Roadside Conservation 2:

The importance and management of roadside vegetation

10th and 11th November, 1998

at C.Y. O'Connor College of TAFE, Northam

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ROADSIDE CONSERVATION

- An Overview

Native vegetation along roadsides is both environmentally significant and important for the effective management of the road reserve.

The roadside vegetation may be the only remaining example of the original vegetation within a cleared area. Also they often harbour the last populations of rare flora. Currently 321 plant species are declared rare under the Wildlife Conservation Act 1950-1979. Of these, more than 100 are known to have roadside populations. In fact roadside plants represent more than 80 per cent of the known populations of 40 of the 'declared rare' species and three of these are known only to exist in roadside populations.

Roadside vegetation is also a vital environmental link for native fauna. Patches and strips of vegetation along rail and roadsides act as habitat for many native species of plants, birds, mammals, reptiles, amphibians and invertebrates. Native shrubs and trees provide nest sites and refuges for native animals as well as acting as biological corridors.

These corridors of vegetation provide wildlife with food and shelter, and enable nomadic and migratory species to move between populations otherwise isolated by areas cleared for agriculture or development.

In addition roadside vegetation assists in vegetation mapping and distribution studies, provides a benchmark for study of soil change during agricultural development, and provides a source of local seed for revegetation projects, (N.B. CALM permit required and local government permission required).

The economic value of roadside vegetation is becoming increasingly recognised. Roadside shelter provides windbreaks and stock shelter areas for adjoining farmland. Native vegetation also helps keep maintenance costs low in terms of soil erosion along the roadside. Roadside flora is the basis of our important wildflower tourist industry

- Remnant Vegetation

Remnant vegetation can be defined as the assemblage of native plants that remains today.

In most of the settled areas of Australia little of the native vegetation that existed prior to European settlement remains today as it has been cleared to make way for agriculture, industry and urban development. Many parts of the wheatbelt now retain less than 5% of the original vegetation. The landscape that we recognise as Australia bears little semblance to that which existed prior to the European settlement.

The impact of European settlement on the native vegetation has been substantial:

- a 36% decrease in the total vegetation cover
- an estimated 1,000,000 million sq. kilometres of land has been cleared
- 40 million ha., i.e.$\frac{2}{3}$ of the total of Australian forests have been cleared
- 63 million $\frac{1}{3}$of the total of scrub and woodland areas in Australia have been cleared
- 95% of the vegetation of Australia has been effected and modified by European settlement

A flow on effect of the loss of native vegetation has been the demise of its attendant fauna and the mass degradation of vast tracts of land. This manifests itself as salinity, soil loss and erosion in much of land that has been cleared for agricultural. The loss of native vegetation also has negative impacts on many wetland systems and streams with increases in sedimentation, salinity and turbidity.

🕮 Further Reading

Bradby, K. and Pearce, H. (eds) (1984) **Diversity or Dust** Australian Conservation Foundation (A variety of authors provide a detailed account of the impact of land clearance in south-western Australia.)

Lamont, D. A. and Blyth, J. D. (1987) Roadside corridors and community networks In: **Nature Conservation: The Role of Networks**. (eds.) Saunders, D.A. , Arnold, G.W., Burbidge, A. A., and Hopkins, A.J.M.. Surrey Beatty and Sons Chipping Norton \

Remnant Vegetation in Australia, (1992) Australian National Parks and Wildlife Service (Provides a broad overview of remnant vegetation.)

Saunders, D.A. , Arnold, G.W., Burbidge, A. A., and Hopkins, A.J.M.. (eds.) (1987) **Nature Conservation: The Role of Remnants of Native Vegetation** Surrey Beatty and Sons Chipping Norton (This extensive volume details the multiple value of remnant vegetation.)

- Endangered Species (flora)

THREATENED FLORA IN W.A.

TRAINING NOTES

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Western Australian Flora

Western Australia has a rich flora, with some 12,000 vascular plant species, about 9,000 of which are formally named. This is about half of the total Australian flora. Some areas are particularly rich, for example, over 800 species are known from the Lesueur area near Jurien Bay, over 1,200 from the Stirling Range National Park, and about 1,400 species from the Fitzgerald River National Park. These three areas are the most species rich, and represent over a quarter of the flora of Western Australia.

On an international scale, by comparison the flora of Western Australia is ten times the total British vascular flora of 1200, and represents some 4.8% of the estimated world vascular flora of 250,000 species.

The Western Australian flora is also unique, with the majority of species being endemic, that is, found nowhere else in the world. 75% of the 6,000 species in the south-west, for example, are endemics.

Part of the reason for the high level of species diversity and uniqueness, especially in the south west agricultural region, is because this landform is extremely old, and has largely weathered in-situ. This has meant that the soils and habitats in the region tend to be a mosaic, and the flora in them have evolved in isolation over a very long time period. The result is a complex series of different evolutionary paths across the landscape.

Threatened Flora

Western Australia also has a large number of plant species that are threatened, or potentially threatened, with becoming extinct. A third of Australia's total of threatened plant species are from Western Australia, while the proportion rises to 46% if rare and poorly known species are included.

There are many reasons for the occurrence of threatened flora. These may relate to natural or evolutionary factors, or to artificial influences resulting from human activity.

Species that are very rare may be threatened as a consequence of their low numbers, that is, they may become extinct through the chance loss of some individuals. Species may be naturally rare because they are dependant on specific, limited habitats, or because they are part of an evolutionary process: either newly evolving species (it is estimated that 40% of W.A.'s flora has evolved from hybridisation), or species that are naturally declining through changed environmental conditions (e.g. relict Gondwanan flora).

The clearing or degrading of bushland is a major threatening process - referred to as habitat loss. Not only does this threaten existing populations, but it also limits the opportunities for the establishment or expansion of populations. Degradation processes include grazing, fertilizer and herbicide drift, weed competition, inappropriate fire regimes and the introduction of pests and diseases. One of the most significant threats to species and habitats is Phytophthora dieback.

Given the great species and habitat diversity of the southwest agricultural region, it is not surprising to find that many of the threatened species in this State are from this region. This can be seen from the table of comparison of threatened, poorly known and rare species between CALM regions (Attachment 1), whereby the Midwest, Wheatbelt and South Coast Regions account for nearly three quarters of the species. The State map of the distribution of the threatened flora (Attachment 2) shows that the concentration of populations is in the agricultural regions of the wheatbelt and the western coastal plain - both extensively cleared landscapes.

Roadside Vegetation

Uncleared roadverges represent tracts across the landscape of the original vegetation. In areas that have been extensively cleared, as in the wheatbelt, these vegetation strips represent significant areas of remnant vegetation. More importantly they contain a random selection of vegetation types, whereas remnants on adjoining lands tend to be more selective, with specific vegetation types associated with arable soils in particular being poorly conserved.

Road verges hence have a proportionately higher number of restricted habitats and rare species. The narrowness of many of these road reserves, coupled with the road maintenance activities to which they are subjected also means that many of these rare species are also threatened.

A quarter of threatened flora populations in Western Australia are found on road verges, with over three quarters of these being along roads managed by local authorities, the remainder being along main roads. Population sizes along the local authority-managed roads tend to be several-fold smaller than those found on other land tenures, including main roads, which demonstrates the difficult task in managing rare flora on these roadsides, where a large number of small populations are involved.

Declared Rare Flora

Existing legislation uses the term "rare flora". It is necessary to continue to use the term "declared rare flora" when quoting the legislation until it is changed, but the term is used for species that are threatened, rather than just rare in numbers. CALM Policy Statement No 9 (Conservation of Threatened Flora in the Wild) lists the policies and strategies for the management of declared rare flora.

Legislation

Rare flora is defined in subsection 23F(1) of the Wildlife Conservation Act as "flora for the time being declared to be rare flora for the purposes of this section." Further clarification is provided in subsection 23F(2):

> "Where the Minister is of opinion that any class or description of protected flora is likely to become extinct or is rare or otherwise in need of special protection, he may, by notice published in the Government Gazette declare that class or description of flora to be rare flora for the purposes of this section throughout the State".

The Schedule of Declared Rare Flora

The Schedule (list) of Declared Rare Flora is reviewed annually.

Plants which are protected flora declared under the Wildlife Conservation Act may be recommended for gazettal as declared rare flora if they satisfy the following criteria:

i) The taxon (species, subspecies, variety) is well-defined, readily identified and represented by a voucher specimen in a State or National Herbarium. It need not necessarily be formally described under conventions in the International Code of Botanical Nomenclature, but such a description is preferred and should be undertaken as soon as possible after listing on the schedule.

ii) Have been searched for thoroughly in the wild by competent botanists during the past five years in most likely habitats, according to guidelines approved by the Executive Director of CALM.

iii) Searches have established that the plant in the wild is either:

a) rare;

or

b) in danger of extinction (including presumed extinct);

or

c) deemed to be threatened and in need of special protection.

(Plants which occur on land reserved for nature conservation may be considered less in need of special protection than those on land designated for other purposes).

or

d) presumed extinct.

iv) In the case of hybrids, or suspected hybrids, the following criteria must also be satisfied:

a) they must be a distinct entity, that is, the progeny are consistent within the agreed taxonomic limits for that taxon group;

b) they must be [capable of being] self perpetuating, that is, not reliant on the parent stock for replacement; and

c) they are the product of a natural event, that is, both parents are naturally occuring and cross fertilisation was by natural means.

That status of a rare plant in cultivation has no bearing on this matter. The legislation refers only to the status of plants in the wild.

Plants may also be deleted from the schedule of declared rare flora.

There are currently 318 extant, plus 23 presumed extinct, taxa of declared rare flora as listed in the 1998 schedule. Some extant taxa are further subdivided to infraspecific levels, and are managed at these levels. There are 327 extant taxa in total.

"Taking" Declared Rare Flora

In the Wildlife Conservation Act (subsection 6(1)) the following definition is given:

> ""to take" in relation to any flora includes to gather, pluck, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means;"

Thus, taking declared rare flora would include not only direct injury or destruction by human hand or machine but such activities as allowing stock to graze on the flora, introducing pathogens that attack it, altering soil moisture or is inundated, allowing air pollutants to harm foliage etc.

