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Forests Department Western Australia

October 1983

DIEBACK REVIEW 1982

SEVEN WAY TEST GUIDELINES

Internal use only -

contents subject to further review

INDEX

INTRODUCTION

The Dieback Policy 1982 states that "before operations are permitted, the following factors must be evaluated:

- Type of operation
- Degree of hygiene
- Risk of introducing *P. cinnamomi*
- Forest type
- Likely impact
- Land use, and
- Consequences of impact on land use"

This SEVEN WAY TEST, as it is now known, can be applied to proposed operations inside or outside of proclaimed Disease Risk Areas.

To assist Divisional and Regional Staff in the preparation of these tests, guidelines were issued early in 1983. These have been tested and have been revised on the basis of the comments received from users.

The tables of impact and consequence have also been revised and represent the current "State of the Art". The substantial contributions made by the Inventory and Planning Branch's dieback interpreters, by Research and by Regional Officers, are acknowledged.

These guidelines and tables will be revised at 12 monthly intervals, as additional data becomes available.

PROTECTION BRANCH
OCTOBER 1983

GUIDELINES FOR THE PREPARATION OF FORM FD 781, SEVEN-WAY TEST

1. THE WORK PROPOSED

Purpose

- Describe briefly but fully the reasons for the test and the need for access.

Location

Maps should accompany the Seven-Way Test form FD 781 and the information that is required to be shown is as follows:-

- 1:50,000 base data
- Contours if available
- Location and type of operation proposed
- Land form and vegetation types
- Dieback and hygiene categories
- Access.

In some cases two plans, or one with an overlay might have to be used to accommodate the above information legibly.

Type and Extent of Work

- Describe briefly the type of operation proposed
- Nominate Division, Block
- Describe by extent (ha), by numbers (20 drill holes), by distance (10 kms)
- Describe intensity of activity, e.g. 5 trees ha^{-1}, $20m^3ha^{-1}$, clearfell, clear and surface mine
- Prior to commencement work, a detailed job prescription should be prepared in most instances.

2. HYGIENE MEASURES REQUIRED

Can the operation be approved without any hygiene? If the answer is no, apply increasing degrees of hygiene, commencing with the simplest and progressing to the most complex, e.g.:

Machines clean on commencement

Dry soil conditions

Supervision - by operating company, e.g. S.E.C.

Supervision - by F.D. staff

Supervision - need for briefing and/or training of staff

Nominate access routes and show these on maps

Upgrade access where necessary.

Dieback hygiene maps - specify type of map, e.g. 70 mm photos, ground surveys by trained interpreters, ground surveys

Dieback categories (see standard categories on dieback hygiene plans (Attachment).

Split-phase operation

Operation based on mini-catchments

Clean-down between mini-catchments

3. RISK OF DIEBACK FUNGUS

- Based on the estimated risk of introducing or of spreading the fungus, the number of possible introductions and the likelihood of the fungus surviving if it is introduced:

  the estimated risk is that which applies AFTER the appropriate hygiene measures have been applied.

- Risk of introduction is related to the type of operation, the time of the year, the hygiene used, the location in the topography and the landform.

- Spread by artificial means is related to the type and scale of operation. It is complicated by the risk of natural spread from existing dieback. See also the hygiene plans, and the time lapse between the photography, the preparation of the plans and the operation.

- Survival can be related to the time of year, the prevailing weather conditions and the landform/vegetation type.

4. LANDFORM AND VEGETATION TYPES

- Describe according to types used in the impact category tables, (Attachment), wherever possible. Avoid using "Jarrah forest with some marri".

- Describe using:

  System 6 vegetative types

  System 6 landform classes

  Mr. Havel's site types

  A.P.I. types

  Mr. McCutcheon's soil classification (Sunklands)

  where these classifications are available.

- Often a number of landforms or vegetation types are involved in an operation. These should be marked on the map. The area of each landform or vegetation type should be shown.

- The vegetation type has a strong bearing on its susceptibility to dieback, e.g. jarrah or wandoo, dense banksia or *Acacia pulchella* etc.

5. LIKELY IMPACT ON VEGETATION

Refer to the relevant tables of impact and to definitions of impact classes. Consider increasing or decreasing the impact, depending on the disturbance to be caused by the operation, e.g. drill hole, a selection cut, clearfelling etc.

