City of Joondalup

City of Joondalup
Pathogen Management Plan

2012-2017

Acknowledgements

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1.0 Introduction

The City of Joondalup is situated along the Swan Coastal Plain, 30 kilometres from the Perth Central Business District. The City covers an area of 96.5 kilometres which encompasses a diverse range of natural areas including 17 kilometres of coastal foreshore, a chain of wetlands and a variety of bushland ecosystems.

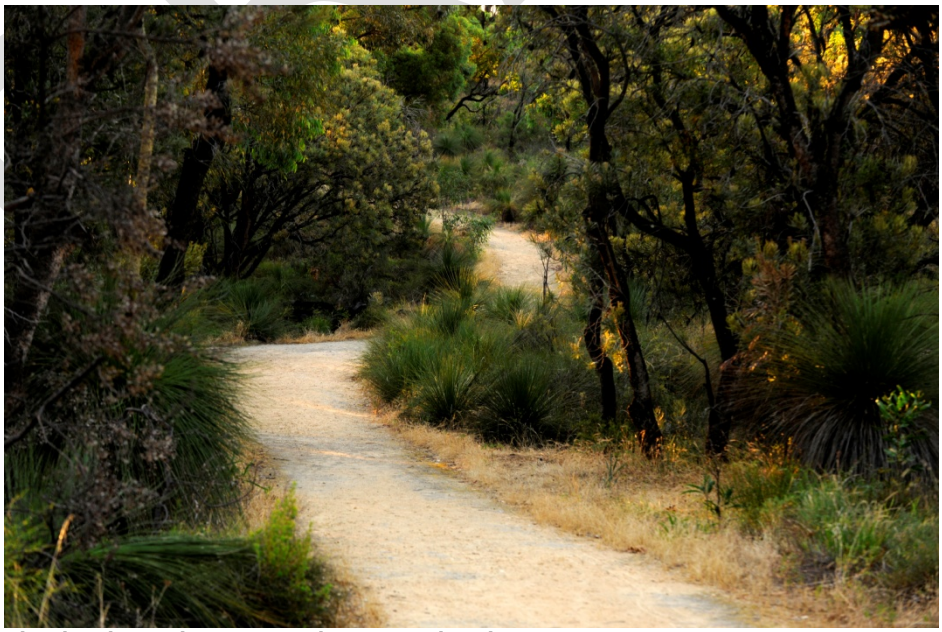
The City's southern boundary is located approximately 16 kilometres from the Perth Central Business District, and is bounded by the City of Wanneroo to the east and north, the City of Stirling to the south, and the Indian Ocean to the west.

There are a variety of regionally, nationally and internationally significant natural areas located within the City including the Yellagonga Regional Park, the Marmion Marine Park, the Neerabup National Park and a number of Bush Forever sites which contain species of high conservation value.

Vegetated areas within the City are at risk from pathogens which poses a serious threat to the biodiversity values within the City's parks and bushland areas. Effective pathogen management is required to ensure that measures are taken to mitigate the effects and limit the spread of pathogens within the City.

In order to protect native vegetation and ecosystems within the City of Joondalup a Pathogen Management Plan has been developed. The Plan identifies the level of risk for pathogens becoming introduced to City parks and natural areas and prioritises the areas for further on ground investigations.

The Plan also provides guidance on the management of pathogens within the City in order to minimise the spread of pathogens. Strategies to engage the community in order to raise the awareness of pathogens within the City of Joondalup are also identified within the Plan.



Shepherds Bush Conservation Area Kingsley

1.1 Purpose of the Plan

The Pathogen Management Plan aims to establish the level of risk of pathogens within City parks and natural areas and identifies areas of high risk where management actions should be concentrated.

The Pathogen Management Plan includes the following:

- Desktop assessment of parks and natural areas for pathogens including *Phytophthora* species and *Armillaria* to establish the level of risk within the City;
- Development of preventive and management strategies and procedures to be employed within activities relating to the use of City parks, streetscapes and natural areas:
- Identification of control and treatment measures for infested areas; and
- Development of education and communication mechanisms to raise the awareness of pathogens within the organisation and the community.

The objective of the Pathogen Management Plan is to protect biodiversity values within the City of Joondalup by minimising the risk of introducing and spreading pathogens including species of *Phytophthora* and *Armillaria luteobubalina* within landscaped and natural areas of the City.

1.2 Strategic Context

The purpose of the Draft Pathogen Management Plan aligns with the environmental aims and objectives of a number of City of Joondalup Plans including:

Strategic Community Plan

The *City of Joondalup Draft Community Strategic Plan 2012 – 2022* highlights the focus on preservation, rehabilitation and maintenance of the City's natural environmental assets and the importance of engaging with the community, key stakeholders and relevant agencies.

Environment Plan

The *City of Joondalup Environment Plan* identifies the key environmental pressures and threats and provides the strategic response to the major issues affecting the City of Joondalup.

Biodiversity Action Plan

The *City of Joondalup Biodiversity Action Plan 2009 – 2019* provides direction for the City's biodiversity management activities and recommends the development of Dieback Management Plans.

The City of Joondalup Strategic Environmental Framework is outlined in *Figure 1.*

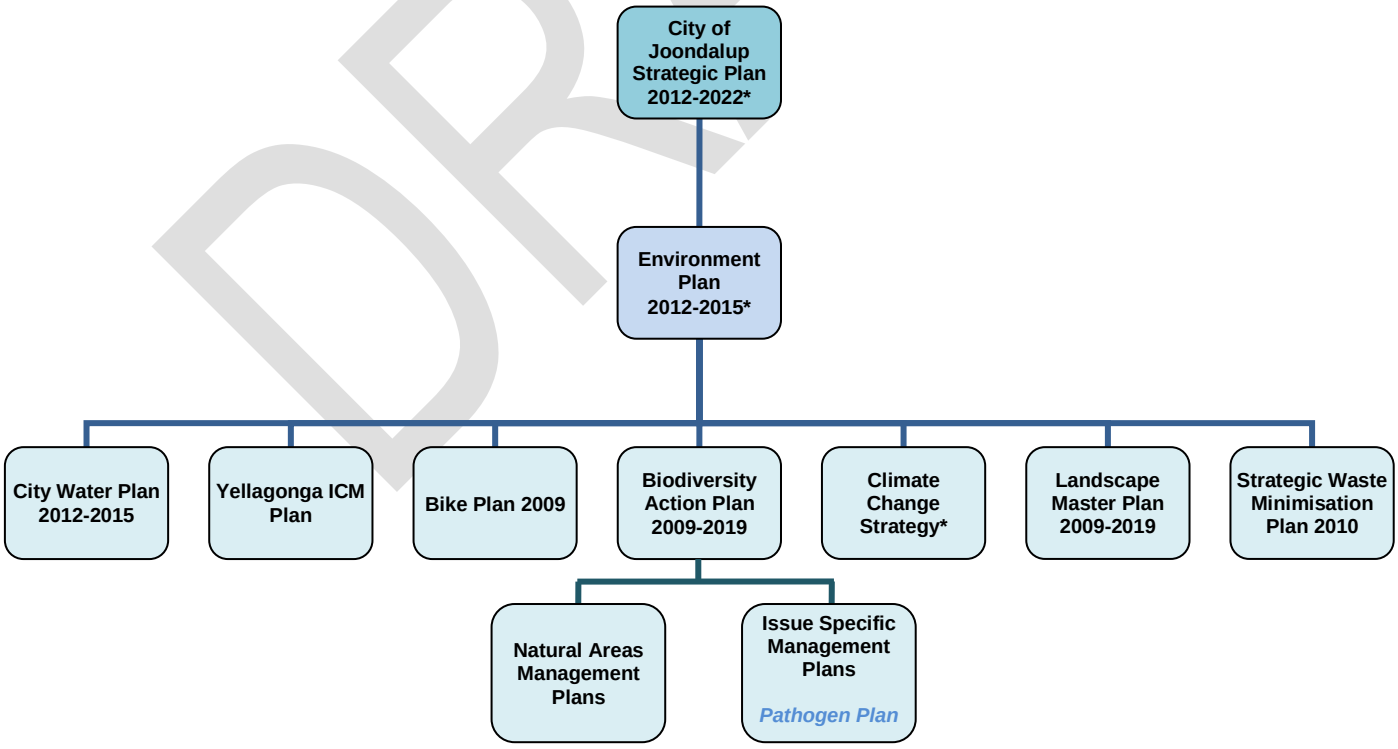


Figure 1- City of Joondalup Strategic Environmental Framework * in development

1.3 What are Pathogens?

Organisms such as fungi, bacteria and viruses that cause plant diseases are known as pathogens. Whilst some pathogens are naturally occurring within soil populations, others have been introduced to the environment through the movement of plant materials and soils.

Pathogens can exist in the soil for long periods of time without causing an outbreak of disease in plants. Disease outbreaks are either caused by an increase in the population of the pathogen or by an increase in the susceptibility of the plant. The population of the pathogen is dependent on whether the soil conditions are favourable for its growth and survival. The conditions that are favourable for the growth and survival of pathogens are different for each species of pathogen but are related to:

- Soil pH;
- Soil water content;
- Soil oxygen level;
- Nutrient levels in soil; and
- The activities of other soil organisms.

The symptoms produced by plants that are affected by pathogens vary depending upon the species of pathogen, host species, environment and climatic conditions. Some pathogens can cause rapid death of plants whilst other result in a slow, perennial decline in health.

The City of Joondalup Pathogen Management Plan provides information and management recommendations to address species of the pathogens *Phytophthora* and *Armillaria* only as these are the plant diseases that can have the greatest potential to impact negatively on the biodiversity values of the City.

1.4 Phytophthora

Ecology and Biology

The scientific name *Phytophthora* (pronounced fy-toff-thor-ah) is derived from the Greek words meaning 'plant destroyer'. *Phytophthora* is a water mould which attacks the roots and stem tissue of living plants causing them to rot. The rotting weakens and kills the plant by limiting the uptake of water and nutrients, as detailed in *Figure 2*.

Phytophthora cinnamomi

Phytophthora cinnamomi, also known as Phytophthora Dieback, is one of the biggest threats to biodiversity within Australia. The *Environment Protection and Biodiversity Conservation Act 1999* lists 'Dieback caused by the root-rot fungus *Phytophthora cinnamomi* as a key threatening process to Australia's biodiversity'.

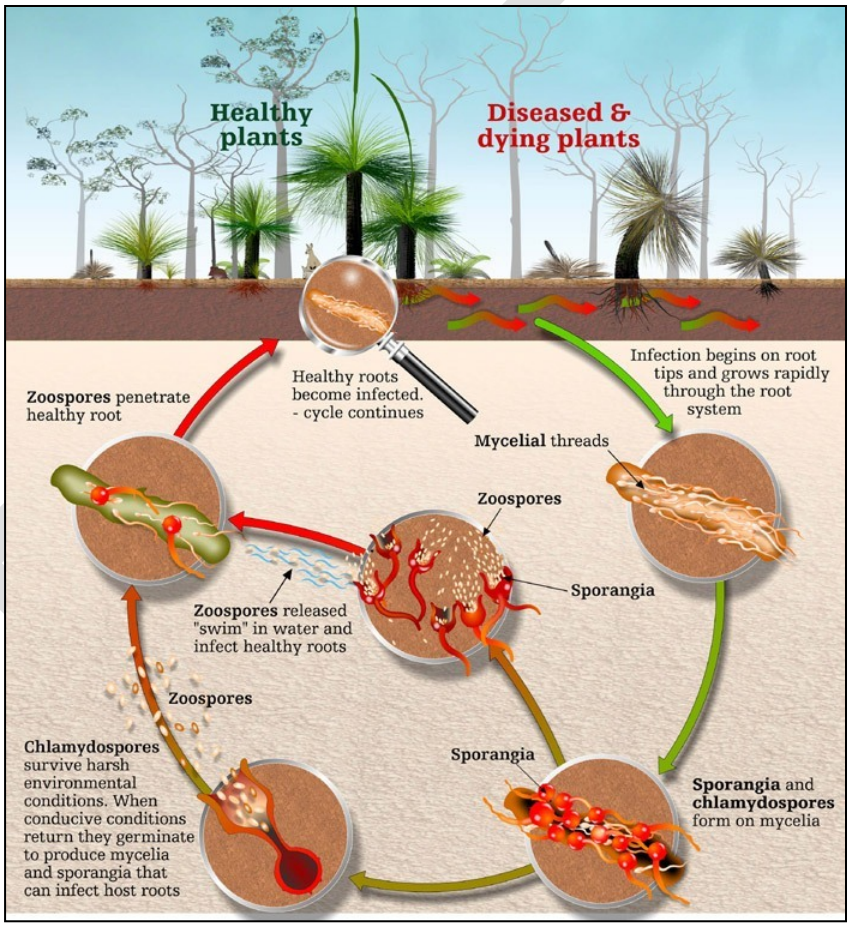


Figure 2- Lifecycle of Typical Phytophthora (Sourced from Dieback Working Group)

*Phytophthora cinnamomi, o*ccurs widely across southern Australia and is most commonly found in areas which receive an average of 600mm of annual rainfall, however the pathogen has been known to extend into areas which receive less rainfall. *Phytophthora cinnamomi* is found in Tasmania, Victoria, New South Wales, Queensland, South Australia and Western Australia.

Phytophthora Dieback is causing significant damage in the South West Australia Ecoregion of Western Australia, as illustrated in *Figure 3*, because:

- Over 40% of native plant species and over 50% of rare or endangered flora species. in the region are susceptible;[1]
- The climate and soils of the South-west Australia Ecoregion suit the pathogen's survival and spread; and
- The pathogen was spread widely before it was identified as the cause of permanent damage to our ecosystems.

Thought to be an introduced pathogen, possibly originating in South-east Asia, *Phytophthora cinnamomi* is widespread throughout the urban areas of Perth. This pathogen has a very wide host range, with more than 2300 species of Western Australian native plants considered to be susceptible. *Phytophthora cinnamomi* can survive for long periods in unfavourable conditions and prefers nutrient poor soils and is not considered to be as damaging within soils with high pH soils such as those within the Quindalup complex (found along coastal areas).

Phytophthora cinnamomi can cause rapid death of plants or cause a slow, perennial decline in health of the crown (upper part of a tree) and is commonly associated with the movement of dieback fronts throughout bushland, killing large numbers of highly susceptible species, earning it the name of the 'biological bulldozer.'

Whilst *Phytophthora cinnamomi* is the most common species within Western Australia other species of the pathogen have also been detected or suspected within Western Australia and the Perth Metropolitan Region, these species include:

- *Phytophthora multivora*
- *Phytophthora humicola*like
- *Phytophthora nicotianae*

Phytophthora multivora

Phytophthora multivora is widespread throughout the south-west of Western Australia with a similar distribution to *Phytophthora cinnamomi*. However unlike *Phytophthora cinnamomi*, it seems to tolerate the higher pH soils of the Quindalup and Spearwood dune systems, and is one of the most commonly encountered *Phytophthora* species associated with disease symptoms of native trees on these soil types.

Phytophthora multivora is common in urban areas of Perth, particularly along the inland dune systems. Probability of entry and establishment may also be higher in parks where containerized nursery stock and soil is introduced, and the use of machinery and vehicles is common.

The symptoms produced on plants vary depending upon the host, environment and climatic conditions; however *Phytophthora multivora* can cause rapid death of plants, or a slow, perennial decline in health of the crown. It has been observed causing large, aggressive lesions on *Banksia* species but on other species such as Tuarts, is considered to be a pathogen of the fine roots only. Unlike *Phytophthora cinnamomi*, it is not associated with 'dieback fronts' but is more commonly associated with individual spot deaths and areas of tree decline.

[1] Shearer et al., 2004

Phytophthora humicolalike

*Phytophthora humicola*like is a new species of *Phytophthora* yet to be formally described. Biologically it is similar in characteristics to other species of *Phytophthora*. *Phytophthora humicolalike* has been associated with decline and death of *Casuarina* species in parts of Western Australia. Currently there is no data on the pathogenicity (ability to produce disease in a host organism) of *Phytophthora humicola*like to hosts plants that reside within the Perth Metropolitan Region.

The known distribution of *Phytophthora humicola*like in Western Australia is limited to a small number of cases in Perth and Esperance. In these cases the pathogen was isolated either directly from streams, or from a site periodically inundated with water, suggesting the species may be well adapted to surviving in such conditions, meaning that wetland ecosystems may be at the greatest risk from this species of *Phytophthora.*

Very little is known about the host range of *Phytophthora humicola*like, other than it being identified in the soil and roots of individual specimens of *Casuarina obesa*. Like other Phytophthora species, it is suspected to be transmitted to other trees via root to root contact and through contaminated mulch.

As *Phytophthora humicola*like is a newly identified species of *Phytophthora* research into the susceptibility and resistance of host plants has not yet been undertaken.

