APPENDIX 4

Forrestfield-Airport Link
Phytophthora Dieback Occurrence Assessment (Glevan Consulting, 2014)

Included as a separate hard copy report

Public Transport Authority

Forrestfield Airport Link

Phytophthora Dieback occurrence assessment

18-06-2014

GLEVAN
CONSULTING

Disclaimer

This report has been prepared in accordance with the scope of work agreed between the Client and Glevan Consulting and contains 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 during the assessmenrt.

Document version No: Final

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1 Summary

Glevan Consulting conducted an assessment of three nominated sections of vegetation associated with the Forrestfield-Airport Link Project for the presence of Phytophthora Dieback. The Project Area covered approximately 17.8 hectares, all of which was assessed for the presence of Phytophthora Dieback.

The assessment was conducted on the 22-05-2014 by Simon Robinson and no records or evidence of previous Dieback assessments were found for the area.

No Phytophthora Dieback infestations were identified during the assessment. The majority of the study area was observed to be unmappable, due to significant levels of disturbance, which has resulted in notable reductions in understorey species richness, and high levels of weed invasion. The disturbed areas exhibited significantly reduced biomass, and a distinct lack of reliable indicator species, meaning disease presence and distribution could not be confidently determined, resulting in an unmappable classification.

A single, relatively small section of vegetation in High Wycombe believed to be uninfested was identified and demarcated during the assessment. The demarcation provides a hygiene boundary between the uninfested and unmappable area, and where practical, will allow for hygiene measures to be incorporated during construction.

Three soil and tissue samples were taken during the assessment, all of which tested negative for the presence of Phytophthora Dieback.

The Phytophthora Dieback category mapping contained in the report is valid for 12 months and will expire on the 22-05-2015.

2 Introduction

2.1 Background

Glevan Consulting was commissioned by RPS on behalf of the Public Transport Authority (PTA) to conduct an assessment of three nominated sections of vegetation associated with the Forrestfield-Airport Link Project for the presence of Phytophthora Dieback. The PTA is proposing a spur rail line from the Bayswater Station/Midland line through to the eastern suburb of Forrestfield. Sections of the proposed rail line will pass through vegetated areas containing vegetation types that are susceptible to Phytophthora Dieback, and such areas require assessment to determine the Dieback status before construction works commence.

2.2 Location of Project Area.

The project area is located in close proximity to Perth Airport approximately 10km east of Perth CBD. The project area is comprised of three vegetated areas of varying size, and covers a total area of 17.8 hectares.