6. LAND USE

- Refer to G.W.P. No. 87 (1982) for land use categories. Consider particularly the primary use, but also secondary and tertiary uses. Is the operation within or outside a proclaimed disease risk area? Is the operation within or outside an active catchment? Is the reservoir used for irrigation, or for domestic use, or both?

7. CONSEQUENCES ON LAND USE

- Refer to the relevant tables, considering particularly the primary use. Also evaluate the consequences on a broad scale, e.g. although 100 ha of forest may become infected, is it likely that the reservoir will become saline? Consider also the consequences of not doing the operation - financial, employment, risk (e.g. deferring prescribed burning), consequences on industry, loss of royalty.

- If hygiene measures are used and are completely successful, there should be minimal impact on vegetation and on land use.

- If extraction roads become infected, then the forest below these roads is placed at risk. There could be moderate-high impact on some vegetative types, with high consequences on land use.

- If hygiene fails totally, all of the area is placed at risk, with potentially high impact on the vegetation and high consequences on land use.

8. EVALUATION OF 7-WAY TEST

- Comment on the additional costs imposed by hygiene on the user or industry, and on the Department. Consider the effects on staff numbers and the time required to supervise the works programme adequately.

FORESTS DEPARTMENT - DIEBACK POLICY 1982 FD 781
2nd EDITION

SEVEN-WAY TEST

DIVISION

DATE

1 THE WORK PROPOSED

PURPOSE

INITIATED BY

LOCATION (block etc)

TYPE AND EXTENT OF THE WORK

ARE OTHER OPTIONS AVAILABLE? Specify, including "do nothing"

2 HYGIENE MEASURES REQUIRED

Summary of hygiene prescription

CLEAN MACHINERY

DRY SOIL

SUPERVISION

ACCESS ROUTES

continued overleaf

HYGIENE MEASURES continued

DIEBACK HYGIENE PLANS - specify type

DIEBACK CATEGORIES

ANY OTHER e.g. split-phase operations, mini-catchments etc.

3 RISK OF DIEBACK FUNGUS (high, moderate, low)

RISK OF INTRODUCTION	RISK OF SPREAD Artificial_____ Natural_____
MULTIPLE INTRODUCTION RISK	RISK OF MULTIPLE SPREAD Artificial_____ Natural_____
RISK OF SURVIVAL	

COMMENTS

4 LANDFORM AND VEGETATION

Describe according to types used in impact category tables

5 LIKELY IMPACT ON VEGETATION Refer to tables of impact

WILL INTRODUCTION OF DISEASE AND IMPACT BE MONITORED?

HOW?

BY WHOM?

6 LAND USE

GWP No. 87

WITHIN DISEASE RISK AREA?
Classify A_1 A_2 etc or other (see Policy No. 10)

WITHIN ACTIVE CATCHMENT?

SALINITY ZONE specify using map in GWP 87

7 CONSEQUENCES ON LAND USE Refer to tables of consequences

IF HYGIENE SUCCESSFUL

IF HYGIENE FAILS

see over

CONSEQUENCES continued

CONSEQUENCES ON BROADER SCALE on catchment, forest ecosystem, landscape

CONSEQUENCES OF NOT PROCEEDING WITH THE WORK on economy, employment etc

8 EVALUATION OF 7-WAY TEST Your comments, signature and date

OIC AREA
REGIONAL SUPERINTENDENT
OIC PROTECTION
POLICY REVIEW GROUP
ACTING CONSERVATOR

THE SWAN COASTAL PLAIN

INTRODUCTION

Although the Swan Coastal Plain supports 29 vegetation complexes (Atlas of Natural Resources, 1980) only a few of these are well represented in State Forests. State Forests considered here include Moore River, Yanchep, Gnangara, Peel, McLarty, Myalup and Ludlow.

DESCRIPTION

Six landforms and soils systems will be described. These include the following:

Aeolian Deposits

- Quindalup
- Cottesloe
- Karrakatta
- Bassendean

Marine Deposits

- Vasse
- Yoongarillup

Quindalup Landform

Dunes and beach ridges composed of calcareous sands. Foredunes, mobile and stable dunes. Extent within State Forests is very limited.

