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PRELIMINARY SITE INSPECTION AND SUMMARY REPORT.

COMPLETED FOR

CITY OF BOROONDARA

AT THE SITE OF

KEW COTTAGES

TABLE OF CONTENTS

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1.0 BRIEF & INSPECTION METHODOLOGY

ENSPEC Pty Ltd was asked by the City of Boroondara's Senior Arborist to conduct a preliminary site inspection to establish why a heritage listed tree had entered into a rapid state of decline. It is believed that *Phytophthora cinnamomi* was the direct cause of the trees decline.

A report completed by Mr Ian Smith, Senior Forest Pathologist, of the University of Melbourne, School of Forest and Ecosystems Science was provided to ENSPEC for reference while conducting this investigation.

Mr Smith had collected 10 samples from the tree in question; the test report paper dated 27th February 2006 identified 3 positive isolations of *Phytophthora cinnamomi* in the soil of the root plate of the tree.

2.0 DATE OF INSPECTION

The site inspection started on Friday 17th March 2006 at 2.15 pm and concluded at approximately 4.00pm. A very brief verbal introduction to the sites history and current state was given to ENSPEC by Stewart Campbell (City of Boroondara Senior Arborist) at the commencement of the inspection.

3.0 ARBORIST CONDUCTING INSPECTION

Name of Arborist	Craig Hallam
Qualifications	Advanced Diploma Arboriculture
Contact phone number	0417 027 152
E-mail Address	craig.hallam@enspec.com
Website Address	**www.enspec.com**

4.0 STATEMENT FROM ARBORIST

I, Craig Hallam at no time entered onto the disturbed soil area of the tree discussed in this report or the tree of the same species adjacent in the same defined lawn area. At the completion of the site inspection my footwear was washed with a mixture of methylated sprits and water to ensure all soil particles were removed and my footwear sterilised.

5.0 SITE ADDRESS AND TOPOGRAPHY

Plate 1 (pink shaded area page 4) indicates the approximate boundaries of the property known as Kew Cottages, Kew, Victoria, 3101. The northern boundary fronts onto Hutchinson Drive and the southern boundary backs onto Main Drive. Boundary Drive and Princess Street form the western and eastern boundaries of the property

The red circle in plate 1 (page 4) identifies the approximate location of the Bishop Pine (*Pinus muricata*) discussed in this report. The tree is located in a lawn area, to the north of Lower Drive and to the west of Brady Lane.

The topography of the site varies. There is a general fall on the site from the southern side of the property, to the north northwest with the Hutchinson Drive side being the lower in elevation. Plate 2 (page 4) provides evidence of the elevation of the immediate area of the tree discussed in this report.

The tree is adjacent to a bitumen road and also two car parking areas. These car parking areas have recently been extended.

Plate 1

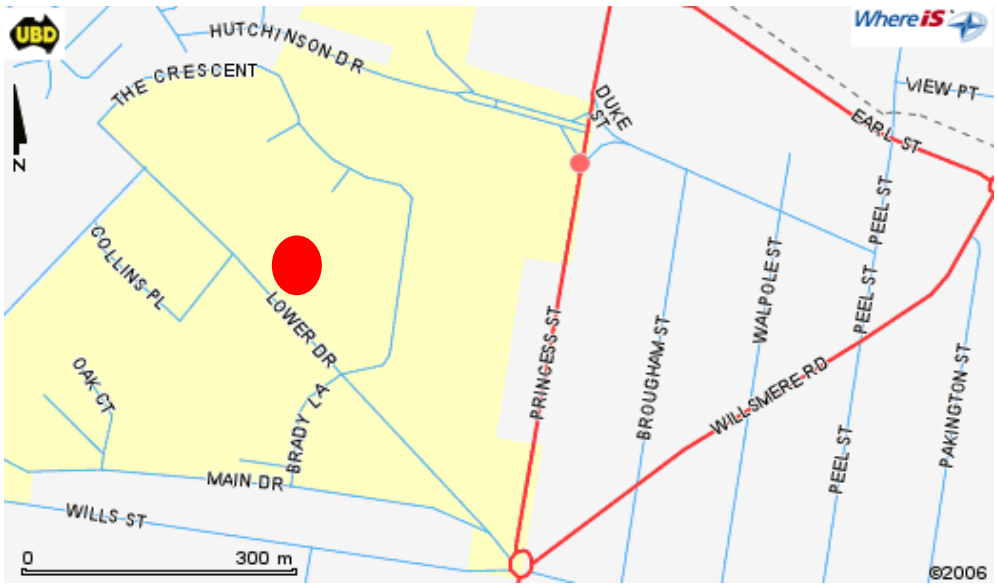

Plate 2

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5.0 DESCRIPTION OF TREE SPECIES & INFORMATION