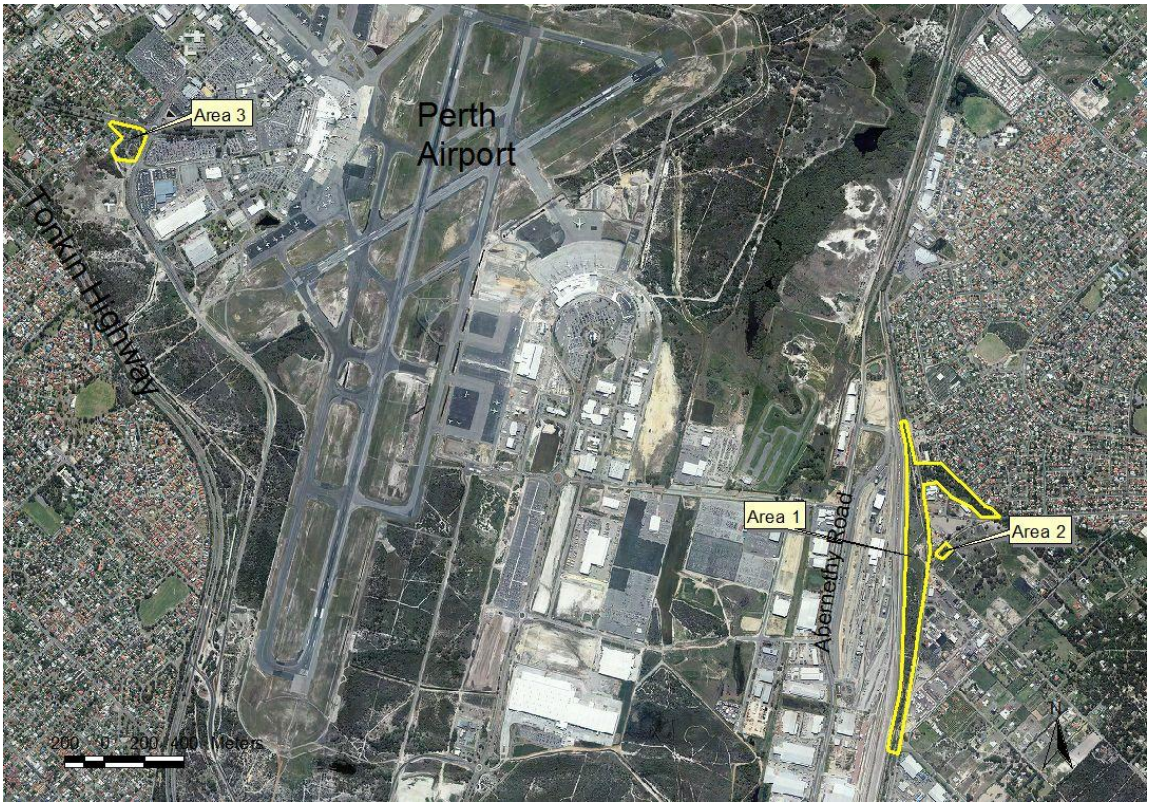

Figure 1 - Project Area

2.3 Historical land use and previous disturbances.

The study area has been subjected to significant disturbance activities in the past, most of which has likely occurred during the construction of the adjacent roads. All sections of the study area are also adjacent to either residential or commercial properties, which may have also contributed to the disturbance levels present.

2.4 Study team

The assessment was conducted by Simon Robinson of Glevan Consulting on the 22nd of May 2014. Mr Robinson is accredited by the Department of Parks and Wildlife in the detection, diagnosis and mapping of the Dieback disease. This accreditation recognises the skills and experience of Mr Robinson.

3 Methods

3.1 Pre survey desktop study

Known databases of *Phytophthora* locations retained by Vegetation Health Services (Department of Environment and Conservation) were searched to determine previous recoveries of *Phytophthora* within the project area.

3.2 Interpretation

During the assessment, the personnel involved in the field work will determine the presence of Phytophthora Dieback based on symptoms and disease signatures displayed in susceptible vegetation. These symptoms may be supported through the recovery of Phytophthora from soil and tissue samples taken during the assessment.

The detection of the plant pathogen Phytophthora Dieback involves the observation and interpretation of plant deaths (or reduction of biomass or perceived temporal change in vegetation structure) using a logical assessment of factors that imply pathogen presence above other possible causes of plant deaths or vegetation change. A combination of the following factors may indicate the presence of disease caused by *Phytophthora* Dieback or other *Phytophthora* species.

Deaths of disease indicating species:

An indicator species is a plant species, which is reliably susceptible to Phytophthora Dieback (i.e. will die). Common indicators include several species of *Banksia, Patersonia*, *Persoonia*, and *Xanthorrhoea*. The distribution and composition of indicator species will vary from place to place according to vegetation types.

Chronology of deaths:

As the pathogen spreads through an area, some or all susceptible plants become infected and die. Consequently there will be an age range from more recent deaths with yellowing or brown leaves through to older leafless stags to remnant stumps in the ground.

Pattern of deaths:

The topography, soil type, vegetation type and drainage characteristics of an area together with the influence of climatic patterns and disturbances will influence the shape or pattern of an infested area over time. A typical recent infestation may show a small cluster of dead indicator species which, in time, will spread to become a small circular shape 'the ulcer effect' and then begin lengthening towards natural drainage channels. A fringe of recent deaths is often seen around the edge of the infested area. Patterns may be further highlighted by a paucity of ground cover within the infested area.

Environmental factors:

Sites will vary in the way that disease is expressed both spatially and temporally. Environmental conditions can either favour or disfavour the growth and spread of the pathogen. Sites that are moist but not saturated are most favourable, sites that are well drained and mostly dry are least favourable.

Other causes of indicator species death:

Phytophthora cinnamomi is not the only agent to cause death of native vegetation. Other agents include, but are not limited to:

- other *Phytophthora* spp, *Armillaria luteobubalina*, various cankers, insects;
- drought, wind scorch, frost, salinity, water logging, fire and lightning;
- senescence, competition, physical damage;
- herbicides, chemical spills (for example fuel).