Cottesloe Landform

Characterised by low, hilly landscapes with shallow brown sands over limestone. Exposed limestone is a feature. In the northern part the vegetation is predominantly a low open woodland of *Banksia attenuata*, *B. menziesii* and *Eucalyptus todtiana* with heath on the limestone outcrops. Further south an open forest of *E. gomphocephala*, *E. marginata* and *E. calophylla* is more common.

Karrakatta Landform

Characterised by an undulating landscape with deep yellow sands over limestone. In the northern part, the vegetation is predominantly a low woodland of *Banksia* and *E. todtiana*. Further south, open forests of *E. gomphocephala*, *E. marginata* and *E. calophylla* or woodlands of jarrah and banksia are more common.

Bassendean Landform

Sand plains with low dunes and occasional swamps. Leached, grey, iron and humus podsols. The vegetation ranges from a low open forest and low woodland of *Banksia* species, *E. todtiana* and *E. marginata*. *Melaleuca* species and sedgelands occupy the wetter sites. Havel (1968) has divided the continuum found on these sands into a series of site-vegetation types.

Vasse Landform

Poorly drained plains with undifferentiated estuarine and marine deposits. Fringing woodlands of *E. rudis* and Melaleuca species in wetter areas, and open forests of tuart, jarrah and marri.

Yoongarillup Landform

Plains with low ridges and swales. Shallow yellow to brown sands over limestone. Tall woodlands of *E. gomphocephala* and *Agonis flexuosa*.

AREA

Precise estimates of the area covered by each of these landforms within State Forests are not yet available.

TABLE 1

SWAN COASTAL PLAIN

LEVEL OF CONSEQUENCE OF DIEBACK INFECTION BY SITE TYPES ON PRIMARY LAND USE CLASSES

SITE TYPE	IMPACT ON VEGETATION		LAND USE CLASSES					
	Overstorey	Understorey	FFL Preservation	Catchment Protection	Water Production	Protection of Forest Values	Timber Production	
							Hardwood	Pines
Quindalup Landform (dunes and beach ridges)	N/A	very low	very low	very low	very low	very low	N/A	N/A
Cottesloe Landform (yellow sands, limestone outcrops)	very low	low	low	low	low	low	N/A	N/A
Karrakatta Landform (deep yellow sands)	low to moderate	moderate	high	low (not saline)	low	moderate	low to moderate	very l
Bassendean Landform (grey sands)	moderate to high (wetter areas)	moderate to high (wetter areas)	high to very high	low (not saline)	low	moderate to high	moderate to high	very l
Vasse Landform (poorly drained plains)	low	low	low	low	low	low	low	very l
Yoongarillup Landform (shallow sands over limestone)	very low	very low	very low	very low	very low	very low	very low	very l

THE NORTHERN JARRAH FOREST

INTRODUCTION

Although the total number of possible permutations is very large indeed, the situation is simplified by the fact that in the Northern Jarrah Forest, physical and biological factors tend to be strongly integrated. The following eight categories can be identified between the Helena and Preston Rivers.

DESCRIPTION

Yarragil Landform

Shallow valleys and depressions in the high rainfall zone, with high opportunity for infection and with physical conditions favouring the development of the disease - types C, D, W, E (Havel, 1975). Within these, there is a gradient with respect to the proportion of susceptible species, ranging from low in case of C, to high in cases of D and E.

Dwellingup Landform

Lateritic uplands in the high rainfall zone, with lesser opportunity for infection and physical conditions only seasonably favouring the development of the disease - types T, S, P and O. Within these there is a gradient of disease impact, fertility and drainage T-S-P-O which favours the intensification of the disease. All types contain a high proportion of susceptible species.

Scarp, Helena and Murray Landforms

Dissected river valleys and scarp in high rainfall zone, with high opportunity for infection from adjacent uplands, offset by physical conditions favouring the host rather than the pathogen - U, Q, T, R, G, C. Within these, there is a variation in the proportion of susceptible species, but the overall susceptibility is low.

Cooke Landform

Monadnocks, with conditions similar to the scarp - G, R, Z, M, S. Opportunity for infection has been increased in part by the use of these high hills as fire lookouts, necessitating the construction of roads. Impact varies considerably, depending on site-vegetation type.

Williams and Michibin Landforms

Dissected valleys in the low rainfall zone, with moderate opportunities for infection, but with physical conditions not conducive to the development of the disease - M, G, Y, L. The susceptibility of these types is further lessened by a high proportion of resistant species, the overstorey and by virtual absence of susceptible second storey.