Botanical Name	*Pinus muricata*
Common Name	Bishop Pine
Tree Height metres (approximately)	10 metres
Tree Spread metres (approximately)	East & West 8 metres North & South 8 metres
Tree Age (estimated)	80 plus years
Diameter at Breast Height	Not measured due to an exclusion zone around the tree (infected area)

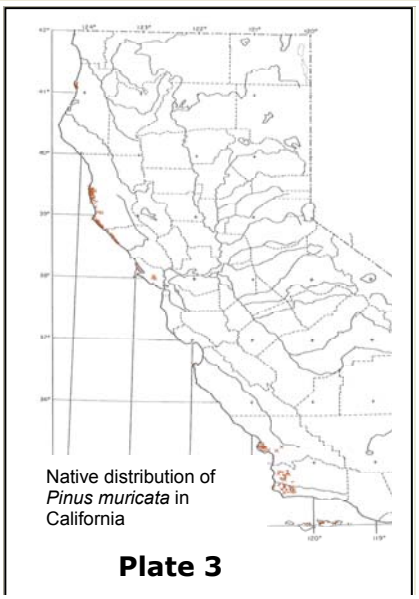

Plate 3

The Bishop Pine (*Pinus muricata*) is found along the northern and central coasts of California. The species is also found in northern Baja California and on the islands of Santa Cruz and Santa Rosa.

This species ranges between 12m and 25m in height and 600 mm to 900mm in diameter at maturity in its native region. The cones are 50mm to 90mm long and elongate-conical in shape; a stalk is absent and the base of the cone is oblique and asymmetric; cones clustered in whorls about the branch; cone scales numerous, with a raised keel, and those on the outer side with a stout terminal spine point toward the base of the cone; cones are very persistent and are sometimes overgrown by the bark and wood of the growing tree.

The needles occur in bundles of 2 and the bundle sheath is not shed after the first year; needles 100mm to 150mm inches in length, thick and stiff, slightly flattened, dull green. The bark is dark gray, very thick, and furrowed into scaly plates. This pine species is found in the hills and plains along the coast of California in the fog belt. It occurs as isolated individuals with other pines or as small groups of trees. The Bishop Pine is at times confused with Monterey Pine and Torrey Pine. The major identification point is that the Bishop Pine has needles in bundles of 2, Monterey Pine has bundles of 3 needles and Torrey Pine has bundles of 5 needles.

This species is known to be disease resistant to Texas Root Rot and *Verticillium* sp. Bishop Pine is however susceptible to *Phytophthora* (Root Rot), Rust and *Fusarium subglutinans* f. sp. pini (Pitch Canker)

6.0 VISUAL OBSERVATIONS OF TREE CONDITION

(a) Root Plate Statement

Under investigation is the root plate of the tree within the canopy drip line. This area has been disturb as a result of an application of metalaxyl fungicide (Ridomil) (this fungicide was recommended in Mr Ian Smith's report).

A chain mesh fence has been erected to define the area of ground treated with metalaxyl (Plate 4).

During my site investigation it was noted that workers were entering the fenced off area and carrying out remedial works (plate 5).

The remedial works consisted of the worker removing the top layer of soil using hand tools, applying the fungicide and the relaying the top soil over the treated areas (Plate 5).