In the case of declared rare plants which need fire or disturbance for regeneration, burning or disturbance at an appropriate time may not adversely affect the survival of the population. However, if existing plants would be injured, it constitutes "taking" under the Act. Therefore, Ministerial approval is required prior to causing a disturbance which affects any species of rare flora.

The Department of Conservation and Land Management has statutory responsibilities for rare flora conservation. This is a major commitment because:

i) Western Australia has a flora that is exceptionally rich in localised and rare endemic plant species. Moreover, areas where rare species are concentrated coincide predominantly with the wheatbelt and other areas where there has been extensive clearing or modification of the native flora.

ii) Section 23F of the Wildlife Conservation Act prohibits the taking (injury or destruction) of declared rare flora by any person on any land throughout the State without the consent in writing of the Minister. A breach of this provision may lead to a fine of up to $10,000. The flora provision of the Act are binding on the Crown.

iii) The Act prescribes that declared rare flora be protected on all categories of land throughout the State.

Priority Flora

In addition to the schedule of DRF, CALM maintains a supplementary listing referred to as the Priority Flora List. This lists those flora which may be rare or threatened but for which there is insufficient survey data available to accurately determine their true status, and those taxa which have been determined as being rare, but are currently not threatened. 1,959 taxa were listed as priority flora in 1998. Priority Flora are ordered according to the perceived urgency for further survey.

The Priority List assigns top priority for survey to those plants whose known populations are few and on land under threat (Priority 1). Second are taxa with few populations known, and which occur on lands considered secure for conservation (eg. nature reserves, national parks, water reserves - Priority 2). Priority 3 taxa have several known populations, some of which occur on secure conservation lands, or the taxa is deemed to be not under immediate threat. And lastly, taxa that have been adequately surveyed and found to be secure but require monitoring to check that their conservation status doesn't change are assigned Priority 4. Full definitions are provided in Attachment 3.

Priority Flora do not have the same level of protection as Declared Rare Flora, but should be managed in a similar manner until their status has been confirmed as being not rare or threatened.

The Need to Conserve Rare Flora

Western Australia's rare flora needs to be conserved for many reasons under the broad headings of altruism, aesthetics and economics.

Altruistically we should conserve all species of flora because they are discrete entities and deserve to persist. Such an argument, however, depends solely on the beliefs of the individual.

From an aesthetical point of view, species conservation means that the public is able to keep seeing the species, and enjoying the sight in itself, and the total landscape effect. Again beauty is in the eye of the beholder.

In an economical sense, rare flora represents a largely untouched resource with unknown potential. The value of most of our species of rare flora (and more common species) for drugs and medicines, foods, genetic additives, horticultural species etc is unknown. This resource should therefore be maintained for its future potential.

Species abundance changes through time. Rare species may either be declining towards extinction, or they may be in early developmental stages and could eventually become relatively common as climatic changes occur. Thus the rare flora of today may be essential elements of future vegetation structures.

Such vegetation - climatic changes normally occur over extended periods, measured in geological time. With current unnatural global climatic changes being predicted, however, such vegetation changes will need to occur at a rate faster than can be naturally accommodated by speciation. Thus there will be a selection pressure on existing species to maintain vegetation compositions. Rare species will have as much chance of being able to persist under new climatic regimes as more common species. It is therefore imperative in areas of remnant vegetation such as in the wheatbelt, and along isolated road reserves, that options for future vegetation development be maintained by retaining the current diversity of species.

Wildlife Management Programs

CALM's Policy Statement No 44 deals with Wildlife Management Programs. Such Programs are prepared for the management of individual species or groups of species. For threatened flora management, two types of Wildlife Management Programs have been prepared:

CALM Region or District summary status programs which document the current population status of the species in an area, and recommend management and research actions. These have been prepared for the former Northern Forest Region, the former Metropolitan Region, and Merredin District. Programs are currently being prepared for Albany, Esperance, Geraldton, Katanning, Moora and Narrogin, and the Central and Southern Forest Regions; and

Species Recovery Plans (and Interim Wildlife Management Guidelines) which document the current knowledge for a species and provide detailed strategies for the management or recovery of the species. Recovery Plans have been prepared for Acacia anomala, Banksia cuneata, Eucalyptus rhodantha and Stylidium coroniforme. Interim Wildlife Management Guidelines have been prepared for Grevillea scapigera and Pityrodia scabra. Research is continuing on a range of other species to provide the necessary detailed information required to prepare a Recovery Plan.

Threatened flora are ranked into the categories Critically Endangered, Endangered and Vulnerable (refer to CALM's Policy Statement No 50 - Setting Priorities for the Conservation of WA's Threatened Flora and Fauna), depending on the degree of threat to the taxon, and hence the urgency for management action. Taxa ranked as Critically Endangered have priority for the preparation of Recovery Plans.

Management Strategies

Many remnants are on lands set aside for purposes other than flora conservation. Flora conservation can thus be a potential inhibition to the normal operation of that land, whether it be a road reserve, farmland, urban area or other land purpose. Good planning and land management can however achieve flora conservation without inhibiting the other uses, and at the same time provide soil conservation, aesthetics and other valuable benefits. Current Main Roads practices are a good example of this.

Rare flora management on road verges presents some specific problems. These problems are related to the purpose to which these reserves are set aside, and to the constraints presented by their size and shape. Such management constraints are also found with many other vegetation remnants.

The shape and size of many remnants results in an insidious, but equally threatening, impact on the flora as does inappropriate landuse practices. Weeds, fertiliser, herbicides, feral animals and fire are some of the major influences on remnants, over which the land manager may have limited control.

Again the use of appropriate procedures to deal with incursions or reduce the incidence of incursions from adjoining lands will reduce their impact.

Weeds and feral animals are perhaps the more difficult management problems in terms of preventing incursions and treating areas after colonisation has occurred. Methods are being developed for managing these problems, but there is still a long way to go in developing management techniques that are sensitive to the environment that is being protected.

Some management notes are:

Grazing - fence areas off.

Fire - ensure fire frequency and seasonality is ecologically based, that is, is not too frequent to promote exotic weeds, and allows the native plants to set seed etc. Areas of native bush do not need to be regularly 'cleaned up'.

Rabbits - use of explosives to destroy warrens without damaging the vegetation.

Weeds - minimise disturbance (including fire) and fertiliser drift to reduce weed growth. Use of selective herbicides that do not affect the native flora. Careful use of sprays when treating encroaching weeds such that the native vegetation and rare flora is not affected.

Accidental destruction - mark areas, especially where works are undertaken, e.g. roadsides or firebreaks. Rationalise, and block off, access tracks.

Exposure - maintain a healthy area of bush, especially around the rare flora, to provide protection and ensure a continuation of the remnant.

Fungal pathogens (dieback) - restrict access, promote hygiene.

One specific aspect of threatened flora conservation and recovery is the collection and storage of propagating material, the propagation of such material, and the establishment of new populations in the wild, or enhancement of existing populations. This is addressed in CALM's Policy Statement No 29 - Captive Breeding and Cultivation of Threatened Species and their Re-establishment or Translocation in the Wild. CALM collaborates with Kings Park and Botanic Garden in this area. Research is being undertaken into storage techniques (including cryostorage), and methods of propagating some of the species.

Management strategies being undertaken by CALM also include the searching for, documentation and monitoring of rare flora populations; the maintenance of a rare flora database; land acquisition; and research into the biology, ecology and management of rare flora.

Confidentiality

The precise location of rare flora populations is kept confidential. This is designed to protect the plants from illicit taking, and from damage either to the plants or the habitat by people wishing to view them. Rare flora locations on private property especially are treated confidentially to safeguard the rights of the property owner who might otherwise be subject to enquires from interested individuals.

Locations of rare flora are provided where this is deemed to be in the better interests of the plants. Thus, for example, land owners/managers, mining tenements holders, local authorities etc. are informed of rare flora populations on, or adjacent, to their operations. Requests for rare flora locality data should be directed to CALM so that the reason can be vetted, and a record kept of such requests.

POPULATION MONITORING

Rare Flora Report Forms

CALM has a standard report form (RFRF) used to record flora population details (Attachment 4). This form is in three main sections: location, habitat, biology and management/administration. The standard form is used to facilitate the computerisation of the data, and also allows the observer to omit re-recording data previously gathered.

Certain information in the form is regarded as essential to be filled in, while other information may be omitted if the observer does not have the time, or if the information has been previously recorded and no change is evident. For example, information that may be omitted includes site and habitat details Essential information includes location details (for identifying the population being monitored), the condition of the population and any threats observed. Population size counts should also be included, but if time does not allow this, then a report on only the condition and threats is preferable.

Information from the RFRF's is entered into CALM's threatened flora database. This database can then be used for determining what threatened flora populations occur in an area, whether it be a grid square, a shire or a CALM District. Data manipulations based on location, habitat, biology or management considerations can also be undertaken for research or management purposes.

What Constitutes a Population?

A population is a discrete group of interbreeding individuals of a species. In the current situation of fragmented vegetation remnants, it is difficult to say what groups of individuals were once interconnected as a population, and which were not.

For the purpose of rare flora management and monitoring, populations are defined as management units of closely associated plants. It is largely up to the observer whether another group of plants nearby are also in the population, are a subpopulation, or are a separate population.

Each population or subpopulation should have a separate RFRF filled in. It should thus be considered when deciding on populations whether it is warranted filling in a separate form, and whether the populations would be distinguishable on a larger scale plan, or the data base that refers to latitudes and longitudes.

Where populations extend over different land purposes they may be divided into subpopulations to allow interpretation of rare flora data on a landuse basis.

Methods of Counting Plants

Where few plants are present, the individuals should be counted. As the number of plants increases, the ease of counting depends on the size/distinctiveness of the plants, the nature of the terrain, and the density of the associated vegetation. Once all individuals cannot be counted, an estimate needs to be taken.

Estimates can be done by several means, but the most reliable is to delineate the area covered by the population (in m^2) and then record the plant density. The product of these will then give the estimate of population size. Plant density can be calculated by traversing the population and estimating the number of plants per unit area, or by counting the number of plants in a selection of set areas and then multiplying the average of these to give the total population estimate.

Population Location

Populations should be marked on maps, and the location in latitude and longitude calculated. Latitudes are found on the sides of the map, and give the values south of the equator. Longitudes are found on the top and bottom of the map, and give the values east of the Greenwich mean line. On some maps Australian Map Grid (AMG) references may be given. These are similar to latitude and longitude, but are measured in metres, rather than degrees. While latitude and longitude are preferred, if they are not available, AMG may be used.

