

Appendix F Dieback Assessment (Glevan 2020)

Main Roads Western Australia

Tonkin Highway Extension

Phytophthora Dieback occurrence assessment – Version 2.0



<i>Client</i>	<i>Main Roads Western Australia</i>
<i>Report name</i>	<i>Tonkin Highway Extension</i>

This report has been prepared in accordance with the scope of work agreed between Main Roads 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 manuals, particularly Phytophthora Dieback Interpreters Manual for lands managed by the Department (DBCA), 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 assessment.

Executive Summary

Glevan Consulting conducted an assessment of the development envelope associated with the Tonkin Highway Extension project for the presence of *Phytophthora Dieback*. The development envelope covers 441.7 hectares, beginning just north of the Thomas Road / Tonkin Highway intersection and extending south for approximately 12 kilometres to Mundijong road, where it extends eastwards for approximately 3.5 kilometres to the intersection of South West Highway and Jarrahdale Road.

The assessment was conducted on June 16, 2020 by Simon Robinson of Glevan Consulting. Two *Phytophthora Dieback* infestations, covering 5.0 ha were observed during the assessment. An additional 7.8 ha of unprotectable uninterpretable vegetation was also identified. The remaining 428.9 ha of development envelope was excluded from the assessment due to being degraded or void of vegetation.

Two soil and tissue sample were taken during the assessment, both of which tested positive for the presence of *Phytophthora cinnamomi*. A desktop assessment of previous *Phytophthora* spp. recoveries for the area indicates that *Phytophthora cinnamomi* was previously recovered at two locations within the development envelope.

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1 Introduction

Glevan Consulting was commissioned by Strategen-JBS&G on behalf of Main Roads Western Australia (Main Roads) to conduct an assessment of the development envelope associated with the proposed Tonkin Highway Extension. A dieback survey is required as part of the baseline surveys for the project to inform the environmental management requirements.

The development envelope covers 441.7 hectares, beginning just north of the Thomas Road / Tonkin Highway intersection and extending south for approximately 12 kilometres to Mundijong road, where it extends eastwards for approximately 3.5 kilometres to the intersection of South West Highway and Jarrahdale Road. (Figure 1).