Plate 4

Plate 5

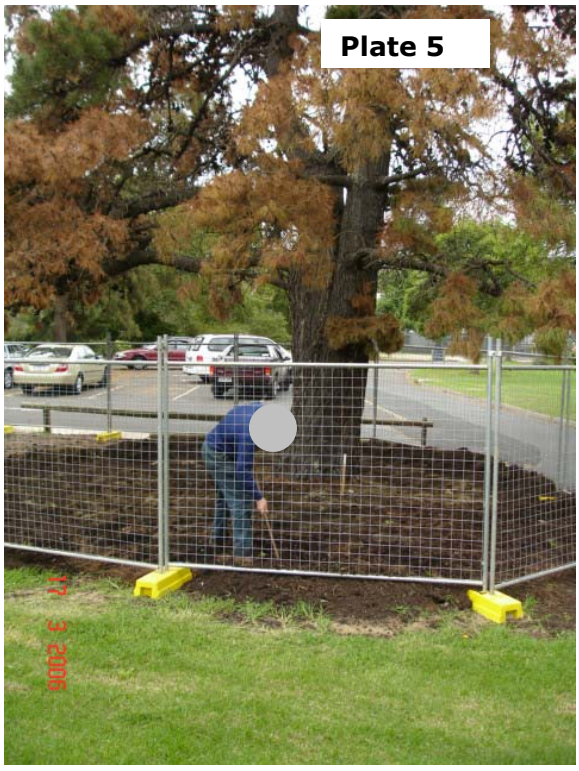

Plate 6

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It was then noted that the worker took the tools and crossed the lawn area and commenced work in another area of the property without cleaning and sanitising tools or footwear. This simple lack of basic fungal spread mitigation allows the sites to be potentially cross contaminated (Plate 6 page 6).

Basic control of any contaminated site whether fungi or other requires that any person or object taken from an infected point to any other point, be sanitised.

Site manager's and or responsible person's must take measures to provide adequate employee and or contractor training and resources to ensure the contamination of additional sites / areas does not occur.

A visual inspection of the fenced off infected area, indicated that there was no evidence that there had been any deep excavations within the Critical Root Zone (CRZ) or Primary Root Zone (PRZ) of this tree. Serious excavation within the CPZ can result in the rapid decline of a tree, similar to the symptoms that this tree is exhibiting. However it would appear that recently several post holes had been dug to fix bollards into the ground to support a wooden guard rail fence close to the drip line of the tree. The exact construction date of this fence is not known.

There is evidence of recent works within the Auxiliary Root Zone (ARZ); this root zone is deemed to be 1.5 times the height of the tree. It can be seen in plate 2 & 6 (page 4 & 6) that additional car paring spaces have been recently constructed in the ARZ of this tree. And although the exact construction method undertaken is not known: compaction to the immediate area or the application of lime to assist with the road base foundation would have resulted in some damage to the feeder roots in the ARZ area.

(b) Root and Trunk Buttress Condition Statement

The root and trunk buttress of this tree appear to be in very good condition, there is no evidence of recent major cambium wounds caused by either mechanical, pathogen or pest damage. It was observed that there is some minor resin flow excreting from the base of the tree trunk, origin at this time unknown.

(c) Tree Trunk Structure and Condition Statement

The tree is classified as having a co dominate stems, in the case of this tree there is no evidence of included bark in the main trunk union even though the trunk union has a very tight 'V' formation. A swelling of the trunk below the 'V indicates a weak stem union. This phenomena was not visible at the time of inspection.

(d) Tree Branches and Limb Condition Statement

The tree branches and limbs throughout the canopy are of good stature, all unions are generally well formed and there is no apparent immediate risk of premature limb failure. The trees branches have formed good compression and tension wood in general. There is no over extended branches that require remedial weight reduction which often occurs often with this genus.

(e) Tree Structure Statement

The visual inspection provides sufficient evidence that the structure of this tree is in sound condition; this is no immediate risk of any branch failures in the short term.

(f) Upper & Lower Canopy Condition Statement

The canopy has entered into a severe state of decline. From a ground visual observation it is estimated that approximately 95% of the canopy is made up of dead foliage.

Plate 4 (page 6) indicates the amount of dead foliage in the lower and upper canopy, from the ground visual inspection it is estimated that only 5% of the total canopy foliage is alive.

Plate 7

Plate 7 is a photo of a Bishop pine located to the west of the Bishop pine discussed in this report. The general density of the canopy is thin. Thin canopies are characteristics of a tree entering into decline. The red circle (Plate 7) indicates where the canopy thinning is most prevalent.