Locations are defined by measuring out horizontally to the side of the map to get the latitude, and the measuring vertically to get the longitude. The exact value is estimated by subdividing the distance between the given values. Each degree is made up of 60 minutes ('), and each minute is made up of 60 seconds ("). Thus a site location may be at the coordinants 32° 10' 40", 115° 50' 30".

Locations should be described in relation to known features, such as towns, roads, named hills, named lakes etc. (e.g. 3.5km SW of Moora, and 250m east along Smith Road from the intersection with Brown Road). Vehicle trip meters should be used to calculate distances from these features where roads exist. Estimates should be as accurate as possible, and preferrably have the site referrenced to a local marker to assist rediscovery (e.g. near the corner fence post, or adjacent to rock outcrop). Where a population is found along a road, the individuals or clumps may be recorded as trip meter readings from a given point (e.g. a road intersection) and appended to the report form.

Population location information needs to be detailed enough to not only allow relocation, but to permit the determination of land ownership or vesting. This is essential for management purposes, as the land manager needs to be informed of the presence of rare flora if it is to be protected and managed.

Access to Private Property and Other Lands

The owners or managers of private property and other lands have the right to control access to their property and to know who and why people are enterring their property. CALM staff should take these rights very seriously and ensure that landowners, leaseholders or managers either know of the intention to access the area, or have previously agreed to an entry procedure.

Where volunteers require access to other lands, CALM will arrange for that access, and the protocol for any future access requirements. Where practicable, the land occupier should still be contacted before enterring as a matter of courtecy. In some situations this may not be possible, e.g. absentee landowners, or where the population is remote from the house.

When operating on other lands, normal protocol should be observed, i.e. gates should be left as found, stock should not be scared, rubbish should not be left, produce (e.g. mallee roots or mushrooms) should not be removed.

Definitions

Flora - any plant which is native to the State (or which is declared by the Minister to be flora under the Wildlife Conservation Act), including any part of the plant and all seeds and spores.

Protected Flora - flora declared under the act to be protected flora for the purposes of the Act, and currently includes all flowering plants, conifers and cycads (Spermatophyta), ferns and fern allies (Pteridophyta), mosses and liverworts (Bryophyta), and fungi, algae and lichens (Thallophyta).

Taxa (singular taxon) - a level of classification. In the current context it refers to the lower level of specificity for which a plant species has been subdivided to, either species, subspecies or variety.

Vascular Plants - plants with a developed fluid conducting system (higher plants), i.e. flowering plants, cone bearing plants and ferns.

Non-vascular Plants - plants without a specialised fluid conducting system (lower plants), i.e. mosses, fungi and algae.

Presumed extinct - not collected or otherwise verified in the wild over the past 50 years despite thorough searching, or whose only known populations have been destroyed more recently.

Endangered - in serious risk of disappearing from the wild within one or two decades if present landuse and other causal factors continue to operate.

Vulnerable - not presently endangered but at risk over a longer period through continued depletion, or which largely occur on sites likely to experience changes in landuse which would threaten the survival of the species in the wild.

Threatened - presumed extinct, endangered or vulnerable.

Rare - used where the species is rare but not considered threatened. May be represented by a relatively large population in a very restricted area, or by smaller populations spread over a wider range. 2000 plants may be used as a guide to rarity, but this is dependant on the biology of the species.

Endangered species (fauna)

A Case Study

In April 1996 Carnaby's cockatoo was listed as 'rare or likely to become extinct' due to its declining loss of habitat, and being taken from the wild illegally. It is now fully protected in WA, however the effects of salinisation on much of the remaining vegetation further threaten the loss of the bird's habitat. Most salmon gums now exist on roadside reserves in many areas of its breeding habitat.

In 1997 70 Carnaby's cockatoo nest sites in the northern Wheatbelt were monitored. This region consists of woodland remnants that are a mixture of salmon gum, wandoo or morrell. The fieldwork revealed that these cockatoos always nested in salmon gums when available. But when they were not wandoo trees were used as nesting sites. The monitoring program also identified several important breeding areas that are not on the formal conservation estate, therefore possibly not adequately protected. Of the 70 nest trees monitored, 34 per cent were on private property, nine per cent on shire reserves and 56 per cent on road and rail reserves. Clearly the retention of these nest trees is critical for the long-term survival of Carnaby's cockatoo.

- Wildlife Corridors

In the broadest of term's wildlife corridors are linear areas of habitat that are in contrast to the surrounding land in

(i) vegetation structure
(ii) and type of land use

Saunders and Hobbs[1] are more specific in their definition of wildlife corridors, defining them as linear features of vegetation that differ from the surrounding vegetation, connecting at least two patches of vegetation that were connected historically.

The more general definition of wildlife corridors promulgated by Wilson and Lidenmayer,[2] "retained and/or restored systems of (linear) habitat which, at minimum, enhances the connectivity of wildlife populations and may help them overcome the main consequences of habitat fragmentation", provides a useful notion of them in roadside conservation terms. However this may be considered to be somewhat simplistic approach if the continuance of ecological processes, e.g. energy flow, nutrient cycling, photosynthesis and decomposition are to be considered.

Principles of Corridor Development

Principle 1	corridors do have a potentially useful function, not only in providing habitat, but also in enhancing the movements of wildlife.
Principle 2	the wider the corridor the better.
Principle 3	corridors must be viewed as subcomponent of a broader regional system – that is one of a number of options to ensure the maintenance of wildlife populations in fragmented, rural landscapes.
Principle 4	connectivity is not necessarily defined, or determined by physical conuity of non-matrix habitat; some populations do have connectivity in patchy landscapes. However some species do not.
Principle 5	a precautionary approach is advised: this begins with the assumption that corridors do have habitat and movement value and therefore should be protected/retained, enhanced/restored (i.e. increased size and habitat quality) and re-established/replanted.
Principle 6	ongoing protection maintenance and monitoring are essential components of the corridor development process. This is essential to ensure habitat suitability over the long term, assess corridor function and effectiveness, and provide information to make further improvements to corridor design
Principle 7	need to design for specific landscape spatial context, surrounding land use and integrated management goals.
Principle 8	must consider how to mitigate the potential disadvantages of corridors such as the dispersal of plant and animal pests and pathogens
Principle 9	research on farms potential for "management as an experimental process".
Principle 10	we cannot wait to have all the answers and scientific information – we must accept that we need more knowledge but cannot wait to establish networks of corridors.

after Wilson and Lindenmayer (1995)

[1] Saunders and Hobbs 1991 (pp. 421-7)
[2] Wilson and Lindenmayer 1995 (pp. 46-49)

Disadvantages of Wildlife Corridors

- Edge effects – can impinge on effectiveness of corridor
- Barrier or filter effect – can act as selective barrier for some species
- Enhance unwanted species – may promote the spread of weeds or unwanted fauna species
- Enhance spread of fire and pathogens – can promote wildfire fire or translocation of pathogens
- Enable the spread of deleterious genes – allow breeding access to formerly discrete populations
- Financial cost – establishment costs may preclude other conservation initiatives

🕮 Further Reading

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- Tourism

Visitors flock to Western Australia in their thousands to see our wildflowers. In a 1989-90 survey of tourists staying in commercial accommodation in WA, it was found that 18 per cent gave wildflower sightseeing as a reason for their stay. And because our roadsides reserves are often the only exposure that travellers have to the world-renowned flora of WA, roadside vegetation is important to our wildflower tourist industry.

While it is impossible to put a price on the 'wildflower experience' the survey did find that visitors had a daily expenditure of $88.33 per adult. Since this figure can only have increased in the past seven years there is a sound economic incentive at local and regional level for managing roadsides in a sustainable manner. Just as obviously, mismanagement of roadsides will quickly erode this potential cash flow.

- Cultural values and Recreational Values

Roadsides often contain significant sites of cultural, historical or heritage value, which contribute to the sense of place or identity of a region. Our mental, emotional and physical well-being is enhanced by our surroundings-and our surroundings are appreciated by many.

Heritage trails such as Yaberoo Budjara, which links Yellagonga Conservation Park near Joondalup and Yanchep National Park, are often located on roadsides. They enhance the tourist experience with photographic or bushwalking opportunities, and offer an insight into local plants and animals.

- The Role of the Roadside Conservation Committee

The Roadside Conservation Committee (RCC) has a vision of conservation networks across the landscape, stretching as far as do the rail and roadsides they border. These would be fully appreciated and supported by all sectors of the public especially local communities. Such a network would consist of both conservation reserves and privately owned remnant vegetation, linking the varying lands they cover.

Objectives

The objectives of the RCC are:

- to promote the appreciation, protection and enhancement of native vegetation on rail and roadsides
- to provide information to government at all levels, utility providers, voluntary groups and the public on the importance of rail and roadside vegetation.
- to develop an understanding of the ecological processes controlling roadside vegetation, and through this devise better techniques for management of rail and roadside corridors

The RCC seeks to foster communication and co-operation between the various groups involved in rail and roadside management. The RCC is also available to develop corridor management plans, and plays an active role in research, training and data collection and mapping in relation to roadside vegetation.

Terms of Reference

The RCC's Terms of Reference are to co-ordinate and promote the conservation and effective management of rail and roadside vegetation for the benefit of the environment and the people of Western Australia.

- The History of the Roadside Conservation Committee

The request to form a roadside conservation committee arose from strong public criticism of the poor conditions of roadside flora. A conservation campaign in 1969 culminated in a march on Parliament which resulted in the State Government agreeing to:

- establish a Ministry for Conservation (now Department of Environmental Protection and Environmental Protection Authority)
- hold an inquiry into the Mining Act
- agree to convene a Committee to investigate roadside conservation

As a consequence the Road Verge Conservation Committee was initially convened at the request of the State Government, by the then Conservator of Forests in December 1969.

The RVCC's brief was to summarise public concern, with particular reference to :

- unsightly debris left after road construction and the work of other agencies working in the road reserve
- damage to native flora by engineering works, exotic plants, vermin control methods and regular verge burning.

Because of the wide range of causes or suspected causes of road verge problems, the RVCC membership was chosen to represent those State and Commonwealth agencies that have an impact on road verges.