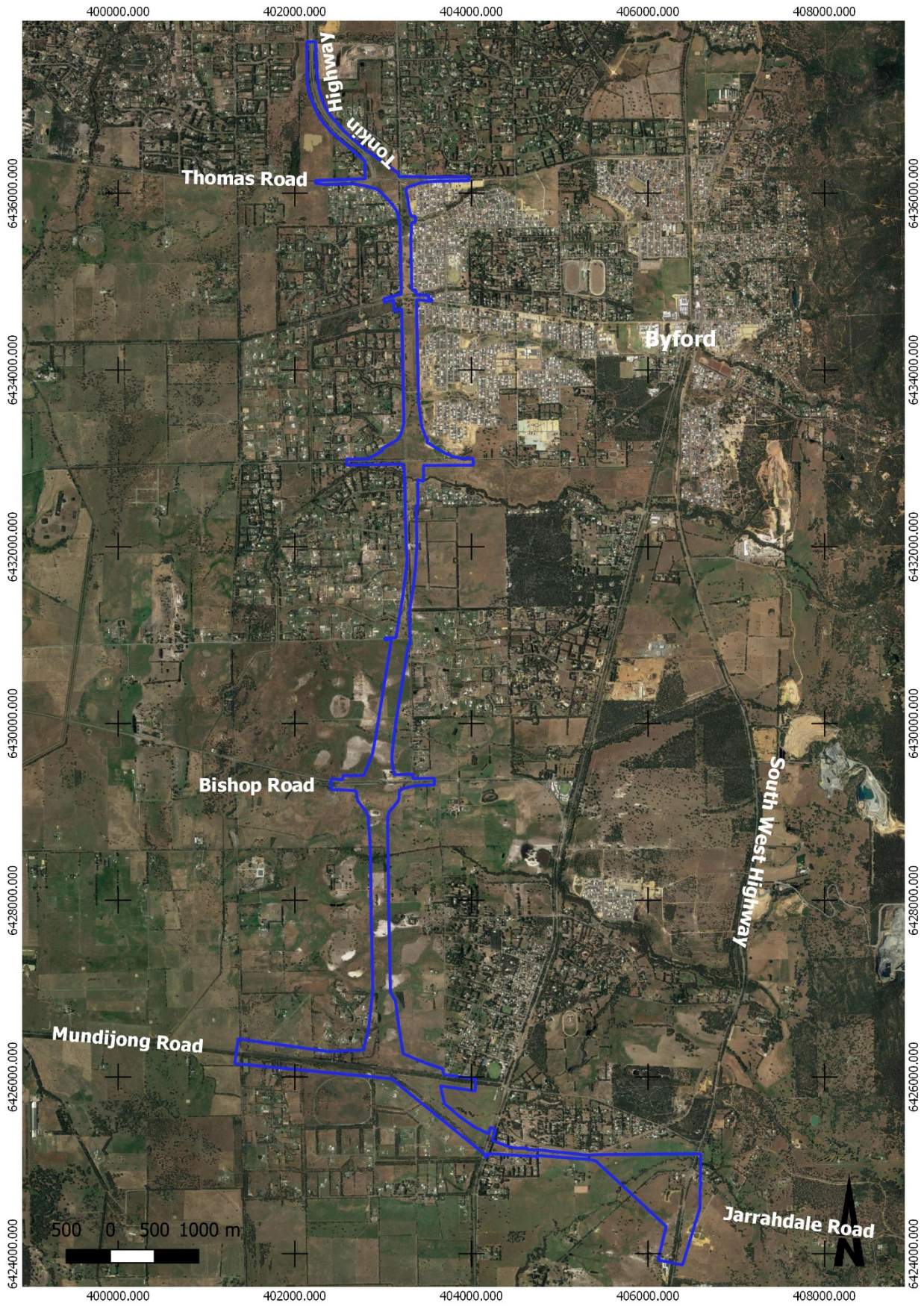


Figure 1 - Assessment area location

2 Background

Thousands of Australian native plant species are susceptible to Phytophthora dieback—a destructive disease caused by the pathogen *Phytophthora cinnamomi* and other *Phytophthora* species. This disease is a major threat to Australia’s biodiversity, placing important plant species at risk of death, local extirpation or even extinction. Its dramatic impact on plant communities can also result in major declines in some insect, bird and animal species due to the loss of shelter, nesting sites and food sources. *Phytophthora* dieback can cause permanent damage to ecosystems. Once an area is infested with the pathogen, eradication is usually impossible. Awareness that human activity can easily spread the pathogen will help prevent an increase in the extent of this disease (Commonwealth of Australia, 2018)

Phytophthora spp. are a group of microscopic water moulds that belongs to the class Oomycetes. Oomycetes organisms are filamentous and absorptive and reproduce both sexually and asexually. *Phytophthora* spp. are considered parasitic. The species behave largely as a necrotrophic pathogen causing damage to the host plant’s root tissues because of infection and invasion. (Department of Parks and Wildlife, 2015) The pathogen infects a host when it enters at a cellular level and damages the cell structure.

Phytophthora Dieback is the result of interaction between three physical components forming a ‘disease triangle’: the pathogen (*Phytophthora* spp.), the environment and the host. All three components are needed for the disease to develop over time. The relationship between the presence of *Phytophthora* spp. and the development of Phytophthora Dieback disease is variable and based on the susceptibility of native plant species and the different environmental characteristics, landform types and rainfall zones across bioregions.

Armillaria Rot Disease (ARD) is a pathogen frequently encountered during Phytophthora Dieback assessments. It is caused by an indigenous fungus which is endemic to the south-west of Western Australia, occasionally presenting symptoms consistent with Phytophthora Dieback presence. The impact of the fungus on the vegetation may range from single dead plants to complete devastation of understorey and overstorey species.