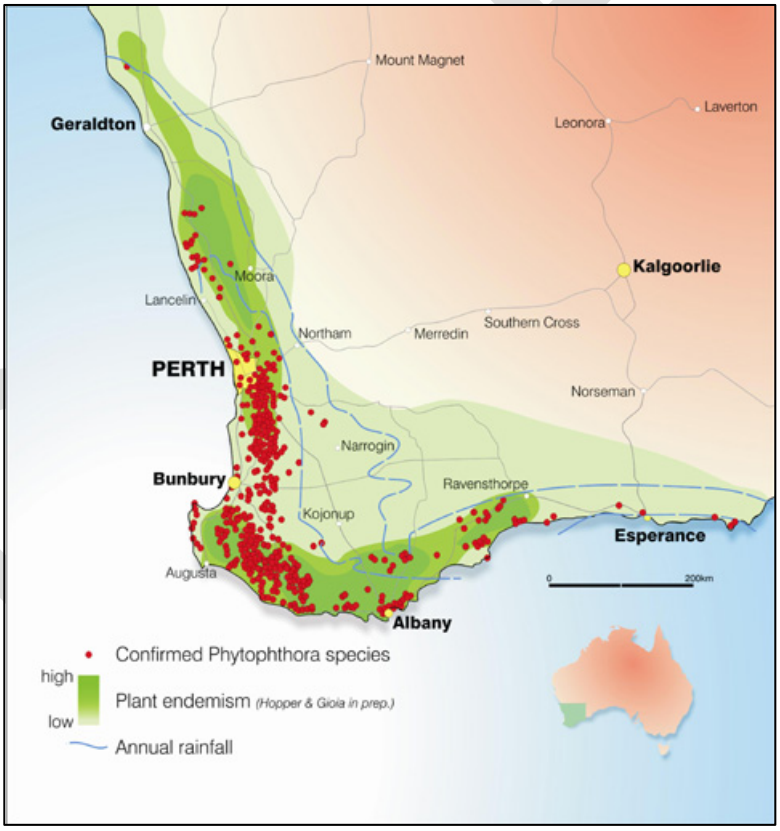


Figure 3- Distribution of *Phytophthora* within the South-west region of Western Australia

Phytophthora nicotianae

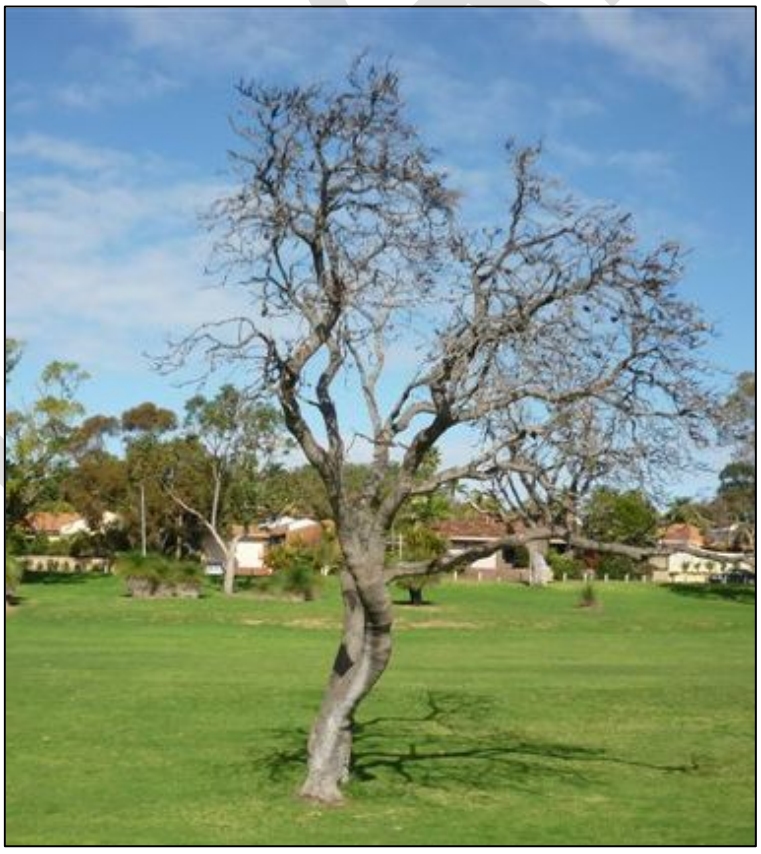
Phytophthora nicotianae is a soil-borne pathogen which was identified as affecting herbaceous and woody plants used within agriculture and horticulture; however it is now established within natural ecosystems of Western Australia.

Phytophthora nicotianae has been recorded from numerous host families in Western Australia including a range of native hosts. The pathogen is found in soil or plant tissue and prefers moist conditions for survival, however it can also survive for long periods in unfavourable conditions.

Phytophthora nicotianae is widely found within nursery stock and therefore has a higher probability of infecting parks and reserves than for species such as *humicola*like, which has never been confirmed within nursery stock. The probability of entry and establishment in parks compared to natural areas is also higher as nursery stock and soil is regularly introduced, and the use of machinery and vehicles is common.[2]

The symptoms produced on plants vary depending upon the host, environment and climatic conditions. It has been associated with large lesions at the base of *Eucalyptus* trees and causes collar rot of *Grevillea* species. *Phytophthora nicotianae* has also been identified as causing fine root death of numerous other native plant species.

Phytophthora nicotianae can move throughout the environment via soil or water or via root to root contact between plants. This pathogen is capable of causing decline and death of seedlings, shrubs and trees and is commonly associated with disease of vegetation throughout the Perth Metropolitan Region.



Suspected *Phytophthora multivora* Granadilla Park, Duncraig

[2] P Barber, 2012

Distribution and Dispersal

A number of species of *Phytophthora* are common throughout the whole of the South West of Western Australia, including within the Perth Metropolitan Region. *Phytophthora* is easily dispersed through the movement of infected soil and plant material by humans and animals. The pathogen is commonly spread by transplanting plants from one site to another or from soil being moved on boots, tools and machinery. The application of untreated or raw green mulch is also considered a source of the pathogen.

Recreational activities within infected areas including cycling and bush walking can also lead to increased infestation. Local Government has an important role to play in managing *Phytophthora* dieback as activities such as road and drain construction and bushland management, have the potential to introduce *Phytophthora* dieback to a previously uninfected area, or increase its rate of spread.

When *Phytophthora* spreads to bushland, it kills many susceptible plants, resulting in a permanent decline in the diversity of the bushland. It can also change the composition of the bushland. Native animals that rely on susceptible plants for survival are also at risk of population decline within sites infested by *Phytophthora.*[3]

Different species of *Phytophthora* affect a variety of host plants with many Western Australian native plant species being susceptible to infection by several species of *Phytophthora* as detailed in *Table 1.*

Proteaceae	Myrtaceae	Epacridaceae	Other
Adenanthos	Agonis	Andersonia*	Allocasuarina
Banksia*	Beaufortia	Astroloma*	Anarthia
Conospermum	Calothamnus	Leucopogon*	Boronia
Dryandra	Calytrix	Lysinema*	Conostylis
Franklandia	Eremaea	Monotoca*	Dampiera
Grevillea	Eucalyptus	Sphenotoma*	Dasypogon
Hakea	Hypocalymma	Styphelia*	Daviesia
Isopogon*	Kunzea		Eutaxia
Lambertia*	Melaleuca		Gastrolobium
Persoonia*	Regelia		Hibbertia*
Petrophile*	Scholtzia		Hovea
Stirlingia*	Thryptomene*		Jacksonia
Synaphea	Verticordia*		Lasiopetalum*
Xylomelum			Latrobea
			Macrozamia
			Oxylobium
			Patersonia
			Phlebocarya
			Xanthorrhoea
			Xanthosia

Table 1- Plant genera with species known to be affected by Phytophthora species (Sourced from Dieback Working Group)

* Many species in the genus are severely affected by *Phytophthora*

[3] Dieback Working Group, 2000

1.5 Armillaria

Ecology and Biology

Armillaria luteobubalina is a soil-borne fungus that causes root rot of a wide variety of plants including many species of native flora. The fungus is native to Australia and can cause major damage to natural ecosystems. *Armillaria* lives and feeds on the wood of infected plants and spreads through the soil as branching threads which can also be found under the bark of trees on the lower portion of the trunk. *Armillaria* reduces the function of the roots and affects the internal structure of the tree, often resulting in a slow decline in health and eventually death in trees.

Armillaria is commonly known as 'Honey Fungus' due to the colour of the fruiting bodies which grow above ground level near infected trees at certain times of the year, as illustrated in *Figure 4*.

Unlike some other root rot fungi, *Armillaria luteobubalina* does not infest soil. It spreads from a woody food base, which may be a tree or a stump, or even a small piece of infected root. As the root systems of many trees in these affected areas are in contact with each other, the fungus can move from its food base into the roots of a healthy tree.[4]

The pathogen commonly infects roots, root collars, basal stems and main stems of susceptible species. If infected trees are removed but the stumps remain in situ, the pathogen will rapidly colonise the stump and remaining roots, becoming a source of infection for many years.[5]

Figure 4- Fruiting Bodies of *Armillaria luteobubalina*

[4] Forest Science Centre (2003)
[5] P Barber, 2012

The spread and development of *Armillaria luteobubalina* is favoured by disturbance and irrigation, particularly through summer, and often occurs throughout managed areas of the Perth Metropolitan Region.

The symptoms produced on plants vary depending upon the host, environment and climatic conditions. *Armillaria luteobubalina* can cause large inverted V shaped lesions at the base of trees. The fruiting bodies, seen generally in June to September in Perth, are a secondary indicator of the *Armillaria* fungus as the pathogen is much more active below ground and is usually a sign that the fungus is well established within the area.

Distribution and Dispersal

Armillaria inhabits temperate regions of Australia and can be found in a range of environments such as coastal dunes and bushland areas including those that occur along the Swan Coastal Plain.[6]

Armillaria luteobubalina has been recorded from more than 50 different plant families throughout Australia, and more than 200 species are affected, not only in native forests, woodlands and heathlands, but also in reserves, parklands and residential gardens. The pathogen commonly affects species of Eucalyptus including Jarrah and Marri. Some Banksia species are also susceptible to the pathogen.[7]

The pathogen does not spread via swimming spores like *Phytophthora* species. *Armillaria luteobubalina* can be spread via spores; however, it is most commonly spread via root to root contact and within diseased plant material. Movement of soil is not considered a common means of dispersal as the pathogen usually requires plant material to survive, particularly in drier sites. Untreated and green mulch is known to be a source; therefore only composted mulch should be used within landscaping activities. Transplanting infected plants from one site to another may spread the pathogen.

Managing the spread of the pathogen once it has entered a site is challenging and costly. Eradication is possible by the complete removal of infected stumps and roots. Deep trenching around infected trees may prevent the spread into adjacent, uninfected areas. There are no commercial fungicides at present that can be successfully prescribed for controlling the pathogen.[8]

Where trees and shrubs are infected and complete removal of the infected stump and lateral roots is not feasible, these trees should be retained rather than felled to minimise the colonisation of the unaffected portions of the specimen and subsequent rapid spread and infection of neighbouring vegetation. The removal of turf and grass and therefore the need for irrigation around trees during summer may also reduce the spread of *Armillaria luteobubalina.*

[6] Smith-White and Summerell, 2003
[7] Shearer, B. L and Tippett J. T, 1988
[8] P Barber, 2012

2.0 Pathogen Risk Analysis

2.1 Introduction

The City of Joondalup engaged consultants Arbor Carbon to undertake a Pathogen Desktop Risk Analysis of vegetated areas within the City. The aim of the Study was to establish the level of risk for infestation of pathogen species within City parks and reserves.

The Pathogen Risk Assessment Study included:

- Identification of areas within the City at risk of pathogen infestation including the likelihood of introduction to or establishment / spread of pathogens within the area.
- Identification of vegetation communities of high priority and assessment of the level of risk pathogens pose to the area.
- Assessment of the manageability of the risk within the Study Area.
- Prioritised list of reserves for further investigations.

For the Risk Analysis consultants Arbor Carbon categorised the four species of *Phytophthora* and *Armillaria luteobubalina* under one group known as 'threatening pathogens'. Results from the Pathogen Desktop Risk Analysis Report have been utilised to inform the development of the City of Joondalup Pathogen Management Plan.

2.2 Study Area

The Study Area for the Pathogen Desktop Risk Analysis includes City parks and natural areas as illustrated in *Figure 4.* A list of the sites included within the Pathogen Risk Assessment Study is included within *Appendix 1*.

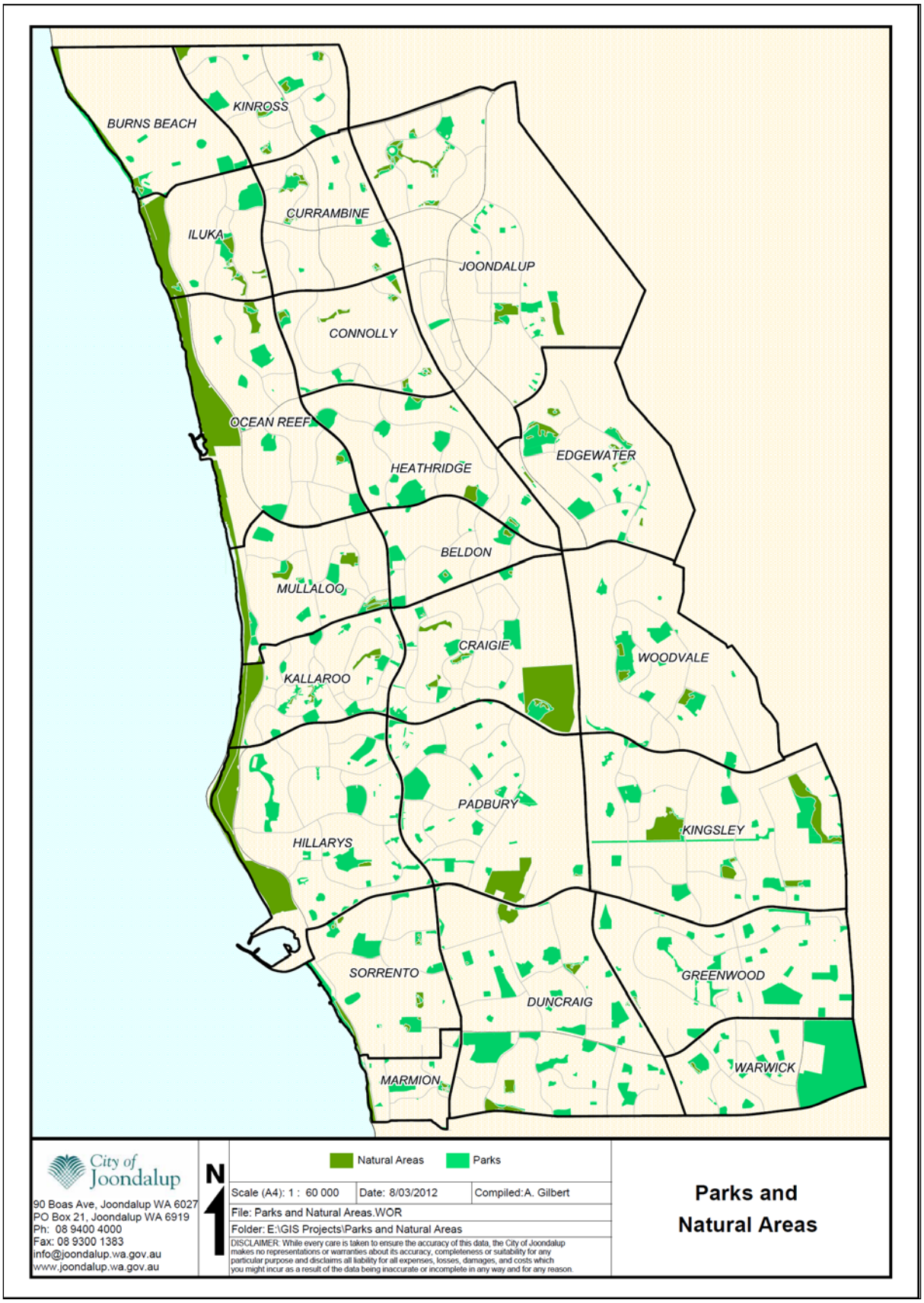


Figure 4- Study Area- City of Joondalup Pathogen Management Plan

2.3 Pathogen Assessment and Mapping

Methodology

In order to assess the level of risk for infestation by threatening pathogens factors, affecting the likelihood for infestation were assessed against each separate park and natural area within the Study Area.

Variables that affect the level of risk which were included within the Desktop Risk Analysis include whether disease is suspected at the site, if the area is irrigated or non-irrigated, proximity to other vegetated areas, vegetation type and the level of protection and priority ranking for natural areas.

Each variable was assigned a value which contributed to the overall score of the park or natural area, which was then classified as being High, Medium or Low Risk of being affected by the threatening pathogens. The overall risk rating for the area will be utilised to develop a program for on ground sampling and investigations to determine the actual extent of pathogens within City parks and reserves.

Details of the criteria and associated values used to assess the level of risk for pathogens within parks and a natural area are provided in *Appendix 2.*

Results

The Pathogen Desktop Risk Analysis demonstrated that there were a total of 58 parks and natural areas which are classified as High Risk (Priority 1), 210 parks and natural areas were classified as Medium Risk (Priority 2), and 112 parks were listed as Low Risk (Priority 3), as illustrated in *Figure 5* and *Figure 6*.