Representatives were drawn from:

Forest Department	Soil Conservation Service
WA Herbarium	Country Shire Councils Association
State Energy Commission	Main Roads Department
Telecom Australia	Lands and Survey Department
Agricultural Protection Board	

At a later stage the Department of Fisheries and Wildlife was included.

After deliberating for about a year the RVCC presented the State Government with a report, which contained eleven recommendations to enhance the conservation of roadside vegetation. The RVCC was then disbanded.

In 1971 the Premier of the day requested the Forests Department to coordinate the various government departments required to implement the recommendations made by the RVCC. As a consequence, a new RVCC was established in 1971. and met on an irregular basis until 1983. During this time the RVCC worked with various state government departments but the lack of resources impeded its effectiveness. This in conjunction with major amendments to the Wildlife Conservation Act and the reorganisation of some state government departments resulted in the RVCC again being disbanded.

However Roadside Conservation Committee (RCC) was again reformed in 1985. Initially the RCC worked under the auspices of the Land Resource Policy Council in the Department of Premier and Cabinet. However this time the State Government made a financial commitment to the RCC with financial resources being made available to employ a full time Executive Officer and finance the production of publications and a research programme.

Within the first year of its reformation the RCC was placed under the auspices of the Department of Conservation and Land Management with this agency providing the Chairman for the RCC. The rationale for this being that as this agency administered the Wildlife Conservation Act it was seen as the most appropriate to support the. Funding for the RCC is provided by CALM and Main Roads WA with some minor supplementary support from Westrail. The RCC is currently located in the Wildlife Branch of CALM State Operational Headquarters and acts as a Ministerial Advisory Committee. The RCC currently consists of representatives, appointed by the Minister for the Environment. Current membership of the RCC includes representatives from the following organisations:

CALM (Chairman)	Main Roads WA
Westrail	Western Power
Alinta Gas	Water Corp
Agriculture WA	Bush Fires Service
Greening WA	WA Wildflower Society
Western Australian Municipal Association (3 representatives)	

- The management principles involved in the conservation of roadside vegetation.

The Verge Environment

The vegetation within any roadside experience unique environmental conditions with respect to climate, physical impacts and fauna influence. In the case of rural roadsides these conditions may include deposition of litter, exhaust gases, physical disruption, extreme wind and lateral isolation and frequent burning. The impact of these influences either singularly or in isolation will invariably result in a rapid change in the character of the native roadside vegetation. To minimise the negative impacts that these factors will cause the roadside vegetation a protective roadside management regime should be implemented.

For most common road reserve widths of 20 or 40 metres, it can be seen that agricultural development, road construction and provision of public utilities have a deleterious effect on the roadside vegetation.

Vermin

Depending on ones viewpoint, road verges can be described as harbours for vermin or refuges for native fauna. In practice both statements have some validity, but the role of verges as corridors for the movement of birds and animals is well established. Small animals use verges as cover while moving from one patch of habitat to the other, and the smaller bird species use them especially the trees for the same purpose.

Poor road maintenance and construction techniques which result in heaps of spoil being left often provide sites that are readily utilised by rabbits or colonised by weeds. Spoil should always be disposed of carefully and should not be stored or windrowed above the backslope of the road.

If rabbits have become a problem on road verges, ripping should be avoided and alternative means of control considered eg warren poisoning, warren destruction with explosives or poison baits.

The role of fire in effective management of the environment

Fire is a natural component of the Australian environment. Most plants have evolved to cope with the periodic occurrence of fire. Fire management for vegetation should ensure that it is not exposed to fire more frequently than the time needed for all plants to reach sustainable reproduction capacity. The fire regime should be planned to encourage community diversity.

Use of fire to abate fire hazards should be confined to those areas where identifiable hazards, high ignition risks and high values exist. In general, these relate to roadsides where the native vegetation has been replaced by annual grasses and weeds.

- Fire Effects

The effects of fire on the environment depends on the nature of the fire (the fire regime). There are four factors which determine the fire regime.

FREQUENCY – the period of time between successive fires

SEASON – the time of year the fire occurs

INTENSITY / DURATION – the severity of the fire in terms of the rate of heat output and the length of time that the fire is sustained

EXTENT / COVERAGE – the size of the area burnt and the proportion of that area burnt.

Fauna

Fire can kill animals outright or affect their long-term survival by destroying or altering their habitat. Survival is determined by the fire characteristics in the order of:

Intensity > Frequency >Season

The most dramatic changes to animal populations are brought about by high intensity low frequency, broad scale summer fires, eg: Ash Wednesday. Areas burnt more frequently and by less intense fires usually also burn smaller areas and leave a greater percentage of the area unburnt. This makes it easier for animals to escape from the fire and recolonise the burnt areas from islands on unburnt vegetation. This supports the practice of mosaic burning of roadsides to achieve fuel reduction, as this will have the least impact on animal survival.

Recovery of the animal populations is related to the recovery of the vegetation. For example, Honeyeaters will not return to a site until tree canopies have recovered and they are providing protection and food again.

Vegetation

Fire characteristics affect vegetation in the order of:

Frequency > Season > Intensity

The fire frequency is important to plants in the way it effects their growth cycle. For example native plants generally flower and set seed once a year, mostly in the Spring/Summer . Fuel reduction burns carried out in Spring usually destroy emerging flowers and prevent the seed set.

If burning is too frequent, i.e. annually, many native species are unable to produce seed before the next burn to ensure their persistence at that site. However, many exotic species of weeds and grasses which flower and set seed much earlier can survive Spring burns, and are often enhanced by it. This allows exotics to out-compete and gradually replace native vegetation.

Fuel reduction burns carried out on roadsides would generally be of high frequency and low intensity (a cool burn). A fuel reduction burn of this type normally removes or reduces understorey shrubs, scorches tree trunks and crowns and reduces plant community diversity. This allows for high species richness as many different species are able to survive although in reduced numbers eg: grasses, sedges, and orchids resprout, and seeds of most other herbs and shrubs would also germinate. In high intensity, low frequency fires (bushfires), all understorey fuel, including larger logs, would be removed. Soil may be heated to a depth of 5cm, killing roots, tubers, bulbs and microorganisms. Seeds of some species may have been destroyed by the heat and will not come back to the site until blown or carried in. This results in low species richness. However, many seeds stored in the soil germinate in response to the heat (wattles, banksias, orchids) at the first rains following the fires, leading to high community diversity. Trees would be burnt, destroying the canopy but the fire would not penetrate the thick bark, allowing healthy trees to respond by sprouting epicormic shoots all along the trunk. Thus, the trees survive. Older trees with hollows may burn internally, die, and eventually fall over.

Weeds

Roadsides are particularly vulnerable to weed invasion as they have a larger perimeter (or edge) in proportion to their overall area. As edges are particularly prone to degradation, the greater the length of the edge, the greater the opportunities for weed establishment in roadsides.

This can occur with the seeds of weeds being by: spread by:

- birds or animals moving along roads,
- wind dispersal from adjacent farmland
- machinery or vehicles
- movement of water in drains
- the movement and dumping of spoil
- grading of road shoulders

The spread of fertiliser is an additional factor that aids weed growth. This is particularly so where soils are heavy and the fertiliser tends to accumulate, benefiting weeds and impeding the growth of endemic species.

Vigorous ground flora may offset this invasion, but open woodland with grass or ephemeral ground flora are very prone to weed invasion. In turn this may necessitate a regular even annual firing of the verge for the protection of adjoining farmland.. However the exclusion of fire and the use of alternative methods has shown that in some circumstances that native vegetation can re-establish it self.

📖 Further Reading

Hussey, B. M. J., Keighery, G. J., Cousens, R. D., Dodd, J. and Lloyd, S. G. (1997) **Western Weeds** Plant Protection Society of WA, Victoria Park.

The use of herbicides in maintaining roadside vegetation.

Strategic and appropriate use of herbicides can assist in the control of weeds and the conservation of remnant vegetation (e.g. on batters or shoulders where native vegetation is growing it may be possible to use a selective herbicide which will control larger broad leafed plants or by over-spraying the native vegetation).

Herbicide use should be restricted to dealing with specific problems that cannot be adequately dealt with by other methods, e.g. mowing or slashing.

Broadacre spraying is not recommended because of the risk to non-target plants and the difficulty in successfully revegetating the large areas left bare by this non-species specific method. **N.B** Herbicides are often used in conjunction with revegetation to prepare sites for direct seeding or major planting zones.

📖 Further Reading

Roadside Handbook, (1998) Western Australian Roadside Conservation Committee

- Responsibility for the management of road reserves

History of Road Reserves

The original purpose of road reserves was to provide for the passage of people and goods from one place to another. These often began as bullock or wagon tracks, and as a consequence, areas dedicated for transport purposes were generally narrow.

Until relatively recent times all road reserves in Western Australia were established at a width of varying from 20.1 to 40.2 metres (1 to 2 chains). In practice therefore most roads in the older settled areas of the southern portion of this state are narrow reserves, even when they have become major roads.

Since 1946 rural road reserves in new agricultural areas have been designated with widths of 60, 80, (etc) up to 400 metres. The construction of highly engineered roads on these reserves ensures the retention of a wide and uncleared road verge, which is more likely to sustain natural vegetation in the long term.

However with the passage of time, a multiplicity of purpose is now attached to road reserves and the community has expectations that every effort will be made to accommodate all values:

(i) high speed, heavy and large capacity commercial transport, domestic and tourist vehicular traffic.
(ii) public utilities, e.g. electricity and telecommunication transmission lines, water and gas pipelines
(iii) scenic routes with an emphasis on roadside flora
(iv) recreation and amenity facilities
(v) biodiversity and conservation values
(vi) landcare values

Because of the changing community perceptions of the uses of road reserves the narrow road reserves which were satisfactory on the past are now under pressure to cater for today's needs. As a consequence wider roads are required and invariably this results in the loss of the existing roadside vegetation remnant. Nevertheless it is important to remember that the primary function of road reserves is that of providing for the passage of vehicles, goods and people

ROAD MANAGER	SEALED km	SEALED %	UNSEALED Km	TOTAL km
Local Government	29,027.56	23.43	94,880.91	123,908.47
Main Roads WA	15,886.31	91.69	1439.62	17,325.93
Federal Government	4,648.19	100		4,648.19
CALM			29,322.81	29,322.81
Total road network in Western Australia				176,205.40

Table 1 Extent of road network in Western Australia

after Main Roads WA June 1996

Road Classification

In every region a classification system can be used to identify the relative importance of a road. This classification provides a basis on which to establish the width of the carriageway.