(g) Size of Dead Wood Statement

There is some deadwood through the canopy of this tree; this is not a high risk issue as there are no targets below the tree. If a dead branch were to fail it would only land on the manqué lawn area.

(h) Pest and Disease Statement

From the rapid decline in the canopy the as identified by Mr Ian Smith (Senior Forest Pathologist, of the University of Melbourne, School of Forest and Ecosystems Science) the rapid decline in the trees canopy condition may be associated with the infestation of the root area by *Phytophthora cinnamomi*. For this disease to development, *Phytophthora* generally prefers soils:

- That are low in organic matter (high organic matter soils contain organisms which compete strongly against *Phytophthora*)
- Are intermittently waterlogged
- Have soil temperatures that exceed 10-15^{o}C (optimum 22-25^{o}C) but not above 35^{o}C.

Due to the moist solid conditions located on the southern side of the tree and the warm humid period of January and February this pathogen may have become active resulting in an association with this trees decline.

(i) Wound Statement

There are no major wounds affecting or could be directly attributed to the decline, stability or health of this tree.

7.0 DISCUSSION

The visual tree assessment established that the tree is rapidly declining. *Phytophthora cinnamomi* has possibly advanced the rate of decline in this tree.

A report submitted by Mr Ian Smith from the University of Melbourne (School of Forest and Ecosystems Science), states that tests carried out 3 metres to the south of this tree trunk at soil depths of 0-10cm and 20-30cm and 3 metres north of the tree trunk at soil depth of 40-50cm found evidence of *Phytophthora cinnamomi*. Generally *Phytophthora cinnamomi* does not cause a rapid decline in tree health in a short period, the fungus attacks the vascular system (water and food conducting tissue) of the roots slowing the distribution of water and nutrients, hence resulting in a slow death. This decline can take from 12 months through to 5 years or even longer. The rate of decline is dependent on the weather conditions, ground temperature and the overall health of the tree.

The rapid decline of the *Pinus muricata* cannot be attributed to just one factor. The site inspection identified a number of factors that have contributed to the trees current condition.

In this discussion some possible scenarios are listed to help fully explore and understand other possible contributing factors to the trees decline.

7.1 The age of the tree must be taken into consideration; the normal expected useful life span (subject to location) is between 80 to 120 years in Victoria. The estimated age of this tree is approximately 80 -100 years of age, this provides support that the tree would be deemed under arboriculture terms to be over mature. The second living *Pinus muricata* directly adjacent is also showing signs of decline in the upper canopy this evidence supports the possibility the infected *Pinus muricata* was already entering into decline prior to *Phytophthora cinnamomi* infestation.

7.2 The trees location and surrounding area must be taken into consideration. The car parking area was recently increased in overall size this would have resulted in soil disturbance within the Auxiliary Root Zone (ARZ). It is well documented that age and a tree specie tolerance to soil changes can have a dramatic affect on a trees health and condition.

7.3 Availability of water can also dramatically affect a trees health and condition. Over the past 8 years Victoria has received lower than average annual rainfalls this has resulted in lower ground water tables. The lowering of the water table can result in the tree root plate becoming separated from the previously continuous water supply. In the short term the trees survived on nutrients and water stored in the root system and trunk. Without a steady supply of water and nutrients the tree becomes stressed. Depletion of a trees stored energy supplies exacerbates this.

7.4 Too much water can be as big a problem as to little water. Drowning a trees root system stops normal root functions. Evidence of this is found in Mr Ian Smiths report. Since the alterations and extension of the upper car park area it would appear that a new water path traverses across the lawn area above the infected tree. As a result water is now pooling at the base of the tree in high rainfall periods where the soil is infected.

7.5 On Saturday 25th February 2006 the Central Business District of Melbourne received 45.8 millimetres of rain. This amount of rain is nearly the entire average rainfall for February. Many northern and eastern suburbs received higher recordings. Northcote received 99mm, **Kew 79mm**, Burwood East 74mm and Coburg 73mm. The issue is not only about rain water. Deluges of rain often flush out contaminants. These poisons may of settled in the ground over the root plate. And although these poisons may not kill a tree outright they further stress a tree. This inturn induces decline.