3 Materials and methods

3.1 The assessment area

As per Department of Parks and Wildlife (DPAW) (2015), areas within the development envelope are excluded from assessment if the vegetation is suffering from significant disturbance. This disturbance (Table 1) is based on Vegetation Condition Scales (Keighery, 1994). The remaining area, including the area outside of the development envelope if necessary, will be categorised post-assessment into Phytophthora Dieback occurrence categories (Table 2, Map 1).

Table 1 - Keighery Vegetation Condition Scale

Scale		Vegetation condition
1	Pristine	Pristine or nearly so; no obvious signs of disturbance.
2	Excellent	Vegetation structure intact; disturbance affecting individual species and weeds are non-aggressive species.
3	Very good	Vegetation structure altered; obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
6	Completely degraded	The structure of the vegetation is no longer intact, and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

Table 2 - Phytophthora Dieback assessment for vegetation condition

Vegetation Condition	Phytophthora occurrence category
Naturally vegetated areas. Keighery disturbance rating of 3 or less. Phytophthora occurrence categorisation is possible.	Infested - Determined to have plant disease symptoms consistent with the presence of <i>Phytophthora cinnamomi</i> .
	Uninfested - Determined to be free of plant disease symptoms that indicate the presence of <i>P. cinnamomi</i>
	Uninterpretable - Undisturbed areas where susceptible plants are absent, or too few to make a determination of the presence or absence of <i>P. cinnamomi</i> .
	Not yet resolved.
Vegetation structure temporarily altered.	Temporarily Uninterpretable - Areas of disturbance where natural vegetation is likely to recover.
Vegetation structure severely altered. Keighery disturbance rating 4 or greater. Phytophthora occurrence assessment is not possible	Excluded.

3.2 The assessment method

All Phytophthora Dieback detection, diagnosis and mapping was performed to standards and procedures defined in FEM047 Chapter 6 (DPAW 2015). These procedures are grounded on the presence in the vegetation of Indicator Species, and the observance of deaths in these plants. An indicator species is a plant species that is reliably susceptible to *Phytophthora cinnamomi*. Indicator species deaths (ISDs) alone do not necessarily indicate disease presence and it is necessary to consider all environmental and ecological factors that may be present. These other factors (as listed in FEM047) include:

- Chronology of deaths;
- Pattern of deaths;
- Topographical position;
- Vectoring – causal agencies, and;
- Biomass and biological diversity reduction.

Other causes of plant deaths need to be considered when determining the presence of Phytophthora Dieback, including (from FEM047):

- *Armillaria luteobubalina*;
- various cankers;
- insects;
- drought, wind scorch and frost;
- salinity and waterlogging;
- fire and lightning;
- senescence and competition;
- physical damage, and;
- herbicides and chemical spills.

Both the linear and comprehensive (featuring transect lines) assessment types were used during the survey and performed to standards defined by Chapter 8, FEM047. Prior to assessment, all information relevant to the project was assembled to assist the interpretation process (as defined in Chapter 7, FEM047). This information included previous assessments of the area, history of burning and possible other disturbances.

3.3 Other *Phytophthora* species

Phytophthora species other than *P. cinnamomi* are identified using DNA analysis by the Centre for Phytophthora Science and Management (CPSM) at Murdoch University following the identification of the presence of a *Phytophthora* species in baiting analysis performed by Vegetation Health Service (VHS) at the Department of Biodiversity, Conservation and Attractions (DBCA).

3.4 Collection of evidence of Phytophthora Dieback

During the assessment process, the collection of evidence to support the field diagnosis is recorded using a tablet running the ESRI Collector application. Waypoints are recorded at locations to show evidence of:

- where field diagnosis is certain or almost certain of Phytophthora Dieback infestation;

- healthy indicator species where field diagnosis is almost certain of the site being uninfested;
- sites with too few or devoid of indicator species, thus supporting uninterpretable classification, or
- areas of disturbance, which are temporarily uninterpretable or excluded from assessment.

Additional waypoints recorded include:

- points requiring soil and tissue sampling;
- points located where samples have been taken;
- points located at ISDs, and
- points that need to be revisited for further examination.

3.5 Soil and Tissue Samples

Soil and tissue samples taken during the assessment were to standards and prescriptions defined in Chapter 11 of FEM047. All samples were analysed in the Vegetation Health Services (DBCA) laboratory using best-practice techniques.

Taking a soil and tissue sample from dead and dying plants is an integral part of assessment – although in some cases sampling is not essential. Sample results provide evidence to support field diagnostic decisions. The following table (Table 3) shows the need for sampling to assist the disease diagnosis process (Department of Parks and Wildlife, 2015).

Table 3 - Determination of requirement for sampling

Observable factors indicating likelihood of <i>Phytophthora cinnamomi</i> presence				
ISD type	Multiple	Cluster	Scattered	Isolated
Species	Some or most indicator species	Any indicator plant	Any indicator plant	Any indicator plant
Pattern development	Obvious			Not obvious
Chronology	Obvious			Not obvious
Topographic situation	Gully/flat	Lower to mid slope	Mid slope to upper slope	Ridge
Causal agent	Obvious			Not obvious
Requirement for soil and tissue sample	Low	High	High	Low

4 Results

4.1 *Phytophthora* Dieback Occurrence

Two *Phytophthora* Dieback infestations, covering 5.0 ha were observed during the assessment (Map 1). An additional 7.8 ha of unprotectable uninterpretable vegetation was also identified. The remaining 428.9 ha of development envelope was excluded from the assessment due to being degraded or void of vegetation (as per DPAW 2015). No protectable areas were identified during the assessment.

A desktop assessment of previous *Phytophthora* spp. recoveries for the area indicates that *Phytophthora cinnamomi* was previously recovered from two locations within the development envelope (Map 1).

Table 4 - Area Summary

Category	Area (ha)	% of total area
Infested (with <i>Phytophthora</i>)	5.0	1.25
Uninterpretable	7.8	1.75
Excluded	428.9	97
TOTAL AREA	441.7	100.0

4.2 Disease symptoms and expression

Evidence of disease presence associated with the Bishop Road infestation was characterised by several *Banksia attenuata* and *Banksia menziesii* deaths, featuring obvious chronology. The Mundijong Road infestation was more subtle, with only occasional *Xanthorrhoea preissii* deaths observed.

4.3 Other *Phytophthora* species

No other *Phytophthora* spp. were identified during the assessment.

4.4 Armillaria luteobubalina

No infestations associated with ARD were observed during the assessment.

4.5 Sample results

Two soil and tissue samples were taken during the assessment. The results are presented in section 7.1.

5 Discussion

The majority of the development envelope was either cleared or completely degraded and void of understorey vegetation. As such, these areas could not be assessed for the presence of *Phytophthora Dieback* and were excluded from assessment. Due to the presence of several water-gaining sites it is likely that the pathogen is present at some sites within the excluded area.

In addition to the recovery (Sample 2) during this survey, *Phytophthora cinnamomi* had been previously recovered in 1999 in two soil and tissue samples in the infested section adjacent to Mundijong Road. Disease expression was subtle throughout this area and the extent of infestation was not entirely clear and there was no apparent disease front. The area contains vegetation indicative of high soil moisture levels, making it a highly favourable site for the pathogen. Not only is pathogen likely to be present throughout the entire site, it is likely that the disease has been present for so long that it has reached a post-epidemic state and is behaving endemically (existing in equilibrium with its environment).

The vegetation to the west of the infested section of Mundijong Road was classified as uninterpretable due to an insufficient coverage of reliable indicator species. While the presence of the disease could not be detected, this section is also a high moisture site and is likely to be infested. No recent indicator species deaths (ISD's) were present and a soil and tissue sample could not be taken to assist in confirming the presence / absence of the disease. Due to the presence of the disease nearby, the high moisture levels of the soil and obvious disturbance throughout the area, the vegetation is not considered protectable. In addition, the strip of vegetation is typically only 40 – 50m wide and is not contiguous with any larger areas of native vegetation.

There are no protectable areas within the development envelope and as such there are no hygiene boundaries. Vehicles and machinery should still be clean when arriving on site to be free of weeds and seeds. After completion of work in the development envelope, vehicles and machinery should also be cleaned prior to use in any other project areas that may contain protectable vegetation.

6 Bibliography

Commonwealth of Australia. (2018). *Threat abatement plan for disease in natural ecosystems caused by Phytophthora cinnamomi*.

Department of Parks and Wildlife. (2015). *FEM047 Phytophthora Dieback Interpreter's Manual for lands managed by the department*. Unpublished.

Keighery, B. (1994). *Bushland Plant Survey: a Guide to Plant Community Survey for the Community*. Wildflower Society of WA (Inc.).

7 Appendices

7.1 Sample Summary

Two soil and tissue samples were taken during the assessment, both of which returned a positive result for the presence of *P. cinnamomi* (Table 5).

Table 5 Sample Results

Sample no	Plant Sampled	Easting	Northing	Result
01	<i>Banksia attenuata</i>	403151	6429335	<i>P. cinnamomi</i>
02	<i>Xanthorrhoea preissii</i>	403885	6425981	<i>P. cinnamomi</i>

7.2 Phytophthora Dieback Occurrence map

The provided map is the Phytophthora Dieback occurrence map. The project area is displayed as a blue boundary line. The following categories are also shown (if present in the project area):

- Excluded (shown as uncoloured). Areas of high disturbance where natural vegetation has been cleared and is unlikely to recover to a level that is interpretable.
- Infested (shown as red). Determined from the assessment to have the plant disease caused by *Phytophthora cinnamomi*. Phytophthora Dieback caused by other *Phytophthora* species will be displayed as other colours, typically shades of orange and yellow.
- Uninfested (shown as green). Determined from the assessment to be free of plant disease Phytophthora Dieback.
- Uninterpretable (shown as purple). Undisturbed areas where susceptible plants are absent, or too few to decide the presence or absence of Phytophthora Dieback.
- Temporarily Uninterpretable (shown as grey). Areas of disturbance where natural vegetation is likely to recover.

Additional spatial data that may be shown include:

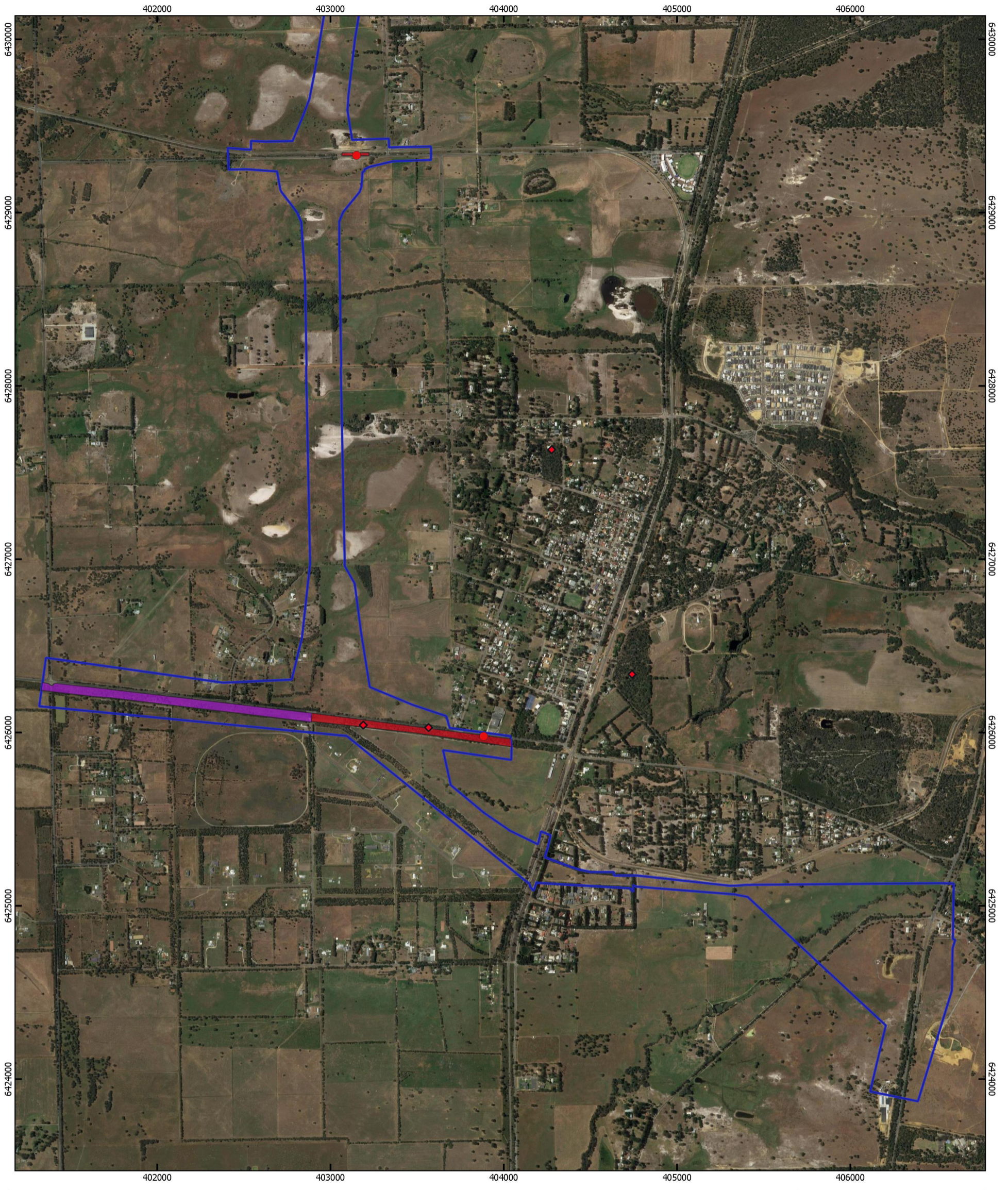
- Sample location

7.3 Mapping Metadata

DATASET DESCRIPTION	
Title	Tonkin Highway Extension
Data Created	16-06-2020
Date Last Updated	20-07-2020
Abstract	Phytophthora Dieback Occurrence and sample location shapefiles for the Tonkin Highway Extension development envelope.
Purpose	Dieback category boundary mapping
Document Number	20-1005
Contact Organisation	Glevan Consulting
Contact Name	Simon Robinson
Contact Position	Phytophthora Dieback Interpreter
Contact Phone	0427 113 336
Contact Email	simon.robinson@glevan.com.au
Lineage	All field data recorded using ESRI Collector on a GPS enabled tablet.
Datum / Coordinate System	GDA94 Zone 50
Geographic Description	From just north of Thomas Road / Tonkin Highway intersection, south to Mundijong road, then east to the intersection of South West Highway and Jarrahdale Road.
Restrictions	None

7.4 Shapefile spatial data

Spatial data is contained in the attached file named Tonkin_Highway_Extension_Shapefiles.zip.



**Map 1
Phytophthora Dieback
Occurrence Map**

**Tonkin Highway Extension
(Southern Section)
Main Roads W.A**

Occurrence

Infested

UI unprotectable

Excluded

Sample sites

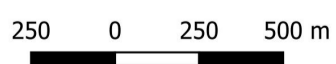
Positive

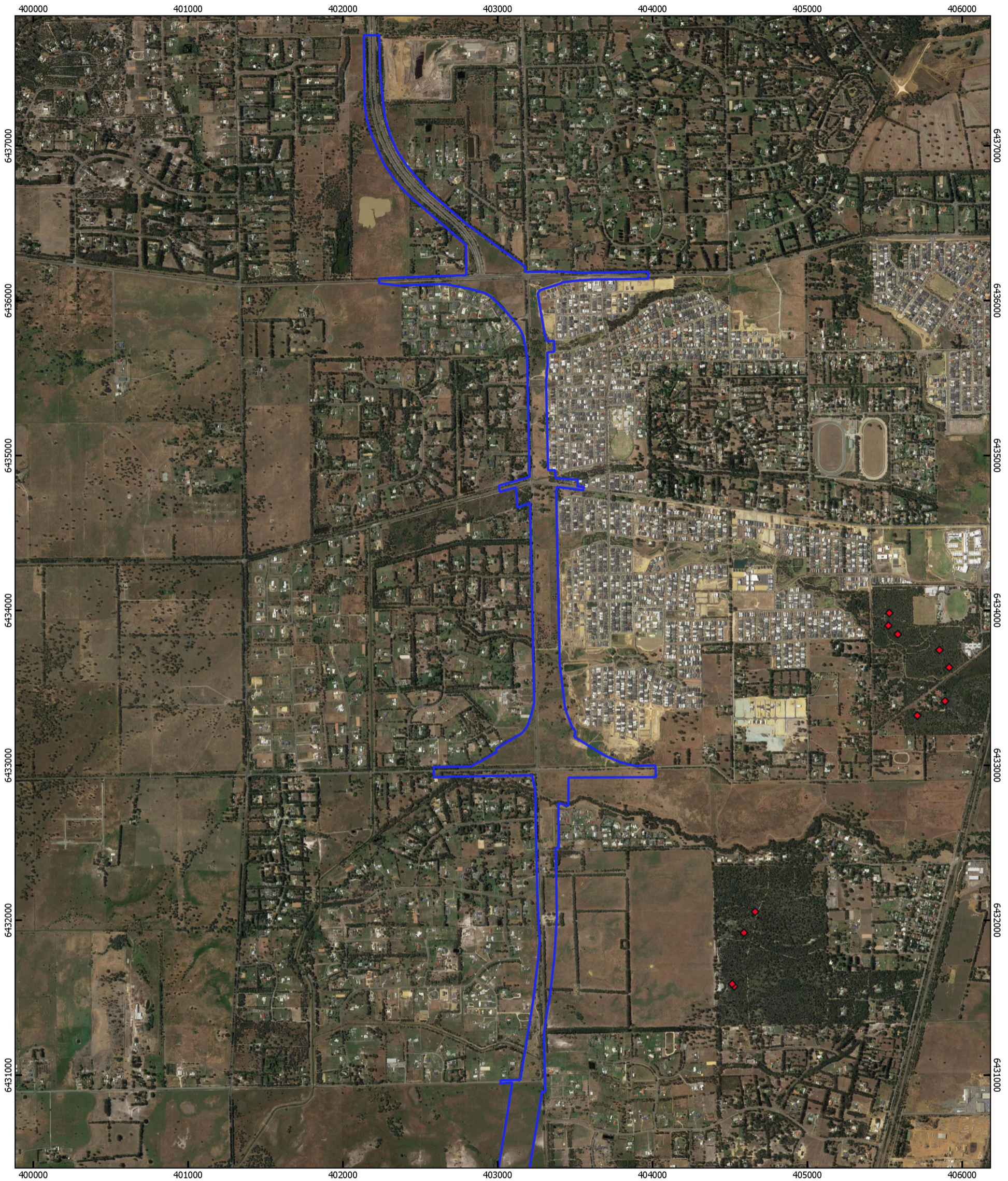
P. cinnamomi all years

Development envelope

Author: Simon Robinson
Date: 18-07-2020

Datum: GDA94 Zone 50
Mapping expiry: 16-06-2021





**Map 2
Phytophthora Dieback
Occurrence Map**

**Tonkin Highway Extension
(northern section)
Main Roads W.A**

Occurrence

- Excluded
- ◆ P. cinnamomi all years
- Development envelope

Author: Simon Robinson
Date: 18-07-2020

Datum: GDA94 Zone 50
Mapping expiry: 16-07-2021