In general, the important factors to be considered in developing classification categories for the road networks include:

Traffic composition - cars, trucks, buses and farm vehicles
Traffic volume - high, low and seasonal usage
Purpose of traffic - commercial, school bus, farm use, or tourism
(For instance roads largely used for scenic or tourist purposes may not need to be designed to as high a standard as roads with an equivalent volume, but different purpose.)

A suggested hierarchy for Local Government roads could be the consideration of 4 categories as shown in Table 1:

CATEGORY	CRITERIA	SUGGESTED CARRIAGEWAY WIDTH
1	Major feeder roads	9m
2	Lesser feeder roads	8m
3	Farm access roads - major	7m
4	Farm access roads - minor	5m

Table 1- Categories of Local Government Roads

Clearing Width

The width required for clearing to accommodate the earthworks for the carriageway is influenced by many factors. Some of the factors to be considered are:

the region of the State
design speed
terrain and soil type
drainage requirements
vegetation type
areas where special roadside vegetation exists
road classification such as a scenic or tourist road

Many wide road reserves are created for the express purpose of protecting and conserving natural vegetation.

The width of clearing required to carry out the earthworks for the road must be based on engineering needs and not on the width of the road reserve. The width on either side of the carriageway used to accommodate the table drain and batters requires careful site specific consideration to ensure that there is minimal disturbance to roadside vegetation.

CATEGORY	CARRIAGEWAY (m)	CLEARING (m)
1	9	15
2	8	14
3	7	12
4	5	7

Table 2 provides a guideline for suggested clearing widths for the four categories of roads defined at Table 1.

DEFINITION OF TERMS

CARRIAGEWAY:	Width of road between guide posts
BATTER:	Slope of banks and cuttings
TABLE DRAIN:	The drain adjacent to the road
CLEARING WIDTH:	The width required to carry out the roadworks during construction
MAINTENANCE ZONE:	Area requiring periodic disturbance to maintain the road and table drain and other drainage facilities
ROADSIDE:	The area between the maintenance zone the road reserve boundary excluding drainage requirements

- **Legislation for commercial harvesting from roadsides**

The diversity of values associated with roadside vegetation has been well documented and acknowledged, hence it is highly desirable that conservation of this asset is managed in such a way as to ensure its sustainability.

In recent times considerable confusion has arisen with regard to the 'ownership' and control of the roadside *per se*. When a public road is created, a corridor of land is dedicated for a road, ie a road reserve. The road formation and its associated works are accommodated within the road reserve. The remaining space is called the roadside and it is the control and management of this area (and flora and fauna residing within it) that is proving to be contentious.

Local government authorities are often approached by various individuals for 'permission' to take flora products from the roadside. Several shires in the wheatbelt have had requests for permission to take material for didgeridoos from roadsides. A number of shires that have previously had a policy to disallow commercial collection of flora products have approved of the commercial harvesting of seed from roadsides.

The provisions imposed on persons by local authorities collecting roadside flora have generally not included any restrictions on the duration or the extent of activities. Licenses allowing for taking of roadside flora have been issued by CALM on the basis of Shire's support.

Legislation

Public roads other than main roads are dedicated under the ***Local Government Act*** (Part XII). Dedication places care and management of the road (street) in the relevant local government authority. However, under Section 286 of the ***Local Government Act*** 1960 land in a road is the absolute property of the Crown, i.e. still Crown land.

Road reserves may be created in the following ways -

- By approval of a Crown subdivisional plans, s.294A of the *Local Government Act*.
- By approval of a freehold subdivisional plan, s.295(5) of the *Local Government Act*.
- By approval of a survey plan (Crown or freehold), s.28 of the *Town Planning and Development Act*.
- By dedication of Crown land (often following acquisition under the Public Works Act), ss.287 and 288 of the *Local Government Act*.
- By a local government undertaking work on a private street, s.296 of the *Local Government Act*.

When a street is dedicated to a public use, it becomes Crown land under the *Land Act*, pursuant to s.286 of the *Local Government Act*. Care, control and management rests in the relevant local government (s.300 of the *Local Government Act*) unless the road is declared a highway, main road or secondary road under the *Main Roads Act*. In the latter case, care, control and management vests in the Commissioner of Main Road (ss.15 and 26 of the *Main Roads Act*). Main Roads Western Australia, rather than DOLA, administers those roads placed under their management responsibility.

The Act appears to be written in an urban context, and does not refer specifically to the management of the roadside, rather it only refers to the road itself. It is therefore difficult to determine to what extent the Act places the care, control and management of the roadside with the local government authority in the case of dedicated roads. It is, however, suggested that where a local government authority is managing a road (reserve) that authority may undertake reasonable management of the roadside to facilitate the roadway, including making the road safe and convenient to use.

With the proclamation of the ***Wildlife Conservation Act*** 1950 the responsibility for flora conservation, including control of harvesting of protected flora, include seed, was given to the Minister of the Crown responsible for Fisheries and Wildlife and the Department of Fisheries and Wildlife. With the formation of the Department of Conservation and Land Management (CALM) in 1984 and the accompanying ***Conservation and Land Management Act*** **1984** the conservation and management of all native wildlife passed to the Minister responsible for that Department and the Department itself. As a consequence CALM has the authority to exert controls on the commercial harvesting of protected wildlife in Western Australia from both Crown and private lands.

The ***Wildlife Conservation Act***, (Section 6) defines flora as "any plant, including wildflower, palm, shrub, tree, fern, creeper or vine which is either native to Western Australia or declared to be flora under the Act and includes any part of flora and all seeds and spores thereof". All parts of the plant including roots, branches, stems, leaves, flowers, seeds and spores come within the legal meaning of flora. Under the ***Wildlife Conservation Act***, protected flora on Crown land is deemed to be the property of the Crown, until legally taken.

"Legally taken" is understood to mean when flora has been taken pursuant to a licence or some other authorisation under the *Wildlife Conservation Act*.

The purpose of the *Wildlife Conservation Act* is "to provide for the conservation and protection of wildlife". In issuing licenses for the taking of protected flora from Crown lands CALM must therefore consider the implications any such authorised taking will have on the conservation of wildlife.
Protected flora may be harvested (ie picked for commercial purposes) from Crown lands subject to management controls as defined by CALM. Management measures available to CALM include:

- licences to control:
  what flora or parts of flora are taken,
  where they may be taken,
  how they are taken.

- licence endorsements which give further control regarding:
  specific localities where flora may be taken and/or
  specific taxa that may be taken by particular licensees.

- The Main Roads Act 1930 Section 15 part 3a vests all vegetation, both living on roads under the control of Main Roads and dead in the Commissioner of Main Roads.

(3) The property in -

(a) the materials of all highways and main roads, and all live and dead timber and vegetation thereon, and all matters and things appurtenant thereto; and

Section 15A of this Act also makes it an offence to damage or remove vegetation from roads vested in the Commissioner of Main Roads.

15A. (1) No person shall cut, break, bark, root up or otherwise damage, destroy or remove the whole or any part of any timber, tree, sapling, shrub, undergrowth, or wildflower in or upon any highway or main road without the prior consent in writing of the Commissioner except when such action is taken to remove a hazard.

CALM Licences

Under the ***Wildlife Conservation Act*** "to take in relation to any flora includes to gather, pluck, cut, pull up, destroy, dig up, remove or injure the flora or permit the same to be done by any means". Under the Act, the taking of protected flora from Crown land is prohibited unless a licence is held. All flora taken from Crown land must be taken within the provisions of either

- a commercial purposes licence(Section 23C (a)) of the ***Wildlife Conservation Act***, for the sale of flora or

- a scientific or other prescribed purposes licence (Section 23C (b)) of the Wildlife Conservation Act, for the taking of flora for scientific or specified non commercial purposes as prescribed by Wildlife Conservation Regulations (56 b).

In cases where Crown land is vested in a government management agency CALM requires, as a licence conditions, that the vesting agency give its written permission to persons wishing to take protected flora.

RCC Policy: Collection of Timber and Commercial Wildflower Harvesting

Timber Harvesting from Roadsides

The RCC seeks to encourage roadside managers to retain timber on roadsides as an important component of the natural habitat, which fulfils ecological, aesthetic and land management functions.

RCC Policy

"Harvesting of timber on roadsides should not be permitted except in defined road safety, fence-line or service clearance zones, or where an individual specimen has fallen, or appears likely to fall into clearance zones.

In all cases the permission of the managing authority (MRWA, LGA or CALM) must be sought before timber is taken."

Within provisions of the *Conservation and Land Management Act* (Section 139 (2)) local government authorities "may fell timber in the process of clearing such roads, and may sell and dispose of the timber so felled, and may fell timber growing on roads within its district for use by the council in the construction and repair of buildings, bridges, culverts, fences and other works."

Commercial Wildflower Harvesting

The legislation and licence categories for the taking of flora have previously been dealt with. The RCC considers that the flora on roadsides is reserved and maintained for the public benefit. Hence it is seen as a contradiction of purpose to allow flora on roadsides to be harvested for private gain.

RCC Policy

1. *Commercial harvesting of native flora on roadsides should not be permitted except as provided for in 2.*

2. *When seed is needed for bona fide revegetation projects, and no other source of local seed is available, then the controlling authority may consider giving permission for collection of seed from roadsides, subject to the issue of the appropriate licence by CALM and provided the harvesting is done in a way which does not endanger the long-term survival of the roadside community.*

3. *No commercial harvesting of any plant product should be allowed for any reason between the markers which delineate a Special Environmental Area.*

The legislation pertaining to the management of road "reserves" is complex. Legislation relating to roadsides includes:

- *Local Government Act 1960*;
- *Land Act 1933*;
- *Soil and Land Conservation Act 1945*;
- *Wildlife Conservation Act 1950*;
- *Conservation and Land Management Act 1984*;
- *Bush Fires Act 1954*;
- *Aboriginal Heritage Act 1972*;
- *Agriculture and Related Resources Protection Act 1976*;
- *Mining Act 1978*;
- *State Energy Commission Supply Act 1979*;
- *Environmental Protection Act 1986*, and the
- *Water Authority Act 1987*.
- *Main Roads Act 1930.*

With such a diversity of legislation influencing the management of roadsides it is not surprising that uncertainty has arisen with regard to the legal responsibility and authority.

