



**Broad scale survey of *Phytophthora*
Dieback Distribution and Reserve
Hygiene Management Plan for Peace
Street and Redgum Lane Reserves and
a portion of the Denmark-Nornalup
Heritage Rail Trail**

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EXECUTIVE SUMMARY

In 2008, Green Skills was commissioned by South Coast Natural Resource Management to conduct an assessment of the presence of the pathogen *Phytophthora* dieback within ten peri-urban reserves in the Shire of Denmark. Assessments were designed to identify healthy and infested reserves and to prioritise and develop recommendations for at least three reserves requiring pathogen management.

As a follow-up to the 2008 interpretation program, the Shire of Denmark engaged Great Southern Bio Logic to undertake a re-assessment of the Peace Street (R46688), Redgum Lane (R41224) and the Denmark-Nornalup Heritage Rail Trail at Wilson Inlet Foreshore (includes Reserve No. 43923 and Rudgyard Place and South Coast Highway road reserves) in November of 2015. This project received funding from the Western Australian Government's State NRM Program.

The objective of the project was to verify the original disease distribution information through the collection of soil and tissue samples, and also to survey the reserves for new areas of disease introduction and spread. This report presents the results of the survey and provides hygiene recommendations specific to the three reserves. It is intended to be used as an addendum to the 2008 Green Skills report which covers ten Shire reserves.

In accordance with the agreed project scope of works, field surveys were undertaken using a methodology referred to as broad scale survey. The broad scale interpretation method is defined in the Department of Parks and Wildlife (DPaW) operational guideline, *Phytophthora Dieback Interpreters Manual for lands managed by the department* (DPaW 2015). Broad scale survey focuses on disease distribution associated with areas of potential disease vectoring, including roads, tracks, drainage lines, gravel pits and other areas where soil moving activities and human traffic provide a potential for the introduction of the disease. Disease distribution information from surveyed areas is then extrapolated using the natural topography to provide a picture of the likely disease distribution across a larger area and to identify areas that can be protected from disease introduction and spread. As not all areas are covered by on-ground assessment, there is a possibility that small infestations may be present within large protectable areas. For the purposes of the Denmark Reserves project, all areas previously identified as uninfested were checked on foot and active disease boundaries were accurately mapped if the uninfested category remained applicable.

The 2015/16 surveys identified *Phytophthora* dieback in all reserves and associated survey areas however some areas of uninfested vegetation were also located and mapped. Some areas of uninterpretable vegetation were also identified in the Peace Street Reserve due to recent fire and the Wilson Inlet Reserve due to low densities of indicator species. All reserves experience high levels of public use for recreation which has facilitated extensive disease spread. While the uninfested areas in each reserve persist, the ongoing disease vectoring associated with the recreational use has resulted in all areas being classified as unprotectable from future infestation.

In addition to the disease management recommendations presented by Green Skills in 2008, Great Southern Bio Logic has made recommendations to address the disease spread since 2008 including operational activities in uninterpretable areas and community awareness.

1 INTRODUCTION

1.1 Background

In 2008, Green Skills was commissioned by South Coast Natural Resource Management to conduct an assessment of the presence of the pathogen *Phytophthora* dieback within ten peri-urban reserves in the Shire of Denmark. Assessments were designed to identify healthy and infested reserves and to prioritise and develop recommendations for pathogen management.

The resulting report, *A Study into the Risk of Phytophthora Dieback in Ten Peri-Urban Reserves within the Shire of Denmark* (Green Skills, 2008), incorporates basic *Phytophthora* dieback information, the results of on-ground surveys and disease management recommendations which serve as a generic disease management plan with specific priority outcomes relating to Mount Hallowell (R46618), Peace Street Reserve (R46688), Wilson Inlet Heritage Trail, a portion of the Rudyard Place road reserve and Redgum Lane Reserve (R41224).

The 2008 field assessment methodology relied on visual interpretation for the presence of *Phytophthora* dieback, involving observations of the general health and occurrence (or unusual absence) of known indicator species and the suspected infestations were subsequently mapped. The report then made key recommendations for management common to all reserves as well as more specific recommendations for each. No soil and tissue samples were collected to verify the disease hygiene categorisations and survey methodology was inconsistent with recognised methods.

As a follow-up to the 2008 interpretation program, the Shire of Denmark engaged Great Southern Bio Logic to undertake a re-assessment of the Peace Street (R46688), Redgum Lane (R41224) and the Denmark-Nornalup Heritage Rail Trail at Wilson Inlet Foreshore (includes Reserve No. 43923 and Rudyard Place and South Coast Highway road reserves) in November of 2015. The objective of the project was to verify the original disease distribution information through the collection of soil and tissue samples, and also to survey the reserves for new areas of disease introduction and spread. This survey report presents the results of the survey and provides hygiene recommendations specific to the three reserves. It is intended to be used as an addendum to the 2008 Green Skills report which covers ten Shire reserves. This project received funding from the Western Australian Government's State NRM Program.

The Mount Hallowell Reserve was previously the subject of a re-assessment project in 2013, conducted by Great Southern Bio Logic. Assessment results were reported, inclusive of amended hygiene management recommendations, in an independent report in June 2014.

1.2 Objectives

The objectives of the 2015 assessment were to survey the Peace Street (R46688), Redgum Lane (R41224) and the Wilson Inlet Foreshore and associated areas for the presence of *Phytophthora* dieback to:

- Validate the existing disease distribution information through a soil and tissue sampling program.
- Identify and map the extent of new infestations and disease spread from existing infestations, using a broad scale survey methodology.
- Review existing hygiene management within the reserve and provide recommendations to update the current hygiene management procedures.

1.3 Scope of Works

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

- A detailed desktop assessment of the three reserves involving an analysis of known infestations, topography, geology, land use and access.
- Completion of a field based, broad scale disease distribution survey across the reserves. The broad scale survey involved:
 - A linear survey of all internal tracks, walk trails and other potential vectoring infrastructure; and
 - Extrapolation of linear survey results to remaining areas to estimate the extent of uninfested areas.
- Mapping of disease fronts using a hand held GPS unit and demarcation of disease boundaries only where they intersected surveyed roads, tracks, access points and other site specific management areas.
- A soil and tissue sampling program to verify field interpretation decisions.
- Application of protectable area criteria to the surveyed areas to identify areas that are considered protectable from future infestation by *Phytophthora* species; and
- Development of this draft report detailing project methodology, results and providing recommendations for hygienic management.

It should be noted that the term *Phytophthora* dieback commonly refers to the pathogen *Phytophthora cinnamomi*. This is because *P. cinnamomi* is most typically associated with widespread impact on native vegetation communities. The survey scope and methodology may however identify additional species of *Phytophthora* should they be present.

