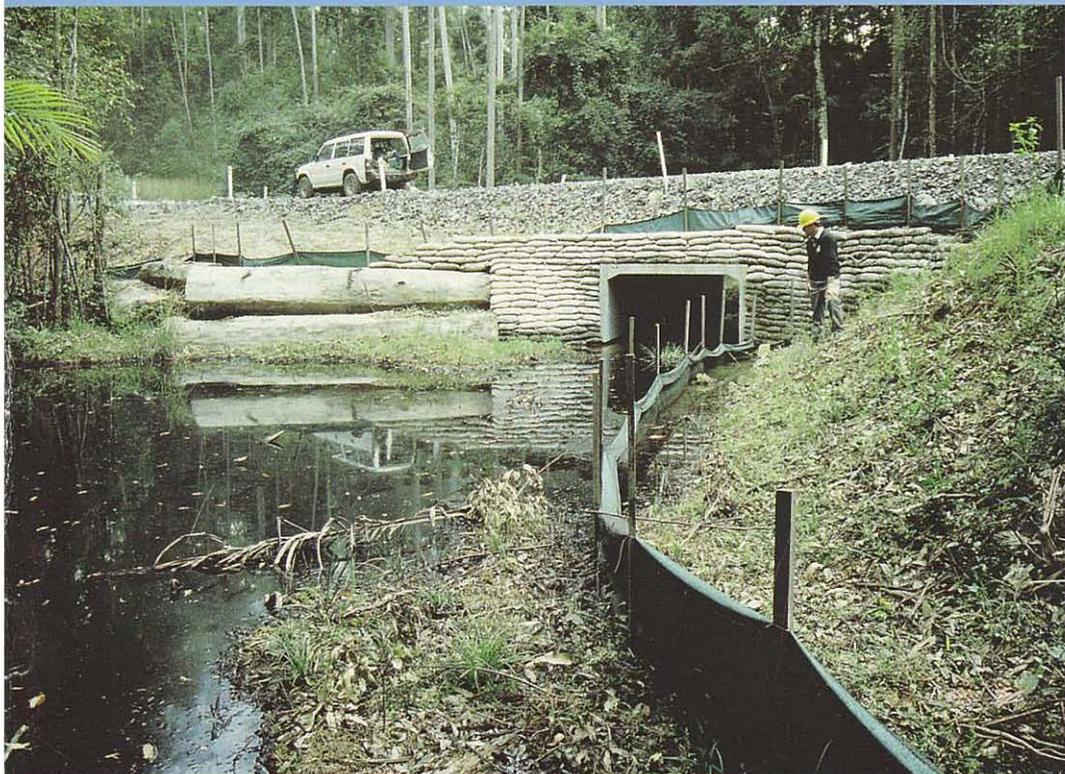


FOREST SOIL AND WATER PROTECTION

A MANUAL FOR FORESTRY OPERATORS



State Forests of New South Wales
June 2000



New South Wales



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❖ This Manual and the associated training program have received an Achievement Award for commitment to excellence in the conservation of natural resources and environmental protection from the International Erosion Control Association.

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STATE FORESTS OF NSW

INTRODUCTION

The mission of State Forests of New South Wales is to manage native forests and plantations for the widest range of benefits for current and future generations of people in NSW.

One of the most important forest resources is soil. Without proper care for the soil, the ability of the forest to grow new trees and support other plants and animals is diminished. Forests also provide the important life-sustaining product of water. Water from forest catchments not only provides downstream agriculture and urban areas with domestic water supply, but is also vital for the river health of aquatic life in streams, rivers and estuaries.

Soil erosion, sedimentation and turbidity are natural processes. Forest managers have a responsibility to ensure that soil erosion and the release of sediments into catchments are minimised through continued improvement of forest management practices.

This Operators Manual and the associated training have received an international environmental achievement award. Their aim is to educate machine operators and supervisors in native forests and plantations in methods to protect forest soils and minimise sediment production. The basic principles and techniques for forest soil and water protection required during harvesting and road construction and maintenance are set out in this manual.

The manual was prepared by State Forests to promote best practice and compliance with regulatory requirements.

Bob Smith
Chief Executive Officer
State Forests of New South Wales

FOREST SOIL AND WATER PROTECTION LEGISLATION AND INDUSTRY REQUIREMENTS

SOIL AND WATER PROTECTION - WHO IS RESPONSIBLE?

As managers and caretakers of the forests, we are all equally responsible for protection of the soil and water resources. To protect these resources, conditions are imposed to minimise the risk of soil movement on hillslopes and sedimentation of streams. We are all responsible for complying with environmental regulations.

TIMBER HARVESTING LEGISLATION

All timber harvesting operations on State forests and other Crown-timber lands, including plantations, are governed by the laws of NSW. State Forests, licensees, contractors and operators must comply with the various Acts and Regulations of Parliament. The Acts relevant to forest soil and water protection are described below. Acts that are relevant to other aspects of harvesting operations, such as occupational health and safety, are listed in the Forest Practices Codes.

- Forestry Act, 1916 (Administered by State Forests (SFNSW)): Requires State Forests to "preserve and improve, in accordance with good forestry practice, the soil resources and water catchment capabilities of Crown-timber lands."
- Integrated Forestry Operations Approval Package (IFOA) contains Environment Protection Licence and Fisheries Licence for forest harvesting and roading.
- Protection of the Environment (Operations) Act, 1997 (Administered by the Environment Protection Authority (EPA) of NSW). The Act encompasses all aspects of air, water and noise pollution including the licencing of activities that may cause pollution.

PLANTATION ESTABLISHMENT LEGISLATION AND GUIDELINES

Plantation establishment is subject to additional legislation and guidelines, primarily including:

- Native Vegetation Conservation Act, 1997: Administered by the Department of Land and Water Conservation (DLWC). Consent to clear native vegetation may be required. The consent, if granted, will specify what trees and other vegetation may be removed.
- Plantation and Reafforestation Act, 1999: Administered by DLWC facilitates the afforestation of essentially cleared land and promotes the ecologically sustainable development of timber and other plantations.
- NSW Code of Plantation Practice: Administered by DLWC this Code defines environmental standards and guidelines for plantation establishment and requires their application.

ENVIRONMENT PROTECTION LICENCES

State Forests holds an Environment Protection Licence for harvesting and related road works, over nominated State forests in New South Wales. This Licence, issued by the Environment Protection Authority, contains conditions which are applied to minimise soil erosion and water pollution. These conditions are set out in a separate booklet that is issued to all licensees, contractors and operators.

FOREST PRACTICES CODES

These Codes set out the minimum standards for the conduct of operations on State forests. A copy of the relevant Code is supplied to all licensees who operate on State Forest. The Codes to date include:

1. Timber Harvesting in State Forest Plantations, SFNSW, July 1995
2. Timber Harvesting in Native Forests, State Forests and Other Crown-timber Lands, Feb 1999
3. Plantation Establishment and Maintenance, SFNSW July 1997
4. Forest Roads and Fire Trails, SFNSW, December 1998.

OPERATIONAL PLANS

GOLDEN RULE: It is your responsibility to read and understand the Operational Plan

All work in the forest must be carried out according to a Plan. Plans are needed to help everyone involved achieve their work objective. The most common plans are the Harvest Plan and the Plantation Establishment Plan. It is your responsibility to ensure that your supervisor has explained the Plan to you and that you understand all of the conditions that relate to your work.

There must be a copy of the Plan kept permanently at every operation for you to access and read.

HARVEST PLANS

Every harvesting operation is controlled by a Harvest Plan which is prepared by a harvest planner. The Plan must be approved by the Regional Manager for SFNSW prior to operations commencing.

A Harvesting Plan issued by State Forests to a licensee or contractor includes a map and a set of operational conditions.

The specific conditions for soil and water protection for the operation are included in the Harvest Plan. They cover:

- drainage feature protection
- construction, maintenance and use of roads
- snigging or timber extraction
- use of log dumps or log assembly areas
- post-harvest rehabilitation
- storage and handling of hazardous wastes

MAPS USED WITH HARVEST PLANS

Harvest Plan maps are clearly marked to help you find your way around the harvest area. They show the location of areas and features to which conditions apply and where you must take special care. These areas include wildlife habitat sites, log dumps and temporary roads, places where soil protection is needed, filter strips and other drainage feature protection areas. Harvesting plans will also indicate areas to be harvested under wet or dry conditions.

PLANTATION ESTABLISHMENT PLANS (PEP's)

Conditions covering all aspects of the operation are detailed in this Plan. They include:

- clearing
- management of existing vegetation
- stacking of cleared vegetation
- sediment control
- drainage feature protection
- site preparation including ripping, cultivating and weed control
- planting and fertilizing
- road construction

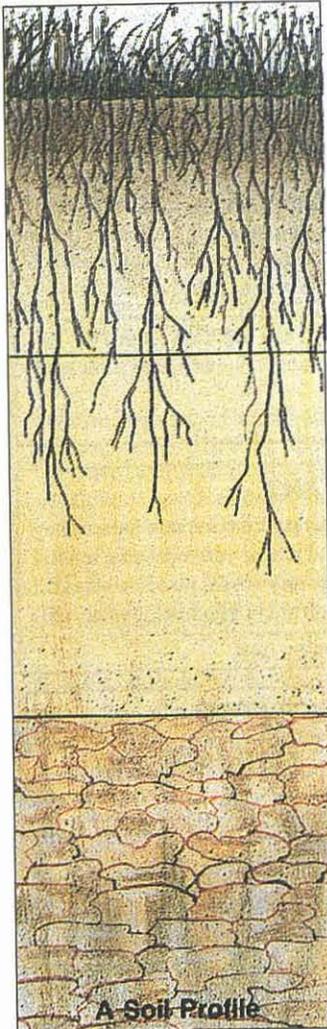
SOILS

Soil forms very slowly. It is derived from rock which breaks down due to wind, rain, sun and chemical action forming soil particles. There are different types of soil, depending on the parent rock (the original rock that was broken down to form the soil) and other factors.

Soils can vary from one site to another in an area. If you look at a road cutting, it will help you identify the type of soil before you start the job.