Dwellingup and Yalanbee Landforms

Lateritic uplands in the low rainfall zone with a low opportunity for infection, and a physical condition only marginally favourable to the establishment of the disease. Although the susceptible second storey is largely or entirely absent, there is a considerable proportion of susceptible species in overstorey and shrub storey - H, Z, P, M.

Pindalup, Coolakin and Goonaping Landforms

Broad shallow valleys in the low rainfall zone, with moderate opportunity for infection due to lower overall activity, and with physical conditions conducive to the development of the disease - F, J, A, B, E, W, Y.

Within these there is a very strong gradient with respect to the presence of susceptible species. Types A and Y which normally occupy valley floors are low in susceptible species, whereas types B, E, F and J have a particularly high proportion of them.

Collie Basin (Collie, Cardiff and Muja Landforms)

Gently undulating landscape with gravels on upper slopes (Collie), broad shallow swampy depressions of grey sands (Cardiff) and sandy swampy valleys (Muja). Impact on both overstorey and understorey is high in the Cardiff Landform, with lesser impact on Muja (greater predominance of resistant species) and Collie (slightly drier and better drained)

AREA

The approximate percentages of the landscape covered by each of these types are as follows (DRSG, 1982):

Yarragil	20%
Dwellingup (western)	15%
Scarp, Helena and Murray	15%
Cooke	2%
Williams and Michibin	3%
Dwellingup and Yallanbee	18%
Pindalup, Coolakin and Goonaping	24%
Collie Basin	3%
	100%

TABLE 2

NORTHERN JARRAH FOREST

LEVEL OF CONSEQUENCE OF DIEBACK INFECTION BY SITE TYPES ON PRIMARY LAND USE CLASSES

SITE TYPE	IMPACT ON VEGETATION		LAND USE CLASSES				
	Overstorey	Understorey	FFL Preservation	Catchment Protection	Water Production	Protection of Forest Values	Timber Production
Shallow valleys and depressions, high rainfall (Yarragil)	low (swamp) to very high (fringes)	moderate (swamp) to very high (fringes)	very high	very high	low	moderate to very high (fringes)	low to very high (fringes)
Lateritic uplands, high rainfall (Dwellingup) deep, well drained	moderate	moderate to high	very high	high	low	moderate to high	moderate
Lateritic uplands, high rainfall (Dwellingup) concreted laterites and black gravels	very high	very high	very high	very high	low	very high	very high
Dissected valleys and scarp, high rainfall (Helena, Murray)	low	low to moderate	moderate	low	low	low to moderate	low
Monadnocks (Cooke)	low to high (localised)	low to very high (localised)	very high	high	low	low to very high(localised)	low to hig (localised
Dissected valleys, low rainfall (Williams, Michibin)	low	low	low	low	N/A	low	low
Lateritic uplands, low rainfall (Dwellingup and Yalanbee)	low	low	low	low	N/A	low	low
Broad valleys in low rainfall (Pindalup, Goonaping, Coolakin	low to moderate	low (clays) to high (sands)	very high	moderate	N/A	low to high (sands)	low to moderate
Collie Basin (Collie, Cardiff and Muja)	moderate to very high	moderate to very high	very high	N/A	low	moderate to very high	moderate very hig

THE SUNKLANDS

INTRODUCTION

Within the Sunklands area, 7 soil types are generally recognised. These are:

Type 1	Laterites (includes gravels)
Type 2	Shallow sand over laterite
Type 3	Deep sandy soils > 50 cm, yellow-brown in colour
Type 4	Deep leached sands
Type 5	Loamy-textured soils at 60 cm (grey-yellow)
Type 6	Heavy-textured at surface with gravels at depth (limited in extent)
Type 7	Soils fringing creeks, often strongly coloured.

South of the Blackwood Type 4 is less important (or dominant) and Type 5 is more important (or dominant).

North of the Blackwood Type 6 is limited in extent. Type 4 dominates in northern part, then Type 3, then Type 5, as one progresses south.

DESCRIPTION

Description of site types (check also Research Paper No. 57 and the Plantation Manual).