1.4 Site Characteristics

The three surveyed reserves are shown on Figure 1 and a brief description of the individual reserve characteristics is presented below.

1.4.1 Peace Street Reserve

The Peace Street Reserve is approximately 24 ha in area and situated immediately west from the Denmark central business district, north of the South Coast Highway. There are several access points to the Reserve including via Peace Street, Jill Street and several walking/cycling trails.

The reserve is adjoined on all sides by residential development however the large private lot to the west remains forested with remnant native vegetation and is listed with Land for Wildlife. There is an old gravel pit located in the northern area to the south of Peace Street and a walk trail heads south through the southern portion of the reserve, originating from the gravel pit.

The reserve itself is located on the eastern flanks of a significant local hill which provides the influencing topography. As a result the western boundary, south of Peace Street, is the highest point and elevations fall away to the east and the north. The vegetation can be broadly described as a closed, mixed forest of *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri) with some *Allocasuarina fraseriana* (Sheoak) over a variable understorey consisting of disease indicator species including *Banksia grandis*, *Patersonia umbrosa*, *Xanthorrhoea*

gracilis and *X. preissii*. The vegetation to the north of Peace Street is described as a tall forest largely dominated by *Eucalyptus diversicolor* (Karri).

All areas of the reserve to the east of Henwood Street, which is an unformed track, have been recently burnt.

1.4.2 Redgum Lane Reserve

The Redgum Lane Reserve is approximately 11 ha in area and situated approximately 2km due south of the Denmark CBD. There are several access points to the Reserve including via Redgum Lane and Berridge Street. The reserve boundaries are formed by a series of well-maintained fire breaks that appear to be used extensively as walking and cycling trails, including the Bibbulmun Track.

The reserve is adjoined by residential development to the east, south and west while Unallocated Crown Land and Reserve 46562 adjoins the northern boundary. Much of the adjoining lands are well vegetated with remnant native vegetation. There appears to be little history of disturbance caused by previous land use activities and recreation along the reserve boundaries and few internal tracks appear to be the predominant current land use.

The vegetation can be broadly described as a closed, mixed forest of Jarrah and Marri with some Sheoak over a variable understorey consisting of disease indicator species including *Banksia grandis*, *Patersonia umbrosa*, *Xanthorrhoea gracilis* and *X. platyphylla*. The reserve is located on low lying land and in some areas, particularly in the southern portion, the understorey is dominated by unsusceptible species including *Taxandria parviceps* and various sedge species. Limited indicator species including *B. littoralis* and *B. quercifolia* do, however, persist.

1.4.3 Denmark-Nornalup Heritage Rail Trail at Wilson Inlet Foreshore

The surveyed area of the Denmark-Nornalup Heritage Rail Trail at Wilson Inlet Foreshore (includes Reserve No. 43923 and Rudgyard Place and South Coast Highway road reserves) is approximately 93ha in area and situated east of the Denmark River. It extends from Springdale Beach east to the Hay River, a lineal distance of approximately 8km. There are several access points associated with adjoining residential developments and roads.

The surveyed area includes sections of the Wilson Inlet Heritage Trail (part of the Denmark-Nornalup Heritage Rail Trail) which follows the historical rail formation. The area is a high use recreation site used by walkers and cyclists and is part of the Munda Biddi Trail. There is also a narrow section of the surveyed reserve that consists of the Rudgyard Place Road Reserve and intersects Crusoe Beach Road, both of which are large gravel access roads. The very eastern extent of the surveyed area is intersected by the South Coast Highway and a Western Power transmission line.

Due to the large linear distance covered by the survey area, the vegetation varies significantly from wetland heath adjoining the Hay River and other major creeklines, through to forests dominated by either Jarrah and Marri or Karri. While some uninterpretable areas were identified along the survey area, indicator species were identified in much of the vegetation. Indicator species included *Banksia grandis*, *B. littoralis*, *B. quercifolia*, *Patersonia umbrosa*, *Xanthorrhoea gracilis* and *X. platyphylla*.

1.5 Climate

The nearest Bureau of Meteorology (BoM) recording station is listed as Denmark, Western Australia. Data from this station shows an average annual rainfall of 1093.6mm with the



wettest month being July (170.9mm) and February is recorded as the driest month (26.8mm). The online temperature data for this site was particularly limited, however, it did indicate that January was the warmest month and May was the coldest.

As *Phytophthora* distribution is closely aligned with climatic conditions these are important statistics. *Phytophthora* requires warm moist conditions and is limited to areas where average annual rainfall exceeds 400mm. From the available BoM data it can be seen that the project area falls within the accepted rainfall zone for *Phytophthora* occurrence.

2 METHOD

In accordance with the agreed project scope of works, field surveys were undertaken using a methodology referred to as broad scale survey. The broad scale interpretation method is defined in the Department of Parks and Wildlife (DPaW) operational guideline, *Phytophthora Dieback Interpreters Manual for lands managed by the department* (DPaW 2015). Broad scale survey focuses on disease distribution associated with areas of potential disease vectoring, including roads, tracks, drainage lines, gravel pits and other areas where soil moving activities and human traffic provide a potential for the introduction of the disease. Disease distribution information from surveyed areas is then extrapolated using the natural topography to provide a picture of the likely disease distribution across a larger area and to identify areas that can be protected from disease introduction and spread. As not all areas are covered by on-ground assessment, there is a possibility that small infestations may be present within large protectable areas. For the purposes of the Denmark Reserves project, all areas previously identified as uninfested were checked on foot and active disease boundaries were accurately mapped if the uninfested category remained applicable.

2.1 Desktop Interpretation

The three reserves were 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 known distribution of *Phytophthora* dieback on or near the reserves;
- The distribution of site specific vectors including but not limited to roads, creek lines, gravel pits and other potentially threatening features; and
- Evidence of existing disease signatures such as areas of obvious vegetation decline.

2.2 Field Survey

The broad scale *Phytophthora* dieback survey involved a detailed assessment of all open vehicle tracks, management access tracks and walk trails by a DPaW registered disease interpreter. Disease distribution and hygiene classification information collected from areas of detailed survey was then extrapolated to unsurveyed areas using the principles of disease movement, natural topography and soil type. This method provides medium confidence disease distribution information and hygiene classification across large areas.

Field data was collected using a hand held GPS unit and converted into ArcGIS™ shape files. Collected field data included all sample locations, a point file of all identified individual plant deaths attributed to *Phytophthora* 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. Where suspicious deaths were identified, soil and root tissue material was collected into heavy duty plastic bags and forwarded to the Department of Parks and Wildlife 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* (DPaW 2015).

