Public Transport Authority

Northern Suburbs Railway

Alkimos to Yanchep

Phytophthora cinnamomi occurrence assessment

Report compiled by Simon Robinson of Glevan Consulting

GLEVAN CONSULTING

Disclaimer

This report has been prepared in accordance with the scope of work agreed between the Public Transport Authority (PTA) and Glevan Consulting, and may contain results and recommendations specific to the agreement. Results and recommendations in this report should not be referenced for other projects without the written consent of Glevan Consulting.

Procedures and guidelines stipulated in various Department of Environment and Conservation and Dieback Working Group manuals are applied as the base methodology used by Glevan Consulting in the delivery of the services and products required by this scope of work. These guidelines, along with overarching peer review and quality standards ensure that all results are presented to the highest standard.

Glevan Consulting has assessed areas based on existing evidence presented at the time of assessment. The *Phytophthora* pathogen may exist in the soil as incipient disease. Methods have been devised and utilised that compensate for this phenomenon; however, very new centres of infestation, that do not present any visible evidence, may remain undetected by dieback assessors.

The entire evidence record dataset, which is a part of every assessment, is not presented as part of this report, but can be delivered to the PTA on request.

Glevan Consulting applies buffer widths according to Department of Environment and Conservation Guidelines. Allowances in buffer widths are not made for extraordinary rates of spread caused by unpredictable significant spring, summer or autumn rain events. All buffers should be rechecked immediately prior to soil moving operations if a rain event of this nature has occurred within the assessment area.

Version Control

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Executive Summary

Glevan Consulting conducted an assessment for the presence of the disease caused by *Phytophthora* Dieback within sections of remnant vegetation associated with the proposed Northern Suburbs Railway – Alkimos to Yanchep extension project. Three sections of the proposed alignment were observed to be unmappable due to disturbance and a lack of reliable indicator species. One section was classified as uninterpretable due to the native vegetation containing very few reliable indicators. No infestations caused by P. *cinnamomi* were identified during the assessment. Four samples were taken during the assessment, all of which tested negative for the presence of *P. cinnamomi*.

Study Team

The assessment was conducted by Jake Cortis and project managed by Simon Robinson from Glevan Consulting in March 2011.

Introduction

Glevan Consulting was commissioned by the Public Transport Authority (PTA) to conduct an assessment of the remnant vegetation associated with the proposed Northern Suburbs Railway – Alkimos to Yanchep extension project, for the presence of *Phytophthora* Dieback. The study area comprises a 40m wide corridor (20m either side of the centre of the alignment), and is approximately 12.5 km in length. The southern extent of the proposed alignment is marked by Romeo Road, and the northern extent occurs approximately 12.2 km north of Yanchep Beach Road. The study area is shown attached in Appendix 1.

A *P. cinnamomi* occurrence assessment is the first step in developing an effective management plan for the pathogen. Assessments can assign four possible categories to landscape of a study area. These categories are; Unmappable, Infested, Uninfested and Uninterpretable.

The following table describes *P. cinnamomi* occurrence categories as defined by the Department of Environment and Conservation in the manual "*Phytophthora cinnamomi*. and disease caused by it, volume 1, Management Guidelines, 2003". The superior categories "Mappable" and "Unmappable" definitions are not yet published by the department, but are in general use at this time.

Table 1 Category definitions

<table>
<tr><td>Unmappable
Areas that are sufficiently disturbed so that P. cinnamomi occurrence mapping is not possible at the time of inspection</td><td colspan="2">Further categorisation may be possible after variable regeneration periods for different types of disturbance</td></tr>
<tr><td rowspan="3">Mappable
Natural undisturbed vegetation. P. cinnamomi occurrence mapping is possible. Three categories may result.</td><td>Infested</td><td>Areas that a qualified person has determined to have plant disease symptoms consistent with the presence of the pathogen P. cinnamomi.</td></tr>
<tr><td>Uninfested</td><td>Areas that a qualified person has determined to be free of plant disease symptoms that indicate the presence of the pathogen P. cinnamomi</td></tr>
<tr><td>Uninterpretable</td><td>Areas where indicator plants are absent or too few to determine the presence or absence of disease caused by P. cinnamomi</td></tr>
</table>

Once *P. cinnamomi* occurrence information has been assessed, protectable and unprotectable management categories can be overlayed on occurrence information to further simplify the management of the area. All infested area is unprotectable. Unmappable, Uninterpretable and Uninfested may be given protectable or unprotectable status depending on local variations and influences.

