acid sulfate soils and water in acid sulfate soil landscapes. Department of Environment and Conservation, Government of Western Australia, Acid Sulfate Soils Guideline Series, January 2009.

Department of Environment and Conservation (2009). Guidelines for the protection of the Values of Informal Reserves and Fauna Habitat Zones, Department of Environment and Conservation, Sustainable Forest Management Series, SFM Guideline No. 4.

Department of Environment and Conservation (2009). Reference Material for the Conservation of Soil and Water Values, Department of Environment and Conservation, Sustainable Forest Management Series, SFM Technical Report No. 4.

Department of Environment and Conservation (2009). Manual for the Management of Surface Water , Department of Environment and Conservation, Sustainable Forest Management Series, SFM Manual No. 3.

Department of Health (2006). Use of herbicides in catchment areas. Public Service Circular 88. Department of Health.

Water and Rivers Commission (2000). Pesticide use in Public Drinking Water Source Areas, Water and Rivers Commission, Statewide Policy No. 2.