

Phytophthora Dieback Survey (Great Southern Biologic 2020)

Phytophthora Dieback Occurrence Survey

Bunbury Outer Ring Road South

3 March 2020



Phytophthora Dieback Occurrence Survey

Bunbury Outer Ring Road South

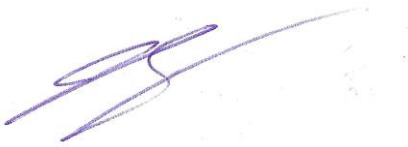
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EXECUTIVE SUMMARY

Main Roads Western Australia (Main Roads) is currently undertaking planning associated with development of the proposed Bunbury Outer Ring Road (BORR). The final alignment of the BORR is yet to be determined, however, a potential project footprint has now been developed for the southern section and forms the Environmental Study Area (Study Area) that is the current focus of planning activities. It is the BORR South Study Area that is covered in this report.

As a part of the environmental surveys that will inform project planning there is a requirement to assess the occurrence of *Phytophthora Dieback* within remnant native vegetation and identify areas within the Study Area that can be protected from the disease.

The *Phytophthora Dieback* occurrence survey was undertaken using survey methodologies referred to as linear and comprehensive transect surveys which are consistent with the DBCA guideline, *Phytophthora Dieback Interpreters Manual for lands managed by the Department* (2015). The information produced using these methods of survey provides operational level disease hygiene information for application across all assessable vegetation within the survey area. Due to the mobility of the disease through autonomous spread and human vectoring, all operational scale disease occurrence data has a limited life of 12 months.

During the desktop assessment and preliminary field visits, it was identified that most of the BORR South Study Area consists of cleared land or remnant vegetation in a degraded state. These areas were excluded from survey as they cannot be assessed due to the lack of disease indicator species required for disease diagnosis and/or a significant history of site disturbance.

Disease occurrence surveys were undertaken in all areas of assessable vegetation within the BORR South Study Area, which covered approximately 67.6 ha. The surveys identified three small areas of infested vegetation covering approximately 0.2 ha. These are all associated with disturbed sites in road verges associated with existing roads. Two of the infested areas are on Lakes Road to the west of the Bussell Highway and one is on the corner of Banksia Road and Woods Road to the east of the Bussell Highway. All other areas of assessable vegetation within the Study Area were determined to be either uninfested or uninterpretable. Approximately 45.7 ha of vegetation was assessed as uninfested and approximately 21.7 ha of vegetation was assessed as uninterpretable.

Seven soil and tissue samples were collected from assessable areas within the Study Area. The samples were collected to support visual disease assessment observed within infested areas. Three samples returned positive results for *P. cinnamomi* while the remaining four were negative, demonstrating that vegetation deaths in those areas are not attributable to *Phytophthora Dieback*.

Following the determination of disease hygiene categories, all uninterpretable or uninfested vegetation was assessed for protectability, using the Department of Biodiversity, Conservation and Attractions (DBCA) protectable areas criteria. It was determined that with the application of suitable hygiene during operational activities, approximately 57.1 ha of remnant vegetation within the Study Area can be protected from future introduction or spread of the disease.

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1 INTRODUCTION

1.1 Background

Main Roads Western Australia (Main Roads) is currently undertaking planning associated with development of the proposed Bunbury Outer Ring Road (BORR). The final alignment of the BORR is yet to be determined, however, a potential project footprint has been developed for the southern section and forms the project area that is the current focus of planning activities. BORR IPT is currently working with Main Roads to assist the project planning phase of the project and are currently co-ordinating a suite of environmental surveys to assess the environmental values within the proposed BORR southern assessment area. The environmental surveys are being performed within the Environmental Study Area (Study Area) which is presented in Figure 1.

As a part of the environmental surveys that will inform project planning there is a requirement to assess the distribution of Phytophthora Dieback within remnant native vegetation and identify areas within the Study Area that can be protected from the disease. Phytophthora Dieback is an introduced soil borne plant pathogen that affects up to 40% of native plant species within Western Australia. Most commonly the disease is caused by the species *Phytophthora cinnamomi*, however, other species such as *P. multivora* can also have significant impact under specific environmental conditions. Phytophthora Dieback is commonly introduced to an area through infested soils carried as basic raw materials or on vehicles, plant and machinery. In favourable conditions the pathogen can result in the collapse of entire vegetation communities. Once introduced to an area, Phytophthora Dieback will spread through further human vectoring and also via water movement and root to root contact, resulting in extensive infestations which may cause significant impact to native vegetation communities. There is currently no practical method of eradication of the pathogen.

1.2 Objectives

The objectives of the Phytophthora Dieback survey are to:

- Determine the presence/absence of the disease within areas of remnant native vegetation across the Study Area;
- Map the occurrence of the disease within areas of remnant native vegetation across the Study Area; and
- Apply relevant criteria to areas of disease free vegetation to determine the distribution of vegetation that can be protected from the future introduction and spread of the disease.