Parks and natural areas within the High Risk (Priority 1) category should be given priority in regard to undertaking further on ground investigations and the implementation of pathogen management actions as these areas are at most risk of being affected by *Phytophthora* or/and *Armillaria* species.

A full list of the parks and natural areas for each of the Priority Areas for Phase 2 (Pathogen Mapping and Monitoring) is provided in *Appendix 3.* The Priority List and the associated values for each reserve will be utilised to inform the development of a Pathogen Interpretation and Mapping Project to establish the extent of pathogen infestation within the City.

Limitations of Desktop Study

It should be noted that the Pathogen Desktop Risk Analysis is based on the assessment of variables for the City's parks and natural areas using data sets provided by the City which includes profiles for individual vegetated areas as well as spatial information. As no on site investigations or ground truthing has been undertaken the Disease Risk for individual areas should only be used as a basis for prioritising areas for further investigations in order to establish the actual extent of threatening pathogens within individual parks and natural areas and for the prioritisation of the implementation of management actions.

The introduction of any species of *Phytophthora* or *Armillaria* into one or more City reserves poses a threat to the health and vitality of the vegetation present, and the long term impact of such an introduction on the native vegetation is unknown. It is therefore recommended that the precautionary principle should be adopted for the management of pathogens within all City parks and reserves.

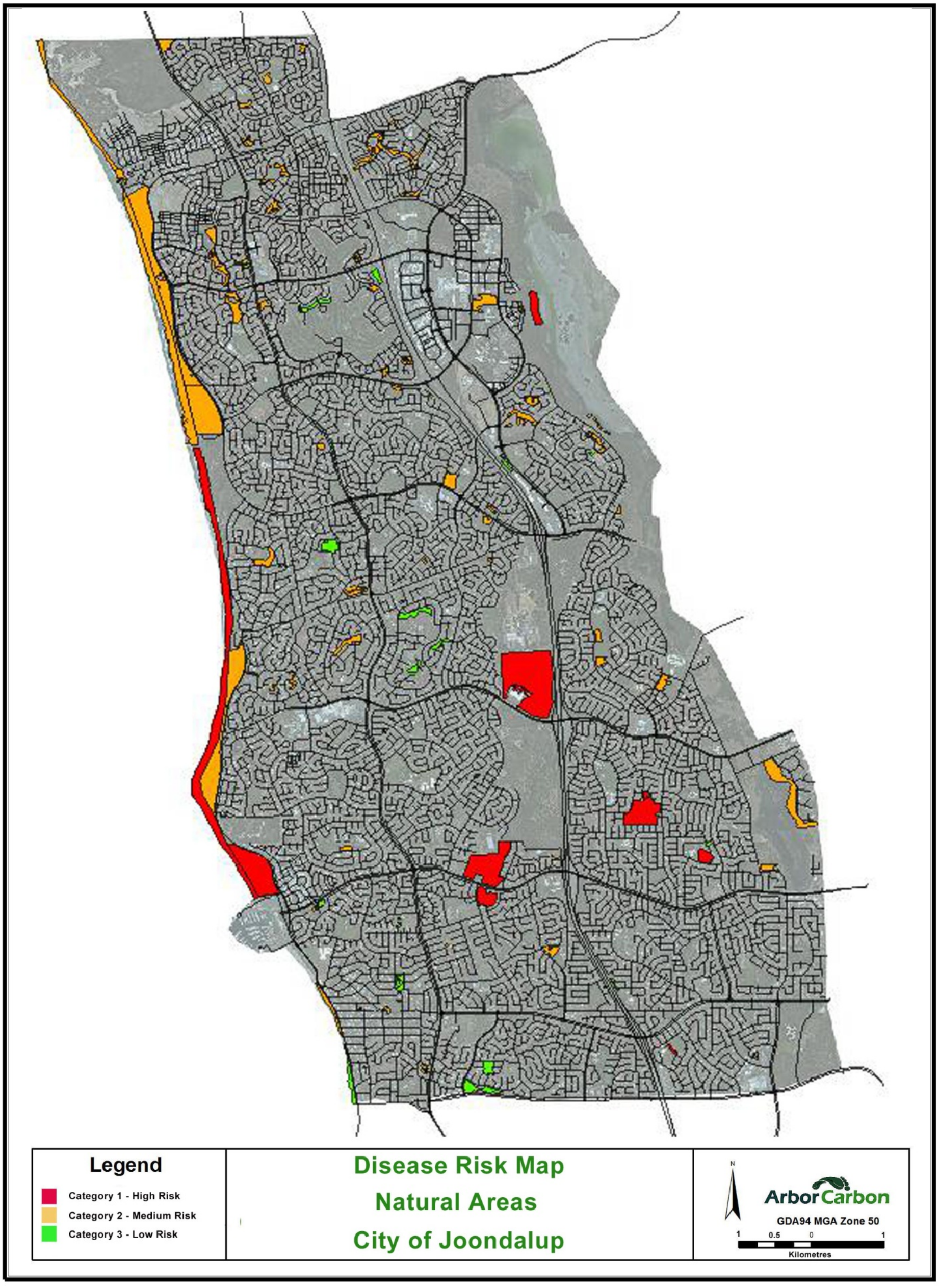


Figure 5- Pathogen Risk within City of Joondalup Natural Areas

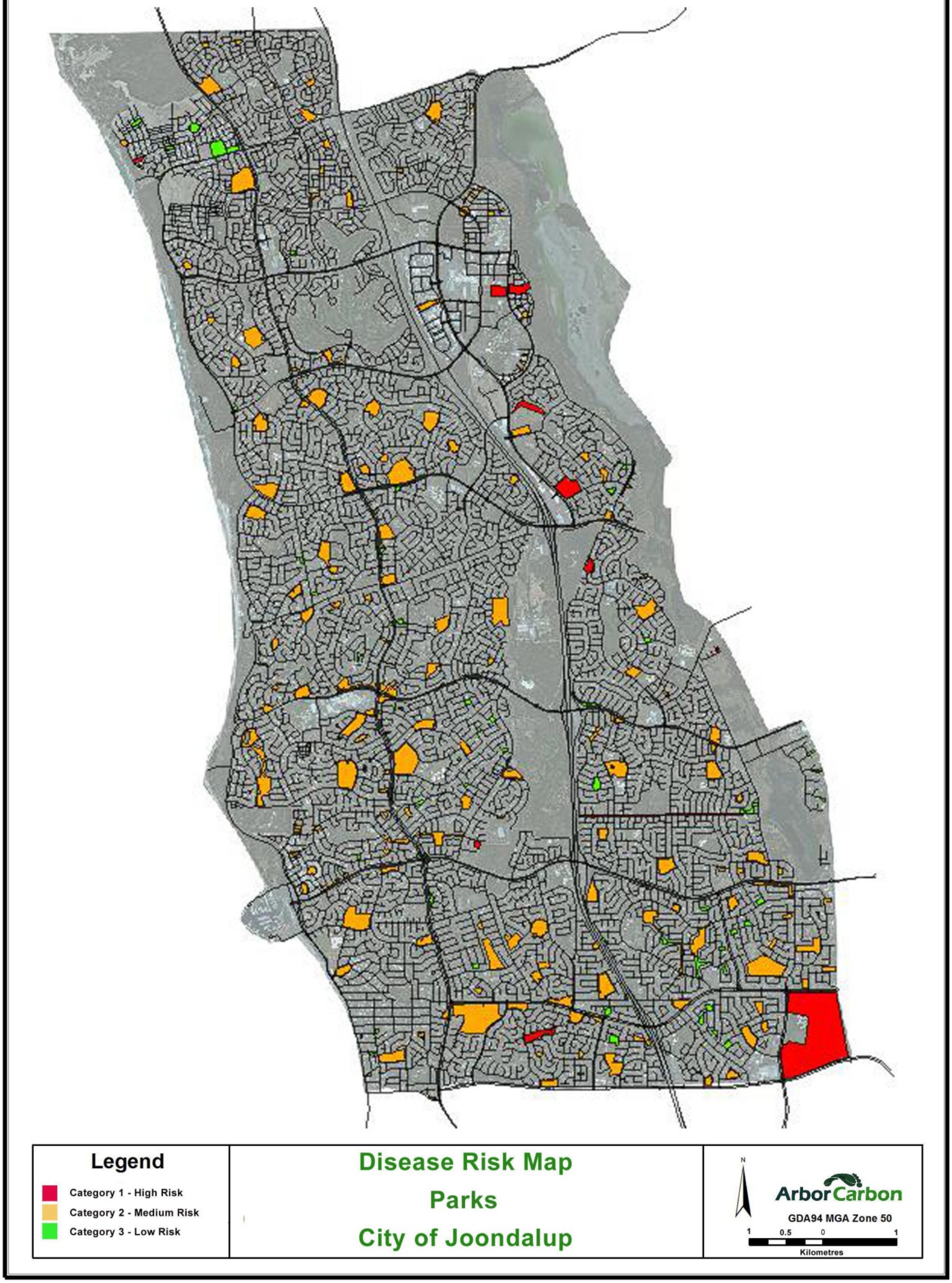


Figure 6- Pathogen Risk within City of Joondalup Parks

2.4 High Resolution Multi-Spectral Imagery

As part of the Pathogen Desktop Risk Analysis, the entire extent of the City of Joondalup was acquired with 0.5m resolution multi-spectral imagery. This involves aerial photography being acquired through a fly over of the area. The imagery is provided in a near-infrared spectral band that is sensitive to changes in chlorophyll and cell structure of vegetation and can be utilised to assess changes in the vigour and condition of trees and plants over a certain time period.

The imagery acquired provides baseline information on the City's vegetation and can be used to monitor the ongoing condition of the City's parks and natural areas to determine areas that are affected by pathogens by identifying declining health of the vegetation. Changes in condition are shown in shades of red, as seen in *Figure 7*. The imagery can also be a valuable tool in assessing improvement in vegetation vigour for parks and natural areas that have been confirmed as having pathogens present and have had treatment applied.

The multi-spectral imagery also has a number of applications other than for pathogen management. For example the imagery can be utilised to provide baseline information on the extent of the City's vegetation in terms of canopy cover and can be used to monitor the progress of rehabilitation or weed management within parks and natural areas.

It is recommended that the City acquires the high resolution multi-spectral imagery on a biennial basis to enable the ongoing monitoring of the condition of vegetation within the City.

Figure 7- Multi-spectral imagery applied to Granadilla Park.

3.0 Pathogen Management

At present there is no reliable mechanism for the complete eradication of *Phytophthora* species and the control of *Armillaria luteobubalina* is both expensive and labour intensive. Management strategies need to be developed to protect biodiversity values and minimise the spread of these pathogens within the City.

The aim of pathogen management is to:

- Protect biodiversity values within the City with a particular focus on the structure and function of susceptible ecosystems;
- Protect social and economic assets within City parks and natural areas;
- Minimise the spread of pathogens from infected areas to areas that are free from pathogens; and
- Raise community awareness of pathogens and the risk to environmental, social and economic values within the City of Joondalup.

Management strategies should be employed to reduce the spread of pathogens within the City, and initiatives developed to engage the community in order to raise the awareness of pathogen management within the City.

Protecting the biodiversity values of the City's significant bushland areas is a key objective of pathogen management, therefore priority for investigation and the implementation of management recommendations should be given to the City's Major Conservation Areas being:

- Lilburne Park;
- Warwick Open Space;
- Hepburn Conservation Area;
- Shepherd's Bush Park; and
- Craigie Open Space.

The following section provides details of the strategies that should be implemented over the life of the Pathogen Management Plan in order to effectively manage the threat of pathogens within the City of Joondalup.

3.1 Pathogen Interpretation and Mapping

Establishing the extent of Pathogens within the City is essential to minimising the spread of *Phytophthora* species and *Armillaria luteobubalina* within parks and natural areas. Whilst initial desktop investigations have been undertaken to inform the development of this Plan, as detailed in Section 2.3, further investigation is required to ascertain the actual extent of pathogens within the City.

Ground truthing and soil sampling involves site assessments of the park or natural area by a qualified consultant to survey the area for signs of pathogen infestation. Soil samples are also taken from the site which are analysed for the presence of pathogens.

Site investigations to determine the presence of pathogens will enable appropriate responses to effectively manage parks and natural areas where pathogens are confirmed to be present.

As ground truthing and soil sampling can be resource intensive it is recommended that a staged approach is taken to the on ground investigations. It is recommended that a schedule

for site investigations is established with parks and natural areas being assessed according to the assigned priority (commencing with Priority 1 reserves) as detailed in *Appendix 3.*

Once the program for onsite investigations of pathogens has commenced and results of analysis are available it is crucial that this information is communicated to relevant internal and external stakeholders to ensure management actions are applied within the park or natural area.

It is recommended that mapping and a spatial layer be established within the City's Geographic Information System (GIS) to provide information on the areas within the City that are known to have pathogens present.

Management Recommendation 1:

Using Reserve Priority Rankings establish a program for undertaking ground truthing and soil sampling at City parks and natural areas to determine the extent of pathogens within the City of Joondalup.

Management Recommendation 2:

Develop a spatial layer on the City's Geographic Information System (GIS) to provide information to City staff regarding areas of known pathogen infestation.

3.2 Bushland Management

Operational activities of managing bushland reserves have the potential to spread pathogens from one area to another. Pathogens can be spread in small quantities of soil, such as mud attached to tyres, tools or walking shoes.

In order to minimise the risk of spreading pathogens a number of factors should be considered when planning and carrying out bushland management activities. This includes timing of activities such as fire break maintenance, slashing and weeding during dry soil conditions. It is essential that soil movement is minimised and that any materials, tools and vehicles that are bought onto the site are free of pathogens.

Other activities undertaken by the City also risk introducing pathogens to a previously uninfected area, or increase its rate of spread, these include road and drain construction and maintenance. Major land developments, landscaping activities and earthworks which involve the importation or movement of soil and plant material pose significant threats for the introduction and spread of the pathogens throughout the City.

Clear and consistent guidance should be provided to staff, contractors and community groups that undertake bushland management activities within vegetated areas of the City in order to minimise the spread of pathogens and prevent new infestations.

Management Recommendation 3:

Develop and implement a City of Joondalup Bushland Management Manual to provide staff, contractors and community groups with guidance for activities undertaken within parks and natural areas that can increase the spread of pathogens.

3.3 Hygiene Measures

Whether or not pathogens have been identified within a reserve, it is necessary to manage vegetated areas for *Phytophthora* and *Armillaria* in order to prevent its introduction to, or spread within parks and natural areas. Hygiene and quarantine measures are essential to managing pathogens as prevention is much more effective and economical than controlling a pathogen once it is established within a site. The movement of soil and plant parts, such as in plant based mulch from one site to another should be avoided unless it has been confirmed as pathogen free.

Tools, machinery, vehicles and boots should be cleaned of soil after being used within areas of known or suspected infestation. City officers and contractors should also avoid working within infested sites during or immediately after rain or irrigation.

Fire management can also contribute to the introduction and spread of pathogens. Fire prevention activities, such as firebreak construction, can spread infested soil. The Implementation of hygiene procedures when undertaking fire management activities can lead to increased protection of natural areas.

The supply of plant stock, soil and mulch that contains pathogens is one of the most common ways that pathogens such as *Phytophthora* and *Armillaria luteobubalina* establish within an area. It is recommended that the City only purchases plant stock from nurseries accredited under the Nursery Industry Accreditation Scheme Australia (NIASA) and that mulch, soil and gravel supplied for landscaping activities is pathogen free.

Modification of operations that have a high risk of introducing or spreading *Phytophthora* and *Armillaria* is also required, particularly when these operations are to occur at sites in or adjacent to areas of high conservation value. The development of guidelines and procedures outlining hygiene measures for City staff, contractors and community groups using City parks and natural areas is essential to controlling the spread of pathogen within the City.

The provisions within the City's Hygiene Guidelines and Management Procedures may also be applicable to the control of other plant diseases within the City including Sting Nematodes.

Management Recommendation 4:

Develop and implement Pathogen Hygiene Guidelines and Management Procedures to provide direction to staff and contractors working within the City's parks and natural areas in order to limit the spread of pathogens within the City of Joondalup.

Management Recommendation 5:

Develop and implement Purchasing Guidelines for the Supply of Landscaping Materials to provide information to City staff, contractors and community groups with information relating to the purchase of pathogen free plant stock, soil and mulch for City parks and natural areas.

3.4 Access

Many of the City's parks and natural areas have unrestricted access and are often traversed by numerous tracks and paths, increasing the likelihood of pathogens being introduced or spread in the area.

Vehicle access for City parks and natural areas should be restricted, particularly for areas that are known or suspected as having pathogens present. Visitors should always use tracks and pathways and avoid passing through vegetated areas. Tracks and pathways should be well maintained and have effective drainage. The establishment of new tracks within areas of known infestation should be avoided.

Quarantine measures should be adopted for areas that are known or suspected of being infected by *Phytophthora* or *Armillaria.* Access to these areas by City staff, contractors and the community should be restricted with signage being placed at the entrance of the site explaining the disease status of the park or natural area. Signage should also provide information on how visitors can minimise the spread of the disease within the area.

For high risks areas or areas where Pathogens are known or suspected, cleaning stations should be installed to ensure that footwear, vehicles and tools are free of soil when entering and exiting infected parks or natural areas.