From the information obtained by the RCC Executive, the following summary of the situation can be given.

Local government authorities have clear management responsibilities for maintaining public roads, other than specific main roads. Main Roads WA is the managing authority. The road management responsibility covers both the actually road surface and the remainder of the road reserve. This management responsibility is, however, limited only to those actions that can reasonably be considered necessary to maintain the roadway in good order.

As road reserves are Crown land, the flora on them is the property of the Crown and subject to the provisions of the *Wildlife Conservation Act*. The flora is not the property of the road management authority. Whilst road management authorities may remove flora as necessary for road construction, road improvement or road safety (fallen trees or limbs) this is done without a licence. In technical terms the road manager has not legally "taken" the flora, but has moved or removed the flora within its rights from a legal "obligation" or "duty" viewpoint. The flora still therefore remains the property of the Crown and a valid licence is required before any other party may legally take the flora.

The *Wildlife Conservation Act* makes no differentiation between "living" or "dead" flora. Thus all flora on roadsides, whether live or dead, or piled there by road workers remains the property of the Crown. Persons wishing to take such flora for use as firewood, craftwood etc, must therefore be licensed by CALM to do so. Similarly, person wishing to take living flora material, including flowers, seeds and stems must also be licensed by CALM.

Current Roadside Flora Management

Under current policy CALM has been enforcing the requirements of the *Wildlife Conservation Act* in relation to roadside flora as Crown flora. CALM has, however, provided road management authorities to take roadside flora by requiring the road management authority to give their approval in order to validate flora collecting licences (this is done via licence conditions). CALM has therefore taken the position that commercial harvesting of flora from roadsides is acceptable providing it is done in a sustainable manner and with the approval of the road manager.

It should be recognised that CALM and the Minister for the Environment are under no obligation to allow flora harvesting from roadsides and that they can refuse to issue licences for such activities even if a road manager supports such harvesting. CALM has also taken action against persons removing flora material resulting from roadworks, where no flora licence had been issued.

CALM is currently reviewing its position in relation to the collection of dead material from roadsides for firewood. CALM is understood to be considering choosing not to enforce the flora licence requirements for removal of dead wood resulting from road works or road maintenance, providing persons have the approval of the road managers to take such material.

The RCC has in the past taken a strong protection line in relation to roadside flora, arguing that in general such flora should not be harvested. Increasingly, in recent years, local government authorities have been giving their support or approval to such harvesting, some on the understanding that CALM provided for such harvesting under its standard flora licences, anyway. Some Shires may have been given their approval for such harvesting on the mistaken belief that the Shire had some property rights over roadside flora. Even if they have not done so, by requiring a road manager to approve such harvesting, before a licence becomes valid, CALM has given Shires and Main Roads standing, in relation to flora conservation on roadsides.

THE ROADSIDE CONSERVATION COMMITTEE

Terms of Reference

To coordinate and promote the conservation and effective management of rail and roadside vegetation for the benefit of the environment and the people of Western Australia.

Policies

The Roadside Conservation Committee will:

- Encourage rail and road management authorities and utility providers to conserve rail and roadside vegetation where possible.
- Provide information on the importance of rail and roadside vegetation for nature conservation, for landscape protection, and as an amenity.
- Develop rail and roadside management practices that conserve the native vegetation while achieving rail and road management objectives.
- Promote model by-laws, codes of practice and roadside management plans for rail and road management authorities and utility providers to use for conserving and managing roadside vegetation.
- Encourage the rehabilitation of degraded rail and roadsides to local native vegetation communities.
- Encourage the community to be involved in all aspects of conserving and regenerating rail and roadside vegetation.
- Promote specific research programs directed toward the conservation and management of rail and roadside vegetation.
- Promote the training of road managers, contractors and workers in techniques for conserving and managing rail and roadside vegetation.
- Encourage the integration of rail and roadside vegetation into regional management (eg. natural resources management, conservation and development) strategies by community groups, local government and government agencies.

Strategies

The Roadside Conservation Committee uses and promotes a number of strategies to implement its Terms of Reference and policies. The strategies outline what people and organisations should do to protect and enhance rail and roadside vegetation. In the strategies that follow, the term 'roadside' refers also to rail reserves and may also be pertinent to other linear corridors.

1 Liaison

- Identify other bodies with a management interest in roadsides, and develop a communication strategy with them.
- Consult with relevant bodies when works might disturb roadside vegetation.

2 Planning

- Ensure the maintenance of roadside vegetation values is taken into account when planning construction or maintenance activities on road reserves.
- Undertake an inventory of roadside values as per the RCC roadside mapping project.
- Develop Roadside Management Plans to conserve those values identified in the roadside inventory.
- Develop a Code of Practice for the implementation of Roadside Management Plans in accordance with the policies and strategies of the RCC.

3 Management of Roadsides with Special Values

- Designate roads with high quality roadside vegetation as Flora Roads if they meet certain criteria, and manage such roads so as to maximise the roadside vegetation values.
- Increase public recognition of Flora Roads by erecting signs that publicise them, and encourage their promotion in tourist literature.
- Identify areas of roadside with special environmental values as Special Environmental Areas (SEA), and get advice about their management from the relevant authority.
- Mark SEAs with standard roadside markers, to prevent them being disturbed accidentally, and inform relevant personnel of the function of such markers.
- Establish a register of Flora Roads and SEAs, for use in planning roadside management and other activities.

4 Clearing for Fenceline and Services

- Locate new or replacement services on cleared land to avoid damaging native vegetation.
- Encourage landowners to set replacement fences further inside their boundaries, avoiding damage to roadside vegetation and allowing for vegetation establishment contiguous with roadside vegetation.
- When fencelines and services are constructed or maintained within roadsides, ensure that the least possible native vegetation is cleared and limit degradation of the remaining vegetation, especially on roadsides with medium to high conservation value.
- Insist that service authorities working on road reserves follow Phytophthora Dieback hygiene procedures.

5 Removal of Timber or Flora

- Timber harvesting should not be permitted from roadside vegetation except in defined road safety, fenceline or service clearance zones, or where an individual tree has fallen or might fall into clearance zones.
- Commercial harvesting of native flora (wildflowers, seeds and cuttings), should not be permitted from roadsides, except as provided for below:

1. Only give consideration for harvesting seed and cuttings from roadside vegetation if the seed and cuttings are needed for bona fide local revegetation projects and there is no other source of local seed.
2. Don't permit harvesting of any plant product for any reason between the markers delineating a Special Environmental Area.
3. Set specific conditions to limit the impact of harvesting of timber or flora, in association with Department of Conservation and Land Management licensing requirements.

6 Regeneration and Replanting

- Revegetate roadsides with the aim of establishing self-sustaining local native vegetation with overstorey and understorey components that will provide wildlife habitat, wildlife corridors, and maintain the region's natural identity.
- On degraded sections of roads with otherwise high conservation values, encourage regeneration of the native vegetation.
- Encourage landowners to plant local native vegetation on their property next to the roadside to protect the roadside vegetation, increase the conservation value and shelter effect of the vegetation itself, and create a wider and more useful wildlife conservation corridor.
- Work through the local Land Conservation District Committee and other community organisations to integrate the roadside vegetation into regional vegetation plans to form a network of conservation corridors.

7 Fire Management

- Implement fire management strategies that do not cause permanent damage to the native vegetation.
- Adopt policies or by-laws to control roadside burning.
- Integrate roadsides into Shire or regional fire management plans.
- When designing a fire management plan, take into account ecological management of the vegetation when addressing abatement of potential fire hazards.
- Do not permit the burning of both sides of any section of a road in any year.
- Allow firebreaks on road reserves only when they are necessary for protecting roadside vegetation, and when construction does not affect existing vegetation values. Furthermore, specify construction methods and the maximum allowable width of the break.
- For disputes about roadside fire management, arbitrate through the Western Australian Bush Fires Service.

8 Weed Control

- Establish a register of weed occurrence on roadsides.
- Control weed species in a way that least harms native vegetation.
- Control roadside weeds which are "declared plants" under the Agriculture and Related Resources Protection Act to the standard laid down in the Act for specific regions.
- Identify other (environmental) weeds, particularly where they compete with native plants, and control them if possible.
- Regularly inspect roadsides for new occurrences of declared or environmental weeds.
- Target new or small weed infestations for control as soon as possible to maximise the success of control measures and to reduce new infestations.
- Minimise disturbance of roadsides to limit opportunities for weeds to invade native vegetation communities.
- Use appropriate hygiene practices in road management to discourage weed seeds spreading between areas, especially when operating between weedy and weed-free areas of a roadside.
- Obtain advice on the most appropriate and environmentally sensitive methods of controlling target weeds.

9 Control of Animal Pests

- Control declared animals on roadsides as the Agriculture and Related Resources Protection Act specifies.
- Use control methods that least damage the roadside vegetation.
- Carry out animal pest control in conjunction with regional control programs.
- Obtain advice on the most appropriate and environmentally sensitive methods of animal pest control.

10 Control of Phytophthora Dieback

- Identify the presence of dieback on roadsides and store this information in a central register.
- Mark dieback occurrence along roadsides using a standard code system.
- When constructing or maintaining roads, establish dieback hygiene procedures and follow them to prevent the spread of disease.
- Test all sources of road building material where interpretable and record whether they are dieback-free or infested. Use only dieback-free materials in dieback-free areas.
- Get advice about dieback management from CALM or Main Roads WA.

DIEBACK MANAGEMENT ON WESTERN AUSTRALIA'S HIGHWAYS AND MAIN ROADS

Anna Napier, Main Roads Western Australia

INTRODUCTION

The construction and maintenance of roads historically has had a significant part to play in the spread of the *Phytophthora* dieback disease. Road making machinery, by its nature, is designed to pick up soil and move it around, sometimes over long distances, and has probably been a major agent of the distribution of *Phytophthora* in Western Australia. In addition, road making gravel was at times deliberately taken from areas of dead and dying jarrah so that valuable timber would not be destroyed when clearing for a pit. It is little wonder, then, that road making organisations have a bad name when it comes to their effect on the distribution of dieback in this State.