3 ASSESSMENT CRITERIA

DPaW 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, eg 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, eg 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 *Phytophthora Dieback Interpreters Manual for lands managed by the department* (DPaW 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 an accredited disease interpreter;
- 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 4ha with a minimum axis of 100m, and not down slope of an infested area;
- Have controllable human vectors; and
- Include high conservation and/or socio economic values.

4 RESULTS AND DISCUSSION

4.1 Peace Street Reserve

The disease distribution and hygiene categories across the Peace Street Reserve are shown on Figure 2 along with the locations of both historic positive sample recoveries and additional samples collected during the December 2015 survey. The VHS sample analysis report is provided as Appendix A.

4.1.1 Disease Expression and Distribution

As shown on Figure 2, *Phytophthora* dieback is distributed widely across the Peace Street Reserve with only a single small area determined to be free of the pathogen. Disease expression varies with soil type ranging from very obvious in areas where the soils are shallow lateritic gravels immediately south of Peace Street and in the old gravel pit, through to very subtle in the Karri forest north of Peace Street.

Previous 2008 disease mapping has identified the edge of the high impact disease expression as the disease boundary and classified the vegetation on the elevated hill top above this area as uninfested. The review of the historic VHS positive sample data and a detailed investigation of the area identified disease presence along the upslope reserve boundary track and several indicator species deaths were located within the vegetation below the track. This has resulted in the disease boundary being extended as shown in Figure 2, leaving only a small uninfested area situated down gradient of the infested track. The mapped uninfested area was intensively traversed on foot and no disease expression was identified, resulting in the application of the uninfested category. However, due to the topographical position of this area with disease expression directly upslope, this area must be considered to be un-protectable from future infestation by *Phytophthora* unless there is intervention via an ongoing treatment program.

The vegetation in the southern portion of the reserve and to the east of Henwood Rd was burnt in October 2013 and it was therefore not possible to map the extent of disease distribution in this area, resulting in the classification of '*temporarily uninterpretable*'. In accordance with DPaW guidelines, vegetation will remain uninterpretable for 3 years or until disease expression can be assessed by a suitably qualified disease interpreter (DPaW 2015). The *temporarily uninterpretable* area includes the old gravel pit, which is considered likely to be infested, and there are also historic positive sample recoveries both upslope and within the vegetation, suggesting that disease is likely to occur east of Henwood Road. Three new samples were also collected from within this area as there were several fresh indicator species deaths identified during the 2015 field survey.

Of these three samples, two returned negative results for *Phytophthora* and are likely to be a result of post fire stress. It is therefore possible that a small area of uninfested vegetation may exist within the area to the east of Henwood Road however, if present, such an area would be classified as un-protectable due to the upslope influence of positive sample recoveries.

The vegetation east of Henwood Road shall remain uninterpretable until October 2016 at the earliest.

The southernmost portion of the reserve sits directly below the private Land for Wildlife property and north of Jill Road as shown on Figure 2.

The vegetation in this area has been classified as uninterpretable based on a low density of indicator species. While occasional *Patersonia umbrosa* plants were identified and presented as healthy, they were too few to enable confident classification. Further, due to the presence

of the positive sample recoveries situated up gradient, it would be expected that the area would be infested however current disease expression is absent. The area must be considered to be up-protectable from the disease.

4.2 Redgum Lane

The disease distribution and hygiene categories across the Redgum Lane Reserve are shown on Figure 3 along with the locations of both historic positive sample recoveries and additional samples collected during the December 2015 survey. The VHS sample analysis report is provided as Appendix A.

As shown on Figure 3, *Phytophthora* dieback is distributed across the majority of the Redgum Lane Reserve, however, a narrow area of disease free vegetation persists in the northern portion of the reserve. This area is associated with a minor topographical elevation which has protected it from infested drainage spreading the disease upslope. Unfortunately, the application of the DPaW protectable areas criteria results in this area being classified as un-protectable as it is less than 4ha and has a minimum axis of less than the required 100m. It is therefore considered that the mechanics of autonomous spread will infest the area unless there is intervention via an ongoing treatment program.

Disease expression across the Redgum Lane Reserve ranged from obvious along the fire break tracks in the north, to quite subtle in the vegetation in the southern areas which generally contained a lower concentration of susceptible species. Three samples were collected during the 2015 survey and two of these returned positive results for *Phytophthora*. Despite the negative result for the sample in the southern portion of the reserve, the infested category has been applied based on local topography and visual observations made during the field survey.

4.3 Denmark-Nornalup Heritage Rail Trail at Wilson Inlet Foreshore

The disease distribution and hygiene categories across the Denmark-Nornalup Heritage Rail Trail at Wilson Inlet Foreshore (includes Reserve No. 43923 and Rudgyard Place and South Coast Highway road reserves) are shown on Figure 4 along with the locations of both historic positive sample recoveries and additional samples collected during the December 2015 survey. The VHS sample analysis report is provided as Appendix A.

4.3.1 Disease Expression and Distribution

As shown on Figure 4, *Phytophthora* dieback is distributed widely across the Denmark-Nornalup Heritage Rail Trail with only a single small area determined to be free of the pathogen. Disease expression varied with vegetation communities and soil types, ranging from very obvious in areas with shallow lateritic gravels to subtle in the low lying areas where soils were sandy and the vegetation contained limited numbers of indicator species. A single area of uninterpretable vegetation was identified and mapped as shown on Figure 4. Other areas of uninterpretable vegetation were also identified in the eastern portion of the surveyed area but active disease expression was noted in upslope areas, resulting in the extension of the infested classification. These areas were associated with the fringing vegetation around the Wilson Inlet and Hay River.

There were three historic positive sample recoveries across the reserve area and an additional five samples were collected during the 2015 survey. Of the five new samples, four returned positive results for *Phytophthora*. Sample 2 returned a negative result for *Phytophthora*, however, further investigation of the fire break track above this sample site

identified significant disease expression with direct topographical influence over the sample site.

A small uninfested area was identified on the top of an old cutting above the rail alignment. Due to its position on top of a steep artificial embankment, it is unlikely to be disturbed in the future and may remain uninfested. It may also be associated with uninfested vegetation within unsurveyed areas to the north. However, based on the DPaW protectable areas criteria, it is not considered to be protectable on its own due to its small size.

4.4 Sample Program

Eleven soil and tissue samples were collected from across the three reserves. Sample locations and results are presented in Figures 2-4 while the VHS laboratory analysis reports are presented in Appendix A. A summary of sample information is presented in Table 1 below.