SOIL PROFILES

A soil profile is the cross section of soil from the surface to the underlying rock. Look at the exposed cross section on a cut road batter for these four layers in a soil profile:



Groundcover/Litter – Vegetation on the ground, fallen or dead plant material and rock or gravel. These materials cover and protect the soil surface against erosion.

Topsoil – Topsoil provides the seed-bed where nutrients accumulate and seeds germinate and grow. Water and air are essential for plant growth and are held in the topsoil. Topsoil is less erodible than subsoil due to the accumulation of soil binding organic material.

Subsoil – Subsoil is generally more likely to erode and has fewer nutrients. It absorbs less water than topsoil, causing greater run-off when exposed. Forest regeneration on exposed subsoil is poor.

Underlying Rock – This is the original rock which has weathered to form the upper layers of soil. Where soils are shallow, the underlying rock may be exposed on the ground surface.

SOIL FEATURES

There are several primary features which distinguish soils from each other. These include:

COLOUR Colour is a simple method for identifying soils in the field. Generally darker coloured red, brown and black soils are less likely to erode and often have a higher content of organic matter. Lighter coloured grey and yellow soils have little or no organic matter and are more likely to erode.

TEXTURE The texture or “feel” of a soil can provide a good indication of how that soil will behave:

Clay soils : Feel sticky in the hand when wet. They can become a problem in the wet with compaction.

Silty soils : Feel floury or silky smooth. They have very little structure and are often easily eroded. They have clay and sand in varying proportions, which sometimes mask the floury texture.

Sandy soils : Feel gritty, are generally poorly structured and therefore easily detached.

Soils can be separated into categories based on the coarseness of the soil particles and their parent material. Coarse-grained (sandy) soils may come from granite and sandstone. Fine-grained (clay and silty) soils may come from rocks like basalt and shale

DEPTH Shallow soils are often found on ridge tops and deeper soils are usually found at the base of slopes but there are exceptions. Be careful not to expose subsoil on shallow soils.



Soil pedestals illustrating the effect of ground cover protection from rainfall. Height of pedestal is an indicator of the extent of soil erosion.

WHAT IS SOIL EROSION?

GOLDEN RULE: Keep soil covered and spread runoff to prevent erosion

Soil erosion is a natural process occurring when soil particles are dislodged by wind, rain and frost.

Forest operations can increase erosion by removing groundcover, loosening and exposing the soil. Good groundcover practices and adequate drainage are the keys to successful erosion control.

TYPES OF EROSION

There are three types of erosion:-

- **sheet erosion** is the removal of surface soil in a thin layer, or sheet. Soil particles are dislodged by raindrop splash and water flowing in a sheet across the soil surface
- **rill erosion** is the removal of soil in small channels caused by the concentration of water flow. The increased energy of the water flow causes shallow scouring to occur in the soil surface up to 30cm in depth
- **gully erosion** is the removal of soil in deep channels greater than 30cm deep caused by water flowing with sufficient depth and speed for too great a distance. Gully erosion can also be caused by the collapsing of exposed dispersible subsoils



Sheet and Rill Erosion



Gully Erosion

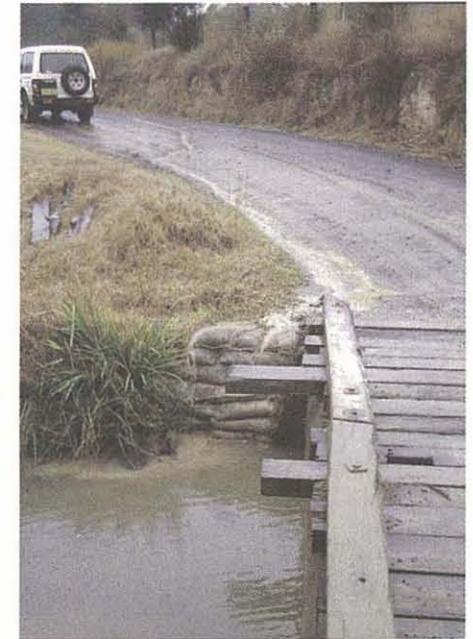
WHAT IS WATER POLLUTION?

GOLDEN RULE: Control soil erosion and you minimise water pollution

- Water pollution is the deposition of foreign material into water. Like soil erosion, water pollution is a natural process that can be accelerated by forest operations.
- The main water pollution risk in forests is the movement of fine soil particles like clay and silt into water, causing "turbidity" - muddy runoff where the fine particles of soil are suspended in water.
- Too much turbid runoff can lead to silting up of drainage features. This reduces the quality of water for agriculture and domestic use and can harm aquatic life.
- Most turbidity is caused by runoff from exposed soil flowing directly into drainage features.



Sediment collection behind a silt fence



Water pollution from road runoff on a local road



Sediment collection at a rollover

FACTORS AFFECTING SOIL EROSION AND WATER POLLUTION

Inherent Soil Erosion and Water Pollution Hazard represents the level of risk that soil in an area will be eroded and the water polluted. This must be taken into account when preparing operational plans. You can find out from the plan what inherent hazard level has been given to the area where you are working.

Soil erosion and water pollution hazard is affected by four primary factors:

- Slope (steepness and length)
- Rainfall
- Soil erodibility
- Ground cover

Slope

The steeper the slope and the further water runs unchecked, the greater the potential for erosion.

Rainfall

Rainfall is the initial cause of soil erosion. Raindrops from heavy storms will cause more damage than raindrops in a light rain shower. Like average rainfall for a district, rainfall energy varies from one location to another.

Soil erodibility

This is a measure of how easily the soil is eroded by running water or raindrop splash. Erodibility varies from soil to soil.

Ground cover

The amount of groundcover is affected by forest practices. When vegetation and forest litter are left intact, there is little opportunity for rainfall and run-off to cause erosion. The intensity of the harvesting operation and the type of machinery used will determine the amount of ground-cover that is removed or disturbed.

Other operational factors may include:

Soil Compaction

Undisturbed forest soils act like a sponge and absorb most rainfall. Soils compacted by machinery movement seal the soil surface, causing rainfall to runoff rather than soak into the ground. A single pass with a machine is sufficient to cause some soil compaction.

Water channelling

Water travelling in a narrow channel has increased energy and therefore can dislodge and carry a greater amount of soil. The moving soil particles cause the most damage by dislodging more soil.

WET WEATHER

GOLDEN RULE: Do not work machinery when soils are saturated

Machinery working in wet weather is more likely to cause problems that lead to damage and loss of soil by:

- increasing soil compaction which increases runoff and water pollution
- wheel rutting which leads to concentration of runoff on road and track surfaces
- damaging road surfaces, increasing road maintenance costs

Wet weather controls are found in the Forest Practices Code. The controls are mainly in the form of forest and road closures but also stipulate the maximum allowable wheel rutting depth in plantation harvesting.

TYPES OF CLOSURES

Automatic Closures – It is the responsibility of all operators to stop operating when:

- it is raining and/or
- water is running in table drains or on road surfaces of natural surface roads or on snig track surfaces

Notified Closures (partial or total) – These are applied with prior notification by the Regional Manager, generally during periods of prolonged wet weather.



A stable, well crowned road and table drain.

FOREST MACHINERY AND GROUND-COVER

GOLDEN RULE: Good operators maintain the ground-cover

All timber-harvesting machinery and other machinery disturb the soil. Tracked and wheeled machinery disturb the soil in different ways. Soil is disturbed by the ground pressure applied by a machine's tracks or tyres that expose and compact the soil. The amount of damage to the soil will depend on its moisture content and erodibility. Poor machinery operation will cause unnecessary damage to the soil.

Avoid these undesirable habits:

- operating machinery during wet soil conditions
- blading off during snigging
- "digging in" or building unnecessary earthworks during snigging
- excessive skewing with tracked machinery.

Where possible limit the skewing of tracked machinery to maintain surface litter and ground vegetation for soil protection. Replace groundcover if possible. Skewing of tracked machinery on road surfaces or road drainage structures is prohibited.



Walkover is more easily achieved in plantations

DRAINAGE FEATURES AND THEIR PROTECTION

All timber harvesting operations take place in a catchment. The water that is collected in a catchment has many uses after it leaves the forest, such as water supply and aquatic habitat, so it is important that it stays clean.

Protecting drainage features within a catchment means reducing the amount of soil particles deposited in drainage depressions, drainage lines, watercourses; wetlands and swamps during forest operations. This is assisted by retaining filter strips and drainage depression buffers (known as drainage feature protection areas in plantation establishment plans) to limit machinery access and to trap sediment.

DRAINAGE DEPRESSIONS

These are gently inclined, open depressions that convey runoff only during or immediately after periods of heavy rainfall. There is no channelised flow of water.

They are generally found above drainage lines in the upper slopes of catchments.

While harvesting and machinery use are not excluded from these areas, care must be taken to ensure that they are not damaged by rutting or disturbance that exposes the soil to concentrated water flow.

BUFFER STRIPS

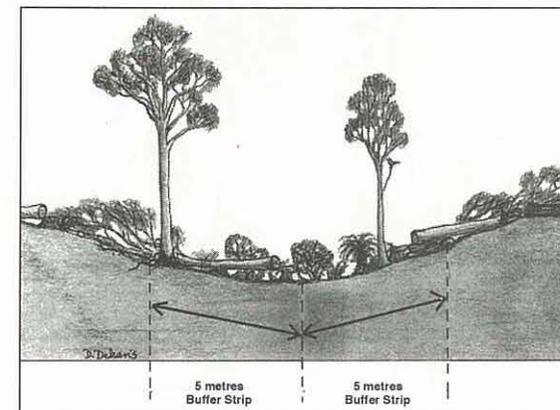
All drainage depressions are protected by buffer strips.

Buffer strips are areas of groundcover and vegetation within and alongside drainage depressions.

Operate machinery so as to minimise ground disturbance.

Trees may be felled into and within buffer strips.

Operators are responsible for identifying drainage depressions and buffer strips.



A drainage depression is a level to gently inclined shallow, open depression with a smoothly concave cross section, rising to moderately inclined hillslopes.