Management Recommendation 6:

Develop a Visitors Guide for City staff, contractors and community groups to provide information regarding access to City parks and natural areas that are known or suspected of having pathogens present.

Management Recommendation 7:

Establish cleaning stations and informational signage at the entrance of designated priority City parks and natural areas.

3.5 Signage

Communicating the disease status of an area to visitors is an important part of preventing and managing the spread of pathogens. In order to provide a consistent approach to signage within the City it is proposed that the *Western Australian Dieback Signage System* is adopted for use within parks and natural areas. The Signage System was developed by the State Government in partnership with key industry groups as part of a state wide Communication Plan that aims to provide consistent and relevant themes and messages in relation to the management of Phytophthora Dieback within Western Australia.

Figure 8- Signage System Disease Status Symbols

The Signage System contains a range of signs that can be used depending on the management objectives of the area. The different signs that make up the Signage System are detailed in the *Western Australian Dieback Signage Protocol*, which is included in *Appendix 4*. The signage utilises a standard set of symbols as illustrated in *Figure 8.*

Priority for the establishment of signage should be given to the City's Major Conservation Areas. Following assessment of a natural area by a qualified consultant, the disease status of the area will then be identified as either:

- Pathogen Free
- Pathogen Infested
- Pathogen Unknown

The Signage System also provides information to visitors to assist in minimising the spread of pathogens. Typically signage would be placed at the entrances of the park or natural area with markers being used along paths and tracks, as illustrated in *Figure 9*.

It is proposed that the term *Pathogen* be used in place of *Dieback* for signage within the City of Joondalup in order to address all four species of *Phytophthora* as well as *Armillaria luteobubalina* in accordance with the objectives of the *Pathogen Management Plan*.

Management Recommendation 8:

Following site assessment and establishment of the disease status implement the Western Australian Dieback Signage System within designated priority City of Joondalup parks and natural areas.

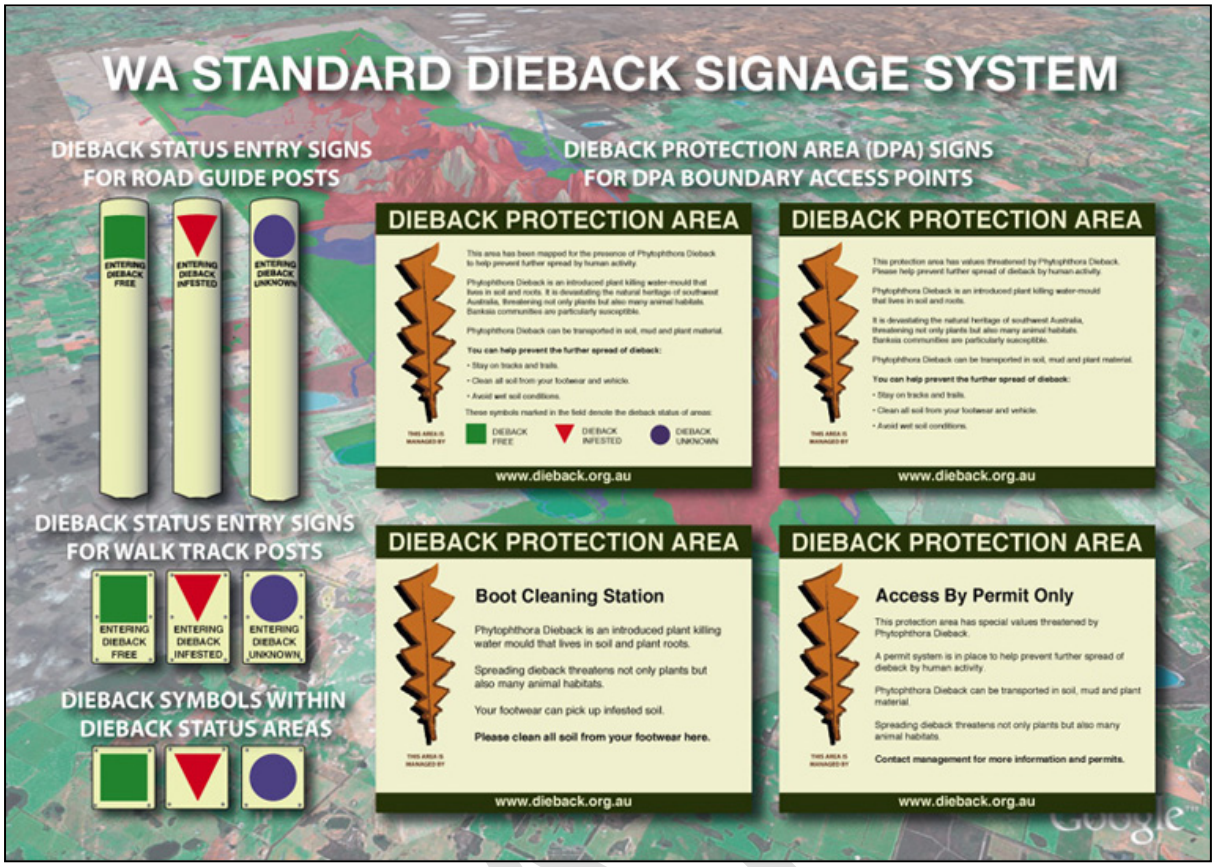


Figure 9- Western Australian Dieback Signage System

3.6 Communication and Education

Raising the awareness of pathogens within the City of Joondalup is critical to minimising the introduction and spread of disease within vegetated areas of the City. In order to provide ongoing and consistent messages to the community regarding the importance of pathogen management an awareness campaign will be developed and implemented as part of the City's Think Green – Environmental Education Program.

The objectives of the awareness campaign will be to:

- Increase the level of awareness of pathogen management within the community;
- Identify attitudes and behaviours of community members; and
- Develop and implement communication tools that are effective in encouraging measurable changes in behaviour regarding pathogen management within City parks and natural areas.

The campaign will provide information on what pathogens are, how they can be spread and ways of managing the diseases. The program will target the general community, environment groups and schools.

Training of City parks and natural areas staff and members of local environment groups that work within vegetated areas will assist to reduce the risk of introducing and spreading pathogens within the City.

Regular training will ensure that staff and community members are kept up to date with industry developments regarding pathogen management and will include topics such as:

- Communicating outcomes of monitoring programs;
- Hygiene and cleaning requirements;
- Quarantine measures; and
- Treatment options.

Management Recommendation 9:

As part of the City's Think Green Environmental Education Program, develop and implement initiatives that raise the awareness of pathogen management within the community.

Management Recommendation 10:

Ensure City staff and community groups who work within City parks and natural areas undertake relevant training to increase awareness of pathogen control measures.

3.7 Partnerships

Keeping up to date with developments in the area of pathogen management will ensure that the City is implementing best practices approaches to the management of *Phytophthora* and *Armillaria* species. There are a number of research and working groups within Western Australia that focus on building the capacity of land managers to effectively address pathogens, including the Dieback Information Group and Centre for Phytophthora Science & Management at Murdoch University. The City should actively partner with these organisations to participate in research projects and take up opportunities for sharing information related to best practice approaches to the management of pathogen species.

Management Recommendation 11:

Investigate opportunities to partner with industry groups and research institutions to enable the City to build capacity and gain information relating to best practice approaches to pathogen management.

3.8 Treatment

Once on site investigations have determined that pathogens are present within a park or natural area treatment options should be investigated. Treatment may include removal of infected parts of the specimen and chemical treatments such as Phosphite.

Phosphite (Phosphonate) is a biodegradable, inexpensive chemical that is systemically transmitted throughout treated plants and has a very low toxicity to animals. Whilst Phosphite does not kill the pathogen, it acts as a booster to native plants enabling them to fight off the pathogen for a significantly longer period of time. Phosphite can be applied ahead of an advancing *Phytophthora* front to form a protective barrier. It can also be applied in an already infested area to protect susceptible plants that have not yet been infected.

Phosphite needs to enter a plant's water transport system in order for it to be effective. This can be done by injecting phosphite directly into the trunk (or roots) of trees, or spraying the leaves of plants.

It is important to note that there is no chemical that will eradicate *Phytophthora* species and *Armillaria luteobubalina.* However, an integrated approach can successfully control the spread and impact of the diseases. An integrated approach may combine strategic chemical treatment, controlling access, maximising drainage and implementing hygiene and quarantine measures.

As treatment options for *Phytophthora* species and *Armillaria luteobubalina* are both expensive and labour intensive, preventing the introduction of the diseases into vegetated areas is the main objective of pathogen management.

Management Recommendation 12:

Apply appropriate treatment options for parks and natural areas that have been confirmed to have pathogens present. Investigate and trial newly developed treatment options to determine the best approach to treating pathogens within the City.

3.9 Monitoring and Reporting

Ongoing monitoring of City parks and natural areas is critical to ensuring the long term management of biodiversity within the City of Joondalup. Regular monitoring of vegetated areas ensures the early detection of new infestations and enables management actions to be assessed in terms of effectiveness in minimising the spread of the disease.

Effective monitoring of large areas of vegetation can be resource and time intensive; however a number of tools are available which can assist in assessing vegetated areas for the signs of pathogen infestation such as high resolution multi-spectral imagery, as discussed in *Section 2.4.*

It is recommended that the City acquires high resolution multi-spectral imagery of parks and natural areas every two years and undertakes analysis to identify changes in the condition of native vegetation in order to identify areas that are potentially affected by pathogens or other diseases.

It is also important to re-survey areas that have been confirmed as having pathogens present every 1-2 years by undertaking field assessments to determine disease movement and new outbreaks. Criteria for identifying signs of pathogens within vegetated areas should be included into a checklist document and provided to City staff to utilise during regular inspections of parks and natural areas to assist with the early detection of newly established pathogen infestations.

Management Recommendation 13:

Acquire and analyse high resolution multi-spectral imagery of parks and natural areas every two years in order to identify changes in vegetation condition in order to identify areas that are potentially affected by pathogens.

Management Recommendation 14:

Develop and implement a Pathogen Identification Checklist to assist City staff to identify signs of pathogen infestation within vegetated areas.

4.0 Management Plan Review

The City of Joondalup Pathogen Management Plan will be reviewed and reported on an annual basis to track the progress of the implementation of recommended management actions.

A major review will be undertaken in 2016/17 in order to ensure that the City is managing pathogens in accordance with best practice approaches.

5.0 Implementation Plan

Note: Items within the Implementation Plan such as cleaning stations, signage and treatment will be implemented in parks and natural areas on an as needs basis and after determination of the disease status of the area has been determined. This will be achieved through the Pathogen Mapping and Sampling Project. Budget amounts are estimates only and will require review prior to the year of implementation.

Management Recommendation (Project)	Management Action	Responsible Business Unit	Timeframe	Proposed Budget
Pathogen Mapping and Sampling Project	Establish a program for undertaking ground truthing and soil sampling at City parks and natural areas to determine the extent of pathogens within the City of Joondalup.	Strategic and Organisational Development	2012/13	Operational
	Engage consultants to implement the program for ground truthing and soil sampling at Priority 1 areas to identify the extent of pathogens at City parks and natural areas.	Strategic and Organisational Development	2013/14-2014/15	$125,000 (Consultancy Fees)
	Engage consultants to implement the program for ground truthing and soil sampling at Priority 2 areas to identify the extent of pathogens at City parks and natural areas.	Strategic and Organisational Development	2014/15-2015/16	$125,000 (Consultancy Fees)
	Develop a spatial layer on the City's Geographic Information System (GIS) to provide information to City staff regarding areas of known pathogen infestation.	IT Services	2013/14-2015/16	Operational
City of Joondalup Bushland Management Manual	Develop a City of Joondalup Bushland Management Manual to provide staff, contractors and community groups with guidance for activities undertaken within parks and natural areas that can increase the spread of pathogens.	Strategic and Organisational Development	2013/14	Operational
	Implement the City of Joondalup Bushland Management Manual.	Operation Services	2013/14	Operational

Management Recommendation (Project)	Management Action	Responsible Business Unit	Timeframe	Proposed Budget
City of Joondalup Pathogen Management Guidelines	Develop and implement Pathogen Hygiene Guidelines, Management Procedures and Purchasing Guidelines to provide direction to staff and contractors working within the City's parks and natural areas in order to limit the spread of pathogens within the City of Joondalup.	Strategic and Organisational Development	2012/13-2013/14	Operational
Landscaping Supplies Purchasing Guidelines	Develop and implement Purchasing Guidelines to provide information to City staff, contractors and community groups with information relating to the purchase of pathogen free plant stock, soil and mulch for City parks and natural areas.	Operation Services	2013/14	Operational
City of Joondalup Parks and Natural Areas Visitors Guide	Develop a Visitors Guide for City staff, contractors and community groups to provide information regarding access to City parks and natural areas that are known or suspected of having pathogens present.	Operation Services	2013/14-2014/15	$5,000 (External Printing)
Pathogen Control Stations	Establish vehicle and boot cleaning stations at the entrances / exits of designated priority City parks and natural areas.	Operation Services	2013/14-2016/17	$3500 (per vehicle cleaning station) $1500 (per Phyto 1000 boot cleaning station)
Pathogen Signage Project	Following site assessment and establishment of the disease status implement the Western Australian Dieback Signage System within designated priority parks and natural areas.	Operation Services	2013/14-2016/17	$5000 per area for complete signage system
Think Green - Environmental Education Program	As part of the City's Think Green Education Program, develop and implement initiatives that raise the awareness of pathogen management within the community.	Strategic and Organisational Development	2013/14-2016/17	$2,000 per year (Program Activities)

Management Recommendation (Project)	Management Action	Responsible Business Unit	Timeframe	Proposed Budget
Pathogen Training Program	Develop and implement a program for City staff who work within City parks and natural areas to undertake relevant training to raise the awareness of pathogens and management practices that should be employed within parks and natural areas.	Operation Services	2012/13-2016/17	$260 per employee per training session
	Develop and implement a program for City of Joondalup Friends Groups to raise the awareness of pathogens and management practices that should be employed within parks and natural areas.	Operation Services	2013/14-2016/17	$150 per volunteer per training session
Pathogen Treatment Program	Apply appropriate treatment options for parks and natural areas that have been confirmed to have pathogens present. Investigate and trial newly developed treatment options to determine the best approach to treating pathogens within the City.	Operation Services	2012/13-2016/17	$100 per treatment of Phosphite per tree
Pathogen Research Partnerships	Investigate opportunities to partner with industry groups and research institutions to enable the City to build capacity and gain information relating to best practice approaches to pathogen management.	Strategic and Organisational Development	2012/13-2016/17	Operational
High Resolution Multi-Spectral Imagery	Acquire and analyse high resolution multi-spectral imagery of parks and natural areas every two years in order to identify changes in vegetation condition in order to identify areas that are potentially affected by pathogens.	Strategic and Organisational Development	2014/15 2016/17	$30,000 (imagery and analysis)
Pathogen Identification Checklist	Develop and implement a Pathogen Identification Checklist to assist City staff to identify signs of pathogen infestation within vegetated areas.	Operation Services	2012/13-2016/17	Operational

6.0 References

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7.0 Appendices

Appendix 1 – Sites included in Pathogen Risk Assessment Study

Appendix 2 – Pathogen Desktop Risk Assessment Criteria

Appendix 3 – Priority List of Parks and Natural Areas for Pathogen Mapping and Monitoring

Appendix 4 – Western Australian Dieback Signage Protocol

Appendix 1 – List of Sites within Study Area

Site Name	Address	Suburb
Alidade Park	Alidade Way	Beldon
Beldon Park	Gradient Way	Beldon
Cumberland Park	Cumberland Way	Beldon
Ensign Park	Ensign Way	Beldon
Gradient Park	Gradient Way	Beldon
Haddington Park	Haddington Street	Beldon
Monument Park	Monument Drive	Beldon
Sandalford Park	Sandalford Drive	Beldon
Beachside Park	Beachside Drive	Burns Beach
Bramston Park	Bramston Vista	Burns Beach
Burns Beach Park	Ocean Parade	Burns Beach
Burns Park	Ocean Parade	Burns Beach
Coastal Foreshore Reserve Burns Beach		Burns Beach
Huxley Park	Huxleys Trail	Burns Beach
Southport Park	Southport Loop	Burns Beach
Third Park	Third Avenue	Burns Beach
Windmill Park	Windmill Circle	Burns Beach
Baltusrol Park	Baltusrol Rise	Connolly
Bonnie Doon Park	Bonnie Doon Gardens	Connolly
Carnaby Reserve	Medinah Mews	Connolly
Cinque Ports Park	Cinque Ports Place	Connolly
Fairway Park	Fairway Circle	Connolly
Huntingdale Park	Huntingdale Crescent	Connolly
Pine Valley Park	Pine Valley Pass	Connolly
St Michael's Park	St Michael'S Avenue	Connolly
Adelaide Park	Adelaide Circle	Craigie
Albion Park	Camberwarra Drive	Craigie
Barwon Park	Barwon Road	Craigie
Camberwarra Park	Camberwarra Drive	Craigie
Cawarra Park	Cawarra Crescent	Craigie
Chadstone Park	Chadstone Road	Craigie
Craigie Open Space	Whitfords Avenue	Craigie
Craigie Park	Barradine Way	Craigie
Madana Park	Madana Place	Craigie
Mandalay Park	Mandalay Place	Craigie
Otago Park	Camberwarra Drive	Craigie
Otway Park	Camberwarra Drive	Craigie
Warrandyte Park	Warrandyte Drive	Craigie
Whitfords East Park	Rosette Close	Craigie
Caledonia Park	Caledonia Avenue	Currambine
Carlton Park	Carlton Turn	Currambine
Christchurch Park	Christchurch Terrace	Currambine