Table 1: Sample information from Peace St, Redgum Lane and the Denmark-Nornalup Heritage Rail Trail

Sample Label	Sample Location		Species Sampled	Result
	Eastings	Northings		
Peace St 1	531538	6131106	<i>B. grandis</i>	Negative
Peace St 2	531441	6131189	<i>P. diversifolia</i>	Negative
Peace St 3	531435	6131025	<i>P. umbrosa</i>	<i>P. cinnamomi</i>
Redgum Ln 1	532724	6129156	<i>X. platyphylla</i>	<i>P. cinnamomi</i>
Redgum Ln 2	532399	6128719	<i>X. gracilis</i>	Negative
Redgum Ln 3	532509	6128996	<i>B. grandis</i>	<i>P. cinnamomi</i>
Foreshore Res 1	535949	6130142	<i>X. gracilis</i>	<i>P. cinnamomi</i>
Foreshore Res 2	537108	6129871	<i>X. preissii</i>	Negative
Foreshore Res 3	539292	6129334	<i>X. preissii</i>	<i>P. cinnamomi</i>
Foreshore Res 4	539820	6129394	<i>B. grandis</i>	<i>P. cinnamomi</i>
Foreshore Res 5	540693	6130677	<i>Patersonia sp</i>	<i>P. cinnamomi</i>

5 DISEASE MANAGEMENT RECOMMENDATIONS

A series of management recommendations for application across all Shire of Denmark Reserves are presented in the 2008 Green Skills document *A Study into the Risk of Phytophthora Dieback in Ten Peri-Urban Reserves within the Shire of Denmark*. Specific recommendations for each reserve are presented in Section 7 of the Green Skills document and generic hygiene recommendations for application across the Shire are presented in tabular format in Section 8. A summary of the key recommendations to be applied across all Shire of Denmark reserves is provided in the Executive Summary of the Green Skills report and presented below.

1. *All works within and around priority reserves to strictly adhere to **Town Planning Scheme Policy No. 1 for Dieback Disease Management** (Shire of Denmark, 1997) hygiene controls including but not limited to:*
 - *No soil movement or extraction within priority reserves*
 - *No operations (firebreaks, earthworks, fencing etc) within or around the vicinity of the Phytophthora Dieback free protection areas unless extremely dry soil conditions*
 - *No unauthorized vehicular access to priority reserves (closure of vehicular access where applicable)*
2. *Installation of Project Dieback signage at Phytophthora Dieback free protection areas and at Phytophthora Dieback infested areas*
3. *Installation of Project Dieback signage at entry to priority reserves to inform users of how to reduce risk of Phytophthora Dieback spread*
4. *Treatment of disease frontlines to stabilize disease movement (once points 1 – 3 have been implemented)*
5. *Develop annual monitoring and treatment program in Phytophthora Dieback free protection areas*
6. *Host Phytophthora Dieback awareness forum (compulsory attendance by Shire works staff and open invitation to community members)*
7. *Assess and develop Phytophthora Dieback management recommendations for remaining Shire of Denmark reserves which were not assessed within this study (Green Skills, 2008)*

Great Southern Bio Logic has reviewed the Green Skills recommendations and believes that if applied, the generic hygiene recommendations made by Green Skills (2008) are suitable for effective mitigation of the risk of further non-autonomous vectoring of the disease. It is however noted, that Green Skills recommendations 4 and 5 are associated with treatment and monitoring programs, designed to protect uninfested areas from all mechanisms of disease movement. While treatment with chemical Phosphite will assist the protection of vegetation within both infested and uninfested areas, it is recommended in situations where the vegetation has significant value as an environmental, social or aesthetic asset. In such cases a treatment program may be applied but will require ongoing commitment of resources and funding. Implementation of the Green Skills recommendations to undertake treatment should be pre-ceded by a detailed assessment of reserve values and the Shires capacity to maintain such programs.

It is further noted that the Green Skills report was produced 7-8 years ago. Since that time knowledge regarding *Phytophthora* Dieback management has improved and its specific applicability to Denmark reserves may have altered. Consideration should be given to undertaking a full review of the document for all reserves.

Great Southern Bio Logic is aware that the current standards for operational hygiene management as defined in *Phytophthora cinnamomi and disease caused by it, Volume 1, management guidelines* (CALM, 2003) is scheduled for review. It is therefore recommended that the 2008 *Study into the Risk of Phytophthora Dieback in Ten Peri-Urban Reserves within the Shire of Denmark* and the *Town Planning Scheme Policy No. 1 for Dieback Disease Management*, be reviewed following the issue of the amended management guidelines.

The following recommendations are provided by Great Southern Bio Logic for implementation within the Peace Street, Red Gum Lane and Wilson Inlet Reserves and associated survey areas specifically. It is intended that these recommendations will replace any previous disease management recommendations for these reserves.

1. Operational Hygiene

- a. All operational activities including firebreak maintenance are to be undertaken in dry soil conditions (see Section 5.2). Undertaking operational activities in dry soil will significantly reduce the risk of transporting infested soil from currently infested areas to uninfested areas in other Shire reserves.
- b. All vehicles, machinery, equipment and footwear are to be effectively cleaned down (See Section 5.1) upon completion of works and before re-locating to other Shire Reserves or areas with uninfested vegetation or unknown disease status. Effective cleandown should be performed on the reserve perimeter, preferably on sealed ground that drains into infested areas of the reserves.
- c. All earthworks, road verge works and street sweeping conducted in any residential area adjoining the reserves is to be undertaken in accordance with *Town Planning Scheme Policy 1* hygiene guidelines. These areas are also considered to be infested through the mechanisms of autonomous spread; therefore the movement of soil and vegetable matter from these areas presents a potential risk of disease vectoring. Private residents and contractors undertaking works should also be urged to comply with this standard.

2. Project Dieback Signage

- a. Existing dieback demarcation signage was only noted on the eastern boundary of Redgum Lane Reserve. This signage is no longer applicable due to the amended disease boundaries and should be removed.
- b. General disease information signage should be considered at reserve entry points in residential areas. Signage should highlight the issues associated with *Phytophthora* and the management actions required to minimise the spread. Signage may assist with communication of these messages but should not be relied on as a stand-alone communication strategy.

3. Community Awareness and Education

- a. The current distribution of *Phytophthora* includes the surrounding residential developments of all reserves. Movement of infested soil from these areas poses a significant threat of disease vectoring to other areas within the Shire of Denmark. Consistent with the solutions to address the threat identified in *A Study into the Risk of Phytophthora Dieback in Ten Peri-Urban Reserves within the Shire of Denmark, Section 8, Limited Education and Awareness in the Community* (Green Skills, 2008), a public communication strategy is recommended for the immediate local community.

4. Re-Survey

- a. Due to the movement of disease boundaries through autonomous spread and human vectoring, operational disease hygiene information is not to be used for operational purposes after 12 months from the date of interpretation. In accordance with DPaW guidelines (2015), operational disease boundaries must be re-checked every 12 months and a full re-interpretation must be undertaken after three years of the original survey.
- b. The area classified as *Temporarily Uninterpretable* in the Peace Street Reserve could not be surveyed due to recent fire. This area should be considered for additional survey before October 2016 to enable classification of disease status in this area.