This paper gives an overview of the progress of one road making organisation, Main Roads Western Australia (MRWA), with regard to its efforts to manage dieback.

THE HISTORY OF DIEBACK MANAGEMENT BY MAIN ROADS

Main Roads Western Australia has been concerned about the potential for the spread of dieback due to its operations since the mid-1970's. At that time MRWA consulted the Forests Department to reduce the possible spread of dieback on roadworks in State Forest areas. The major precautionary measure undertaken was to ensure that 'clean' gravel was used in forest areas. However these precautions did not extend to roads outside forests.

By 1980 some roadworks contracts in forest areas known to be infected with the dieback fungus contained quite comprehensive dieback management clauses. These clauses included provisions for vehicle washdown in a specific area, the use of copper sulphate in washdown water, marking of infected areas, education of personnel and a requirement for the contractor to remove any suspected infected soil which may have been inadvertently moved onto a healthy area.

In 1983 consideration was given to the management of dieback on roadsides outside forest areas. Specific attention was given to roads through National Parks, gravel supplies to important roads, new roads in the Shires of Ravensthorpe and Esperance and works in the Metropolitan area.

In 1985 a decision was made to provide guidelines and procedures for dieback management on all roadworks jobs but the Department did not have sufficient expertise or staff to produce such a document. Work on the project stalled until 1989 when dieback was included in the Draft Environmental Management Manual. This Manual included guidelines for the assessment of dieback in roadworks planning and followed the CALM 7-way test and hygeine procedures (CALM, 1986). Additionally, published information on dieback was distributed to all personnel involved in roadworks in southern Divisions.

All construction jobs since 1989 in dieback risk areas have been considered for their potential to spread the disease. Those areas known to be infected with dieback have been managed to minimise the chance of spread. Works areas that are 'clean' or uninterpretable have also been managed accordingly. Construction works which have incorporated dieback hygiene principles include areas at Mt Barker, Bunbury, Bindoon and in the Metropolitan area. Two case studies are given at Appendix 1.

In addition, any Biological Surveys and Environmental Impact Assessment reports carried out in areas which may contain dieback are now required to provide details of the presence or absence of the disease with mapping and confirmation of suspected outbreaks. In this way MRWA has begun to build up a picture of the occurrence of the disease on main roads and highways and can then more carefully manage and monitor any movements.

A consultant was engaged in early 1990 to develop a Dieback Management Manual. Dr Ray Hart of Hart, Simpson and Associates consulted with Divisional staff to establish the chains of responsibility and special considerations required for dieback management in road construction and maintenance. The manual was completed early in 1992 and has been distributed as a draft document but has not yet received final approval. A discussion of the contents of the Dieback Management Manual can be found later in this paper.

SPECIFIC PROBLEMS WITH DIEBACK MANAGEMENT ON ROADSIDES

Roadsides have a range of factors which make management of dieback difficult when compared with, for example, minesites, Nature Reserves or development sites. Many of these factors cannot be mitigated by altering practices and therefore must be a consideration in the assessment of the potential 'reward for effort' in dieback management procedures.

The factors can be divided into four categories.

1. Uncontrolled Access - access to roadsides is uncontrolled over the whole life of the road. Potential vectors include the travelling public, roadworks on adjoining gravel roads and farm entrances and crossovers, works by Telecom, SECWA and the Water Authority and the activity of adjacent landholders. Adjacent landholders may alter drainage (although not to the physical detriment of the constructed road), plough firebreaks and drive machinery inside boundary fencelines adjoining roadsides - all of which has the potential to introduce or spread dieback into the road reserve.

2. Road Drainage - most roads have a table drain to take water away from the bitumen surface and off-shoot drains specifically designed to collect water and then shed it. These can be ideal sites for the survival and spread of the dieback fungus.

3. Ongoing Maintenance - maintenance of road shoulders and drains occurs over the life of the road and is often carried out when soils are damp, for example, grading (for ease of compaction) and damage repair after heavy rainfall. Such maintenance may be over long distances and can involve drain clearing and reconstruction.

4. Gravel supplies - gravel for road building and maintenance is becoming more difficult to find. Bush sites are generally unavailable in the south-west of the State and gravel from cleared farmland sites is uninterpretable with regard to its dieback infection status. Assumptions have to be made on the status of the material in many cases where no other options are available. Other materials are becoming more suitable in some areas e.g. crushed limestone in coastal regions.

5. Dieback Mapping - many roadside areas have been considerably disturbed and dieback existence or absence cannot be confirmed. In such cases it is difficult to assign suitable procedures and justify any extra management expense required.

Despite these problems there is still evidence that careful management of soil and equipment movement and the use of uninfected gravel can significantly reduce the introduction and spread of dieback on roadsides. Main Roads does not use these difficulties as a reason for not applying management precautions wherever possible and especially in areas of high conservation value. The organisation has shown a willingness to manage dieback and to encourage other roadside users to do the same.

DIEBACK MANAGEMENT POLICY, PROCEDURES MANUAL AND TRAINING

Development of the Policy and Procedures

In the late 1980's it was decided to employ a specialist consultant to investigate how dieback might be managed on roadsides and for preparation of a policy and procedures document.

In early 1990 the consultant began to talk to personnel in relevant Divisions to ascertain the current dieback management practices that were in place and who was responsible for the steps in construction and maintenance. Of considerable importance was to establish which management procedures were feasible in the construction and maintenance processes and which were impractical or too expensive to implement. Without access to a 'reasonable' option in dieback control, commitment to overall control is likely to be poor. Office and site discussions were held in the worst affected Divisions to establish potential problems in both practical management and attitudes.

It has been important to allocate responsibility for the steps in dieback management : planning, soil sourcing, plant and machinery movement, washdowns, staff education etc. When areas of responsibility are clearly defined it is more likely that the control measures will be a success.

The Manual has been developed into four main sections :

- Policy
- Organisational Procedures
- Techniques
- Performance Assessment

Policy

The Main Roads policy on dieback is aimed at recognition of the problem and the development of management procedures for all operations to minimise impact. This will include recognising priority areas, liaison with other agencies which use Main Roads controlled land and a regular review of procedures.

Organisational Procedures

This section of the Manual deals with the strategies required to implement the policy. It puts forward a process by which dieback is integrated into the planning and execution of all activities which have the potential to spread the disease. Underlying the process is the need to establish priorities for the allocation of resources for dieback control. It may be both unrealistic and unnecessary to attempt to apply controls to all operations immediately.

Many aspects of road management can be agents of the spread of dieback. These include the management of land owned by MRWA which is set aside for proposed roads or realignments, maintenance of existing roads, new road construction and rehabilitation works.

Flow charts have been provided in the Manual to aid decision making on issues of dieback management (Fig. 1). Similar charts are available for construction planning, construction, rehabilitation works and vacant land management. These indicate possible steps and actions dependent upon the individual situation. However, certain information must be known about the site and management procedure. This includes a knowledge of -

- existing infections and the degree of and potential for damage,
- the probability that dieback would be spread or introduced during the proposed operation and what damage this could cause, and
- the feasibility of control and whether it is realistic with the resources available.

It is recommended that such information is gained wherever possible at the planning stage so that the most appropriate and effective decisions are made. If the environmental values of the areas are not sufficient to warrant the costs of dieback control the process may not be further considered.

Dieback Management Techniques

The Manual provides detailed information on a number of techniques used in dieback management. It is possibly the most important section of the document and includes details on the following topics :

- deciding whether dieback is an issue
- identifying and mapping existing dieback infections
- assessing dieback hazards and potential impacts
- setting priorities for applying dieback controls

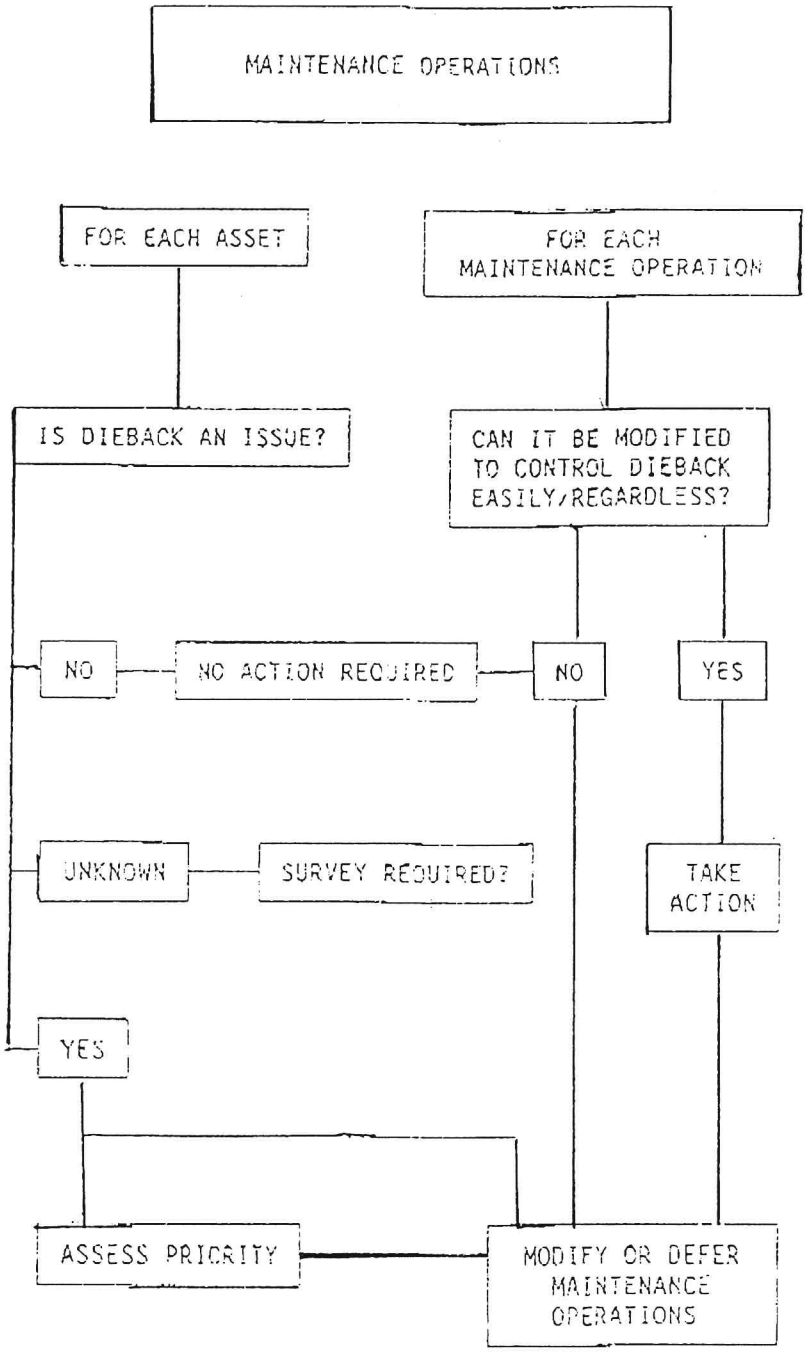
MAINTENANCE OPERATIONS
FOR EACH ASSET
FOR EACH MAINTENANCE OPERATION
IS DIEBACK AN ISSUE?
CAN IT BE MODIFIED TO CONTROL DIEBACK EASILY/REGARDLESS?
NO
NO ACTION REQUIRED
NO
YES
UNKNOWN
SURVEY REQUIRED?
TAKE ACTION
YES
ASSESS PRIORITY
MODIFY OR DEFER MAINTENANCE OPERATIONS