Site Name	Address	Suburb
Clermont Park	Caledonia Avenue	Currambine
De Crillon Park	De Crillon Way	Currambine
Doncaster Park	Doncaster Square	Currambine
Fairmont Park	Fairmont Place	Currambine
Negresco Park	Negresco Turn	Currambine
Riversdale Park	Riversdale Gardens	Currambine
Santa Ana Park	Aberfoyle Heights	Currambine
Alder Park	Alder Way	Duncraig
Alfreton Park	Alfreton Way	Duncraig
Bracken Park	Bracken Court	Duncraig
Buckthorn Park	Buckthorn Way	Duncraig
Castlefern Park	Castlefern Way	Duncraig
Coolibah Park	Coolibah Place	Duncraig
Galston Park	Galston Place	Duncraig
Geddes Park	Geddes Close	Duncraig
Glenbar Park	Glenbar Road	Duncraig
Glengarry Park	Merrick Way	Duncraig
Granadilla Park	Langholm Place	Duncraig
Greenlaw Park	Greenlaw Street	Duncraig
Hilton Park	Hilton Place	Duncraig
Juniper Park	Juniper Way	Duncraig
Kelvin Park	Campion Street	Duncraig
Lanark Park	Lanark Mews	Duncraig
Lilburne Park	Lilburne Road	Duncraig
Macaulay Park	Macaulay Avenue	Duncraig
Marri Park	Marri Road	Duncraig
Melene Park	Melene Road	Duncraig
Noel Gannon Park	Lennoxtown Road	Duncraig
Oakapple Park	Oakapple Drive	Duncraig
Pentland Park	Pentland Avenue	Duncraig
Percy Doyle Reserve	Warwick Road	Duncraig
Portree Park	Portree Way	Duncraig
Poynter Park	Poynter Drive	Duncraig
Salata Park	Salata Place	Duncraig
Sycamore Park	Scaddan Street	Duncraig
Telopia Park	Telopia Drive	Duncraig
Trigonometric Park	Truslove Way	Duncraig
Wanbrow Park	Wanbrow Way	Duncraig
Wandina Park	Wandina Place	Duncraig
Beaumont Park	Beaumont Way	Edgewater
Edgewater Park	Edgewater Drive	Edgewater
Emerald Park	Emerald Way	Edgewater
Garrong Park	Garrong Close	Edgewater
Hilltop Park	Hilltop Place	Edgewater
Lakevalley Park	Lakevalley Drive	Edgewater

Site Name	Address	Suburb
Lakeview Park	Lakeview Drive	Edgewater
Lookout Park	Quarry Ramble	Edgewater
Okely Park	Joondalup Drive	Edgewater
Picnic Cove Park	Edgewater Drive	Edgewater
Quarry Park	Joondalup Drive	Edgewater
Quarry Ramble Park	Quary Ramble	Edgewater
Ridge Park	Ridge Close	Edgewater
St Clair Park	Joondalup Drive	Edgewater
Stillwater Park	Reflection Close	Edgewater
Tuart Park	Tuart Trail	Edgewater
Wedgewood Park	Wedgewood Drive	Edgewater
Annato Park	Annato Street	Greenwood
Birch Park	Birch Place	Greenwood
Blackall Park	Blackall Drive	Greenwood
Blackthorn Park	Blackthorn Road	Greenwood
Calectasia Park	Calectasia Street	Greenwood
Cockman Park	Cockman Road	Greenwood
Filbert Park	Filbert Street	Greenwood
George Sears Park	Wanneroo Road	Greenwood
Gerda Park	Gerda Court	Greenwood
Hartley Park	Hartley Court	Greenwood
Kanangra Park	Kanangra Crescent	Greenwood
Karuah Park	Karuah Way	Greenwood
Kilrenny Park	Gilmerton Way	Greenwood
Kurrajong Park	Kurrajong Place	Greenwood
Leaside Park	Leaside Way	Greenwood
Mamo Park	Mamo Place	Greenwood
Oleaster Park	Oleaster Way	Greenwood
Parin Park	Canham Way	Greenwood
Paveta Park	Paveta Court	Greenwood
Penistone Park	Penistone Street	Greenwood
Rodgers Park	Rodgers Street	Greenwood
Sheoak Park	Tuart Road	Greenwood
Sherington Park	Sherington Road	Greenwood
Strathaven Park	Strathaven Crescent	Greenwood
Warrigal Park	Madrona Crescent	Greenwood
Abrolhos Park	Abrolhos Drive	Heathridge
Admiral Park	Admiral Grove	Heathridge
Balanus Park	Balanus Way	Heathridge
Conidae Park	Conidae Drive	Heathridge
Faversham Park	Faversham Way	Heathridge
Heathridge Park	Sail Terrace	Heathridge
Larkspur Park	Larkspur Place	Heathridge
Littorina Park	Littorina Avenue	Heathridge
Lysander Park	Lysander Drive	Heathridge

Site Name	Address	Suburb
Poseidon Park	Poseidon Road	Heathridge
Prince Regent Park	Prince Regent Drive	Heathridge
Banks Park	Banks Avenue	Hillarys
Broadbeach Park	Broadbeach Boulevard	Hillarys
Conica Park	Conica Crescent	Hillarys
Fenton Park	Fenton Way	Hillarys
Flinders Park	Centennial Gardens	Hillarys
Gleddon Park	Gleddon Way	Hillarys
Harbour View Park	Azzuro Crescent	Hillarys
Harcourt Park	Harcourt Drive	Hillarys
Hillarys Park	Absolon Way	Hillarys
James Cook Park	Banks Avenue	Hillarys
Leeward Park	Leeward Chase	Hillarys
Lymburner Park	Lymburner Drive	Hillarys
Maquire Park	Maquire Road	Hillarys
Marbella Park	Mallorca Avenue	Hillarys
Mawson Park	Mawson Crescent	Hillarys
Nash Park	Nash Street	Hillarys
Nimrod Park	Nimrod Place	Hillarys
Ninnis Park	Ninnis Place South	Hillarys
Oahu Park	Oahu Gardens	Hillarys
Orient Park	Orient Circuit	Hillarys
Parkinson Park	Parkinson Place	Hillarys
Pinnaroo Point	Whitfords Avenue	Hillarys
Scott Park	Webb Place	Hillarys
Whitford Nodes Central	Whitfords Avenue	Hillarys
Whitford Nodes South	Whitfords Avenue	Hillarys
Whitford Nodes South	Whitfords Avenue	Hillarys
Bethany Park	Bethany Gardens	Iluka
Coastal Foreshore Reserve Iluka	Burns Beach Road	Iluka
Discovery Park	Discovery Circuit	Iluka
Iluka District Open Space	Miami Beach Promenade	Iluka
Iluka Foreshore Reserve	Ocean Reef Road	Iluka
Kuta Park	Kuta Circuit	Iluka
Naturaliste Park	Naturaliste Boulevard	Iluka
Sir James McCusker Park	Silver Sands Drive	Iluka
Albright Park	Cornell Parade	Joondalup
Aldgate Park	Aldgate Street	Joondalup
Blue Lake Park	Blue Mountain Drive	Joondalup
Candlewood Park	Candlewood Boulevard	Joondalup
Central Park	Grand Boulevard	Joondalup
Charing Cross Park	Charing Cross Road	Joondalup
Elcar Park	Elcar Lane	Joondalup

Site Name	Address	Suburb
Embankment Park	The Embankment	Joondalup
Greenshank Park	Cockatoo Ridge	Joondalup
Katrine Park	Katrine Crescent	Joondalup
Lady Evelyn Park	Lady Evelyn Retreat	Joondalup
Lakeside Park	Waterbird Turn	Joondalup
Manapouri Park	Manapouri Meander	Joondalup
Nanika Park	Nanika Crescent	Joondalup
Neil Hawkins Park	Boas Avenue	Joondalup
Piccadilly Park	Piccadilly Circle	Joondalup
Portwood Park	Cornell Parade	Joondalup
Queensbury Park	Queensbury Road	Joondalup
Regents Park	Regents Park Road	Joondalup
Sittella Park	Sittella Turn	Joondalup
Stilt Park	Cockatoo Ridge	Joondalup
Thornbill Park	Thornbill Meander	Joondalup
Walsh Park	Joondalup Drive	Joondalup
Water Tower Park	Moondarra Way	Joondalup
Wesley Park	Cornell Parade	Joondalup
Windermere Park	Candlewood Boulevard	Joondalup
Woodlea Park	Woodlea Crescent	Joondalup
Aristride Park	Aristride Avenue	Kallaroo
Belrose Park	Belrose Entrance	Kallaroo
Bridgewater Park	Bridgewater Drive	Kallaroo
Castlecrag Park	Castlecrag Drive	Kallaroo
Culwalla Park	Culwalla Close	Kallaroo
Dampier Park	Dampier Avenue	Kallaroo
Delaware Park	Delaware Place	Kallaroo
Glenbank Park	Awhina Place	Kallaroo
Kiernan Park	Kiernan Place	Kallaroo
Kilarney Park	Kilarney Heights	Kallaroo
Maritana Park	Maritana Road	Kallaroo
Merrifield Park	Northshore Drive	Kallaroo
Montague Park	Montague Way	Kallaroo
Stanford Park	Stanford Road	Kallaroo
Whitford Nodes North	Northshore Drive	Kallaroo
Whitfords West Park	Marmion Avenue	Kallaroo
Barridale Park	Barridale Drive	Kingsley
Bindaree Park	Bindaree Terrace	Kingsley
Cadogan Park	Cadogan Street	Kingsley
Calthorpe Park	Calthorpe Place	Kingsley
Chelsea Park	Chelsea Court	Kingsley
Dollis Park	Dollis Way	Kingsley
Forest Hill Park	Kingsley Drive	Kingsley

Site Name	Address	Suburb
Greenwich Park	Greenwich Court	Kingsley
Illawong Park	Illawong Way	Kingsley
Kingfisher Park	Kingfisher Way	Kingsley
Kingsley Park	Kingsley Drive	Kingsley
Legana Park	Legana Avenue	Kingsley
Lehmann Park	Lehmann Court	Kingsley
Moolanda Park	Moolanda Boulevard	Kingsley
Newham Park	Newham Way	Kingsley
Plover Park	Plover Way	Kingsley
Robertson Road Cycleway	Barridale Drive	Kingsley
Shepherds Bush Park	Shepherds Bush Drive	Kingsley
Spoonbill Park	Spoonbill Grove	Kingsley
Talbot Park	Talbot Drive	Kingsley
Wallangarra Park	Wallangarra Court	Kingsley
Callander Park	Callander Avenue	Kinross
Cranston Park	Cranston Loop	Kinross
Earlsferry Park	Earlsferry Green	Kinross
Falkland Park	Falkland Way	Kinross
MacNaughton Park	Macnaughton Cresecent	Kinross
Menteith Park	Selkirk Drive	Kinross
Roxburgh Park	Roxburgh Circle	Kinross
Rutherglen Park	Rutherglen Circle	Kinross
Stonehaven Park	Stonehaven Parade	Kinross
Stow Park	Stow Lane	Kinross
Thornton Park	Thornton Retreat	Kinross
Banksia Park	Banksia Dale	Marmion
Braden Park	Braden Way	Marmion
Cliff Park	Cliff Street	Marmion
Clifford Coleman Park	Troy Avenue	Marmion
Cliverton Park	Cliverton Court	Marmion
Coastal Foreshore Reserve Marmion	West Coast Drive	Marmion
Finney Park	Finney Crescent	Marmion
Keppell Park	Keppell Road	Marmion
Magpie Reserve	Ozone Road	Marmion
McKirdy Park	Mckirdy Way	Marmion
Anemone Park	Anemone Way	Mullaloo
Blackboy Park	Balga Way	Mullaloo
Charonia Park	Charonia Road	Mullaloo
Gunida Park	Gunida Way	Mullaloo
Kallaroo Park	Kallaroo Place	Mullaloo
Korella Park	Korella Street	Mullaloo
Periwinkle Park	Periwinkle Road	Mullaloo
Tom Simpson Park	Oceanside Promenade	Mullaloo
Triton Park	Triton Place	Mullaloo

Site Name	Address	Suburb
Waltham Park	Waltham Street	Mullaloo
Wolinski Park	Key West Drive	Mullaloo
Beaumaris Park	Beaumaris Boulevard	Ocean Reef
Herreshoff Park	Herreshoff Ramble	Ocean Reef
Lexcen Park	Venturi Drive	Ocean Reef
Mirror Park	Mirror Place	Ocean Reef
Ocean Reef Park	Marina Boulevard	Ocean Reef
Southern Cross Park	Souther Cross Circle	Ocean Reef
Tarolinta Park	Tarolinta Gardens	Ocean Reef
Trig Point Park	Shoran Court	Ocean Reef
Bannister Park	Bannister Road	Padbury
Barclay Park	Barclay Avenue	Padbury
Brazier Park	Brazier Rise	Padbury
Brisbane Park	Brisbane Drive	Padbury
Byrne Park	Byrne Close	Padbury
Cunningham Park	Cunningham Place	Padbury
Fernwood Park	Fernwood Square	Padbury
Forrest Park	Forrest Road	Padbury
Fraser Park	Fraser Way	Padbury
Gibson Park	Gibson Avenue	Padbury
Hepburn Conservation Area	Hepburn Avenue	Padbury
Leichhardt Park No1	Leichhardt Avenue	Padbury
MacDonald Park	Macdonald Avenue	Padbury
McKinlay Park	Macarthur Avenue	Padbury
Mueller Park	Mueller Court	Padbury
Paterson Park	Paterson Place	Padbury
Simpson Park	Forrest Road	Padbury
Wentworth Park	Wentworth Way	Padbury
Newcombe Park	Newcombe Way	Padubry
Santiago Park	Santiago	Parkway
Albacore Park	Albacore Drive	Sorrento
Clare Park	Clare Street	Sorrento
Geneff Park	Padbury Circle	Sorrento
Hakea Park	Hakea Place	Sorrento
Harman Park	Harman Road	Sorrento
Lacepede Park	Lacepede Drive	Sorrento
Porteous Park	Porteous Road	Sorrento
Robin Park	Robin Avenue	Sorrento
Seacrest Park	Seacrest Drive	Sorrento
Sorrento Foreshore	West Coast Drive	Sorrento
Tom Walker Park	Sandpiper Street	Sorrento
Aberdare Park	Aberdare Way	Warwick
Carr Park	Carr Crescent	Warwick
Chelsford Park	Chelsford Road	Warwick

Site Name	Address	Suburb
Churton Park	Churton Crescent	Warwick
Circle Park	The Circle	Warwick
Ellersdale Park	Ellersdale Avenue	Warwick
Glenmere Park	Glenmere Road	Warwick
Hawker Park	Hawker Avenue	Warwick
Hillwood Park (North)	Hillwood Avenue	Warwick
Hillwood Park (South)	Hillwood Avenue	Warwick
Springvale Park	Springvale Drive	Warwick
Warwick Open Space	Beach Road	Warwick
Chichester Park	Trappers Drive	Woodvale
Cornish Park	Cornish Avenue	Woodvale
Delonix Park	Delonix Circle	Woodvale
Gascoyne Park	Gascoyne Avenue	Woodvale
McCubbin Park	Mccubbin Boulevard	Woodvale
Parkside Park	Parkside Ramble	Woodvale
Plumdale Park	Plumdale Way	Woodvale
Timbercrest Park	Trailwood Drive	Woodvale
Timberlane Park	Althaea Way	Woodvale
Trailwood Park	Trailwood Drive	Woodvale
Trappers Park	Trappers Drive	Woodvale
Waterview Park	Waterview Drive	Woodvale

Appendix 2 – Pathogen Desktop Risk Assessment Criteria

Parks Assessment- Part 1: Disease Risk

Variable	Calculation
Disease confirmed in or within a connected park	50
Disease suspected in or within a connected park	35
Disease not confirmed or suspected in or within a connected park	0
Connected to a Natural Area	25
Not connected to a Natural Area	0
Irrigated	10
Not irrigated	0

Table 1- The variables used and their associated values inserted into the calculation to determine the total risk value and ranking of Parks in order of risk of disease from the threatening pathogens.

An example of the calculation used for a typical park such Aberdare Park, which had no confirmation of disease or suspected disease in or within a connected park, is not connected to a Natural Area, and is irrigated, would be as follows:
0 + 0 + 10 = 10

Parks ranged in total values from 71 down to 0. The Disease Risks for the parks was determined using the above criteria and categorised as either:

- Risk category 1 (High) – greater than 10
- Risk category 2 (Medium) – 1 to 10
- Risk category 3 (Low) – 0

Parks Assessment- Part 2: Overall Risk and Prioritisation for Pathogen Monitoring and Mapping

Variable	Calculation
Disease Risk Category High	15
Disease Risk Category Medium	10
Disease Risk Category Low	5
Heddle Vegetation Complex	
Karrakatta complex central and south	4
Herdsman complex	3
Cottesloe complex central and south	2
Quindalup complex	1

Table 2- The variables used and their associated values inserted into the calculation to determine ranking of parks for overall risk and prioritisation of Phase 2 activities.