Type 1 Laterites - uplands mainly, with boulders or gravelly, sandy to loamy matrix. Drainage may be impeded. Jarrah and jarrah-marri, generally of above-average site quality. Sheoak, *Agonis parviceps*, *Persoonia longifolia*, some *Banksia grandis*. Some dieback occurrences with high impact. Kingia landform.

Type 2 Shallow sands over laterite - downslope and adjoining Type 1. Soil depth less than 50 cm over gravels or massive laterite. Jarrah, sheoak, *Banksia grandis* and *B. attenuata*, *P. longifolia*, blackboys. Generally lower site quality. Dieback impact moderate to high, site dry. Jarrahwood landform.

Type 3 Deep sands over 50 cm (coloured) - midslope to lower slope, light yellowish-brown, occasional gravel < 20%, jarrah and jarrah-marri overstorey. Woody pear, *B. grandis, Persoonia, Casuarina, Kingia,* blackboys. Impact on overstorey and understorey is moderate to high, especially at wetter end of the type.

Type 4 Deep sands over 50 cm (leached) - plateaux, upper slopes to midslope (Sunklands), ranging from dry, 4 a, to wet swamps, 4 d. Coffee rock layer present. More open jarrah, marri rare, understorey at dry end *B. attenuata, B. ilicifolia*; understorey at wet end *Melaleuca preissiana, B. litteralis,* occasional bullich and blackbutt, Type 4 understorey *Persoonia, A. parviceps,* blackboys. Impact on understorey - very high at wet end on susceptible species, less so at drier end. Impact moderate on overstorey except on fringes of wetter areas. Mungardup landform.

Type 5 Loamy-textured to 60 cms - low slopes (north of Blackwood), more widespread through the landscape (especially south of Blackwood). Grey to yellow, low gravel per cent, sand to loamy at surface. Jarrah with marri more dominant, sometimes bullich. *B. grandis, A. parviceps, Kingia, B. littoralis.* Impact on understorey moderate if banksias dominate, elsewhere is low. Preston landform.

Type 6 Excluded because of limited extent.

Type 7 Creeks - lower slopes, strongly coloured (browns, yellow-brown, yellow-red), loams to silty loams. May be underlain by lateritic pavement. Occasional jarrah, marri, bullich, *Hakea lasiantha, A. divergence.* Impact on understorey low, as many species are resistant. Impact on jarrah high to very high.

AREA

Area (percentages) from original surveys are as follows:

	Sues Road	Jarrahwood
Laterites	10%	24%
Shallow sand	2	12
Deep sands	19	27
Leached sands	39	24
Loamy-textured	22	7
Heavy-textured	1	-
Creeks	4	7
	97%	101%

TABLE 3

SUNKLANDS

LEVEL OF CONSEQUENCE OF DIEBACK INFECTION BY SITE TYPES ON PRIMARY LAND USE CLASSES

SITE TYPE	SOIL TYPE	IMPACT ON VEGETATION		LAND USE CLASSES				
		Overstorey	Understorey	FFL Preservation	Catchment Protection	Water Production	Protection of Forest Values	Timber Productio
Jarrah/marri (laterites) (Kingia)	1	high to very high	high to very high	very high	N/A	N/A	high to very high	high to very hig
Jarrah (shallow sands over laterite) (Jarrahwood)	2	moderate	moderate to high	very high	N/A	N/A	moderate to high	moderat
Jarrah/marri (deep coloured sands)	3	moderate	moderate to high (wetter areas)	very high	N/A	N/A	moderate to high (wetter areas)	moderat
Open jarrah (deep leached sands) (Mungardup)	4	moderate to high (wetter areas)	high to very high (wetter areas)	very high	N/A	N/A	high to very high (wetter areas)	moderat to high
Marri/jarrah (loamy-textured soils) (Preston)	5	low	low to moderate	moderate	N/A	N/A	low to moderate	low
Creeks (coloured loams to	7	high to very high on	low	very high	N/A	N/A	low	low (few jarr

THE SOUTHERN JARRAH FOREST

INTRODUCTION

The forest covered by these descriptions generally lies to the south of the Preston River and to the east of the Darling Scarp. It contains the fullest extent of mapping coverage (Atlas of Natural Resources, 1980, Collie Sheet), eastwards to Boyup Brook and southerwards to Palgarup.

DESCRIPTION

Five landform and soils systems will be described. These include the following:

Major Valleys -

Lowdon, Bridgetown, Balingup (higher rainfall)
Michibin (lower rainfall)

Minor Valleys -

Catterick

Lateritic Uplands -

Hester (higher rainfall)
Wilga (lower rainfall)

Lowdon, Bridgetown, Balingup Landforms

Deeply incised valleys, shallow red and yellow earths, with rock outcrops in places. Narrow alluvial terraces. Open forest of jarrah and marri with a fringing woodland of flooded gum along the streams. Dominant vegetation types C, Q, T, D and W.

Michibin Landform

Moderate slopes with yellow duplex soils and some rock outcrops. Open woodlands of *E. wandoo* with some admixture of *E. loxophleba*. *Acacia acuminata* and *Casuarina huegeliana* dominate the understorey.

Catterick Landform

Valleys of the south-eastern part of the Darling System. Yellow duplex soils and red earths on the slopes, with narrow alluvial terraces. Open forest of jarrah-marri on the slopes with blackbutt, flooded gum and river banksia on the valley floors. Dominant vegetation types C, D, W, Q. Medium to high rainfall.

Hester Lanform

Narrow remnants of the plateaux. The lateritic duricrust and gravels are flanked by gravelly duplex soils. Open forest of jarrah and marri. Dominant vegetation types S and T.

Wilga Landform

Flat or gently undulating divides with grey sands, some swamps. Open forest of jarrah and marri. Dominant vegetation types H, W and R.

AREA

Precise estimates of the area covered by each of these landforms within State Forests are not yet available.

TABLE 4

SOUTHERN JARRAH FOREST

LEVEL OF CONSEQUENCE OF DIEBACK INFECTION BY SITE TYPES ON PRIMARY LAND USE CLASSES

SITE TYPE	IMPACT ON VEGETATION		LAND USE CLASSES				
	Overstorey	Understorey	FFL Preservation	Catchment Protection	Water Production	Protection of Forest Values	Timb Produc
Lowdon, Bridgetown and Balingup Landforms (incised valleys, medium to high rainfall)	very low	low	low	low	N/A	low	very
Michibin Landform (broad valleys, lower rainfall, wandoo)	very low	low	low	low	N/A	low	very
Catterick Landform (valleys of medium to high rainfall area)	low (swamp) to high (fringes)	moderate to very high (fringes)	very high	high	N/A	moderate to very high	low (swa to high (fringe
Hester Landform (laterites and lateritic gravels)	low to moderate	moderate to high	high to very high	moderate	N/A	moderate to high	low to moderat
Wilga Landform (gently undulating, sandy soils)	low to moderate	moderate	high	moderate	N/A	moderate	low to moderat

THE KARRI FOREST

INTRODUCTION

System 6 mapping for landform and vegetation does not cover the main karri belt. Some landform mapping is available (McArthur and Clifton), and further landform mapping by CSIRO has been undertaken but is not yet published. It may be some time before landform or vegetation maps of the karri and southern jarrah forests become available. However, several distinct vegetation types can be recognised and these will be used until the more detailed landform/vegetation maps become available.

DESCRIPTION

Eleven site-vegetation types will be described. These are as follows:

Karri forest in pure and mixed stands
Jarrah forest of high quality with karri type understorey
Jarrah forest on laterites
Jarrah forest on depositional sands
Jarrah forest on quartzites
Jarrah forest on shallow podsols
Wandoo woodlands
Jarrah woodlands and low rainfall forest
Banksia and Casuarina woodlands
Stabilised dunes
Flats

Karri forest in pure and mixed stands

The impact is very low on the overstorey and very low to low on the understorey on marginal karri sites. Chief significance is as a potential reservoir of inoculum.

Jarrah forest of high quality with karri type understorey

High quality jarrah forest with understorey of ferns, netic *Acacia urophylla, Leucopogon verticillatus*. High rainfall zone on slopes and ridges, e.g. Carey Block. Impact low on overstorey and on understorey. Of significance as a potential reservoir of inoculum.

Jarrah forest on laterites

Many sites show low to moderate impact, despite considerable opportunities for infection. May have high to very high impact where sites are shallow and concreted or if heavily disturbed and repeatedly inoculated.

Jarrah forest on depositional sands

Jarrah on depositional sands with ti-tree, bullich and blackbutt - in the ti-tree swamp the overall impact on the understorey and overstorey is very low. On the fringes, especially when slopes are gradual, the impact on both understorey and overstorey is high.

Jarrah forest on quartzites

Jarrah forest on deep quartzite sands high in the landscape, with ti-tree, blackbutt, jarrah and bullich. Where the forest is open, with blackboys, zamia palms, *Persoonia* and *Podocarpus drouyniana*, the impact is high in the understorey and moderate in the overstorey. Where the forest has dense ti-tree, the impact is low in both overstorey and understorey.

Jarrah on shallow podsols

Jarrah on shallow grey and yellow podsols on mildly undulating slopes and ridges, e.g. Quininup area. Dense understorey. Impact on understorey and overstorey is low to moderate, depending on site wetness, position on the slope and aspect.

Wandoo woodlands

These sites have few indicator species. The impact on understorey and overstorey is very low, but these areas may act as a potential reservoir of inoculum for the adjacent jarrah and banksia woodlands.

Jarrah woodlands and low rainfall (<900 mm) forest

Typical eastern jarrah forest < 900 mm, often with numerous small trees. In the uplands and slopes, impact to date on both the understorey and overstorey has been low. May have high impact if heavily disturbed and repeatedly inoculated. In the gullies and low slopes impact on understorey and overstory is high in the susceptible species.

Banksia and Casuarina woodlands

These may be extensive in area, on drier sandy soils, on slopes and ridges. Impact to date has been low, with only odd individual plants killed near roads and creeks. The impact may be increased if these sites are heavily disturbed and repeatedly inoculated.

Stabilised dunes

Grey to white sands with jarrah, marri, zamia palms, peppermint. The overall impact on the overstorey and understorey is low.

Flats

Flats with ti-tree, blackboys, sedges, with jarrah and banksia on slight rises. Overall impact on understorey vegetation is low, but the susceptible species (mainly blackboys) are killed. In the fringes, on gradual slopes, the impact on the understorey and overstorey is moderate.

AREA

Estimates of the percentages of the landscape covered by each of these types are not yet available.

TABLE 5

SOUTHERN JARRAH AND KARRI FOREST

LEVEL OF CONSEQUENCE OF DIEBACK INFECTION BY SITE TYPES ON PRIMARY LAND USE CLASSES

SITE TYPE	IMPACT ON VEGETATION		LAND USE CLASSES				
	Overstorey	Understorey	FFL Preservation	Catchment Protection	Water Production	Protection of Forest Values	Timber Production
Karri forest (pure or mixed)	very low	very low to low	low	N/A	N/A	very low	very low
Jarrah high quality forest (karri understorey)	low	low	low	low	N/A	low	low
Jarrah forest (concreted laterites)	very high	very high	very high	very high	N/A	very high	very high (localised)
Jarrah forest (laterites)	low to moderate	low to moderate	high	moderate	N/A	low to moderate	low to moderate
Jarrah forest (depositional sands)							
swamp	very low	very low	very high	high	N/A	very low	very low
fringes	high	high				high	high(localised)
Jarrah forest (quartzite)	low to moderate	low to high (localised)	high	moderate	N/A	low to high	low to moderate
Jarrah forest (shallow podsols)	low to moderate	low to moderate	high	moderate	N/A	low to moderate	low to moderate
Wandoo woodlands	very low	very low	low	low	N/A	very low	very low
Jarrah woodlands and low rainfall forest (<900 mm)							
uplands	low	low	very high	high	N/A	low to high	low to high
gullies	high	high					(localised)
Banksia & Casuarina woodlands	N/A	low	low	low	N/A	low	N/A
Stabilised dunes	low	low	low	N/A	N/A	low	N/A
Flats							
true flat	low	low	high	moderate	N/A	low	N/A
fringes	moderate	moderate				moderate	

IMPACT

Earlier studies (eg Batini, 1973; Havel, 1975; Shea, 1975) showed that dieback and site were related and proposed reasons for this.

In the tables contained in this document, the observed impact of dieback on the understorey and overstorey vegetation are given. These impacts relate to mortality and not to effects on growth or other parameters of plant health.

These impacts have been subdivided into five classes. These classes and their relationship to those used in the Dieback Policy 1982 (page 7) are as follows:

DIEBACK POLICY 1982	TABLES OF IMPACT AND CONSEQUENCE	
Low impact	Very low:	Very few, if any, species or individual plants are killed
	Low:	Few species are susceptible, some individuals are killed
Moderate impact	Moderate:	Most of the dominant species are susceptible and some of the individuals are killed
High impact	High:	Most of the dominant species are susceptible and many of the individuals are killed
	Very High:	Most of the dominant species are susceptible, most individuals are killed

The data in these tables is based on existing experience and the observed impacts to date. These data will be improved as research continues into the effects of site vegetation type, disturbance, climate and landform on disease expression. As new data becomes available, these tables will be revised. It is, however, essential to collate the best available knowledge in one place at this point in time.

The impact observed relate to disturbance equivalent to "group selection" cutting. This silvicultural system is widely used in forest areas. Levels of disturbance to the ecosystem are considered to be of importance. Thus the impact should be increased or decreased depending on the level of disturbance caused by an operation. The following list rates several operations in order of increasing disturbance, especially to soil moistures and soil temperature regimes:

low	-	drill hole
moderate	-	group selection cut, minor road
high	-	clearcutting, major road
very high	-	mining

The effects of repeated disturbance should also be considered. These will tend to increase the observed impact on a site.

References: Bulletins 84, 85 and 87 Forests Department of W.A.

CONSEQUENCES

The tables also show the assessed level of consequence of dieback infection, by site types, on the primary land use class. Five land use classes are shown:

FFL Preservation

Catchment Protection

Water Production

Protection of Forest Values

Timber Production

FFL Preservation - the consequences shown are higher than the impact rating. Any impact of dieback in FFL Preservation areas will have serious consequences on the land use.

Catchment Protection - the consequences shown are higher than the impact rating on the overstorey component. In this land use category, it is important that a deep-rooted, tree component be retained, so as to control salinity.

Water Production - the consequences are lower than the impact rating. Dieback has substantially increased water yield in some areas.

Protection of Forest Values - the consequences listed are the same as the assessed level of impact on the understorey vegetation.

Timber Production - the consequences listed are the same as the assessed level of impact on the overstorey vegetation.

The tables can be used to assess the level of consequence on secondary and tertiary uses as well. For example, a Water Production MPA would have secondary uses such as Catchment Protection and Timber Production, and a tertiary use such as Protection of Forest Values. Levels of consequence (Dwellingup, high rainfall, deep, well drained, lateritic uplands) would then be as follows:

Primary Use	Water Production	Low
Secondary Uses	Catchment Protection Timber Production	High Moderate
Tertiary Use	Protection of Forest Values	Moderate to High

HYGIENE MAP - LEGEND

SECURE DIEBACK-FREE:

GREEN — Forest apparently free of dieback and upslope from Dieback, Suspect, Uninterpretable and NEQ roads.

LOW POTENTIAL RISK:

GREY — Forest apparently free of dieback but downslope from Dieback, Suspect, Uninterpretable or *NEQ. Considered to have low potential for infection by *Phytophthora cinnamomi* by natural spread.

UNINTERPRETABLE:

PURPLE — Forest in which susceptible plants are absent or too few to enable the interpretation of *P. cinnamomi* presence or absence.

NEQ:

YELLOW — Forest adjacent to roads in which there is a potential for *incipient disease.

HIGH POTENTIAL RISK:

BROWN — Forest apparently free of Dieback or Uninterpretable, but downslope from, or in the same swamp as Dieback or Suspect. Considered to have a high potential for infection by *P. cinnamomi* by natural spread, in free water.

SUSPECT:

BLUE — Forest in which the evidence for *P. cinnamomi* presence or absence is inconclusive.

DIEBACK:

RED — Forest areas which show current dieback symptoms and are supported by laboratory recoveries of *P. cinnamomi* from soil and tissue samples.

* NEQ - Not Effectively Quarantined

Roads, tracks within the Disease Risk Area which have had considerable use throughout all seasons, with an unknown degree of hygiene.

* Incipient Disease

Forest in which *P. cinnamomi* may be present, but symptoms are yet to appear.

PROCEDURE

PRODUCTION OF GUIDELINES

1. Prepare first draft of guideline, Protection Branch, in consultation.

2. Distribute first draft for comments from experts.

3. Re-draft original guideline.

4. Distribute to Regions/Divisions for implementation.

5. Obtain comments and suggestions from users.

6. Re-draft and improve, 6 to 12 monthly review.