FIGURE 1

- developing an asset management plan for dieback (on land where no roads currently exist)
- dieback management of maintenance operations
- incorporating dieback controls into the planning of a construction project
- applying dieback controls in a construction project
- incorporating dieback controls into rehabilitation works
- practical procedures - marking dieback boundaries
  - cleaning vehicles and machinery
  - phosphorus acid application.

Some of the decision-making techniques involve answering a series of questions, with relevant information given on how to answer them, or as checklists of points to be considered. In many cases there is no definitive single procedure available or recommended, and the emphasis is on establishing a basis for making the best possible assessment of what can be done in each case.

There is considerable scope for innovation in many of the techniques and this is already occurring as staff at Main Roads look at new materials and practices.

Monitoring the Effectiveness of Dieback Controls

It is of considerable importance, as with any new or altered procedures, to assess whether they have worked or been worth the effort or expense involved. In the case of dieback management, the proof is in what has not happened rather than in what has! However, any sort of certainty at the effectiveness of the controls may be not be available for some years, if at all. Accurate knowledge and records of the pre-existing condition of the vegetation and drainage, the methods employed during alteration of the site and any subsequent external factors affecting the site is required to provide any real assessment of success or failure.

Additionally, it is important to assess the success of the planning and procedures themselves as an indication of what can be easily achieved and what difficulties were encountered. Modifications to practices and procedures may be required to make them more cost effective, more acceptable to staff or more effective in dieback control.

Training of Main Roads Staff

Staff education and training is a critical factor in incorporating dieback control procedures into roadworks operations. It is an ongoing process which can have a significant effect on the acceptance of any new procedures introduced and the willingness of staff to carry them out diligently.

Initial training of Main Roads staff has been carried out in most Divisions which manage roads in dieback risk areas. The programmes have attempted to include a cross-section of personnel from all areas of road works. Staff from survey teams, materials, engineering planning and construction and maintenance sections are involved as well as the Division's Roadside Management Officer.

Training has generally involved a three-hour talk-slide presentation giving details of the introduction, life cycle, dispersal and spread of the fungus along with examples of management techniques and pointers for field recognition. A practical exercise includes a field visit to known dieback sites, and a proposal for roadworks in an infected area. Teams of trainees are then encouraged to develop a dieback management plan for the roadworks which includes a consideration of survey and soil sourcing activities, management of machinery, planning of events and siting of washdown areas if required. The plan is presented at the final session and other groups are invited to discuss the work and suggest any alterations.

Talk-slide presentations have been given to some staff from Main Road's head office and further training is required to educate planning staff in dieback and its management. In addition, the Roadside Management Officers in each Division have developed some expertise in the recognition of dieback through attendance at courses run by the Department of Conservation and Land Management and the Roadside Conservation Committee and through spending time in the field with a dieback specialist. Most are beginning to map roads in their Divisions for suspected dieback occurrence and have learnt to collect suitable sample material for laboratory testing.

A poster titled "Dieback on Roadsides' has been produced as an aid to education and has been distributed to all Divisions. The poster shows the effects of the disease, describing how it is dispersed and what individuals can do to help prevent further spread.

Training effort has significantly raised the profile and knowledge of dieback in Main Roads. Management of the disease is now considered as a 'normal' part of a roadworks job. Further training and application of control procedures will cause dieback management to be accepted in the same way as have other environmental and safety issues.

PLANS FOR THE FUTURE

The most urgent need for MRWA is to establish the extent of *Phytophthora* infections on its road network and other lands under its control. With some 3,000 km of roadsides in areas of dieback risk the task is large. Effective dieback management procedures are dependent on accurate information on the distribution of the disease although many areas are likely to be uninterpretable. At present disease mapping is carried out for areas of proposed roadworks but is not available for routine maintenance works.

As a result of practical experience with dieback management and exercises in training courses there have already been a number of suggestions for changes in techniques to achieve hygiene measures more easily. Of particular interest are ideas for portable washdown bays, for attachments to machinery and for the use of different road building materials. Useful innovations need to be further encouraged, developed and documented. Where staff feel ownership of a procedure they are far more likely to carry it out.

The development of the possibilities for plant inoculation and spraying as a preventative measure against dieback has provided a useful practical procedure for roadside management in some areas. Main Roads has already treated some highly susceptible vegetation in areas

known to be infected with dieback and is hoping to extend the practice. It is seen as a feasible adjunct to hygiene measures in areas where roadside vegetation is generally well conserved and valuable.

Finally, further education of both Main Roads staff and other roadside users is of considerable importance in order to achieve control aims. The concept of attempting to control the spread of a fungus which is not visible and with results which may never be seen is a difficult one to grasp for many people. Although the effects of the disease can be graphic enough it can be difficult to convince personnel that one slip in hygiene processes may be enough to negate all the other management work which has been diligently carried out.

The education of other road users and adjacent landholders must also be attended to so that Main Roads personnel do not consider their efforts to be jeopardised by outside influences.

Main Roads has made considerable steps forward in the management of dieback on its roadworks in recent years. It is still on the learning curve but a great many practical and planning advances have been made and there is an awareness amongst staff of the disease and the need for control.

REFERENCES

Department of Conservation and Land Management, (1986) "Dieback Hygiene Manual".

Main Roads Department, (1989) 'Environmental Management Manual' DRAFT.

APPENDIX 1

CASE STUDY - CONTRACT DUAL CARRIAGEWAY CONSTRUCTION - BUNBURY 1990

The contract included the construction of one side of a dual carriageway road to a length of 11.3 km. Dieback was identified along a creek line over which the road passed and a infection area of 360 metres was designated. Much of the remainder of the road passed through well conserved, highly susceptible jarrah-Banksia woodland which required protection from the disease. The following is a summary of steps in road planning and clauses in the contract which were incorporated specifically for dieback management on the job.

1. Department of Conservation and Land Management consulted at planning stage.

2. Dieback infection mapped pre-construction and boundaries specified in contract. Boundaries marked with written signs for the duration of the construction project.

3. Plant Management:
   - All plant and equipment to be cleaned down before beginning on site.
   - Machinery used in designated section to be cleaned down before leaving the section.

4. Washdown bay specified. This included details of fungicide quantities, requirement to replace fungicide daily and provision for a sump to collect overflow and waste fluids.

5. Soil Management

i) Cleared vegetation from the designated area to be retained in the area and burnt.
ii) Topsoil removed from designated area to be retained and respread in the area.
iii) Excavated material from the infected area to be buried under any embankment construction within the area.
iv) Imported embankment material to be backed in from the edge of the designated area so that it forms a 'clean' pad on which to work.
v) Sub-base backed in from the edge of the designated area to form a 'clean' pad on which to work.

Alterations to Specification

The washdown bay was not constructed as specified. However, a simple washdown pad on the edge of the infected area was used. Waste and overflow water from this area drained directly down into the already infected creekline.

Outcome

All other specifications in the contract were adhered to and to date no evidence of the spread of dieback upslope of the infected area has been seen. The job was a good learning experience for both MRWA and the contractor and did not create significant operational problems.

CASE STUDY - PASSING LANE CONSTRUCTION - BINDOON HILL 1990

Passing lanes were constructed leading up to the summit of Bindoon Hill on the Great Northern Highway over a distance of 3.7 km. *Phytophthora citricola* was identified in jarrah-Banksia woodland at the top of the hill and in the associated drainage system of the road. A pit and gravel stockpile on adjoining land and the water source for the job (Nooning Spring) were designated free of dieback by Department of Conservation and Land Management.

The following clauses (paraphrased) were included in the contract specification in order to minimise the risk of spread of dieback.

1. Plant management - All plant to be washed down before entering the job site or any of the pits.
   Cleandown requirements were specified.
   - Plant to be washed down during the construction job in accordance with Table 1.

2. Water treatment - All water used for construction, haul roads and any other works to be treated with fungicide. (Amounts and renewal times were specified).

3. Cleandown bay specified. This included the provision of two such sites, details of fungicide to be used, dimensions and provision of a sump.

4. Plant movement. Trucks to cart water from water source to storage site on the job to be separate from those used to cart water from the storage site to the construction site to avoid contamination of the water source. The area around the storage site to be constructed and managed in such a way that the trucks carting from the source to the storage site will not pick up any soil and mud.

5. Material handling. No material to be removed from the job site without the approval of the Superintendent.

TABLE 1 - PLANT WASHDOWN REQUIREMENTS

ITEM OF PLANT	MOVING FROM JOB SITE TO PITS	MOVING FROM JOB SITE TO WATER SOURCE	MOVING OFFSITE
Water trucks	Washdown	Washdown	Washdown
Water carting trucks	No washdown (1)	No washdown (1)	Washdown
Trucks	No washdown (1)	Washdown	Washdown
Construction Machinery	Washdown	Washdown	Washdown
Vehicles	No washdown (1)	Washdown	No washdown (1)

Note 1 : except as directed by the Superintendent.