DRAINAGE LINES AND WATERCOURSES

Drainage lines concentrate natural water flows during or immediately after periods of heavy rainfall. They are characterised by having either a carved out channel more than 30 cm deep, or having signs of active erosion or soil deposition.

Drainage lines require protection. The number and closeness of drainage lines in the harvest area will affect log extraction and tracking patterns. Drainage lines must only be crossed by machinery at specified crossing points.

Watercourses, which include streams, creeks and rivers, require protection because surface water flows on a permanent or semi-permanent basis in channels with a well defined bed and bank.

WETLANDS AND SWAMPS

Wetlands and swamps are vegetated areas with seasonal or permanent water laying above or close to the ground surface. Vegetation type often indicates a wetter environment (or riparian area) than the surrounding area.

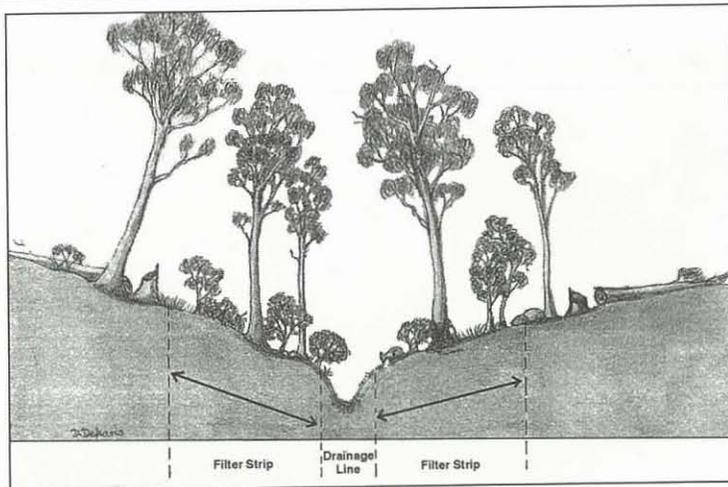
FILTER STRIPS

Filter strips are areas of undisturbed vegetation along each side of a drainage line or watercourse and surrounding a wetland or swamp.

Filter strips are usually marked in the field by the Supervising Forest Officer. Make sure that you know where the boundaries of filter strips are located in the field.

Keep machinery out of filter strips.

Do not fall trees into filter strips.



A drainage line exhibits one or a combination of the following features:

- Evidence of active erosion or deposition, eg: gravel, pebble, rock, sand bed, scour hole, knick point or;
- An incised channel of more than 30cm depth, with defined bed and banks.

MEASURING SLOPES USING A CLINOMETER

A clinometer is an instrument that helps you to measure the angle of a slope.



Knowing the angle of a slope enables you to:

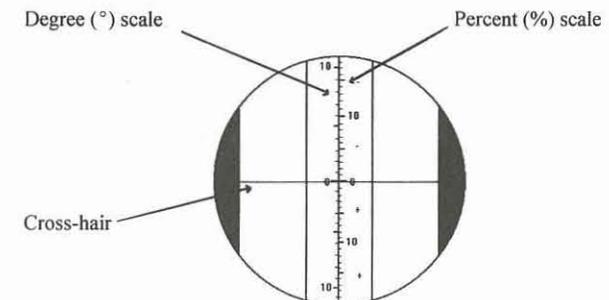
- know when it is too steep to harvest
- know when it is too steep to snig
- construct roads to the correct grade
- determine maximum road and snig track drainage spacing

MEASURING SLOPES

To use a clinometer:

- hold it to your eye and sight the crosshair at an object on the slope you are going to measure
- make sure that the distant object is the same height off the ground as your eye (about 1.5 metres)
- focus on the distant object and then refocus on the scale and read the slope angle
- there are usually two scales in the eyepiece (often degrees on the left, percent on the right)
- the scales read in different directions depending on whether you are reading up or down hill
- as a hint, it is always handy to mark your eye height on a tree as you walk past and take a back sight on it
- there are detailed instructions for use supplied with each instrument, or ask your supervisor

View through clinometer eyepiece



TIMBER HARVESTING IN NATIVE FORESTS

The timber extraction method may be specified in the Harvesting Plan. If harvesting is on gentle slopes, snig track construction may be unnecessary and walkover techniques that have minimal disturbance on the ground vegetation may be suitable. On steeper slopes, a combination of constructed and walkover snig tracks may be used.

BEST PRACTICE FOR SNIGGING

Choose a snigging pattern most suitable for the terrain, using uphill snigging where possible.

Locate tracks so as to minimise disturbance to soil and regrowth.

Limit the number of tracks open and in use at any one time.

Avoid tracks coming together at the bottom of slopes.

Where tracks converge or join, place adequate drainage to cope with concentrating run-off.

Construct snig tracks for optimum drainage eg: change track direction where possible.

Make full use of natural ridges for main tracks.

Only use stream or drainage line crossings where necessary and approved.

Work progressively back to the log dump, installing drainage as each section of track is finished.

Cover tracks with slash from tree heads to minimise exposed soil.

Remove all windrows and log furrows prior to putting in drainage.

WHAT IS WALKOVER TIMBER EXTRACTION?

Walkover extraction means maintaining as much litter and topsoil in place as possible by walking over harvest debris and groundcover with the blade raised above the ground and therefore not blading off to create a snig track.

Although walkover is most commonly seen in plantations with forwarders, it can be used with all other types of harvesting machinery.

Walkover extraction is most common on flatter country where a track is only used a few times for snigging and where bare earth is not required for traction.

DOWNHILL SNIGGING

Downhill snigging is used where the road system cannot be efficiently constructed to allow for uphill snigging. There are often locations within a compartment where downhill snigging is appropriate. A few rules should apply to downhill snigging:

- avoid tracks meeting close to log dumps as they may be difficult to drain
- make sure that track drainage does not flow unchecked onto other tracks, roads or log dumps
- tracks should enter the log dump from the side or below
- a drainage structure must be in place before a track enters the dump at the end of each day
- only snig downhill where approved
- keep the length of the downhill snig as short as possible

SNIG TRACK DRAINAGE

Some important rules to remember:

- all snig tracks require draining
- drainage can be by design or constructed
- construct tracks with outfall drainage
- maintain logging slash on tracks to slow runoff
- progressively drain sections of snig track once snigging is complete



Snig track with good outfall and minimum topsoil disturbance



Effective crossbank construction

CROSSBANK DRAINAGE

Crossbanks are required where tracks do not have continuous effective outfall drainage or are covered with logging slash.

Construction should create a cross bank that is designed to slow and divert runoff water with a minimum of earthworks. Height should not exceed 50 cm.

The finished bank should have a slightly sloping channel that diverts runoff water onto a stable ground surface.

DRAINAGE FEATURE CROSSINGS FOR SNIG TRACKS

The same rules that apply to road crossings apply to snig track drainage feature crossings.

Only snig track crossings approved by the Supervising Forest Officer may be constructed.

Where possible, use snig track patterns that avoid crossing drainage lines.

LOG DUMPS

Log dump locations are shown on the operational map and are marked in the field by the Supervising Forest Officer.

Dumps are located in areas that allow easy access for log trucks, allow water to run off readily and allow easy, efficient snigging of logs.

Log dumps should be kept to a minimum size.

LOG DUMP CONSTRUCTION AND USE

Strip topsoil and stockpile for later respreading if specified in the Plan.

Provide adequate drainage above and below the dump.

Have snig tracks entering from the sides of the dump to prevent runoff draining down onto snig tracks.

Keep the dump well drained both during and after operations by diverting runoff from the dump as well as run-off that may flow onto the dump.

Distribute bark left at the dump throughout the surrounding harvest area.

Bark can be used to provide groundcover on closed snig tracks and roads.

Bark must be kept well away from all retained trees and from drainage feature protection areas as it adds to the fuel load in fires.

After use, the dump should be restored by respreading topsoil, deep ripping, seeding and fertilising, if specified in the Plan.

TREE FELLING

TREE FALLER RESPONSIBILITIES

- Read the harvest plan and identify the net harvest area boundaries
- Understand the tree marking code and tree felling boundary markings
- Identify any maximum slope limitations for falling/snigging within the harvest area
- Identify the various drainage features and their protection measures
- Implement directional felling to prevent trees from entering exclusion areas (including filter strips)
- Fall trees on the contour on steep slopes to prevent tree loss down the slope
- Consider the felling direction for snigging purposes
- Report all accidental felling of trees into exclusion areas
- Report unmarked drainage lines to the SFO and implement filter strips for unmarked drainage lines
- Fall tree heads onto snig tracks where possible for groundcover protection

TIMBER HAULAGE AND ROAD USE

TIMBER HAULAGE AND OTHER ROAD USER RESPONSIBILITIES

- Implement road closure requirements during periods of wet and other adverse weather conditions
- Understand the various methods of road drainage and their protection
- Understand and observe the protection measures required at drainage feature crossings
- Prevent damage to the road pavement, table drain, road shoulder and road drainage structures
- Ensure that SFO approval has been given for blading off roads
- Ensure log dump remains well drained
- Roll in newly constructed or upgraded roads
- Report damage to roads and drainage structures
- Report drainage structures which require maintenance or are operating inefficiently
- Report any road structures considered to be unsafe for log haulage
- Haulage operators can assist with road maintenance by acting responsibly during haulage and reporting maintenance problems

TIMBER HARVESTING IN PLANTATIONS

Plantation sites are often less steep than in native forests and the area more open because it was cleared before planting. The relatively clear forest floor in a plantation allows wheeled extraction machinery to be used, such as forwarders and skidders, and excavator based processing machinery.

In plantations, roads have been previously constructed and may only require maintenance before operations begin. This maintenance may involve the repair of drainage structures, the removal of any vegetation on the road pavement that may cause problems for traffic and the grading and gravelling of the road pavement where needed. During harvesting operations, avoid damage to roads.