5.1 Effective Clean Down Standards

The management solutions identified in Section 8 of *A Study into the Risk of Phytophthora Dieback in Ten Peri-Urban Reserves within the Shire of Denmark* also identify requirements for the clean down of vehicles when entering and exiting infested and uninfested sites. It is further recommended that requirements for cleandown be expanded to include all vehicles, machinery, equipment and footwear. Table 2 below has been provided as a guide for the requirement for cleandown when crossing disease hygiene category boundaries.

Table 2: Requirement to undertake effective cleandown when crossing disease category boundaries

Exiting Category	Entering Category	Cleandown Required
Uninfested	Infested	No
	Uninterpretable	No
	Un-mappable	No
Infested	Uninfested	Yes
	Uninterpretable	Yes
	Un-mappable	No
Uninterpretable	Uninfested	Yes
	Infested	No
	Un-mappable	No
Un-Mappable	Uninfested	Yes
	Infested	No
	Uninterpretable	Yes

Effective clean down involves the removal of all soil and plant material from machinery, vehicles, equipment, tools and footwear so it cannot be transported. Attention needs to be given to removing soil and plant material from under vehicles and machinery, especially from running boards, belly plates, spare tyres and wheels.

If operations are conducted in dry soil conditions the requirements for clean down are reduced as the soil material does not readily adhere, and clean down can be performed using a stiff brush or compressed air.

Drainage from clean down areas needs to be controlled so that effluent from clean down operations does not drain into uninfested or uninterpretable areas.

Hand held equipment, tools and footwear can be sterilised using methylated spirits. Place methylated spirits into a suitably labelled spray bottle, spray to cover all surfaces and allow a few minutes to soak in. Other equipment can be sterilised by soaking in a disinfectant such as bleach (active ingredient sodium hypochlorite). Dilute the bleach (1 part bleach to 10 parts water), soak tools for a few minutes then rinse, following the manufacturer's safety instructions.

Water can be sterilised by adding 6ml of sodium hypochlorite (bleach or pool chlorine) to every 10L of water. Safety instruction should be followed.

5.2 Dry Soil Conditions

Dry soil conditions are when soil moisture content of open ground or on unsealed roads is not high enough to allow soil material to adhere to vehicles, machinery, equipment and footwear. The level of soil moisture required for soils to be classified as dry soil varies between soil types, however, a general rule commonly applied is that greater than 5mm of rainfall over a 24 hour period will result in moist soil conditions.

6 REFERENCES

Bureau of Meteorology (BoM) (2015): <http://www.bom.gov.au/climate/data/>

Department of Parks and Wildlife (DPaW) (2015), *Phytophthora Dieback Interpreters Manual for lands managed by the department*, Perth

Department of Environment and Conservation (CALM) (2003): *Phytophthora cinnamomi and disease caused by it, Volume 1, management guidelines*, Department of Conservation and Land Management, Perth

Green Skills (2008): *A Study into the Risk of Phytophthora Dieback in Ten Peri-Urban Reserves within the Shire of Denmark*, Unpublished report

7 LIMITATIONS

This report was prepared for the Shire of Denmark, 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.

Great Southern Bio Logic and its agents have exercised reasonable care, skill and diligence in the conduct of project activities and preparation of this report. However, except for any non-excludable statutory provision, Great Southern Bio Logic and its agents provided no warranty in relation to its services or the report, and is not liable for any loss, damage, injury or death suffered by any party (whether caused by negligence or otherwise) arising from or relating to the services or the use or otherwise of this Report.

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



Figures

Broad scale survey of Phytophthora Dieback Distribution and Reserve Hygiene Management Plan for Peace Street and Redgum Lane Reserves and a portion of the Denmark-Nornalup Heritage Rail Trail

