

A Vegetation and Dieback Survey of part Lot 1650, North Boyanup

Prepared for
GHD

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Summary

A flora, vegetation and Dieback (*Phytophthora cinnamomi*) disease survey was carried out over approximately 13 ha of land on Lot 1650 North Boyanup Road in the Shire of Capel (the Survey Area). An application is being made to clear the Survey Area for sand extraction.

Because of the time of the survey few annual or annually-renewed species were identified. Species richness overall was relatively low, both because of the time of survey, and also because of the level of disturbance within the Survey Area. No Declared Rare Flora (DRF) or Priority Flora (*Wildlife Conservation Act, 1950*) or species listed as threatened under the Commonwealth *Environmental Protection and Biodiversity Act (1999)* were found. However, a spring survey will be required to ascertain whether any annual or annually-renewed rare species are present – such as two DRF orchids that potentially occur there.

Three vegetation types were identified and mapped, however one of these, *Kunzea* Tall Shrubland, is a degraded form of the *Banksia* Woodland that is the most extensive vegetation type. The *Banksia* Woodland appears to be identical with the Priority Three ecological community: “Southern *Banksia attenuata* woodlands” (SWAFCT 21b). The native vegetation of the Survey Area is mapped as “Bassendean Complex – Central and South”. While the remaining area of this complex on the Swan Coastal Plain is 27%, its remaining area in secure tenure is only 0.7 percent.

Vegetation condition within the Survey Area ranged from “Completely Degraded” to “Good”. All of it has degraded to some extent by past disturbance for construction of sandpits and tracks, disease caused by *Phytophthora cinnamomi* (Dieback) and heavy grazing by kangaroos. Only 15.7% of the Survey Area was classed as in “Good” condition, with by far the largest proportion (67%) classified as “Degraded”.

Symptoms of *Phytophthora* Disease (Dieback) were widespread within the Survey Area, with 78.5% mapped as “infested”. The uninfested vegetation forms an “island”, covering only 4.1% of the Survey Area, on the highest ground. Signs of recent disease activity (recently dead *Banksia* trees) are also widespread. Three root tissue samples from recently killed *B. attenuata* were taken for testing for presence of the *Phytophthora* pathogen, the results for these were

Seventeen percent (2.3 ha) of the Survey Area was classed as having a “Severe” impact (i.e. 75% or more of susceptible species have been lost), and a further 40% of the Survey Area (5.2 ha) was classed as having a “High” impact. Only a small portion (5.3%) was assessed as having “Nil” impact; that is, there were no symptoms of disease expression.

Project Background

A dieback and vegetation assessment was required of approx 13 ha of bushland (the “Survey Area”), forming part of Lot 1650 SW Highway Boyanup (Fig. 1). The client is proposing to develop a sand pit at the site and is at the early stages of seeking an extractive industry license and DEC Clearing permit. Ekologica Pty Ltd was engaged by GHD Australia to carry out the assessment.

1. Scope and Outputs

The scope of work is to:

- Assess the vegetation for dieback status and its protectability
- Assess and map the site in respect to vegetation type
- Assess and map the site in respect to vegetation condition
- List flora species present
- Identify the potential for threatened or priority flora

The output of the survey is to be a brief report on the methodology and outcomes of the site survey including:

- Assessment of the vegetation in respect to its local and regional representativeness based on Mattiske and Havel (1998) and Molloy et al (2007)
- Flora species list
- Plan showing vegetation type
- Plan showing vegetation condition
- Plan showing dieback status if appropriate
- Any other comments thought appropriate

2. Objectives

To survey and assess the Study Area to determine the;

- vegetation species composition and structure and likely relationship to plant communities determined for the southern Swan Coastal Plain,
- vegetation condition (using the scoring method of Keighery, 1994),
- presence and impact of disease caused by *Phytophthora cinnamomi* (“Dieback Disease”),
- likelihood of rare flora being found during a spring survey.

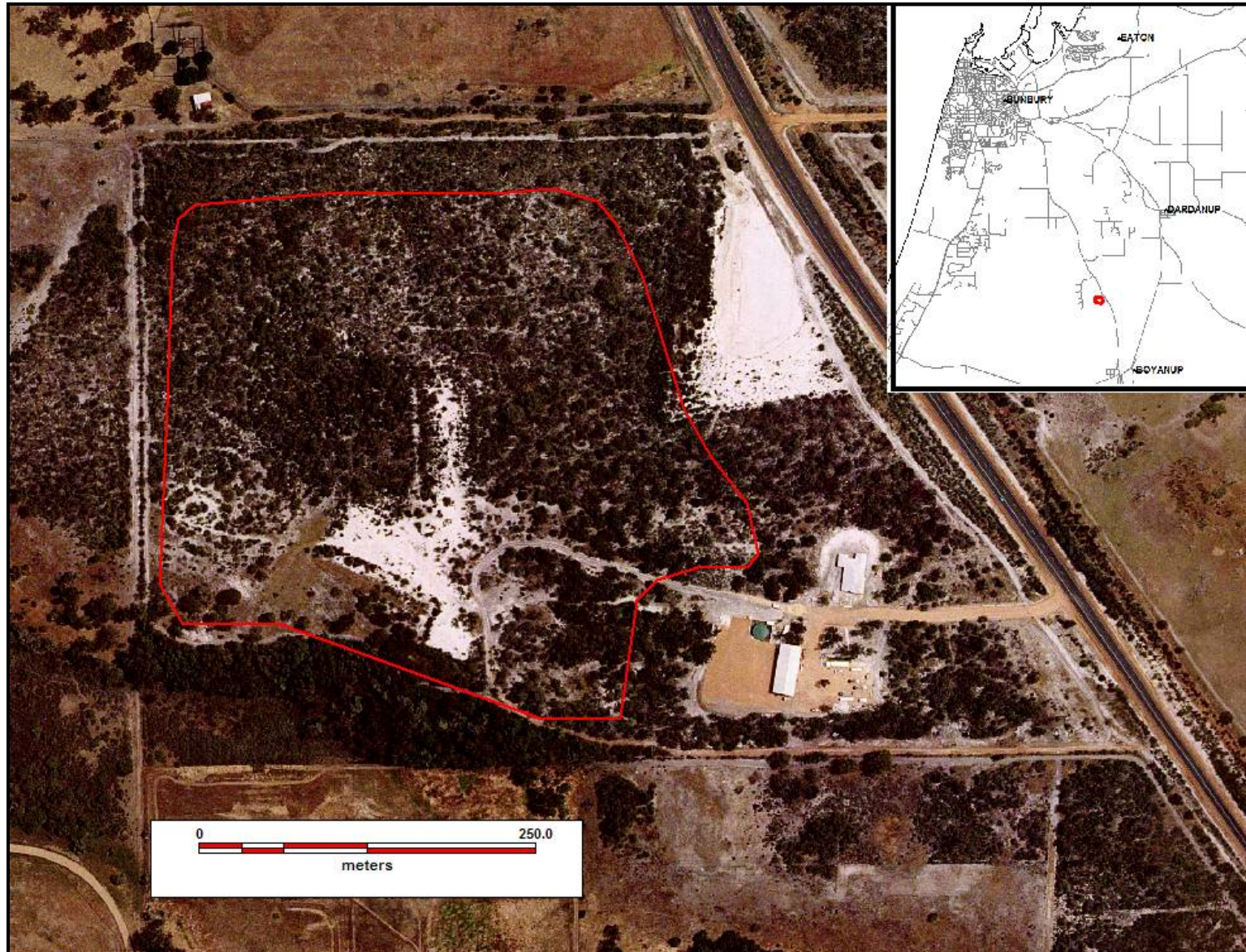


Figure 1. The Survey Area on Lot 1650, North Boyanup (shown by red boundary line).

3. Regional Setting, Landforms and Soils

The Study Area lies on the Swan Coastal Plain approximately 16 km south east of the regional city of Bunbury. Elevation rises from about 28 m AHD at the northern and southern boundaries to 43 m AHD at the top of the low hill in the middle of the Study Area. The soils belong to the Bassendean Dune System; B1a phase (Tille, 1996), which are described as;

“Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m; *Banksia* dominant.”

The Study Area is bounded to the north and south by the alluvial soils of the Pinjarra Plain System.

4. Vegetation

The Survey Area falls within the area mapped as Bassendean System by Beard (1980). The north-eastern half of the site is mapped as “Southern River Complex” and the south-western half as “Bassendean – Central and South” by Heddle *et al.*, (1980). However, the boundaries of the broadscale mapping by Heddle *et al.* (1980) is not very accurate at a local scale and does not coincide with the more accurate mapping of soils by Tille (1996). The Study Area should actually be all mapped as “Bassendean – Central and South”, which is described as;

“Vegetation ranges from woodland of *E. marginata* - *C. fraseriana* - *Banksia* spp. to low woodland of *Melaleuca* species, and sedgelands on the moister sites.”

The vegetation community types which occur on the Bassendean System tend to be those that occur in Super Group 3, as identified in Gibson *et al.* (1994). These communities are SWAFCT20, SWAFCT21a and 21b, SWAFCT22 and SWAFCT23. The most likely to occur in the Study Area is community SWAFCT21b.

“Community 21b: structurally this community is naturally *Banksia attenuata* or *Eucalyptus marginata* - *Banksia attenuata* woodlands. It is also likely to contain *Acacia extensa*, *Jacksonia* sp. *Busseleton*, *Laxmannia sessiliflora*, *Lysinema ciliatum* and *Johnsonia acaulis*.”

5. Methods

The Study Area was surveyed on 19th and 20th March 2012.

5.1. *Flora and Vegetation Type and Condition*

A comprehensive list of vascular flora occurring within the Survey Area was compiled using data from two 100 m² quadrats and lists taken at 19 releves. Species taxonomic names were checked using the DEC database “Max”. Vegetation type and condition was assessed at 32 releves situated within and just outside the Study Area. At each releve the following information was recorded;

- plant species occurring within approximately 10 m radius,
- a GPS waypoint,
- a photograph,
- the vegetation condition score (Keighery, 1994),

This information was used to derive broad vegetation types for mapping.

5.2. *Dieback Disease Status*

Initial and field interpretation was done according to the methods described in the “Detection, Diagnosis and Mapping Manual”, Sections 2, 3, 4 (Department of Conservation and Land Management, 2001). Other methods employed were;

- All *P. cinnamomi* disease boundaries were mapped using a non-differential global positioning system (GPS) unit. Sample points were recorded as individual GPS waypoints within the Study Area,
- Strip widths were set according to manual specifications, dependent on vegetation density. In the Study Area 30 m strip width was used,
- Digital aerial photography was used to interpret infested area within the assessment area. The photography was used in conjunction with field assessment results,
- Field evidence points have been collected according to methods described in appendix 13 of the Detection Diagnosis and Mapping Manual.
- In addition within the infested areas evidence points signifying proportion of susceptible species death within 20 m of the observer with the purpose of producing an map of relative impact. Aerial photography (2004, 2011) was used to assist in the determination of impact class. The three impact classes used for this assessment were;
 - Severe – Determined to have lost more than 75% of susceptible species due to affects of the pathogen *P. cinnamomi*.

- High – Determined to have lost between 25% and 75% of susceptible species due to affects of the pathogen *P. cinnamomi*.
- Low-Moderate – Determined to have lost up to 25% of susceptible species due to affects of the pathogen *P. cinnamomi*.

The percentages for the impact classes refer to the proportion of susceptible plants (generally *B. attenuata* and *B. ilicifolia*) that have been killed or are dying from the effects of disease caused by *P. cinnamomi*.

5.2.1. Demarcation

The area infested by *Phytophthora cinnamomi* was demarcated using a single band of “Day-Glo orange” flagging tape. Knots in the tape are placed facing towards the infestation. A variable buffer width was applied to every infestation boundary as per the “Detection Diagnosis and Mapping Manual”, Section 7 (Department of Conservation and Land Management, 2001). In general the buffer width was 15 m to 25 m. The areas determined to be “uninterpretable” were not demarcated.

5.2.2. Sampling

Three soil and tissue samples were taken according to the method described in the “Detection Diagnosis and Mapping Manual”, Section 6 (Department of Conservation and Land Management, 2001).

5.2.3. Mapping

Mapping was carried out by overlaying data collected by GPS in the field (waypoints and tracks) on digital aerial photography in the office using a GIS software program. The categories mapped for the Survey Area were “unmappable”, “infested”, “uninfested” and “uninterpretable” (see the Glossary below). The definition of the terms “unmappable” (and its alternative “mappable”) are not yet published by the Department of Environment and Conservation, but have been use by it for some time.

6. Results and Discussion

6.1. Vegetation Type

Three vegetation types were identified and mapped within the Survey Area (Table 1, Fig. 2), however one of the vegetation types (*Kunzea* Tall Shrubland) was originally *Banksia* Woodland but has been severely degraded by *Phytophthora cinnamomi* disease. The remainder of the

Survey Area is mapped as “Disturbed” and is comprised of a former sandpit and partially cleared areas. These areas have scattered shrubs, mainly *K. glabrescens* and annual weeds, particularly **Ehrharta calycina*. A description of the vegetation types, using the structural method of Muir (1977) is given below.

Vegetation Type	Ha	%
<i>Banksia</i> Woodland	8.56	65.2
Marri-Peppermint Woodland	0.50	3.8
<i>Kunzea</i> Tall Shrubland	2.27	17.3
Disturbed	1.80	13.7
	13.13	100.0

Table 1. Areas and percentages of vegetation types in the Survey Area

Banksia Woodland

Woodland of *Banksia attenuata* and *B. ilicifolia* (with occasional emergent *Eucalyptus marginata* and *Nuytsia floribunda*) over *Kunzea glabrescens* (\pm *Podocarpus drouynianus*) Low Scrub A over *Melaleuca thymoides*, *Stirlingia latifolia*, *Hypocalymma robustum*, *Calytrix fraseri*, *Macrozamia riedlei*, *Acacia pulchella* and *Jacksonia horrida* Heath B over *Adenanthos meisneri*, *Hemiandra pungens*, *Dasypogon bromeliifolius*, *Hibbertia racemosa* Dwarf Scrub C over *Patersonia occidentalis*, *Hypolaena exsulca* and *Lyginia barbata* Open Low Sedges. (Note: in places the shrub *P. drouynianus* dominates the understorey). [Fig. 3].

Kunzea Tall Shrubland

Low Woodland B to Scrub of *Kunzea glabrescens* (with occasional *B. attenuata*, *B. ilicifolia* or *N. floribunda*) over Low Scrub B of *Calytrix fraseri*, *Hypocalymma robustum*, *Melaleuca thymoides*, *Adenanthos meisneri* and *Stirlingia latifolia* over *Patersonia occidentalis*, *Hypolaena exsulca* and *Lyginia barbata* Open Low Sedges and **Ehrharta calycina* Open Tall Grass. [Fig.4].

Marri-Peppermint Woodland

Woodland of *Agonis flexuosa* with *Corymbia calophylla* (downslope) over sparse understorey of *Pteridium esculentum* Open Ferns, and **Ehrharta calycina* and **Briza maxima* Low Grass and other annual exotic species. [Fig. 5].

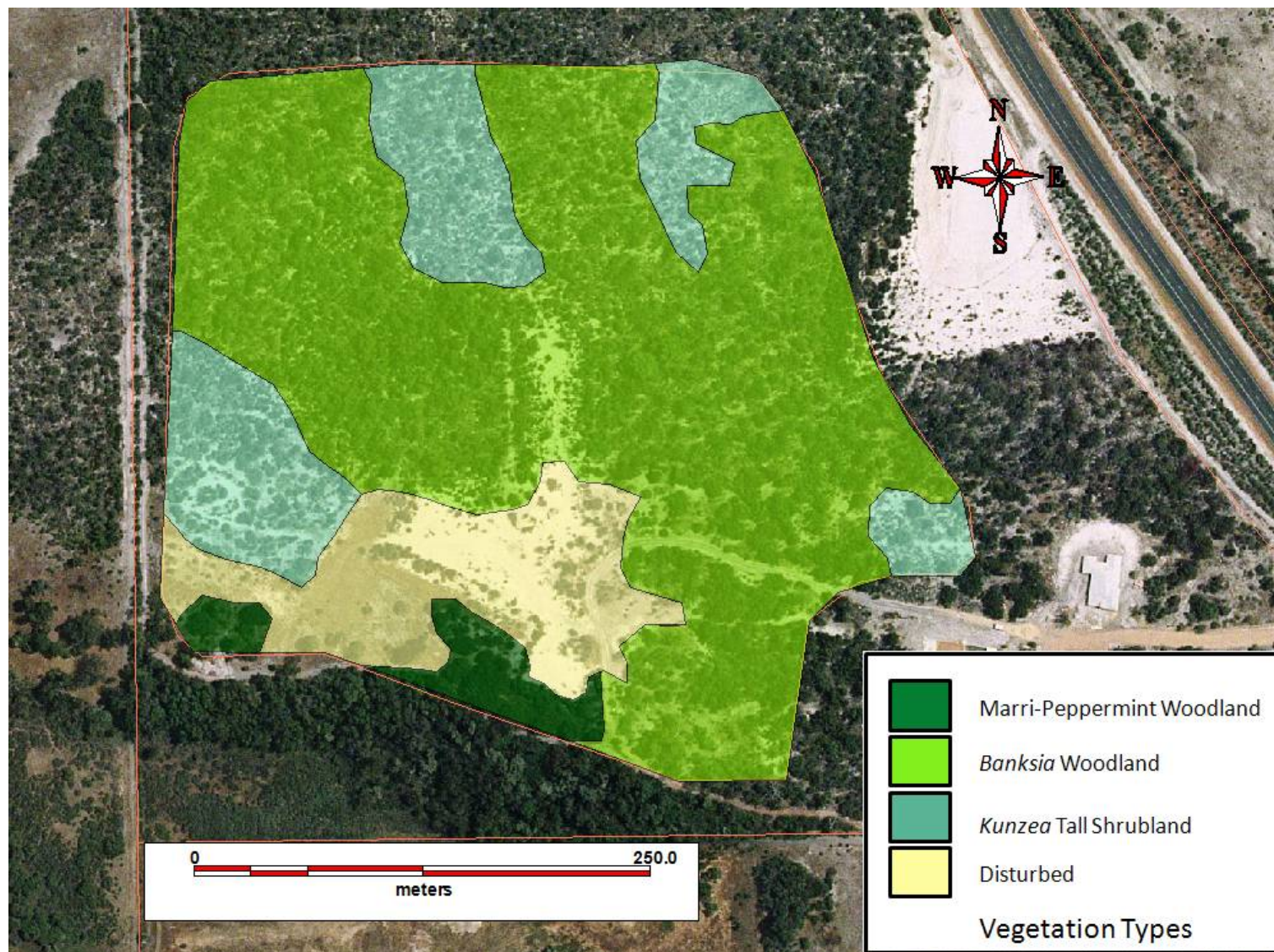


Figure 2. Vegetation Types in the Survey Area.



Figure 3. *Banksia* Woodland



Figure 4. *Kunzea* Tall Shrubland



Figure 5. Marri-Peppermint Woodland

The vegetation type mapped as *Banksia* Woodland is most similar to the floristic community type “Southern *Banksia attenuata* woodlands” (SWAFCT 21b) (Gibson *et al.*, 1994). Among the “typical” species it shares with SWAFCT 21b are *Banksia attenuata*, *Calytrix fraseri*, *Hypocalymma robustum*, *Jacksonia horrida*, *Melaleuca thymoides*, *Stirlingia latifolia* and *Dasypogon bromeliifolius*). More than twenty of the “typical” and “common” species associated with SWAFCT 21b were found within the Survey Area. Floristic Community Type SWAFCT21b is recognised as a Priority Three ecological community (DEC, 2011b).

Originally the areas mapped as *Kunzea* Tall Shrubland would have been covered with the *Banksia* Woodland vegetation type. The effects of disease caused by *P. cinnamomi* root-rot have been to remove all or most of the susceptible species in these areas. Primarily the overstorey of *B. attenuata* and *B. ilicifolia* has been removed, or very much reduced. In addition other susceptible species from the mid and understorey have been removed by the disease, such as the highly susceptible *Xanthorrhoea brunonis* and *X. gracilis* and eventually other less susceptible species such as *Jacksonia horrida*, *Leucopogon conostephioides* and *Podocarpus drouynianus* (Groves *et al.*, 2008). The other vegetation type within the Survey Area, Marri-Peppermint Woodland is a degraded fragment of the Flooded Gum-Marri-Peppermint-Paperbark woodland/open forest that fringes the wet shrubland along the southern boundary of Lot 1650. This community probably belongs to floristic community type “Forest and woodlands of deep seasonal wetlands of the Swan Coastal Plain” (SWAFCT15).

6.2. Vegetation Condition

Vegetation condition within the Survey Area is quantified in Table 2 and mapped in Fig. 6. Most (67%) of the area was mapped as “Degraded”. The main factors in degrading the vegetation have been *Phytophthora* disease (“Dieback”), previous disturbance related to construction of tracks and sandpits and heavy grazing pressure by kangaroos and rabbits. The areas classed as in “Good” condition are those where the canopy of *Banksia* is predominantly intact although there may be isolated dead or dying trees of these species.

Heavy grazing, particularly by kangaroos, is evident throughout the Survey Area, and this together with the effects of *Phytophthora* disease has led to a reduction in the density of the understorey over much of the area. The invasive perennial grass *Ehrharta calycina* is evident in many areas, particularly where heavy physical disturbance has taken place. It has also invaded some of the more intact *Banksia* woodland (Fig. 7).

Status	Ha	%
Good	2.06	15.7
Degraded	8.80	67.0
Completely Degraded	2.28	17.4
	13.13	100.0

Table 2. Vegetation Condition within the Survey Area

6.3. *Phytophthora* Disease (Dieback) Status and Distribution

The total area assessed was 13.1 ha, with 2.3 ha (the heavily disturbed areas) being classified as “unmappable” (Fig. 8). Of the 13.1 ha within the Survey Area, 10.3 ha (78.5%) was assessed as “infested” and 0.5 ha (4.1%) was assessed as “uninfested”. The uninfested area forms an “island” on the highest ground near the middle of the Survey Area.

Three root tissue samples were collected from recently killed plants within the Survey Area (Fig. 8). The samples were sent to the Vegetation Health Service laboratory of the Department of Conservation and Land Management for analysis. The results are given in Table 3, below.

Sample No.	Species Sampled	Result
1	<i>Banksia attenuata</i>	
2	<i>Banksia attenuata</i>	
3	<i>Banksia attenuata</i>	

Table 3. Results of root tissue sample analysis for *Phytophthora*.

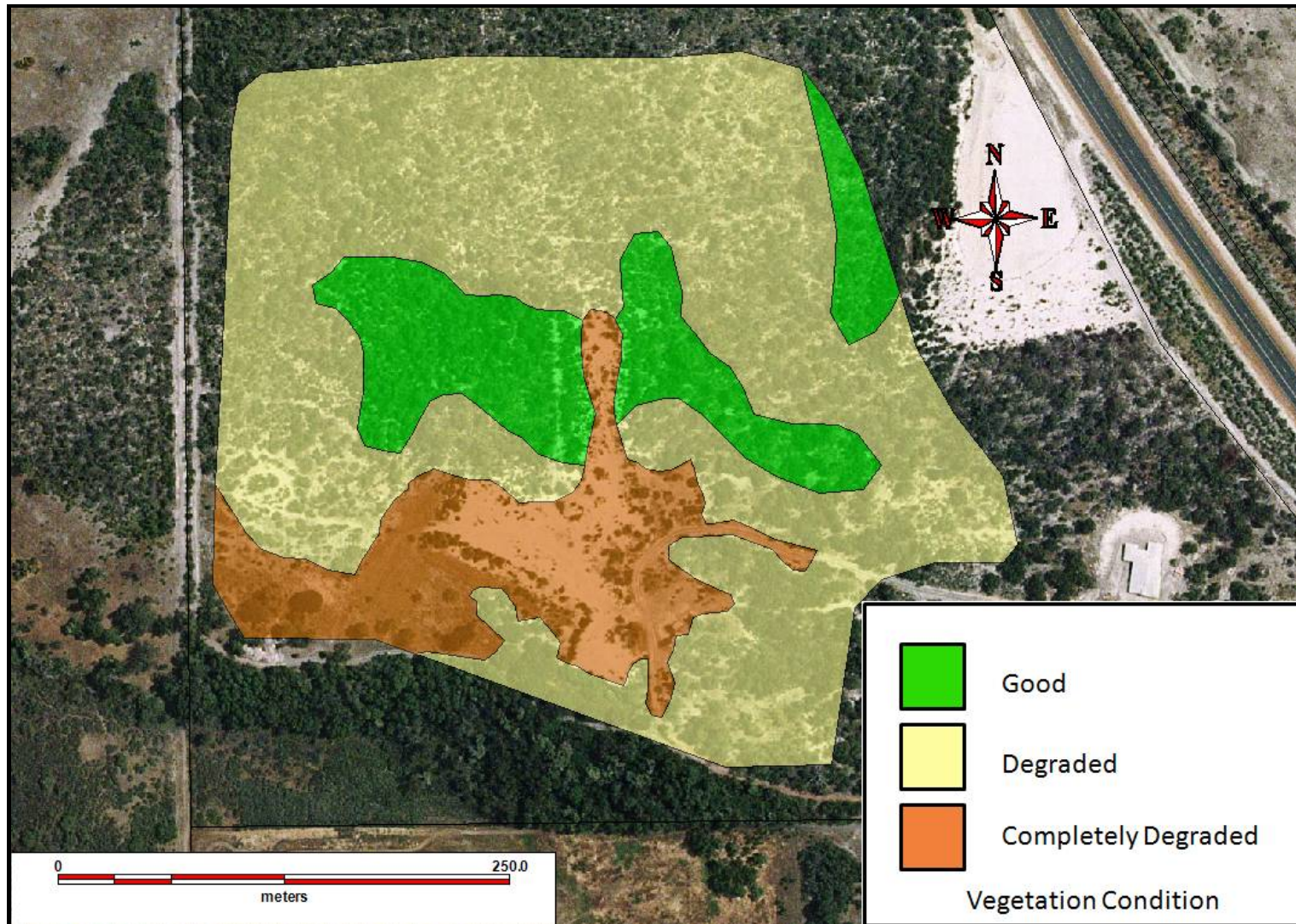


Figure 6. Vegetation Condition in the Survey Area.



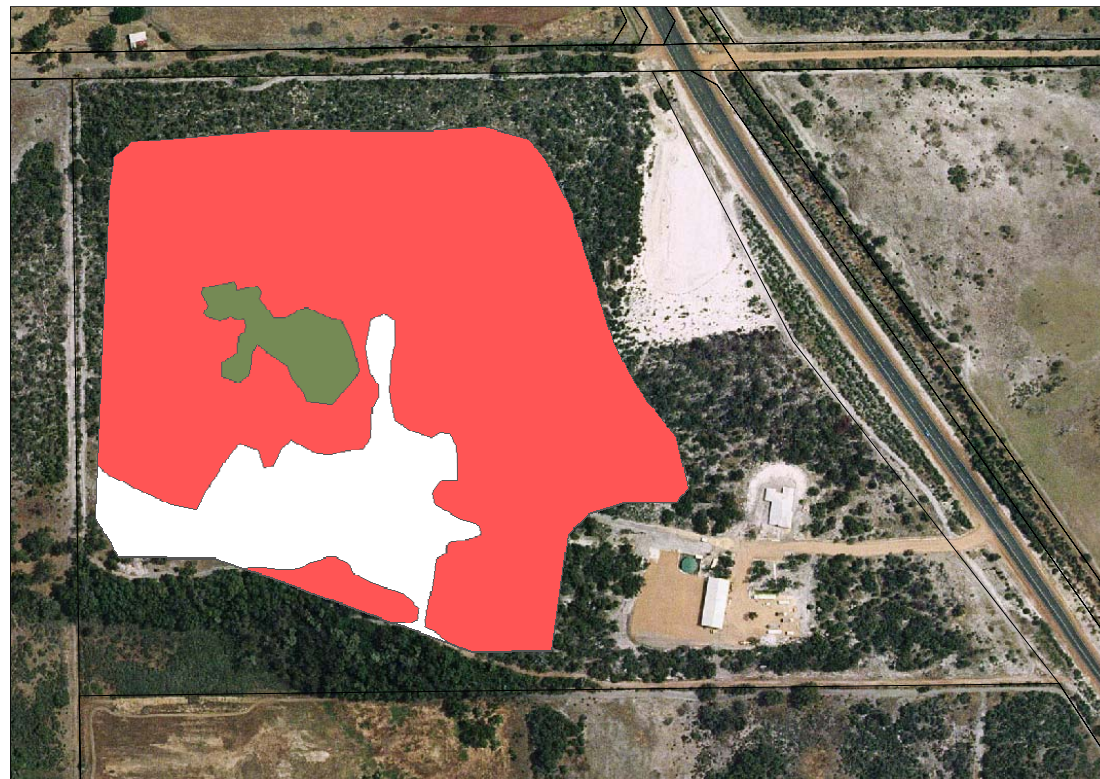
Figure 7. Invasion of *Banksia* woodland by *Ehrharta calycina* (Perennial Veldt Grass)

6.4. *Phytophthora cinnamomi* Disease Expression

The most common susceptible overstorey species within the Survey Area are *Banksia attenuata* and *Banksia ilicifolia*. Other susceptible species less commonly found in the survey area (Smith, 2008), mainly near the eastern and southern margins, are *Macrozamia riedlei*, *Podocarpus drouynianus* and *Xanthorrhoea brunonis* and *X. gracilis* (Groves, et al., 2008). The pattern of disease development appears to be that *Banksia attenuata*, *B. ilicifolia* and the *Xanthorrhoea* species succumb first, followed eventually by the other susceptible species once the disease is well established in an area. Although Jarrah (*E. marginata*) is susceptible to the disease few of this species within the Survey Area have died, although they all have dead “stags” on them.

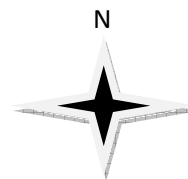
The distribution of “recent deaths” of susceptible species (mainly *B. attenuata*) and also the locations where root tissue samples were taken in relation to the distribution of disease symptoms is shown in Fig. 9. “Recent deaths” were recorded if the plant was dead but still had most (> 90%) of its leaves still in place (Fig. 10). Most of these have almost certainly been caused by *P. cinnamomi*, but the possibility of drought as a cause of some deaths cannot be ruled out, particularly for isolated deaths in areas with no other symptoms. The pattern of recent deaths indicates the location of current disease activity. Dead and dying plants form “fronts” of disease expression in some areas (Fig. 11).

Figure 8. *Phytophthora* Disease (Dieback) Status and Distribution



0 100 200 300 400 metres

Lot 1650, North Boyanup Road, Shire of Boyanup-Capel-Dardanup



Infested – Determined by a qualified interpreter to have plant disease symptoms consistent with the presence of the pathogen *P. cinnamomi*.



Uninfested – Determined by a qualified interpreter to be free of plant disease symptoms which indicate the presence of the pathogen *P. cinnamomi*.



Unmappable – Disturbed areas where susceptible plants are no longer present or are too few, or have been damaged so that interpretation is not possible.

AGE LIMITS

Boundaries should be checked before operations proceed if this map is more than 1-year-old, 21st March 2013.

This map should not be used if it is older than 3 years, 21st March 2015.

Areas that have had an soil disturbance operation in them become unreliable and should be checked prior to further or new activities.

AREA STATEMENT

Infested	10.30 ha
Uninfested	0.54 ha
Unmappable	2.29 ha
Total Area	13.13 ha

Field interpretation and mapping by Russell Smith

Figure 9. Recent Deaths of Susceptible Species and Sample Points in Relation to *Phytophthora* Disease (Dieback) Status and Distribution

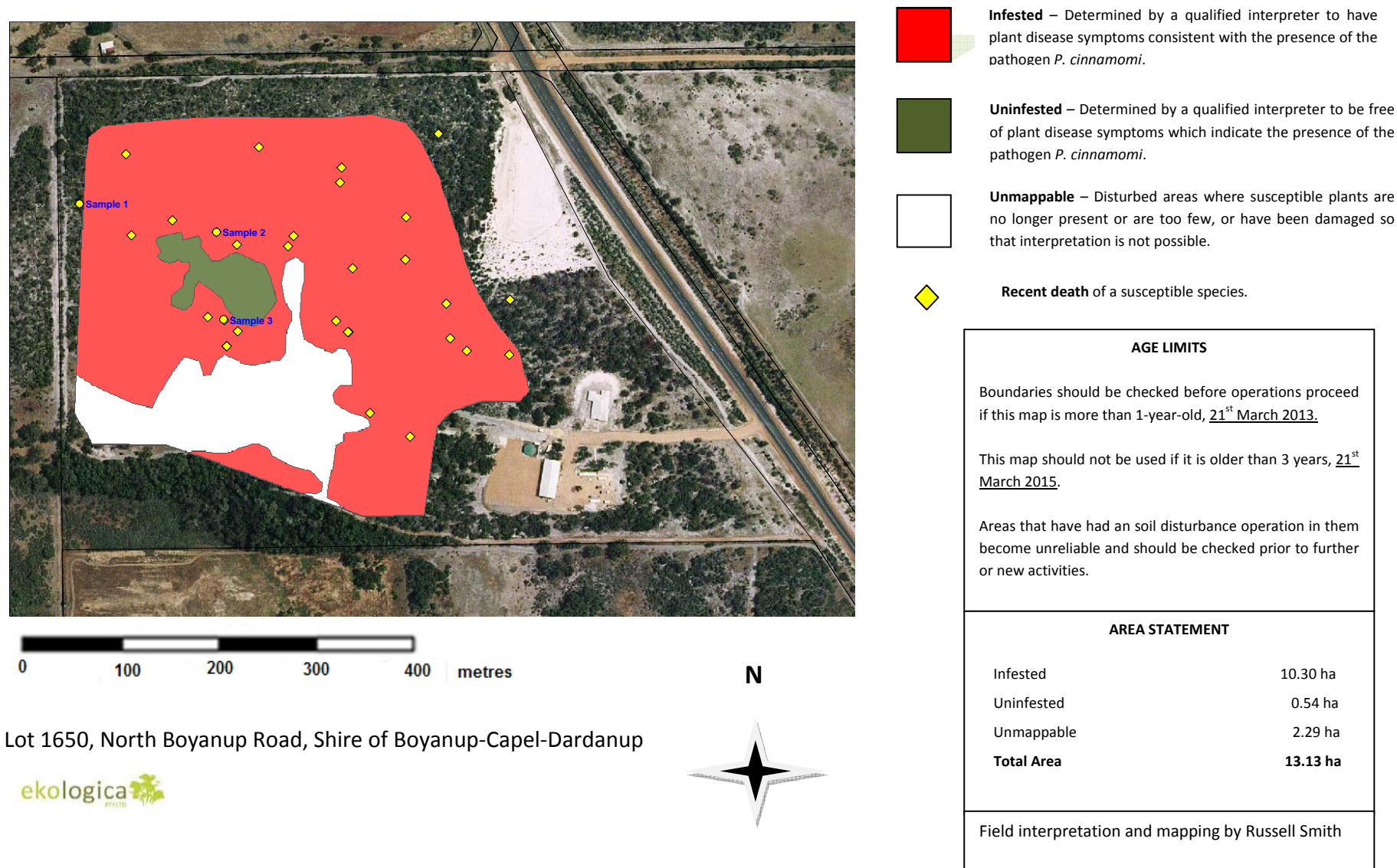




Figure 10. A “recent death” of a small *Banksia attenuata* tree. (Sample 1).



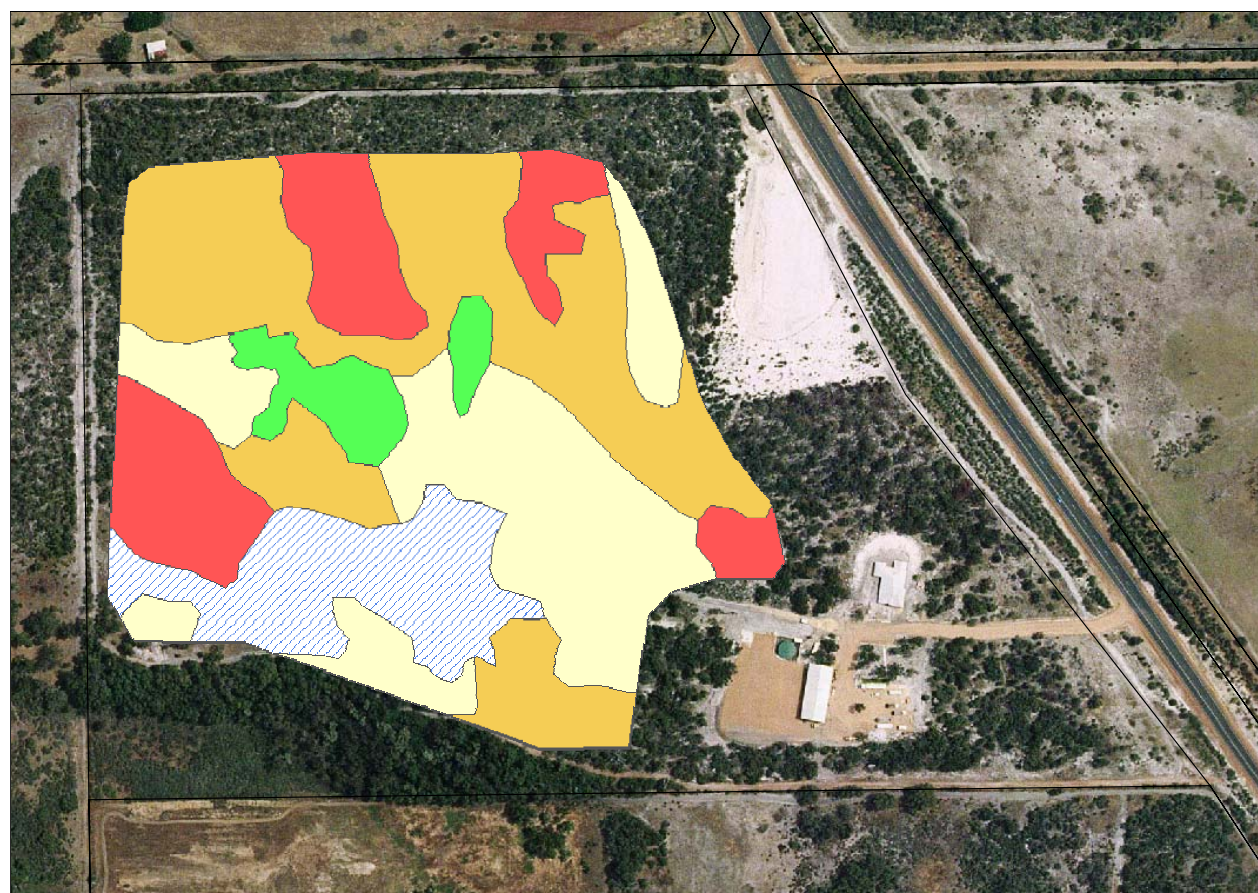
Figure 12. A *Phytophthora* disease “front” showing dying *Podocarpus drouynianus* plants.

6.5. Level of Impact by *Phytophthora cinnamomi* Disease

The level of impact by *Phytophthora cinnamomi* disease is mapped in Fig. 13. Seventeen percent (2.3 ha) of the Survey Area was classed as having a “Severe” impact (Fig. 14), and a further 40% of the Survey Area (5.2 ha) was classed as having a “High” impact. Only a small portion (5.3%) was assessed as having “Nil” impact. However, the high degree of physical disturbance over much of the Survey Area (13.7% was not assessable) and the invasion of weeds, particularly Perennial Veldt Grass (*E. calycina*) into the *Banksia* woodland coupled with loss of native species through heavy grazing has probably concealed the full impact of “dieback” overall.



Figure 13. Area of “High” impact with almost all susceptible species removed by the effects of disease caused by *Phytophthora cinnamomi*.



- Severe** – Determined to have lost more than 75% of susceptible species due to effects of the pathogen *P. cinnamomi*
- High** – determined to have lost between 25% and 75% of susceptible species due to the effects of the pathogen *P. cinnamomi*.
- Low-Moderate** – Determined to have lost up to 25% of susceptible species due to the effects of *P. cinnamomi*.
- Nil** – No symptoms of disease expression and no loss of susceptible plant species due to effects of the pathogen *P. cinnamomi*.
- Not Assessed** – Heavily disturbed, much bare ground and few susceptible species. No signs of *P. cinnamomi* disease expression.

Area Statement	
Severe	2.3 ha
High	5.2 ha
Low-Moderate	3.2 ha
Nil	0.7 ha
Not Assessed	1.8 ha
Total Area	13.1 ha

Field interpretation and mapping by Russell Smith

Lot 1650, North Boyanup Road, Shire of Boyanup-Capel-Dardanup

Figure 13. The distribution of *Phytophthora cinnamomi* impact classes within the Survey Area

6.6. *Flora and the Potential for Rare Flora in the Survey Area*

A total of sixty six species of vascular flora were identified within and close to the boundary of the Survey Area. These species are listed in Appendix A. Species richness is relatively low, even allowing for the time of survey – this is probably due to the high level of disturbance in the Survey Area. Two 100 m² quadrats were placed and species occurring within them were listed. Information about the quadrats is given in Appendix 2. Few annual or annually-renewed species were identified within the Survey Area and a spring survey will be required to pick up these species, including those in the quadrats.

6.7. *The Potential for Rare Flora to occur within the Survey Area*

None of the species identified during the survey are Declared Rare Flora, Priority Flora or otherwise of conservation significance. However, as noted above a spring survey is required to ascertain whether any annual or annually-renewing rare flora occur within the Survey Area. A list of Declared Rare Flora and Priority Flora known to occur within 5 km of the Survey Area is provided in Table 4 (DEC, 2012). Of the species listed in Table 4, the two DRF orchids, which would not have been visible at the time of this survey, have a moderate likelihood of occurring within the Survey Area and a spring survey (October) would need to be conducted whether they occur there.

Taxon	Priority	Habitat	Likelihood
<i>Drakaea elastica</i>	DRF	White/grey sand adjoining swamps	Moderate
<i>Drakaea micrantha</i>	DRF	White-grey sand.	Moderate
<i>Eleocharis keigheryi</i>	DRF	Freshwater: creeks, claypans.	None
<i>Boronia humifusa</i>	P1	Gravelly clay loam over laterite.	Unlikely
<i>Synaphea odocoileops</i>	P1	Swamps, winter-wet areas.	Unlikely
<i>Leptomeria furtiva</i>	P2	Winter-wet flats.	Unlikely
<i>Mitreola minima</i>	P3	Peaty swampy areas.	Unlikely
<i>Thelymitra variegata</i>	P3	Sandy clay, sand, laterite.	Low
<i>Acacia flagelliformis</i>	P4	Winter-wet areas.	Unlikely
<i>Acacia semitrullata</i>	P4	White/grey sand.	Moderate
<i>Aponogeton hexatepalus</i>	P4	Freshwater	None
<i>Franklandia triaristata</i>	P4	White or grey sand.	Moderate
<i>Ornduffia submersa</i>	P4	Freshwater.	None
<i>Pultenaea skinneri</i>	P4	Winter-wet depressions.	Unlikely

Table 4. Declared Rare (DRF) and Priority Flora occurring within 5 km radius of the Survey Area.

7. Conclusions

7.1. *The Vegetation in the Survey Area with regard to its Regional and Local Representativeness*

As stated in Section 5, above, the native vegetation in the Survey Area lies with the “Bassendean Complex – Central and South”. The remaining area of this complex is 27%, while its remaining area in secure tenure is only 0.7 percent (EPA, 2006). This is far below the desired reservation target of 15% (EPA, 2002).

The majority of the vegetation in the Survey Area (i.e. the *Banksia* Woodland and *Kunzea* Tall Shrubland) belongs to the “Southern *Banksia attenuata* woodlands” (SWAFCT 21b) floristic community type (Gibson *et al.*, 1994). As noted in subsection 7.1, this floristic community is listed as Priority Three. The *Kunzea* Shrubland is a degraded form of the *Banksia* Woodland, most if not all of the characteristic overstorey species, *Banksia attenuata* and *B. ilicifolia* having been killed by “Dieback” disease and it is debatable whether it still qualifies as representative of this community. As stated in subsection 7.2, 67% of the native vegetation in the Survey Area is “Degraded”, with a further 17% categorized as “Completely Degraded”.

The 2 ha of *Banksia* woodland in “Good” condition within the Survey Area has value as an occurrence of the Priority Three ecological community SWAFCT21b. However, given its small size and relatively large boundary/area ratio it is at significant risk of further loss of species, particularly through Dieback disease. Given a conservative rate of advance (c. 1 m/yr⁻¹)¹ for the Dieback fronts surrounding the pockets of *Banksia* Woodland in “Good” condition (currently uninfested or only lightly impacted) the current extent of 2 ha will probably have halved within 10 years.

7.2. *Ecological Linkages*

The native vegetation within the Survey Area is classed as 1b under the schema of Molloy *et al.* (2009) for identifying regional ecological linkages. These areas represent native vegetation touching, or less than 100 m from vegetation classed as 1a. Vegetation classed as 1a touches or is within 100 m of a linkage. Under the ecological linkages analysis scheme “The landscape function of an ecological linkage will be considered impaired where the proposed development causes the proximity value of a level 1 patch of remnant vegetation to change to a level 2.”

¹ Rates of advance for Dieback fronts in *Banksia* woodland have been measured at 1.0-4.0 m/yr⁻¹; Hill *et al.*, 1994; Shearer *et al.*, 2004.

There is a small amount of vegetation of 1c class to the west of the Survey Area but after the proposed development this would still have a connection to the main linkage via a corridor of vegetation retained along the northern and southern edges of the Survey Area.

7.3. *Rare Flora*

As stated in subsection 7.7 there are several rare flora species potentially occurring in the Survey Area that would not have been visible or identifiable at the time of the present survey. It is recommended that a spring survey be carried out to determine whether any rare flora occur within it.

References

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Glossary

Buffer width : A zone adjacent to an infested area that, although disease symptoms are not yet evident, may be infested. Soil and the root systems of both susceptible and non-susceptible species adjacent to a visibly infested area may harbour the pathogen but not yet exhibit symptoms.

Disease : A combination of a pathogen, host and correct environmental conditions, which results in disease symptoms or death of a host.

Disease expression : The visible symptoms of the disease in susceptible plants.

Host : The plant which is invaded by a pathogen and from which the pathogen derives its energy.

Impact: The effects of disease on plant health.

Pathogen : Any organism (e.g. *P. cinnamomi*) or factor that causes disease in a host.

Susceptible : Influenced or harmed by *Phytophthora cinnamomi*.

Rate of Spread (R.O.S): Speed (usually measured in m/yr^{-1}) that a *Phytophthora* disease front moves into uninfested vegetation. Autonomous spread of the pathogen in *Banksia attenuata* woodland through root-root contact may occur at $1.0\text{--}4.0 \text{ m/yr}^{-1}$.

Risk : The chance of an uninfested area becoming infested through the autonomous actions of the pathogen (*P. cinnamomi*) or the actions of people and animals or a combination of these factors, measured in terms of the magnitude of consequences of that event should it occur and the likelihood of the event and its consequences occurring and assessed in the context of existing controls.

Uninfested : An area that an accredited person has determined may be free of plant disease symptoms that indicate the presence of *P. cinnamomi*.

Uninterpretable : Lack of susceptible plant species precludes disease expression.

Appendix A: List of vascular flora identified with and just outside the Survey Area.

Note: Species occurring within the two quadrats placed within the Survey Area are indicated.

FAMILY_NAME	LATIN NAME	NATURALISED	VERNACULAR	Quadrat 1	Quadrat 2
Fabaceae	<i>Acacia extensa</i>		Wiry Wattle		
Fabaceae	<i>Acacia huegelii</i>				
Fabaceae	<i>Acacia pulchella</i>		Prickly Moses	x	x
Proteaceae	<i>Adenanthos meisneri</i>			x	
Myrtaceae	<i>Agonis flexuosa</i>		Peppermint		
Casuarinaceae	<i>Allocasuarina humilis</i>		Dwarf Sheoak		
Poaceae	<i>Amphipogon turbinatus</i>				
Myrtaceae	<i>Astartea scoparia</i>				
Poaceae	<i>Austrodanthonia setacea</i>				x
Poaceae	<i>Austrostipa flavescens</i>				x
Myrtaceae	<i>Babingtonia camphorosmae</i>		Camphor Myrtle		
Proteaceae	<i>Banksia attenuata</i>		Slender Banksia	x	x
Proteaceae	<i>Banksia ilicifolia</i>		Holly-leaved Banksia		x
Fabaceae	<i>Bossiaea eriocarpa</i>		Common Brown Pea		
Poaceae	<i>Briza maxima</i>	*	Blowfly Grass	x	x
Colchicaceae	<i>Burchardia congesta</i>				
Fabaceae	<i>Callistachys lanceolata</i>		Wonnich		
Myrtaceae	<i>Calytrix fraseri</i>		Pink Summer Calytrix	x	x
Ericaceae	<i>Conostephium pendulum</i>		Pearl Flower		
Haemodoraceae	<i>Conostylis aculeata</i>		Prickly Conostylis	x	x
Myrtaceae	<i>Corymbia calophylla</i>		Marri		
Dasypogonaceae	<i>Dasypogon bromeliifolius</i>		Pineapple Bush	x	
Asteraceae	<i>Dittrichia graveolens</i>	*	Stinkwort		
Poaceae	<i>Ehrharta calycina</i>	*	Perennial Veldt Grass	x	x
Myrtaceae	<i>Eucalyptus marginata</i>		Jarra	x	
Myrtaceae	<i>Eucalyptus rudis</i>		Flooded Gum		
Fabaceae	<i>Gompholobium tomentosum</i>		Hairy Yellow Pea		
Proteaceae	<i>Hakea varia</i>		Variable-leaved Hakea		
Fabaceae	<i>Hardenbergia comptoniana</i>		Native Wisteria		

FAMILY_NAME	LATIN NAME	NATURALISED	VERNACULAR	Quadrat 1	Quadrat 2
Lamiaceae	<i>Hemiandra pungens</i>		Snakebush		x
Dilleniaceae	<i>Hibbertia racemosa</i>		Stalked Guinea Flower		x
Dilleniaceae	<i>Hibbertia vaginata</i>			x	
Myrtaceae	<i>Hypocalymma robustum</i>		Swan River Myrtle	x	
Restionaceae	<i>Hypolaena exsulca</i>			x	x
Restionaceae	<i>Hypolaena pubescens</i>				
Fabaceae	<i>Jacksonia furcellata</i>		Grey Stinkwood		
Juncaceae	<i>Juncus microcephalus</i>	*			
Myrtaceae	<i>Kunzea glabrescens</i>		Spearwood	x	
Myrtaceae	<i>Kunzea glabrescens</i>		Spearwood		
Cyperaceae	<i>Lepidosperma leptostachyum</i>			x	
Cyperaceae	<i>Lepidosperma longitudinale</i>		Pithy Sword-sedge		
Ericaceae	<i>Leucopogon conostephioides</i>				
Ericaceae	<i>Leucopogon propinquus</i>				
Anarthriaceae	<i>Lyginia barbata</i>			x	
Zamiaceae	<i>Macrozamia riedlei</i>		Zamia	x	x
Restionaceae	<i>Meeboldina roycei</i>				
Myrtaceae	<i>Melaleuca lateritia</i>		Robin Redbreast Bush		
Myrtaceae	<i>Melaleuca preissiana</i>		Moonah		
Myrtaceae	<i>Melaleuca thymoides</i>			x	x
Myrtaceae	<i>Melaleuca viminea</i>		Mohan		
Loranthaceae	<i>Nuytsia floribunda</i>		Christmas Tree	x	
Orobanchaceae	<i>Orobanche minor</i>	*	Lesser Broomrape		
Iridaceae	<i>Patersonia occidentalis</i>		Purple Flag	x	x
Proteaceae	<i>Persoonia longifolia</i>		Snottygobble		
Proteaceae	<i>Petrophile linearis</i>		Pixie Mops		
Haemodoraceae	<i>Phlebocarya ciliata</i>			x	
Apiaceae	<i>Platysace filiformis</i>				
Podocarpaceae	<i>Podocarpus drouynianus</i>		Wild Plum		

FAMILY_NAME	LATIN NAME	NATURALISED	VERNACULAR	Quadrat 1	Quadrat 2
Dennstaedtiaceae	<i>Pteridium esculentum</i>		Bracken		
Proteaceae	<i>Stirlingia latifolia</i>		Blueboy	x	x
Myrtaceae	<i>Taxandria linearifolia</i>				
Cyperaceae	<i>Tetraria octandra</i>				
Asteraceae	<i>Ursinia anthemoides</i>	*	Ursinia		
Xanthorrhoeaceae	<i>Xanthorrhoea brunonis</i>				
Xanthorrhoeaceae	<i>Xanthorrhoea gracilis</i>		Graceful Grass Tree		

Appendix B. Floristic Quadrats Installed in the Survey Area

Quadrat 1 – Lot 1650, North Boyanup Road, Boyanup

Latitude: -33.44378 deg

Longitude: 115.71512 deg

Landform: Gentle ridge

Soil: Light grey sand

Vegetation: *Eucalyptus marginata*-*Banksia attenuata*-*Nuytsia floribunda* woodland

SPECIES	COVER	SPECIES	COVER
<i>Acacia pulchella</i>	1	<i>Hypolaena exsulca</i>	1
<i>Adenanthos meisneri</i>	1	<i>Kunzea glabrescens</i>	3
<i>Banksia attenuata</i>	3	<i>Lepidosperma leptostachyum</i>	1
<i>Briza maxima</i>	1	<i>Lyginia barbata</i>	1
<i>Calytrix fraseri</i>	1	<i>Macrozamia riedlei</i>	1
<i>Conostylis aculeata</i>	2	<i>Melaleuca thymoides</i>	2
<i>Dasypogon bromeliifolius</i>	2	<i>Nuytsia floribunda</i>	1
<i>Ehrharta calycina</i>	1	<i>Patersonia occidentalis</i>	4
<i>Eucalyptus marginata</i>	3	<i>Phlebocarya ciliata</i>	4
<i>Hibbertia vaginata</i>	1	<i>Stirlingia latifolia</i>	3
<i>Hypocalymma robustum</i>	1		



Quadrat 2 – Lot 1650, North Boyanup Road, Boyanup

Latitude: -33.44325 deg

Longitude: 115.71593 deg

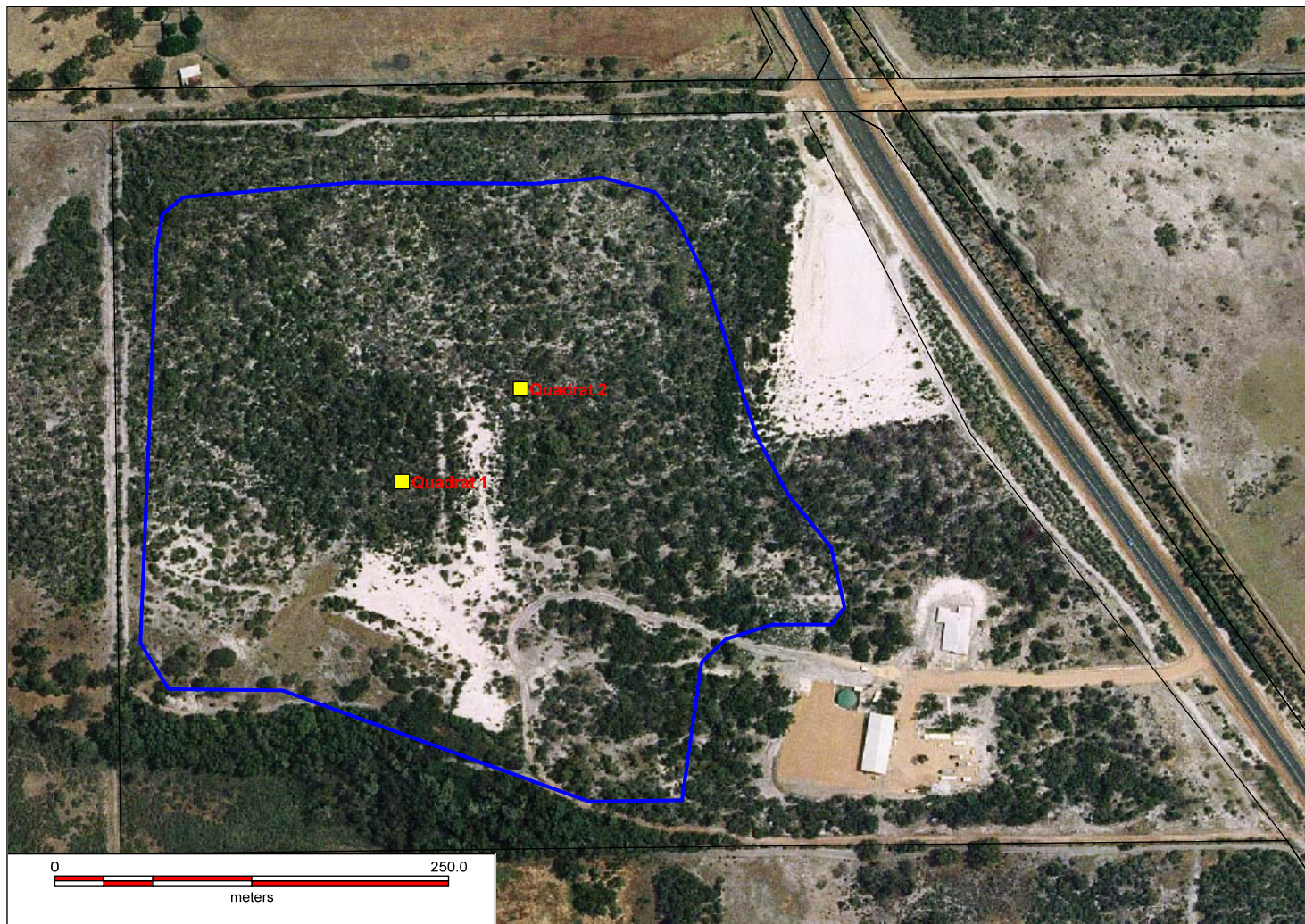
Landform: Gentle ridge

Soil: Light grey sand

Vegetation: *Banksia attenuata*-*B. ilicifolia* woodland

SPECIES	COVER	SPECIES	COVER
<i>Acacia pulchella</i>	1	<i>Hypolaena exsulca</i>	1
<i>Austrodanthonia setacea</i>	1	<i>Macrozamia riedlei</i>	1
<i>Austrostipa flavescens</i>	1	<i>Melaleuca thymoides</i>	1
<i>Banksia attenuata</i>	4	<i>Patersonia occidentalis</i>	1
<i>Banksia ilicifolia</i>	1	<i>Stirlingia latifolia</i>	3
<i>Briza maxima</i>	1		
<i>Calytrix fraseri</i>	1		
<i>Conostylis aculeata</i>	1		
<i>Ehrharta calycina</i>	1		
<i>Hemiandra pungens</i>	1		
<i>Hibbertia racemosa</i>	1		





Location of 100 m2 quadrats on Lot 1650