During plantation thinning, slash and other logging debris is left behind. The slash is an important source of groundcover to spread over outrow tracks and other extraction areas. In some plantation thinning operations there may not be sufficient vegetation and debris to cover the extraction tracks, increasing the need to construct track drainage. In some instances, full crossbank drainage may need to be used where walkover techniques cannot be carried out.

When plantations are clearfelled, the extraction methods of logs may include cable logging (where the logs are moved above the ground by cable) or by skidders. Cable logging may only require the rehabilitation of dump areas as snig tracks have not been created. However skidder use will result in the need to drain the extensive network of snig tracks prior to the re-establishment of the site.

RULES FOR USING PLANTATION ROADS

- Keep tracked and wheel-chained harvesting and processing machinery off roads.
- Keep tree debris out of roadside drainage structures by removing it on a daily basis.
- Forward and load logs along roads only as permitted in the Harvesting Plan.
- Keep crossing of roads with wheel chains to a minimum.
- Avoid damage to road drainage structures and batters.

LOG ASSEMBLY AREAS

New log assembly areas must be constructed as specified in the Harvesting Plan. Runoff water from log assembly areas should drain onto undisturbed ground with adequate cover.

Log assembly areas should be located so as to:

- minimise soil exposure
- avoid standing trees
- keep well drained during and upon completion of operations
- avoid damage to roads and drainage lines

The Harvesting Plan will specify areas that are not suitable for log stockpiling including within drainage feature protection areas.

FORWARDING AND PROCESSING IN PLANTATIONS

Process logs outside drainage lines.

Take care to cover outrows and other extraction tracks with slash during processing.

Avoid forwarding along drainage depressions.

Minimise ground disturbance and topsoil exposure in drainage depressions.

Place sufficient slash in drainage depression crossings ahead of forwarder operations.

Avoid using the same extraction route continually when snigging logs to minimise rutting.



Plantation processing with ground cover retention

USING SKIDDERS FOR EXTRACTION

Later thinning and clearfall operations may use skidders rather than forwarders for extraction. The amount of slash generated by these operations will often be significantly less than in earlier thinnings and will include a larger proportion of heavy branch debris. The following rules should be observed:

- place slash on tracks to provide groundcover and avoid rutting
- avoid the removal of topsoil by minimising the use of machine blades
- do not use skidders to extract logs along drainage depressions
- constructed track drainage is required when tracks do not have adequate groundcover which may include undisturbed vegetation, needle litter or slash

ROAD CONSTRUCTION

Forest roads are the major source of sediment that can pollute water during forestry operations. Forest roads may be classed as either temporary or permanent. Temporary roads are usually of a lower standard and used for accessing log dumps. They are sometimes closed on completion of operations.

Permanent roads are of a higher standard and are permanently maintained to allow efficient forest management, fire protection and access for harvesting. Many roads are used for public access and recreation. These permanent roads are planned to cause the least environmental damage in the form of soil erosion and water pollution. Road building crews must ensure that this intent is carried out through good construction practices.

Harvest Plans or Road Plans will include conditions that ensure road construction or maintenance will result in as little erosion and water pollution as possible during the proposed operation. A road plan may form part of a Harvest Plan or Plantation Establishment Plan (PEP).

PLANNING ROAD CONSTRUCTION

Road locations are always marked on the Plan map and in the field by a Supervising Forest Officer.

There must be no change from the Plan or the marked line unless approved.

Walk the marked line with your supervisor and discuss any suggested changes.

Plan the location and construction of road drainage ahead of earthworks.

While you are at the location and using the map or plan, familiarise yourself with:

- boundaries
- sensitive areas such as watercourses, wetlands and other drainage features
- approved drainage line and watercourse crossings

NEW ROAD CONSTRUCTION

Construct the road in stages, including drainage and restoration of groundcover, before commencing the next stage, where possible. Otherwise ensure that drainage is installed progressively as the earthworks are completed.

Install and maintain temporary drainage daily until permanent drainage can be installed.

Begin scheduled maintenance as soon as construction is completed.

Sediment and erosion control works, such as of silt fencing or replacement of groundcover, must be installed immediately. New earthworks are more prone to erosion.

CLEARING THE ROAD LINE

Keep as much original vegetation as possible.

Keep to the clearing width specified in the Plan.

Place windrow vegetation and other debris parallel to the road to act as a sediment barrier.

Fall trees rather than bulldoze them where clearing is needed outside the road formation.

Minimise machinery disturbance outside the road line particularly above cut batters and adjacent to drainage outlets.

Strip topsoil and stockpile it for respreading where-ever possible.

CONSTRUCTION OF ROAD BATTERS

All batters should be constructed to a stable slope. Incorrect slope can result in slumping or erosion.

The batter grade may be specified in the Plan.

Vertical batters may be acceptable in stable soils on lower standard roads.

Avoid using road-clearing debris in fill batter construction to avoid poor compaction and instability.

Compact the fill batters.

Protect high fill batters by diverting runoff with an earth windrow or by installing batter drop down structures.

Batters constructed in unstable soils should not be laid back unless the batter is to be topsoiled and seeded.



Topsoiling a new batter (before revegetation)



Seeding and revegetating (3 months after photo above)



Jute mesh matting for erosion control

ROAD MAINTENANCE

GOLDEN RULE: Everyone is responsible for road maintenance

Plan all upgrading and maintenance of roads well before they are required for regular use.

MAINTENANCE TIPS

All roads which have regular use require regular maintenance.

Undertake regular inspections to ensure that drainage is working effectively and that the road is stable, particularly after rain.

Inspect inlets and outlets of drain culverts and crossbanks on a weekly basis during harvesting operations and otherwise at regular intervals depending upon traffic use.

Ensure effective outfall drainage by removing earth windrows caused by traffic rutting.

Report major problems to a supervisor.

Carry a shovel in your vehicle to clean out culverts and drains. Timely cleaning can prevent damage to the road and minimise water pollution.

GRADING ROADS

Take care when grading not to undercut batters or damage the sumps of culverts.

Only grade when road surface conditions are moist, but not when saturated or dry and powdery. Otherwise a water cart and roller should be considered.

Do not grade stable table drains and mitre drains, if they are working effectively.

Do not deposit spoil or loose earth within drainage feature protection areas or where there is concentrated water flow.

Avoid constructing mitre drains with excessive grade or length.

Reconstruct mitre drains if originally constructed with excessive grade.

Remove earth windrows from the sides of roads to allow free drainage unless required to protect high fill batters.

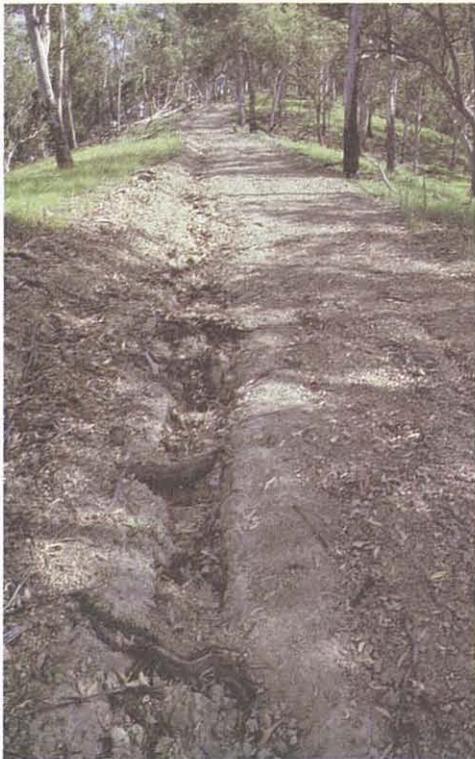
Avoid deep V shaped table drains and mitre drains.



This road requires improved pavement drainage



Avoid lengthy box cuts which are difficult to drain



Poorly constructed trail with inadequate drainage



A well drained and maintained road



Jute mesh drop down associated with rollover bank



A distant pipe culvert shows signs of carrying excess water volume

ROAD SURFACE DRAINAGE

Diversion of runoff from the road surface is essential to minimise sediment loss and to maintain a trafficable road surface.

PRINCIPLES OF ROAD SURFACE DRAINAGE

Roads must be adequately drained at all times, particularly during log haulage, as more sediment is generated during this period.

Construct road drainage structures within the maximum spacing and at the required height as specified in the Plan.

Take advantage of the best location on the road to locate drainage structures, provided the maximum distance between structures is not exceeded.

Regularly remove debris and earth windrows formed by vehicle traffic where outfall drainage is required.

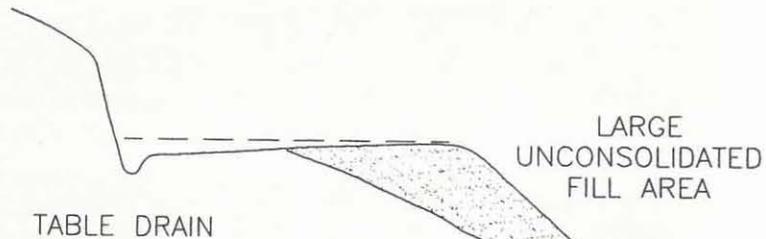
Keep drainage structures free of log debris at all times.

Minor debris in drains may reduce runoff velocity and maintain stability.

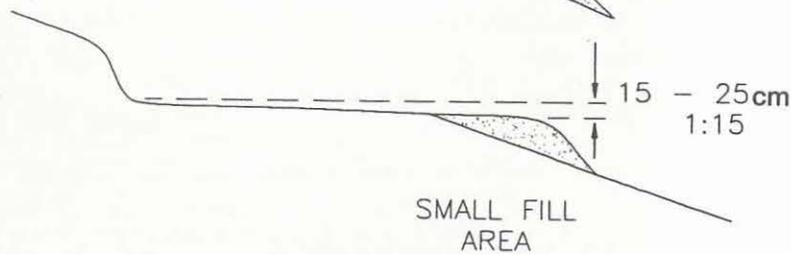
Ensure runoff is diverted onto undisturbed vegetation.

TYPES OF CROSSFALL DRAINAGE

Infall



Outfall



Crowning



CROSSFALL DRAINAGE

Crossfall drainage removes runoff from the road surface. There are three types of crossfall:

Outfall: Where the road surface slopes away from the hillside shedding water evenly to the lower side of the road. Use outfall where possible but do not direct runoff onto high or erodible fill batters. Remove earth windrows unless they are designed to prevent water running onto fill batters.