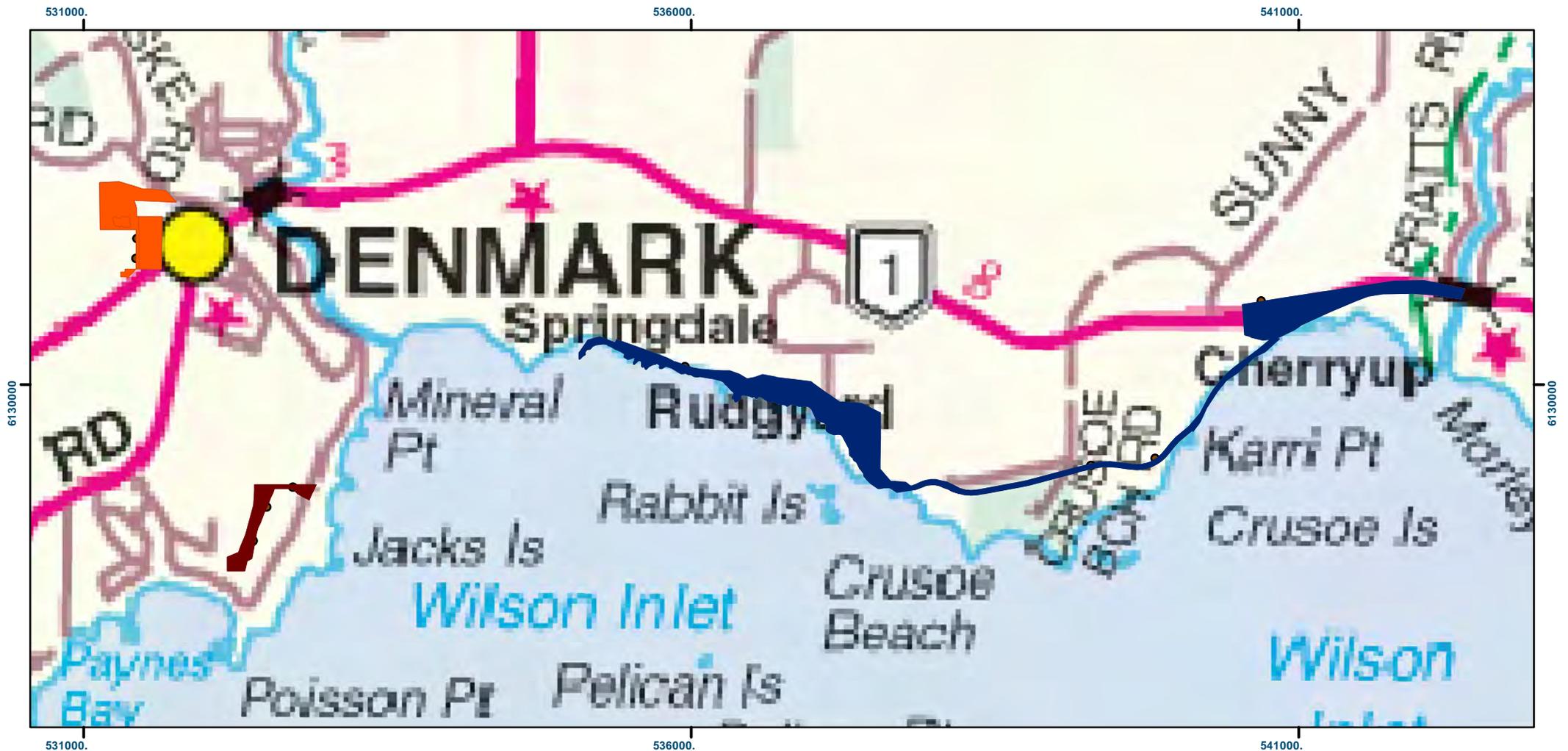


Figure 1: Regional Location and Sites



Great Southern Bio Logic does not guarantee that this map is without flaw of any kind and disclaims all liability for any errors, loss or other consequence which may arise from relying on any information depicted.

Ref: GSBL204
 Date: 18/02/2016
 Image: LandgateTravellers Atlas 2009

Broadscale survey of *Phytophthora Dieback* distribution and Reserve Hygiene Management Plan for Peace Street and Redgum Lane Reserves and a portion of the Denmark-Nornalup Heritage Rail Trail prepared for Shire of Denmark, January, 2016

LEGEND

SITE LOCATIONS

- Peace Street
- Redgum Lane
- Selected Heritage Rail Trail



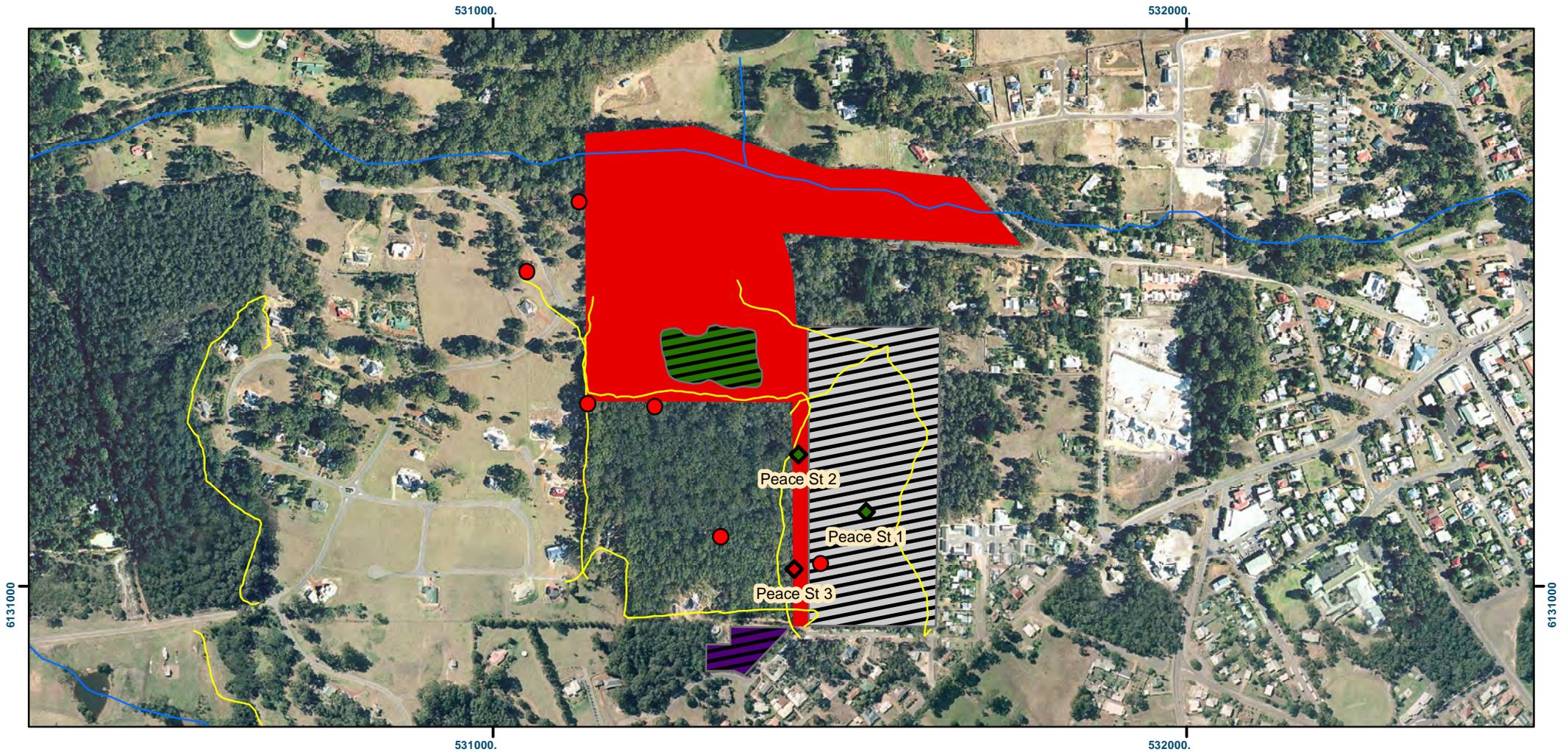


Figure 2: Peace Street Phytophthora Dieback distribution with sample locations



Great Southern Bio Logic does not guarantee that this map is without flaw of any kind and disclaims all liability for any errors, loss or other consequence which may arise from relying on any information depicted.

Ref: GSBL204
Date: 19/02/2016

Broadscale survey of Phytophthora Dieback distribution and Reserve Hygiene Management Plan for Peace Street and Redgum Lane Reserves and a portion of the Denmark-Nornalup Heritage Rail Trail prepared for Shire of Denmark, January, 2016

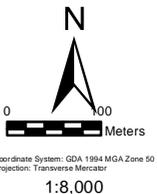
LEGEND

Status

- Infested
- Uninfested
- Uninterpretable
- Temporarily uninterpretable
- Unprotectable

Sample result

- Phytophthora cinnamomi
- Negative
- VHS Historic Pc 2013
- Strategic Fire Breaks
- Hydrography