1.3 Scope of Works

In order to achieve the project objectives, the following scope of works was undertaken:

- Completion of a detailed desktop assessment of the Study Area involving an analysis of known infestations, topography, geology, land use and access;
- Completion of a comprehensive linear survey along each assessable road reserve within the Study Area, in accordance with the relevant methodology defined in the *Phytophthora dieback interpreters manual for land managed by the department* (Department of Biodiversity, Conservation and Attractions (DBCA), 2015);

- Completion of a comprehensive transect survey across each non-linear area of vegetation within the Study Area, in accordance with the relevant methodology defined in the *Phytophthora Dieback interpreters manual for land managed by the department* (DBCA, 2015);
- Collection of field data using a hand held GPS unit. Field data includes disease evidence points, sample locations, demarcated disease hygiene category boundaries and survey effort track files;
- Completion of a soil and tissue sampling program to verify field interpretation decisions. All samples were transported to the DBCA Vegetation Health Service (VHS) in Perth for analysis;
- Application of protectable area criteria to the site to identify areas that can be considered protectable from future infestation by *Phytophthora* species; and
- Development of a disease occurrence report inclusive of disease occurrence figures and associated spatial data. The report shall also present an assessment of the disease occurrence data against criteria in the *Phytophthora Dieback Management Manual* (DBCA 2017) and provide recommendations for the requirement of a Dieback Management Plan.

1.4 Site Characteristics

1.4.1 Study Area

The Study Area for the BORR South alignment, as defined by the BORR IPT Environmental Study Area shown in Figure 1, covers an area of approximately 296 ha. It intersects with the Bussell Highway at Centenary Road to the south of Bunbury and includes a corridor of land that extends east to adjoin the northern BORR alignment and also heads south to Ducane Road. From Ducane Road it turns south west and again intersects the Bussell Highway, in the vicinity of Lakes Road. The BORR South Study Area also covers a linear area of approximately 3.3 km of the existing Bussell Highway to the north and south of Lakes Road.

1.4.2 Land Use

The proposed BORR South footprint traverses a range of current land uses vested as both private and public lands. The majority of the Study Area consists of land that is currently privately owned and used for agricultural purposes and there is a small area that intersects land currently within an industrial quarry. In the southern area, to the west of Jilley Rd, the alignment follows a Main Roads reserve through the Gelorup residential area.

1.4.3 Climate

The Bureau of Meteorology (BoM) broadly classifies the climate across the south west region of Western Australia as warm summers with cold winters. The BoM maintains a network of weather stations across Australia to record weather data, with the nearest station to the project area being Bunbury. The long term average annual rainfall data from Bunbury shows that that annual average rainfall is 726.1mm/yr.

This is an important figure as the accepted distribution of *Phytophthora* is generally restricted by the 400mm isohyet with distribution in the 400-600mm/yr zone further restricted to sites with high summer rainfall averages or associated with water gaining sites. Based on the BoM climate classification and rainfall data it can be seen that the Study Area experiences suitable climatic conditions for *Phytophthora* to have a significant impact.

2 METHOD

In accordance with the agreed project scope of works, the field survey was undertaken using survey methodologies referred to as linear and comprehensive transect surveys. The linear survey and comprehensive transect survey methods are consistent with the DBCA guideline, *Phytophthora Dieback Interpreters Manual for lands managed by the Department* (2015). The information produced using these methods of survey provides operational level disease hygiene information for application across all assessable vegetation within the Study Area.

Due to the mobility of the disease through autonomous spread and human vectoring, all operational scale disease occurrence data has a limited life of 12 months. A summary of key survey activities is provided below.

2.1 Desktop Interpretation

The proposed northern BORR Study Area was subject to an initial desktop assessment involving a review of the Vegetation Health Service (VHS) *Phytophthora* sample database and examination of available aerial imagery to assess:

- The extent of assessable remnant native vegetation occurring within the Study Area;
- The known occurrence of *Phytophthora Dieback* within or influential to the Study Area;
- The occurrence of site specific or influencing high risk vectors including but not limited to roads, creek lines and gravel pits; and
- Evidence of existing disease signatures such as areas of obvious vegetation decline.

2.2 Field Survey

The operational scale survey was undertaken by a DBCA registered disease interpreter and involved visual diagnosis of the disease within areas of assessable remnant vegetation within the Study Area. Visual diagnosis was supported by laboratory assessment of soil and tissue samples.

Once identified, the occurrence of the disease was mapped using a hand held GPS unit and demarcation of disease hygiene boundaries was performed in the field using appropriately coloured flagging tape. All potentially uninfested areas upslope of infestations were traversed on foot to confirm the absence of the disease. In non-linear survey areas, transects through uninfested vegetation were spaced at 50 m intervals to ensure complete visual coverage of the entire assessable area to confirm the uninfested status.

Demarcation of disease hygiene boundaries was performed in accordance with the requirements defined in the *Phytophthora Dieback Interpreters Manual for lands managed by the Department* (2015). Flagging tape used for demarcation of hygiene boundaries is defined below:

- Infested vegetation – Dayglo Pink tape
- Uninterpretable – Pink and Black striped tape
- Uninfested – No demarcation

Demarcation tapes are tied on trees and other suitable bushes or shrubs, along the category boundary. Knots on the demarcation tapes face the category being demarcated. When demarcating infested or

uninterpretable vegetation adjoining uninfested vegetation, the tapes are placed 20m into the uninfested vegetation to allow a buffer between the hygiene categories. Adjoining uninfested and uninterpretable vegetation that are both classified as protectable are not demarcated.

Field data including disease presence and vegetation information was collected using a hand held GPS unit and converted to ArcGIS™ shapefiles. Collected field data included all sample locations, a point file of all identified individual plant deaths attributed to *Phytophthora*, disease hygiene boundaries and track files of the area covered during survey.