P. cinnamomi is an introduced soil-borne pathogen (water mould) that causes the death of a vast and diverse range of plant species in South West Western Australia through a disease known as 'Dieback'. The disease enters through the plant roots, gradually breaking down the structure of the roots, ultimately causing roots to 'rot'. As a result of this 'root rot', the vascular system (xylem and phloem) in the root region of the plant is destroyed and the ability to transport water and nutrients is lost along with it. Additional information on the Disease is provided in Appendix 2.

Method

Qualified dieback interpreter Jake Cortis of Glevan Consulting traversed the study area in March 2011.

Glevan Consulting uses methods prescribed in the manual "*Phytophthora cinnamomi* and disease caused by it, Volume II Interpreter Guidelines for detection, diagnosis and mapping, DEC 2001"

Results

Four samples were taken during the assessment, all of which returned negative results for the presence of *Phytophthora* (Table 2). Approximately 11.2 hectares of the proposed alignment are unmappable, and a further 1.8 hectares are uninterpretable. The remaining 45.2 hectares are uninfested (see Table 3).

Table 2 Sample Results

Sample	Species	Other Species Deaths	Vector	Pattern	Other Possible causes of Death	Expected Result	Actual Result
1	*Xanthorrhoea preissii.*	*None*	Yes	No	Drought	Negative	Negative
2	*Xanthorrhoea preissii.*	*None*	Yes	No	Drought	Negative	Negative
3	*Banksia menziesii*	*None*	Yes	No	Drought	Negative	Negative
4	*Banksia menziesii*	*None*	Yes	No	Drought	Negative	Negative

Table 3 Area Statement (based on 40m wide survey corridor)

CATEGORY	AREA (ha)	% of total area
Infested *(Phytophthora cinnamomi)*	0.0	0.0
Uninterpretable	1.8	3.1
Uninfested *(Phytophthora cinnamomi* Free)	45.2	77.7
Unmappable	11.2	19.2
TOTAL AREA	**58.2**	100.0

Discussion

No infestations caused by *Phytophthora* were identified during the assessment. Whilst *Phytophthora* was not identified within the study area, it should be noted that the entire alignment is underlain by the Spearwood and Quindalup Dune systems. This is significant as *P. cinnamomi* does not typically express significant disease symptoms on the alkaline, calcareous soils associated with these dune systems. The pathogen may be present within the soil, but it will subsist as an organism, rather than proliferate and manifest as significant disease.

The mappable sections of the study area have been classified as uninfested.

Three sections of unmappable vegetation were observed during the assessment (see Appendix 1). The section of alignment between 6506600N and 6507800N contains plantations, and is largely void of remnant vegetation. The other two unmappable areas are associated with disturbance factors such as clearing, weed invasion and vehicle access. These disturbance factors have resulted in a significant reduction in native vegetation biomass, and as result, there are no longer sufficient indicator species to enable accurate disease detection and mapping.

There is also an uninterpretable section between 6500700N and 6501000N where the native vegetation is dominated by *Acacia* species that are not reliable indicators.

Several other sites exhibiting signs of vegetation decline were observed throughout the study area. Representative samples were taken from several of the affected areas, and all tested negative for the presence of *Phytophthora.* The results were expected, as the sites did not display the characteristic pattern associated with *Phytophthora* infestation. And while there was a slight chronology amongst the deceased plants, several of the deaths were clearly 'staged', meaning that the plant had died gradually over time, rather than experiencing a sudden death, which is typically associated with Phytophthora infection.

Recommendations

- Do not introduce soil or plant material of infested or unknown dieback status to the study area.

- Do not take soil or plant material from the study area for use at any other uninfested, protectable site.

- Ensure vehicles and machinery are clean upon entry into all sections of the study area