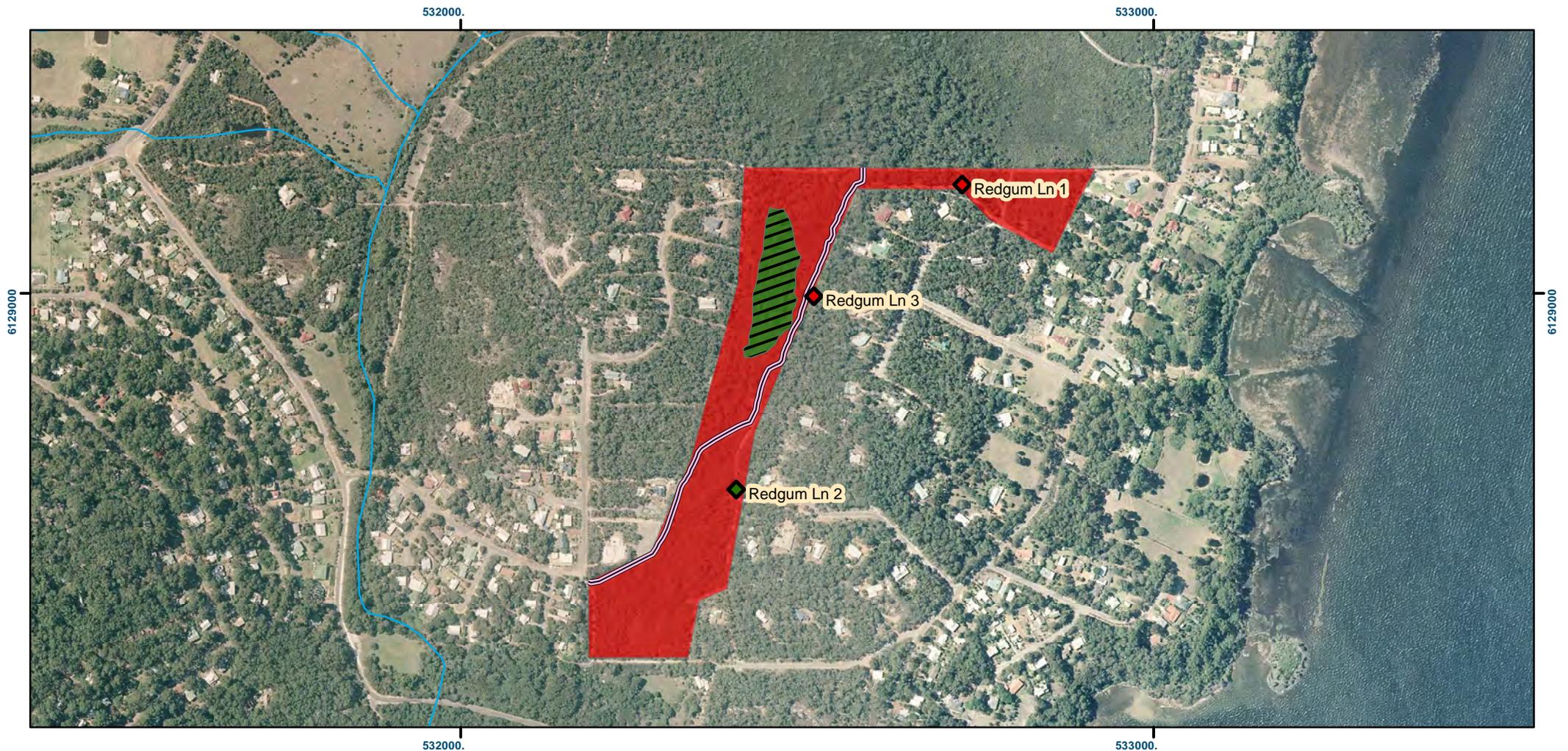


Figure 3: Redgum Lane Phytophthora Dieback distribution with sample locations



Great Southern Bio Logic does not guarantee that this map is without flaw of any kind and disclaims all liability for any errors, loss or other consequence which may arise from relying on any information depicted.

Ref: GSBL204
 Date: 18/02/2016
 Image: Parry Inlet 2007

Broadscale survey of Phytophthora Dieback distribution and Reserve Hygiene Management Plan for Peace Street and Redgum Lane Reserves and a portion of the Denmark-Nornalup Heritage Rail Trail prepared for Shire of Denmark, January, 2016

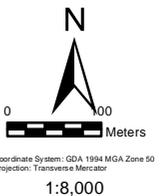
LEGEND

Status

- Infested
- Uninfested
- Uninterpretable
- Temporarily uninterpretable
- Unprotectable

Sample result

- ◆ Phytophthora cinnamomi
- ◆ Negative
- VHS Historic Pc 2013
- Bibbulmun Track
- Hydrography