2.3 Sampling Program

Sampling for *Phytophthora* Dieback involves the collection of soil and tissue samples from fresh deaths of plants considered to be reliable indicator species of *Phytophthora* expression. Where suspicious deaths were identified, soil and root tissue material was collected into heavy duty plastic bags and forwarded to the Vegetation Health Service (VHS) laboratory for analysis.

All sampling undertaken was performed in accordance with the methods described in the *Phytophthora Dieback Interpreters Manual for lands managed by the Department* (DBCA, 2015).

3 ASSESSMENT CRITERIA

DBCA (2015) guidelines identify six potential disease hygiene categories based on presence/absence of the disease, or the unknown disease status of an area. An area can have an unknown disease status if the vegetation at the site is not susceptible to the disease or it cannot be assessed because of disturbance, e.g. fire. As a result, even if the pathogen is present, there may be no interpretable signs.

Only areas with suitable remnant native vegetation can be assessed. Areas that have been cleared or significantly altered are excluded from survey. In some cases small excluded areas may be afforded a hygiene category if they are small enough to be influenced by adjacent surveyed vegetation or situated such that topographical influences can be used to determine disease presence or absence.

The six possible disease categories are listed and described below:

1. **Infested** – Areas a registered interpreter determines to have plant disease symptoms consistent with the presence of *Phytophthora cinnamomi*.
2. **Uninfested** – Areas determined by a registered interpreter to be free of plant disease symptoms that indicate the presence of *P. cinnamomi*.
3. **Uninterpretable** – Natural, undisturbed areas where susceptible plants are absent, or are too few to make a determination of the presence or absence of *P. cinnamomi*.
4. **Temporarily uninterpretable** – Areas where disease presence or absence cannot be determined due to a level and type of site disturbance that will recover within the short to medium term, e.g. fire, rehabilitation.
5. **Not yet resolved** – *Phytophthora* occurrence diagnosis cannot be made because of inconsistent or incomplete evidence (including sample results). The category is only to be used in low interpretability zones (400mm to 600mm rainfall range).
6. **Disease risk roads (DRR)** – Interpreters will use the DRR category to show the disease status is unknown because of suspected or apparent recent use under unknown hygiene conditions.

Following the determination of disease categories, protectable areas are identified to determine areas that are likely to remain free from the disease with the application of appropriate disease hygiene as required.

Protectable areas are defined in the *Phytophthora Dieback Interpreters Manual for lands managed by the Department* (2015) as areas that:

- Have greater than 600mm of annual rainfall or are water gaining sites in the 400mm -600mm rainfall zone;
- Are determined to be free from *Phytophthora cinnamomi* by a DBCA registered disease interpreter. Uninterpretable areas may be classified as protectable;
- Comprehensive transect survey areas that are positioned in the landscape and are of sufficient size that they will not be engulfed by *Phytophthora* via autonomous spread. Such an area is defined as being greater than 3ha with a minimum axis greater than 100m, and not down slope of an infested area;

- Linear assessment areas longer than 100m after the application of appropriate disease category buffers;
- Have controllable human vectors; and
- Include high conservation and/or socio economic values.

4 RESULTS AND DISCUSSION

The BORR South Study Area is shown in Figure 1. A summary of key statistics are presented in Table 1 below while the disease occurrence and location of soil and tissue samples across the BORR South Study Area is shown in Figures 2a – 2c. The location of protectable areas that will require the application of appropriate hygiene during operational soil movement activities area also presented in Figures 2a – 2c. The results of the protectability assessment are presented in Section 4.4. Appendix A presents the VHS laboratory certificates for all samples collected during the assessment.

Table 1 – Summary of key statistics from the BORR south Study Area

BORR South Study Area – Summary of Key Statistics	
Area of Assessable Vegetation	67.6 ha
Infested Vegetation	0.2 ha
Uninfested Vegetation	45.7 ha
Uninterpretable Vegetation	21.7 ha
Protectable Vegetation	57.1 ha
Unprotectable Vegetation	10.5 ha

4.1 Desktop

4.1.1 Previous interpretation data

No previous disease assessment reports were available for lands within with the BORR South Study Area, however, a review of the VHS sample database identifies multiple historic positive recoveries of the disease within the vicinity of the Study Area, as shown on Figures 2a – 2c. Historic positive recoveries are usually associated with previous assessment but only represent confirmed disease present at a specific location. They do not define the extent of disease occurrence within an area.

Several VHS positive recoveries are situated to the north of the Study Area around the Bunbury airstrip and a single recovery was also noted to the north of the Study Area near the Centenary Road alignment. The closest of these is approximately 600m from the nearest point of the BORR southern Study Area.

There is a cluster of positive recoveries within remnant vegetation adjoining the Bussell Highway to the north of Harewoods Road and more positive recoveries south of Calinup Road to the east of the Bussell Highway. The closest is over one kilometre from the BORR south Study Area and none are considered to be directly influential to disease occurrence within the Study Area.

4.1.2 Assessable remnant native vegetation

As defined in the assessment criteria presented in Section 3, only areas with suitable remnant native vegetation can be assessed. Areas that have been cleared or significantly altered are excluded from assessment (i.e. those classed as degraded or completely degraded under the Keighery (1994)

condition scale). The extent of areas considered to be assessable due to the presence of remnant vegetation was initially determined during a review of available aerial imagery. Following this preliminary desktop assessment, 21 areas were considered to contain potentially assessable vegetation within the Study Area.

4.2 Comprehensive Transect and Linear Assessments

Due to the significant expanse of the BORR South Study Area the results of the comprehensive transect and linear surveys are reported as three separate survey sections that together encompass the 21 potentially assessable vegetation areas identified during the desktop assessment. Each section and associated area of assessable vegetation are shown and annotated on Figures 2a – 2c.

The majority of the Study Area traverses cleared agricultural land which is excluded from survey. There are also several vegetated areas identified during the desktop assessment as potentially assessable, but which have subsequently been excluded from assessment following preliminary site visits. These include:

- Areas of planted, non-native vegetation;
- Highly fragmented and weed impacted vegetation classified as degraded or completely degraded (Keighery 1994);
- Native remnant vegetation located on private property that was not approved for access and mapping (Lot 54 on P016596).

Vegetation descriptions provided for areas are not intended as botanical descriptions but instead are suitable for defining the vegetation in terms of assessability and interpretability for *Phytophthora Dieback*. It is assumed that detailed flora and vegetation descriptions will be provided by flora and vegetation surveys conducted independently of this *Phytophthora Dieback* report.

4.2.1 Section 1 – Centenary Rd Reserve to Lillydale Rd Jenour Farm; Lots 5, 100, 101, 161 and 244

Section 1 extends from the Centenary Road reserve, which forms the northern extent of the BORR South Study Area, south to Lillydale Road. It includes remnant vegetation within the Centenary Road reserve on both sides of the Bussell Highway, vegetation within five private properties currently managed as a single farm (Jenour Farm) and also vegetation within the Jules Road and Lillydale Road reserves. The desktop assessment identified 10 areas of potentially assessable vegetation in Section 1. These are referred to as survey areas (SA) 1 – 10. Disease occurrence and protectability classifications for SA 1 – SA 10 are shown on Figure 2a.

4.2.1.1 Vegetation

The vegetation in SA 1 consists of *Agonis flexuosa* (Peppermint) woodland on the corner of the Bussell Highway and Centenary Road and a narrow strip along Centenary Road that transitions from the woodland into wetland vegetation dominated by *Melaleuca* species. Both vegetation units are in Good condition.

Remnant native vegetation in SA 2 to SA 6, on the Jenour Farm, consists of a *Eucalyptus marginata* (Jarrah) forest over Peppermint over a mid-storey with *Banksia attenuata* and *B. illicifolia* over an understorey with scattered *Xanthorrhoea gracilis*. In SA 5 *B. illicifolia* is the dominant species while in

SA 4 the density of *Banksia* species was very low. Vegetation condition in the assessed vegetation was generally Good to Excellent, however, there were also significant areas where vegetation condition was Degraded to Very Degraded and so disease occurrence assessment was not possible.

Remnant vegetation in SA 7 and SA 9 consisted of wetland vegetation dominated by *Melaleuca* species with Peppermint trees around the perimeter. Vegetation condition in SA 7 ranged from Good to Very Good but detailed assessment was not possible as the area was largely under water. Vegetation condition in SA 9 was Degraded to Good.

Remnant Vegetation in SA 8 consisted of a narrow strip of *Corymbia calophylla* (Marri) forest over a mixed understorey of shrubs and herbs with significant impact from grassy weeds. Vegetation condition was assessed as Good to Degraded.

4.2.1.2 Disease Expression

No Phytophthora Dieback disease expression was observed in Section 1.

4.2.1.3 Disease Occurrence and Hygiene categories

As shown in Figure 2a, all vegetation in SA 1 SA 4, SA 7, SA 8, SA 9 and SA 10 has been classified as uninterpretable due to either insufficient disease indicator species or absence of disease indicator species within the vegetation. Similarly, the southern portion of SA 5 and small vegetated pockets in the west of SA 5 have also been classified as uninterpretable due to the low density of disease indicator species.

4.2.2 Section 2 – Lillydale Road to Jilley Road

Section 2 consists of remnant native vegetation within the Hasties Road, Allenville Road, Ducane Road and Marchetti Road reserves. It also includes Lots 1, 154 and 155 on Ducane Road. The desktop assessment identified seven areas of potentially assessable vegetation in Area 2. These are referred to as SA 11 – 16 and part of SA 9 which adjoins assessable vegetation on the Jenour Farm north of Lillydale Road. Disease occurrence information for SA11 – SA 16 are shown on Figure 2b while the southern portion of SA 9 was excluded from assessment following a site visit.

4.2.2.1 Vegetation

The vegetation in SA 11, SA 12 and the southern part of SA 9 were mostly introduced native species, planted along the perimeter of the industrial quarry site, presumably for screening or stabilization purposes.

The vegetation in SA 13 consisted of an open forest of Jarrah and Marri over a mid-storey with *B. attenuata*, *B. grandis* and *B. ilicifolia* over scattered shrubs and herbs including *X. gracilis*. SA 13 includes vegetation within Lot 1 Ducane Road, the adjacent Allenville Road reserve, and the Ducane Road reserve. In the very northern portion of SA 13 the vegetation was highly fragmented and impacted by grassy weeds resulting in a Degraded vegetation condition. This area was excluded from disease occurrence survey. The remaining vegetation in Lot 1 was in Very Good to Excellent condition, however, due to the impact of weeds and illegal dumping the vegetation in the two road reserves was Good to Very Good.

Vegetation in SA 14 and SA 15 to the south of Ducane Road consisted of a *Banksia* woodland dominated by *B. attenuata* with *B. grandis* and *B. ilicifolia*, over an open understorey of introduced

grasses but with *X. gracilis* and *Hibbertia hypercooides* also dominant. Occasional Jarrah and Marri trees were also noted but not common. SA 14 was particularly fragmented with minimal understorey species and was heavily impacted by grassy weeds. On this basis SA 14 was classified as Degraded and was excluded from further assessment. SA 15 was in Very Good condition with the exception of a small area in the south west which is highly fragmented and weed infested. This small area was in Degraded condition and excluded from disease occurrence assessment.

The vegetation in SA 16 is largely contained within the Marchetti Road reserve and consisted of an open Jarrah Marri forest over a mid-storey dominated by *Melaleuca*, but with some scattered *B. attenuata* and *B. grandis*. The condition ranged from Degraded to Good on the eastern side of the road with some Very Good to Excellent vegetation to the south of the road, however, this side of the road had been recently burnt.

4.2.2.2 Disease Expression

No visual disease expression was observed in Section 2, however, occasional scattered deaths of *Banksia* species were noted along roadsides outside of the BORR South Study Area.

4.2.2.3 Disease Occurrence and Hygiene categories

As discussed in Section 4.2.2.1 SA 9, SA11 and SA 12 were excluded from survey as they did not contain native remnant vegetation.

The assessable vegetation in the north of SA 13 was classified as uninterpretable on the basis of insufficient indicator species, which is the same classification applied to the vegetation along Ducane Road. The majority of the vegetation within Lot 1 and the Allenville Road reserve was classified as uninfested.

All assessable vegetation in SA 15 was classified as uninfested. This area contained a very high density of *Banksia* species which are highly susceptible to the disease and only occasional deaths were noted, with no obvious pattern of infestation that would be expected had *Phytophthora* been present. The native pathogen, *Armillaria luteobubalina*, which also kills *Banksia* species, was noted as fruiting bodies and fungal mycelium under the bark of dead individuals leading to the conclusion that *Armillaria* is the cause of vegetation deaths in SA 15.

SA 16 has been classified as uninterpretable on the basis of limited disease indicator species. Vegetation in this area also contained Degraded patches where disease presence cannot be confidently assessed. A single soil and tissue sample was collected from roadside vegetation approximately 200m north of SA 16 and it returned a positive sample so it is considered likely that the disease will be present in SA 16 but was undetectable at the time of survey. The results from the soil and tissue sampling program are presented in Section 4.3.

4.2.3 Section 3 – Jilley Road to Bussell Highway

Section 3 includes remnant vegetation within the proposed BORR reserve and associated road reserves including the Bussell Highway, with five areas of potentially assessable vegetation identified. These are referred to as SA 17 – 21. Disease occurrence information for SA 17 – SA 19 is shown on Figure 2c while SA 20 and SA 21 were excluded from assessment following a site visit.

4.2.3.1 Vegetation

A minor watercourse flows along the southern boundary of the eastern section of SA 17 and here the vegetation is dominated by a mixed open forest of over sedges and wetland vegetation. The remainder of vegetation in SA 17, SA 18 and SA 19 consists of a mixed forest with Jarrah, Marri and *Eucalyptus gomphocephala* (Tuart) over a mid-storey of Peppermint, *B. attenuata*, *B. grandis* and *B. ilicifolia*, with the *Banksia* species becoming more dominant as the alignment heads west. There are some small areas of vegetation associated with narrow road reserves where the vegetation condition ranges from Totally Degraded through the Good, however, the majority of the vegetation in Section 3 is considered to be in Excellent condition.

4.2.3.2 Disease Expression

Phytophthora Dieback was identified through fresh deaths of *Banksia attenuata* and *B. grandis* on roadsides where there is ongoing uncontrolled access and disturbance. Expression at every confirmed infestation included several fresh plant deaths and a range of older deaths indicative of progressive disease movement across the area through root to root contact.

4.2.3.3 Disease Occurrence and Hygiene categories

One infestation was identified in vegetation on the corner of Banksia Road and Woods Road in SA 18. The infestation spreads into the private property on the western side of Banksia Road and while disease expression was absent on the eastern side of the road, it has also been classified as infested as it falls within the required buffer for infested vegetation. The assessable vegetation on Banksia Road does not extend onto Woods Road and so it was not possible to map the extent of the infestation along Woods Road, however, there was no disease expression to the south of Woods Road or along Woods Road to the east of Banksia Road.

Another infestation was identified on the southern side of Lakes Road to the west of the Bussell Highway in SA 19. The vegetation in this area is limited to a narrow continuous strip within the road reserve. The infestation was identified under a power line at the intersection of Lakes Road and Tamara Close. From this point the road reserve heads west up a minor rise which was uninfested at the time of survey. The infestation again impacts vegetation within the road reserve west of the small rise and extends further west and heads outside of the Study Area.

The minor watercourse in SA 17 is classified as uninterpretable due to an absence of disease indicator species and a temporarily uninterpretable area has been mapped to the north of SA 17 where a small area has been recently burnt. The remainder of the assessable vegetation within Section 3 has been classified as uninfested.

4.3 Sample Program

Seven soil and tissue samples were collected from assessable vegetation within the Study Area. The samples were collected to support visual disease assessment observed within infested areas. All sample locations and results are presented on Figures 2 a – c which also show the locations of historic VHS positive sample records. Three samples returned positive results for *P. cinnamomi* as shown in Table 2 below.

Table 2 – Sample data from the BORR South Study Area

Soil and Tissue Sample Data – BORR South Study Area			
Sample label	Species sampled	Location	Sample result
Bunbury Outer Ring Road Sth 1	<i>B. attenuata</i> , <i>B. grandis</i>	E 370869 N 6299048	<i>P. cinnamomi</i>
Bunbury Outer Ring Road Sth 2	<i>B. attenuata</i>	E 372095 N 6300165	<i>P. cinnamomi</i>
Bunbury Outer Ring Road Sth 3	<i>B. attenuata</i>	E 373579 N 6300624	Negative
Bunbury Outer Ring Road Sth 4	<i>B. attenuata</i>	E 374239 N 6301329	<i>P. cinnamomi</i>
Bunbury Outer Ring Road Sth 5	<i>B. attenuata</i>	E 373941 N 6305090	Negative
Bunbury Outer Ring Road Sth 6	<i>B. attenuata</i>	E 374185 N 6305090	Negative
Bunbury Outer Ring Road Sth 7	<i>X. gracilis</i>	E 374247 N 6301070	Negative

4.4 Protectability Assessment

The assessment of protectability for each area of assessable vegetation within the Study Area uses the protectability criteria presented in Section 3 applied to the vegetation under the circumstances observed during the disease occurrence survey. Protectable areas within the BORR South Study Area listed in Table 3 below and presented in Figures 2a – 2c.

Table 3 – Protectable Area assessment for the BORR South Study Area

Protectable Area Assessment – BORR South Study Area				
Assessable Vegetation Survey Area	Disease Hygiene Category	Protectability Assessment	Area (ha)	Justification
SA 1	Uninterpretable	Unprotectable	0.45	Uncontrollable human vectors
SA 2	Uninfested	Protectable	2.12	Controllable human vectors With adjoining vegetation, greater than 3ha
SA 3	Uninfested	Protectable	0.67	Controllable human vectors With adjoining vegetation, greater than 3ha
SA 4	Uninterpretable	Unprotectable	0.15	Uncontrollable human vectors
SA 5	Uninfested	Protectable	1.48	Controllable human vectors With adjoining vegetation, greater than 3ha
SA 6	Uninfested	Protectable	4.27	Controllable human vectors
	Uninterpretable	Protectable	8.08	Controllable human vectors No known disease in catchment – likely to be

Protectable Area Assessment – BORR South Study Area

Assessable Vegetation Survey Area	Disease Hygiene Category	Protectability Assessment	Area (ha)	Justification
				uninfested
SA 7	Uninterpretable	Unprotectable	3.41	Low lying area receiving drainage from uncontrollable vectors with known Pc in catchment
SA 8	Uninterpretable	Unprotectable	0.9	Uncontrollable human vectors
SA 9	Uninterpretable	Unprotectable	1.15	Insufficient size Low lying area receiving drainage from uncontrollable vectors
SA 10	Uninterpretable	Protectable	1.8	Controllable human vectors With adjoining vegetation, greater than 3ha
SA 13	Uninfested	Protectable	1.59	Controllable human vectors With adjoining vegetation, greater than 3ha
	Uninterpretable	Protectable	1.23	Controllable human vectors With adjoining vegetation, greater than 3ha No known disease in catchment – likely to be uninfested
	Uninterpretable	Unprotectable	0.28	Uncontrollable human vectors
SA 15	Uninfested	Protectable	5.85	Controllable human vectors Greater than 3ha
SA 16	Uninterpretable	Unprotectable	0.26	Uncontrollable, infested human vectors
SA 17	Uninfested	Protectable	7.03	Controllable human vectors
	Uninterpretable	Protectable	0.1	Controllable human vectors With adjoining vegetation, greater than 3ha
	Uninterpretable	Unprotectable	2.96	Watercourse receiving drainage from uncontrollable vectors
SA 18	Uninfested	Protectable	21.93	Controllable human vectors With adjoining vegetation, greater than 3ha Linear area greater than 100m
	Infested	Unprotectable	0.02	Positive sample recovery, disease expression
	Uninfested	Unprotectable	0.34	Uncontrollable human vectors
SA 19	Uninfested	Protectable	0.23	Controllable human vectors With adjoining vegetation, greater than 3ha
	Uninfested	Unprotectable	0.08	Insufficient size/length
	Infested	Unprotectable	0.13	Positive sample recovery, disease expression
	Uninterpretable	Unprotectable	0.27	Uncontrollable human vectors

4.5 Limitation of results

Phytophthora Dieback is a soil borne plant pathogen that spreads autonomously via root to root transmission, independently through the soil and also with the movement of water. The disease is also widely spread by human activities involving the movement of infested soil and plant material. As a result, the edge of a disease infestation is considered to be an actively spreading disease front, and all uninfested areas of vegetation that are associated with human vectors such as tracks and access ways are considered to be at risk of future infestation unless appropriate management is applied.

The disease occurrence data presented in this report is representative of the distribution of Phytophthora Dieback within assessable vegetation in the BORR South Study Area at the time of assessment. In accordance with DBCA guidelines (2015, 2017) Phytophthora Dieback occurrence data is valid for a period of 12 months from the date of assessment. After 12 months a disease re-check assessment is required and after three years a full re-assessment of the survey area will be required.

5 RECOMMENDATIONS

As shown in Figures 2a – 2c, protectable vegetation has been identified within road reserves and private property in the BORR South Study Area.

The DBCA *Phytophthora dieback management manual* (2017) guides the development of Phytophthora Dieback Management Plans (PDMP) for specific projects and is designed for application across lands vested with the DBCA during all potential soil movement activities. While not directly applicable to the proposed BORR South Study Area, development of a PDMP is considered Industry best practice. It is recommended that a PDMP consistent with the DBCA guidelines accepted by the Dieback management industry, other government authorities and regulatory agencies be developed.

The PDMP will need to address:

- Hygiene requirements associated with mitigating risks of exporting disease from infested and potentially infested areas of the survey area to all other areas, including other Main Roads sites external to the BORR South Study Area;
- Protection of protectable areas within the BORR South Study Area;
- Application of hygiene during all potential soil moving activities inclusive of preliminary site investigations, construction works and post construction revegetation and ongoing maintenance.

6 REFERENCES

Bureau of Meteorology (BoM) (2019): <http://www.bom.gov.au/climate/data/>

Department of Biodiversity Conservation and Attractions (DBCA) (2015), *Phytophthora Dieback Interpreters Manual for lands managed by the department*, Perth

Department of Biodiversity Conservation and Attractions (DBCA) (2017), *Phytophthora Dieback Management Manual*, Perth

Keighery, B.J. (1994), *Bushland plant survey. A guide to plant community survey for the community.* Wildflower Society of WA (Inc.), Nedlands, Western Australia.

7 REPORT DISCLAIMER

This report was prepared for BORR IPT, solely for the purposes set out in the scope of works and it is not intended that any other person use or rely on the contents of this report.

Whilst the information contained in the Report is accurate to the best of our knowledge and belief, Great Southern Bio Logic and its agents cannot guarantee the completeness or accuracy of any of the descriptions or conclusions based on the information supplied to it or obtained during the site investigations, site surveys, visits and interviews. Furthermore, field and / or regulatory conditions are subject to change over time, and this should be considered if this report is to be used after any significant time period after its issue.

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This report must be read, copied, distributed and referred in its entirety.

Figures

Phytophthora Dieback Occurrence Survey – Bunbury Outer Ring Road South





Figure 1: Environmental Study Area showing extent of Assessable Vegetation - Bunbury Outer Ring Road - South - October, 2019




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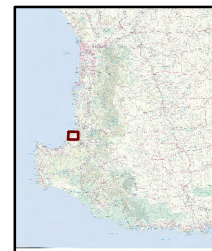
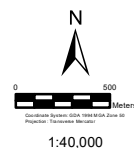
Ref: GSBL384
Date: 31-Oct-19