7.6 Although no exploratory excavation works have been undertaken it is possible existing irrigation or drainage pipes are leaking. Water would then 'pool' around the root plate. This additional water would result in the *Phytophthora cinnamomi* being active in the soil for a longer period of time.

To summarise, excesses in water availability is as detrimental to a tree as lack of water.

Excesses in water availability combined with high temperatures, increases humidity. These are conditions that favour the rapid spread of *Phytophthora cinnamomi.*

A tree that is already stressed will succumb quicker to additional problems than a healthy tree.

8.0 USE LIFE EXPECTANCY (ULE)

The useful life expectancy of the *Pinus muricata* is less than 6 months. This tree should be removed but must only be removed in accordance with procedures that comply with the Department of Sustainability and Environment safe handling of *Phytophthora cinnamomi*.

9.0 INTRODUCTION TO PHYTHOHTHORA CINNAMOMI

9.1 General information on *Phytophthora cinnamomi*

There are several stains of *Phytophthora species.* *Phytophthora cinnamomi* is found in most regions of Australia and across the world.

Plate 8 is a generalised explanation of the life cycle of *Phytophthora cinnamomi*. There are no set time tables for the completion of this cycle.

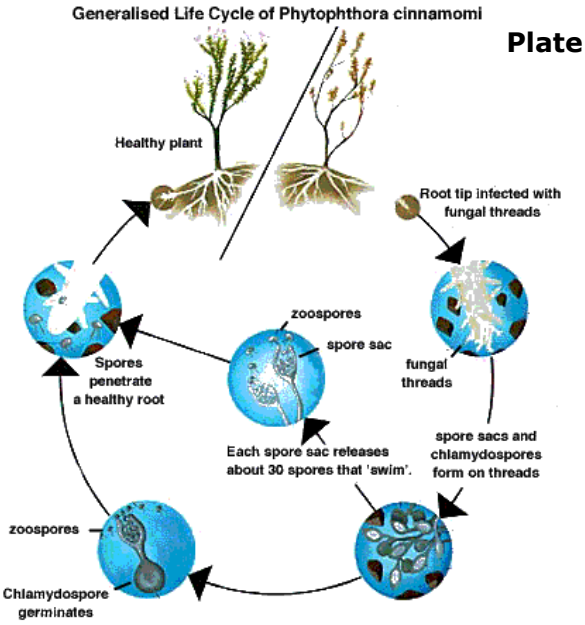

Plate 8

Phytophthora cinnamomi is found in many areas of Victoria as the map below shows. Areas of Melbourne are also known to be infected.

Phytophthora cinnamomi is a microscopic soil-borne organism, invisible to the naked eye, which causes root rot to a wide variety of plant species including many native and introduced plants.

