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PINE MANAGEMENT GUIDE

(CENTRAL REGION)

AUGUST 1984

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D. S[illegible]

AUTHORISED BY A/SUPERINTENDENT

FORESTS DEPARTMENT OF WESTERN AUSTRALIA
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INDEX

INDEX

INDEX

INDEX

INDEX

INDEX

INDEX TO APPENDICES

INDEX TO APPENDICES

SECTION 1

INTRODUCTION

1.1. Scope of Document

About this Document.

This document attempts to cover all pine forests operations pertaining to the Central Region. The main body of the "Pine Management Guide" deals with brief summaries of operational procedures, policies etc. Details are directed to appendices or to existing references such as the Foresters Manual. This document aims not to replace the Foresters Manual but to complement it.

Information in this document will be based on the latest techniques and policies, and will be updated continuously. However a formal review will take place annually each October. This will enable work to be programmed and next years estimates prepared from up to date information.

This document has replaced the Sunklands Development Plan. Two copies of "The Pine Management Guide" will be distributed to each Division and one copy to listed specialist personnel. The number of copies made available will be restricted. This will ease the task of recalling the documents for the update procedure.

1.2. Departmental and Government Policy

Current Policies

A report of the House of Representatives Standing Committee on Environment and Conservation into the operation of the Softwood Forestry Agreement Acts of 1967 - 1972 stated that the isolation of Western Australia justifies its Softwood Planting programme. The Forests Department has recognised the need to maintain wood supplies to the level of reasonable self sufficiency. To achieve this objective the Department has seen the need to plant pines at the rate of 3,250 ha per annum (Forests Department of Western Australia 1984).

Pine planting guidelines issued by A/Conservator of Forests 1st June 1984 state:

The State Government has accepted that W.A. should aim for a large degree of self sufficiency in sawlog resources. Self sufficiency requires a continuing pine planting programme to compensate for reduced production from native forests over the next 50 years.

This period is required to enable regrowth native forests to reach full production.

It is Government policy that for the present, the requirement for land for the P. radiata programme will come from cleared private land rather than from conversion of native forest. The land will be obtained by purchase or exchange or some form of leasehold yet to be developed.

1.3. Departmental Objectives

Overall aims

"To ensure that the estimated local demand for sawn timber and other wood products is met as far as possible from local suppliers. To gradually adjust the cut from the forest to a level consistent with the long term productive capacities of each species having due regard for employment in the timber industry and the associated regional economic stability." (General Working Plan No. 87 1982).

Increase annual pine sawlog production from the Forests Department plantations to approximately 960,000 cubic metres by the year 2020.

1.4. Regional Objectives

Regional aim to plant 2250ha per annum

The Central Regions annual planting target is to be 2,250ha. For 1985 and 1986 about 1,500ha is to come from areas already cleared in the Sunklands (Ref. Sec. 14 app. 25). The balance is to be made up from private property purchases, leases and exchanges. For the foreseeable future there shall be no further clearing of native forest in the Sunklands. In addition to the Central Region planting targets, the Northern and Southern Region are each to plant 500ha giving a Departmental total of 3,250ha.

Plant mainly P. radiata.

As far as possible the principle species planted in the Central Region shall be P. radiata. Other species P. pinaster and P. taeda can be used to "square off" management boundaries on sites not favourable to p. radiata. ie. either too dry or too wet.

Trained soil Surveyor

Develop in each Division a group of trained soil surveyors able to rapidly investigate properties on offer.

Sawlog commitment

Ensure known annual pine sawlog committments to industry are met, consistent with sensible silviculture viz.

1984 - 35000m^3	1987 - 68000	1990 - 160000	1993 - 210000
1985 - 58000m^3	1988 - 135000	1991 - 185000	1994 - 210000
1987 - 68000m^3	1989 - 160000	1992 - 185000	1995 - 210000

Promote the investigation and application if necessary of techniques such as variation in silviculture, fertilizing and establishment of legumes to accelerate the production of mill logs by economic means.

Improve quality of pine forests

Review establishment tending and other silvicultural techniques annually to update practices in the light of experience and any new research information so that future targets for the various pine log products are met at minimum cost.

Advance Planning

Promote advance planning of all major operations by Regional/Divisional meetings for major activities, e.g. planting.

Prepare advance 5 year harvesting plans by April of each year for all Central Region Plantations, with year one of the plan detailing specific operational areas and predicted yields by product classes. Prescriptions to be prepared for each area to cover requirements for minimising environmental damage.

Encourage the development, by I & P of improved forecasting of yields by quality and size classes for the various pine log products to be produced from individual cutting coupes.

Examine the feasibility of handling pine harvesting operations in the Region via a core group of functional officers from Divisions.

Liaise with Specialists

Encourage the interaction of operational and specialist people, e.g. harvesting and utilisation, research, protection, I & P and extension services in the development and review of all aspects of plantation management.

Encourage the development of grazing in plantations, particularly where grazing is likely to be feasible and viable for many years.

	Develop cost effective crushing methods for treating 2nd rotation debris instead of burning.
Inform General Public	Encourage and develop a better understanding and support for pine plantation by the general public by holding information tours for Shire Councillors, etc., developing demonstration forests, agro-forestry trials, etc.
Assist private pine forest owners	Become more active in assisting private pine forest owners on silvicultural techniques and plantation management generally.

SECTION 2

LAND FOR PINE FORESTS

2.1. Private Property acquisition

2.1.1. Purchase

Notification

Notifications of land for sale can originate from the following sources:

(a) Direct from the owner

or

(b) From a Real Estate Agent.

To avoid confusion from the outset, all notifications received should be forwarded immediately to the Superintendent of the Region.

Offer to sell and Permission to enter

Before carrying out preliminary reconnaissance of the land on offer, the Officer in Charge of the Division must complete Offer to Sell and Permission to enter Property form and have it signed by the owner. See Appendix 1.

Preliminary Reconnaissance Procedure

The O.I.C. of a Division will designate a competent officer to inspect the area offered for sale, having notified the owner and obtained permission to enter the property for this purpose. It is essential that the entire property be inspected on a systematic basis from boundary to boundary.

Reconnaissance Check List

A brief report; map should then be submitted by the Divisional O.I.C. to the Supt. of the region giving the details as outlined in the Private Property Reconnaissance Check List. Appendix 2.

If the Superintendent wishes to proceed with the purchase he will follow the procedure outlined by the A/Conservator of Forests dated June 8th 1984 as quoted below:

"In the development of pine forests on re-purchased farmland it is essential that the advice of specialist sections is incorporated

at appropriate stages of the development and that the interests of all external parties are accounted for. The following procedures are to be adopted:

Procedures to be followed

1. When an offer to sell a property to the Department has been made and the Regional Superintendent wishes to proceed with the matter, the Landscape Planning Section will be advised. They will immediately check for any gross adverse impacts of possible pine forest development.

2. If no gross adverse impacts are foreseen, the Superintendent will authorise a soil survey to be carried out in the usual way.

3. After completion of evaluation of a property by regional staff, the Superintendent will make a decision as to whether the property is worth proceeding to the stage of making an offer.

Consult appropriate Sections.

4. If it appears the property is a good proposition for purchase, the advice of Protection and Harvesting Branches and the Landscaping Section will be sought by the regional office to enable a generalised planting plan to be prepared. It is at this stage that the major technical input from specialist branches is expected.

5. Care is required to ensure the purchase would conform in proposed use to zoning schemes (eg. for catchment clearing).

6. The Regional Superintendent will then prepare his report and recommendation as to whether an offer will be made on the property and forward it to the Chief of Division, Operations.

Shire Council to be informed.

7. At the time of agreement on offer, a clause will be inserted to obtain agreement of the owner so that the Shire Council can be informed of the proposed purchase. When agreement to this is obtained, the Superintendent concerned will see that personal contact is made with the Shire Clerk and that any comments are recorded. Where the owner does not agree to discussion of the transaction with the Shire, the Minister will be so informed when seeking approval to purchase.

8. After a property has been purchased, the advice of specialist branches will be again called upon, where necessary, to ensure correct implementation of the ideas developed in stage 4 above.

Advise and Liaise with Neighbours.

9. Following purchase, the D.F.O. will personally advise all neighbours of the intended use of the land and welcome any constructive advice concerning the planning and management of the enterprise. Further, prior to any major establishment operation, the neighbours will be advised of the intentions, as is the current case with prescribed burning.

In order to assist with the implementation of the pine planting programme, a set of guidelines on pine planting has been prepared, and is attached. The guidelines will be updated as necessary"

2.1.2. Land Exchange

Need to thoroughly examine benefits of exchange.

Land exchange is a very complex and lengthy business. Officers in Charge should take care to ensure that a definite benefit exists before an exchange is entered into. Following preliminary positive reconnaissance inspection a detailed and thorough land inspection must be carried out.
Refer:
To Section 2.030 of the Foresters Manual.

2.1.3. Lease

Potential to lease land from private owners.

In future pine forests may be established on private land under lease agreements as discussed in the Treloar Report.

2.2. Crown Lands

2.2.1. P.W.D. Catchments

P.W.D. catchments and pines.

In the Central Region there is some potential for planting pines on properties acquired by P.W.D. in catchments. Further discussion with P.W.D. in this regard is required, whenever P.W.D. purchase land with pine planting potential.

2.2.2. State Forests

Policy on clearing native land.

At present there are restrictions on the clearing of native forests for the establishment of pine. There are significantly large areas of low quality forest in the Sunklands that can be converted to pine, if above policy changes.

2.2.3. Other

Other Crown Lands for pines.

Other Crown Lands outside of State Forests should be looked at in terms of exchange for pine plantable land.

APPENDIX 1

OFFER TO SELL & PERMISSION TO ENTER PROPERTY

I/WE .....

.....

of .....

Phone No.....(Business).....(Home)

hereby offer for sale to the Forests Department, the land described below comprising about.....hectares for the sum of $.....

Permission is granted to the Forests Department to enter these locations for the purpose of carrying out a reconnaissance and/or soil survey of the area.

This offer remains open till.....

DATED this .....day of.....19 .

SIGNED.....

Details of land offered for sale

- Location numbers, map reference, attached map.

APPENDIX 2

PRIVATE PROPERTY RECONNAISANCE CHECK LIST

SECTION I (Information fron owner)

1. Owners name (address and telephone number) or names if joint ownership _____
2. Location numbers _____
3. Map reference _____
4. Total area _____
5. Accurate map from owner attached. YES ☐ NO ☐
6. Boundary Survey required YES ☐ NO ☐
7. Asking price _____

SECTION II (Information from reconnaissance)

1. Area cleared and pastured _____ HA
2. Area regrowth and part cleared _____ HA
3. Area of native forest _____ HA
4. Cut over YES ☐ NO ☐
5. Volume standing _____ m3
6. Poles standing _____ Per HA
7. Type of native forest species _____
8. Quality of native forest GOOD ☐ FAIR ☐ POOR ☐
9. Area planted with pine species P. ..... _____ HA Age: _____
10. Area suitable for P. radiata _____ HA
11. Area unplantable _____ HA
12. Public utilities (Powerlines etc.) _____ HA

13. Shire zoning (Horticulture etc.) _____

14. Strategic values

- adjacent to existing plantations YES ☐ NO ☐
- distance from Bunbury _____ KMS
- access _____

  _____
- fire protection _____

  _____

15. Area with slopes over 14° _____ HA

16. Within Town Protection Area YES ☐ NO ☐

Distance from town _____ KM

17. Impact on landscape _____

_____

_____

18. Impact on other land uses _____
(Water supplies etc.
Catchments, recreation) _____

_____

19. Grazing potential GOOD ☐ POOR ☐

20. Noxious weeds Type _____

Area _____

21. Other improvements

Value of house _____

Transportable YES ☐ NO ☐

Other buildings Type _____

Value _____

Fences boundary (condition) _____

_____

Fences internal (condition) _____

_____

Dams Number _____

SECTION 3

SOIL SURVEYS

All detailed soil surveys will be supervised, co-ordinated and reported on by a Regional designated officer.

Soil Grid (200m x 100m)

Soil Grid System

The soil grid will be carried out by trained Divisional officers, or other designated officers in liaison with the Divisional O.I.C.'s. Before a detailed soil survey is commenced the Divisional O.I.C. must notify the owner that a detailed soil survey has been approved and explain what is involved.

Timing of the survey may have to co-incide with crop harvesting or other problem areas. The O.I.C. soil surveys will ensure that all staff designated to carry out soil survey field grids are fully conversant with the procedure.

Soil Map and Report

Soil Map and Report

On completion of the soil grid a map will be produced showing the various soil grades, other relevant information and the allocation of a soil survey identification number. This will be a combined operation involving the O.I.C. field grid and the O.I.C. Soil Surveys.

The O.I.C. Soils will then prepare a soil survey report on the property using the following headings:-

(1) Improvements

- 1.1. Cleared land
- 1.2. Regrowth
- 1.3. Bush
- 1.4. Buildings and fences
- 1.5. Water
- 1.6. Power lines (plantable area lost if relevant)

(2) Topography

(3) Access

(4) Standing timber

(5) Soil Grades

- 5.1. Grade A
- 5.2. Grade B
- 5.3. Grade C
- 5.4. Grade D
- 5.5. Grade E
- 5.6. Grade F

(6) Summary

(7) Recommendation

The final report and map will then be discussed with, the Regional Superintendent.

After discussion at the regional level, the map, report, and recommendation will be forwarded to C.O.D. Operations State Headquarters. As properties are often only on option for a limited time, speed is of the essence in processing these reports.

3.1. Hills

Soil types in Hills.

All hills soil surveys will grade for the growing of p. radiata only. For soil grades and soil grid procedure Appendix 3, also Ref. Foresters Manual Part 16, Soil Surveys.

3.2. Sunklands

Soil types in Sunklands

If soil surveys in the Sunklands are undertaken in the future, detailed descriptions of soil types and procedures as regards surveying and demarcation are shown in Appendix 4.

3.3. Coastal Plains

Soil types in Coastal Plains.

The coastal soils are split into two categories, yellow sands for radiata and grey sands for pinaster. For detailed descriptions see Appendix 5.

APPENDIX 3

SOILS GRADES - HILLS

A - Excellent (No change)

Exceptionally deep dark red to dark brown loam to sandy loam, with depths randing from 90 to 180cm. Derived from eroded mid-slope igneous rock formation; generally located in pockets along the lower slopes of dissections.

B - Good (No Change)

Dark red to brown loam to sandy loam with a minimum root-penetrable depth of 90cm. Generally located along the lower slopes of weathered igneous rock dissections, away from the laterite cap.

C - Satisfactory

Grade Ca

To 50cm at least a brown to yellow loam, sandy loam, or clay loam.

From 50cm - 90cm at least a yellow clay loam, sandy clay, or sandy gravelly clay.

Grade C1

To 50cm at least a brown yellow sandy gravelly loam, or loamy sand.

50cm - 90cm at least a yellow sandy gravelly clay.

D - Marginal

Grade Da

To 50cm (as for Ca) with the addition of yellow, grey and white sands.

From 50cm - 90cm (as for Ca) except the depth to gravelly clay, solid clay or rock occurs between 50 - 90cm.

Grade D1

To 50cm (as for C1) with the addition of yellow and grey sands.

From 50 - 90cm (as for C1) except the depth to gravelly clay, solid clay, iron-stone or heavy gravel occurs between 50 - 90cm.

E - Sub-marginal

Grade E1, Ea and Eo

Depth to impenetrable layer of clay, or rock is less than 50cm.

F - Unsuitable

Grade F

Sheet or broken rock with skeletal soils.

The following suffices are used after the grade initial (e.g. Bb) to demonstrate the soil origin:

a	acid soils
b	basic soils
d	dioritic soils
l	lateritic soils
m	metamorphic soils
o	alluvial soils

Field book gravel indications	g^1	0 - 20%
	g^2	20 - 60%
	g^3	60% +
Field book rubble indications	Ru^1	0 - 20%
	Ru^2	20 - 60%
	Ru^3	60% +

A g^3 and Ru^3 content from 0 - 50cms within the profile will automatically drop the soil grade to E.

APPENDIX 4

SUMMARY OF

SOIL TYPES OF THE DONNYBROOK SUNKLAND

Generalised description of the soil types set up for Forests Department mapping purposes. The type numbers do not equate with site qualities.

TYPE 1 LATERITE

Any soil having more than 20% by volume of hard lateritic gravel within 20cm of the surface. This includes boulder laterites.

TYPE 2 SHALLOW 'SANDS'

Loamy sands with a depth of between 20 and 51cm before gravel in excess of 20% by volume is encountered. Usually the gravel is considerably in excess of 20%, or the limit to depth may be massive laterite.

The colour of the 'sand' may be yellowish brown or greyish.

TYPE 3 YELLOWISH BROWN 'SANDS' DEEPER THAN 51cm

The texture is loamy sand or sand above a depth of 51cm but may be heavier below that.

There may be up to 20% by volume of gravel in the upper 51cm but that is usually of fine or medium grade. The limit to depth is usually heavier gravel or massive laterite, rarely clay.

There is occasionally present a thin layer, continuous or gragmentary, of accumulated organic matter (A_3 horizon).

TYPE 4 GREYISH BROWN 'SAND' DEEPER THAN 51cm

The texture again may be loamy sand or sand, and the colour may range from light grey (Munsell Soil Colour notation 5Y 7/2) through to dark grey (Munsell notation 5Y 4/1), or dark greyish brown (Munsell notation 2.5Y 4/2).

A common feature of this type is the presence of an A_3 horizon with its upper limit between about 60cm and 100cm. In most cases this forms a continuous 'coffee rock' layer but it may be fragmentary or only a dark brown colour horizon. The average thickness is about 15cm.

The type is sub-divided into three moisture phases which are characterised by the groups of indigenous plants which they support and which consequently are identified by addition of the letter-codes+ applicable to those groups, viz:-

4A - dry, highly leaches. Main indicator species are Banksia attenuata, Melaleuca thymoides, Leucopogon glabellus and Petrophile linearis.

4C - moderately moist, darker colour than above. 'Coffee rock' may occur in the profile. Main indicator species are Adenanthos obovata, Dasypogon bromeliifolius, Daviesia incrassata and Agonis parviceps.

4D - wet profile which may be shallow to a thick and dense layer of 'coffee-rock'. The most noticeable indicator plants are 'Swamp Banksia' and 'Paperbark' but Hakea ceratophylla, Dasypogon hookeri and Mesomelaena tetragona are more common.

+ See F.D., W.A. 1980, Research Paper 5/.

TYPE 5 LOAMY SOILS

The texture in the upper A_2 horizon is usually at least sandy loam but some profiles with loamy sand at this level are admitted because the texture becomes sandy loam or heavier within 61cm of the surface. The colour is most commonly light yellowish brown or yellowish brown but may be light greyish brown.

A soil may be classified at Type 5 even if gravel is present, as long as the proportion of gravel within 20cm of the surface is less than 20% by volume. A more frequent occurrence is the presence of gravel up to 10% only, before a limiting horizon with about 50% gravel is encountered. Usually, however, there is no gravel and the limiting horizon is clay.

The depth may vary quite widely.

TYPE 6 VERY HEAVY SOILS

The texture at the surface is at least sandy loam (often sandy clay) and grades down to sandy clay before the depth of 60cm has been reached.

The colour is light greyish brown, with mottling evident in about half the profiles, or light yellowish brown with mottling less frequently seen.

Gravel is present (at least 50% by volume) in admixture with the sandy clay of both colour phases, but more commonly in the yellowish soils.

TYPE 7 'ALLUVIAL' SOILS

These are soils having strong colours of brownish yellow (Munsell notation 10YR 6/8), strong brown (7.5YR 5/8), or yellowish red (5YR 5/6), usually associated with watercourses.

The texture is usually silty loam, silty clay loam, or sandy loam in the upper A_2 horizon, but may become heavier with increasing depth.

Gravel may be present in some profiles to the extent of 20% by volume, usually of fine grade.

The depth is usually in the range of 75cm to 121cm with laterite as the limiting horizon. Where clay texture is taken as the limiting horizon depth may be as little as 35cm.

POTENTIAL FOR PINE PLANTATIONS

All these soils have very low natural fertility. Type 1 is known to be unsuitable and type 6 is likely to be so because of poor aeration and penetrability. Type 2 appears likely to support only a slow growth rate at an uneconomic cost. Type 7 soils may support a rapid growth rate, but trees grown on them would be liable to instability in winter; in any case, most of the occurrences fall within mandatory stream reserves. Soil types 3,4 and 5 are regarded as the plantable land with the proviso that wet areas of type 4 must be left unplanted, at least initially.

KEY TO SUNKLANDS SOIL TYPES (FORESTS DEPARTMENT 1974)

			SOIL TYPE NO.
A		Gravel percentage within 50cms of surface more than 20%	
	B	Texture "sand" or "loamy sand"	
	C	Gravel more than 20% within 20cms of surface.	
D		Gravel within 20cms of surface more than 60%; massive laterite present	1b
D		Gravel within 20cms of surface; less than 60%; nor massive laterite	1g
	C	Gravel more than 20% deeper than 20cms from surface	
D		Colour range grey or greyish-brown	
	E	Basement is moderate to heavy gravel	2Gg
	E	Basement is massive laterite	2Gg
D		Colour range yellowish-brown or brownish-yellow	
	E	Basement is moderate to heavy gravel	2Yg
	E	Basement is massive laterite	2Yb
	E	Texture "sandy loam" or heavier	
	C	Gravel more than 20% within 20cms of surface	1F
	C	Gravel more than 20% deeper than 20cms from surface	
D		Colour range grey, greyish brown, yellowish brown	
	E	Basement is moderate to heavy gravel	
	F	Texture between gravel not heavier than "clay loam"	5G(shallow phase
	F	Texture between gravel "sandy clay" and maybe "clay" at surface; colour pale and mottling a feature.	6 (shallow phase
	E	Basement is massive laterite	5b
D		Colour range brownish yellow, strong brown, reddish; usually associated with drainage lines	7 (shallow phase

A		Gravel percentage within 50cms of surface less than 20%	
	B	Texture "sand" or "loamy sand"	
	C	Colour range light yellowish brown to brownish yellow	3
	C	Colour range light grey to dark greyish brown	
D		Profile dry; texture "sand", colour very light grey	4A
D		Profile moist but well drained; texture "loamy sand"	4
D		Profile moist to wet; texture "loamy sand"; organic "coffee-rock" present	4C
D		Profile poorly drained, or water-gaining site	4D
	C	Colour strong brown or reddish and associated with drainage line	7
	B	Texture "sandy loam" or heavier	
	C	Colour range, greys, greyish brown, yellowish brown	
D		Profile shows change of two texture classes between A_2 and B horizons	5D
D		Texture change down profile is gradual	
	E	Gravel forms base to profile, with matrix of "sandy clay" which texture may occur at surface; profile colour pale and mottling a feature	6
	E	If gravel base, matrix texture not heavier than "clay loam"	5G
	C	Colour strong brown or reddish; usually associated with a drainage line	7

NOTE: Characterising texture (level B in the key) is normally determined at 60cms depth, unless it is obvious from the profile description that a lesser depth applies. In this case the depth of description will be that immediately above some limiting feature.

Moisture status of greyish sands may be partly inferred from colour (amount and depth of black humus incorporation) and from texture.

APPENDIX 4 CONT'D

FIELD SELECTION OF SUNKLAND SOILS

1. METHODS USED

1.1. PRELIMINARY SUB-DIVISION PLANS

After the decision that No. 1 soil types were unplantable and that No. 2 soil types would be considered as marginal plantable soils, soil plans have been produced of the plantations selected from previous soil surveys.

The soil plans show the unplantable No. 1 type soils using a diagonal hatch, and No. 2 type soil boundaries are shown by a dot and dashed line. Treeless flats and 4D's are also shown dotted and Type 6 soils are shown with horizontal hatch .

1.2. SOIL TYPE SELECTION

The soil type boundaries were selected originally using aerial photograph interpretation and ground traverses.
Errors made in photo interpretation must be corrected in the field.

1.2.1. SOIL TYPE DESCRIPTION

The boundary to be selected in the field to segregate the plantable soils from the unplantable soils has now been decided as follows.

1.2.2. PLANTABLE SOILS

Plantable soils must have a minimum depth of 50cm of sand, sandy loam, or clay loam over a penetrable gravel layer to 90cm. (Generally a penetrable layer will have a gravel content no greater than 50%). Gravel in the upper 50cm of the profile is acceptable if it does not exceed 30% of the soil volume.

1.2.3. UNPLANTABLE SOILS

Unplantable soils have less than 90cm effective rooting depth. Soils in this category are sheet ironstone, ironstone boulders, and heavy to massive laterites at a depth of less than 90cm.

1.3. FIELD METHOD OF DEMARCATION

1.3.1. Selection of soils in the field is to be done systematically completing all soil boundary demarcation within a compartment before moving to another.

1.3.2. The information given on the sub-division plans shows the approximate position of the unplantable No. 1 type soils. (See areas diagonally hatched) It also shows the approximate position of the marginal No. 2 soil types bordered by a dot and dashed line (see areas on plan). Also 4D and treeless flats shown dotted and Type 6 in horizontal hatch.

By the correct use of this information we are able to define a line of the ground dividing as accurately as possible the plantable from the non-plantable soils. The method used is possible because almost 100% of No. 2 soils occur along the edges of the No. 1 type.

1.3.3. PRESENT METHOD

a) Within a compartment all No. 1 type soil areas are given reference letters (i.e., A to H).

b) Using a series of straight lines and starting from a fixed point on the perimeter of a No. 1 soil type the bearings and distances are measured around each pocket of a No. 1 type soil within a compartment. The results are booked, adding local magnetic variation and compass error to each reading. Each soil pocket must be booked separately under its reference letter (i.e. A,B etc.)

c) In the field using a reliable compassman and chainman the line of the No. 1 soil type is accurately traced on the ground starting always from the known fixed point. Thi trace line acts as a guide only to the field officer selecting the soil boundary.

d) The field officer using a reliable compassman starts off inside or outside the trace depending where he locates the edge of the plantable soil type. To find the depth required a narrow steel probe is used, marked at 50cm. With this instrument it is simple to select a depth of suitable soils to 50cm +, however, it is not possible to tell from probing whether a hard basement struck at 50cm is penetrable gravel of 50% or sheet ironstone. This operation will be carried out in May - October.

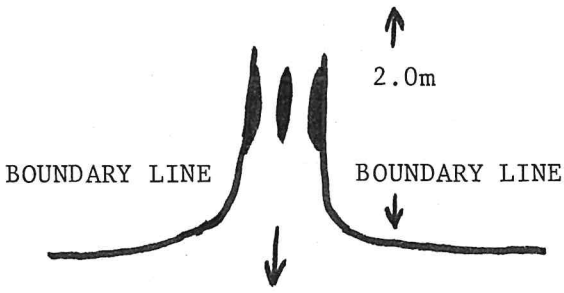
The soil selector accompanied by a fourth man who is used to axe blaze the soil line where indicated by the selecting officer. The selecting officer will veer away from the traverse trace when selecting the correct soil depth at times excluding unsuitable No. 2 type soils well outside the traverse trace or he may cut inside the trace to include in the plantable area a soil type wrongly interpreted as a No. 1.

No matter which side of the trace he veers the soil selector and the trace traverse will end up where they started off with the correct soil boundary marked on the ground.

The trace traverse acts as a guide to the soil selector and from its location he is able to mark on a field plan the approximate deviation of the soil boundary line from the original placement of the No. 1 type soil boundary.

e) Soil Boundary Marking When the final soil boundary has been decided, the edge of the forest to be left uncleared will be permanently marked as follows:-

Intervisible trees to be blazed with an axe at approximately 2.0m from the ground using the soil survey three blaze system. (ie. the two outer blazes to face the forward and backward line of the boundary and the centre blaze to face the area to be cleared - see sketch.



The blazes to be painted yellow and clearly intervisible to dozer operators. When the area is cleared all blazed boundary trees must be left standing.

f) Type 4D's, Treeless flats and Type 6's

These types as shown on the sub-division plans should be inspected in the field by the demarcating officer; if they are considered unplantable they should be demarcated out using the standard blazing system. Recognition of these types and if they are plantable or not comes with experience.

2. SUMMARY

To date field experience has shown that the overall plantable area will be reduced within compartments. This is mainly due to the loss of unsuitable No. 2 soils and under estimated No. 1 types.

This is partly balanced by the gain of No. 2 and No. 4 plantable soils wrongly classified from aerial interpretation as No. 1 sites. The overall loss will not be large and does not warrant alteration of the original selection system.

APPENDIX 5

SOIL TYPES COASTAL SANDS

Three soil types are involved where coastal pine forests are located as follows:-

a) Karakatta Sands

Consisting of undulating landscape with deep yellow calcaveous sands overlying limestone and classified as suitable for Radiata pine provided the depth of sand to limestone exceeds 90cms.

(Sometimes referred to as Tuart sands in the Ludlow area where yellow sands can reach depths of 10m).

b) Bassendean Sand Plain

The soils are mainly humus podsols with depths ranging from 90 - 36cms and consisting of leached grey sand overlying an organic or iron hard pan.

This soil type is located due east of the Karrakatta yellow sand belt on the Harvey Coastal Plain.

Currently this soil type is classified as suitable for Pinus pinaster only until further researcy proves otherwise.

c) Southern River Sand Plain

This soil type lies to the east of the Karakatta sands at Ludlow (Coolilup) and consists of grey sands with intervening swamps, iron and humus podsols, peats and clays. Only the drier sites are suitable for Pinaster growth.

SECTION 4

MANAGEMENT PLANNING

Following the soil survey (and the purchase of the property) a Management Plan will be prepared and approved. When preparing the Management Plan, the Officer in Charge should involve the following sections: Procurement, Protection and Landscape Section.

4.1. Planning

4.1.1. Landscape and Land Use

Landscaping planning & conservation.

The protection of rare species, catchments, creek reserves erosion, areas of particular scenic interest must be considered when designing the Management Plan.
Landscape Architects of the Information Branch must be consulted in the preparation of this Plan.
Conservation and land use details for the Sunklands that need to be carried forward are shown in Appendix 6. Refer to "Guidelines to Management principles for Forest Priority use areas" - May 1984.

4.1.2. Sub-Division

Engineering Planning

The road system should be designed primarily to provide access for operations and fire control. Long term requirements for logging should be made in consultation with procurement staff. For all aspects and requirements on subdivision refer to Section 16 of the Foresters Manual.

4.1.3. Fire Protection

Fire Protection Planning

The Management Plan must be designed in such a way that Fire Control, pre-suppression and suppression requirements are met. For Ref. Foresters Manual Section 16, and Section 9, Protection Section should provide the O.I.C of the Division with a framework of protection requirements for each pine forest.

4.2. Management Maps

4.2.1. Proposed forest establishment

The final Management Map

Once the detailed planning has been completed, all pertinent information must be placed on one composite map. Management mapping procedures as supplied by Mapping Branch are detailed in Appendix 8. The Officer in Charge will submit the Management Map to the Regional Superintendent for approval.

The Regional Superintendent will pass on the map to Protection Sections and Extensions Sections for their perusal and comment. The final draft approved by C.O.D. Operations then becomes a true Management Map. This Management Map then has the authority for the programming of all further works.

Management legend.

For Management Plan Legend see Appendix 9.

4.2.2. Existing Forests

Review and update all Management Maps.

Existing forests should have their Management Map updated in line with current policy. Once changes are made to Management Maps they must be formally submitted to the C.O.D. to approve these changes. New Management Maps should be prepared to cater for areas being prepared for 2nd rotation.

APPENDIX 6

LAND USE CONSIDERATIONS

1. MANAGEMENT PRIORITY AREAS

Several Management Priority Areas have been designated within the Donnybrook Sunklands. Any proposed logging, burning, gravel removal or road construction within the buffer or core area of an M.P.A. must have prior approval from the Superintendent.

NO.	Name	Purpose	Area
1.1.	Whicher	Lateritic uplands and incised valleys of the upper Sabina River in Whicher Range. E. haematoxylon Some endemic species.	6765ha
1.2.	Mowen	Conservation of Swamp Vegetation.	3242ha
1.3.	Chester	Conservation of only occurrence of Karri within Sunklands.	489ha
1.4.	Paget	Typical of wetter southern extremity of Sunkland complex. Conservation of Boronia megastigma	1427ha
1.7.	Rapids	Recreation.	2400ha
12.2	St John Brook	Incised valley of St John Brook in eastern Sunklands. Outstanding development of blackbutt with shrub understorey. Possible rare fauna habitat	3300ha
12.3	Milyeannup	Conservation of flora, fauna and landscape. All variations of Sunklands landscape. Complete range of vegetation types from open jarrah marri forest to sedgeland and shrubland	5700ha
12.4	Blackwood River	Recreation	16200ha

2. GAZETTED ROADS

"Gazetted major roads and other important roads" include C.A.R.G. roads, Shire roads and generally any roads which are reasonably well used by the public.

The native vegetation 10m each side of the centre-line of gazetted roads is to be demarcated and not cleared (Paragraph 1.3.1.8.)

APPENDIX 6 CONT'D

Cundinup	Sues
Jalbarragup	Rapids
Claymore	Mowen
White	Canebreak
Goodwood	Sabina

3. CATCHMENTS

There are four research catchments in the Sunkland:-

Apostles Brook 609/008 of 2630ha in Jarrahwood Plantation.
Ludlow River at Claymore 610/007 of 1010ha in Claymore Plantation.
St Paul Brook at Dido Rd. 609/004 of 2480ha in St Pauls Plantation.
Margaret River North at Whicher Range 610/008 of 1480ha in Baudin Plantation.