Based on the field assessment, the Project Area may be distributed across the following occurrence categories.

Table 1 - Phytophthora Dieback occurrence categories

Vegetated area	Infested	Areas that have plant disease symptoms consistent with the presence of Phytophthora Dieback
	Uninfested	Areas free of plant disease symptoms that indicate the presence of Phytophthora Dieback.
	Uninterpretable	Areas where indicator plants are absent or too few to determine the presence or absence of Phytophthora Dieback.
	Unmappable	Areas that are sufficiently disturbed so that Phytophthora Dieback occurrence mapping is not possible at the time of inspection.
	Not yet resolved	Areas where the interpretation process has not confidently determined the status of the vegetation.
Non-vegetated area	Excluded	Areas devoid of vegetation are excluded from the assessment area.

3.3 Landform and vegetation complexes.

Landform and vegetation types were taken into consideration when conducting the assessment, as both of these factors can significantly influence disease presence and distribution. Low-lying areas, and areas with highly susceptible vegetation are more likely to be infested, and are therefore targeted during the assessment. On the Swan Coastal Plain this means targeting interdunal depressions and Banksia Woodland.

3.4 Demarcation of hygiene boundaries

The boundary between the area believed to be uninfested, and the surrounding unmappable area was denoted with black and pink tiger tape. The taped boundary was positioned approximately 5-10m outside the unmappable areas, to provide a small buffer zone, and placed approximately 10m apart.

3.5 Soil and tissue sampling

Suspicious sites can have a representative soil and tissue sample taken to assist with the interpretation process. The laboratory result can confirm the presence of the *P. cinnamomi* pathogen. A negative result does not necessarily prove that the pathogen isn't present at the site, and should be supported by the field interpretation.

Sampling was conducted using the following procedure:

- All digging implements used were thoroughly sterilised prior to use with methylated spirits. The implements were then allowed to dry so that the integrity of the sample was not compromised.
- The area around the base of the plant/s to be sampled was cleared of vegetative matter to aid the digging process.
- The plant was dug to a satisfactory depth so that the tissue with the highest moisture content was obtained.
- Sections of the roots and stem base from all sides of the plant were taken and placed in a plastic bag. If any lesion was noticed on the tissue, it was also placed in the bag. A few handfuls of sand from various depths were also deposited in the plastic bag.
- The sample bags were irrigated with distilled water to try and simulate the optimum conditions for the *Phytophthora* to survive.
- Details, such as the date, sample number and interpreters were written on an aluminium tag, which was left at the site. The tag was demarcated with a strip of day-glow orange flagging tape.
- All digging implements used were again sterilised after each sample was taken to ensure that infected soil was not transported to the next sample site.

3.6 Mapping

Subsequent to hygiene boundary demarcation, the boundaries were again walked and recorded utilising a handheld GPS. The recorded data was then transferred to a desktop computer and used to produce the relevant maps.

3.7 Limitations of disease mapping

The assessment for the disease caused by Phytophthora Dieback is based on interpreting the vegetation for symptoms which can be ascribed to the disease presence. These observable factors must be present during the assessment period. Management recommendations may be included if it is considered that the disease may be cryptic, or the project area displays evidence of activities that are considered a high risk of introducing the disease.

The validity of the hygiene boundaries mapped for this project is twelve months from the completion of this project. All boundaries should be reassessed by 22/5/2015 if activities are still occurring beyond this time.

4 Results

4.1 Phytophthora Dieback occurrence distribution

No Phytophthora Dieback infestations were mapped within the study area. The majority (95%) of the study area was observed to be unmappable due to disturbance and a lack of reliable indicator species. The remaining 5% appears to be uninfested (Table 2). The potentially uninfested section occurs in Area one (High Wycombe, Refer Map 1.1).

Table 2 - Area Summary

Category	Area (ha)	% of total area
Infested (with *P. cinnamomi*)	0.0 ha	0%
Unmappable	17 ha	95%
Uninfested	0.8 ha	5%
TOTAL AREA	17.8 ha	

4.2 Soil and tissue samples

A total of three soil and tissue samples were taken during the assessment, all of which tested negative for the presence of *Phytophthora cinnamomi*.