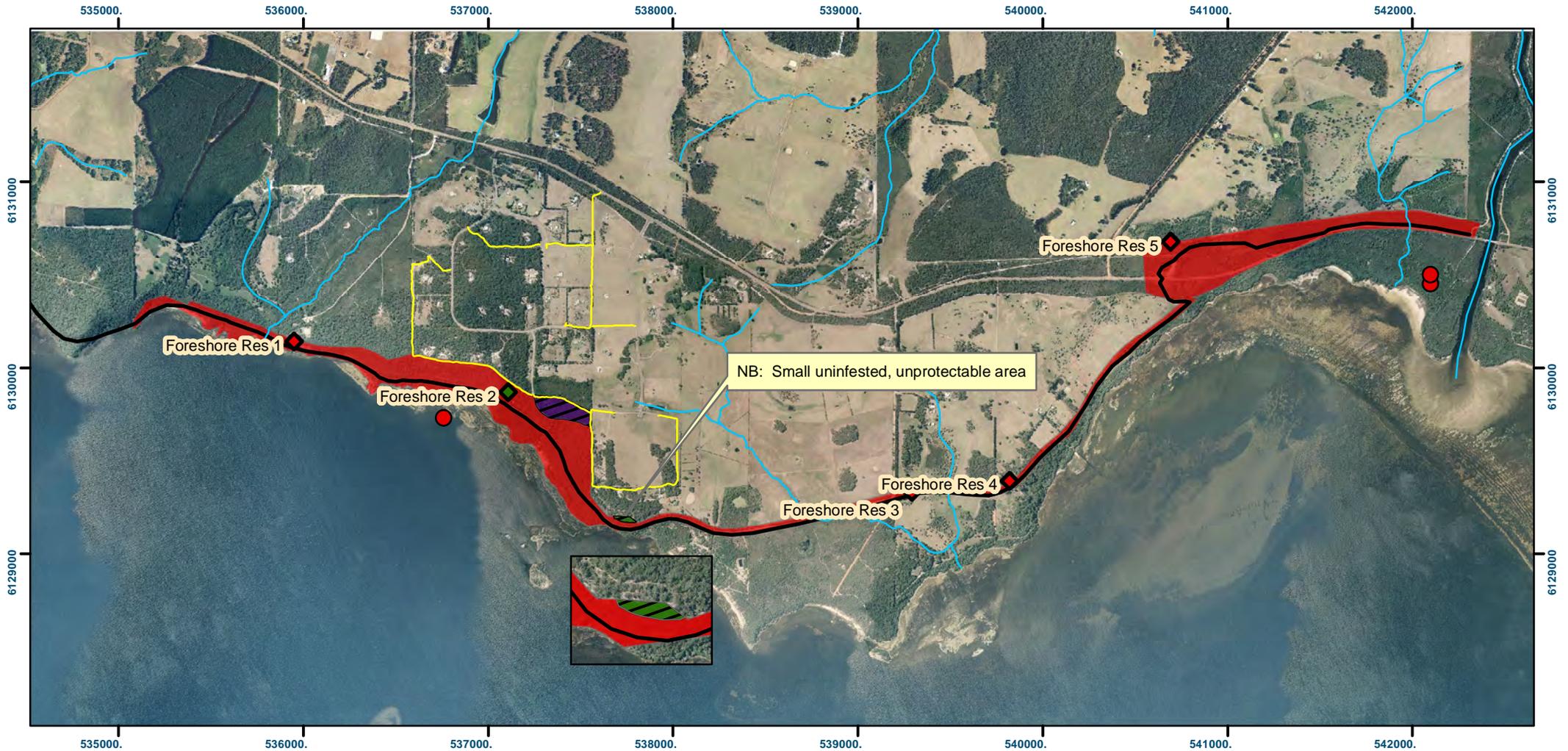


Figure 4: Phytophthora Dieback distribution with sample locations across a portion of the Denmark-Nornalup Heritage Rail Trail



Great Southern Bio Logic does not guarantee that this map is without flaw of any kind and disclaims all liability for any errors, loss or other consequence which may arise from relying on any information depicted.

Ref: GSBL204
 Date: 18/02/2016
 Image: Parry Inlet 2007

Broadscale survey of Phytophthora Dieback distribution and Reserve Hygiene Management Plan for Peace Street and Redgum Lane Reserves and a portion of the Denmark-Nornalup Heritage Rail Trail prepared for Shire of Denmark, January, 2016

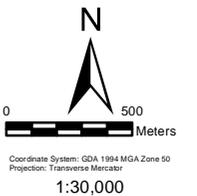
LEGEND

Status

- Infested
- Uninfested
- Uninterpretable
- Temporarily uninterpretable
- Unprotectable

Sample result

- Phytophthora cinnamomi
- Negative
- VHS Historic Pc
- Denmark Nornalup Railway Heritage Trail
- Strategic Fire Breaks
- Hydrography





Appendix A

VHS Certificate of Analysis



Department of
Parks and Wildlife

Vegetation Health Service – Phytophthora sample information

**FORM
FEM046**

CONTACT DETAILS of sender

Name Jeremy Spencer

Fax No. _____ Phone No. 0400 113 093

DPW Office or Company Name GS Bio Logic

Job Type (Please indicate)

Private

VHA use only

Date received 5.11.15

Date faxed 16.11.15

GDA(1) GDA 94

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 samplenummer)	Plant species sampled	Site Impact (2)	Zone 50 or 51	Map Reference (3)	Land Tenure (4)	RESULT s/s root (5)	RESULT bait (5)
VHS33625 	30-10-15	Peace Street Reserve 1	<i>B. grandis, P. umbrosa</i>	M	50	E 531538 N 6131106	R		NEG
VHS33626 	30-10-15	Red Gum Lane Reserve 1	<i>X. platyphylla, P. umbrosa</i>	L	50	E 532724 N 6129156	R		CIN
VHS33627 	30-10-15	Red Gum Lane Reserve 2	<i>X. gracilis</i>	M	50	E 532399 N 6128719	R		NEG
VHS33628 	30-10-15	Red Gum Lane Reserve 3	<i>B. grandis, X. gracilis</i>	M	50	E 532509 N 6128996	R		CIN
						E - - - - - N - - - - -			
						E - - - - - N - - - - -			
						E - - - - - N - - - - -			
						E - - - - - N - - - - -			

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), Westrail (W), Private (P), Gravel Pit (GP), or other. (Other - describe in comments below).
5. Result codes used – CIN = *Phytophthora cinnamomi*, MUL = *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:



Department of
Parks and Wildlife

Vegetation Health Service – Phytophthora Sample information

FORM
FEM046

CONTACT DETAILS of sender

Name Jeremy Spencer

Fax No. _____ Phone No. 0400 113 093

DPW Office or Company Name GS Bio Logic

Job Type (Please indicate)

Private

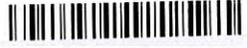
VHA use only

Date received 30.11.15

Date faxed 14.12.15

GDA(1) GDA 94

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 sample 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)
VHS33812 	20-11-15	Peace Street Reserve 2	<i>P. diversifolia</i>	M	50	E 531441 N 6131189	R		NEG
VHS33813 	20-11-15	Peace Street Reserve 3	<i>P. umbrosa</i>	L	50	E 531435 N 6131025	R		CIN
VHS33814 	20-11-15	Foreshore reserve 1	<i>X. gracilis</i>	M	50	E 535949 N 6130142	R		CIN
VHS33815 	20-11-15	Foreshore reserve 2	<i>X. preissii</i>	M	50	E 537108 N 6129871	R		NEG
						E N			
						E N			
						E N			

NOTES:

- Please tick this box if your map references are supplied in the **GDA 94** standard. If not, please specify the datum used.
- Site impact - Low, Moderate, or High (as in the Dieback Interpreter's Manual).
- An MGA map reference with prefixes **must** be supplied for all samples.
- Land tenure - State Forest (SF), National Park (NP), Reserve (R), Westrail (W), Private (P), Gravel Pit (GP), or other. (Other - describe in comments below).
- Result codes used – CIN = *Phytophthora cinnamomi*, MUL = *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:



Department of
Parks and Wildlife

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 4.12.15

Date faxed 16.12.15

GDA(1) GDA 94

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 sample 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)
VHS33862 	30-11-15	Foreshore reserve 3	<i>X. preissii</i>	M	50	E 539292 N 6129334	R		CIN
VHS33863 	30-11-15	Foreshore reserve 4	<i>B. grandis</i>	M	50	E 539820 N 6129394	R		CIN
VHS33864 	30-11-15	Foreshore reserve 5	<i>Patersonia sp.</i>	M	50	E 540693 N 6130677	R		CIN
						E - - - - - N - - - - -			
						E - - - - - N - - - - -			
						E - - - - - N - - - - -			

NOTES: Please tick this box if your map references are supplied in the GDA 94 standard. If not, please specify the datum used.

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4. Land tenure - State Forest (SF), National Park (NP), Reserve (R), Westrail (W), Private (P), Gravel Pit (GP), or other. (Other - describe in comments below).
5. Result codes used - CIN = *Phytophthora cinnamomi*, MUL = *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

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COMMENTS: