ANNUAL REPORT 1977

Forests Department
PERTH, W.A.

TO THE HON. M. J. CRAIG, M.L.A.
MINISTER FOR FORESTS.

In accordance with Section 42 *of the Forests Act, I have the honour to submit the Annual Report of the operations of the Department for the year ended June* 30, 1977.

B. J. BEGGS,
Conservator of Forests.

Front cover:
One of the agro-forestry trials being undertaken in the Busselton Division.

T04445—(1)

FOREST LEGISLATION

In September 1976, Parliament approved a number of amendments to the Forests Act. The changes made will be of considerable significance in the future operations of the Forests Department. In particular, the following new authorities given are of importance:

- To provide services, equipment or facilities to allow work to be undertaken on behalf of other Government departments, public statutory authorities and other persons and organisations.
- To advise and assist persons in growing and managing forests.
- To allow persons who are trained in disciplines other than in forestry to be employed in the professional branch of the Forests Department.
- To establish management priorities for the State forests in order to allow the principles of multiple-use management to be achieved.
- To amend the financial provisions of the Act—
  - in order to consolidate and simplify the accounting procedures of the Department;
  - with the approval of the Treasurer, to allow the Conservator to borrow money for the purposes of carrying out his powers and functions under the Act.

GENERAL WORKING PLAN No. 86

On 27th January 1977, The Governor in Executive Council approved a General Working Plan which prescribed the management principles for the State forests of Western Australia for a period of five years.

It is of considerable significance to report that for the first time, a large part of the Working Plan has been made available to the public. Former plans have not been generally available but because of the interest shown, the greater part of the plan has been released.

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PRINCIPAL OFFICERS*

Conservator of Forests	B. J. Beggs, B.Sc. (For.), Dip. For. (Canb.)
Deputy Conservator of Forests	P. J. McNamara, M.A. (Oxon.)
Assistant Conservator of Forests	W. H. Eastman, B.Sc. (For.) Dip. For. (Canb.), Dip. For. (Oxon.)
Chief of Division	J. C. Meachem, D.F.C., B.Sc. (For.) Dip. For. (Canb.)
Chief of Division	J. B. Campbell, B.Sc. (For.), Dip. For. (Canb.)
Chief of Division	E. R. Hopkins, Ph.D. (Melb.), B.Sc. Dip. For. (Canb.)
Chief of Division	F. J. Campbell, B.Sc. (For.) Dip. For. (Canb.)
Chief of Division	S. J. Quain, B.Sc. (For.) Dip. For. (Canb.)
Superintendent	D. E. Grace, B.Sc. (For.) Dip. For. (Canb.)
Superintendent	C. J. Edwards, B.Sc. (For.) Dip. For. (Canb.)
Superintendent	J. K. Smart, B.Sc. (For.) (Aber.)
Superintendent (Research)	J. J. Havel, M.Sc. (Qld.) Dip. For. (Canb.), Dip. Ed.
Superintendent (Extension Services)	P. N. Hewett, B.A. B.Sc. (Adel.), Dip. For. (Canb.)
Superintendent (Plantation)	A. C. van Noort, B.Sc. (For.), Dip. For. (Canb.)
Chief Draftsman	R. M. Davis, E.D., M.A.I.C.
Secretary	K. G. Hide, B.A. Dip. Pers. Mgt.
Accountant	V. K. Combs, A.A.S.A., A.P.A.A., A.A.I.M.

*At 30th June, 1977

STATISTICAL SUMMARY OF MAJOR OPERATIONS

Sawnwood Production

Total Production of Sawn Timber .... 385 836 m³

Trends in Production and Consumption

Year ended 30th June	Production (cubic metres)				Total Export	Local Availability	Number of Sawmills	Monthly Average No. of Employees
	Hardwood	Softwood	Hewn Hardwood	Total				
1938	331 928	....	72 883	404 811	213 695	191 116	134	3 112
1946	251 194	....	398	251 592	95 524	156 068	128	2 876
1951	356 029	....	33	356 062	66 339	289 723	256	4 047
1956	544 134	....	150	544 284	129 367	414 917	274	5 804
1960	470 833	....	....	470 833	174 643	296 180	265	5 037
1965	460 246	22 667	....	482 913	133 565	349 348	206	3 615
1966	475 642	16 499	....	492 141	68 885	423 256	203	3 518
1967	461 176	17 085	....	478 261	138 723	339 537	202	3 173
1968	469 818	16 531	....	486 349	84 569	401 779	188	3 209
1969	413 666	19 643	....	433 309	86 455	346 854	191	3 233
1970	425 295	16 893	....	442 188	96 275	345 914	163	2 869
1971	420 777	21 595	....	442 372	79 437	362 935	150	2 401
1972	379 006	21 733	....	400 739	101 191	299 548	154	2 533
1973	375 135	23 283	....	398 418	111 547	286 871	145	2 825
1974	374 899	26 534	....	401 433	98 200	303 233	140	2 215
1975	368 844	27 086	....	395 930	100 127	295 803	129	2 228
1976	383 010	16 258	....	399 268	94 136	305 132	129	2 211
1977	369 151	16 685	....	385 836	N/A	N/A	136	2 242

Log Production* (m³)

	Crown Land	Private Property
Saw Logs Hardwood	931 613	106 513
Saw Logs Softwood	45 017	335
Other Logs Hardwood	377 021	....
Other Logs Softwood	75 842	....

* Includes sawlogs and logs for plywood, veneer and reconstituted wood (particle board etc.), and chipwood.

Forest Area

Additions to State forest	19 025 ha
Excisions from State forest	162 ha
Land purchased for pine planting	591 ha
Total Area of State forest	1 851 940 ha

Pine Establishment

Area planted with pines 1976		2 931 ha
Pinus radiata	1 792 ha	
Pinus pinaster	1 139 ha	
Total area of pine plantation established to date		41 761 ha
Pinus radiata	19 455 ha	
Pinus pinaster and other species	22 306 ha	
Total experimental areas (additional)		465 ha

Management

Area covered by hardwood assessment	104 000 ha
Engineering, new works—	
Roads and tracks	471 km
Houses	Nil

Protection

Prescribed burning area	243 240 ha
Fire outbreaks—	
Number of fires	227
Area burnt	5 570 ha

Nurseries (Hamel and Narrogin)

Produced for private buyers	257 330 trees
Produced for Forests Department	80 709 trees

Sandalwood

Quantity exported	1 222 tonnes

Chipwood (hardwood)

Quantity produced	377 021 m^3

THE FOREST AREA

State Forest (Forests Act 1918–1976)

The total area of State forest at 30th June, 1977 was 1 851 940 hectares which is an increase of 18 862 hectares compared with the total area at 30th June, 1976.

The major portion of the increase occurred as a result of a large area of Crown land near the south coast being dedicated as State forest.

Timber Reserves (Forests Act 1918–1976)

The total area held under Timber Reserves at 30th June, 1977 was 116 998 hectares, which is a decrease of 66 hectares compared with the total area at 30th June, 1976.

Land Alienations, etc.

During the year 100 applications concerning forest land were received covering a total of 35 193 hectares.

The Department agreed to the following:

Alienations			Leases (Pastoral, Grazing etc)		
Timber Zone		Outside Timber Zone	Timber Zone		Outside Timber Zone
State Forest	Crown Land		State Forest	Crown Land	
hectares	hectares	hectares	hectares	hectares	hectares
6	2 135	23 862	1 960	85	....

A total of 30 alienations and 9 new leases were approved.

The total freehold land held at 30th June, 1977 in the name of the Conservator of Forests was 25 693 hectares.

	30 June 1976	30 June 1977	Change
		(Hectares)	
State forest (Forests Act 1918-1976)	1 833 078	1 851 940	*Increase* 18 862
Timber Reserves (Forests Act 1918-1976)	117 064	116 998	*Decrease* 66
Freehold land in the name of the Conservator of Forests	25 054	25 693	*Increase* 639
	1 975 196	1 994 631	*Increase* 19 435

This area may be classified into the following broad forest types; rounded to nearest 1 000 hectares:

Types*	Area (ha)
Jarrah	1 450 000
Karri	140 000
Wandoo	105 000
Mallet	10 000
Tuart	3 000
Goldfields species	30 000
Pinus radiata	20 000
Pinus pinaster	22 000
Very open areas	215 000
	1 995 000

* *Jarrah type includes:* pure jarrah; mixture of jarrah with marri, blackbutt, wandoo, karri and sheoak as minor species; stands dominated by marri with jarrah as the minor species; stands dominated by blackbutt with jarrah or marri as the minor species; stands dominated by bullich with jarrah or marri as the minor species.

Karri type includes: pure karri; mixtures of karri with marri as the major or minor species; mixtures of karri with jarrah or the tingles as minor species; stands dominated by the tingles.

Wandoo type includes: pure wandoo; pure powderbark wandoo; mixtures of these with jarrah, marri and mallet as minor species.

Mallet type includes: 8 300 hectares of plantation mallet; mixture of mallet with wandoo as the minor species.

Goldfields species include: pure stands and mixtures, of salmon gum; Dundas mahogany; Dundas blackbutt; Cleland's blackbutt; silver gimlet; sandalwood; jam; and many others.

Very open areas include: swampy and rocky areas; areas with sparse tree canopy; areas cleared for mining, powerlines and dams.

THE ESTABLISHMENT AND TENDING OF NATURAL FORESTS

Jarrah Forest

Logging operations are excluded from forest disease risk areas, and activity is mainly confined to clean cutting on dieback affected forest in the north and selection cutting in the south. In the clean cutting areas 233 hectares were rehabilitated by planting with dieback tolerant species.

Karri Forest

Regeneration treatments were applied to 1 800 hectares of forest where cull felling for woodchip material greatly assisted the operation.

A dwindling seed source necessitated partial restocking with karri seedlings. Seeding and planting will be required for more than 2 000 hectares of regeneration treatment in 1977–78, and the West Manjimup nursery was enlarged by nine hectares to cater for increased seedling production.

Wandoo Forest

Cull felling was completed for regeneration trials on 50 hectares of wandoo forest.

Mallet Forest

Thinning to produce logs for posts and tool handles was carried out on 329 hectares of mallet forest.

Softwood Forest

Planting Programme

A major aim of forest management in Western Australia is to ensure that, as far as possible, future demand for sawn timber can be met from local supplies. To this end the Department has adopted a pine planting programme of 3 000 hectares per annum. This level of planting is determined from predictions of demand and supply and takes account of anticipated additional planting by private interests.

The Department planted 2 931 hectares in 1976, bringing the total area of State pine plantations to 41 761 hectares.

During the year the Department purchased 591 hectares of farmland for pine planting in the Blackwood Valley.

Departmental Plantation Areas

The distribution of plantation areas by Divisions as at December 1976 was as follows:

Division	*P. radiata*	*P. pinaster* and other species	Total
Wanneroo	738·5	16 428·6	17 167·1
Metropolitan	10·0	324·9	334·9
Mundaring	740·3	636·7	1 377·0
Kelmscott	392·2	1 110·6	1 502·8
Dwellingup	578·3	87·5	665·8
Harvey Hills	1 884·3	15·9	1 900·2
Harvey Coast	1 114·9	2 254·7	3 369·6
Collie	2 360·1	83·5	2 443·6
Kirup	5 249·8	77·3	5 327·1
Nannup	5 068·5	109·4	5 177·9
Busselton	892·3	1 132·3	2 024·6
Manjimup	207·9	....	207·9
Pemberton	218·4	44·5	262·9
Totals	19 455·5	22 305·9	41 761·4
* Experimental Planting	226·1	238·6	464·7
Grand Total	19 681·6	22 544·5	42 226·1

* Includes Esperance.

Areas planted in 1976 totalling 2 931·3 ha are detailed below:

Division	*P. radiata*	*P. pinaster* and other species	Total
Wanneroo	38·5	1 038·1	1 076·6
Mundaring	27·2	1·3	28·5*
Harvey Coast	270·0	91·7	361·7
Collie	90·6	....	90·6
Kirup	637·9	....	637·9
Nannup	591·8	....	591·8
Busselton	135·9	8·3	144·2
Total	1 791·9	1 139·4	2 931·3

* Includes 21·5 ha second rotation planting.

196·9 ha of mature plantation were clear felled.

Private Plantations

Private interests advised that they planted 1 607 hectares of pine in 1976, bringing the total area of privately owned pine forest in the State to approximately 9 221 hectares as at March 1977.

Tending of Plantations

Tending and maintenance of the increasing area of pine plantations has become a major part of the Forests Department's operations. During the year the following plantation tending was carried out:—

Scrub control	3 219 ha
Fertilising with superphosphate	1 417 ha
Fertilising with minor elements	1 470 ha
High pruning	1 769 ha
Low pruning	2 073 ha
Cleaning	2 908 ha

Low pruning and cleaning programmes are to schedule. Some arrears in high pruning should be made up in the next twelve months.

Tree Nurseries

For many years the Forests Department has actively encouraged and fostered the planting of trees for shelter and amenity purposes throughout the rural areas of the State by means of advice and by provision of trees at minimum cost. Last year Hamel and Narrogin nurseries sold 257 330 trees for farm and town improvement.

These nurseries also produced eucalypt seedlings for rehabilitation and amenity planting in State forests.

Nursery production for the year is summarised in the following table.

	Number of Plants Sold				Departmental Use		Total Plants	
Nursery	Pots	Trays	Open Rooted	Total	Eucalypts	Total	No. of Species	Total
Hamel	66 447	25 550	78 450	170 447	75 000	75 000	210	245 447
Narrogin	85 058	525	1 300	86 883	5 709	5 709	106	92 592
Total	151 505	26 075	79 750	257 330	80 709	80 709	....	338 039

Departmental pine nurseries raised some 3·8 million tree seedlings for the afforestation programme. About 3·4 million of these were used in departmental planting and 428 000 were sold for private projects.

Seed Supplies

Demand for seed of Western Australian tree species for afforestation projects both overseas and within Australia continued. The value of sales through the Forests Department seed store during the year amounted to $17 317.

LAND MANAGEMENT

Management Priority Areas

Management priorities have been defined in certain areas as part of the Forests Department formalisation of multiple land use management plans.

This policy was approved by Government in 1976 and the main strategies are set out in General Working Plan No. 86 of 1977.

The management priority for an area is determined by:

—the potential of the site for each value
—the estimated level of demand in relation to locality
—legislative and economic constraints
—compatibility between uses
—protection requirements of various resource values.

The major forest values currently recognised in forest management, and for which management priority areas will be designated, are those associated with water, timber, recreation, flora, fauna, scientific study, education and minor forest products such as sandalwood, honey and wildflowers. Special provision of land is also made for service functions such as roads, dams, transmission lines and pipelines as well as for mining of minerals defined under the Mining Act and gravel, stone and sand defined as forest produce under the Forests Act.

Land use plans are currently being prepared for State forests and a total of 419 541 hectares has so far been formally categorised into the following Management Priority Areas.

Management Priority	Area
Conservation of flora and fauna	.... 362 539 ha
Recreation	.... 34 719 ha
Scientific study	.... 22 283 ha
	419 541 ha

The Government has adopted a recommendation of the Environmental Protection Authority that a special category of Management Priority Areas be denominated as Forest Parks. Legislation is in train which will require proposals for change of purpose of management in Forest Parks to be considered by both Houses of Parliament.

M.P.As. for conservation will help protect animals and birds such as the tawny frogmouth (*Podargus strigoides*).

Submission to the Environmental Protection Authority

In 1972 the Environmental Protection Authority (E.P.A.) commissioned the Conservation Through Reserves Committee (C.T.R.C.) to look into the question of providing for an adequate system of conservation and recreation reserves in Western Australia and to review the recommendations of the 1962 Academy of Science Report on National Parks and Nature Reserves in W.A. To facilitate its work the C.T.R.C. sub-divided the State into 12 areas, called systems. Since the publication in 1974 of the C.T.R.C. report, covering 10 of the 12 systems, their recommendations have undergone a process of refinement and change through the scrutiny of the public, Government Departments, and where necessary special review committees. Of the systems in which the Forests Department is directly involved (1, 2, 3, 4 and 6) all except System 6 have been subject to final recommendations by E.P.A. These recommendations have now been accepted by Cabinet.

System 6, the last and most complex area, is now at the stage where invited submissions are under study by an inter-disciplinary organization set up for that purpose by the E.P.A. System 6 covers the Perth Metropolitan Area, Bunbury, the Swan Coastal Plain and the adjoining Darling Plateau and escarpment. Many land use conflicts are involved.

Most, and certainly the best, of the remaining jarrah forest occurs in State forest within System 6. State forest also covers part of the coastal plain, particularly north of Perth. As the manager of most Crown lands within System 6, the Forests Department has the responsibility to ensure that a full range of natural ecosystems characteristic of the region are preserved in perpetuity. Proposals for 39 Management Priority Areas covering 173 213 hectares under the control of the Conservator were approved by Government in General Working Plan No. 86 of 1977 and formed part of the submission by the Forests Department.

The concept of the Management Priority Area (M.P.A.), as described above, was used to give effect to conservation within a multiple use framework. In its submission to E.P.A. the Forests Department confined its attention to M.P.As. having a priority for conservation of flora, fauna and landscape. Recreation was considered best treated on a broad basis throughout all State Forest, and the limited items of historical interest could best be dealt with individually.

The procedure for the selection of M.P.As. began with a review of existing National Parks and flora and fauna reserves in System 6 to discover where the main deficiencies lay. The basis for the assessment of adequacy took into account climate, geomorphology and vegetation. Other aspects considered were the core and buffer concept, freedom from the presence or potential infection of *Phytophthora cinnamomi*, impact on the timber resources available to industry, fire protection and the fixing of logical practical boundaries.

Perspective for Multiple Use

In April 1977, the Department published an important planning document; "A Perspective for Multiple Use Planning in the Northern Jarrah Forest".

A good stand of bullich (*Eucalyptus megacarpa*). The department has the responsibility to ensure that a full range of natural ecosystems are preserved.

The document describes the enrivonmental features, economic and legal constraints, current management and resource use over an area of 784 000 ha situated between the Preston River and the Great Eastern Highway. The area was divided into 6 management zones based on geomorphology and climate and for each zone the Department's management strategy was clearly stated and discussed.

The Perspective is a precursor to more detailed land use planning, that will form the basis of operational planning and control.

Integration of Agriculture and Forestry

Research into various aspects of integration of agriculture and forestry are being studied at Busselton, Nannup, the Helena catchment and the C.S.I.R.O. farm at Yallambie. Inter-departmental projects have involved C.S.I.R.O. and the Departments of Public Works, Agriculture and Forests.

A combination of agriculture and forestry with the hydrologic potential of a forest and the productive potential of a farm is seen by some scientists as a possible solution to the salt pollution problems of some of our rivers, such as the Collie. Further, grazing under pines can substantially reduce weed control and fire protection costs, and assist in the build up of soil fertility.

Trials are investigating the grazing potential under trees; the potential for crop production; the effects of cropping on tree establishment and survival; and the effects of grazing on tree survival.

In September 1977 a workshop on this topic will be held in Bunbury under the auspices of the Australian Agricultural Council. It is anticipated that some 40 scientists from Australia and New Zealand will attend the workshop.

On an applied scale, several leases have been let for grazing under pines for fire hazard reduction in the Blackwood Valley. The application of agro-forestry to hardwood forests in salt sensitive areas is also being investigated.

RESOURCE MANAGEMENT

Timber Production

During the year 36 098 hectares of hardwood forest were cut-over for sawlogs:

	ha
Jarrah forest	32 317
Karri forest	2 614
Wandoo forest	1 167

The production of 385 836 m³ of sawn timber, including hardwood and softwood was a decrease of 13 432 m³ on last year's figure. Of the total output, 38 043 m³ came from private property, a decrease of 841 m³ on the 1975/76 figure.

At December 31, 1976 there were 136 sawmills registered of which 81 operated on Crown land and 55 on private property. Details of the annual intake of mill logs and production of sawn timber are given in accompanying tables.

The annual intake of logs for the period 1968–1977 is given in Appendix 5.

Local plywood factories obtained the following quantities of peeler logs—

	m³
Karri	4 662
Jarrah	87
Pine	2 244
	6 993

Timber Inspection

The total quantity of timber inspected during the year was 69 061 m³ made up as follows—

	m³
Railway Sleepers—	
Ex Crown Land	39 764
Ex Private Property	8 546
	48 310
Other Sawn Timber	20 751

PRODUCTION OF LOG TIMBER FOR YEAR ENDED JUNE 30, 1977
EXCLUSIVE OF MINING TIMBER, FIREWOOD, POLES AND PILES

Tenure	Sawlog Volume by Species (1)								Total	Other Log Material (2)		Total	Grand Total
	Jarrah	Karri	Wandoo	Yarri	Sheoak	Marri	Pine	Other		Hard-wood	Pine		
Crown Land m³	629 875	287 361	3 606	2 606	1 133	4 324	45 017	2 708	976 630	377 021	75 842	452 863	1 429 493
Private Property m³	62 706	34 176	7 307	1 521	....	94	335	709	106 848	....	....	....	106 848
	692 581	321 537	10 913	4 127	1 133	4 418	45 352	3 417	1 083 478	377 021	75 842	452 863	1 536 341

(1) Includes sawlogs and logs used in the production of plywood veneer.
(2) Includes Chipwood.

QUANTITY OF SAWN TIMBER PRODUCED FROM CROWN LANDS
AND PRIVATE PROPERTY FOR THE PAST TWO YEARS

Year Ended June 30	From Crown Lands		From Private Property		Total Quantity
	Sawn Timber other than Sleepers	Sawn Sleepers	Sawn Timber other than Sleepers	Sawn Sleepers	
1977 m³	308 029	39 764	29 497	8 546	385 836
1976 m³	294 156	66 228	28 771	10 113	399 268

Sandalwood

Sandalwood exports for the year were contained at 1 222 tonnes which represents only a slight increase on last year's figure of 1 206 tonnes.

Sandalwood received at the Spearwood depot of the Sandalwood Co. Ltd., during the year totalled 1 348 tonnes compared with 1 300 tonnes for the year 1975/76. This has enabled a small stockpile to be retained against possible fluctuations in supply over the coming year.

Sandalwood Received	Tonnes 1976/77	1975/76
Logwood (incl. Roots and Butts)	922	967
Pieces	403	328
Private Property	23	5
	1 348	1 300

It will be noted from the above table that logwood obtained from Crown land declined by 45 tonnes while pieces increased by 75 tonnes over that obtained during 1975/76.

This is in keeping with the sound management principle of making the maximum use of dead sandalwood which would otherwise become worthless if left to deteriorate.

A larger proportion of the sandalwood received during the year was obtained from fire damaged trees. In addition there has been a decrease in the intake of cleaned wood, more logwood now being received with bark removed only. This results in a higher return per tree pulled.

Firewood Production

	Crown Land	Private Property	Total
			Tonnes
Sawmills			
General Purpose and Sleeper			
For Sale	47 587	....	47 587
Own Use	13 574	....	13 574
Private Property			
For Sale	....	10 357	10 357
Own Use	....	244	244
Domestic			
Local Firewood License	5 080	....	5 080
Forest Produce License	12 335	....	12 335
Industry			
Wundowie	93 747	....	93 747
Kalgoorlie			
Industrial	2 604	....	2 604
	174 927	10 601	185 528

Other Forest Produce

Poles and piles obtained from Crown land during the year amounted to 498 193 lineal metres, compared with 379 849 metres for the previous year. Supplies of piles and poles from private property are dwindling and accurate production figures are not available.

Fence posts and strainers cut from Crown lands totalled 359 827. Records received show that 8 734 posts and strainers were obtained from private property, but this was only a small percentage of the total production from this source.

OTHER FOREST PRODUCE

Description	South-west Division and Agricultural Areas		Goldfields Area	Total
	Crown Land	Private Property		
Mining Timber South-West m^3	2 304	....	....	2 304
Mining Timber Goldfields Areas m	....	....	93 700	93 700
Piles, Poles and Bridge Timber m	498 193	....	....	498 193
Fence Posts and Rails No.	256 769	8 734	61 808	327 311
Strainers No.	33 952	....	7 298	41 250
Boronia Kg	6 606	127	....	6 733
Gravel and Stone m^3	291 698	....	....	291 698
Sand m^3	34 101	....	....	34 101
Sawdust as fuel Tonnes	45 838	....	....	45 838
Bean Sticks No.	3 700	....	150	3 850

Woodchip Operations

A total of 377 021 m^3 of marri and karri chip logs were received at the W.A. Chip and Pulp Company's mill near Manjimup for the production of woodchips. The intake consisted of 66 per cent marri and 34 per cent karri.

This material, unsuitable for sawmilling, came from a total area of 2 458 hectares of which 2 130 hectares were marri/karri forest types and 328 hectares were of jarrah/marri forest types.

In addition, 3 827 m^3 of karri mill waste were purchased from other mills along with 31 150 tonnes of prepared chips.

Softwood Production

Pine log production from Departmental plantations, mainly in the form of thinnings amounted to 120 859 m³ which was an increase of 15 292 m³ or 14·5 per cent on last year's figure. The following figures show the trend in pine log removals in recent years.

Year ended June 30	m³ (U.B.)
1950	8 440
1955	20 131
1960	28 394
1965	48 766
1970	81 281
1971	86 245
1972	90 761
1973	100 420
1974	123 393
1975	129 086
1976	105 567
1977	120 859

Removals by category were as follows:—

Category	Total m³
Sawlogs and Peeler Logs	45 017
Other Log Material	75 842
	120 859

Production from the various plantations was as follows:—

	m³
Wanneroo (Gnangara)	24 640
Metropolitan (Collier and Somerville)	17 522
Mundaring	5 785
Gleneagle	118
Dwellingup	6
Harvey	12 629
Collie	15 589
Kirup (Grimwade)	34 503
Nannup	336
Busselton—	
Ludlow	....
Keenan	6 189
Pemberton	2 416
Miscellaneous	1 126
	120 859

Sawn Production from all sources was 16 685 m³ which is an increase of 427 m³ on 1975/76 production.

Utilisation

Hardwoods

Departmental hardwood conversion operations continued at normal levels. Operational trials of log stockpiling and different logging methods were conducted at Dwellingup to assist in developing hygienic logging methods for areas affected by dieback. Logging trials were also carried out jointly with the industry in the Manjimup area to evaluate techniques for application in the combined sawlog-woodchip logging operations.

Softwoods

Depressed trading in sawn pine continued until the end of 1976 when the impact of devaluation became apparent on the price of imported timbers. A dramatic increase in demand for pine then resulted and the financial year closed with significant delays in supply.

Progress in the development of pine framing is rather slow, due to limited availability and difficulties of gaining general acceptance for the Australian Light Timber Framing Code.

A mobile high lead logging unit was acquired for experimental purposes to prove the feasibility of this type of logging system on the very steep slopes of the Blackwood plantations.

Construction of the experimental high temperature kiln at Harvey is nearing completion. This kiln will be used for investigations of high temperature seasoning technology and its application to rapidly-grown pine and other refractory timbers from small logs.

Timber Industry Regulation Act 1926–1969

The number of mills registered under the provisions of the Act as at December 31, 1976 totalled 136 (81 Crown land and 55 private property).

The average number of persons employed in the timber mills each month throughout the year was 2 242, an increase of 31 on last year's figure of 2 211.

The District and Workmen's Inspectors made 873 mill inspections and 455 bush inspections.

There were 167 notifiable accidents for the year ending June 30, 1977, one being fatal. The number of accidents per 100 persons employed was 7·45, a decrease on last year's figure of 9·91.

The cost of administering the Timber Industry Regulation Act for the year ending June 30, 1977 was:

Salaries	$32 338
Mileage, Allowances, Office Rent, Plant Cost and Sundries	$13 654

Forest Offences

Twenty seven breaches of the Forests Act and Regulations were reported during the year. Legal proceedings were instituted in one case and three cases were dealt with in accordance with other provisions of the Forests Act. One offence resulted in the cancellation of an apiary site permit and warnings were issued in all other cases.

Employment in Forestry and the Timber Industry

The number of wage earners directly employed in Forestry and the Timber Industry was estimated at 3 600 made up as follows:

Forestry—		
Professional Officers	72	
General Field Staff	286	
Clerical and Drafting	90	
Cadets—		
Professional	4	
Field	26	
Wages employees	487	
Contractors and employees (estimated)	20	
		985
Timber Industry—		
*Sawmill employees including bush workers	2 242	
Firewood and mining timber cutters and pole getters working under permits	174	
Sandalwood workers	61	
Apiarists estimated (1 771 sites registered)	138	
		2 615
		3 600

* Includes employees of registered sawmills only and excludes persons employed in associated yards in the metropolitan area.

Recreation and Tourism

Camps

Former Departmental settlements now leased for use as holiday camps are being regularly used and provide interested groups with the opportunity to relax in a pleasant forest environment.

The settlement at Dryandra near Narrogin is leased to Lions International while those at Pimelea, Lewana, Wellington and Myalup are under lease to the Community Recreation Council.

Walking Tracks

Further modifications were made to the route of the proposed Bibbulmun Bushwalking Track.

Picnic Areas

An inventory of picnic areas existing in State forest has been compiled. Part of the inventory has been used by a sub-committee of the System 6 Study, the remainder being for internal use in assessment of maintenance requirements. There are more than 100 picnic areas for which the Department accepts maintenance responsibilities.

Flora and Fauna

A field tour for the Western Australian Wildlife Authority to the southern forests was arranged during the year. The group inspected fauna work in the Perup Management Priority Area, the Marri Woodchip Licence Area and the Donnybrook Sunkland with the objective of informing members of the research and management situation. The visit was considered to be most successful.

The Department has had the responsibility for implementation of the Native Flora Protection Act as the 1976 Amendments of the Wildlife Conservation Act have yet to be proclaimed.

Science and Education

A field study centre to be managed jointly with the Education Department, was officially opened at Jarrahdale in July, 1976. During the year, the centre was moved to a larger building—the former Nursing Aid Post—in Jarrahdale, to provide a better range of facilities.

In addition to week-day use by high school groups, members of staff have been involved with a number of weekend in-service courses for teacher groups.

High school students from the Jarrahdale Field Study Centre conducting a botanical survey in nearby State forest.

Mining Rehabilitation

Reforestation after Bauxite Mining

A total of 139 hectares of bauxite pits were rehabilitated at Jarrahdale and Dwellingup.

The 54 hectares at Jarrahdale were planted by the Forests Department and 85 hectares were planted by Alcoa at Dwellingup to departmental specifications.

Species planted include *Eucalyptus wandoo*, *E. calophylla*, *E. resinifera*, *E. accedens*, *E. saligna*, *E. maculata*, *E. laeliae*. Trial plantings were established with *Eucalyptus salmonophloia*, *E. diversicolor*, *E. crebra* and *E. cypellocarpa*.

In addition to trees, mixed native shrub species, mostly acacias, were artificially applied to rehabilitated areas to improve shrub recolonisation rates. This application was introduced this year as a standard operational practice and followed successful research initiated by the Department's team at the Dwellingup station in 1975. Successful germination has been obtained from the application of 1 Kg/ha of seed plus 300 Kg/ha of zinc-copper-superphosphate. Application was carried out by aircraft at Jarrahdale and by ground methods at Dwellingup,

The Interdepartmental Working Group has continued to visit both major mine sites during the year to determine methods of erosion control and revegetation.

Reforestation after Mining Gravel

Reforestation of 32 former Main Roads Department gravel pits, covering 33 hectares of State forest was completed. The work was carried out by the Forests Department and expenditure recouped from the Main Roads Department, their continued interest in pit reforestation being acknowledged.

A further 13 pits occupying 21 hectares of State forest have been rehabilitated.

Coal Mining Rehabilitation

A joint interdepartmental committee is investigating technical aspects of rehabilitation following coal mining.

Protection: Fire

All the land under the control of the Department was protected. This amounted to 1 851 940 hectares. Other public lands and private property in the vicinity of State forest were afforded some measure of protection because of their strategic importance relative to State forest or their forest value.

The Fire Season

Rainfall over the past year has been well below average and most centres recorded accumulated deficits in excess of 300 mm.

The summer drought extended through autumn and significant rains were delayed until early May.

The data below were recorded at forest weather situations at Dwellingup and Pemberton.

	Jarrah		Karri	
	Average	1976/77	Average	1976/77
Rainfall—				
Annual (mm)	*1 307	951	*1 245	971
October to April inclusive	283	307	355	299
Number of Wet Days—				
Annual	137	123	184	158
October to April inclusive	39	39	72	62
Temperature—				
Mean Maximum October to April °C	25·3	25·9	22·8	23
Days of 38° or over (No.)	3·4	3	1·4	1
Days of 32° or over (No.)	28·9	34	13·9	9
Relative Humidity—				
Days of 10% minimum or less (No.)	1·4	....	0·3	0
Days between 11% and 15% (No.)	6·6	2	1·7	0
Days between 16% and 25% (No.)	30·3	32	8·9	3
Fire Hazard—				
Number of Dangerous Days	11·2	2	1·4	0
Number of Severe Days	24·4	32	7·1	0

* Bureau of Meteorology.

Prescribed Burning

The areas of prescribed burning for the past five fire seasons are given below:—

	Season				
	1972/73	1973/74	1974/75	1975/76	1976/77
	hectares	hectares	hectares	hectares	hectares
State Forest—					
Hand burning	114 822	74 716	78 686	64 497	49 405
Aircraft burning	190 438	253 699	287 925	215 513	185 236
Total	305 260	328 415	366 611	280 010	234 641
Advance, Top Disposal and Regeneration Burns	5 314	12 035	2 378	4 532	3 563
Plantations—					
Clearing burns	2 520	1 139	3 088	2 872	2 752
Burning under pine canopy	687	1 028	2 494	1 958	2 284
Total	3 207	2 167	5 582	4 830	5 036

The area of prescribed burning fell below average due to the prolonged autumn drought and unfavourable conditions for burning under forest.

Aerial and hand burning was also carried out for the Avon Valley Protection Committee, Public Works Department and other organisations. A highly successful aerial burn was carried out in the Denbarker area as a co-operative venture involving brigades, shires, Bush Fires Board and the Forests Department. This burn reduced fuel hazards over a large area of Crown land.

Detection

The period between first and last watch for wildfires was longer for pine plantations than for indigenous forest where it has been possible to reduce fuels through prescribed burning.

	Pine	Jarrah	Karri
First Watch	16/10/76	27/10/76	14/11/76
Last Watch	14/5/77	9/5/77	30/4/77

The area covered by spotter aircraft was increased last fire season to include valuable pine plantations in the Blackwood Valley. Eight aircraft provided surveillance over State forest between Mundaring and Walpole and this cover included adjacent private property and Crown lands.

Lookout towers were retained for the Wanneroo pine plantations and as a back-up for aircraft at Harvey and Nannup. The remaining towers were not manned but maintained in a serviceable condition for emergencies.

Wildfires

The table below shows the number of fires attended and area burnt during the past five fire seasons:

	Season				
	1972/73	1973/74	1974/75	1975/76	1976/77
Number of fires attended—					
Indigenous State forest	211	104	139	99	120
Adjacent private property and Crown land	105	86	79	64	86
Pine plantation	61	76	36	20	21
Total Number	377	266	254	183	227
Area of State forest fires (hectares)—					
Indigenous	7 684	1 017	8 850	3 883	5 553
Pine plantation	21	19	40	8	17
Total Area	7 705	1 036	8 890	3 891	5 570

The number of fires attended and area burnt approximated the average for the past five seasons.

There were three large and intense wildfires attended by the Department's forces at Lake Muir near Manjimup, in the Lunenburgh Valley east of Brunswick and in the Canning Dam area. These fires originated in heavy fuel accumulations outside State forest and required difficult and costly fire suppression operations before control was established.

The Department assisted with notable saves of private property at Dwellingup, Pemberton and Collie.

General

Several schools were conducted for field staff, aimed at improving the effectiveness of the fire training programme and dieback hygiene during fire fighting operations. Assistance was given to the Bush Fires Board by providing practical training in fire fighting methods for new staff.

Trials were conducted into effectiveness of fire retardant dropped from aircraft to aid fire suppression in pine and karri forest. Locally produced retardant developed by the Department was as effective as imported brands. For the relatively small load capacity of the agricultural aircraft used in these trials, drops were more effective in lighter pine fuels than heavy accumulations under karri.

Eight new tankers were built in the Department's workshop to replace worn out equipment.

The replacement of lookout towers by spotter aircraft has removed a valuable source of weather recording within the forest. To cater for this need a prototype remote weather station capable of transmitting readings by radio was developed by a Protection Branch technician.

Protection officers gave talks at a number of Shire and Bush Fires Board seminars on fire behaviour and fire effects. They also attended shire advisory committee meetings.

Protection: Disease

Arrangements to quarantine an additional 211 000 ha of State forest in the southern region are expected to be concluded during the latter part of 1977. This will bring the total area under quarantine since the 16th January 1976, to 720 000 ha which embraces some 40 per cent of State forest.

Departmental officers discussed the proposal with five Shire Councils, forty organisations and over one hundred individual land holders, to ascertain their access requirements.

One hundred and ninety eight illegal entries into forest disease risk areas were detected in the northern region and were concentrated in Mundaring division. Only a small percentage of offenders were apprehended. Detection means included ground patrol around quarantine boundaries and the use of spotter aircraft on both day and night patrols. Night air reconnaissance gave good results when navigation was facilitated by moonlight or proximity to water reservoirs. Other illegal activities were observed (e.g. taking of marron in water supply reservoirs) and some offenders were apprehended by concurrent ground patrols. One conviction was obtained but the emphasis is on education, not prosecution. Official letters were sent to other offenders pointing out the consequences of further breaches.

SUPPORT SERVICES AND RESEARCH PROGRAMMES

The work of the Research Branch continued to cover a very wide field of investigation. Each of the five research centres covered projects relevant to their particular location, with Como providing supporting services.

Research: Como

Activities continued in chemical analyses, statistical analyses, plant identification, editing of research publications, and liaison with other research organisations.

Soils and Nutrition

The major analytical programme was the analysis of soil cores collected from projects instituted by the Bauxite Mining and Woodchip Committees. In addition analyses of water from bores and weirs were carried out on samples from Mundaring, Dwellingup, Busselton and Manjimup.

The second important study was the analysis of *Pinus radiata* aml *P. pinaster* foliage collected from established field trials investigating the nutrition of the two species on a range of soil types. The major deficiencies observed were nitrogen, phosphorus, copper, manganese and zinc.

A brief examination was made of the nitrogen status of the jarrah forest species and it was observed that the native legumes and *Macrozamia* were efficient accumulators of nitrogen into the ecosystem. Over a wide range of samples and areas the mean foliar nitrogen values were:—

Legumes and zamia	1·41%
Non-legumes	0·94%

Conservation of Inland Flora

Ecological studies and investigation of the status of inland species of eucalypts were continued. At least 13 rare species, and others of wider distribution are at present regarded as inadequately protected. The selection of suitable reserve areas is being undertaken.

Rehabilitation of inland areas damaged by wildfire and other agencies forms part of the research function. Regeneration is being monitored in borrow pits cleared in 1973 for ballast for the Kambalda railway line. The effects and recovery of the natural vegetation from the devastating fires of summer 1974–75 also form a study in areas north and east of Kalgoorlie. In an area where 60 per cent of the ground area was covered by fire, half of the salmon gums (*E. salmonophloia*) were killed. Trees not killed but with more than 20 per cent of the crown scorched, now exhibit dry sides up to 3 metres, and dense epicormic growth from the butt, bole, or crown. Trees with crowns less than 5 per cent scorched now show little signs of the effects of the fire. Natural regeneration by seedlings following the fire is absent due to the trees bearing no seed at the time of the fire.

Ecological Studies

The vegetation of the northern Management Priority Areas was assessed and reviewed to meet requirements of the General Working Plan and the System 6 study of the Environmental Protection Authority. Work was commenced to extend this information into a vegetation map for the entire area of System 6.

Ecological studies were conducted on the Northern Swan Coastal Plain to establish vegetation patterns prior to the extraction of ground water by the Metropolitan Water Supply, Sewerage and Drainage Board. It has been demonstrated in earlier work that soil moisture is one of the main determinants of plant species distribution in this area. Therefore the initial investigations in this study are aimed at determining changes in plant communities over the past few years which can be ascribed to natural climatic fluctuations.

Dwellingup

Rehabilitation of Land Mined for Bauxite

Two techniques developed in recent research into rehabilitation methods were applied in field scale trials during autumn 1977.

- Broadcast seeding of native shrub species. Aerial application and application with tractor-drawn fertilizer spreader are being tested on an operational basis. Seed broadcasting will give better long-term stability to pit surfaces and a better aesthetic appearance than will tree planting in lines.
- Straw mulching to give immediate control over the turbidity of run-off water. This technique was applied to a 30 hectare pit to enable water to be discharged from the pit into an adjoining forest stream. The ability to discharge water from pits will reduce infiltration and so reduce the potential for salination to develop.

These techniques, in addition to others already developed, give greater flexibility in choosing the character of the rehabilitated landscape.

The main thrust of research work is directed to evaluating the potential salt stabilizing capacity of various tree species. Three aspects are being investigated:—

- Root habit—a deep rooting habit is necessary for maximum water consumption. Root systems are being examined by excavation and a radioactive tracer root mapping technique is being developed.
- Transpiration capacity—the ability to continue a high level of transpiration in dense canopies right through summer will be an important characteristic. A simple technique of monitoring transpiration resistance of a range of species is being developed.
- Hydrological performance—the capacity of plantations of a species to stabilize salt would be reflected in the flow of water and salt in streams. A stream sampling programme has been initiated in a large plantation of *Pinus radiata* in a salt-sensitive area near Boddington.

Bauxite mining has been found to affect the forest outside the open-cut pits, mainly due to the spreading of dieback by the mining activities. As the main criterion in the rehabilitation following mining is the preservation of quality water yields, the concept of total catchment rehabilitation, as opposed to rehabilitation confined to the mined pits, has gained acceptance during the year. A comprehensive assessment of the options available for whole catchment rehabilitation is in preparation and will form the basis of a pilot project.

Jarrah Dieback Research

The jarrah dieback research programme has been intensified during the past twelve months, with additional staff being employed on the problem. Modification of the environment so that the fungus causing the disease (*Phytophthora cinnamomi*) is made inactive continues to be the most promising approach to the control of the disease. Research has been concentrated on using native legume species to bring about these changes in the environment, as this appears to be the only practical method which can be used on a broad scale.

Two important advances have been made in the past twelve months. Firstly, in addition to the favourable effect of leguminous species on the physical environment and micro-biological environment, recent research has shown that some of the native legume species exude a chemical which strongly inhibits sporulation by *P. cinnamomi*. The chemical involved has not yet been identified, but a co-operative study, including the Department's chemistry section and the Western Australian Institute of Technology, is currently in progress.

The second advance is in the area of fire ecology. It had previously been shown that native legume germinations occur in the northern jarrah forest following high intensity wildfires. The association between high intensity fire and legume germination is unusual, since in other forest ecosystems, legume germination occurs following low to moderate intensity fire.

Studies at Dwellingup have shown that fires of high intensity are necessary to stimulate legume germination because legume seed is redistributed vertically in the soil profile by ants.

A series of experimental burns were carried out during 1976 and 1977 to test the effect of fire intensity and season of burning on legume germination. The results of these trials indicate that if burning is carried out when the soil is dry, legume germination can be achieved at considerably lower fire intensities.

Hydrology

Monitoring of the Yarragil and South Dandalup catchments has continued for a second full year. The results obtained from the dry year of 1975/76 further emphasized the marked variability in water and salt yield within the two catchments. Only the high rainfall western third of the South Dandalup catchment contributed stream-flow to the dam itself. A study of individual micro catchments in this zone showed water yields to be between ten per cent and eighty per cent of the yields recorded in the previous year. Similarly, micro catchment yields in the Yarragil catchment were less than ten per cent of the 1974/75 figures. The lack of rainfall, and hence runoff, which normally dilutes the saline ground waters contributing to streamflow, caused weighted average salinities to rise.

Two new important hydrological projects were started during the year. The first deals with the hydrological characteristics of the jarrah forest prior to mining for bauxite. It involves the monthly monitoring of groundwater and salinity levels in eighty bores sited at six locations on the Inglehope Ridge to the east of Dwellingup. The second has as its objective the investigation of increasing water yields from jarrah forest catchments in high rainfall areas to the north of Dwellingup and was undertaken with the assistance of the Public Works Department, Water Resources Section.

Two catchments which are heavily infected with dieback will be compared with four relatively healthy catchments. Water yields and quality will be monitored for a calibration period of five years after which replanting and thinning treatments will be tested.

Manjimup

Karri Silviculture

Seed set in karri is poor, averaging about one per capsule, which makes seed collection an expensive operation. An investigation into some factors which may affect seed set has been started. Two aspects currently being looked at are the time of flowering and availability of pollinators, and the nutritional status of the tree.

The forecasting of future seed crops is a necessary basis for planning seed collection and natural regeneration. Although the method of forecasting has been well researched, there remain operational difficulties in examining tree crowns over large forest areas. A trial of aerial location of stands with heavy crops of flower buds has proved remarkably successful, but only clavate buds (a few months off flowering) can be detected while they occupy the terminal twigs of the crown. This limits the season of detection to winter and early spring, after which the new flush of leaves hides the buds.

Methods of rehabilitating areas damaged by logging activities are being devised. The techniques being tested are ripping to overcome soil compaction, fertilization to compensate for loss of nutrients, mulching with sawdust and bark, and sowing native legumes concurrently with planting karri seedlings. Through this the research is aimed at shortening the time needed to restore the productive and aesthetic values of these areas. Coupled with this work are investigations aimed at quantifying the level of damage and determining any long term effects on stand growth and productivity.

Testing the progeny of superior karri trees selected from the entire range of the species was started in 1969. To the present, seedlings from 150 trees have been raised and planted out in replicated trials at three localities. During the year seed was collected from another 60 trees. An assessment of the earlier plantings suggests that material collected from the Warren River valley is superior in early growth rates to that from most other localities.

Fauna and Flora

The impact of forest operations, particularly logging and prescribed burning, on fauna populations is being studied in a number of projects. Estimates of bird populations in uncut karri and jarrah forests were made during spring 1976. The experimental areas have now been logged and similar annual spring surveys will be continued to determine the short and long term effects of this operation on the bird populations.

The study of the effects of a hot fire in karri forest on vegetation structure and bird and small mammal populations entered its sixth year. Bird and bush rat populations have remained stable after reaching the pre-fire equilibrium three and five years respectively after burning.

Ecological factors influencing populations of small mammals were studied in an area of karri forest scheduled for logging in autumn 1977. The native bush rat was the predominant species and its numbers were closely related to bulk density and penetrability of the soil. The lighter, more easily penetrable soils were favoured, due presumably to the ease of digging burrows in these types. The age, structure, and floristic composition of the vegetation, and also the age and depth of litter on the ground, were relatively unimportant factors in bush rat distribution in the uncut forest. A similar range of measurements are to be made following logging.

All river and creek systems in the southern forests are being surveyed to determine the distribution of the quokka. One area adjoining the Warren River has been selected for the study of the effect of karri logging operations on this species.

Two biological surveys were carried out in Management Priority Areas set aside for scientific values. Milyeannup Block in the Donnybrook Sunklands was surveyed for birds and mammals in October 1976. Mitchell Block, which forms part of a large area representing vegetation types of the southern forest, was surveyed in May 1977. The latter proved rich in native mammals of which 16 species were identified.

Surveys to determine accurately the distribution and habitat types of species which appear to be confined to the southern forest areas were continued.

The studies of life cycles of the dominant shrub species in the karri forest community are continuing. Moderately good seed crops were recorded in *Acacia* and *Bossiaea* species during the year, maintaining the pattern of alternate heavy and light seeding years for these species. The natural life span of the smaller species of fireweeds, mainly *Acacia*, has been found to be 10 years or less. Germination studies on the seed of fireweed species were continued.

Hydrology

Continuous stream level recorders were established in the four coupes of the project planned by the Kelsall Steering Committee to investigate the effects of the woodchip project. By the end of June 1977, felling was completed in two of the coupes and almost completed in the other two, and the pre-logging data collected over the previous two years were being analysed.

Two established programmes of stream sampling within the woodchip licence area were continued. A further 110 streams were sampled for their base-flow salinities as part of a project to map salt sensitive areas. The data collected over the past three years have permitted the mapping of more than half the woodchip licence area for probable salt sensitivity. Nearly all areas carrying commercial forest have been covered.

The second stream sampling programme is confined to the winter months and involves streams entering and leaving coupes currently being logged. Samples are taken, generally after heavy rainstorms when run-off is high, and analysed for turbidity, suspended sediment, and their nutrient content.

Fire Protection

Extensive trials were established in 8, 10, and 12 year old regrowth karri stands to determine fuel loads, fire behaviour, and the effect of various intensities of fire on the young karri crop. Preburn measurements of fuel levels and of the tree crop were completed during the year.

The efficiency of fire retardants delivered from aircraft was tested using three retardant formulations applied to four vegetation types, varying in density from open grassland to dense karri regeneration. Preliminary results indicated that two formulations gave acceptable patterns of ground distribution and fire retarding potential, whereas another was inferior in both areas.

The fire retardant potential of a compound bears a direct relationship with the quantity which reaches the flammable fuel. In this respect, grassland and thinned pine plantations showed up as potential areas for operational use, whereas unthinned pine and dense karri regeneration intercepted too much of the retardant for it to be effective.

In the past fuel hazard reduction in pine plantations has largely been achieved by careful prescribed burning of strategic buffer zones within plantation systems. The current systems of management for the rapid production of sawlogs involve heavy, early thinnings. These result in much heavier fuel loads in younger crops. Current research is involved in the management of these heavy fuels, and in particular in techniques of disposing of them. Disposal by prescribed burning requires reasonably accurate estimates of the quantity of flammable fuel and of its distribution. An investigation into the relationship between stem diameter at the base of the crown and the flammable needle mass in *Pinus radiata* logging residues was completed during the year.

Busselton

Pine Nutrition

It is now evident that substantial improvements in early *Pinus radiata* growth can be achieved from an application of a nitrogen and phosphate fertilizer mixture at planting. The table below shows the comparison between a mixture and the normal standard application of phosphate alone.

Mean Height Increments 1976—77 (cm)

Rate per Tree (gm)	Phosphate (P)	Nitrogen and Phosphate (NP)
50	9·3	22·7
100	14·8	25·5
200	14·2	29·5

Combined NP fertilizers will be tested in operational field trials in the 1977 planting season.

Refertilization of five year old *P. radiata* with an NP mixture has given useful growth responses in the Sunklands and on the dry coastal sands. However, mineral nitrogen fertilizers are likely to be freely leached from these sites, so field trials have been established to evaluate lupins and subterranean clover as slow release nitrogen sources.

Integration of Agriculture and Forestry

Research into techniques of integration has continued during the year with trials being maintained in the Blackwood Valley, at Wonnerup and in the Sunklands.

The experimental work covers the techniques of establishing pine seedlings in pasture, determination of optimum pine stocking rates while ensuring an adequate pasture, and the pruning regimes necessary to ensure good timber quality.

Previous trials have demonstrated unacceptable levels of damage when sheep are grazed among pines less than three years old, and the idea of agricultural cropping between the pines during the first three years is being investigated.

Hydrology

Monitoring of run-off and water quality in the pilot plantation area at Jarrahwood suggests that the conversion of native forest to pine plantation will have little effect on water quality, although there is likely to be some increase in run-off in the early years after clearing.

The results of a broadscale survey of stream salinity in the Sunklands were published during the year.

Wanneroo

Provenance Testing Pinus pinaster

A provenance trial established at Yanchep in 1967 included the progeny of pedigree trees so enabling an assessment of the potential of the various provenances as breeding material. The three major provenances, Leirian, Landes and Corsican were represented. The Leirian provenance was represented by pedigree lines based on superior trees in Portugal and Western Australia, and by bulk seed imported from Portugal, formerly used for the routine raising of planting stock. The Landes provenance was also from pedigree stock and the Corsican from selected, superior trees. At age 7·5 years the comparative performances were assessed and are summarised below:

Provenance	Acceptably Straight Stems (per cent)	Mean Volume per tree (m^3)	Mean Height (M)
Leiria, pedigree	78	·015	7·7
Leiria, routine	61	·011	6·8
Landes	80	·007	5·5
Corsican	88	·006	4·8

The height and volume growth of the Leirian provenance was superior to Landes and Corsican. However, the percentage of acceptably straight stems was low in the Leirian strain, but showed a marked improvement in the pedigree stock produced in the local breeding programme. The superiority of pedigree stock in height and volume growth was also very noticeable.

In May 1977 deaths from drought were observed in this trial. They were confined to the Corsican and Landes provenances indicating a superior resistance to drought in the Leirian strain.

Tree Improvement, Pinus pinaster

The tree improvement programme has concentrated on the Leirian strain of *P. pinaster* with the objectives of improving the straightness of the bole of the tree while at least maintaining the current level of vigour for the provenance. Locally bred progeny have been under trial for ten years and have exhibited some outstanding improvements in bole straightness and vigour. The number of straight trees has been increased by 40 per cent, and very straight trees by 150 per cent. Increases in vigour have varied according to the location of the trials. Volume production per tree has shown increases of between 33 and 66 per cent.

Provenance Testing Pinus radiata

In contrast to the intensive controlled breeding programme for the *P. pinaster* species, activity for *P. radiata* has been at a much lower level. The few tests that have been planted are in the main based on polycross seed collected from seed orchards. The first tests planted in 1969 and 1971 used poly-cross seed with A.C.T., South Australian and Victorian parentage. As parents are from external selection, this series will provide valuable information on genotype-environment interaction.

The Forests Department participated in an international gene pool project for *P. radiata* in 1972 with the establishment of plots of genetically selected trees at two locations. For this project half sib or full sib seed from plus trees was provided to a central pool from New Zealand, Tasmania, South Australia, Victoria, New South Wales, Australian Capital Territory, Queensland, Western Australia, South Africa, Kenya, France, and California, U.S.A. Each lot of seed was divided among all the participants. Western Australia received seed from 319 plus tree sources of the Monterey strain for testing under plantation conditions. Height measurements were made at one planting site in 1976. Averaged over the trials, 90 per cent of the local families consistently appeared in the top quartile of the population, compared with 22 per cent of the imported families. The mean height at age four years was 6·3 m for local families and 5·8 m for imported families.

Publications

During the year eight new research papers and three new bulletins were published. See appendix 6 for details.

Inventory and Planning

Re-Organisation of the Working Plans Branch

The Working Plans Branch is now known as the Inventory and Planning Branch. The two major components of the Inventory and Planning Branch work are the day to day implementation of relevant aspects of the General Working Plan, and the preparation and review of a major part of the General Working Plan itself. These are now catered for by a re-organisation in line with the new functional structure of the department. Manjimup Office is now directly responsible to the southern region planning officer and Harvey Office to the central region planning officer. Until a separate Working Plans Office is established for the northern region, Harvey Office will also assist in the northern region. Inventory and planning activities are co-ordinated from Como.

Changes have also been made at field level where there is now far greater integration of planning and operational staff on inventory projects, and a greater range of activities is now covered. To underline the importance of this aspect of the Department's work, it is intended that all junior field staff will in future spend some time in the Inventory and Planning Branch as part of their training.

Multiple Use Planning

The planning concepts outlined in "A Perspective for Multiple Use Planning in the Northern Jarrah Forest" (see page xx) have now been extended to Dwellingup, Kelmscott and Mundaring Divisions. For each of these divisions a detailed multiple land use plan is nearing completion. The Dwellingup multiple land use plan has been presented to a number of other organisations for comment. The concepts have been outlined to over 90 individuals from Alcoa of Australia (W.A.) Ltd., Government Departments and other authorities.

Hardwood Inventory

A feature of field activities in the last year was the continued emphasis on management level inventory. A sampling intensity of approximately two per cent was used, compared to approximately 0·3 per cent for the previously used resource level inventory. In Dwellingup, Harvey, Collie, Busselton and Nannup Divisions 1 610 hectares of the management level assessment provided information on

75 000 hectares of hardwocd. This level of assessment is necessary to cope with more intensive forest management practices carried out against a background of a hardwood resource depleted by past cutting, dieback disease, and the provisions of special management priority areas for uses other than timber production.

In addition, considerable effort is made to ensure that estimates relate to usable timber volume. However, the problems of changing marketability factors and the difficulty of assessing defect in a standing tree, remain unsolved. Research projects to evaluate new methods of assessing these factors have been commenced.

In the marri chip licence area, 710 hectares of management level assessment provided information on 55 cutting coupes covering 29 000 hectares. This is a sampling intensity of 2·2 per cent.

One hundred and eighty one permanent growth plots were established to cover a wider range of sites than before. Fifty two established growth plots were re-measured.

Chipwood Resource: A statement of the karri and marri chipwood resource in the chip licence area was refined to allow for new boundaries of road and stream reserves, catchment study areas, and other areas which do not have timber production as their management priority.

New Hardwood Inventory: Further work was done on devising a new type of hardwood inventory based on assessment of logs within a tree rather than assessment of the tree as a whole. A flexible fieldsheet has been designed to handle several types of assessment.

Photodendrometer: Photography and measurement of a further 26 plots containing 219 trees was carried out. Regression equations for volumes of karri trees to 20 m bole height have been derived. Further trees are required for calculation of volume regression equations above 20 m bole height.

Assessment by Photoplots: An attempt is being made to estimate volumes by log classes directly from the appearance of the forest on aerial photos. Ninety plots have been measured for ground truth and correlation of these volumes with the photo appearance is about to begin.

Hardwood Operational Control System (HOCS): This was extended to the hardwood forest outside the marri chip licence area during the year. It uses the forest block as the unit of management and provides a sound basis for operational control as well as enabling more accurate records to be maintained than the previous progress plan approach.

Softwood Inventory

Softwood utilisation planning for the central region required a number of computer simulations of the yield of various products over the next twenty years. Logging plans were developed to provide for a balanced yield of pulp quality material to the Dardanup Particle Board factory and of saw-logs to pine sawmills.

A further 1 655 permanent plots were established and 430 established plots were re-measured.

Large Scale Aerial Photographs

Seventy millimetre colour transparencies are continuing to be evaluated for detecting and mapping dieback infection.

Performance trials of the modified transponder navigation system revealed satisfactory accuracy for dieback mapping, although a need for a higher standard of mechanical reliability was also evident.

Suitable autumn conditions, high cloud and an absence of tree shadows, still appear to be the main operational constraint. Based on this factor, an estimated 120 000 to 150 000 hectares a year appear possible with one aircraft photography unit.

A comprehensive range of 35 mm oblique photographs were taken from spotter aircraft flying fire control missions, and used in four main ways:—

- For maintaining an accurate record of cutting and regenerated areas for the hardwood operational control system, as well as determining the progress of cutting in uncompleted coupes.
- For use as an accurate mapping aid in connection with karri regeneration burn operations.
- For determining the location and extent of the area burnt in wildfires.
- As an aid to planning in connection with the management of recreational areas.

Updating of the General Working Plan and Dieback Maps

Information was prepared and detailed planning carried out in relation to the approved cut for each mill. Preliminary work has begun on the design of a system of manual updating of the resource information contained in the General Working Plan. A longer range project to develop a computer based information system has been commenced.

Following minor revision to various dieback maps the approximate area of dieback risk categories in areas under Forests Department control is shown in the table below:

Category	Hectares	% of Total Area
Dieback or suspect dieback	194 000	9·7
Not protectable from dieback	156 000	7·8
Protectable from dieback	1 258 000	63·0
Resistant to dieback—		
Jarrah	87 000	4·4
Wandoo	105 000	5·3
Mallet	10 000	·5
Tuart	3 000	·2
Karri	140 000	7·0
Pines	42 000	2·0
* Total Area under Forests Dept. Control	1 995 000	100·0%

* It should be noted that these areas will be subject to revision as figures for dieback extent, land form and forest type are themselves revised.

Economic Analyses

Projects have included a review of pine stumpage rates; collection of data for indexation of royalties; a regional analysis of the economics of the sunklands project and an examination of self-sufficiency of timber supply in Western Australia. A critical review of the Bureau of Agricultural Economics report on Australia's softwood requirements was also carried out.

Automatic Data Processing (A.D.P.)

Activities have been directed mainly towards maintenance and modifications to existing systems, in particular to pine and hardwood resource production programmes. Some new computer systems have been developed to assist fire control operations. These include a set of weather forecasting programmes and the prediction of smoke dispersal patterns resulting from prescribed burns.

Routine activities have continued to concentrate on the processing of statistical analyses and the provision of both hardwood and pine resource estimates, but there have been increasing demands for pine management information and for the processing of hydrological data and investigations of hydrological problems.

A feasibility study for a land data base covering the south-western area of the state has been completed.

Mapping

Single and multi-coloured maps were prepared to illustrate the 1977 General Working Plan, the research publication "A Perspective for Multiple Use Planning in the Northern Jarrah Forest" and submissions relating to Management Priority Areas. The planning for the implementation of Southern Region dieback quarantine, the introduction of the Hardwood Operational Control System and salinity research projects have each required a large amount of mapping.

The conversion of the Standard map series to metric scale is proceeding and a total of 15 map sheets are being prepared for printing. The progress with this conversion has been slow owing to the need to maintain the imperial scale maps until there is Divisional coverage with the new series. A total of 7 old system map sheets were revised and republished and a further 6 are being revised.

Photo-control for the mapping of the Murray and Proprietary plantation groups and the Dwellingup settlement was obtained and stereo-plotting is proceeding. A total of 2 890 ha of pine plantation and environs were mapped from aerial photographs to define new clearing, road works and the boundaries of older plantings. A total of 900 ha of Kirup group was mapped with contours. A major and continuing project is the revision of topographical detail on the API and standard map series from current aerial photography.

Extension Branch

Displays

Display material was made available to many agricultural shows during the year. The Royal Show display was successful in winning an exhibitor's award.

Information and Advisory Services

Information on the establishment of native plants, seed collection and wildflowers was supplied to many enquirers.

Private Plantations

The Department provides information and advice based on experience to assist private growers in the management of their plantations.

Management enquiries now tend to outnumber those relating to establishment of plantations.

During the year departmental staff assisted with a symposium on private forestry following which a Western Australian chapter of the Australian Forest Development Institute was formed.

Education

Close liaison was maintained with primary and secondary schools and with tertiary institutions. A total of some 50 talks being provided on a wide range of topics. There was an increased interest in the topic of Multiple Use Planning for forests.

Library

Demand for library services from within the Department increased in scope and number during the year. There was also an increase in enquiries from outside the Department. Due to a serious staff shortage there was a restriction in the services given to circulation of library material and accession lists.

Forest Engineering

Roading

During the year, 471 kilometres of roads, tracks and firelines were constructed and 3 647 kilometres of roads were maintained.

Plant and Equipment

Eleven workshops staffed by a total of 42 tradesmen and 17 apprentices maintained a total of 442 vehicles and 122 items of industrial equipment. Eight new fire pumper units mounted on 5 tonne four wheel drive trucks and two tractor mounted hydraulic power packs for pine pruning were the major items constructed in the workshops.

Two agricultural grain harvesters were modified for separation of seed capsules from branchlets during karri seed harvesting operations.

A four wheeled drive articulated tractor was fitted with a 3 000 litre fibreglass tank, pump and engine for use as an off-road fire suppression unit.

Buildings

Extensions to offices at Harvey, Dwellingup and Narrogin were completed during the year. New single officer accommodation was constructed at Manjimup. Additional ablution facilities were provided at Como research centre. The vehicle workshop was extended at Dwellingup.

Communications

The radio repeater at Margaret River was resited at Mowen Tower, with marked improvement of communications in the Busselton division.

Following successful trials with solar cell arrays for battery charging at Mowen Tower similar equipment has been installed at six other repeaters to replace wind-driven generators. This resulted in reducing maintenance costs.

Three radio installations were completed at Bunbury airport to provide for co-ordination of fire spotting aircraft, contact between ground forces and aircraft, and interdivisional communication.

The ten aircraft used for fire spotting were equipped with radios for contact with fire suppression vehicles and divisional control centres. These radios were modified to allow for their use as emergency repeaters.

A more compact, portable repeater kit was developed for use in remote areas and to provide an additional radio channel at prescribed burns or wildfires.

The annual maintenance check of V.H.F. radios was carried out on 255 vehicles and 84 new vehicles were wired.

FINANCE, ACCIDENT PREVENTION AND STAFF

Finance

Amendments to the Forests Act, that altered the method of financing the operations of this Department, were proclaimed on the 24th September, 1976.

All Departmental revenue is now paid into the Consolidated Revenue Fund and allocations are made from the Consolidated Revenue Fund and Loan Fund to the Forestry Fund.

The statement for 1976/77 contains elements of both methods of financing and no comparison is made with the previous year's results.

Source and Application of Funds

	1976/77 $
Source	
Consolidated Revenue Fund	10 706 635
Reduction in unexpended balance	471 437
General Loan Fund	1 663 000
Commonwealth Aid Road Grant	321 366
Rents	184 388
Commonwealth Softwood Forestry Agreement	775 634
Mining Compensation	51 919
Sundry Revenue	214 772
Conservator's Borrowings	800 000
	$15 189 151
Application	
Forest Development	4 597 738
Forest Maintenance	10 591 413
	$15 189 151

Accounting Computer

Installation of an "on line" Interdata 7/32 computer system with a remote access facility at Bunbury was completed by consultants during the year. The system has initially been applied to pine marketing with subsidiary applications to fire weather forecasting and fire behaviour prediction. Ultimately the computer facility will be extended to include financial reporting for management purposes as well as certain aspects relating to yield control.

Completion of this system on a regional basis will eliminate time lags in transporting documents between country centres and will result in a much improved up to date information service for management purposes.

Accident Prevention

The conclusion of the 1976/77 year marked the first decade of a sustained accident prevention programme in the Forests Department. During this decade there has been outstanding improvement as shown by the following figures.

	1966/67	1976/77
Number of Lost Time Accidents	185	32
Frequency Rate L.T.A.	100+	19
Man Days Lost	2 896	620

Comparison of days lost in 1966/67 with days lost in 1976/77 shows a reduction of 2 276 man days lost, which when valued at current rates shows an annual saving in wages alone of $90 000. When coupled with the indirect savings such as overheads, damage to equipment and machinery, the need for staff replacements and training, the monetary savings gain in significance. The National Safety Council estimates total money savings to be at least four times the value of direct savings. There are even greater benefits with respect to human feelings and the effects on employees' families. The following table sets out in more detail the Forests Department's Safety achievement over the last decade.

SUMMARY OF TEN YEARS OF ACCIDENT STATISTICS

Year	M.H.W.	L.T.A.	M.T.A.	Total Accidents	Frequency Rate			Man Days Lost	Duration Rate	Severity
					L.T.A.	M.T.A.	L.T.A.+ M.T.A.			
1966/67	....	185	....	....	100+	....	100+	2 896	....	....
1967/68	1 895 600	124	312	436	65	164	230	1 701	14	900
1968/69	2 019 568	96	155	251	48	76	124	1 738	18	860
1969/70	1 901 020	70	129	199	37	67	104	721	10	379
1970/71	1 808 406	48	158	206	27	76	110	458	9	253
1971/72	1 759 888	40	128	168	23	72	95	275	6	156
1972/73	1 728 577	45	112	157	26	64	90	414	9	239
1973/74	1 651 621	45	119	164	27	72	99	359	8	217
1974/75	1 748 219	55	127	182	31	72	104	634	11	362
1975/76	1 762 693	31	113	144	17·5	64	82	383	12	217
1976/77	1 707 635	32	157	189	19	92	111	620	19	363

LTA—Lost time accidents. MTA—Medical treatment accidents.

In 1976/77 there was one more lost time accident than in 1975/76 however, it is pleasing to note that the corresponding frequency rate of 19 rose only marginally.

The Medical Treatment accidents increased from an almost all-time low of 113 last year to 157 in 1976/77. This emphasises the need for continuous attention to all aspects of the accident prevention programme.

During the year the Kelmscott, Busselton, Mundaring and Walpole divisions, Research Branches, Head Office and the Cadet Training School achieved further accident-free periods of twelve months. Special mention should be made of Walpole Division who completed their sixth consecutive accident free year and the Cadet Training School with five years free of accidents. The Walpole achievement is a record in W.A.

The composition and functions of the Central Safety Committee have been reviewed and modified. The accent of the Committee's work now is to formulate and recommend accident prevention policy, set and maintain safety standards, and liaise with other agencies and between regions. Responsibility for the day to day safety administration rests with the regions.

Staff

Public Service Act

Mr. J. K. Smart was promoted to Superintendent.

Mr. P. C. Kimber, Mr. J. B. Sclater and Mr. B. J. White were each promoted to the position of Inspector.

Mr. K. G. Hide was appointed to the position of Secretary.

Mr. G. S. McCutcheon, Mr. T. B. Butcher, Mr. N. G. Ashcroft and Mr. G. Malajczuk were reclassified as Senior Divisional Forest Officers.

Mr. P. C. Pedretti was appointed to the position of District Inspector under the Timber Industry Regulation Act.

Forests Act

Mr. J. W. Humphreys was promoted to District Forester.

Mr. J. Reynolds and Mr. L. J. Marshall were reclassified as Technical Officers Grade I.

Mr. M. H. Welch was promoted to Technical Officer Grade I.

Mr. C. E. Hopkinson, Plant Inspector, Mr. E. H. Randall, Technical Officer and Mr. J. Marshall, Senior Forester (Safety), retired from their positions with the Department.

The death of District Forester N. K. James is reported with regret.

Conferences and Study Tours

This year 18 officers attended a total of 17 interstate and overseas conferences, courses and study meetings involving such subjects as softwood logging, pine marketing, biological control research, utilisation, systems analysis techniques applicable to forest management problems, afforestation and financial management.

APPENDIX 1A

Statement of Revenue Paid into Consolidated Revenue Fund for the year ended June 30, 1977

1975/76	Revenue	1976/77
$	*Royalties*	$
4 341 185	Logs	4 438 430
....	Chip Logs	286 514
26 316	Sleepers	38 305
99	Sawn Timber	....
258 366	Poles and Piles	356 493
11 008	Mining Timber	12 299
20 987	Firewood	15 577
32 698	Posts	36 584
22 948	Sandalwood	23 474
27 778	Miscellaneous	25 854
4 741 385		5 233 530
	Pine Conversion	
1 246 618	Pine Logs	1 601 875
1 181 291	Sawn Pine	1 261 452
2 427 909		2 863 327
	Hardwood Conversion	
212 109	Sawn Hardwood	203 644
198 644	Logs	203 435
5 024	Posts and Other	3 164
415 777		410 243
	Other Sales and Fees	
83 744	Seeds and Trees	112 618
90 341	Inspection Fees	70 203
35 616	Rents and Leases	43 398
399 048	Miscellaneous	497 734
234 518	Compensation—Mining and Other *	....
843 267		723 953
	Recoupable Projects	
173 437	Miscellaneous	80 819
173 437		80 819
8 601 775		9 311 872

* Now paid to Forestry Fund

APPENDIX 1B

Forestry Fund Account for Year ended June 30, 1977

Expenditure—		
Hardwood Forests—Establishment and Tending		1 143 793
Softwood Forests—Establishment and Tending		2 120 856
Access Roads Construction		255 782
Land Purchases		389 978
Plant and Equipment		320 893
Housing and Buildings		208 399
Sawmilling and Seasoning Plant		158 037
Forest Protection		1 399 440
Access Roads Maintenance		478 639
Research and Other Services		675 828
Commercial Operations		2 222 296
Trade Operations		115 189
Recoupable Projects		149 093
Salaries	4 911 224	
Less Charged to Development	1 285 000	3 626 224
Administration Expenses	2 615 162	
Less Charged to Development	746 000	1 869 162
Cash Order Balance		55 542
		15 189 151
Source of Revenue—		
Balance B/F		1 014 818
9/10 Contribution—July/September 1976		1 260 381
Arrears 9/10 Contribution 1974/75, 1975/76		170 765
House Rents		184 388
Commonwealth Aid Road Grants		321 366
Mining Compensation		51 919
C.R.F. Contribution		9 275 489
General Loan Funds		1 663 000
Commonwealth Softwood Agreement Act 1976		630 000
Commonwealth Softwood Arrears 1975		145 634
Conservator's Borrowings		800 000
Sundry Revenue Pine Plant Disposals etc.		214 772
		15 732 532
Less Balance C/F		543 381
		15 189 151

APPENDIX 2A

Exports *from Western Australia of Timber, Tanning Substances and Essential Oils for the Year ended June* 30, 1976

	Item and Destination	Quantity	Value
		m³	$
1	Sawlogs and veneer logs, in the rough or roughly squared—conifer	....	....
2	Sawlogs and veneer logs, in the rough or roughly squared, non-conifer (including poles, piling, posts and other wood in the rough)—		
	Interstate—		
	Victoria	598	46 946
	South Australia	137	10 603
	Total	735	57 549
	Overseas—		
	China—Taiwan Prov. only	74	20 983
	Total	74	20 983
3	Sleepers—		
	Interstate—		
	South Australia	5 784	609 329
	Total	5 784	609 329
	Overseas—		
	Germany, Fed. Rep. of	2 515	313 522
	South Africa, Rep. of	19 155	1 866 740
	United Kingdom	21 824	2 705 930
	Total	43 494	4 886 192
	Timber sawn lengthwise, sliced or peeled, but not further prepared, of a thickness exceeding 5 mm—Non-conifer.		
4	Jarrah—		
	Interstate—		
	New South Wales	26	2 288
	Victoria	1 842	177 445
	South Australia	13 387	1 235 130
	Northern Territory	440	49 511
	Total	15 695	1 464 374
	Overseas—		
	Bahrain	68	12 173
	Germany, Fed. Rep. of	14	2 223
	Greece	15	2 404
	Iran	98	18 107
	Mauritius	90	13 640
	Netherlands	41	6 802
	New Zealand	5	800
	South Africa, Rep. of	200	31 376
	United Kingdom	134	19 491
	U.S.A.	219	28 799
	Total	884	135 815
5	Karri—		
	Interstate—		
	New South Wales	6 244	468 465
	Victoria	592	56 178
	South Australia	13 089	1 121 880
	Northern Territory	1 876	168 515
	Total	21 801	1 815 038
	Overseas—		
	Germany, Fed. Rep. of	468	64 396
	South Africa, Rep. of	774	105 438
	United Kingdom	337	69 614
	U.S.A.	436	98 660
	Total	2 015	338 108
6	Other—		
	Interstate—		
	Overseas—		
	Libyan Arab Republic	103	25 195
	Singapore, Republic of	....	10
	United Kingdom	44	5 416
	U.S.A.	8	1 479
	Total	155	32 100
	Timber (including blocks, strips and friezes for parquet or wood block flooring, not assembled), planed, tongued, grooved, rebated, chamfered, V-jointed, beaded, centre beaded or the like but not further manufactured—		
7	Flooring—	m³	$
	Interstate (*a*)—		
	New South Wales	1 758	204 551
	Victoria	979	130 562
	South Australia	572	78 791
	Northern Territory	53	13 408
	Total	3 362	427 312
	Overseas (*b*)—		
8	Other (*c*)—		
	Interstate—		
	South Australia	6	1 081
	Northern Territory	20	6 943
	Total	26	8 024
	Overseas—		
	Christmas Island	4	363
	Greece	56	15 539
	United Kingdom	51	12 311
	Total	111	28 213
	Total Timber Items 1-8	94 136	9 823 037
9	Wood, sawn lengthwise, sliced or peeled, but not further prepared, veneer sheets and sheets for plywood, of a thickness not exceeding 5 mm—plywood, blockboard, laminboard, and the like; inlaid wood, cellular wood panels, whether or not faced with base metal—	m³	$
	Interstate	NRS	NRS
	Overseas—		
	New Zealand	100	180
	Singapore, Republic of	1	41
	United Kingdom	7	151
	Total	108	372
10	Reconstituted wood (also known as particle board, chip board, sliver board, shaving board, flake board, residue board and wood waste board)—		
	Interstate	(d)	(d)
	Overseas—		
	Japan	....	828 029
	New Zealand	....	180
	Singapore, Republic of	....	25 346
	United Kingdom	....	151
	Total	....	853 706
11	Casks, vats, barrels, etc., Empty (*e*)—		
	Overseas—		
	United Kingdom	....	8 859
	Total	....	8 859
12	Manufacturers of wood (except furniture), N.E.I. (*f*)—		
	Interstate—		
	New South Wales	....	1 028
	Victoria	....	81 206
	Queensland	....	18 117
	South Australia	....	18 973
	Northern Territory	....	7 978
	Total	....	127 302
	Overseas—		
	Christmas Island	....	2 714
	Singapore, Republic of	....	110
	U.S.A.	....	136
	Total	....	2 960
13	Tanning substances of natural origin—	N.R.S.	N.R.S.
		kg	$
14	Essential oils; concretes and absolutes; resinoids—		
	Interstate—		
	New South Wales	16 608	162 939
	Victoria	2 936	19 558
	South Australia	161	15 262
	Total	19 705	197 759
	Overseas—		
	Germany, Fed, Rep. of	700	2 854
	Italy	200	3 910
	United Kingdom	1 000	3 535
	U.S.A.	716	6 860
	Total	2 616	17 159
	Total value of exports on this return	....	11 031 154

(*a*) Relates to interstate exports of non-conifer flooring only.
(*b*) Relates to overseas exports of conifer flooring only. Overseas exports of non-conifer flooring included in Item 8.
(*c*) See Footnotes (*a*) and (*b*). Item also includes conifer timber, sawn lengthwise, sliced or peeled, but not further prepared, of a thickness exceeding 5mm.
(*d*) Details not available for publication.
(*e*) Interstate exports included in Item 12.
(*f*) Includes cork manufacturers.

"N.E.I." means "not elsewhere included",
"N.R.S." means "not recorded separately".
Basis of Value—F.O.B. at point of final shipment.
(Information supplied by the Australian Burea of Statistics)

APPENDIX 2B

Imports *into Western Australia of Timber, Timber Products, Tanning Substances and Essential Oils for the Year ended June* 30, 1976

	Item and Origin	Quantity	Value
		m³	$
1	Sawlogs and veneer logs, in the rough or roughly squared, non-conifer, (including poles, piling, posts and other wood in the rough) (*a*)—		
	Overseas	5 011	200
2	Railway Sleepers—		
	Overseas—		
	Malaysia	16 870	2 710 237
	Singapore, Rep. of	5 037	747 795
	Total	21 907	3 458 032
	Timber, sawn lengthwise, sliced or peeled, but not further prepared, of a thickness exceeding 5 mm—Conifer (*b*)—		
3	Douglas Fir (*c*)—		
	Overseas—		
	New Zealand	165	10 609
	U.S.A.	1 207	169 979
	Total	1 372	180 588
4	Other—		
	Interstate (*d*)—		
	New South Wales	60	3 088
	South Australia	281	47 716
	Total	341	50 804
	Overseas—		
	New Zealand	....	12
	U.S.A.	223	43 843
	Total	223	43 855
	Timber, sawn lengthwise, sliced or peeled, but not further prepared, of a thickness exceeding 5 mm—Non-Conifer (*b*)—		
5	Meranti (*e*)—		
	Overseas—		
	Indonesia	111	6 828
	Malaysia	2 280	163 825
	Singapore, Rep. of	862	60 035
	Total	3 253	230 688
6	Ramin (*e*)—		
	Overseas—		
	Indonesia	407	31 555
	Malaysia	420	50 506
	Singapore, Rep. of	263	25 941
	Total	1 090	108 002
7	Teak (*e*)—		
	Overseas—		
	Thailand	454	177 778
	Total	454	177 778
8	Kapur (*e*)—		
	Overseas—		
	Indonesia	239	14 942
	Malaysia	3 657	289 310
	Singapore, Rep. of	73	6 683
	Total	3 969	310 935
9	Keruing (*e*)—		
	Overseas—		
	Malaysia	1 507	140 202
	Singapore, Rep. of	12	1 505
	Total	1 519	141 707
10	Nyatoh (*e*)—		
	Overseas—		
	Malaysia	9 880	850 881
	Total	9 880	850 881
11	Other (*f*)—		
	Interstate—		
	Overseas—		
	Malaysia	1 154	99 388
	Singapore, Rep. of	98	8 279
	Total	1 252	107 667
12	Shooks and staves, sawn lengthwise, sliced or peeled, but not further prepared of a thickness exceeding 5 mm (*g*)—		
	Overseas	....	....
13	Wooden beadings and mouldings (including moulded skirting and other moulded boards) (*h*)—	m³	$
	Overseas—		
	Belgium-Luxembourg	....	2 748
	France	....	2 390
	Germany, Fed. Rep. of	....	13 362
	Japan	....	7 275
	Malaysia	....	8 489
	Netherlands	....	147
	Norway	....	2 605
	Singapore, Rep. of	....	8 869
	Spain	....	1 390
	Thailand	....	419
	United Kingdom	....	27 997
	Total	....	75 691
	Timber (including blocks, strips and friezes for parquet or wood block flooring, not assembled), planed, tongued, grooved, rebated, chamfered, v-jointed, beaded, centre-beaded or the like, but not further manufactured—		
14	Flooring (*i*)	....	....
15	Other—		
	Interstate (*j*)—		
	Overseas—		
	Germany Fed. Rep. of	1	2 076
	Indonesia	12	1 155
	Malaysia	1 773	263 081
	Singapore, Rep. of	201	21 703
	U.S.A.	7	806
	Total	1 994	288 821
	Total Timber Items 2-15	47 254	6 025 449
16	Wood, sawn lengthwise, sliced or peeled, but not further prepared, veneer sheets and sheets for plywood, of a thickness not exceeding 5 mm; plywood, blockboard, laminboard and the like: inlaid wood, cellular wood panels, whether or not faced with base metal—	m²	
	Interstate—		
	New South Wales	74 628	201 054
	Victoria	8 865	25 767
	Queensland	171 569	510 468
	South Australia	8 792	12 486
	Total	263 854	749 775
	Overseas (Country details not available)	8 795 788	1 975 408
17	Reconstituted wood (also known as particle board, chip board, sliver board, shaving board, flake board, residue board and wood waste board)—		
	Interstate (separate State details not available for publication)		
	Total	674 813	2 319 453
	Overseas—		
	Korea, Rep. of	....	2 666
	South Africa, Rep. of	....	3 784
	Total	....	6 450
	Total Timber Items 16-17	....	5 051 086
	Total Timber Items 2-17	....	11 076 535
18	Match splints (*h*)—		
	Overseas—		
	Finland	....	70 208
	Total	....	70 208
19	Rulers, Wooden (*a*)—	Number	
	Overseas—		
	Germany, Fed. Rep. of	5 212	2 509
	Japan	5	1
	United Kingdom	3 152	5 107
	Total	8 369	7 617
20	Table mats, Wooden	N.R.S.	N.R.S.
21	Wood Flour (*h*)—		
	Overseas	....	....
22	Clothes Pegs, Wooden	N.R.S.	N.R.S.

APPENDIX 2B—*continued*

Imports *into Western Australia of Timber, Timber Products, Tanning Substances and Essential Oils for the Year ended June* 30, 1976

	Item and Origin	Quantity	Value
			$
23	Tool handles, Wooden		
	Interstate (*k*)—		
	New South Wales	....	592
	Victoria	....	3 359
	Queensland	....	128 016
	Total	....	131 967
		Dozen	
	Overseas—		
	Denmark	1 092	794
	Germany, Fed, Rep. of	6	81
	Japan	8	117
	Switzerland	1	2
	United Kingdom	13	32
	U.S.A.	1 888	23 100
	Total	3 008	24 126
		Number	
24	Doors not incorporating locks, hinges or similar fittings—		
	Interstate—		
	New South Wales	42 336	718 030
	Victoria	580	5 522
	South Australia	42 894	581 695
	Total	85 810	1 305 247
	Overseas—		
	China-Taiwan Prov. only	75 231	229 852
	Japan	10	1 100
	Malaysia	10	198
	Philippines	....	79
	Singapore, Rep. of	27	663
	Total	75 278	231 892
		kg	
25	Manufactures of wood (except furniture, N.E.I.) (*l*)—		
	Interstate—		
	New South Wales	....	266 197
	Victoria	....	833 329
	Queensland	....	167 087
	South Australia	....	147 077
	Tasmania	....	17 333
	Total	....	1 431 023
	Overseas—		
	Belgium-Luxembourg	....	667
	Canada	....	86 924
	China-Excl. Taiwan Prov.	....	3 967
	China-Taiwan Prov. only	....	220 527
	Czechoslovakia	....	416
	Denmark	....	20 424
	France	....	122
	Germany, Fed. Rep. of	....	39 034
	Greece	....	38
	Hong Kong	....	12 085
	India	....	8 521
	Indonesia	....	1 812
	Italy	....	8 500
	Japan	....	25 677
	Kenya	....	68
	Malaysia	....	48 781
	Mauritius	....	962
	Mexico	....	79
	Nepal	....	324
	Netherlands	....	2 292
	New Zealand	....	14 422
	Norway	....	270
	Pakistan, Islamic Rep. of	....	411
	Papua, New Guinea	....	65
	Philippines	....	99 713
	Singapore, Rep. of	....	17 905
	South Africa, Rep. of	....	43
	Spain	....	21 734
	Sri Lanka	....	2 093
	Sweden	....	71 939
	Switzerland	....	815
	Thailand	....	73 668
	Tonga	....	104
	United Kingdom	....	16 748
	U.S.A.	....	83 251
	Yugoslavia	....	352
	Origin unknown	....	188
	Total	....	884 941

	Item and Origin	Quantity	Value
		Number	$
26	Furniture, wood or wood framed (*m*)—		
	Interstate—		
	New South Wales	....	468 833
	Victoria	....	1 354 941
	Queensland	....	2 599
	South Australia	....	1 108 225
	Tasmania	....	595
	Total	....	2 935 193
	Overseas—		
	Australia (Re-imported)	....	45
	Belgium-Luxembourg	....	38 571
	Canada	....	1 552
	China-Excl. Taiwan Prov.	....	22 648
	China-Taiwan Prov. only	....	450 458
	Denmark	....	8 173
	Finland	....	9 455
	France	....	609
	Germany, Fed, Rep. of	....	13 005
	Hong Kong	....	75 642
	India	....	7 922
	Indonesia	....	899
	Italy	....	105 146
	Japan	....	59 267
	Korea, Rep. of	....	5 112
	Malaysia	....	183 322
	Netherlands	....	9 157
	New Zealand	....	300
	Norway	....	9 975
	Philippines	....	21 864
	Singapore, Rep. of	....	369 426
	South Africa, Rep. of	....	72
	Spain	....	11 503
	Sweden	....	13 491
	Thailand	....	21 579
	United Kingdom	....	340 843
	U.S.A.	....	65 868
	Yugoslavia	....	15 768
	Total	....	1 861 672
		kg	
27	Wattle Bark Extracts (*n*)—		
	Overseas—		
	South Africa, Rep. of	1 491 500	189 934
	Total	1 491 500	189 934
28	Other (*n*)—		
	Overseas—		
	France	20 000	9 274
	Italy	76 150	20 127
	United Kingdom	5 519	4 492
	Total	101 669	33 893
29	Synthetic Tanning Substances—		
	Tanning extracts of vegetable origin—		
	Artificial bates for pre-tanning; Tanning (Tannic Acids) and their salts, esters and other derivatives—		
	Interstate (*o*)—		
	New South Wales	37 107	50 541
	Victoria	40 396	38 822
	South Australia	390	360
	Total	77 893	89 723
	Overseas—		
	Germany, Fed. Rep. of	79 180	30 169
	United Kingdom	33 425	29 612
	Total	112 605	59 781
30	Essential Oils; concretes and absolutes; resinoids—		
	Interstate—		
	New South Wales	235	783
	Victoria	3 659	25 769
	Total	3 894	26 552
	Overseas—		
	China—Excl. Taiwan Prov.	1 050	1 151
	Indonesia	2 000	4 384
	Japan	12	525
	Singapore, Rep. of	28	33
	Swaziland	23 348	98 869
	U.S.A.	....	1
	Total	26 438	104 963
	Total value of imports on this return	....	20 465 267

(*a*) Interstate Imports are not recorded separately.
(*b*) Overseas imports exclude shooks and staves—see Item 12.
(*c*) Interstate imports included in Item 4.
(*d*) See Footnote (*c*). Item also includes imports of conifer timber, planed tongued, grooved or the like.
(*e*) Interstate imports included in Item 11.
(*f*) See Footnote (*e*).
(*g*) Interstate imports included in Item 4 (Conifer) and Item 9 (Non-conifer).
(*h*) Interstate imports included in Item 25.
(*i*) Figures relate to overseas imports of conifer flooring only, interstate imports of flooring included in Item 4 (Conifer) and Item 15 (Non-conifer).
(*j*) Relates to non-conifer timber only. All conifer timber, planed, tongued, grooved, etc. included in Item 4.
(*k*) Includes Brush and broom handles and the like.
(*l*) Includes imports of wooden packing cases, casks, domestic articles of wood, and similar products.
(*m*) Excludes imports, if any, of wooden medical, dental, surgical or veterinary furniture, non-domestic wooden chairs, and wooden legs imported separately as parts.
(*n*) Interstate imports included in Item 29.
(*o*) See Footnote (*n*).

"N.E.I." means "not elsewhere included".
"N.R.S." means "not recorded separately".
Basis of value: Overseas—F.O.B. at the point of final shipment.

Basis of value: Interstate—landed cost in Western Australia.
(Information supplied by the Australian Bureau of Statistics.)

APPENDIX 3

SUMMARY OF EXPORTS OF FOREST PRODUCE

Year	Timber		Wood Manufacture Value	Essential Oils and Tanning Material*
	m^3	value		
		$	$	$
Brought forward	13 081 830	177 786 912	8 536 935	17 368 964
1968	84 569	4 947 595	3 016 850	280 806
1969	86 455	4 984 098	3 802 927	267 565
1970	96 275	5 661 547	3 906 699	317 553
1971	79 362	4 803 842	2 110 802	343 512
1972	101 191	6 439 732	2 369 541	348 762
1973	111 547	7 036 637	2 604 116	377 736
1974	98 200	7 366 709	3 769 461	433 627
1975	100 127	9 080 092	132 278	479 019
1976	94 136	9 823 037	993 199	214 918
1977†				

* Tanning materials not recorded separately since 1967.
† Not Available.

APPENDIX 4

SUMMARY OF IMPORTS OF FOREST PRODUCE

Year	Timber Woodware	Tanning Materials	Essential Oils
	$	$	$
Brought Forward	63 937 163	1 344 397	4 600 226
1968	8 135 532	75 657	143 696
1969	8 731 114	109 905	206 309
1970	10 968 170	153 169	293 845
1971	6 761 806	103 857	175 331
1972	5 578 819	144 219	227 530
1973	8 326 939	225 463	366 786
1974	11 738 861	420 010	271 713
1975	14 053 751	465 884	641 859
1976	19 960 421	373 331	131 515
1977†			

† Not available.

APPENDIX 5

SUMMARY OF LOG PRODUCTION

Year	Crown Land m^3	Private Property m^3	Total
Brought Forward	44 466 501	15 455 468	78 705 715*
1968	1 231 517	228 281	1 459 978
1969	1 143 705	160 771	1 304 476
1970	1 121 396	175 686	1 297 082
1971	1 145 161	161 990	1 307 151
1972	1 096 236	106 993	1 203 229
1973	1 060 359	102 992	1 163 351
1974	1 084 463	91 884	1 176 347
1975	1 096 356	87 957	1 184 313
1976	1 194 667	111 761	1 306 428
1977	1 429 493	106 848	1 536 341

* Includes 18 783 746 cubic metres estimated cut prior to 1917.
Note—as in previous years this total includes log material used for reconstituted wood and chipwood.

APPENDIX 6

FORESTS DEPARTMENT RESEARCH PAPERS AND BULLETINS PUBLISHED DURING THE YEAR ENDED JUNE 30, 1977.

Research Papers

19—A. B. Hatch .... The relationship between electrical conductivity of soil: Water suspensions and soluble salts in some Western Australian forest soils. 1976.

20—J. McCormick .... Recovery of Maritime Pine (*Pinus pinaster*) after severe crown scorch. 1976.

21—S. R. Shea & R. J. Kitt .... The capacity of Jarrah forest native legumes to fix nitrogen. 1976.

22—S. R. Shea & A. B. Hatch Stream and groundwater salinity levels in the South Dandalup Catchment of Western Australia. 1976.

23—F. E. Batini, A. B. Selkirk & A. B. Hatch Salt content of soil profiles in the Helena Catchment, Western Australia. 1976.

24—F. H. McKinnell .... Water quality in the Donnybrook Sunkland (Blackwood Plateau). 1976.

25—F. E. Batini & J. N. Cameron The effects of temperature on the infection of New Zealand Blue Lupins by *Phytophthora cinnamomi*. 1975.

26—P. C. Kimber .... Aerial application of Urea fertilizer to Jarrah Pole Stands. 1976.

Bulletins

86—J. J. Havel .... Site-vegetation mapping in the northern Jarrah forest (Darling Range). 1. Definition of site-vegetation types. 1975.

87—J. J. Havel .... Site-vegetation mapping in the northern Jarrah forest (Darling Range). 2. Location and mapping of site-vegetation types. 1975.

88—P. Christensen .... Jarrah Dieback—Soil temperature and moisture regimes of some southern forest types. 1975.

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