An example of the calculation used for a typical park such as Beachside Park, which had a Disease Risk ranking of medium, and is comprised of vegetation within the Quindalup, would be as follows:
10 + 1 = 11

Parks ranged in total values from 19 down to 5. The overall risk and priority for Phase 2 assessment (Pathogen Mapping and Monitoring) was determined using the above criteria and categorised as either:

- Priority 1 (High) – greater than 10
- Priority 2 (Medium) – 10
- Priority 3 (Low) – 5 to 9

Natural Areas Assessment- Part 1: Disease Risk

Variable	Calculation
Disease confirmed in or within a Natural Area	50
Disease suspected in or within a Natural Area	35
Disease not confirmed or suspected in or within a connected Natural Area/Park	0
Connected to a Bush Forever Park	1
Not connected to a Bush Forever Park	0
Connected to an irrigated park	1
Not connected to an irrigated park	0

Table 3- The variables used and their associated values inserted into the calculation to determine the total risk value and ranking of Natural Areas in order of risk of disease from the threatening pathogens.

An example of the calculation used for a typical Natural Area such Cadogan Park, which had no confirmation of disease but was suspected of having disease, is not connected to a Bush Forever site, and is not irrigated, would be as follows:
35 + 0 + 0 = 35

Natural Areas ranged in total values from 52 down to 0. The Disease Risks for the natural areas was determined using the above criteria and categorised as either:

- Risk category 1 (High) – > 34
- Risk category 2 (Medium) – 1 to 34
- Risk category 3 (Low) – 0

Natural Areas Assessment- Part 2: Overall Risk and Prioritisation for Pathogen Monitoring and Mapping

Variable	Calculation
Disease Risk Category High	150
Disease Risk Category Medium	100
Disease Risk Category Low	50
Heddle Vegetation Complex	
Karrakatta complex central and south	4
Herdsman complex	3
Cottesloe complex central and south	2
Quindalup complex	1
NAIA Priority Rank	100 minus rank value

Table 4- The variables used and their associated values inserted into the calculation to determine ranking of natural areas for overall risk and prioritisation of Phase 2 activities

An example of the calculation used for a typical Natural Area such as Craigie Open Space, which had a Disease Risk ranking of high, and is comprised of vegetation within the Karrakatta complex central and south, and a NAIA Priority ranking of 4 would be as follows:
150 + 4 + 96 = 250

Natural Areas ranged in total values from 250 down to 50. The overall risk and priority for Phase 2 assessment (Pathogen Mapping and Monitoring) was determined using the above criteria and categorised as either:

- Priority 1 (High) – > 149
- Priority 2 (Medium) – 100 to 149
- Priority 3 (Low) – 50 to 99

Appendix 3 – Overall Risk / Priority Listings for Parks and Natural Areas

Priority 1- Parks and Natural Areas

Name	Street	Suburb
Aberdare Park	Aberdare Way	Warwick
Baltusrol Park	Baltusrol Rise	Connolly
Beachside Park	Beachside Drive	Burns Beach
Beaumaris Park	Beaumaris Boulevard	Ocean Reef
Blackboy Park	Balga Way	Mullaloo
Blue Lake Park	Blue Mountain Drive	Joondalup
Bonnie Doon Park	Bonnie Doon Gardens	Connolly
Brazier Park	Brazier Rise	Padbury
Burns Beach Park	Ocean Parade	Burns Beach
Burns Beach Park	Ocean Parade	Burns Beach
Cadogan Park	Cadogan Street	Kingsley
Central Park	Lakeside Drive	Joondalup
Chichester Park	Trappers Drive	Woodvale
Clermont Park	Caledonia Avenue	Currambine
Craigie Open Space	Whitfords Avenue	Craigie
Cranston Park	Cranston Loop	Kinross
Emerald Park	Emerald Way	Edgewater
Fairway Park	Fairway Circle	Connolly
Fernwood Park	Fernwood Square	Padbury
Garrong Park	Garrong Close	Edgewater
Gibson Park	Gibson Avenue	Padbury
Granadilla Park	Granadilla Street	Duncraig
Greenshank Park	Cockatoo Ridge	Joondalup
Hawker Park	Hawker Avenue	Warwick
Hepburn Conservation Area	Hepburn Avenue	Padbury
Hillarys Park	Absolon Way	Hillarys
Juniper Park	Juniper Way	Duncraig
Lakeside Park	Waterbird Turn	Joondalup
Lakevalley Park	Lakevalley Drive	Edgewater

Name	Street	Suburb
Legana Park	Legana Avenue	Kingsley
Lexcen Park	Venturi Drive	Ocean Reef
Lilburne Park	Lilburne Road	Duncraig
Macnaughton Park	Macnaughton Cresecent	Kinross
Maritana Park	Maritana Road	Kallaroo
Merrifield Park	Northshore Drive	Kallaroo
Nanika Park	Nanika Crescent	Joondalup
Naturaliste Park	Naturaliste Boulevard	Iluka
Negresco Park	Negresco Turn	Currambine
Neil Hawkins Park	Boas Avenue	Joondalup
Plumdale Park	Plumdale Way	Woodvale
Quarry Park	Regatta Drive	Edgewater
Robertson Road Cycleway	Barridale Drive	Kingsley
Robin Park	Robin Avenue	Sorrento
Sandalford Park	Sandalford Drive	Beldon
Shepherds Bush Park	Shepherds Bush Drive	Kingsley
Sir James Mccusker Park	Silver Sands Drive	Iluka
St Clair Park	Joondalup Drive	Edgewater
St Michael's Park	St Michael's Avenue	Connolly
Third Park	Third Avenue	Burns Beach
Timberlane Park	Althaea Way	Woodvale
Tom Simpson Park	Oceanside Promenade	Mullaloo
Trappers Park	Trappers Drive	Woodvale
Warrandyte Park	Warrandyte Drive	Craigie
Warwick Open Space	Beach Road	Warwick
Waterview Park	Waterview Drive	Woodvale
Whitford Nodes South	Whitfords Avenue	Kallaroo

Priority 2- Parks and Natural Areas

Name	Street	Suburb
Abrolhos Park	Abrolhos Drive	Heathridge
Adelaide Park	Adelaide Circle	Craigie
Admiral Park	Admiral Grove	Heathridge
Albacore Park	Albacore Drive	Sorrento
Albright Park	Cornell Parade	Joondalup
Aldgate Park	Aldgate Street	Joondalup
Alfreton Park	Alfreton Way	Duncraig
Annato Park	Annato Street	Greenwood
Aristride Park	Aristride Avenue	Kallaroo
Balanus Park	Balanus Way	Heathridge
Banks Park	Banks Avenue	Hillarys
Barridale Park	Barridale Drive	Kingsley
Barwon Park	Barwon Road	Craigie
Barwon Park	Barwon Road	Craigie
Beaumont Park	Beaumont Way	Edgewater
Beenyup Park	Timerlane Drive	Woodvale
Beldon Park	Gradient Way	Beldon
Belrose Park	Belrose Entrance	Kallaroo
Bethany Park	Bethany Gardens	Iluka
Bindaree Park	Bindaree Terrace	Kingsley
Birdland Park	Birdland Court	Edgewater
Blackall Park	Cedarwood Circle	Greenwood
Blackall Park	Blackall Drive	Greenwood
Blackthorn Park	Blackthorn Road	Greenwood
Blue Lake Park	Blue Mountain Drive	Joondalup
Braden Park	Braden Way	Marmion
Bridgewater Park	Bridgewater Drive	Kallaroo
Brisbane Park	Brisbane Drive	Padbury

Name	Street	Suburb
Brisbane Park	Brisbane Drive	Padbury
Broadbeach Park	Broadbeach Boulevard	Hillarys
Buckthorn Park	Buckthorn Way	Duncraig
Cadogan Park	Cadogan Street	Kingsley
Caledonia Park	Caledonia Avenue	Currambine
Callander Park	Callander Avenue	Kinross
Callion Park	Pinnaroo Drive	Padbury
Calthorpe Park	Calthorpe Place	Kingsley
Camberwarra Park	Camberwarra Drive	Craigie
Carina Park	Carina Loop	Ocean Reef
Carlton Park	Carlton Turn	Currambine
Castlecrag Park	Castlecrag Drive	Kallaroo
Castlefern Park	Castlefern Way	Duncraig
Cawarra Park	Cawarra Crescent	Craigie
Chadstone Park	Chadstone Road	Craigie
Charing Cross Park	Aldwych Way	Joondalup
Charonia Park	Charonia Road	Mullaloo
Chelsea Park	Chelsea Court	Kingsley
Chelsford Park	Chelsford Road	Warwick
Christchurch Park	Christchurch Terrace	Currambine
Churton Park	Churton Crescent	Warwick
Cinque Ports Park	Cinque Ports Place	Connolly
Circle Park	The Circle	Warwick
Coastal Foreshore Reserve Iluka	Burns Beach Road	Iluka
Cockman Park	Cockman Road	Greenwood
Conica Park	Conica Crescent	Hillarys
Conidae Park	Conidae Drive	Heathridge
Coolibah Park	Coolibah Place	Duncraig
Cunningham Park	Cunningham Place	Padbury
Dampier Park	Dampier Avenue	Kallaroo
De Crillon Park	De Crillon Way	Currambine

Name	Street	Suburb
Delaware Park	Delaware Place	Kallaroo
Delonix Park	Delonix Circle	Woodvale
Discovery Park	Discovery Circuit	Iluka
Dollis Park	Dollis Way	Kingsley
Doncaster Park	Doncaster Square	Currambine
Earlsferry Park	Earlsferry Green	Kinross
Edgewater Park	Edgewater Drive	Edgewater
Elcar Park	Elcar Lane	Joondalup
Ellersdale Park	Ellersdale Avenue	Warwick
Embankment Park	The Embankment	Joondalup
Ensign Park	Ensign Way	Beldon
Fairmont Park	Fairmont Place	Currambine
Falkland Park	Falkland Way	Kinross
Faversham Park	Faversham Way	Heathridge
Fenton Park	Fenton Way	Hillarys
Finney Park	Finney Crescent	Marmion
Flinders Park	Centennial Gardens	Hillarys
Forest Hill Park	Kingsley Drive	Kingsley
Forrest Park	Forrest Road	Padbury
Galston Park	Galston Place	Duncraig
Gascoyne Park	Gascoyne Avenue	Woodvale
Geddes Park	Geddes Close	Duncraig
Geneff Park	Padbury Circle	Sorrento
George Sears Park	Wanneroo Road	Greenwood
Gleddon Park	Gleddon Way	Hillarys
Glenbank Park	Awhina Place	Kallaroo
Glenbar Park	Glenbar Road	Duncraig
Glengarry Park	Merrick Way	Duncraig
Gradient Park	Gradient Way	Beldon
Greenlaw Park	Greenlaw Street	Duncraig

Name	Street	Suburb
Haddington Park	Haddington Street	Beldon
Harbour View Park	Azzuro Crescent	Hillarys
Heathridge Park	Sail Terrace	Heathridge
Herreshoff Park	Herreshoff Ramble	Ocean Reef
Hilltop Park	Hilltop Place	Edgewater
Hilton Park	Hilton Place	Duncraig
Huntingdale Park	Huntingdale Crescent	Connolly
Illawong Park	Illawong Way	Kingsley
Iluka District Open Space	Miami Beach Promenade	Iluka
Iluka Foreshore Reserve	Ocean Reef Road	Iluka
James Cook Park	Banks Avenue	Hillarys
Kallaroo Park	Kallaroo Place	Mullaloo
Kanangra Park	Kanangra Crescent	Greenwood
Katrine Park	Katrine Crescent	Joondalup
Keppell Park	Keppell Road	Marmion
Kiernan Park	Kiernan Place	Kallaroo
Kilarney Park	Kilarney Heights	Kallaroo
Killin Park	Sycamore Drive	Duncraig
Kimberley Park	Kimberley Road	Hillarys
Kingsley Park	Kingsley Drive	Kingsley
Korella Park	Korella Street	Mullaloo
Lacepede Park	Lacepede Drive	Sorrento
Lacepede Park	Lacepede Drive	Sorrento
Lady Evelyn Park	Lady Evelyn Retreat	Joondalup
Larkspur Park	Larkspur Place	Heathridge
Leeward Park	Leeward Chase	Hillarys
Lehmann Park	Lehmann Court	Kingsley
Leichhardt Park No1	Leichhardt Avenue	Padbury
Littorina Park	Littorina Avenue	Heathridge
Lymburner Park	Lymburner Drive	Hillarys

Name	Street	Suburb
Lysander Park	Lysander Drive	Heathridge
Macaulay Park	Macaulay Avenue	Duncraig
Macdonald Park	Macdonald Avenue	Padbury
Mamo Park	Mamo Place	Greenwood
Mamo Park	Cedarwood Circle	Greenwood
Manapouri Park	Manapouri Meander	Joondalup
Maquire Park	Maquire Road	Hillarys
Marbella Park	Mallorca Avenue	Hillarys
Marri Park	Marri Road	Duncraig
Mawson Park	Mawson Crescent	Hillarys
Mccubbin Park	Mccubbin Boulevard	Woodvale
Mckirdy Park	Mckirdy Way	Marmion
Melene Park	Melene Road	Duncraig
Menteith Park	Selkirk Drive	Kinross
Mirror Park	Mirror Place	Ocean Reef
Montague Park	Montague Way	Kallaroo
Moolanda Park	Moolanda Boulevard	Kingsley
Nash Park	Nash Street	Hillarys
Newcombe Park	Newcombe Way	Padubry
Newham Park	Newham Way	Kingsley
Ninnis Park	Ninnis Place South	Hillarys
Noel Gannon Park	Lennoxtown Road	Duncraig
Oahu Park	Oahu Gardens	Hillarys
Ocean Reef Park	Marina Boulevard	Ocean Reef
Oleaster Park	Oleaster Way	Greenwood
Orient Park	Orient Circuit	Hillarys
Otago Park	Camberwarra Drive	Craigie
Oxley Park	Oxley Avenue	Padbury
Parin Park	Canham Way	Greenwood
Parkinson Park	Parkinson Place	Hillarys
Parkside Park	Parkside Ramble	Woodvale

Name	Street	Suburb
Penistone Park	Penistone Street	Greenwood
Percy Doyle Reserve	Warwick Road	Duncraig
Periwinkle Park	Periwinkle Road	Mullaloo
Piccadilly Park	Piccadilly Circle	Joondalup
Picnic Cove Park	Edgewater Drive	Edgewater
Pine Valley Park	Pine Valley Pass	Connolly
Pinnaroo Point	Whitfords Avenue	Hillarys
Porteous Park	Porteous Road	Sorrento
Portree Park	Portree Way	Duncraig
Portwood Park	Lakeside Drive	Joondalup
Poseidon Park	Poseidon Road	Heathridge
Poynter Park	Poynter Drive	Duncraig
Prince Regent Park	Prince Regent Drive	Heathridge
Quarry Ramble Park	Quary Ramble	Edgewater
Queensbury Park	Queensbury Road	Joondalup
Regents Park	Regents Park Road	Joondalup
Rev John Smithies Park	Lakeway Drive	Kingsley
Riversdale Park	Riversdale Gardens	Currambine
Rodgers Park	Rodgers Street	Greenwood
Roxburgh Park	Roxburgh Circle	Kinross
Rutherglen Park	Rutherglen Circle	Kinross
Salata Park	Salata Place	Duncraig
Santiago Park	Santiago	Parkway
Scott Park	Webb Place	Hillarys
Seacrest Park	Seacrest Drive	Sorrento
Sheoak Park	Tuart Road	Greenwood
Sherington Park	Sherington Road	Greenwood
Simpson Park	Forrest Road	Padbury
Sittella Park	Sittella Turn	Joondalup
Sorrento Foreshore	West Coast Drive	Sorrento
Southern Cross Park	Souther Cross Circle	Ocean Reef

Name	Street	Suburb
Springvale Park	Springvale Drive	Warwick
Stanford Park	Stanford Road	Kallaroo
Stilt Park	Cockatoo Ridge	Joondalup
Stonehaven Park	Stonehaven Parade	Kinross
Stow Park	Stow Lane	Kinross
Sycamore Park	Scaddan Street	Duncraig
Tarolinta Park	Tarolinta Gardens	Ocean Reef
Telopia Park	Telopia Drive	Duncraig
Third Park	Third Avenue	Burns Beach
Thornbill Park	Thornbill Meander	Joondalup
Thornton Park	Thornton Retreat	Kinross
Timbercrest Park	Trailwood Drive	Woodvale
Tom Walker Park	Sandpiper Street	Sorrento
Trig Point Park	Shoran Court	Ocean Reef
Trigonometric Park	Truslove Way	Duncraig
Triton Park	Triton Place	Mullaloo
Wallangarra Park	Wallangarra Court	Kingsley
Walsh Park	Joondalup Drive	Joondalup
Wanbrow Park	Wanbrow Way	Duncraig
Warrigal Park	Madrona Crescent	Greenwood
Water Tower Park	Moondarra Way	Joondalup
Wedgewood Park	Wedgewood Drive	Edgewater
Wesley Park	Cornell Parade	Joondalup
Whistler Park	Whistler Close	Edgewater
Whitfords East Park	Rosette Close	Craigie
Whitfords West Park	Marmion Avenue	Kallaroo
Windermere Park	Candlewood Boulevard	Joondalup
Wolinski Park	Key West Drive	Mullaloo
Woodlea Park	Woodlea Crescent	Joondalup