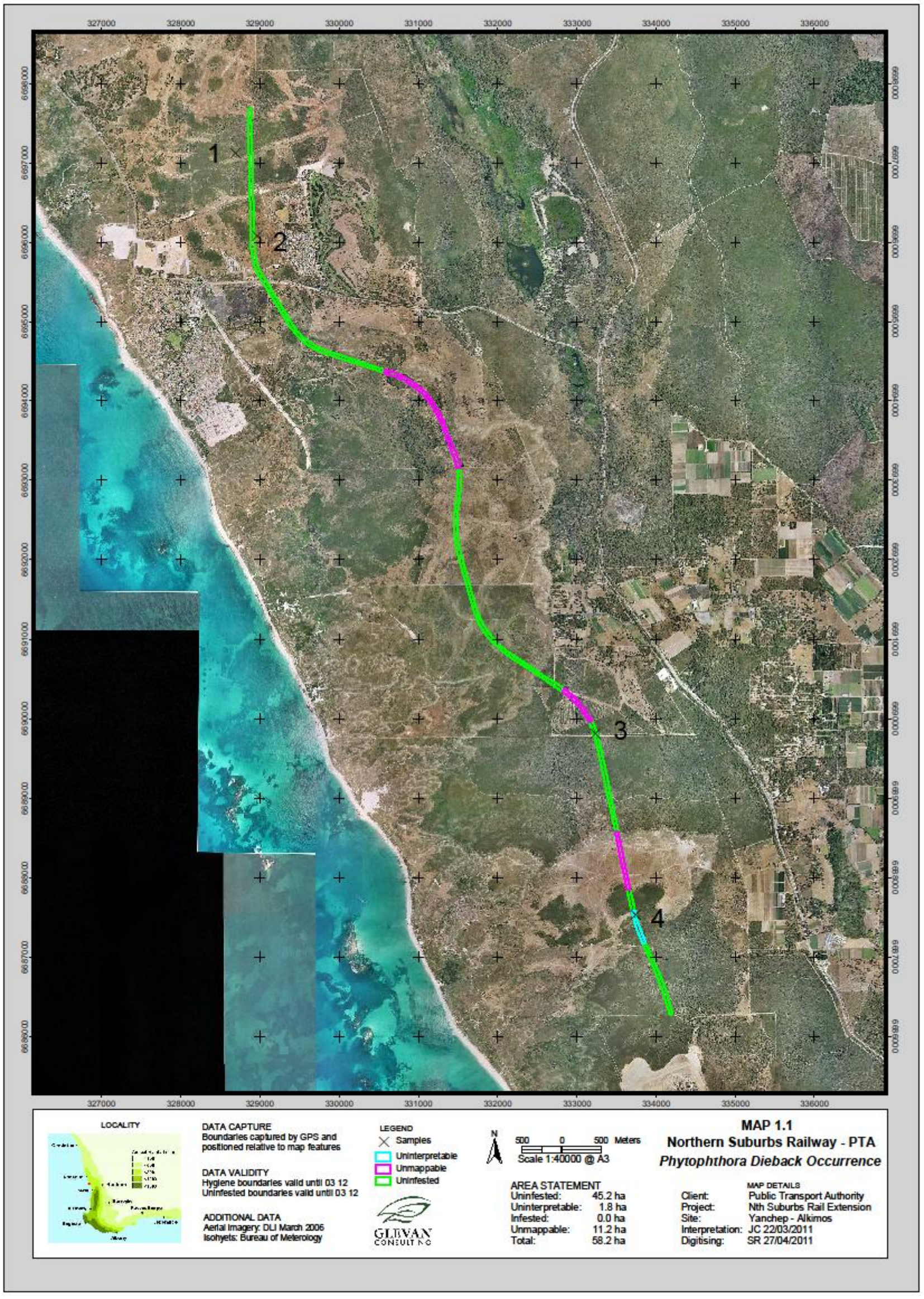
- Ensure that vehicles and machinery are inspected and cleaned down (where necessary) when moving from unmappable or uninterpretable areas to uninfested areas.

References

DEC (2003) *Phytophthora cinnamomi and the disease caused by it. Volume I – Management guidelines*. Department of Environment and Conservation.

DEC (2001) *Phytophthora cinnamomi and the disease caused by it. Volume II - Interpreter Guidelines for Detection, Diagnosis and Mapping*. Department of Environment and Conservation.

Appendix 1 – Maps



Appendix 2 – *Phytophthora cinnamomi* (Dieback)

Phytophthora cinnamomi is an introduced soil-borne pathogen (water mould) that kills a diverse range of plant species in South West Western Australia. Jarrah Dieback, the name given to the disease associated with *P. cinnamomi* is actually something of a misnomer. The Jarrah *(Eucalyptus marginata*) *is susceptible to P. cinnamomi*, but it also demonstrates a degree of resistance to the pathogen (that most susceptible species appear to lack), and hence it is often observed to gradually 'die back'. Most susceptible species however, do not gradually dieback, but rather experience a 'sudden death' in which the entire plant dies at once.