Infall: Where the road slopes into the hillside directing runoff into a table drain where it can be picked up by a drainage structure and diverted onto stable ground.

Crowning: Where the road surface is shaped to shed water from a high point in the centre of the road to both sides.



Well constructed outfall drainage makes this road efficient to maintain

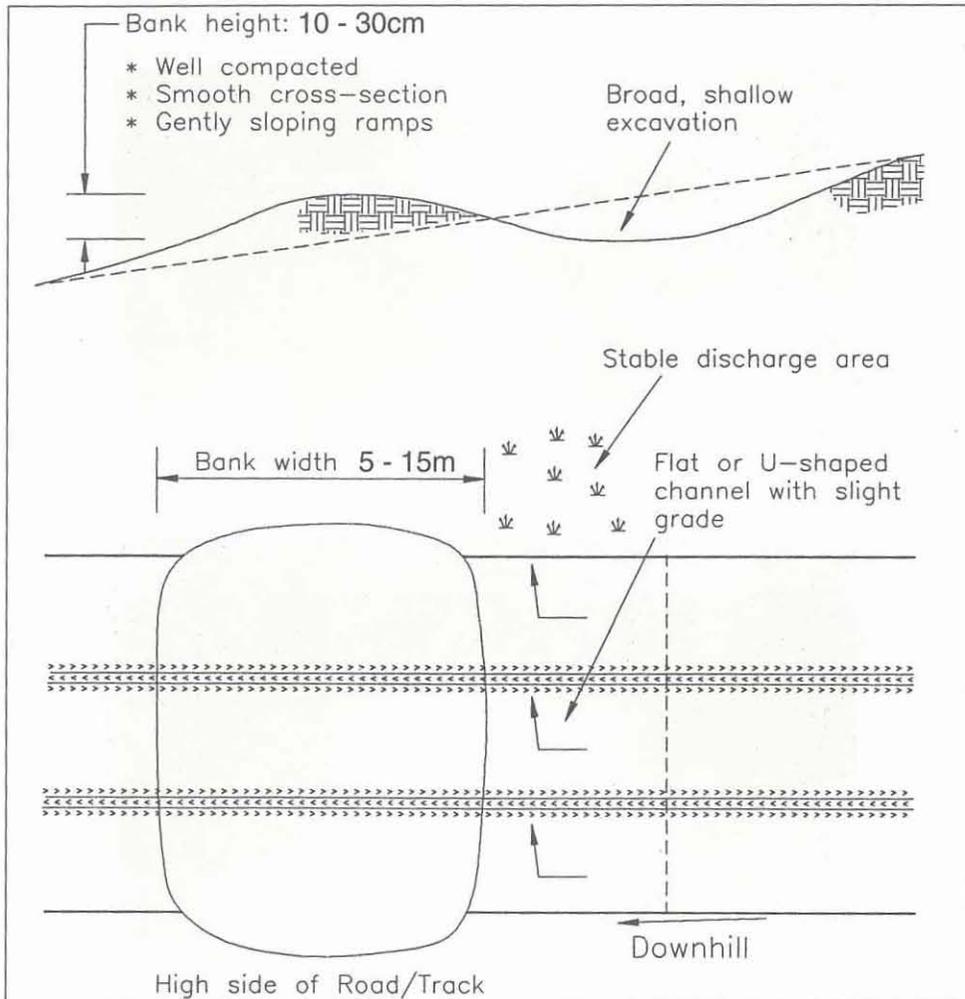


Infall drainage requires table drain and pipe culvert maintenance

DRAINAGE STRUCTURES

Drainage structures are used in conjunction with crossfall drainage to divert runoff from the road surface or tabledrains. These may include:

- mitre drains
- relief pipes
- rollover banks
- earth crossbanks
- spoon drains
- rubber flap drains and other prefabricated structures on the road surface



Profile of a rollover crossbank (not to scale)



Rollover crossbank with effective outlet



Rubber flap drain on haulage road



Roadside revegetation following road maintenance

RELIEF PIPE DRAINAGE

Install relief pipes within the maximum required distance to minimise scouring of table drains

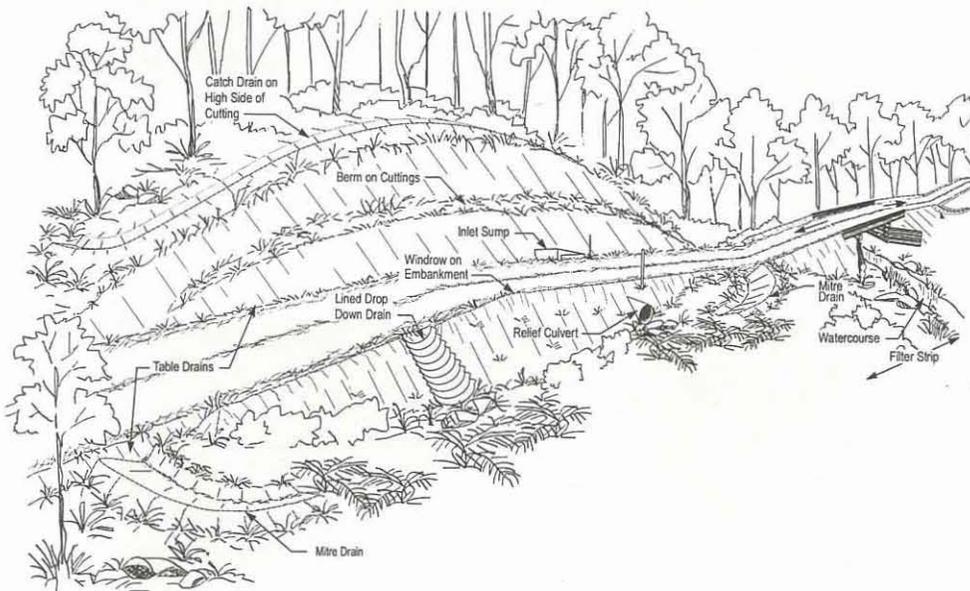
Locate relief pipes where the fill batter height is lowest

Install sumps and headwalls for batter and pipe protection

Protect relief pipe outlets with dropdown structures and dissipaters on fill batters

Do not discharge relief pipe drainage directly into drainage features

Keep relief pipes free of debris



Road drainage features



Drop down flume and rock dissipaters



Roadside and headwall sediment protection



The outcome of no headwall is soil erosion and road narrowing

EROSION AND SEDIMENT CONTROL MEASURES

EROSION CONTROL MEASURES

Erosion is controlled by maintaining groundcover as well as breaking up and spreading water flow. Following are some examples of erosion control measures used in road construction and maintenance.

- **Artificial revegetation**, usually by seeding. **Topsoil** is the key to revegetation and longterm stability of exposed areas. Without topsoil, germination is reduced, resulting in stunted plant growth and poor overall groundcover. Fertilizer may also be required.
- **Erosion control matting or mulch (natural or synthetic)** used for stabilisation of exposed earth on road batters and around drainage feature crossings. Mostly used in conjunction with seeding.
- **Rock or aggregate** used to armour exposed earth particularly at drainage feature crossings or to protect unstable road table drains and drainage structure outlets.
- **Specialised erosion control products** such as rock mattresses and gabions, pipe inlet sumps, headwalls, dissipaters, flumes and other geotextile products for site specific problems.

SEDIMENT CONTROL MEASURES

Sediment movement is ideally controlled by diverting runoff from logging areas or roads onto undisturbed ground, logging slash or bark.

Where sediment control cannot be achieved by natural means, sediment control structures may be required. Examples include:

- **Silt dams** are designed to contain runoff to allow coarse sediment to settle. Sandbags or a geotextile lined log can be used. A hole in the ground may be sufficient.
- **Silt fencing** is a temporary barrier of geotextile filter fabric usually supported by wooden stakes or steel posts.
- **Straw bale dams** are effective, temporary structures to impede water flow and contain coarse sediment. Use stakes to hold bales in place.
- **Geotextile fabrics** have four functions - separation, filtration, drainage and re-enforcement which enable the products to be useful for sediment control.
- **Headwalls and retaining walls** are often used to contain soil at drainage feature crossings.

DRAINAGE FEATURE CROSSINGS

Drainage feature crossings will differ, according to the type and size of drainage line or watercourse to be crossed, and the amount of traffic using the crossing. The location and type of all crossings must be specified in the Plan.

CROSSING CONSTRUCTION

- Read the Plan for site specific requirements
- Construct approaches at right angles to the drainage feature in order to keep the length of road in the filter strip to a minimum
- Have a sufficient waterway area to carry prescribed water flows
- Ensure that the bed and banks are adequately protected during crossing construction and that no spoil enters the waterway. If so remove it immediately.
- Where possible construct the final road surface at stream bed level to allow the free flow of water **and to avoid blocking fish passage**

PREVENTING SEDIMENT POLLUTION AT DRAINAGE FEATURE CROSSINGS

- Contain all loose earth around the crossing site with logs or headwalls or cover with ground protection material
- Minimise ground disturbance outside the road line
- Allow adequate drying of the road surface within the crossing area by removing overhanging tree cover
- Use geotextile material on earth fill log bridges to contain the earth
- Divert runoff from the road surface well away from the crossing and again near the crossing site to ensure no direct runoff into the drainage feature or runoff over loose earth



Aggregate protection of a drainage depression crossing



A natural sheet rock causeway crossing



Typical pipe culvert crossing



Silt fence prevents sediment reaching the water course



A well constructed and stable bridge crossing

SOIL EROSION MITIGATION GUIDELINES (SEMG) FOR HARVESTING NATIVE FORESTS OF INLAND N.S.W.

While the principles outlined in this manual provide a sound background for soil and water protection techniques across the State, the conditions of the Inland SEMG provide the details necessary for compliance during harvesting in the inland forests of NSW.

These guidelines mitigate the soil erosion and water pollution in excess of natural levels following harvesting operations. The boundary of this inland area is defined in the SEMG and is a subset of the area west of the Great Dividing Range. The eastern boundary is approximately Moree to Narrandera. This SEMG does not apply to the Red Gum forests of the Murray/Darling basin.

The inherent soil erosion and water pollution hazard category for harvesting inland forests is usually "low" for the following reasons:

<u>Natural Features</u>	<u>Unit</u>	<u>Relative Hazard</u>
Rainfall Erosivity	750 - 2000 MJ.mm/ha/hr/yr	Low
Harvest Yields	7 - 12 cu.m./ha	Low
Average Log Size	0.22cu.m.	Very Low
Harvesting Frequency	20 -40 years	Low
Harvesting Machinery	Mostly Walkover	Low

Nevertheless, there are localised sites where the soil and water pollution hazard is higher and management of these sites needs to be strictly controlled. The Inland SEMG provides the means of early identification of such sites and soil protection techniques to minimise soil erosion and water pollution.

LOCALISED HIGH HAZARD SITES

Banks of watercourses/drainage lines:

- "No Harvest Zones" adjoin banks of watercourses/drainage lines
- machinery cannot enter "No Harvest Zones", except at planned crossings
- tree felling is prohibited in "No Harvest Zones", except at planned crossings
- "No Harvest Zones" are wider in areas where banks are actively eroding

Drainage Line Crossings:

- minimise the number of crossings
- select site of least potential disturbance
- crossings must be adequately drained

Natural Surface Roads:

- must be adequately drained and maintained
- should be located as far away from watercourses/drainage lines as practical.

SOIL CONSERVATION MEASURES FOR LOGGING IN RIVER RED GUM FORESTS OF THE MURRAY/DARLING CATCHMENT

The soil conservation measures for logging in River Red Gum forests on the depositional floodplain of the Murray/Darling catchment were developed in consultation with DLWC for site specific conditions relating to these unique and long managed forests.

The skills expected of forest operators and supervisors in the protection of soil and water values include:

- knowledge of the conditions relating to Prescribed Streams
- knowledge of the conditions relating to Nominated Streams
- knowledge of the conditions relating to debris free runnels
- knowledge of wet weather conditions relating to logging operations and timber haulage

CONDITIONS FOR LOGGING IN RIVER RED GUM FOREST

Siting of log dumps and sawmill/timber processing sites:

Sites must be located at least 20 metres from banks of Nominated Streams (including Prescribed Streams) or major ephemeral runnels.

Where necessary, sites should be marked on the harvesting plan and in the field.

Logging Debris:

Logging debris must be removed from within, and within 20 metres of, all Nominated Streams (including Prescribed Streams) or major ephemeral runnels unless otherwise specified.

The extent of Prescribed Stream or Nominated Stream length to which the 20 metre debris free zone applies must be specified in the harvesting plan. Where necessary this may be supported by field demarcation.

Access Roads:

Access roads that traverse Nominated Streams (including Prescribed Streams) or major ephemeral runnels must be located to minimise or, where possible, avoid bank excavation.

Where earth or similar fill material (rock, logs, soil) is placed within the bed of the Prescribed Stream or Nominated Stream to achieve access, the resultant hydrological impact must be taken into account. Unless otherwise specified, all fill or similar material shall be removed and/or relocated on cessation of the logging operations.

The siting of Prescribed Stream or Nominated Stream crossings is only permitted as specified in the harvesting plan and supported where necessary by field marking.

Implementation Monitoring:

The above soil conservation measures will be monitored as part of the environmental compliance procedures for all harvesting operations conducted by State Forests.

PLANTATION ESTABLISHMENT

Plantation establishment operations can have a major effect on water quality if not conducted properly. The key to reducing the effect of plantation establishment on water quality is to retain drainage feature protection areas (strips of undisturbed vegetation along drainage features), to minimise runoff from disturbed areas and to reduce sediment movement within and from the plantation area.

Drainage feature protection areas conserve water quality by maintaining undisturbed groundcover which filters out sediment and other pollutants by promoting infiltration rather than the overland flow of runoff. They also protect the bed and banks of drainage lines and watercourses.

CLEARING AND SITE PREPARATION

The clearing and site preparation practices for plantation establishment should aim to maintain as much ground cover as possible to minimise the potential for runoff and soil erosion.

CLEARING GUIDELINES

- Read and understand the Plantation Establishment Plan
- Do not clear during heavy rainfall
- Stay out of drainage feature protection areas (DFPA)
- Do not disturb marked trees and stay out of retained vegetation areas
- Stack timber debris in windrows on the contour, away from drainage feature protection areas, retained vegetation and property boundaries.
- Minimise the amount of soil pushed into windrows. This is more easily achieved by using rake blades rather than conventional blades
- Backfill stump holes
- Keep roads open and avoid damage to road surfaces and road drainage structures
- In clearfelled softwood plantations, where trees and substantial debris have been felled into drainage lines or water courses, removal should minimise damage to the bed and banks.

DRAINAGE FEATURE PROTECTION AREAS (Plantation establishment areas only)

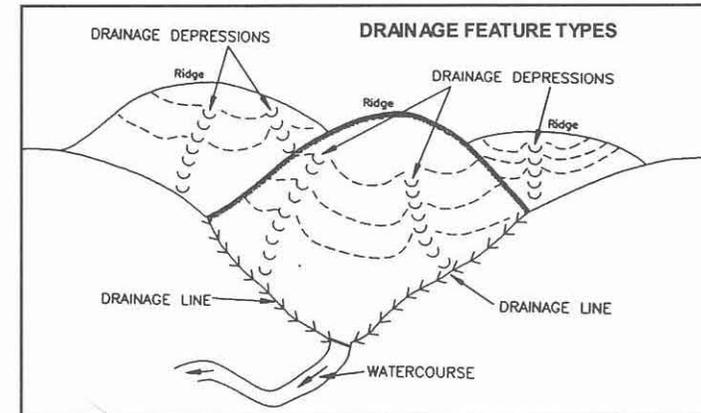
These are areas of retained vegetation on each side of drainage depressions, drainage lines, watercourses, wetlands and swamps.

Protection areas are marked on the Plantation Establishment Plan.

Some operations are excluded from drainage feature protection areas.

SITE PREPARATION

- Implement temporary sediment control measures, as specified in the Plantation Establishment Plan
- Ripping/cultivating/mounding layout should follow the Plan
- Do not operate while it is raining or when the soil is saturated
- Stay out of drainage feature protection areas - know the minimum non-disturbance distances
- Do not rip or turn tracked machinery on roads, tracks or firebreaks
- Rip on the contour unless otherwise instructed
- Keep soil disturbance to a minimum when turning at the end of rows
- Spot ripping and mounding will be required in sensitive areas where specified



MAPS USED WITH PLANTATION ESTABLISHMENT PLANS

The map is clearly marked to help you work in the plantation establishment area. It indicates areas where special conditions apply including retained vegetation, utility easements and other site infrastructure to be protected from machinery, drainage feature protection areas and location of roads, tracks and crossings.

ROAD CONSTRUCTION AND MAINTENANCE

Refer to the chapter on Road Construction and Maintenance in this Manual.

CHEMICAL POLLUTION PREVENTION AND RESPONSE

Chemicals such as fuel, lubricants and herbicides are potentially hazardous to the environment. Precautions must be taken to ensure that these types of substances do not pollute water ways and groundwater. The Environment Protection Licence requires:

- that fuel oils must be stored and handled in compliance with Australian Standard AS 1940-1993 "The Storage and Handling of Flammable and Combustible Liquids".
- that chemicals must be stored and handled in compliance with the Control of Workplace Hazardous Substances - National Model Regulation and National Code of Practice, June 1991, published by Worksafe Australia.

STORAGE AND HANDLING OF HAZARDOUS AND FLAMMABLE SUBSTANCES

- Agricultural chemicals should be transported in minimum quantities in properly secured loads. Chemicals should not be transported in passenger vehicles or the cabs of trucks.
- Damaged and leaking containers must not be loaded.
- All fuel, lubricants and agricultural chemicals are to be stored within a bund.
- Mobile fuel containers are not to be located within 10m of a drainage feature protection area.
- All servicing and repairs to machinery must be carried out in a manner that prevents the pollution of water or contamination of land.
- Fire fighting equipment, including the appropriate fire extinguisher, must be on site where flammable substances are stored. This includes field locations.

FUEL AND LUBRICANT BUND

- The bund is designed to contain spillages and leaks from stored fuel and lubricants, and may comprise an earth embankment surrounding the fuel or lubricant storage tank.
- Breaching of the bund wall must be repaired immediately.
- The bund must be large enough to contain the volume of fuel or lubricant stored within it, without breaching the wall of the bund if leakage occurred. A 0.5m high bank constructed no less than 1 metre away from the storage is recommended.
- Regularly inspect valves, pumps and hoses as a preventative measure. Leaking assemblies must be immediately repaired.
- After rainfall, all bunds must be emptied as soon as possible to maintain full capacity of the structure.

DEALING WITH SPILLS

- Ensure the spill is contained by bunding with available equipment.
- Notify the Supervising Forest Officer or contact State Forests immediately.
- If the substance is flammable cover the spill with fire retardant from the fire extinguisher and ensure the fire fighting equipment is ready for use.
- Contaminated water within the bund should be disposed of in a manner that minimises the risk of pollution

DISPOSING OF CONTAMINATED SOIL

- When soil has become contaminated, a decision must be made regarding measures to deal with it. The quantity of spilt material and its potential impact on the ground water will need to be assessed.
- The proximity to a drainage feature and the permeability of the soil are two of the main considerations. Options include:
 - recovering the material for off site disposal
 - on site treatment
 - on site disposal
- The off site disposal location and the on site disposal may require EPA approval. This will depend on the hazardous nature of the material and the quantity.