Priority 3- Parks and Natural Areas

Name	Street	Suburb
Albion Park	Camberwarra Drive	Craigie
Alder Park	Alder Way	Duncraig
Alidade Park	Alidade Way	Beldon
Anemone Park	Anemone Way	Mullaloo
Bage Park	Bage Court	Hillarys
Banksia Park	Banksia Dale	Marmion
Bannister Park	Bannister Road	Padbury
Barclay Park	Barclay Avenue	Padbury
Batavia Park	Batavia Place	Kallaroo
Bigola Park	Bigola Court	Kallaroo
Birch Park	Birch Place	Greenwood
Bracken Park	Bracken Court	Duncraig
Bramston Park	Bramston Vista	Burns Beach
Burns Park	Ocean Parade	Burns Beach
Byrne Park	Byrne Close	Padbury
Calectasia Park	Calectasia Street	Greenwood
Captain Park	Captain Court	Heathridge
Carr Park	Carr Crescent	Warwick
Cliff Park	Cliff Street	Marmion
Clifford Coleman Park	Troy Avenue	Marmion
Cliverton Park	Cliverton Court	Marmion
Colac Park	Colac Way	Duncraig
Cornish Park	Cornish Avenue	Woodvale
Craigie Park	Barradine Way	Craigie
Culwalla Park	Culwalla Close	Kallaroo
Cumberland Park	Cumberland Way	Beldon
Doveridge Park	Doveridge Drive	Duncraig
Ellison Park	Ellison Drive	Padbury
Filbert Park	Filbert Street	Greenwood
Fraser Park	Fraser Way	Padbury

Name	Street	Suburb
Gerda Park	Gerda Court	Greenwood
Glenmere Park	Glenmere Road	Warwick
Glenunga Park	Glenunga Way	Craigie
Greenwich Park	Greenwich Court	Kingsley
Grenfell Park	Grenfell Avenue	Duncraig
Gull Park	Gull Street	Marmion
Hakea Park	Hakea Place	Sorrento
Harcourt Park	Harcourt Drive	Hillarys
Hartley Park	Hartley Court	Greenwood
Hawick Park	Hawker Avenue	Warwick
Hillwood Park	Hillwood Avenue	Warwick
Hughes Park	Hughes Court	Padbury
Huxley Park	Huxleys Trail	Burns Beach
Karuah Park	Karuah Way	Greenwood
Kelvin Park	Campion Street	Duncraig
Kingfisher Park	Kingfisher Way	Kingsley
Kurrajong Park	Kurrajong Place	Greenwood
Lakeview Park	Lakeview Drive	Edgewater
Lanark Park	Lanark Mews	Duncraig
Leaside Park	Leaside Way	Greenwood
Leichhardt Park No2	Leichhardt Avenue	Padbury
Macarthur Park	Macarthur Avenue	Padbury
Mackay Park	Mackay Way	Hillarys
Magpie Reserve	Ozone Road	Marmion
Mayflower Park	Mayflower Crescent	Hillarys
Mckinlay Park	Macarthur Avenue	Padbury
Mcrae Park	Mcrae Court	Padbury
Minchin Park	Minchin Court	Padbury
Monkhouse Park	Monkhouse Way	Hillarys
Monument Park	Monument Drive	Beldon
Mueller Park	Mueller Court	Padbury

Name	Street	Suburb
Nalpa Park	Kenny Drive	Duncraig
Nekaya Park	Nekaya Way	Duncraig
New Cross Park	New Cross Road	Kingsley
Nimrod Park	Nimrod Place	Hillarys
Oakapple Park	Oakapple Drive	Duncraig
Otway Park	Camberwarra Drive	Craigie
Paterson Park	Paterson Place	Padbury
Paveta Park	Paveta Court	Greenwood
Plover Park	Plover Way	Kingsley
Ranford Park	Ranford Way	Hillarys
Readshaw Park	Readshaw Road	Duncraig
Reserve For Recreation	Grand Ocean Entrance	Burns Beach
Ridge Park	Ridge Close	Edgewater
Sanday Park	Hawker Avenue	Warwick
Santa Ana Park	Aberfoyle Heights	Currambine
Southport Park	Southport Loop	Burns Beach
Spoonbill Park	Spoonbill Grove	Kingsley
Stillwater Park	Reflection Close	Edgewater
Strathaven Park	Strathaven Crescent	Greenwood
Talbot Park	Talbot Drive	Kingsley
Trailwood Park	Trailwood Drive	Woodvale
Tuart Park	Tuart Trail	Edgewater
Village Park	Village Walk	Ocean Reef
Waltham Park	Waltham Street	Mullaloo
Wandina Park	Wandina Place	Duncraig
Warner Park	Warner Place	Greenwood
Wentworth Park	Wentworth Way	Padbury
Windich Park	Windich Court	Padbury
Windmill Park	Windmill Circle	Burns Beach
Woodland Park	Woodland Loop	Edgewater
Candlewood Park	Candlewood Boulevard	Joondalup

Name	Street	Suburb
Candlewood Park	Candlewood Boulevard	Joondalup
Carnaby Reserve	Medinah Mews	Connolly
Clare Park	Clare Street	Sorrento
Coastal Foreshore Reserve Marmion	West Coast Drive	Marmion
Culwalla Park	Culwalla Close	Kallaroo
Dardanus Park	Telstar Place	Heathridge
Gunida Park	Gunida Way	Mullaloo
Harman Park	Harman Road	Sorrento
Harman Park	Harman Road	Sorrento
Harman Park	Harman Road	Sorrento
Kilrenny Park	Gilmerton Way	Greenwood
Kuta Park	Kuta Circuit	Iluka
Ledge Park	Ledge Place	Sorrento
Lookout Park	Quarry Ramble	Edgewater
Madana Park	Madana Place	Craigie
Madana Park	Madana Place	Craigie
Mandalay Park	Mandalay Place	Craigie
Okely Park	Joondalup Drive	Edgewater
Pentland Park	Pentland Avenue	Duncraig
Sweeney Park	Sweeney Way	Padbury

Appendix 4 – Western Australia Dieback Signage Protocol

Standard Dieback Signage

Protocol for Use

May 2008

This document sets out the protocols for the use of Standard Phytophthora Dieback Signage on all land tenures in Western Australia.

Summary

Any person or organisation responsible for the management of lands either with or neighbouring native vegetation in the South West of Western Australia should consider the threat that Phytophthora Dieback presents to the maintenance of biodiversity. This is important particularly for areas receiving more than an average annual rainfall of 400mm.

A professional assessment should first be made to determine the disease status of an area. Standard signage is then available which can be used to insure protection of disease free areas.

A range of signs are available depending on the management objectives for an area or works and activities planned.

The signage system is based on the following status symbols:

Soil, gravel, sand and plant material should never be moved from areas that are known to be infested to areas known to be disease free. It is important to get the message across “Be Clean in the Green” and “Don’t Spread the Red”.

Interpreting the disease status of areas can be difficult especially as many area of the South West have been affected for many decades. Signage should only be used if qualified environmental consultants have sampled and verified the disease situation in an area.

There are many reasons for the cause of plant deaths so it is important to confirm presence of *Phytophthora cinnamomi* in any candidate areas for signage. However, if field interpretation is not available in the short term for a potentially threatened area, non-mapped “Dieback Protection Area” signs are available until a Phytophthora Dieback assessment can be made.

Project Dieback, in conjunction with the State Dieback Consultative Council (DCC), Dieback Working Group (DWG) and Department of Environment & Conservation (DEC), have developed this standard dieback signage system to assist in the management of Phytophthora Dieback. Project Dieback is a Natural Resource Management (NRM) initiative to protect environmental, social and economic values from the dieback threat in Western Australia. The Australian Government and Western Australian Government fund the project through the joint National Action Plan for Salinity and Water Quality programme and the Natural Heritage Trust.

Introduction

The south west of Australia is extensively invaded by the introduced soil borne water mould *Phytophthora cinnamomi* known as Phytophthora Dieback. The pathogen is recognised as one of the key threatening processes to Australian biodiversity.

Humans are the greatest vectors in spreading Phytophthora Dieback. People can carry the plant pathogen from infested areas in many ways. Often by mud on footwear or vehicles, shifting infested soil or gravel, grading roads or moving infected plant material.

The aim of the signage is to raise dieback awareness and to assist land managers, operations staff and contractors involved in any earthworks to minimise the risk of spreading existing infestations and protecting areas still free from this invasive species.

The Western Australian Standard Dieback Signage System has been developed for use across all land tenures, including areas managed by local and state government, private property and mining areas. Land managers, government agencies, extractive industries and developers should use the signage system as part of an overall disease risk management plan to minimise the risks of establishing new infestations as a result of human activity.

The signage system is designed particularly to protect valued areas threatened by dieback following the field interpretation and mapping of *Phytophthora cinnamomi*. These areas may be identified as Dieback Protection Areas and dieback infestations can be delineated from dieback free areas using the signs.

The signage has a standardised series of designs to ensure consistency across land tenures and therefore higher recognition and understanding of the threat. Consequently, the signage will be the same format in national parks and reserves, mine sites, along road sides and in local government parks.

To be effective, signs must be considered an integral part of an area's overall management. Use of signage to guide public staff and contractors should be one component of management. Managers, government agencies and developers are advised to also adopt best practise disease management to minimise the risks of establishing new infestations as a result of soil movements.

This protocol describes the signage system, sets out a flow chart to graphically represent the sequencing of steps required to use the signs and provides information required for signage application, installation and management.

Standard Dieback Signage System

The signage system was designed as part of a state communication plan that aims to have consistent relevant themes and messages for stakeholder groups to use in Western Australia in regard to Phytophthora Dieback management.

The signs aim to enable people to gain the right message, do the right actions and be aware of Phytophthora Dieback in the environment.

The signage system is based on the following status symbols:

A range of signs and markers are available depending on an area's requirements including for roadsides, walk tracks and Dieback Protection Areas. (Section 1: Dieback Signs and markers.)

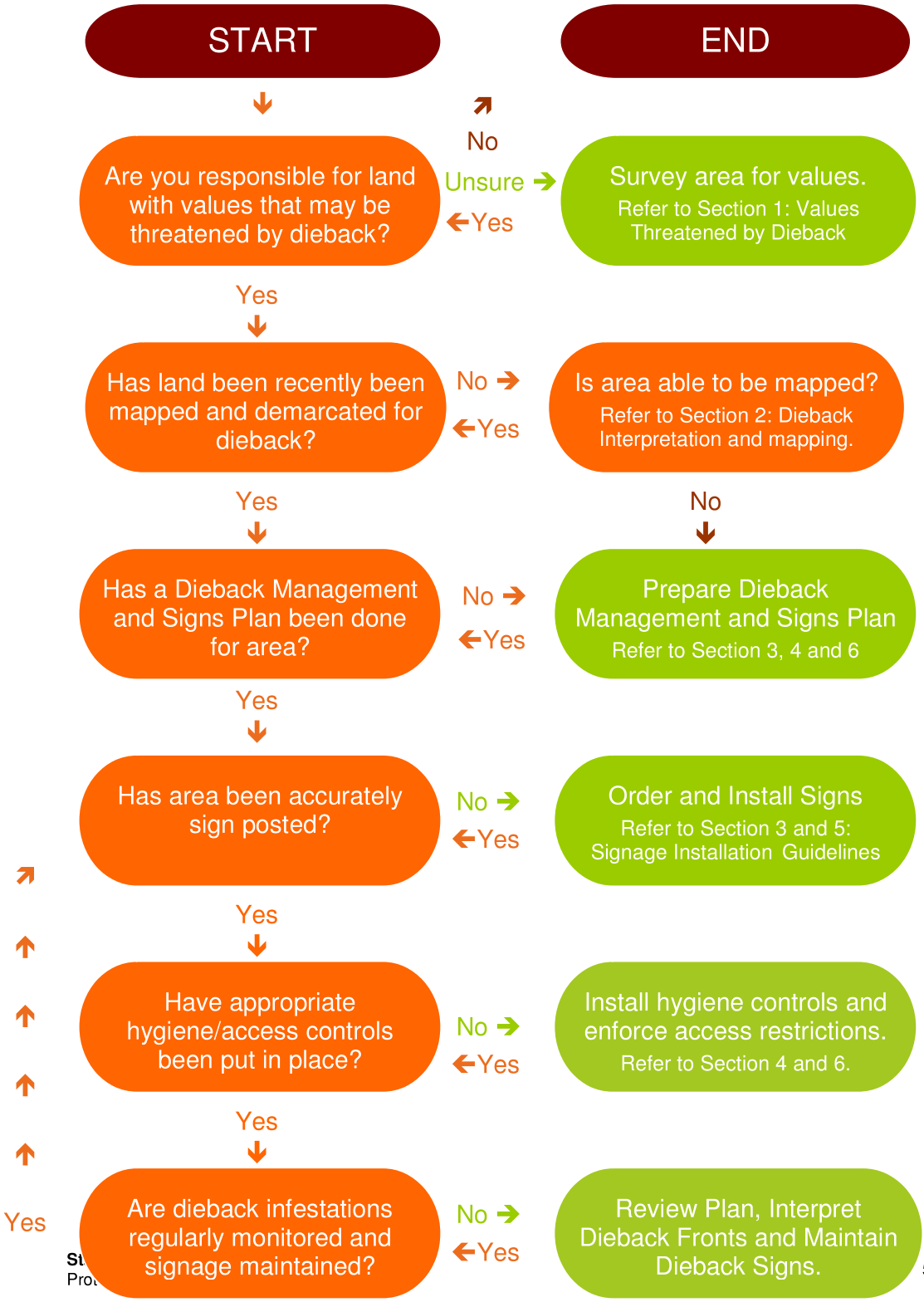
Picture 1: Example of Dieback Protection Area sign.

There is an option to have management logos integrated into Dieback Protection Area signs and changes to wording for specific area requirements. These wording changes however still need to be approved to ensure messages and themes are accurate and consistent with Phytophthora Dieback management.

The Dieback Signage flow chart sets of the procedure to follow in regard to using the signs.

Protocol Flowchart

The following flowchart provides guidance for incorporating the Standard Dieback Signage System into an area.



Section 1: Values Threatened by Dieback

Phytophthora Dieback impacts over 40% of the plant species in Southwest Australia which consequently threatens many environmental values including changes to ecosystems and destruction of habitats. Dieback threatens social and economic values impacting natural resources and horticultural industry.

When assessing the risks from Phytophthora Dieback, values should to be prioritised to ensure management resources are designated effectively.

Area may have access roads, tracks or drainage lines into other areas with values that are threatened by Phytophthora dieback and therefore neighbouring areas should to be taken into consideration in surveying values and Dieback Management planning. Hygiene control is advised during any ground survey.

An overall strategic risk assessment has been carried out for the south west of WA and is also a resource that can assist in value assessment. Details can be accessed thought the www.dieback.org.au website as well as a list of the most susceptible species threatened by Phytophthora Dieback. The following lists some of the values that may be impacted.

Environmental Values

Environmental Values may include:

- healthy bushlands with susceptible plant communities,
- endangered plants,
- rare animal habitats.

A susceptible plant species list is available on www.dieback.net.au. Technical advice is available through your NRM Dieback officer, DEC or local environmental officer.

Social Values

Social Values may include:

- wildflower viewing areas,
- cultural places,
- bush tucker resources.

Economic Values

Economic Values may include:

- tourist areas,
- timber resources,
- nurseries
- susceptible horticultural plantations
- honey production.

Section 2: Dieback Interpretation and Mapping

Dieback Interpreters carry out a detailed procedure to determine the presence of Phytophthora Dieback (*Phytophthora cinnamomi)* in bushland and forest areas.

The presence of this soil borne pathogen is typically undertaken using a combination of aerial photography interpretation (API), assessment of existing vegetation using certain susceptible species as indicators and sampling soil and plants to confirm infestation through laboratory testing.

The determination of the presence of Phytophthora dieback requires significant technical knowledge and it is recommended that suitably qualified and experienced professionals undertake this assessment.

Consultants provide a Dieback report, management recommendations, detailed maps of dieback status/protectable areas and ground demarcation usually with coloured tape. Old mapping and demarcation may need to be refreshed as dieback has been known to move downhill over ten metres a year and even uphill one metre a year though root to root contact. Dieback status signage should only be used in areas where the dieback has been recently verified.

Phytophthora Dieback indicator plants include members of the Proteaceae, (Banksia, Grevillea, Hakea etc), Myrtaceae (Eucalyptus, Verticordia, Calothamnus etc), as well as species such as grasstrees (Xanthorrhoea sp.), and zamia palms (Macrozamia sp.). More details of susceptible can be found at www.dieback.org.au

Consultants that can provide assessment of lands and arrange analysis of soil samples for dieback can be found in Section 9: Contacts.

Section 3: Dieback Signs and Markers

1. Dieback Protection Area (DPA) Signs

DPA Signs are digitally printed on 600 x 450 aluminium panels.

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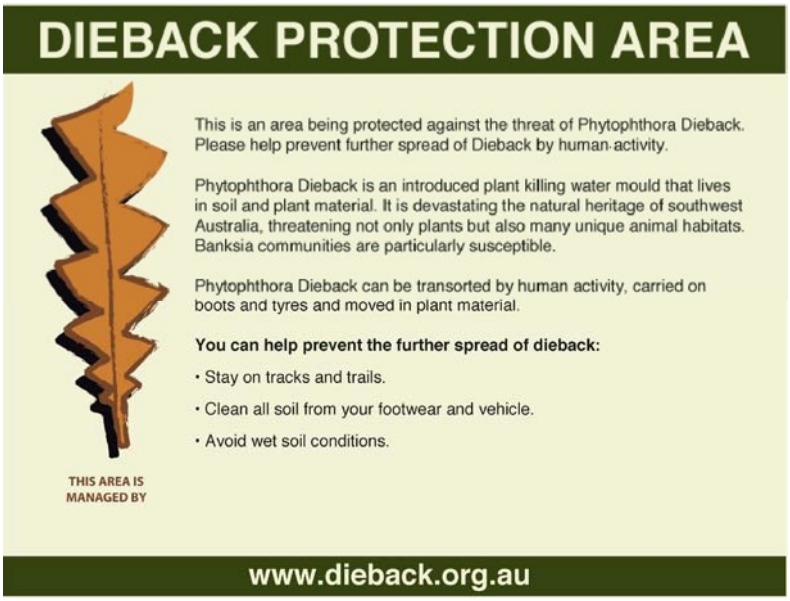
1.1 DPA Boundary Entry Signs for dieback mapped areas:

Item Code: *DPA07-1*

1.2 DPA Boundary Entry sign for non-mapped areas

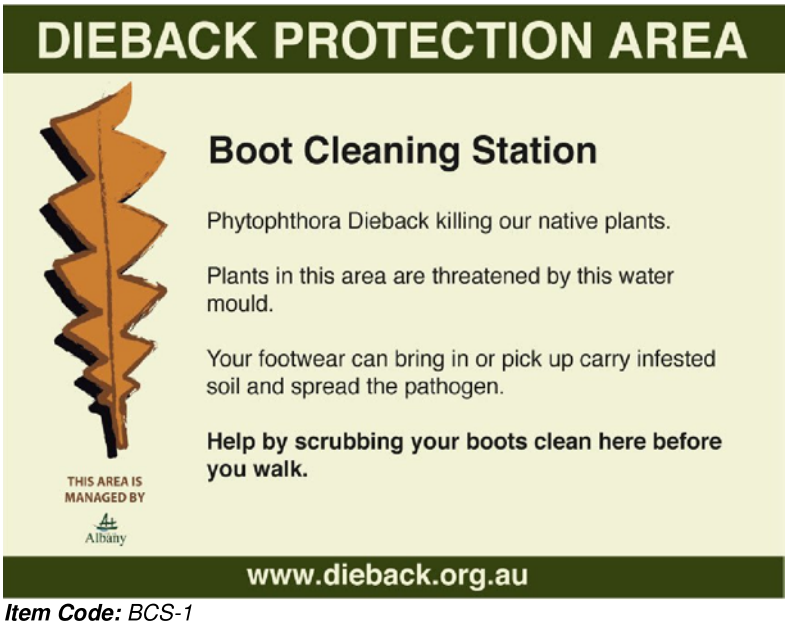


Item Code: *DPA07-2*

1.3 DPA Boundary Entry Signs for Access By Permit Only Areas:

Item Code: *DPA07-3*

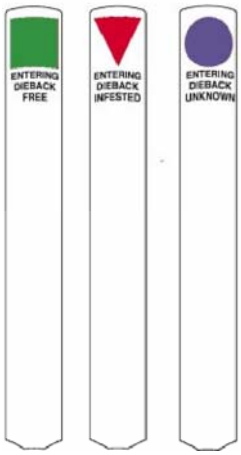
1.4 DPA Boundary Entry Signs for Hygiene Stations - Footwear:



Item Code: *BCS-1*

2. Dieback Status Markers and Symbols

2.1 Dieback status boundary markers for roads and walk tracks are indicated using status stickers on white steelflex guideposts.



Item Codes:
Steelflex Posts - EDSF1300-WHT
Vinyl Stickers -

- *Entering Dieback Free – EDF-TV*
- *Entering Dieback Infested – EDI-TV*
- *Entering Dieback Unknown – EDU-TV*

2.2 Dieback status symbol alternative for roads and walk tracks are on 95 x 140mm aluminium panels.

Item Codes:
Aluminium Panels -

- *Entering Dieback Free – EDF-TA*
- *Entering Dieback Infested – EDI-TA*
- *Entering Dieback Unknown – EDU-TA*

2.3 Dieback status symbol indicators used within dieback status areas on 95 x 140mm aluminium panels or vinyl stickers.

Item Codes:
Aluminium Symbol Panels -

- *Dieback Free Symbol – DF-SA*
- *Dieback Infested Symbol – DI-SA*
- *Dieback Unknown Symbol – DU-SA*

Vinyl Symbol Stickers

- *Dieback Free Symbol – DF-SV*
- *Dieback Infested Symbol – DI-SV*
- *Dieback Unknown Symbol – DU-SV*

3. Ordering Signs

Signs may currently be ordered directly through Jason Sign Makers or through Cranmill Environmental Services, who are also able to provide organisations signage advice and can coordinate any changes and approvals to signs if required. (See Section 9: Contacts).

Section 4: Dieback Management and Signs Plan

A signs plan is done in conjunction with the area's overall management plan. The Signs plan records required signs in regard to access points, awareness objectives, restrictions, hygiene stations and future predicted autonomous spread.

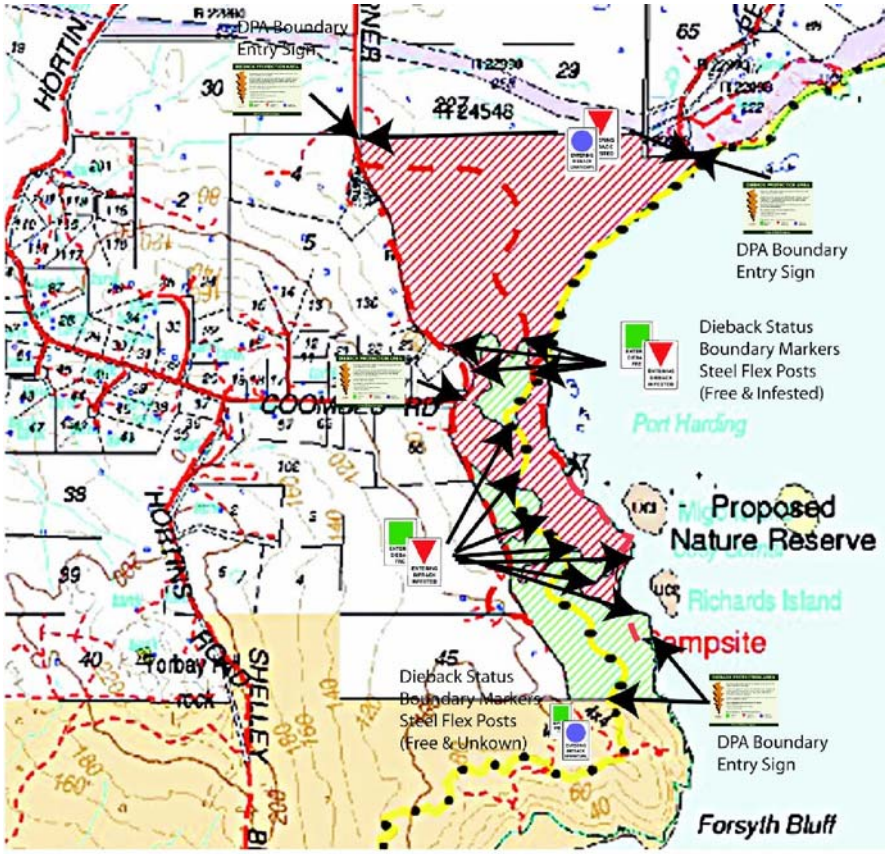
The Area Signage Plan should also designate hygiene requirements for installation and future dieback monitoring and signs review. It is essential that signs are maintained in good condition and a register of installations be made.

All Dieback Signage used in any area is to be documented as part of the signs plan and a summary is requested to be sent to the DCC State Register (Appendix 1).

Example of a Signs Plan Map

Phytophthora Dieback Signs Plan Map
Cosy Corner Reserve, Albany

Item Code	Item Design	Signage Details	No. req.
DPA 07-1		DPA Boundary Entry Sign	*4*
EDSF 1300 WHT		Dieback Status Boundary Markers Steel Flex Posts	*16*
EDF-TV		Dieback Status Boundary Sticker DIECKBACK FREE	*13*
EDI-TV		Dieback Status Boundary Sticker DIECKBACK INFESTED	*13*
EDU-TV		Dieback Status Boundary Sticker DIECKBACK UNKNOWN	*2*



Section 5: Signage Installation Guidelines

The correct placement of signs along the dieback boundary and at entrances to areas affected by Dieback is important assist in reducing the spread of Phytophthora Dieback.

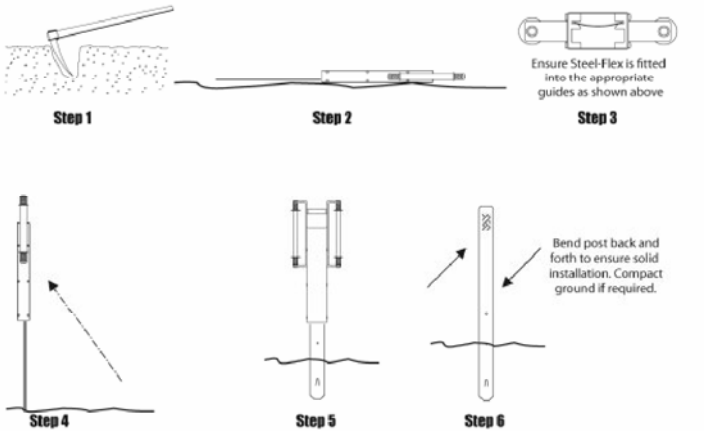
Dieback Protection Area Entry signs (DPA-071, DPA-072;) should be placed at road and walking trail entrances. This should be at a location where vehicle speeds are at a minimum such as a gate, or walking trail entrance. These signs should be installed on posts of sufficient length to enable them to be visible over any vegetation. 4x4 wooden posts are acceptable or the 2250 mm steel posts (code Calm2250-csa) which can be driven directly into the ground.

Posts for the delineation of the dieback front are to be Ezydrive Steel Flex posts. (Code EDSF1300-WHT) with self adhesive symbols (code DF-SA, DI-SA, and DU-SA) to be applied to the posts. These should be installed so that the posts are aligned with the axis of the dieback front as demarcated by the Dieback Interpreters.

Installation of the Posts

The easy drive steel flex posts from Rondo Building services are easy to install using a hand driver. It is critical that care is taken to ensure all equipment is clean before use in installation of posts. Signage should be installed under dry soil conditions and no soil should be moved on vehicles or equipment away from infested areas. Always install signs into disease free areas prior to any with in infested areas. Advice on hygiene and sterilants is provided in Section 7.

It is preferable to locate the correct location for the sign by GPS and ground demarcation. This information is to be provided by the mapping consultants. Be sure to place signs at the correct buffer width from the visible disease front (15m up slope or cross slope, and 25m + down slope depending on rate of spread.) This allows for cryptic disease which will be present but not showing symptoms. Buffers also allow for some movement of the disease as it grows.



Section 6: Standard Hygiene and Management

To manage Phytophthora Dieback in any area, there is a need to plan ahead. The introduction or human-assisted spread of the pathogen can be avoided if activities are well planned and management procedures are in place. Phytophthora Dieback management procedures must be integrated into all land management activities if the spread and impact of this organism is to be minimised.

Organisations such as the Department of Environment and Conservation (DEC), Alcoa World Alumina Australia and Main Roads WA follow procedures to minimise the risk of their activities spreading the pathogen. Many local governments are also adopting Phytophthora Dieback management policies and implementing management procedures. Anyone who owns, manages or uses a bushland area can also take steps to ensure that their activities don't introduce or spread the pathogen. Any operations which involve soil movement can put disease free areas at risk.

Standard hygiene and management may vary for each status area.

DIEBACK FREE	DIEBACK INFESTED	DIEBACK UNKNOWN
Cleandown stations should be used to remove or sterilize mud and soil from footwear, equipment and vehicles when **entering** Dieback Free. Avoid moist soil conditions. Access may be restricted.	An effective hygiene cleandown must be carried out when **leaving** a Dieback Infected area into Dieback Free. Ensure no infested soil, gravel or plant material crosses the dieback boundary.	Areas are unknown if they have not been mapped or do not have indicators that identify the presence of Phytophthora Dieback. Areas may still have hygiene and access restrictions.

Hygiene is essential to any operation or activity aiming to minimise the spread of Phytophthora Dieback. Next section details some guidelines applicable to the cleaning of vehicles, equipment and footwear. Also included are some points about sterilisation of water, equipment and footwear. Where practical it is preferable to use the dry cleaning methods (air compressor, brushes) rather than cleaning with water as it has a significantly lower chance of accidentally spreading the pathogen.

It should be noted that dust and grime on vehicles or equipment is not a threat in terms of spreading Phytophthora Dieback.

Section 7: Guidelines for cleaning vehicles/equipment

- Cleaning will be easier and more effective if completed at a depot or designated cleaning area.
- Field-based cleaning requires:
- A hard, well-drained surface (e.g. road) that is well away from native vegetation. Any washdown effluent should be collected on-site and must not be allowed to drain bushland.
- Minimise water use to remove soil and mud from equipment/vehicles. This can be achieved by preferentially dry cleaning techniques e.g. stiff brushes.
- Washdown on ramps if possible.
- Prevention of mud and slurry from entering into uninfested or uninterpretable bushland. Soil and waster can be collected for sterilisation (see guidelines for sterilising below).
- Pay particular attention to mudflaps and tyres.
- Do not drive through effluent generated from cleaning when exiting the washdown facility.

Guidelines for cleaning footwear

- Try to remove mud and soil when it is dry. Remove as much mud and soil as possible with a stiff brush or stick and minimise the amount of water used.
- Collect all mud and soil removed and place in a bucket or bag for later disposal at a site that is infested with P. cinnamomi or that contains no native vegetation.

Guidelines for sterilising

- Sterilisation of equipment, footwear and vehicle tyres can be used to take an extra precaution. Sterilisation of nursery equipment using steam is common practice, however the use of steam is not practical in the field. The following sterilisation methods can be used in the field.
- Spray methylated spirits on small hand tools and footwear covering all surfaces and allowing a few minutes for it to soak into all soil material.
- Spray diluted bleach (sodium hypochlorite) onto equipment and footwear allowing a few minutes before rinsing the bleach off using water. Dilute bleach so that solution contains 1% active ingredient sodium hypochlorite. Be sure to follow any of the manufacturer's safety instructions provided on the bleach container.
- Spray Phytoclean® can be used in footbaths, washdown facilities and during the cleaning of equipment. See the manufacturer's details for directions.

Section 8: Publications and resources

- "Signage For All" DL Pamphlet

Produced by Project Dieback April 2008

- "Botanical Grim Reaper Signage Awareness" A3 Posters

- Project dieback website www.dieback.net.au

Pamphlets and posters are free on request from South Coast NRM Inc. on Mercer Rd., Albany or Cranmill Environmental Services.

Section 9: Contacts

Dieback Consultants

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Ordering Signs

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Web: jsm.net.au

State Dieback Signs Register

The following Signage Summary Sheet should be completed and copied for each area where signage is installed. A copy should be sent to Cranmill Environmental Services who are coordinating the state register funded by Project Dieback on behalf of the Dieback Consultative Council.

Reserve or Location:

Central GPS Reading:	Closest road name:
Contact person or position:	
Organisation:	
Phone:	
Email:	
Values at risk:	
 DPA Entry with Status Symbols	Total Number Used:
 DPA Entry without Status symbols	Total Number Used:
 Boot Cleaning Station	Total Number Used:
 Road/Track Posts	Total Number Used:
 Track Markers Panels 95 x 140 (Aluminium)	Total Number used:
 Track Markers 95 x 95 (Aluminium)	Total Number Used:
Dieback interpretation done by:	
Date of installation:	
Monitoring of disease fronts in vicinity of signs.	Dates to be visited by officer responsible.

Comments/Requests:

Acknowledgements

Great Southern TAFE
Students assisted in developing this system and have also developed icons representing values and threats which could be made available if any land managers felt they would assist them in communicating with the public.