P. cinnamomi is thought to have been introduced to Western Australia shortly after European colonization and has since produced a complex mosaic of infected and uninfected areas throughout the southwest of the State. The spread of the pathogen accelerated after World War II with the use of heavy machinery being used for road building and logging activities and unknowingly spreading infected soil.

The life cycle of *P. cinnamomi* depends on moist conditions that favour the survival, sporulation and dispersal of the spores. The pathogen is not capable of photosynthesis and must extract food from living plant tissue. It does this via a mass of microscopic threadlike mycelium that forms the body of the organism that grows through host tissue. The mycelia continue to grow within the host tissue when the ambient moisture content is above 80%. The mycelia may be transported in soil and host tissue and then deposited where it may infect new hosts. During favourable (warm, moist) conditions, the mycelium, are capable of producing the millions of tiny spores that reproduce the pathogen. Two spore types are produced;

Zoospores

Zoospores are very small spores that can actively swim very short distances towards new hosts and initiate new infections. They are short-lived and fragile but produced in large numbers, and are the mode for the spread of the disease from one plant to the next. Zoospores can also be carried along in moving water over large distances. As they move through the soil zoospores lodge on plant roots, infect them, and in susceptible plants produce mycelia. The mycelium grows, feeding on the host, rotting the roots and cutting off the plant's water supply. The mycelium may grow from plant to plant via root-to-root contact points and/or root grafts.

Chlamydospore

Chlamydospores are larger spores that are tough and long-lived (within dead plants and the soil). They are produced under unfavourable conditions and are the resistant resting phase of the pathogen. They may be transported in soil or roots and then germinate to cause a new infection when they encounter favourable conditions. The chlamydospores produce mycelium and zoospores.

When conditions are warm and moist, microscopic spore sacks called sporangia and thick walled chlamydospores are produced vegetatively from mycelia strands that form the body of the pathogen in the soil or host tissue. The sporangia release motile zoospores in free water to infect host roots. Following infection, the pathogen invades root bark and forms lesions that may extend in to the plants stem collar. In susceptible species, the infection of roots and collar will result in the death of the host.

Mycelia of different mating types may grow together inducing the production of thick walled sexual spores called oospores. The two recognised mating types are known as either A1 or A2, and only one of these mating types (A1) is known to occur in WA. As a result, the pathogen cannot reproduce sexually in WA and relies on vegetative reproduction for survival and dispersal.

P. cinnamomi has a very wide host range, with at least 1000 species from taxonomically diverse families reported as hosts, almost half of which have been recorded from research in Australia. Indigenous species most affected belong to four families:

- Proteaceae
- Epacridaceae
- Papilionaceae/Fabaceae
- Myrtaceae

It has been estimated that approximately 1500 to 2000 species of the estimated 8000 species of vascular plants in the South West of WA may be susceptible to the degree that successful infections result in the death of the host. It is important to note however that not all genera within a family or all species within a genus are necessarily susceptible. Some species of *Eucalyptus,* for example*,* are highly resistant (including Karri, Marri, Wandoo and Tuart) while others, such as Jarrah, are affected but have the ability to resist the invasion of the pathogen under certain conditions (Tissue moisture content < 80%).

The survival of any *Phytophthora* species is dependant upon the presence of a combination of the pathogen, host and suitable environmental conditions. The optimum temperature for the growth of the organism is between 15°C and 30°C while the optimum temperature for sporulation is 25°C to 30°C. Temperatures less than 0°C and greater than 35°C are unfavourable to the survival of the spores and mycelium of *P. cinnamomi*.

Infertile soils are more compatible to *P. cinnamomi* where there is a good movement of water and little biomass with few antagonistic microflora. The soil texture allows for the easy lateral movement of the motile zoospores and the easy development of mycelium. Native vegetation that has adapted to the infertile soils through a large surface area of root matter is at greater risk of infestation.

Clay and laterite are significant components of some soil types of the southwest and may act as impeding layers and cause subsurface ponding, which can facilitate the production of spores. These soils tend to drain laterally, further spreading the zoospores. The moisture content of the soil must be at a level that provides for aerobic environmental conditions. Saturated soils may become anaerobic and will not contain the oxygen levels required for the production of sporangia.

In some areas that are environmentally suited to the establishment, survival and reproduction of the pathogen, the spread of *Phytophthora* infections has reached epidemic proportions. These areas are generally in areas receiving more than 800mm of rainfall annually. In areas receiving between 600-800mm, the occurrence of *P. cinnamomi* is less extensive and confined to water-gaining sites in the landscape.