Table 3 – Project Area Sample Summary

Sample	Plant sampled	Easting	Northing	Result
1	***Xanthorrhoea preissii***	**404915**	**6464345**	***Negative***
2	***Xanthorrhoea preissii***	**404740**	**6464001**	***Negative***
3	***Xanthorrhoea preissii***	**400811**	**6466354**	***Negative***

5 Discussion

Almost all (95%) of the 17.8 ha of vegetation assessed during the survey was observed to be unmappable, due to disturbance and an insufficient coverage of reliable indicator species. The remaining 5% (0.8 ha) of the project area has been mapped as uninfested. No infestations associated with Phytophthora Dieback were mapped within the study area.

Area Three is located at the corner of Dunreath Drive and Brearley Avenue (map 1.2) and exhibited a pattern of vegetation decline that is largely consistent with that normally associated with Phytophthora Dieback. The water-gaining sections of Area Three appear likely to be infested, but disturbance levels are such that this cannot be confidently determined. Evidence supporting the presence of Phytophthora Dieback included reduced biomass and several indicator species deaths exhibiting a notable degree of chronology. However, no evidence of a definitive disease front could be found, and the disturbance levels present mean that accurate delineation of disease boundaries would not be possible anyway. These factors, combined with the negative soil and tissue sample result, resulted in the area being classified as unmappable rather than infested.

Area One is located adjacent to Dundas Road in High Wycombe (Map 1.1) and is by far the largest of the areas assessed (15.2 ha). The majority of this area exhibited high levels of disturbance, and large sections that appeared to have been revegetated. Such areas did not contain a sufficient coverage of reliable indicator species, and were classified as unmappable.

Area One was also observed to contain a section (0.8 ha) of vegetation that is believed to be uninfested, which has been demarcated in the field to enable hygiene measures to be put in place, should it be practical for such measures to be employed during construction. The potentially uninfested section measures approximately 180m in length and is about 50m wide (Map 1.1), and contains a relatively undisturbed (most other areas are moderately or heavily degraded) and species rich understorey, with a reasonable coverage of larger trees throughout.

While this section is relatively undisturbed, the levels of weed infestation, and fairly low densities of reliable indicators, mean that it is not possible to be 100% certain of the Dieback status. The visual evidence, combined with the negative sample result, does however suggest that the section is uninfested and should be considered for protection during construction.

Area Two is a small section (0.28 ha) of highly disturbed vegetation immediately east of Area One (Map 1.1). The area contained several scattered *Xanthorrhoea preissii* deaths, and a sample was taken to confirm if the deaths are related to Phytophthora Dieback. The sample produced a negative result and the decline is thought to be related to factors other than Phytophthora Dieback. Again, the levels of disturbance present, meant that disease detection and distribution mapping was not possible, and the area was classified as unmappable.

6 Recommendations

- Consider employing hygiene measures at relevant points on the boundary of the section within Area One believed to be uninfested.

- Because the status of the potentially uninfested section within Area One is not 100% certain, soil and plant material from this area should not be used at other uninfested areas.

- Soil and plant material should not be transported from the unmappable sections of the study area for use at any other uninfested area.

- Soil and plant material of infested or unknown dieback status should not be introduced to uninfested or unmappable sections of the study area.

- Soil movement within each Dieback occurrence category is permissible, but should not occur across category boundaries, except where the source is uninfested.

- Vehicles and machinery should be clean upon entry into any of the site categories and when moving across category boundaries. Moving from uninfested areas into other categories does not require clean down measures.

7 Bibliography

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Keane, P., & Kerr, A. (1997). Factors affecting disease development. In APPS, J. Brown, & H. Ogle (Eds.), *Plant Pathogens and Plant Diseases* (pp. 287-298). Rockvale Publications.

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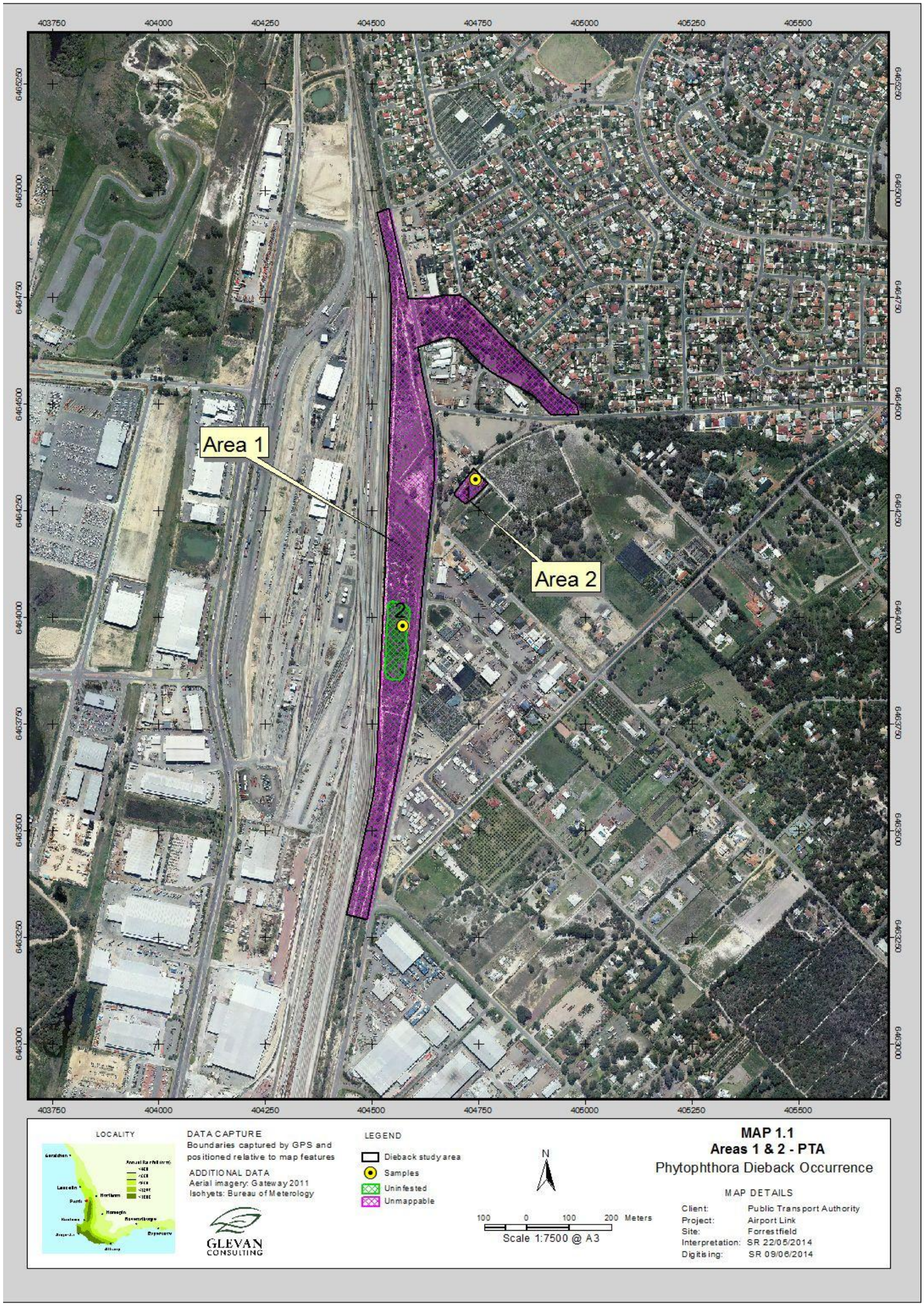
8 Appendix – Phytophthora occurrence map

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Area 3
LOCALITY
DATA CAPTURE
Boundaries captured by GPS and positioned relative to map features
ADDITIONAL DATA
Aerial imagery: Gateway 2011
Isohyets: Bureau of Meterology
GLEVAN CONSULTING
LEGEND
Dieback study area
Samples
Uninfested
Unmappable
N
10 0 10 20 Meters
Scale 1:1000 @ A3
MAP 1.2
Area 3 - PTA
Phytophthora Dieback Occurrence
MAP DETAILS
Client: Public Transport Authority
Project: Airport Link
Site: Forrestfield
Interpretation: SR 22/05/2014
Digitising: SR 09/06/2014

9 Appendix – Introduction to Phytophthora

Phytophthora Dieback is the name generally used in Western Australia to describe the disease symptoms of, and the causal agent, *Phytophthora cinnamomi*. This introduced soil-borne pathogen is a major threat to Australian vegetation, and in particular, the vegetation and dependent biota within the south west botanical province. This disease is listed as a key threatening process under the Environment Protection and Biodiversity Conservation Act 1999, with a subsequent threat abatement plan introduced in 2001 (Environment Australia 2001).

It is generally believed that Phytophthora Dieback was introduced to Australia during the early European settlement. From 1921, patches of healthy jarrah forest were observed to be dying, with Frank Podger and George Zentmyer establishing in 1964 that *Phytophthora cinnamomi* was the causal agent for the forest decline (DWG 2011).

The impact of the disease on the vegetation is dependent on climatic conditions along with host plant species and suitable soils (Keane and Kerr 1997). This relationship, shown in Figure 1, describes all aspects required to create the disease.

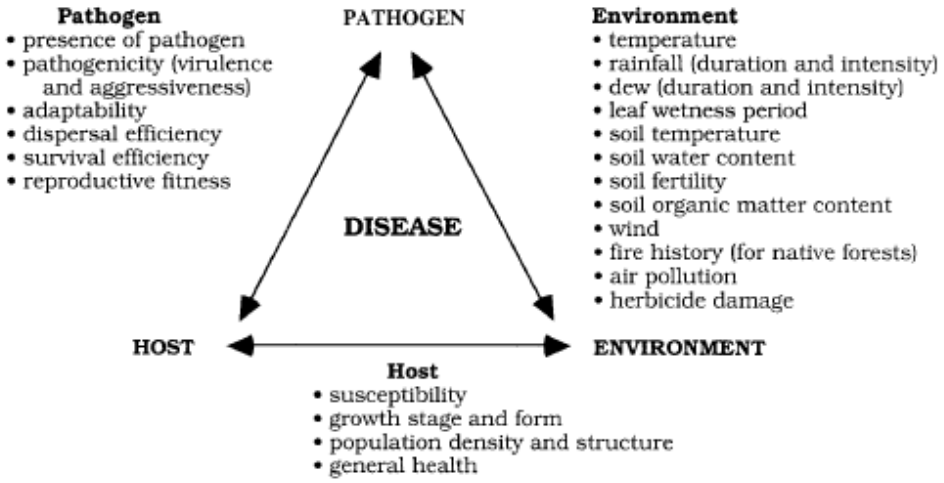

Figure 2 - Disease Triangle

This relationship is also described in Management of *Phytophthora cinnamomi* for Biodiversity Conservation in Australia Part 2 - National Best Practice Guidelines / Appendix 3

as the disease pyramid (O'Gara, et al. 2005). This figure includes the additional element of time to demonstrate the progressive impact of the disease on susceptible vegetation.

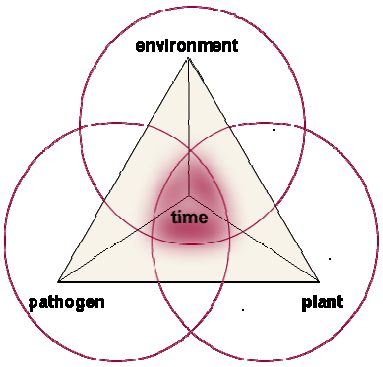

Figure A3.2 Disease pyramid showing disease epidemic (red shading) resulting from the convergence of virulent pathogen, susceptible host, suitable environment and time.

Figure 3 - Disease pyramid

It is recognised that Phytophthora Dieback has a greater and more widespread impact in areas of Western Australia where the average annual rainfall exceeds 600mm and the soil structure has a more acidic composition (Hardy, et al. 2001). The impact of the disease can be significant (but less widespread) in areas of lower rainfall if there are extra-ordinary rainfall events, or the pathogen is situated in a rainfall aggregating site, e.g. creek lines, water shedding from granite outcrops.

The impact of the pathogen on the Australian economy is significant, and is estimated to cost between $160 million (Carter 2004) and $200 million annually (EPA 2011).

The impact of the disease on animals is less understood, however the greatest impact is likely to be on those species that require relatively dense species-rich shrub lands or have restricted diets. There is a growing body of evidence that the dramatic impact of Phytophthora Dieback infestations on plant communities can result in major declines in some animal species due to the loss of shelter or food sources.