These catchments are used to quantify the effects of pine plantations on the hydrology of the Sunklands region.

Apostles Brook - guaging station was established about April 1976. At that time there was about 240ha of pine plantation P71-P76 on the catchment. Since then a further 700ha approx. has been planted in P77-P79.

This catchment is being used to monitor the increase in water usage by the pines as they grow.

Ludlow River at Claymore guaging station was established in about May 1977. Clearing for pine plantation establishment is not permitted before 2000. There is no pine planted to date. The status of this catchment will be reviewed in 1990.

St. Pauls Brook at Dido Road guaging station was established about November 1974. There is no pine planted to date. It was intended to be a long term control catchment but is required for pine plantation establishment by the Forests Department.

Margaret River North at Whicher Range gauging station was established in about May 1977.

General Comments:-

(i) The conversion process from sawlog cutting to planting is to be carried out over the shortest possible number of years. The current technique involves 4 years from initial clearing to planting but this may change.

(ii) Rotational prescribed burning of these four catchments is to be prescribed to minimise scorch height. Spring burning with 6 metre maximum scorch height and 60 - 80% of area burnt is acceptable Autumn burning is not acceptable.

(iii) St Pauls Brook and Apostles Brook catchments may be burnt at the same time but it is desirable that Claymore, Margaret River North and St. Pauls Brook/Apostles Brook are burnt in different years.

This would seem feasible at present with the next burns prescribed as follows:-

St Pauls Brook/Apostles Brook due November 1985.
Claymore due November 1984.
Margaret River North due November 1983.

(iv) Details of when road construction, logging, initial clearing, final clearing, ploughing and planting take place in each catchment are to be recorded to the nearest month by the Forests Department Division involved.

(v) The Forests Department Divisions involved are to keep the area Hydrographer (Don Barrett) P.W.D. Water Resources Branch at Manjimup informed of when it is intended to burn each catchment and before cutting, roading or clearing operations are to take place. This is to ensure protection of P.W.D. instrumentation.

4. JARRAHWOOD

Railway Reserve

East of compartments 6,5 and 14 , the clearing will be to the edge of the railway reserve. The reserve to be maintained clear of vegetation by the Forests Department for its length along the plantation edge. This will require discussion and agreement with the railway authority.

Timber Reserve

In the south-east corner of compartment 6, part of a timber reserve under the Forests Act has been included for clearing. Head Office was contacted on this subject and no objection was raised.

Jarrahwood Mill Settlement and Private Property

The Jarrah Forest around the mill and settlement, including private property location 2654, will require regular inspection and burning to ensure plantation safety.

Special Flora Locations

Two special flora locations occur in Jarrahwood plantation for the preservation of rare plant species:-

(a) Frank landia fucifolia occurs in compartment 11.

(b) Callistemon speciosus occurs on the southern boundary of compartment 6.

5. CLAYMORE

Railway Reserve

West of compartments 1,2,3 and 4, the clearing will be to the edge of the railway reserve. The reserve to be maintained clear of vegetation edge. This will require discussion and agreement with the railway authority.

Vasse Highway

No clearing within 200, on each side of the Highway.

Special Flora Locations

A special flora location for the preservation of the rare plant species Franklandia fucifolia occurs in compartment 3 on Pit Road.

6. ST PAUL

Whicher M.P.A.

The Whicher M.P.A. adjoins compartments 1 and 2 on the western edge of the plantation, and consideration must be given to this recreation, flora and fauna area when clearing burns take place and any other operation which may endanger the reserve.

P.W.D. Catchment Study

No clearing to proceed in St Paul Brook Catchment without approval from P.W.D.

Special Flora Locations

A special flora location for the preservation of the rare plant species Conospermum teretifolium is located in compartment 4.

7. BAUDIN

Whicher Reserve

The Whicher Reserve adjoins compartments 1,2,3,4 and 5 on the northern edge of the plantation, and consideration must be given to this recreation, flora and fauna area when clearing burns take place and any other operation which may endanger the reserve.

P.W.D. Catchment Study

Compartments 2,3,4 and Pt. 5 are in a P.W.D. catchment study area.

Pink Flowering Marri

A group of pink flowering Marri have been excluded from the plantation area. The group of trees situated north of Jalbarragup Road, Ref. GA 34 slightly north of Ref. tree (2) have been identified and marked with permanent marks and posts on the ground.

Special Flora Locations

There are five special flora locations in Baudin plantation for the preservation of rare plant species.

(a) Lambertia rariflora:

(i) south west corner of compartment 4
(ii) northern boundary of compartment 10
(iii) south west corner of compartment 2
(iv) boundary of compartments 2 and 11.

(b) Franklandia fucifolia occurs on the eastern boundary of compartment 13.

8. VASSE

Special Flora Locations

Six special flora locations for the preservation of rare plant species have been identified with Vasse Plantation.

(a) Lambertia rariflora - the four populations of Lambertia rariflora are located along streams which run into the Boyanup River to the north of the plantation.

(i) FW 18 - Vasse 2
(ii) FW 19 - Vasse 3
(iii) FW 20 - Vasse 3
(ix) FW 20 - Vasse 4

(b) A population of Brachysema sericeum is located on the eastern boundary of Vasse 3.

(c) The treeless flat in the north east corner of Vasse 3 contains several rare plant species.

Rapids M.P.A.

Rapids M.P.A. adjoins Vasse Compartment 8 on its southern boundary and encompasses part of the Margaret River catchment. Any operations within the buffer or core area of the M.P.A. must have prior approval from the Superintendent.

APPENDIX 6 CONT'D

9. SHELLEY

Vasse Highway

The road survey to be properly located and marked before clearing takes place. No clearing to take place within 200m each side of the Highway.

10. MILESI

Rapids M.P.A.

Rapids M.P.A. adjoins compartments 1,3 and 12 on the western edge of the plantation, and consideration must be given to any effect on recreation potential of the M.P.A.

Mowen M.P.A.

Mowen M.P.A. adjoins compartments 11 and 12 on the southern edge of the plantation, and consideration must be given to the fauna, flora and landscape values of the M.P.A.

11. CHAPMAN

Blackwood River M.P.A.

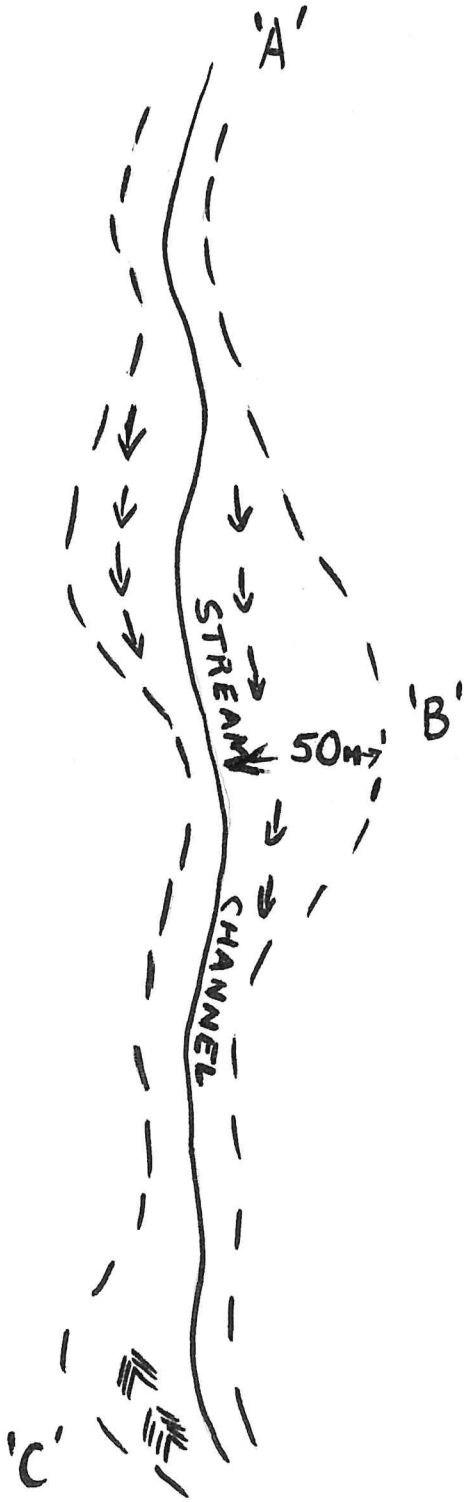
The Blackwood River M.P.A. adjoins compartments 5, 6 and 7 on the edge of the plantations, and consideration must be given to the recreational and conservational values of the M.P.A.

12. GENERAL NOTE

Location of rare species should not be made public. All data on location of rare species should be kept on H.O.C.S. and P.O.C.S. sheets and should be referred to by O.I.C. before carrying out all operations.

APPENDIX 7

STREAM RESERVES - CLEARING PRESCRIPTIONS



(a) All mapped streams must be left uncleared for a minimum distance of 10 metres each side of the main drainage channel. (See 'A') These are conservation areas and all flora must be protected.

(b) Where the stream disappears into a treeless flat, the uncleared strip will be widened to include the treeless flat. (See 'B')

(c) The edge of the strip to be left must be selected and marked clearly on the ground prior to machine clearing. Use the same marking as for soil edge (ie., yellow paint blazes). The marking should be clearly visible to a machine operator.

(d) At times Site 1 soil types may also cause the stream reserve to be left uncleared wider than 10 metres (see 'C')

(e) Windrows to be located at least 20 metres from the edge of the stream reserves.

(f) No debris to be pushed into stream reserve.

(g) Where recognised stream reserves cut a first class road, the creek reserve will be cleared and maintained in a clear condition for 10 metres each side (Except where a stream reserve is part of an unplantable internal pocket of hardwood forest.

PLANTATION PLAN DEVELOPMENT

Plantation Base requested over specific area. (MAPPING BRANCH ONLY)
JOB SHEET prepared SCALE 1 : 50000

SUNKLAND DEVELOPMENT SOIL SURVEYS

SOIL SURVEY PLAN - F.D. 1400 SCALE 1 : 25000
to show all soil types.

Contours supplied where available.

PRELIMINARY MANAGEMENT PLAN - F.D. 1095 SCALE 1 : 25000
To show 1 Plantable and Unplantable areas from soil survey plans.
2 Draft of proposed Subdivisions

DEMARCATION STAGES.

FINAL MANAGEMENT PLAN SCALE 1 : 25000
To show 1 Compartments
2 Plantable and Unplantable areas when demarcation and clearing is complete or well advanced.

HILLS SOIL SURVEYS

F.D. 1251 SCALE 1:12,500

MANAGEMENT PLAN SCALE 1:12,500

PLANTATION BASE PLAN SCALE 1 : 12500 (MAPPING BRANCH ONLY)
To show 1 Cadastral Information
2 Topo Information
3 Cultural Information
4 Contours

DEMARCATION PLAN SCALE 1 : 12,500
To show 1 Proposed Compartments
2 Plantable and Unplantable areas
3 Native Forest

PLANTATION PLAN SCALE 1 : 12500
When planting is of age it is plotted from photos on to the cronar base. This information is considered permanent. and P.O.C.S. sheets are updated from these plans.

APPENDIX 9 - MANAGEMENT PLAN LEGEND

MANAGEMENT LEGEND.

MAJOR ACCESS ROAD — C.A.R.G. SPECI. AND ABOVE

TRAFFICABLE ROADS (all vehicles) — — — — — —

TRACKS - - - - - - - - -

(4x4) FIRE BREAK (width.) - - - 4x4 / 5m - - - -

PLANTATION BOUNDARY

SUB SPECIES BOUNDARY .....

HOSE LAY TRACK — — · — — · — —

WATER POINT—PROPOSED W

WATER POINT—DEVELOPED Ⓦ

STRATEGIC F.R.B.'s PINE (BROWN)

HIGH RISK F.R.B.'s (RED)

HARDWOOD FOREST REGULARLY BURNT (year of burn shown in circle) [1] (ORANGE)

UNPLANTABLE

PARKLAND CLEAR & STAG FALL

LOADING RAMP — PROPOSED R

LOADING RAMP — DEVELOPED [R]

TURNING POINTS — PROPOSED T

TURNING POINTS — DEVELOPED Ⓣ

REFERENCE TREE COMPASS ◯1 THEODOLITE ◎

TRANSMISSION LINE

FENCE

FLATS, SWAMP

M.P.A.'s (GREEN BORDER)

SECTION 5

ENGINEERING

5.1. Roads

Plan roading density.

Pine forests will be divided by trafficable roads into compartments carying in size from 100ha in the hills to 400ha in the Sunklands. Each compartment is to be bordered by a second class road. Where practicable these roads should follow soil boundaries.
For specifications see Appendix 10.

5.2. Access Tracks

Need for occasional access.

For Fire Control and management reasons further access tracks might have to be constructed to provide access to areas of not more than 20ha. These tracks will primarily apply to the Sunklands plantations and coastal forests.

5.3. Firebreaks

Firebreaks adjoining S/F and P/P

Fuel free breaks are to be constructed on all external boundaries. Adjoining private property a 20 metre break is required. Adjoining State Forest boundaries a 10 metre break is required.
(This includes the width of the road surface).

5.4. Airstrips

Location of Airstrip.

Airstrips adjoining or very close to each major plantation can be extremely valuable for aerial fertilizer application and fire suppression, eg. reconnaissance or fire retardant drops. All strategically located airstrips should be marked on management maps. Where some are available or not really suitable, O.I.C.'s should carry out investigations of land on both State Forest and/or private property. Before developing a strip, liaise with the F.D. Aircraft managers and experienced aerial agricultural operators. See Appendix 11 for construction specifications

5.5. Water Supplies

Water point specifications and intensity.

All water points are to be established near arterial roads. All water points are to be constructed on a 3 kilometre grid or on the basis of a 20 minute turn around time for a heavy duty. Where possible, water points should be constructed by excavation to a permanent capacity of 200,000 litres. Otherwise tank and overhead fitting arrangements have to be made. For specifications see Appendix 12. Where grazing is envisaged provision should be made for stock access to water.

5.6. Fencing

Fences and specifications.	Where grazing is to be practices, existing fences are to be retained and maintained. If fences are to be constructed they should be as per specifications in Appendix 13.

APPENDIX 10

ROAD CONSTRUCTION

SPECIFICATIONS

1) 9m clearing width.

2) 7m formation width.

3) Turn around points to be constructed every 500m.

4) Side drains to be constructed every 100m.

5) Road clearing debris to be heaped into natural openings off the road survey and surrounded by a 3.5m mineral earth break.

6) Contractor is responsible for preparing creek crossings and subsequent earthworks, following pipe installation by the Forests Department.

7) An additional 20m clearing width to be provided where roads cross stream reserves.

8) All rocks and sticks to be swept off the road when the grader is forming the road.

Gravelling

Generally gravel will be applied over the 4 or metre road width to a depth of 15cm, however this will increase in areas prone to floading, or to cover pipes. All rocks and sticks are to be removed from the road surface, and final grading is to ensure that the road is properly crowned, and that all necessary site drains and grade drains have been installed and are free of obstruction.

Gravel Pits

All gravel pits are to be rehabilitated following the gravelling operation, with the exception of those required for future maintenance operations.

The procedure for operating a gravel pit is to be as follows:-

i) clear all vegetation from the demarcated pit area, and ensure heaps are not placed across the natural drainage lines from the pit.

ii) all merchantable trees are to be blazed by a Forest Officer, and kept separate from the debris heaps.

iii) all debris heaps are to be neatly stacked around the pit edge.

iv) any topsoil is to be pushed (or scraped) off the pit surface, and placed in separate heaps on the edge of the pit for later re-spreading.

APPENDIX 10 CONT'D

v) gravel removal is to proceed in a co-ordinated face to ensure effective utilisation of the resource, and as few "islands" as possible.

vi) following the gravel removal operation, rehabilitation proceeds with the initial respreading of stockpiled topsoil evenly over the pit area.

vii) banks of gravel pit are to be battered to form a shallow angle around the pit edge using a bulldozer.

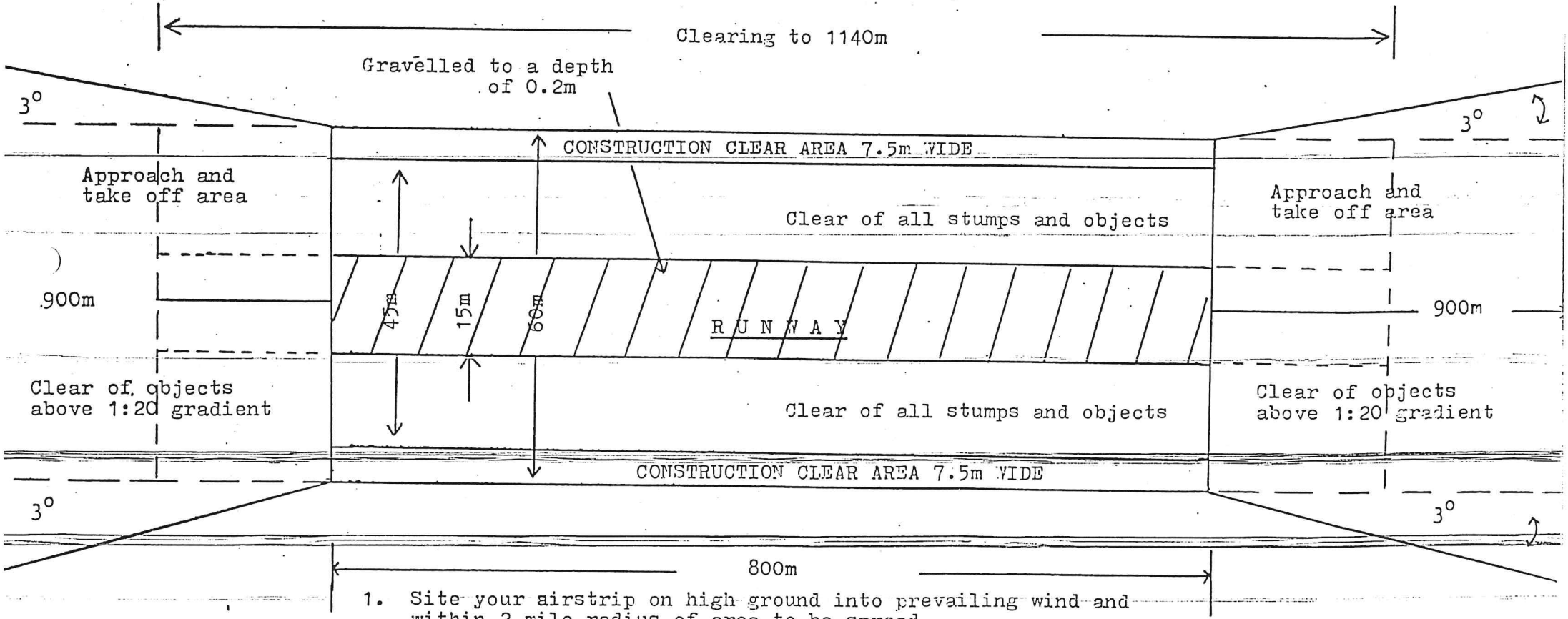
viii) the floor of the pit shall be ripped (using a bulldozer) to a depth of at least 1 metre, in lines 3 metres apart. All ripping shall be on the contour.

ix) Debris from the pit clearing operation shall than be pushed back into the pit, and stacked in tight heaps (maximum size 30m long by 3m wide) for later burning, with a minimum distance of 10 metres to the native forest.

x) the pit shall be drained where necessary to prevent pounding of groundwater.

xi) a sample rehabilitated pit should be inspected by the contractor before tendering to demonstrate the minimum standard required.

AIRSTRIP SPECIFICATIONS



1. Site your airstrip on high ground into prevailing wind and within 2 mile radius of area to be spread.
2. To test airstrip surface, drive car over it at 50 m.p.h. - there should be very little pitching or bouncing. Surface should feel smooth.
3. Cut excess grass from airstrip prior to use. Long grass creates a fire hazard and reduces aircraft acceleration.
4. Clear site on left hand side of airstrip for super dump. (e.g. : 50 tons - 50' x 30").
5. Ensure pilot has necessary qualifications and is prepared to land on the strip.

Runway Extension Graded 170m

Runway Extension Graded 170m

DAMS FOR FIRE CONTROL AND STOCK WATERING

1. Dam to be located in permanent wet situation (seepage area), preferably 2 metres out of stream bed.

2. Spoil to be spread and levelled away from dam edges.

3. Up and down stream sides to be battered to 3:1 slope, for stock access, and stone faced on seepage areas.

4. Front of dam to have bumper log and hand rail along face.

5. Dam dimensions:-

   i) width at top - 10 metres.

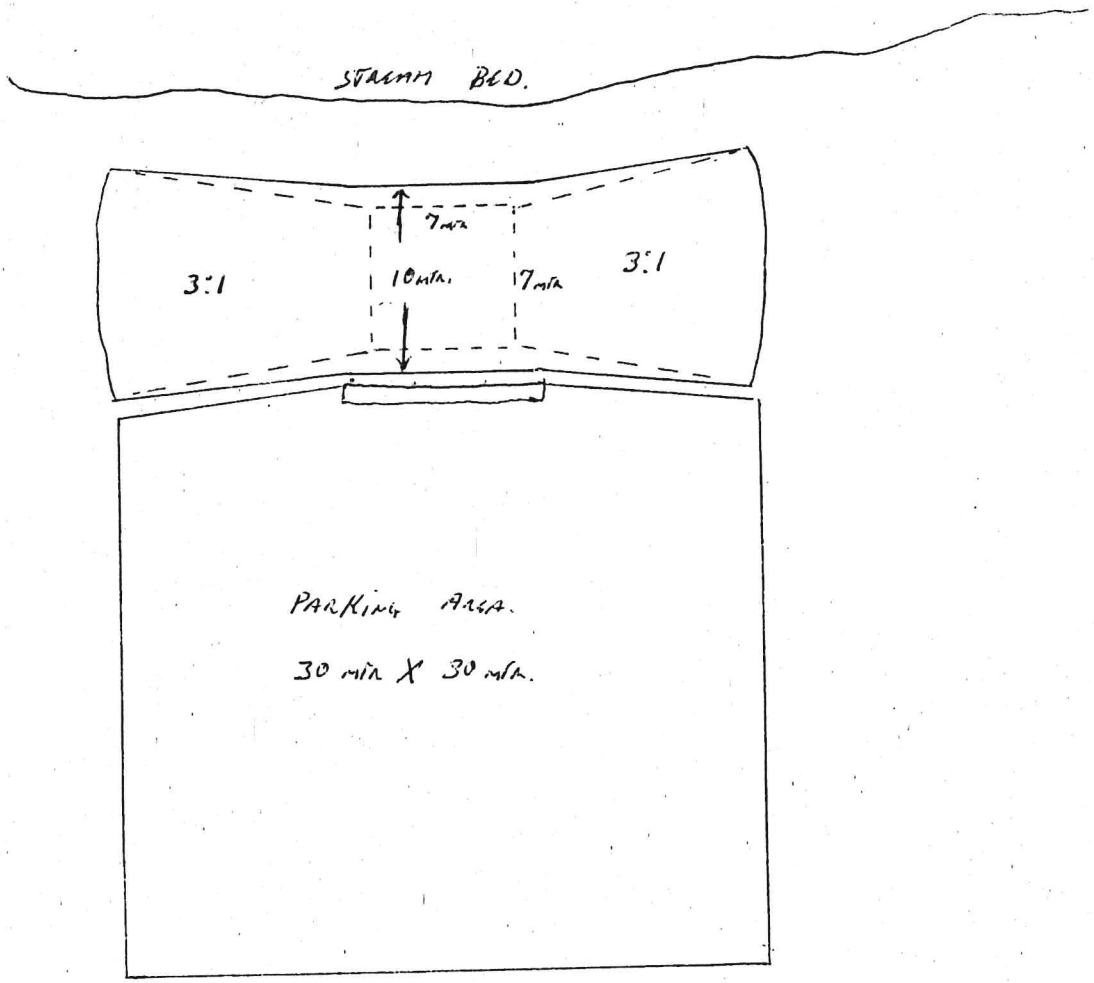
   ii) base - 7 metres square.

   iii) depth - 4.2 metres (of water).

   iv) stock access banks, full width, with 3:1 slope.

   v) park area, 30 metres by 30 metres. Gravelled where necessary.

6. Location, on through road access.



APPENDIX 13

FENCING SPECIFICATION

All Purpose Fence to be constructed using:

1. 6 line hinge joint (28" or 709mm) stapled to post, 5cm clear of ground.

2. Split jarrah posts at 12 metres.
   Posts 1.8 metre buried to minimum depth of .6 metre using post rammer or post hole borer.

3. 1 plain wire (2.8mm high tensile), strung through holes bored 15cm above hinge joint netting. Attach netting to plain wire at 2 points between posts using 10cm cyclone couplers.

4. Strainers, minimum of 20cm crown x 2.10 metre, buried to minimum depth of .9 metre.
   Stayed with 3.3 metre x 12cm crown horizontal stays, strapped with two laps of plain 2.8mm high tensile wire, strained not twisted.

5. Strainers to be erected at change in fence direction and at gates.

6. "Mallee" or galvanised gates where required as specified.

7. Fence line to be stump clean and graded with trafficable break of 3.5 metres both sides.

8. Fence line siting to give maximum length straight runs, and exclude large hardwood pockets from grazing.

Cattle Fence:

The potential of electric fencing for cattle grazing to be investigated.

SECTION 6

ESTABLISHMENT

6.1. Utilization of Native Timber

Remove all saleable material

Before clearing of native timber is undertaken the area must be fully utilized of all saleable material. To be able to do this in an orderly fashion, it is essential that careful and forward planning is carried out.

6.2. Clearing

Clear only to final management boundaries.

Prior to clearing commencing, the Officer in Charge must ensure that the management boundaries have been carefully marked in the field, that stream reserves have been demarcated and landscape requirements have been met.

6.2.1. Initial Clearing

Clearing by chaining

Initial clearing will be carried out by chaining or windrowing on a contract basis. For specifications see Appendix 14 and 15.

6.2.2. Clearing Burn

A good clearing burn can save costs.

Considerable savings can be made by ensuring a thorough burn is achieved. Protection buffers must be burnt around the areas proposed for clearing. This is to take place in early Spring. To achieve a successful clearing burn in a chained area, it is important to have about 4 years litter accumulation. Trials have indicated that the optimum drying period prior to burning is 1 summer. Consideration should be given to protecting all internal hardwood pockets.

6.2.3. Final clearing

Clearing standards.

Following a thorough burn by the Forests Department, windrows or chaining will be restacked into heaps. For specifications see Appendix 16 and 17. In fuel reduced buffers all debris should be final cleared and stumps removed.

6.3. Ground Preparation

6.3.1. Hills

Need to control noxious weeds, coppice, scrub & grass.

Euclaypt regrowth, bracken, noxious weeds should be controlled twelve months prior to planting.

In pastured areas the grass will be voroxed at the time of planting. (For details of chemical control, see the relevant sections in the Chemicals Manual.)
Compacted pasture areas which cannot be machine planted might have to be contour ripped.

6.3.2. Sunklands

Ploughing and mounding.

All areas will be totally ploughed to minimum depth of 20cm. In some types of soils with Emu Bush, double ploughing might be required.
Mounding is done with a specific mounding plough This treatment provides better drainage and aeration of soil and is essential if free water is likely to lie on the surface in winter.
To date it has been found necessary to mound each planting line as standard practice.
Mounding is to be at right angles to the contour and parallel to the rows of debris.
Mounds are to be three metres apart and .2 to .3 metres in height. Mounding is to stop 2 metres from the roads.
For specifications (see Appendix 18)

6.3.3. Coastal Plains

Ploughing and Furrow lining.

All areas will be totally ploughed to a minimum depth of 20cms. Furrow lining on planting lines is essential to concentrate water.

Establishing Clover.

6.4. Clovering

In 1979 it was decided for the Sunklands that the establishment of clover would become standard practice as an aid to soil fertility. Primarily clover establishment was to take place "in the Sunklands", but it is to be used in second rotation areas in the Hills and Coastal pine forests. Where it is not possible to establish clover on the coastal plain. Lupins might be used. For specifications (See Appendix 19).

Advantages of Clover

Benefits of Clover pines.

1. Assist machine flotation in advance clover situations.
2. Reduces scrub control problems, through the process of competition for moisture in the seedling stage and through the process of grazing.
3. Nitrogen fixing resulting in reduction in value of and the amount of inorganic fertilizer required.
4. Reduction of leaching of fertilizer.
5. Potential to graze and thus reduce fuels and fire hazards.
6. Investigate possible clover in older stands to build up fertility for 2nd rot. and control natural regeneration.

6. Potential to reduce costs by leasees applying fertilizer.

Possible Disadvantages

1. When planting into one year old clover, vorox strip spraying is required.

2. Late Spring build up of native bud worm on clover may lead to defoliation of pine seedlings. This problem should be monitored and reported to Divisional O.I.C.

3. Moisture competition may arise in sandy soils.

4. Ungrazed clover in the young pine stands add to fire hazard.

5. The broadcast fertilizer may increase scrub density, especially when initial clover establishment is poor.

6.5. Planting

6.5.1. Organisation

Need for annual Pre-planting meeting.

Regional officers and Divisional officers in charge should ensure that all preparation has been carried out as per this guideline and as per the Foresters Manual. A regional meeting should be convened with all the Divisional O.I.C.'s involved in planting to ensure that the co-ordination and sharing of plant and manpower and other resources is carried out in the most effective manner. This meeting should be well in advance of the planting season and should take place in the month of March. In the Hills, the planting season is generally limited to June and July. In the Sunklands the start of the planting season will depend on the amount of rain received.

Early start to planting is important

The soil profile must be wet before planting will proceed. In the Sunklands this might take place any time after mid-April. Flotation should be recognised as a problem and planting areas should be categorized into wet and dry areas. Wet areas should be planted first.

6.5.2. Hand Planting

Encourage piecework.

Hand planting will only be carried out where:

(a) flotation does not permit the use of tractors,
(b) to complete programme if machine planting falls in arears.
(c) to complete planting lines along debris heaps and road sides.

(d) in areas where it is too steep to use a tractor.

6.5.3. Machine Planting

Maximise machine planting

As much as possible all planting should be carried out by means of a tractor drawn planting machine. In the Sunklands and the coastal pine forests planting machines will be equipped with fertilizer despensers to apply a measured quantity of fertilizer to each newly planted tree. In the Hills pasture country the tractor will be fitted with spray equipment to apply weedicide along the planting line.

6.5.4. Care of Plants

Need for annual training sessions.

Prior to the planting season the Officer in Charge of the Division should ensure that there is a training session for all employees to instruct them on planting techniques and the care of plants. See Foresters Manual Section 16

APPENDIX 14

INITIAL CLEARING BY CHAINING

SPECIFICATIONS

Push down all trees using a chain and two bulldozers.

The following requirements will need to be met:-

1. No debris to be pushed outside the area to be cleared.
2. Machine and debris to be kept off formed roads.
3. Machine and debris to be kept out of creek reserves and unplantable areas.
4. Internal roads to be kept clear of debris.
5. A 60m break to be constructed around all unplantable areas. The windrows to be at least 30 metres from all native boundaries, roads and creek reserves.
6. Windrows to be broken every 200m by a gap of 20m.

APPENDIX 15

INITIAL CLEARING BY WINDROWING

SPECIFICATIONS

Push down all trees and windrows on a minimum of 60 metre centres in an area for plantation establishment. Rootrake between windrows removing all material of greater than 1 metre in length and/or 15cm in diameter working at right angles to the direction of the windrows. The following requirements will need to be met:

1) windrows aligned at right angles to the direction of contour.

2) No debris pushed outside the area to be cleared.

3) windrows to be broken every 200 metres by a gap of 20 metres.

4) windrows to be kept a minimum distance of 30 metres from creek reserves, roads and natural bush boundaries.

5) machines to be kept off formed existing roads.

6) a sample cleared area must be inspected so contractors can see the minimum standard required.

7) back blade prominent stump holes.

8) Internal roads to be kept clear of debris.

APPENDIX 16

FINAL CLEARING - CHAINING

SPECIFICATIONS

Following a thorough burn by the Forests Department debris will be heaped at minimum of 60m centres at right angles to the contour.
Rootrake between heaps removing all material greater than 1 metre in length and/or 15cms in diameter. The final heaps not to exceed 3.0 metres in width or 30 metres in length. Remaining debris heaps to be atleast 40 metres apart.

The following requirements will need to be met:

1) no debris to be pushed outside area to be cleared.

2) heaps to be pushed as high as possible and to contain minimum earth.

3) heaps to be aligned at right angles to contour.

4) machines to be kept off formed roads.

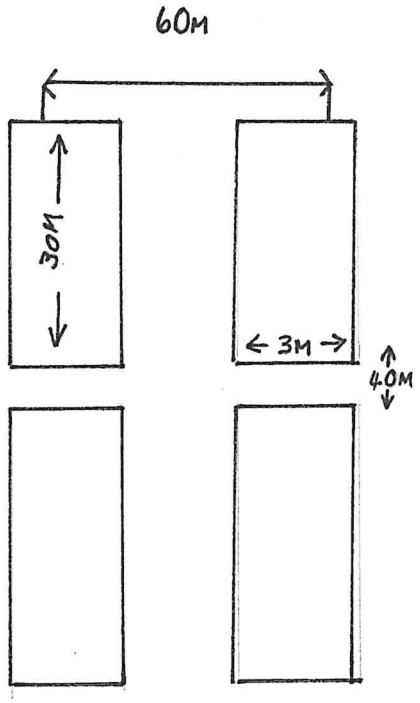
5) heaps to be kept 30m away from roads, creek reserves and natural bush.

6) a sample cleared area must be inspected so contractors can see the minimum standard required.

7) back blade prominent stump holes.

8) Relighting of heaps where directed by F.D to be the responsibility of Contractor.

Diagram



APPENDIX 17

FINAL CLEARING WINDROWS

SPECIFICATIONS

DESCRIPTION

Following a thorough burn by the Forests Department windrows will be restacked into heaps. Tge length of the heap will depend on amount of debris remaining following the burn but must not exceed 30 metres - area to be raked sufficiently to ensure material greater than 1m in length or greater than 150mm in diameter are in final heaps.

Unburnt log debris will be accepted in the heaps provided the total width does not exceed 3.0 metres. Remaining debris heaps to be at least 40 metres apart.

The following requirements will need to be met:

1) no debris to be pushed outside the area to be cleared.

2) heaps to be kept a minimum distance of 30 metres from creek reserves, roads and natural bush.

3) heaps to be pushed as high as possible, and to contain minimum amounts of earth.

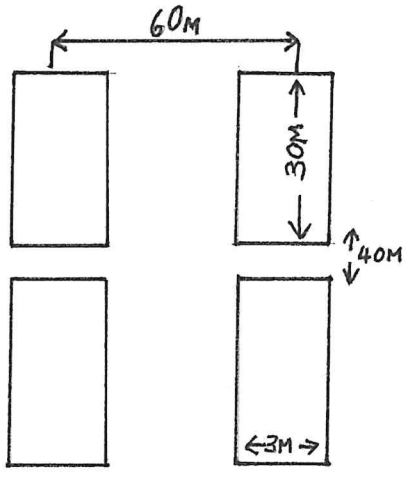
4) machines to be kept off formed existing roads.

5) a sample cleared area must be inspected so contractors can see minimum standards required.

6) back blade prominent stump holes.

7) Relighting of heaps where directed by the F.D. to be responsibility of contractor.

Diagram



APPENDIX 18

GROUND PREPARATION

PLOUGHING

Description: Plough, making a single pass over compartment cleared for plantation establishment; to a minimum depth of 20cms.

Machines: A tractor, suitable to pull a Connor Shea Little Giant or equivalent, plough.

MOUNDING

Description: Mound at right angles to the contour. Mounds are to be 3.0m apart 0.2 to 0.3m in height. Mounding is to stop 2m from the road.

Machines: A wheeled tractor, minimum H.P. rating equivalent to a M/F 165, Mound plough to be supplied by Forests Department.

APPENDIX 19

CLOVER ESTABLISHMENT

All planting areas to be clovered using the following guidelines:

1. Ground broadcast with large capacity trailing spreaders.

2. Application rates of 12kg/ha of Esperance Trikkala mix, proportions to be determined by harvest recoveries.

3. Application with 500kg/ha of Super CuZnMo No. 2 mix.

4. Application to commence third week in April.

5. Ground preparation to be standard for Sunklands Plantations ie. plough and mound.

6. All areas to be covered harrowed within 48 hours of broadcast.

7. Trial area with split application to be:

   A. spread with fertilizer as of 1st April.
   B seed spread with vicon T.P.L. spreader and cover harrowed as of 1st of May, preferably as one operation.

If this operation proves practical, it should be used in all future pasturing operations to overcome problems with fertilizer acidity affecting seed and inoculand viability. It will also enable seed to be broadcast and cover harrowed into damp soil after rains start, without worry of bulk fertilizer being weather spoiled.

Preparation:

1. Allow for areas to be clovered on estimates.

2. Write and call contracts for carting and spreading, by mid February.

3. Prepare job prescriptions (available through Busselton)

4. Plantation areas to be checked, all boundary tracks to be graded for access.

5. Selection of fertilizer dump sites for each compartment.

Materials:

1. Calculate the amounts of fertilizer and seed required for each compartment.

2. Requisition fertilizer, (Bulk Super CuZnMo No. 2) through Stores Branch to obtain G.S.O. for C.S.B.P. Picton, in January. Contractor to pick up and deliver to site, weather proofing to be provided.

3. Production area clover seed to be obtained through Busselton Office. If needed, requisition extra seed.

4. Seed to be suitable cleaned and scarified. Contractor to collect seed from Ludlow. Inoculation lime pelleting to be done less than one week prior to sowing.

Operation:

1. Maximum swath width of 12 metres.

2. Clover seed to be uniformly spread and mixed into fertilizer when hopper is levelled at 1/3 full.

3. Machine calibration to be checked at commencement of operation, and monitored progressively.

SECTION 7

SCRUB CONTROL

Competition from re-growth of native plants restricts the growth of pine. Control of this re-growth is essential to optimise pine growth.

7.1. Hills

Control of Eucalypt coppice.

Methods to be used in the control of regrowth of Eucalypt coppice is detailed in Appendix 20.

7.2. Sunklands

Inter-row cultivation and control of scrub.

Control of Eucalypt re-growth is detailed in Appendix 20. In areas where there is dense scrub re-growth, inter-row cultivation in the summer following planting shall be carried out. There is evidence that both a dense sward of clover and grazing will control re-growth to some extent. Every endeavour should be made to graze these areas as soon as the pines are sufficiently tall (Age 2 - 3)

7.3. Coastal Plains

Voroxing for grass competition.

Generally in the coastal plain scrub and grass is not a problem. However, the Officer in Charge should closely monitor the situation and if necessary vorox should be applied to control the grass and inter-row cultivation carried out to control dense scrub re-growth.

The control of Eucalypt re-growth is detailed in appendix 20.

CONTROL OF EUCALYPT REGROWTH

1. Foliar spray

1.1 Time of treatment: November to February

1.2 Size of regrowth: Less than 800 mm in height

1.3 Equipment:- drench guns fitted with Rega No. 6 nozzle or plastic pressurised pack sprays
- small axe
- mixing tank
- safety equipment (see F.D. 729)

1.4 Mixture: 1 part "Roundup" to 15 parts of clean water. Add Ciba Geigy red herbicide dye if required

1.5 Method: complete coverage of foliage

2. Stem injection (Notching)

2.1 Time of treatment: end of September to April

2.2 Size of regrowth: when stem diameter is greater than 25 mm and less than 100 mm

2.3 Equipment:- drenching gun fitted with "Rega" No. 6 nozzle
- notching axe (25 mm blade width)
- mixing tank
- safety equipment (see F.D. 729)

2.4 Mixture: 1 part "Roundup" to 1½ parts of water

2.5 Method: the point of injection must be as close to ground level as possible. Treat all stems in a stool including those that appear insignificant. The frequency of notches is 1 for every 25 mm of stem diameter. Make deep clean notches, placing them evenly round the stem and apply 2 ml of mixture to each notch.

3. Cut stump

3.1 Time of treatment: end of September to April

3.2 Size of regrowth: greater than 1 m in height

3.3 Equipment:- drenching gun fitted with "Rega" No. 6 nozzle
- small chainsaw
- mixing tank
- safety equipment (see F.D. 729)

3.4 Mixture: 1 part "Roundup" to 10 parts of water. Add "Ciba Geigy" red herbicide dye.

3.5 Method: fell the regrowth as close to the ground as possible leaving a horizontal surface.

.../2

Apply 2ml of mixture for every 25mm of stem diameter concentrating on the area of the cambium. Treat all stems in a stool including those that appear insignificant. Small regrowth and lignotuberous growth may be foliar sprayed using the same concentration (refer Section 1).

CONTROL OF SCRUB SPECIES

4. Interrow cultivation

4.1 Timing: in the summer following planting of pines

4.2 Equipment: 1.8m Connor-shea plough or Horwood Bagshaw blade plough with coulter.

4.3 Prescription: all plantations will be interrow cultivated.

5. Dense clover and grazing

5.1 Clover: clover must achieve 100% cover in the first year for there to be effective reduction of scrub species.

5.2 Grazing: for grazing to an effective means of reducing scrub, clover should be established at least one year in advance of planting. Sheep should not be introduced to plantations until trees are 2m in height (2-3 years old). In normal circumstances grazing is not an effective means of controlling eucalypt regrowth.

6. Control of clover on the mounds by herbicides

6.1 Herbicide: "Velpar L" (250 gm.l^{-1} hexazinone)

6.2 Equipment: tractor mounted cone or even spray nozzle(s)

6.3 Rate: 6 litres per sprayed hectare

6.4 Calibration: 200-250 litres per sprayed hectare

6.5 Swath: 1 metre or total coverage of the mound

6.6 Method: nozzles must be attached behind the planting machine to avoid incorporation of herbicide into the soil around the pine roots.

6.7 Safety instructions: refer to F.D. 729, No. A28.

SECTION 8

NUTRITION

Aim for optimum growth yield.

It is imperative that each area planted with pines is growing at an optimum rate. Maximising volume per hectare will mean that less area of pine has to be planted. All the pine forests planted on poor soils have nutritional regimes prescribed. (For example, Sunklands and Harvey Coast.) Hills Forests which have been planted on average sites or stands that have been suppressed through delayed thinnings might not be growing at optimum rates and should be considered for fertilization.

8.1. Regimes

The current fertilizing regimes are detailed in Appendix 21.

Regime A

Regime A is to apply to the following pine forests:-

1. P. radiata on yellow sands
2. P. radiata on grey coastal sands
3. P. radiata on Stockton Plantation
4. P. radiata on non-clovered areas in the Sunklands.
5. P. pinaster on non-colovered areas in the Sunklands.
6. P. taeda and P. elliottii in small areas in the Sunklands.

Regime B1

Regime B1 is to apply to the following Sunklands pine forests:-

1. P. radiata clovered in the Sunklands on the new schedule with no advanced clovering.
2. Other species, such as P. pinaster, P. taeda and P. Elliottii in the Sunklands in small areas with no advanced clovering.

Regime B2

Regime B2 is to apply to the above Sunklands pine forests but for areas covered by old schedule with no advanced clovering.

Regime B3

Regime B3 is to apply to the Sunklands pine forests in areas with advanced clovering.

Regime C

Regime C is to apply to P. pinaster forests on grey coastal sands.

Regime D

Regime D is to apply to P. radiata forests on average hill sites

There is no fixed fertilizer regime for these areas. Problem areas are to be treated for deficiency as required and particularly after first thinning. More research input is required in the Hills areas to see what response can be gained from fertilization.

8.2. Timing

Fertilization of clover in Autumn.

Where forests are grown on clover, the clover must be re-fertilized in Autumn. For details see Appendix 19.

Fertilization of pine stands in Spring.

For all other subsequent application of fertilizer, the programme should be ready and the fertilizer should be applied by September. Timing of application is paramount, if the fertilizer is applied too early, unnecessary leaching occurs. If the fertilizer is applied too late, then the benefit from the fertilizer is lost due to the lack of rain fall.

8.3. Application Methods

Spreading of fertilizer methods.

Where access is possible in the younger pines, ground application should be considered because it is less expensive and a more uniform spread can be achieved. It might be possible to also use ground application methods after first thinning. In other instances, aerial methods should be used. Aerial application can be used effectively if the boundaries are carefully marked in the field with navigational aids.
To ensure an even application from an aerial method a grid system can be used.

8.4. Deficiency Detection

Monitoring & Recognising nutrient and trace element deficiencies.

All staff and operators should be trained in recognizing deficiency symptoms. This is to apply in all pine forests Hills included and to apply to all deficiencies, nitrogen, phosphorous and trace elements. See Appendix 22 for details.

APPENDIX 21

PLANTATION NUTRITION REGIMES - CENTRAL REGION

Regime A to apply to the following pine forests:

1) P. radiata on yellow sands
2) P. radiata on grey coastal sands
3) P. radiata on Stockton Plantation
4) P. radiata on non-clovered areas in the Sunklands
5) P. pinaster on non-clovered areas in the Sunklands (small areas not worth separating)
6) P. taeda and P. elliottii in small areas in above plantation sites

N.B. There is insufficient research information available to separate 1.1 and 1.2

Age/Yrs	Fertilizer	Rate
0	Super Cu Zn 'B': Agras No. 1 (3:1)	150g/tree
0.5	Foliar Spray Zn: Cu S04	5kgs:0.2kg/h
2	Super Cu Zn 'B':Agras No. 1 (3:1)	400kgs/ha
	Foliar Spray Zn:Cu S04	10kgs:0.5kg/
4	Super Cu Zn B: Agras No. 1 (3:1)	400kgs/ha
6	Super Cu Zn B: Agras No. 1 (3:1)	400kgs/ha
	Foliar Spray Zn: Cu S04	20kgs:1kg/ha
12-14	Super Cu Zn B: Agras No. 1 (3:1)	400kgs/ha

Regime B1 to apply to the following Sunklands pine forests:

(1) P. radiata clovered in Sunklands new schedule with no advanced clovering
(2) P. pinaster)
(3) P. taeda) - in small areas within stands not worth separating
(4) P. elliottii)

NOTE: This expensive regime is approved for use only where absolutely necessary. As far as possible, nitrogen deficiencies are to be overcome by introducing legumes either at establishment or later in the rotation. The treatment of marginal sites is questionable and must be critically considered with a view to the possibility of abandoning sites too poor to respond economically.

Age (Yrs)	Fertilizer	Rate(Kg/ha)
0	Super Cu Zn Mo No. 2 applied with 12kg/ha clover seed	500
	3 Super CuZn 'A': 1 Agras No. 1	235g/tree
1	Superphosphate (9.1%P)	400
3	Superphosphate (9.1%P)	200
5	Superphosphate (9.1%P)	200
5	Zn SO_4) If required. Foliar sprays*	20
	Cu SO_4)	1
12 - 14 (or one year after thinning)	Su Cu Zn Mo No. 2	400

Regime B2 to apply to above Sunklands pine forests but for areas covered by old schedule with no advanced clovering.

Age	Fertilizer	Rate
0	Super Cu Zn Mo No. 2 applied with 12kgs clover seed.	500kg/ha.
	Super Cu Zn B	150gms/tree
2	Super (9.1%P)	200kgs/ha
4	Super (9.1%P)	200 "
6	" "	200 "
6	Zn Cu SO4 if required foliar spray	20:1kgs/ha
12 - 14	Super Cu Zn Mo No. 2	400kgs/ha.

Regime B3 to apply to above Sunklands pine forests but for areas with advanced clovering

Age	Fertilizer	Rate
-1	Super Cu Zn Mo No. 2 applied with 12kgs clover seed	500kgs/ha
0	3 Super CuZn 'A': 1 Agras No. 1	235gms/tree
1	Super (9.1%P)	400kgs/ha
3	Super (9.1%P)	200kgs/ha
5	Super (9.1P)	200kgs/ha
	Zn Cu S04 if required, foliar spray	20:1kgs/ha
12-14	Super Cu Zn Mo No. 2	400kgs/ha

Regime C To apply to P. pinaster forests on grey coastal sands

Age	Fertilizer	Rate
0	Super (9.1%P)	60gms/tree
8	Super (9.1%P)	500kgs/ha
16	" " (After T.)	500kgs/ha
	" "	

Regime D P. radiata forests on average hill sites are not to have a fixed fertilizer regime. Problem areas are to be treated for deficiencies as required, (particularly after first thinning)
More research input required in this field to see what response and yield increases can be gained from a fertilizer regime.

Regime E To apply to all Second Rotation P. radiata in the Hills forests (leave for one summer prior to crushing)

Age	Fertilizer	Rate
0	Crush debris, do not burn Agras No. 1	150gms/tree
N.B. No recommended subsequent fertilizer regime. Treat individual problem sites as necessary until further research information becomes available.		

Regime F To apply to all Second Rotation P. radiata forests on coastal Sands (leave for one summer prior to crushing)

Age	Fertilizer	Rate
-1	Crush debris do not burn	
-1	Cn Zn Super B with 50kgs/ha	
	Lupin seed (variety fest)	500kgs/ha
0	Super Cu Zn B: Agras No. 1 (3:1)	150g/tree
	Super potash 5:1	200kgs/ha
+1	Super potash 5:1	200kgs/ha

Regime G Second Rotation P. pinaster on coastal sands

Because there is a survival problem avoid clear felling on grey sands for time being. Until further research information becomes available if required use same regime as for P. radiata (Regime F)

NOTE: Not approved. Techniques for second rotation establishment are still being developed. Serious weed problems are still to be overcome. Windrowing and burning may be required in some cases. The role of legumes needs to be clarified.

APPENDIX 22

RECOGNITION OF NUTRIENT DEFICIENCIES

With the current practice eliminating the 6 month foliar spray and subsequent aerial minor element applications, it will be necessary to closely monitor the nutrient status of the pines.

The following is a guide to recognising the element deficiency by observing the foliar condition.

Note that disorders of trees can be caused by incorrect mineral nutrition, poor soil structure, unsuitable climatic factors, pathogens and management effects.

Symptoms of mineral nutrient imbalance must be assessed in conjunction with the stand history, climatic and soil factors.

1.

10 Year old P. Radiata

Phosphorous:

Foliage has a darker green colour than usual. Thin crown with shorter needles, a tufty appearance.

2.

1 Year old P. radiata.
Chronic Zinc deficiency.

Zinc:

Rosetting occurs, needles are much shorter. Seedlings have a flat top appearance. The terminal needles are yellow at the tops and last years needles are shed.

3.

1 Year old P. radiata.
Early stages of copper deficiency.

Copper:

Foliage turns bluish green, the tip of the needles die, shoot growth is weak and drooping, having a 'candelabra' appearance.

4.

1 Year old P. radiata.
A combination of Copper and Zinc deficiency.

5.

Chronic Zinc deficiency in 15 year old
P. radiata.

6.

P. radiata Copper deficiency induced by the application of Nitrogen.

7. Nitrogen — Foliage shows uniform yellowish green colour becoming yellow under severe deficiency. Crowns are thin.

8. Manganese: — Buds turn brown, the juvenile needles are almost normal in colour yellowing near the apex. Old needles die turning a copper colour.

SECTION 9

SILVICULTURE

Aims of silviculture

Pine forests silviculture aims at maximising sawlog production on a short rotation through heavy early thinnings an high pruning of crop trees where necessary.

In broad terms silviculture should aim to keep knott size below 35mm and the knotty core of the log below 150mm diameter.

9.1. Silvicultural Schedules

Silvicultural Schedules

Regimes for pruning and thinning vary depending on the species, the terrain and the markets available for the thinnings. For details of silvicultural schedule see Appendix 23.

9.2. Low Prune and Cull

Pruning on time.

Where-ever possible all low pruning should be done with secateurs. Chainsaws should only be used in areas where the limbs are excessive. Where Chainsaws are to be used, care must be exercised not to cut into the collar surrounding the branch to be removed.

9.3. Crop Tree Selection

Selecting final crop.

At the time of crop selection, fifth row extraction tracks should be marked. Crop trees will be marked in the bays at the correct number of stems per hectare for that schedule. Crop trees are selected for their straightness, vigour and fine branching. (For further details refer to Foresters Manual Section 16.) (See appendix 31 for guidelines)

9.4. High Pruning

Need to high prune in F.R.B.'s and where limb size is large.

Great care should be exercised to ensure that high prunin schedules are followed and carried out on time. In most areas two high pruning lifts are recognised 2 - 5 metres and 5 - 7.5 metres. Pruning should be carried out during the dormant period of the year to reduce the incidence of epicormic shoots. Generally epicormic shoots will present a problem in widespread forests such as F.R.B.'s. Where epicormic shoots have developed dollowing a pruning operation they should be removed with the subsequent lift. As much as possible all pruning should be carried out on piecework. For further details on high pruning equipment etc. refer to Foresters Manual Section 16 - 131.

9.5. Thinning

Thinning on time.

It is imperative that thinning is carried out on time so that crop tree development can be encouraged and the final sawlog volume can be maximised. The pertinent details for thinning are shown in the silvicultural schedules in Appendix 23.
Refer to Forsters Manual Section 16 - 132.

9.6. Clear Felling

Rotation Age.

For P. radiata the rotation age is to be about 30 years and for P. pinaster about 40 years, but this will vary according to site quality. The timing of clear felling is also influenced by the demand for sawlogs and can increase or decrease the rotation age.

NOTE: It is proposed to modify these schedules in 1984. However, until modifications have been approved the following will apply with the exception that culling to 750 sph has been approved and this modification can be introduced to all stands at time of pruning.

SCHEDULE 1

P. radiata - High Quality Sites

Age (years)	Height (m)	Treatment
0	-	Plant 1330 spha (3m x 2.5 m spacing).
3 - 5	5	Low prune all well formed trees to 2 m, cull malformed stems and whips.
5 - 7	9 - 10	High prune to 5 m (350 spha).
6 - 8	14 - 15	High prune to 7.5 m (200 spha).
*9 - 11	18 - 20	First thinning from 1330 to 350 spha.
18 - 20	-	Second thinning from 350 to 200 spha.
30	-	Clear fell.

* First thinning may need to be deferred in open stands on high quality sites to prevent excessive branch development following thinning. Thinning should be delayed until the branches ten metres up the stem have been suppressed by competition.

SCHEDULE 2

P. radiata - Average quality sites

Age (years)	Height (m)	Treatment
0	-	Plant 1330 spha (3 m x 2.5 m spacing).
5	5	Low prune to 2.5 m all well formed trees, cull malformed stems and whips.
11 - 14	18 - 20	First thinning from 1330 to 250 spha.
18 - 20	-	Second thinning from 250 to 125 spha.
30+	-	Clear fell.

No high pruning is listed for this regime. However, limb development needs to be monitored and if excessive branching occurs, proposals should be submitted for some high pruning. Where stands have already been culled to 750 spha and low pruned to 2 m, high pruning of 125 spha stands to 5 m is to be carried out.

SCHEDULE 3

P. radiata - Low Quality Sites

- No tending Regime

Age (years)	Height (m)	Treatment
0	-	Plant 1330 spha (3 m x 2.5 m spacing).
14 - 18	18 - 20	Thin from 1330 to 250 spha.
30 - 40	-	Clear fell.

Consideration will be given to low pruning the 250 crop trees for fire control purposes.

SCHEDULE 4

P. radiata - Steep (over 14^{o} slopes)

Age (years)	Height (m)	Treatment
0	-	Plant 1330 spha (3 m x 2.5 m spacing).
5	5	Low prune to 2.5 m, all well formed trees, cull malformed stems and whips.
11 - 14	18 - 20	First thinning from 1330 spha to 250 spha.
30	-	Clear fell.

When stands have previously been culled to 750 spha, high pruning to 5 m of 250 spha stands will normally need to be carried out. First thinning should be delayed until branches ten metres up the stem have become suppressed.

SCHEDULE 5

P. radiata - Drought prone sites

Age (years)	Height (m)	Treatment
0	-	Plant 1100/ha (3 m x 3 m).
5	5	Cull to 750 spha. and low prune 750 to 2.5 m.
11 - 14	18 - 20	First thinning to 200 spha.
30	-	Clear fell.

Requirements for high pruning will need to be monitored.

SCHEDULE 6

P. radiata - High Risk F.R.B.

Age (years)	Height (m)	Treatment
0	-	Plant 1330 spha (3 m x 2.5 m).
3 - 5	5	Low prune to 2 m and cull to 500 spha.
4 - 6	8 - 9	High prune to 3.5 m (250 spha).
5 - 7	9 - 10	High prune to 5 m (250 spha).
6 - 9	14 - 15	High prune to 7.5 m (100 spha).
9 - 11	18 - 20	*High prune to 10.0 m (100 spha).
9 - 11	18 - 20	First thinning from 500 to 250 spha.
15 - 18	-	Second thinning from 250 to 100 spha.
30 - 40	-	Clear fell.

* If branch development makes this necessary.

Where only 200 spha have been pruned to 3.5 m or above, the stand should be reduced to the 200 high pruned trees at the first thinning.

High risk F.R.B.'s will be grazed throughout the rotation.

SCHEDULE 7

P. radiata - Strategic F.R.B.

Age (years)	Height (m)	Treatment
0	-	Plant 1330 spha (3 m x 2.5 m).
3 - 5	5	Low prune all well formed trees to 2 m, cull malformed stems and whips.
5 - 7	8 - 10	High prune to 5 m (250 spha).
6 - 9	14 - 15	High prune to 7.5 m (100 spha).
9 - 14	18 - 20	First thinning from 1330 to 250 spha.
15 - 18	-	Second thinning to 100 spha.
30 - 40	-	Clear fell.

Strategic F.R.B. will be grazed in the early years until canopy closure and for the balance of the rotation after first thinning.

Detailed prescriptions for fuel reduction or FRBs are to be prepared in local fire control working plans.

SCHEDULE 8

Regime for pedigree P. pinaster - Wanneroo Plantations

Age (years)	Height (m)	Treatment
0	-	Plant 1000 spha. (3m x .25 m).
5 - 6	5	Low prune to 2m all well formed trees and cull malformed trees and whips.
8 - 11	10 - 11	High prune to 5m (250 spha).
10 - 14	13 - 14	High prune to 7.5m (100 spha).
11 - 15	-	First thinning to 250 spha.
18 - 25	-	Second thinning to 100 spha.
24 - 32	-	Third thinning to 50 spha.
30 - 40	-	Clear fell.

Older, non pedigreed stands of P. pinaster should be brought into line with this regime as the opportunity occurs.

SCHEDULE 9

P. pinaster - Harvey Coast, Sunkland and Other

Age (years)	Height (m)	Treatment
0	-	Plant 1330 spha (3m x 2.5 m)
5 - 6	5	Low prune all well formed trees to 2m, cull malformed trees and whips.
8 - 11	10 - 11	High prune to 5m (250 spha).
11 - 15	-	First thinning to 250 spha.
20 - 25	-	Second thinning to 100 spha.
30 - 40	-	Clear fell.

This regime also applies to stands already culled to 750 spha.

PRUNING

With the exception of poor quality sites, all plantations receive some pruning. Apart from enhancing timber quality, pruning improves working conditions, access, visibility and safety in the plantation. It is also important in fire control.

SECTION 10

HARVESTING & UTILIZATION

For details refer to Forsters Manual Part 17 Softwood Utilization.

10.1 5 Yr. Logging Plan

Important to plan logging in advance.

To facilitate the requirements of silviculture; procurement; protection and landscaping, it is important that advanced planning takes place.
The Regional Planning Officer should draw up a 5 Yr Logging Plan and this should be reviewed each year after consultation with above sections.
The fuel accumulation in fuel reduced buffers and other hazardous areas should be planned well in advance so that proper reduction measures can be implemented.

10.2 Annual Operations Logging Plan

Yearly Logging Plans.

The Annual Operations Logging Plan is drawn up to meet the market requirements for that year. It is important that not only market requirements are considered, but all other considerations of silviculture; protection are taken into account. This plan is drawn up in April each year by I & P after consultations with the Regional Planning Officer; Mr. Gilchrist; representatives from the Protection and Procurement Sections. (See Appendix 26)

10.3 Six Month Yield Report

Importance of actual yield information.

Each 6 months a yield report is prepared by Mr. Gilchrist which is based on the actual volume produced by each operation. From each silvicultural operation yields are calculated and compared with previous years. This information is extremely valuable in the planning of all future logging operations.
This actual data should also be compared with the predicted yields as provided by Inventory & Planning. Adjustments should be made by Inventory & Planning in areas where large descrepancies occur.

10.4 Roading

Planning Logging Roads.

Roading for extraction should be planned on the 5 Yr Logging Map and constructed at least 12 months in advance of the actual operation. Pine forest establishment from 1973 onwards in the Hills Plantations did not construct the intensity of roading that is currently required for procurement. This will mean that the thinning of stands from 1973 onwards will require more road construction than previously.

10.5 Logging Methods

Slopes determine logging methods.

In the Hills pine forests the logging method is determined by the slope. In slopes over 14^{o} cable logging method is used and in other areas machine harvesting is used. Hand falling is used in the flat areas where machine harvesting cannot meet the required supplies. Handfalling with chainsaws is used in all steep country over 14^{o}. In small high risk fuel reduced buffer areas where it is not economic to use contracted machines, the Forests Departments Cat 930 and whole tree extraction method can be used. For further details refer to Code of Softwood Operations and the Foresters Manual.

SECTION 11

PROTECTION

11.1 Fire Protection

11.1.1. History

(1) Pre-1977

Early protection System.

Pine forest protection systems were based on internal and external fire-breaks; access; water points and external hardwood rotational fuel reduction burning.

(2) In 1977

1977 Introduction of fuel reduced buffer concept.

The Chipwood Plant bombing attempt and threats to pine forests precipitated a review of the protection system. This review recommended the establishment of fuel reduced buffers within pine forests. Integrated Management Plans were drawn up for the Blackwood Valley.

(3) In 1980

Pine Silviculture and fire protection

Pine silviculture was changed and another review of the protection system took place This review endorsed the fuel reduced buffer concept but for silvicultural reasons it was decided not to establish strategic Fuel Reduced Buffers until after the first commercial thinning.

11.1.2. Regional Protection Objectives

Protection priorities
: Life
: Property
: Forest

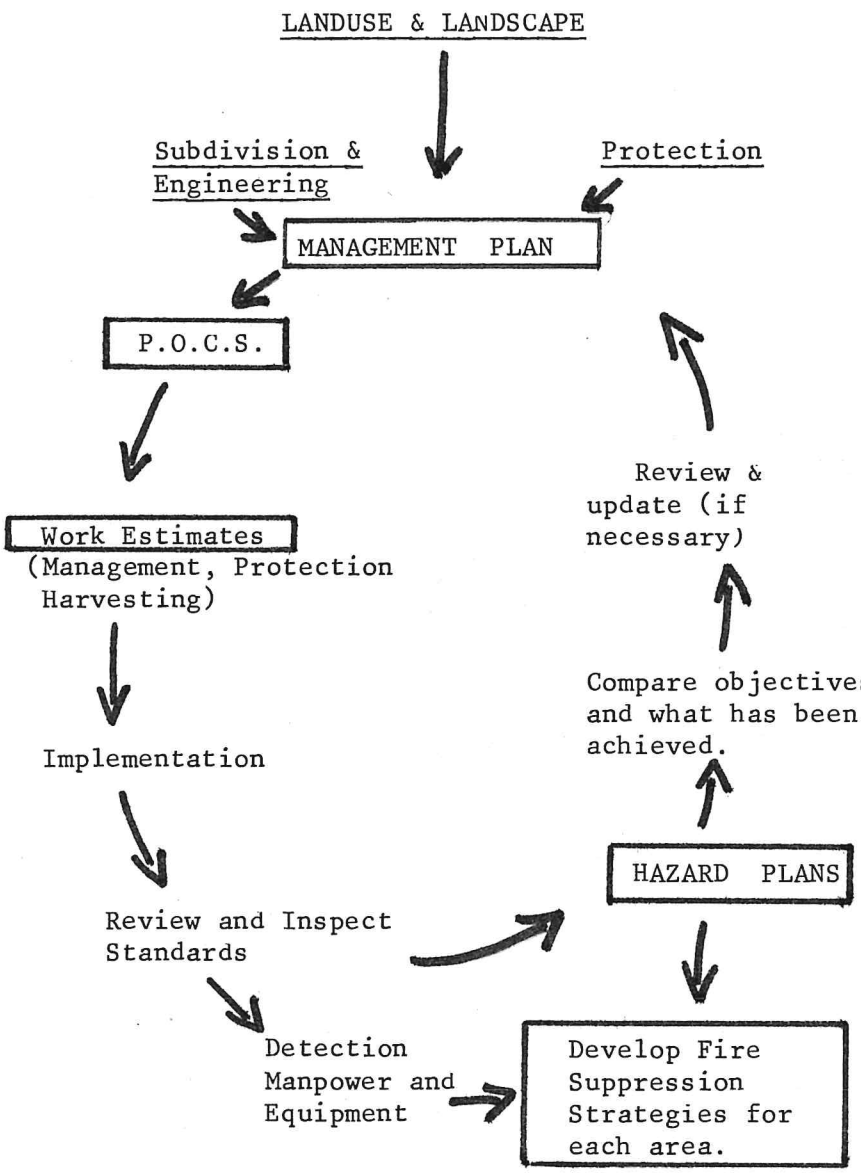
(1) To protect life and property.

(2) To protect timber values by restricting the potential spread of wildfires in the pine forests.

(3) To provide rapid detection and suppression attack on wildfires.

11.1.3. Planning and the Management System

The Management System



The management system is self explanatory. It is important to realise how the Management Plan states protection objectives and how it is related to the Hazard Plan, which shows in an update what has been achieved in fuel reduction etc. Information gained from the Hazard Plans is to be used to develop Fire Suppression Strategies for each area.

11.1.4. Management Plans

Planning protection of pine forests.

(1) Each plantation is to have a Management Plan (refer Foresters Manual) Management Plans must be designed to meet access, procurement and protection requirements and deal with problems anticipated for that particular plantation.

(2) The data required on Management Plans is shown in Appendix 9. These plans must show the position of all roads, waterpoint; firebreaks and proposals for fuel reductio

Need for C.O.D. approval.

(3) Prior to field work commencing management plans must be approved by C.O.D. Operations. They then become valuable management tools as works estimates can be programmed with the backing of this authority.

Regular review required.

(4) Management Plans should be programmed to last throughout the duration of the rotation. However with changing policies and techniques all plans should be reviewed 2 yearly and if necessary, updated. If there are basic changes proposed to protection strategies then approval from the C.O.D. Operations must b sought in a formal submission of the revised plan.

11.1.5. Fuel Reduction

(1) Objective

F.R.B. to surround 100-500ha units of pine.

The objective is to protect plantation units of 100ha to 500ha using a series of hazard reduced strips. Within pine plantations strips can range from 500m to 1000m width. However, grazed private property surrounding the plantation and regularly burnt hardwood forest can form buffers much wider than this and should be used where possible. These buffers are referred to as Strategic F.R.B.'s. Along high fire risk areas such as Highways, major roads, rivers, etc. narrower strips 50m - 100m in width should be used for fuel reduction. These are referred to as High Risk F.R.B.'s.

(2) Fuel Free External Breaks

Firebreaks.

Adjoining private property are to be 20m wide. Adjoining State Forest 10m wide (including roadways).

Hardwood forest as F.R.B.

(3) Hardwood Forest adjoining plantations can form part of the fuel reduced buffer system and should be maintained with fuels less than 8 spha.

Advanced mop-up adjoining pines.

(4) Advance mop-up Stag falling should be carried out in the hardwood forest to be regularly burnt, to a distance of 100m from the boundary of pines. Parkland clearing will be carried out to a distance of 20m. This work should preferably be done at time of initial clearing.

(5) High Risk F.R.B.'s (Pine)

Where risk of starting fires is high.

Appendix I shows the detailed prescription of the treatments these F.R.B.'s should receive throughout the rotation. The basic objective is to reduce available flash fuel levels to below 2 tonnes per ha., by whatever means available, although grazing of grass fuels is preferred. The height of grass should be grazed below 7cms by November each year to be considered an effective F.R.B. These strips 50 - 100m wide should be located in pine that is adjacent an area where the risk of a fire starting is high eg. adjacent to tourist roads, rivers railways etc.

(6) Strategic F.R.B.'s (Pine)

F.R.B.'s as crown fire free zones.

Appendix II shows the detailed prescriptior of the treatments these F.R.B.'s should receive. These Strategic Strips 500 - 100(wide protecting pine areas of about 500ha should be located on ridge rops in steep country. It is there where fire suppressic is most effective.
Until the time of first thinning (age 10?) these areas will receive normal plantation fuel reduction eg. intermittent grazing where-ever possible etc. It is intended that if necessary, after first hinning, pasture improvement work be carried out and the area then maintained in a grazable condition through to the end of the rotation. After first thinning flash fuels should be maintained below 6spha and grass grazed to below 7cms. These areas need to be fenced and managed in manner that will facilitate intensive grazing. The strategic F.R.B. concept should be used when designing protection systems around towns, settlements etc.

(7) Gazetted Roads - Fuel Reduction

Fuel reduction along main roads.

Approval for fuel reduction along these roadsides adjoining plantations should be obtained from the relevant authority. If these roadsides constitute part of a fuel reduced buffer than fuel reduction should be achieved by advance mop-up, voroxing annual burning of grass or regular burning of eucalypt fuels. The Management Plan should show what fuel reduction is required along each roadside, eg. annual voroxing of grass growth.

(8) Water Supplies

Specifications for water supplies.

Should be developed and maintained on the basis of a 20 minute turn around time for a heavy duty. There should be a minimum supply of 100,000 litres per water point. Study the natural availability of tanks have to be constructed.

11.1.6. Type of Fuel Reduction

(1) Grazing

Need to reduce grass below 7cms in F.R.B.'s

Where possible grazing is favoured as the means of fuel reduction within P. radiata pine forests. Grass should be grazed below 7cms in height by Nov. to be considered an effective fuel reduced buffer.

(2) Under Pine Canopy Burning

Fuel reduction and under pine canopy burning.

Where grazing is not possible as a means of fuel reduction, pine canopy burning can be developed. Whilst broad area pine canopy burning in radiata pine is not practicable, burning in the narrow high risk F.R.B.'s is much easier to achieve. Following thinning top disposal must be carried out around final crop trees. It is important that the "red top" condition is programmed for winter so that fuel reduction can be carried out with safety.

(3) Mechanical

Mechanical means of fuel reduction.

Mechanical means of fuels reductions (by crushing etc.) is still being developed. However mechanical harvesting achieves this to some degree and is the favoured harvesting method in all fuel reduced buffers. Grading of fire breaks is still practiced in most pine forests.

(4) Chemical

Chemical means of fuel reduction.

Chemical fuel reduction is practiced to remove grass fuels on firebreaks and high risk F.R.B.'s when pines are not sufficiently tall enough to withstand grazing.

11.1.7. Hazard Plans

Pine fuel accumulation maps.

(1) Each pine forest is to have a fuel hazard plan prepared for and submitted to Protection Branch Bunbury prior to 1st December (refer Foresters Manual). These plans should show:-

(a) the accumulation or reduction of fuels in pine forests by categories.

(b) Other important factors such as slope and pine age categories.

Hazard Plan Legend.

(2) Hazard Plan Legend

Changing fuel situation.

(3) Fuel accumulation is a dynamic process and has to be updated when significant changes occur. Pruning, thinning and grazing can change the fuel condition and the hazard category. When this occurs the hazard plan should be amended.

Accurate pine fuel recording and importance to fire suppression.

(4) The purpose of the hazard plan is to enable the controller of a wild fire to be in possession of the latest fuel hazard information. He can then accurately make fire appreciation calculations as the fire passes from one fuel category into another. Slope and pine ages are also shown on the Hazard Plan. Because pine age and damage from fire are related, the Controller can assess from the plan the likely damage potential to young, intermediate and old pine under different fuel hazards and slopes.

(5) Annual Review of Hazard Plans and Approval for Major Variations from Management Plan Design

The Planning process and review.

As per the Foresters Manual Section this plan should be prepared annually and despatched to Protection Section Bunbury prior to 1st December. Any major variation or deviation from the protection design should be highlighted and approved by Region, Protection Section and C.O.D. Protection.

11.1.8. Integration with Silviculture and Harvesting

F.R.B.'s & P.O.C.S.

(1) The latest Management Information should be entered in the P.O.C.S.

F.R.B.'s and Logging Plans.

(2) The Pine Procurement Section and R/L Planning when preparing their logging plan for next year should have access to and consult any F.R.B. information etc. throug the P.O.C.S.

F.R.B.'s and conflicts of priorities.

(3) Any major conflict between protection aims and procurement programmes should be resolved prior to finalization of the logging plans.

Prevent debris accumulation in F.R.B.'s during Summer.

(4) Commercial thinning and pruning of F.R.B.' should be on time or as early as practicab Timing of pruning and thinning should be i months of March, April & May (This is particularly important where winter slash burning is prescribed. The "red top" conditions during summer months must be avoided.

F.D.I. & Restrictions

(5) Refers Foresters Manual 17.044 outlining the restrictions when procurement operatio are in pine forests.

P.O.C.S. and Work Estimates.

11.1.9. Using Management Plans, Hazard Plans, Procurement Plans etc. the latest relevant information should be entered in the P.O.C.S. It is also from these records that next years estimates are planned from.

11.1.10. Fire Suppression Strategies

Plan fire suppression strategies for each pine forest.

For each pine forest or area, developed fire suppression strategies based on fire appreciation calculations using the following information and under varying weather conditions.

(1) Pine fuel accumulation and reduction.

(2) Age, density and height of pine forest.

(3) Slope.

(4) Access

(5) Distance from HQ.

(6) Detection.

(7) Manpower and Equipment availability.

(8) Water supplies.

(9) Possible field control points.

Fires in Red Action Zones must receive automatic despatch orders and a L.F.O. must be set up immediately.

11.2. Noxious Weeds

Eradication of noxious weeds before planting.

The Officer in Charge must ensure that before an area is planted all noxious weeds are eradicated. Prescriptions for the eradication of noxious weeds will be as prescribed by the Agricultural Protection Board. This information will be used through Form 729 of the Chemical Users Manual. The noxious weeds that are dealt with in pine forest establishment are as follows:-

(1) Blackberry

(2) Arum Lily

(3) Variegated Thistle

(4) Ordinary Thistle

(5) Apple of Sodom

(6) Double-gee

(7) Pattersons Curse

(8) Cotton Bush.

Eradication programmes of these noxious weeds is in progress throughout established pine forests.

11.3. Fungi

Dieback and potential effect on pines.

There is no recognised fungi problem in the Hills forests. Pythium and Fuserium (damping off fungi) are a problem in the Nurseries but are dealt with in Nursery Manual. Main concern is with the spread of Phytophthora Cinnamomi in the hardwood forests and the effects of this disease on the pine in the Sunklands. Research is monitoring the effects or likely effects of this disease on pines in the Sunklands forests.

Dieback and Need for hygiene.

11.3.1. Dieback Hygiene must be applied to all operations in the Sunklands. Refer Departmental Circulars and instruction manuals for standards.
Much of the Sunklands has been affected with dieback (Phytophthora Cinnamomi). However there are significant areas of forest that are not infected and are dieback free. All unplantable uninfected areas must receive full hygiene measures. Work that is confined entirely with an area to be cleared and planted does not require special treatment. All machines must be washed down thoroughly after the work is completed and prior to leaving the area. Most of the Sunklands development work is carried out during the summer period for

floatation reasons. This must be encouraged to maximise periods of temporal safety.
Access throughout plantable areas that are uninfected would be along spacially safe network of roads. Planting and some tending operations require winter access. Care must be taken to select safe access for these operations into the uninfected and unplantable areas.

11.3.2. Other

Be able to recognise Needlecast Disease.

Although there are no known occurrenced of needlecast disease (Dothestroma) in Western Australia, we should keep our eyes open for likely infections.

Blue Stain

The sapwood of many species of pine is attacked by fungi that stains it dark blue. Although the fungi do not decay the wood, the discolouration greatly reduces its market value. Although Blue Stain is more frequently found in felled timber, it is not uncommon in living trees that have been weakened by drought, fire, attacked by the ip beetle or some other adverse factor. Blue Stain is caused by several different fungi Ceratostomella coreulea is the most common one.

Sawn pine is dipped into santabrite immediately following conversion and this prevents the stain from entering the wood. To prevent Blue Stain entering the wood prior to dipping, pine logs should be converted within 10 days of the falling operation.

Pine seedling stem fungi.

Botrytus cineria (stem fungus) will affect conjested pine seedlings with increasing temperature.

11.4. Erosion

11.4.1. Clearing

Planning and Erosion Control.

Care must be taken in all clearing operations to ensure that erosion is not caused by the machines disturbing the soil. In steep country where this is likely to occur, consideration should be given to constructing contour banks. These contour banks should be spaced down the slope in such a way that they will hold any movement of soil and water.

Erosion control and good drainage.

These contour banks should be aligned along the contour on a slope of 1/40 and forward to drain into a natural water course. In the Sunkland Forests, mounds are aligned at rightangles to the contour to facilitate

run-off of water. However in certain circumstances, this can cause erosion. Where this is likely to occur, the mounds should be angled slightly across the contour. To prevent the accumulation of water, artificial drains might have to be constructed leading into natural water courses.

11.4.2. Land Slides

Note Existing and Potential Landslides.

Where existing landslides occur, before establishment proceeds, consideration should be given to the arresting of these slides through engineering means or through planting up with species such as Poplar. The construction of roads should avoid these landslides. Drainage should not be chanelled into areas where these slides would be aggravated.

11.4.3. Roading and Logging

Carefull drainage of Roads.

In the construction of roads for access or logging care must be taken to ensure that adequate drainage is provided for. The number of pipes to be installed will vary on the slope and the soil type. Logging damage should be kept to a minimum by careful planning of winter operations. The operations in the Hills should be carefully monitored and logging should cease prior to damage occurring.

11.5. Insects

The Ips Beetle and damage to Pines.

The main insect damage in pine forests is from the Ips Beetle. The Ips will effect living trees when the trees are under stress and the sap pressure drops. Avoid logging in drought stressed areas to avoid logging debris build up which will increase the Ips population.

Be able to recognise Sirex Wasp.

Fire damage will also have a similar effect on the trees that will facilitate Ips damage. The Sirex Wasp has done considerable damage in the Eastern States and New Zealand P. radiata forests. There is no known occurrence of this insect in Western Australia. However, all forest officers should be familiar with what this insect looks like, and what damage it can do so that informal monit oring can take place throughout our pine forests.

SECTION 12

SECOND ROTATION

12.1 Five Year Clear Felling Map

Need for Advanced Planning

A map showing the next 5 years clear felling operations should be drawn up. This map should be drawn up at the time as the 5 Year Logging Plan. This advance planning is important so that second rotation planting can be programmed. Advance planning is also required to protect existing plantations from excessive build up of debris in high risk areas.

12.2 Revised Management Map

Update Management Maps.

Prior to the forest reaching rotation age, the revised management map should be drawn up.

This management map should take in all principles that were expanded in Section 4. The revised management plan should then be submitted to the Chief of Division of Operations for formal approval. Only then can it be used for the preparation of estimates and works programmes.

12.3 Establishment Techniques

At this stage there is no clear-cut prescription for second rotation establishment on Hills or Coastal Plantations. Much more research effort is requires in this field.

12.3.1. Nutrition

Value of Mulch to Pine Nutrition.

It is widely accepted that there is fertility loss in the second rotation. This fertility loss is aggravated by the burning up or removal of slash and debris. On the fertile soils of the Hills Plantation, there is no evidence that there will be a nutritional problem in the second rotation.

To date, the clearfelled areas in the Hills Plantations have been on very poorly cleared land. The clearing of the old hardwood logs ar other debris has meant the total disturbance of the site is unavoidable. This has meant that the prescription favoured in the Hills involved the total clearing of debris with establishment of clover.

12.3.2. Slash Disposal

For nutrition reasons slash disposal should be carried out using mechanical crushing techniques. There are mechanical crushers used effectively in the Eastern States for this purpose: eg. The Marden Roller.

Need for mechanical mulching and second rotation research.

Trials are urgently required to test out alternative methods of crushing in the second rotation areas. To date, the second rotation areas in Western Australia are relatively small eg. 100ha per annum. This may not warrant large capital expenditure required for the Marden Roller. However, these areas will increase in size and therefore the need will be accentuated. Capital expenditure on a crushing machine might be warranted now to facilitate the handling of these areas in the future.

The retention of slash and disposal mechanically by crushing is of more significance on the poorer soils of the coastal plain and the Sunklands.

12.3.3. Scrub Control

Fire and mechanical disturbance and dense acacia scrub germination.

In the Hills areas where clover is to be used, great care must be taken to ensure that scrub germination is controlled. There is evidence that once the soil is disturbed either mechanically or through the process of fire, dense germination of acacia species and natural re-generation can occur. This can be controlled by clovering, grazing and chemical spraying or a combination of these three. To fully ensure that all scrub, noxious weeds and eucalypt regrowth is eradicated before planting commences, plenty of lead time is required. This time to facilitate the preparation of the site for planting would take about 2 years.

12.3.4. Natural Regeneration

Value of natural regeneration trials.

The value of natural re-generation should not be overlooked. It is evident that significant cost savings and nutritional benefits exist in promoting natural regeneration. There are existing naturally regenerated areas that show promising results. These areas situated at Grimwade and Lewana Pine Forests should be closely monitored.

Successful natural regeneration can be established from stands where closed canopy exists at the clearfelling stage. Following clearfelling, debris should be disposed of through mechanical means only, in other words the area should not be burnt. The natural regeneration that occurs is even aged and can be managed as such.

SECTION 13

PINE OPERATIONS CONTROL SYSTEMS & RECORDS

13.1 P.O.C.S. - Estimates

Need to Plan, implement; control; review and record all operations.

All silvicultural operations are recorded in this system. From the P.O.C.S. system all estimates and works programmes are prepared. The updating of all operations in the P.O.C.S. system takes place once per annum. This is carried out at the end of the financial year. However, logging records are up-dated every 6 months. This system is based on the planting year as the unit of management. This information storage has to be carried out manually and therefore is relatively slow and cumbersom. The management of the softwood forests in Western Australia are very complex because of the great variety of sites and plantation distribution. This complexity will increase as the pine forests estate increases. It is strongly recommended that the computerisation of pine forest management is advanced as rapidly as possible.

Pine Management and need for computerisation.

13.2 Operations Calendar

Thorough Planning Operations.

All O.I.C.'s should draw up yearly Operations Calendars from this guide and the Foresters Manual.

13.3 Job Prescriptions

Job Prescription Form.

A job prescription format has been drawn up for the Central Region See Appendix 25.
All jobs should have a job prescription to facilitate effective man and resources management.

13.4 Use of Chemical Controls (FD 729)

Use of Chemicals and safety F.D. 729

When using chemicals which are listed in the Chemical Users Manual on a FD 729 a copy of this form must accompany the job prescription. The job prescription and the form 729 should be in the posession of the Overseer in Charge of that job. No operation using chemicals should be commenced in the field without an accompanying 729.

JOB PRESCRIPTION

JOB TITLE

JOB NUMBER

DIVISION

LOCATION

FINANCIAL YEAR

OFFICER RESPONSIBLE

O/S RESPONSIBLE

COMMENCE BY

COMPLETED BY

	QUANTITY	UNIT COST	MAT.	CONT.	OTHER	WAGES	PLANT	TOTAL
APPROVED EST.								
PROGRESS COST								

PRODUCTION RATE (per man day etc.)

WHAT IS REQUIRED

MANPOWER	MACHINES	MATERIALS	EQUIPMENT

SAFETY (rules & safety equipment)

do	don't

DIEBACK HYGIENE

IS WASHING DOWN NECESSARY BEFORE START OF JOB?	YES	NO
IS WASHING DOWN NECESSARY BEFORE LEAVING THE JOB?	YES	NO

SPECIFY OTHER HYGIENE NECESS.

P.T.O.

JOB DESCRIPTION (REASON FOR DOING THE JOB)
JOB PRESCRIPTION (HOW TO DO THE JOB)
JOB REVIEW (HOW TO IMPROVE THE JOB)

PLAN ATTACHED H.O.C.S. P.O.C.S.

SECTION 14

CENTRAL REGIONS PINE PLANTING PROGRAMME

The Central Regions pine planting programme is detailed in Appendix 25.
It must be noted that although the Regional target is 2250ha per annum, there is a shortfall.
If possible this shortfall will be made up by the purchase of cleared land as finance is made available.
The programme will be updated and extended as land becomes available.

CENTRAL REGIONS PINE PLANTING PROGRAMME

26/7/1984

P. YEAR	INITIAL CLEAR	FINAL CLEAR	PRE PLANT WEED & SCRUB CONTROL	PRE PLANT VOROX GRASS	PLOUGH	MOUND	CLOVER	PLANT	REGIONAL SUMMARY
		B20-53-B C13-189-K			B19-53-B B18-242-B	B19-53-B B18-242-B	B19-53-B B18-242-B	B19-53-B B18-242-B	B-879
P.85		C14-240-K*			B16-223-K	B16-223-K	B16-223-B	B16-223-N	N-463
		C15-223-K			B20-438-B	B20-430-B	B20-438-B	B20-438-B	K-434
/85	NIL	C16-195-K			C5-144-K	C5-144-K	C5-144-K	C5-144-K	
	HIL-100-K*	B20-438-B			C14-240-K	C14-246-K	C14-240-K	C14-240-N	
		HIL-150-K	HIL-150-K*					HIL-150-K	
			HIL-110-K*	HIL-110-K*				HIL-110-K	
			HIL-30-K*	HIL-30-K*				HIL-30-K	
	100	1488	290	140	1340	1338	1340	1630	
		S/R-150-H*					S/R-150-H*		
SECOND ROTATION		S/R-190-K							
			S/R-146-B	S/R-146-B				S/R-146-B	
		340	146	146			150	146	1776
					C13-189-K	C13-189-K	C13-189-K	C13-189-K	K-679
P.86					C15-223-N	C15-223-N	C15-223-N	C15-223-N	H-100
					C16-195-N	C16-195-N	C16-195-N	C16-195-N	N-418
5/86		HIL-100-K	HIL-100-K	HIL-200-K				HIL-300-K	
		100	100	200	607	607	607	907	
		S/R-100-H		S/R-150-H			S/R-100-H	S/R-150-H	
SECOND ROTATION			S/R-190-K	S/R-190-K				S/R-190-K	
		100	190	340			100	340	1197

* NO MONEYS ALLOCATED
on 84/85 BASE BUDGET

SECTION 15

PINE ESTABLISHMENT AND TENDING COSTS

The current (1984) costs are detailed in Appendix 26.

These costs are averages only and will fluctuate up or down between Divisions and depending on site factors and conditions.

Divisional O.I.C.'s should monitor progressive costs on 097's and make every endeavour to keep them as low as possible.

Incentive schemes such as piecework should be promoted for as many operations as possible.

With incentive schemes great care must be exercised in supervising operations to ensure that optimum standards are maintained.

APPENDIX 26.

PINE ESTABLISHMENT & TENDING COSTS (August 1984)

OPERATIONS	HILLS COSTS		SUNKLANDS COSTS		COMMENTS
	YEAR	$/HA	YEAR	$/HA	
Roading costs/ha & firebreaks and access tracks	-2	17	-3	8	Sunklands $350/km & Hills $2000/km.
Initial clear & chain			-3	70	
" " windrow	-2		-2	160	
Final clear chain			-1	150	
" windrow	-1		-1	70	
Pre plant weed & scrub control.	-1	35			
Plough			0	45	
Mounding			0	40	
Clovering			0	90	
Planting & Fert.	0	100	0	140	Does not include cost of plants
Fencing			0	30	1000/km
Voroxing (on plant machine)	0	10			
Maint. fert. clover			1	40	400kgs/ha super (CuZnB)
" " nonclover			2,4,6	70	" " 3P:IN mix
Maint. fert. clover			1	30	
Inter-row cultivation			1	35	
tching-coppice		50	2-3	50	Either/or
Foliar spray - coppice	1		1	35	
Maint. fert. clover			3	30	200kgs/ha super
Low prune & cull	4-5	245	4-5	240	
Maint. fert. clover			5		200kgs/ha super
High prune 250sph/5M	5-7	220	6-8	200	
" " 200sph/7.5M	6-8	165	7-9	150	

Total $842 Total $1303 (for current regime)

Say add price P/P 1200

$2042

N.B. Above costs do not include O/H's and costs of plants ($50/ha)

SECTION 16

PINE FOREST AREA STATEMENTS

Appendix 27 summarises all Departmental pine plantings by Regions, species and decades.

Appendix 28 details all Central Regions pine plantings by P-Years, species and plantations.
Availability of site quality maps is indicated.

Appendix 29 details and summarises Sunklands pine plantings by P-Years plantations and species.

These statements will be updated at the time of reviewing this document annually each October.

APPENDIX 27

F.D. PINE AREA STATEMENT

(CURRENT (1984) FIGURES IN HECTARES)

1. TOTALS BY REGION AND MAJOR SPECIES (UP TO AND INCLUDING 1984)

REGION	P. RADIATA	P. PINASTER & OTHER SPP*	TOTAL
CENTRAL	28,663	5,084	33,747
NORTHERN	2,401	22,210	24,611
SOUTHERN	675	34	709
TOTAL:	31,739	27,328	59,067

2. TOTAL AREAS BY MAJOR SPECIES WITHIN FOUR PLANTING YEAR CATEGORIES

PLANTING YEAR	P. RADIATA	P. PINASTER & OTHER SPP*	TOTAL
PRE 1956	459	4,261	4,720
1956 - 1965	4,925	4,142	9,067
1966 - 1976	12,338	13,266	25,604
1977 - 1984	14,017	5,659	19,676
	31,739	27,328	59,067

N.B. 'Other SPP' represents less than 2% of the P. pinaster and Other Spp category.

CENTRAL REGION PLANTATIONS - SUMMARY OF AREAS PLANTED

N.23.

BY PLANTATION AND PLANTING YEAR.

(Correct at October 1984).

(*Asterisk indicates Site Quality map is available).
P.Radiata: Top figure in heavy type
P.Pinaster & Other Species: Lower figure.

	GRIMWADE	FERNDALE	KELLY	BALINGUP	SOUTHAMPTON	SAVAGE CREEK	THOMSON BROOK	CLAYMORE	LUDLOW	WILLCOCK	MARGARET	VASSE	BAUDIN	JARRAHWOOD	HARVEY WEIR	MYALUP	McLARTY	TALLANALLA	BRUNSWICK	TUMLO	MINGALUP	WELLINGTON	BUSSELL	STOCKTON	FOLLY	LEWANA	BROCKMAN	MILWARD	SHELLEY	ELLIS	DALGARUP	NELSON	MILES
RE 1949	76*/17								12/345		14/4				9*/5	1/168	2												6*			
1949	17*																															
1950	21*/1										1*/1					24																
1951	22*/4							3			2*/16					38																
1952	18*								10	4/75	3*/8					4/41	6															
1953	10*/0									4/29	7*/1					5/31	1/15															
1954	13*/8								4/17	2/27	13*/2					38	0/16															
1955	46*/2								9		15/12				35*	11/64	4/33	3*											6*			
1956	106*								17/8						18*		9/62			6*/0					116*							
1957	85*/2								21/17		9*/15				18*	17/55	8/39				75*		3*		92*/1			84				
1958	70*								2						34*	17/12	15				86*							166*				
1959	75*								14							14/52	2/36		29/1		65*		29*		2*			247*/0				
1960	128*														70*	66	34					39*	103*		245/2							
1961	147*/0							7								63	19		43*		34*		59*				53*/0					
1962	67*	5*														68	20		18*			79*	38*		138*/1		11*					
1963	93*								3						1*	5/53			49*				120*		142*		98*					
1964	140*								*/13							17*/61	4*/44	94*	9*	6*			39*				155*/1					
1965	103*		50*						5*/3							8*/39	10*/8	107*		6*			37*/2				70*		1*			
1966	150*		1*						1*/0						*/1	3*	5*/38	3*/23	107*				94				162*/1					
1967	169*								10*	*/8						1*	10*/29	26*/21	140*				73*/3				234*	*/6				
1968		177*							47*	*/49					*/15	11*	29*/50	33*/33	179*				83*				168*					
1969		186*							5*	*/28	*/7	*/24			*/2	7*	55*/103	30*/39	168*/1				179*				257*/7	1*/36				
1970	175*/1	23*/0							39*/34			4*/26	3*/3		3*	52*/86	3*/20	155*/8					167*/20		150*/2	32*	4*/19					
1971		196*/0						2/2	54	7/21	16*/2	4/2	6	4			60/65	75*/0	65*				128*/44		207*/12		9*/9					
1972	12*	295*						7	4			17	13/5	14/5	8*	12/52	38/51		101*			87*	18*/12		222*/8	91*	12*/4					
1973	8*	356*							17						24*	54/27	5/90		103*			121*			317*	73*						
1974		369*												30/6	12*	12	54/53		63*			127*		4		84*/3		165*		116*		
1975		431*		55*									4	46			227/54						117*			100*				265*		
1976	139*			248*	197*							1		124/8		2	263/93							100						482	23*	
1977	70*	96*		258*	192*									197			243/40							192*							296*	
1978	2*	267*			223*	118*								457/46		235								185*	7*				50*	397*	260*	
1979	252*	148*	142*										203/20	407/24		184			16				217*			14*				394*		
1980				137*			418					510/134	143/239			110/45			12					12*					271/20				
1981	17*			228*			111				103*/6	558/118	301/92			42/249									13*				213/17		15*		
1982								524/6			87	398	171/52	167/56		30/15	338/120															
1983	32			39			111	98				479/105	33/107		10											45			533			
1984	13			23				10					849																585			498
TOTAL	2276/35	2549	193	988	612	118	640	641/18	255/456	17/237	270/74	1971/409	1726/518	1446/163	264/5	931/1567	1361/1051	1028/9	508/1	18	260	453	1504/81	493	1651/26	1647/12	26/74	663	1602/37	919	1125	260	498

AREA PLANTED BY P.YEARS, PLANTATION, SPECIES IN THE SUNKLANDS.

P.YEAR	P.radiata							P.pinaster							Other Species							TOTAL	PROG. TOTAL
	JWD	VASSE	BAUDIN	MILESI	S'LLY	C'MORE	TOTAL	JWD	VASSE	BAUDIN	MILESI	S LLY	C'MORE	TOTAL	JWD	VASSE	BAUDIN	MILESI	S'LLY	C'MORE	TOTAL		
P 66								1.2						1.2								1.2	1.2
P 67																							
P 68								14.6						14.6								14.6	15.8
P 69								2.5	22.5					25.0		2.0					2.0	27.0	42.8
P 70		4.5	3.1				7.6		17.0	2.8				19.8		9.1					9.1	36.5	79.3
P 71	3.8	4.3	6.4			2.5	17.0		2.5				2.5	5.0								22.0	101.3
P 72	14.3	17.5	12.8			7.0	51.6	0.9		2.7				3.6	3.8		2.0				5.8	61.0	162.3
P 73																							
P 74	29.8						29.8	6.4						6.4								36.2	198.5
P 75	45.7		4.2				49.9															49.9	284.4
P 76	123.9	1.3					125.2	4.4						4.4	3.6						3.6	133.2	381.6
P 77	196.7						196.7	46.5						46.5								243.2	624.8
P 78	457.1						457.1	24.4						24.4								481.5	1106.3
P 79	407.4		202.7				610.1			20.1				20.1								630.2	1736.5
P 80		509.7	142.7		271.2		923.6		106.3	184.0		6.8		297.1		28.0	55.4		13.5		96.9	1317.6	3054.1
P 81		558.2	301.3		213.3		1072.8		117.0	91.7		17.1		225.8		0.8					0.8	1299.4	4353.5
P 82	167.1	397.8	171.1			523.9	1259.9	45.8						45.8	10.6		52.1			5.4	68.1	1373.8	5727.3
P 83		484.1	33.3		533.0	97.9	1148.3		39.5					39.5		65.1	106.7				171.8	1359.6	7086.9
P 84																							
TOTAL	1445.8	1977.4	877.6	-	1017.5	631.3	5949.6	146.7	304.8	301.3	-	23.9	2.5	779.2	18.0	105.0	216.2	-	13.5	5.4	358.1	7086.9	7086.9

Area includes all plantings recorded under plantation compartments on P2 plans, refer to P2 plans for species and serial numbers.

Planting prior to 1974 were either research plots or old Molloy Plantation (now Vasse) now included within existing plantations on P2 plants. (See Appendix 4 for a list of trial plots).

Areas derived from Latest P.O.C.S. prints and plantation area statement.

Jwd = Jarrahwood
S'lly = Shelley
C'More = Claymore

APPENDIX 31

PINE SILVICULTURE

Guide for selection of crop trees to be High Pruned or retained at each thinning stage

1. Selection for High Pruning

   (a) The attached chart is to be used as a general guide to aid selection marking of crop trees at all high pruning stages.

   (b) The actual stocking should be constantly checked and the ratio of selection altered if necessary to obtain the correct numbers of crop trees stated in the schedule being followed.

   (c) Where stockings are well below the schedule being followed and the number and quality of selection is poor, it must be brought to the attention of the O.I.C. and the area concerned inspected and reported on.

   (d) Regular checks must be made to ensure that correct selection numbers are being obtained.

2. Thinning Marking

   (e) The first thing the marker must check is the actual density of the stand to be marked. Then he selects a marking ratio to retain the numbers of trees required.

   (f) All pine thinning marking must be checked daily by the marker to ascertain that the correct number of stems per/ha are being retained as laid down in the Schedule being followed.

   (g) Prior to commencing a thinning operation of any schedule, the stocking marked for retention must be checked and altered if required by the O.I.C. Divisional procurement to match the thinning instructions on the operations sheet.

   (h) Within the years 67, 68 and 69 only 125sph were high pruned per hectare and later some Divisions increased this to 250 sph. Where only 125 sph are high pruned and the residual stocking to be held after a first thinning is 250 sph or 350 sph the extra trees must be marked for retention.

   (i) If the marker cannot obtain sufficient well formed trees over an operational area to match the thinning schedule being followed it should be brought to the attention of the O.I.C.

TABLE 1 - PINE SELECTION FOR HIGH PRUNING

Species	Nominal Age	Height (m)	Stocking sph prior to selection	Stocking Allowing for 5th row removal	No of trees to be pruned per hectare	Selection Ratio within bays
Radiata	5-7	8-10	750	600	125	Select, mark & H/P 1 tree out of 4
Radiata	5-7	8-10	750	600	250	Select, mark & H/P 2 trees out of 4
Radiata	5-7	8-10	500	400	200	Select, mark & H/P 3 trees out of 5
Radiata	5-7	8-10	750	600	200	Select, mark & H/P 2 trees out of 5
Radiata	5-7	8-10	1,100	800 (approx)	250	Select, mark & H/P 2 trees out of 6
Radiata	5-7	8-10	1,330	1000 (approx)	250	Select, mark & H/P 1 tree out of 4
Radiata	5-7	8-10	1,100	800 (approx)	350	Seclect, mark & H/P 3 trees out of 7
Radiata	5-7	8-10	1,330	1000 (approx)	350	Select, mark & H/P 2 trees out of 6
Pinaster	8	7-8	300	No outrows required.	300	All trees to be high pruned.
Pinaster	8	7-8	300	240 (allowing for outrows)	240	All trees to be high pruned.
Pinaster	8	7-8	750	600	250	Select, mark and H/P 2 trees out of