LEGEND

 Study Area

 Assessable Vegetation Survey Areas

 Location



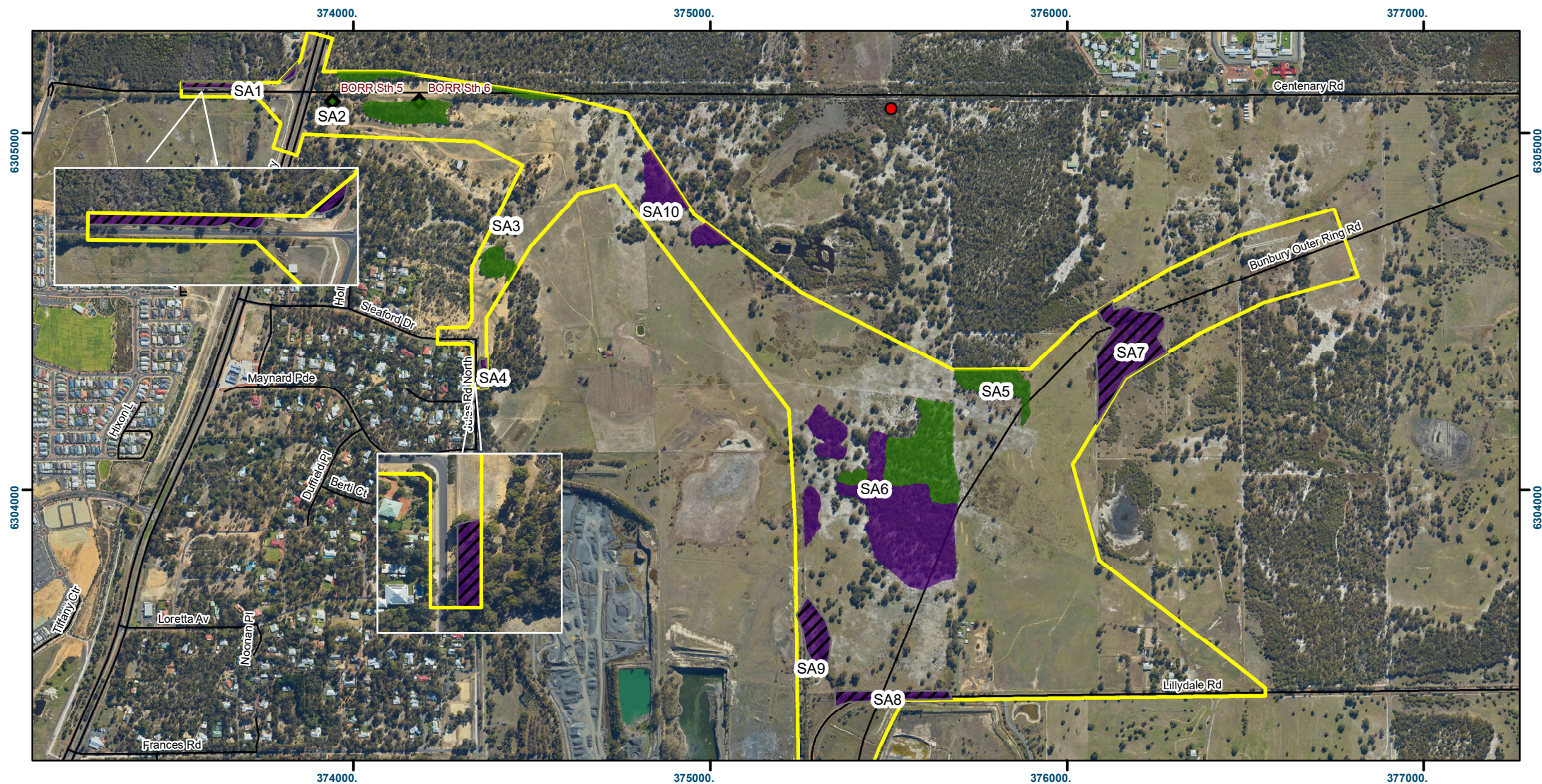


Figure 2a: Bunbury Outer Ring Road South - Section 1 Showing Disease Status, Protectability and Sample Results

LEGEND

- Study Area
- Status
- Infested
- Uninfested
- Uninterpretable
- Temporarily Uninterpretable
- Unprotectable

- Result
- P. cinnamomi
- Negative
- Historic P. cinnamomi



Figure 2b: Bunbury Outer Ring Road South - Section 2 Showing Disease Status, Protectability and Sample Results

LEGEND

Study Area

Status

- Infested
- Uninfested
- Uninterpretable
- Temporarily Uninterpretable
- Unprotectable

Result

- P. cinnamomi
- Negative
- Historic P. cinnamomi



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Date: 31-Oct-19



1:15,000



Figure 2c: Bunbury Outer Ring Road South - Section 3 Showing Disease Status, Protectability and Sample Results

LEGEND

- | | |
|--|--|
| Study Area | Result |
| Status | ◆ P. cinnamomi |
| Infested | ◆ Negative |
| Uninfested | ● Historic P. cinnamomi |
| Uninterpretable | |
| Temporarily Uninterpretable | |
| Unprotectable | |

Appendix A

VHS soil and tissue sample analysis report



Vegetation Health Service – Phytophthora sample information

FORM FEM046

CONTACT DETAILS of sender

Name Jeremy Spencer Phone No. 0400 113 093
 Fax No. _____ DPW Office or Company Name GS Bio Logic

Job Type (Please indicate)
 Private

VHA use only
 Date received 26.9.19
 Date faxed 10.10.19

SEND TO: Vegetation Health Service,
 Ecosystem Health Branch – Dept. Parks
 & Wildlife, 17 Dick Perry Ave,
 KENSINGTON 6151
 Phone: (08) 9334 0317
 Fax: (08) 9334 0114

VHS Identification Number (VHS USE ONLY)	Sample Date	Sample label (Give location, eg. Forest Block or Shire, etc. and sampler number)	Plant species sampled	Site Impact (2)	Zone 50 or 51	Map Reference (3)	Land Tenure (4)	RESULT s/s root (5)	RESULT bait (5)
VHS 39985	16-09-19	BORR Sth 1	<i>B. grandis</i> , <i>B. attenuata</i>	M	50	E 370869 N 6299048	R		CIN
VHS 39986	16-09-19	BORR Sth 2	<i>B. attenuata</i>	M	50	E 372095 N 6300165	R		CIN
VHS 39987	17-09-19	BORR Sth 3	<i>B. attenuata</i>	M	50	E 373579 N 6300624	R		NEG
VHS 39988	17-09-19	BORR Sth 4	<i>B. grandis</i>	M	50	E 374239 N 6301329	R		CIN
VHS 39989	18-09-19	BORR Sth 5	<i>B. attenuata</i>	M	50	E 373941 N 6305090	R		NEG
VHS 39990	18-09-19	BORR Sth 6	<i>B. attenuata</i>	M	50	E 374185 N 6305090	R		NEG
VHS 39991	18-09-19	BORR Sth 7	<i>X. gracilis</i>	M	50	E 374247 N 6301070	R		NEG

NOTES:

1. Please tick this box if your map references are supplied in the GDA 94 standard. If not, please specify the datum used.
 2. Site impact - Low, Moderate, or High (as in the Dieback Interpreter's Manual).
 3. An MGA map reference with prefixes must be supplied for all samples.
 4. Land tenure - State Forest (SF), National Park (NP), Reserve (R), Westral (W), Private (P), Gravel Pit (GP), or other. (Other - describe in comments below).
 5. Result codes used - CIN = *Phytophthora cinnamomi*, MLL = *P. multivora*, CRY = *P. cryptogea*, PI = *P. inundata*, ARE = *P. arenaria*, ELO = *P. elongata*, THE = *P. thermophila*, PM = *P. megasperma*, PN = *P. nicotianae*, CON = *P. constricta*, NEG = negative, SUB = subcultured for further tests.
- Please Note: a.) NEG results cannot be used to represent a total absence of *Phytophthora* in the sampled area. b.) Information from your samples will be incorporated into the VHS database and map products, which may be made available to the public and third parties to be used for research and other purposes.

COMMENTS:

BUNBURY OUTER RING ROAD