References

- Forest Practices Code Part 1: Timber Harvesting in State Forest Plantations**, *State Forests* July 1995
- Forest Practices Code Part 2: Timber Harvesting in Native Forests, State Forests and Other Crown-timber Lands**, *State Forests* November 1998
- Forest Practices Code Part 3: Plantation Establishment and Maintenance**, *State Forests* July 1997
- Forest Practices Code Part 4: Forest Roads and Fire Trails**, *State Forests* December 1998
- Standard Erosion Mitigation Guidelines for Logging in New South Wales (SEMGL)**: *Department of Land and Water Conservation, Soil Conservation Service* March 1993
- Erosion and Sediment Control Strategy for Eucalypt Plantations on the North Coast of NSW**, *Department of Land and Water Conservation and State Forests of NSW Hardwood Plantation Division*, 1997
- Soil Erosion Mitigation Guidelines For Native Forests of Inland NSW**, *Department of Land and Water Conservation and State Forests of NSW*, June 1999
- Soil Conservation Measures for Logging in River Red Gum Forests on the Depositional Floodplain of the Murray-Darling Catchment**, *Department of Land and Water Conservation and State Forests of NSW* (1993)

Dictionary

- “**aggregate**” means a unit of soil structure consisting of primary soil particles held together by cohesive forces or by secondary soil materials such as iron oxides, silica or organic matter;
- “**air-dry aggregate**” means the state of dryness of a soil aggregate at equilibrium with the water content in the surrounding atmosphere. The actual water content will depend upon the relative humidity and temperature of the surrounding atmosphere;
- “**armour**” means to provide a protective surface that is resistant to erosion or displacement by machinery or vehicles;
- “**Australian Map Grid**” means the 13 digit map coordinates (6 digit Eastings and 7 digit Northings) provided on a 1:25 000 or 1:50 000 map sheet produced by Land Information Centre (formerly Central Mapping Authority);
- “**batter**” means an earth slope formed by the placing of fill material or by cutting into the natural hillside;
- “**batter drain**” means a constructed and stabilised drain to carry runoff down a batter without scouring or erosion;
- “**batter stabilisation**” means the provision of adequate vegetative, structural or mechanical measures to control erosion from batters. Measures may include the provision of catch drains, topsoiling, seeding, mulching, geofabrics, benching, use of batter drains or use of retaining walls or other engineering structures;
- “**bench**” means a strip of relatively flat earth or rock breaking the continuity of a slope;
- “**best management practice**” means practices that have been developed to prevent or minimise pollution and to protect the environment. They are often applied to non-point sources of pollution where there is need to define a range of practices that need to be applied to prevent degradation of the environment;
- “**blading off**” means the removal of surface soil from a snig track or road in wet conditions in order to expose a drier or firmer surface for use by machinery;
- “**borrow pit**” means an excavation which does not form part of the road, from which fill material is extracted for road construction, upgrading or maintenance;
- “**bridge**” means a structure designed to carry a road over a drainage feature by spanning it;
- “**buffer strip**” means a strip along each side of a drainage depression in which soil disturbance during forestry activities must be prevented to the greatest extent practicable;

“**catch drain**” means a diversion drain excavated on the high side of the batter, embankment or road to intercept and divert surface runoff water before it reaches the batter, embankment or road;

“**causeway**” means a natural or man made crossing which enables vehicles to ford a drainage feature. The pavement of a causeway may consist of gravel, rock, bitumen or concrete, or of a stable natural surface;

“**Code of Logging Practice**” means:

- a) in the case of plantations harvesting, “Forest Practices Code: Part 1: Timber Harvesting in State Forests Plantations”, prepared by State Forests, July 1995;
- b) in the case of native forests, the “Forest Practices Code: Part 2: Timber harvesting in Native Forests, State Forests and Crown-timber Lands” prepared by State Forests, February 1999;
- c) in the case of plantation establishment, “Forest Practices Code: Part 3: Plantation Establishment and Maintenance” prepared by State Forests, July 1997; and
- d) in the case of roads and fire trail construction and maintenance, “Forest Practices Code: Part 4 - Forest Roads and Fire Trails” prepared by State Forests, February 1999.

“**compartment**” means an area of forest designated for forestry management purposes, principally for the cutting and removal of timber. A compartment is an area of forest identified by a compartment number and a State Forests name. Compartment boundaries are delineated on State Forests’ Geographic Information System (GIS).

“**concentrated water flow**” means the discharge of water from a structure across a surface in a manner other than a sheet of water, up to the peak discharge from a storm event of less than or equal to the required design specification for that structure. Concentrated water flow is evidenced by rivulets, rills, gullies or streams of water, or the eroded areas where rivulets, rills, gullies or streams of water have flowed.

“**constructed snig tracks**” means snig tracks that have had some form of machinery preparation prior to use, ranging from removal of leaf litter to the benching in of tracks around steep ground slopes;

“**construction**” means the act of building, erecting or installing;

“**crossbank**” means a hump of earth constructed across an extraction track, snig track, log dump or road to baulk the flow of water so that it can be diverted;

“**crossing structure**” means a structure designed to allow the crossing of a drainage feature. Crossing structures are bridges, causeways, and culverts;

“**crown timber land**” means lands for which the Forestry Commission of New South Wales has responsibility under the Forestry Act 1916, including State Forests, Flora Reserves, Timber Reserves, unoccupied Crown Lands, lands held in specified Crown tenures and Purchase tenure which have timber rights reserved;

“**culvert**” means one or more adjacent enclosed conduits for conveying a drainage feature underneath a road formation; .

“**deposition**” means the laying down of solid material which has been eroded and transported from a distant part of the land surface;

“**directional felling**” means the felling of a tree in such a way that it falls in a pre-determined direction. This is achieved by cutting the tree at a particular angle;

“**dispersibility**” means the behaviour of a soil material, whereby soil aggregates break down and separate into their constituent particles in water, due to deflocculation.

“**dispersible soils**” means soils which have been classified class 2, 3 or 4 as determined using the methodology specified in Module 3 of Schedule 3 of this licence;

“**dispersion**” means the process whereby soil aggregates break down and separate into their constituent particles in water, due to deflocculation;

“**disturbed area**” means an area which is susceptible to erosion because the vegetative soil cover has been removed or altered. The disturbance may be accompanied by the mixing or removal of some soil horizons;

“**drainage depression**” means a level to gently inclined shallow, open depression with a smoothly concave cross-section, rising to moderately inclined hillslopes;

“**drainage feature**” means a drainage depression, drainage line, major water storage, watercourse, swamp or wetland;

“**drainage feature protection area**” (plantation establishment only) means strips of retained vegetation along each side of a drainage feature to retard sediment movement and reduce the risk of erosion of banks, channels and depressions.

“**drainage line**” means a channel down which surface water naturally concentrates and flows. Drainage lines exhibit one or a combination of the following features which distinguish them from drainage depressions:

- a) evidence of active erosion or deposition - e.g., gravel, pebble, rock, sand bed, scour hole, knick points; or
- b) an incised channel of more than 30 centimetres depth with defined bed and banks;

“**drop-down structure**” means a non-erodable channel or hydrologic structure that discharges water over a fill batter. Drop-down structures may be constructed of gabion baskets, rock mattresses, precast concrete segments, geotextiles or half round sections of plastic, corrugated or concrete pipes. An energy dissipater must be used in conjunction with a drop-down structure.

“**earthworks**” means mechanical soil movement and disturbance. This may include the construction, upgrading and maintenance of log dumps, roads, drainage feature crossings, snig tracks and extraction tracks;

“**effective bank height**” means the minimum height of a crossbank above the outlet;

“**energy dissipater**” means a device in the base of a channel or running water that dissipates the energy of the flow. The dissipater reduces the velocity and depth by spreading the water flow over a larger area. Energy dissipaters may be constructed from rocks, logs, steel baffles and concrete blocks;

“**environmental goals**” means the environmental goals referred to in condition 2 (Objects of this licence);

“**EPA**” means the Environment Protection Authority;

“**erosion**” means wearing away of the land by running water, rainfall, wind, ice or geomorphological agent, including but not limited to processes such as detachment, entrainment, suspension, transportation and mass movement, at a rate accelerated due to forestry activities;

“**excavator**” means a tracked machine which moves earth by means of a bucket or other implement mounted on an hydraulically operated boom;

“**existing roads**” means roads which were in existence prior to the commencement of a forestry activity;

“**extraction**” means a route for transport of logs from the point of felling to the log dump or log landing;

“**extraction track**” means a track along which forwarding machinery travels;

“**felling**” means the process of cutting down standing trees;

“**fill**” means a previously excavated material that is used to raise the surface of an area to a specified level;

“**filter strip**” means a strip of vegetation or groundcover along each side of a watercourse or drainage line retained for the purposes of:

- a) retarding the lateral flow of runoff and facilitating its infiltration into the soil, thereby causing deposition and filtration of transported material, and reducing sediment movement into the stream; and
- b) retarding sediment movement into the stream by minimising ground disturbance which may reduce infiltration and concentrate water; and
- c) reducing the risk of erosion of the channel and bank;

“**forestry licence**” means any licence issued by State Forests under the Forestry Act 1916 or the Forestry Regulation 1999 which authorises the holder to carry out any forestry activities covered by this licence;

“**forwarding**” means the carrying of logs by vehicles from the point of felling to the log dump in such a manner that the logs are fully supported off the ground;

“**full supply level**” means the maximum level to which water is normally stored, not including any temporary surcharge due to flooding effects;

“**geotextile**” means a product used as a soil reinforcement agent and as a filter medium. It is made of synthetic or natural fibres manufactured in a woven or loose non-woven manner to form a blanket-like product;

“**grade**” means a unit of slope measured from a horizontal plane (measured in degrees);

“**gravel**” means a natural occurring mixture of coarse mineral particles larger than 2.0 mm and smaller than 75 mm in diameter. Gravel is placed on the surface of a road to increase the load bearing capacity of a natural surface;

“**gravel pit**” means a pit formed by extraction of gravel for the purposes of road construction, upgrading or maintenance;

“**gross area**” means the total area of land within a compartment or roading area, before exclusion areas are removed (in hectares);

“**ground-based harvesting**” means felling of trees where those trees will be extracted from the compartment using:

- (a) a dozer, skidder or forwarder; or
- (b) a winch attached to a dozer or skidder.

“**groundcover**” means material which covers the ground surface and has the effect of reducing erosion. Groundcover may include existing vegetation, leaf litter, tree debris, gravel, rock, straw, mulch, geotextiles, erosion control mats, jute mesh and coconut mesh;

“**groundslope**” means the angle of inclination of the ground surface from the horizontal expressed in degrees;

“**gully**” means an open incised channel with a depth of >0.3 metres and characterised by moderately to very gently inclined floor and steep walls. For the purpose of this licence, a gully is a type of drainage line;

“**gully stuffer**” means a type of crossing for a road or snig track or extraction track across a drainage feature. It is formed by filling the drainage feature with trees, debris, spoil, soil, rock or other material to the level of the road or track;

“**harvesting**” means the cutting and removal of forest products;

“**haulage operations**” means the removal and transport of timber products from, the point of loading within the compartment or roading area by machinery or truck along a road;

“**infall drainage**” means a drainage method for a section of road located in steep side slope terrain where the whole surface is in-sloped against the natural surface side-slope;

“**inherent soil erosion and water pollution hazard**” means the potential for soil erosion and water pollution to occur in an area as a result of forestry activities, and takes into account rainfall erosivity, soil erodibility (and dispersibility), slope, mass movement, existing erosion, groundcover and intensity of forestry activities. Inherent soil erosion and water pollution hazard is determined in accordance with Schedule 3;

“**licence**” refers to the Environment Protection Licence (EPL) issued by the Environment Protection Authority to State Forests of NSW.

“**log dam**” has the same meaning as “gully stuffer”;

“**log dump**” means areas where forest products are assembled for processing and sorting of logs prior to loading onto a truck;

“**logging debris**” means tree debris resulting from a forestry activity;

“**log landing**” has the same meaning as “log dump”;

“**machinery**” means all mechanical equipment used in the forest except chainsaws;

“**major water storage**” means a dam constructed for public irrigation or the supply of town water;

“**mass movement**” means the downslope movement greater than 10 cubic metres of soil regolith, where gravity is the primary force and where no transporting medium such as wind, flowing water, or ice are involved. The key factors which affect mass movement are slope angle, material strength, vegetal cover and site drainage. This may include, but is not limited to earth slumps, translational slides and earth flows;

“**mitre drain**” means a drain used to conduct runoff water from the shoulders of a road to a disposal area away from the road alignment. Often it is the extension of a table drain away from the road surface;

“mulch” means a natural or artificial layer of plant residue or other material covering the land surface that conserves moisture, holds soil in place, aids in establishing plant cover and minimises temperature fluctuations;

“natural surface road” means a road that is unsealed or not gravelled;

“net harvestable area” means the portion of a compartment available for forestry activities. The net harvestable area does not include any exclusion areas within the compartment;

“old roads” means roads which were in existence prior to the commencement of a forestry activity;

“outfall drainage” means drainage which occurs when the surface of a road, snig track or extraction track has cross slope causing water to flow across and off the surface. This flow of water is away from and not into the hillside;

“outlet” means the point at which water discharges from a:

- a) river, creek or other flowline; or
- b) lake; or
- c) tidal basin or drainage depression; or
- d) pipe, channel, dam, or other hydrologic structure;

“peak flow” means the maximum flow which occurs during a flood of a specified average recurrence interval. (Refer to Part C of Schedule 2 of this licence);

“permanent extraction track crossing” means a crossing or crossing structure that is retained at the completion of harvesting;

“permanent snig track crossing” means a crossing or crossing structure that is retained at the completion of harvesting;

“pollution of waters” has the same meaning as in the Protection of the Environment Operations 1997;

“post-harvest burning” means burning associated with the cutting and removal of timber which is carried out within 18 months of the timber being cut and removed;

“pulplog” means logs suitable for the manufacture of reconstituted products including paper and panel board;

“rainfall erosivity” means a measure of the ability of rainfall to cause erosion;

“rehabilitate” means to return an area of land or a road or track surface to a stable condition. This may involve reshaping the land, spreading topsoil, constructing banks, revegetating or employing a combination of these;

“relief pipe” means a pipe used to direct water from a table drain and under the road;

“revegetate” means to establish an effective vegetative groundcover by either natural regeneration or sowing with a seed and fertiliser mixture;

“rill” means a form of erosion that is characterised by small channels up to 0.3 metres deep which have cut into the surface of a slope;

“road” means any route used for the vehicular access to, and the transport of logs from, the point of loading within the compartment or roading area;

“road drainage” means a structure designed to direct water along, across or underneath a road, and includes catch drains, mitre drains, relief pipes, rollover banks, spoon drains, and table drains;

“road prism” means that part of the road from the inflexion point at the toe of the fill batter to the inflexion point at the top edge of the cut batter. Where there is no cut or fill batter as part of the road, then the road prism is to be taken from the outside edge of the table drain on either side of the road;

“roading area” means land which is disturbed by the construction of access roads necessary to enable or assist the cutting and removal of timber;

“rollover crossbank” means a crossbank constructed with a smooth cross-section and gentle batters, and which is well compacted to allow permanent vehicular trafficability;

“rollover drain” has the same meaning as “rollover crossbank” ;

“runnel” or runner is a depression or small stream which carries ephemeral flood waters through red gum forests;

“runoff” means that portion of the precipitation falling on a catchment area that flows from the catchment past a specified point;

“saprolite” means part of the weathered soil regolith profile. It is characterised by the preservation of structures that are present in the unweathered rock material;

“saturated soil” means the physical condition of a soil in which no more moisture can be absorbed or accepted. Saturated soils are subjected to compaction, rutting or displacement by machinery and vehicles;

“sawlog” means logs suitable for processing through a sawmill into solid timber products;

“sedimentation” means the process of sediment deposition.

“sediment control measures” means a measure or practice that is used to mitigate, reduce or prevent the amount of sediment in runoff waters;

“sediment trap” means a structure designed to mitigate, reduce or prevent the amount of soil that is being transported by runoff;

“SEMGL” means the “Standard Erosion Mitigation Guidelines for Logging in New South Wales” prepared by the Department of Conservation and Land Management, 5 March 1993 version;

“silt fence” means a fabric or mesh placed in the path of runoff which acts as a filter to reduce and detain sediment from runoff waters;

“slaking” means the partial breakdown of soil aggregates in water due to the swelling of clay and the expulsion of air from pore spaces.

“slash” means tree debris resulting from a forestry activity;

“snigging” means the pulling of logs, either wholly on the ground or partly supported from the point of felling to the log dump. Wheeled or tracked vehicles are used for this purpose;

“snig track” means a track along which snigging equipment travels;

“soil erodibility” means the susceptibility of a soil to erosion due to rainfall and the surface runoff of water;

“soil regolith” means the mantle of the earth and soil, including rocks and sediments altered or formed by land surface processes;

“soil stabilisation” means the provision of vegetative, structural or mechanical measures to prevent or control erosion by providing an energy-absorbent or energy resistant barrier on the soil surface;

“spoil” means excess soil, rock or other material excavated during forestry activities;

“spoon drain” means a drain with a semi-circular cross-section and which has no associated ridge of soil. Its capacity is solely defined by the excavated channel dimensions;

“stable” means the physical condition of a parcel of land or flowline which experiences no appreciable soil erosion, or sedimentation, and is protected from erosive agents. “Stable” also means a soil conservation or hydraulic structure which is functioning effectively and is not adversely affected by erosive agents;

“stable outlet” means an outlet which is protected from erosion, up to peak discharge of water flow from a storm event of less than or equal to the design specification of the structure;

“State Forests” means the Forestry Commission of New South Wales;

“State Forests’ licensee” means the holder of any licence issued by State Forests under the Forestry Act 1916 and the Forestry Regulation 1999 which authorises the holder to carry out any forestry activity covered by this licence;

“substantial debris” means logging debris greater than 100 millimetres in diameter and three metres in length;

“swamp” has the same meaning as “wetland”;

“**table drain**” means the side drain of a road adjacent to the shoulders of the road;

“**temporary extraction track crossing**” means a crossing or crossing structure that is removed at the completion of harvesting;

“**temporary snig track crossing**” means a crossing or crossing structure that is removed at the completion of harvesting;

“**toe**” means the bottom intersection line of two slope planes, that is the toe of a fill is the line formed by the intersection of a fill batter with the natural ground surface;

“**topsoiling**” means the application of topsoil to exposed or eroded areas, including batters and earthworks, to encourage the rapid growth of vegetation over them, for the purpose of soil stabilisation against erosion.

“**track drainage structure**” means any structure designed to direct water across an extraction track or snig track surface. These may include crossbanks, hay bales or sand bags;

“**tracksavator**” means a self-propelled, tracked tractor, commonly fitted with log forks, used for snigging and loading logs;

“**tree**” means a perennial plant with a self-supporting woody main stem or trunk which usually develops woody branches, and includes a sapling, shrub or scrub;

“**upgrading**” means the act of improving or replacing;

“**walk-over**” means timber extraction or snigging without removing or unduly disturbing the existing natural groundcover; that is, where no snig track construction or blading off is required or performed;

“**watercourse**” means a channel, having a distinct bed and banks, down which surface water flows on a permanent or semi-permanent basis;

“**wetland**” means a vegetated depression with a permanent, seasonal or intermittent water table at or slightly above the floor of the depression. The vegetation type in a wetland typically indicates a wetter micro-environment than the surrounding country;

“**windrow**” means an accumulation or mound of soil material on the edge of a road or snig track formed by the spillage from the edge of a blade or other similar machine during earthmoving operations;

STATE FORESTS OF NSW

VISION

More people benefiting from the diversity of State Forests’ products and services more often.

MISSION

We manage native and plantation forests for the widest possible range of benefits for current and future generations of people in NSW

VALUES

- Open and accountable to the people of NSW
- Innovative and responsive in achieving commercial and environmental goals
- Demonstrating integrity in how we deal with people both inside and outside of State Forests
- Meeting our commitments to our people, the community and the Government

State Forests is the trading name of the Forestry Commission of New South Wales



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