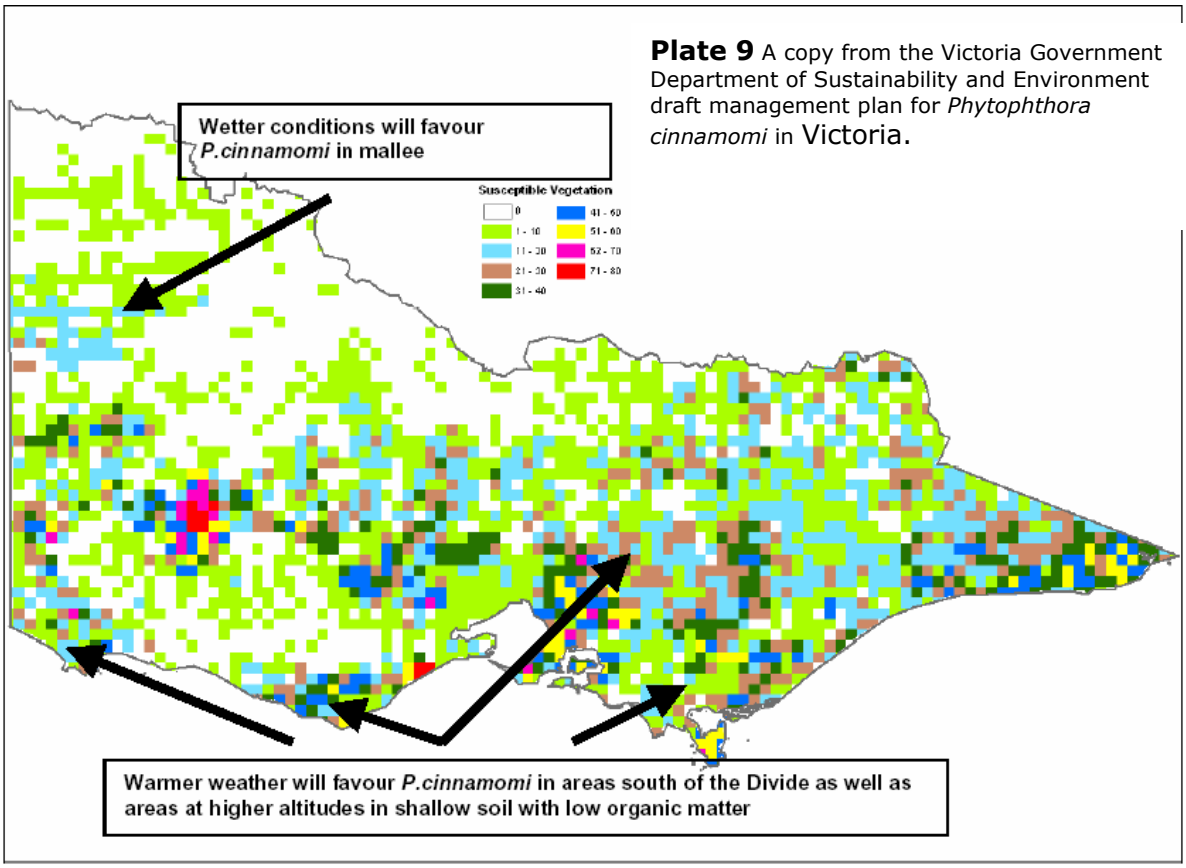

Plate 9 A copy from the Victoria Government Department of Sustainability and Environment draft management plan for *Phytophthora cinnamomi* in Victoria.

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Infection often results in the death of the plant, with earlier symptoms including wilting, yellowing and retention of dried foliage and darkening of young feeder roots and occasionally the larger roots. *Phytophthora cinnamomi* requires moist soil conditions and warm temperatures (optimum 22-25^{o}C) to be active, but damage caused by the disease most often occurs in summer when plants are drought stressed. This is because damage to a plants root system restricts water absorption, results in withering of the leaves and the plant entering onto decline.

These spores of the fungus are easily transported in storm water, drainage water, contaminated soil, on tools, footwear and vehicles. The fungus is very adaptive as it has the capability to produce spores that can wait for favourable conditions even if the time is not right now to proliferate. This allows *Phytophthora* to survive in dead plant tissue and in the soil for extended periods.

Presently there is no one simple method for controlling *Phytophthora cinnamomi*. Control relies on a combination of sanitation measures, good horticultural management, selective use of some fungicides and the addition of organic matter to soils to retard the activity of *Phytophthora*.

9.2 Garden plantings

As with all works, preparation is extremely important. Good site preparation regardless of whether the pathogen is present in a soil or not. If organic matter is required in the soil add it. Adding organic matter increase the level of soil micro-organisms, such as fungi (Trichoderma), actinomycetes and bacteria, these suppress the activity of *Phytophthora* and retard disease development in the soil. The use of mulches also minimise the contact between soil and footwear so that there is less potential for the transport of soil.

Do not use techniques such as post-hole diggers to prepare planting holes as these techniques result in poor drainage, thus enhancing disease development.

Ensure that drainage is adequate to prevent water logging, which promotes disease incidence and severity. All run-off water from known infected sites should be contained and directed to the storm water channels. Remember that water can very easily transport the swimming zoospores of *Phytophthora cinnamomi.*

9.3 Hygiene:

Sanitation of tools, machinery and boots is the most effective means by which the spread of *Phytophthora cinnamomi* can be limited.

In situations where you are planting a number of plants or continually disturbing soil in different locations take a container of disinfectant with you and disinfect tools between sites.

Boots and tyres are also an important means by which *Phytophthora* may be transported, as soil containing the fungus may cling to the boot or tyre. Therefore remove soil from boots and tyres and limit the movement of soil and the fungus.

Sanitation procedures may seem time consuming and annoying, but prevention and limitation of a disease such as *Phytophthora* is the most effective means of disease control.

9.4 Prevention and caring of infected plants

Fungicides containing potassium phosphonate are registered for control of this disease in certain situations. Information on these fungicides can be obtained from your local nursery or on the websites of the manufacturers. It is however important to ensure that application occurs when the plant can be expected to be actively exporting from the leaves to the root system ie. summer (once in early summer and then 4-5 weeks later), so that the chemical is transported to the roots where it is required. Plants should be sprayed for quite a wide area around the infected site. If you have to move or replant material never move a plant from an infected site to an uninfected site.

When removing infected plants it is essential to remove as much of the plant as possible.

Do not replant in the same plant hole as a diseased plant. Plant away from the dead plant, preferably upslope as plants down slope from any infected site will be at the greatest risk from the disease.

Remember that unassisted movement of *Phytophthora* up a slope is very slow, while downward movement may be quite rapid.

9.5 Prevention and control of spread in large areas

Phosphite can control many plant diseases caused by *Phytophthora*. The term 'phosphite' refers to salts of phosphonic acid (H3PO3). Phosphite treatment induces a strong and rapid defense response in the challenged plant.

Phosphite in Natural Ecosystems in Western Australia is currently being applied to native plant species as an injection to the trunks of trees or large shrubs and as a conventional foliar application to run-off. Foliar applications to run-off are either from spray backpacks or trailer mounted spray equipment.

It costs approximately $0.50 cents to treat a medium size jarrah (*E. marginata*) tree by injection. The best time to inject a tree is during spring and summer in the morning when the tree is actively transpiring. When injecting a tree, the aim is to apply as much phosphite as possible without causing phytotoxicity. Generally, rates vary between 50 and 200 gL-1 phosphite depending on the sensitivity of the species to phytotoxicity. If injecting trees of unknown sensitivity to phosphite it is appropriate to test for phytotoxicity before settling on a rate of application. It is critical to add an adjuvant when applying phosphite as a foliar application. In Western Australia, Synertrol Oil (Organic Crop Protectants Pty Ltd), based on food grade canola oil (832 g L) is used.

Recently, the results of plant tissue analysis suggest that the mineral oil surfactant, Ulvapron may be a more effective adjuvant for use with phosphite in aerial applications. Other adjuvants have been used, but the majorities of these are expensive, while some cause phytotoxicity in their own right or are unsuitable for use in native plant communities.

10. IMMEDIATE RECOMMENDATIONS

The immediate recommendations are to ensure the spread of the *Phytophthora cinnamomi* is eliminated by poor work practices. The immediate recommendations must be expanded in the future total management plan for this site.

i. It is recommended before any further excavation works are commenced anywhere on this site a hygiene management procedure must be developed and implemented for *Phytophthora.* This should include appropriate training for all managers, employees and contractors who conduct works on the site that could shift soil during their day to day work activities.

ii. A hygiene procedure should clearly define the correct method of cleaning all hand tools including motorised, tyres, mechanical excavation equipment, equipment used to shift/cart soil, machinery for mowing lawns, machinery for mulching woodchips or carting woodchips, footwear and spoiled clothing.

iii. Prior to any excavation works within 100 metres of the current defined infected site, soil tests must be conducted to ascertain if *Phytophthora cinnamomi* is present.

iv. Prior to the removal of the *Pinus muricata* the site should be excavated to establish if the *Phytophthora cinnamomi* contributed to the decline of the *Pinus muricata.* This would involve root wood samples being taken and tested at an approved laboratory.

v. It is also recommended that increment cores are taken from the trunk of the tree and viewed under a microscope. The distance between the annual growth rings will provide valuable information as to when the tree entered into decline.

vi. It is recommended that the *Pinus muricata* discussed in this report is removed. When the tree is removed all wood, branches and foliage should be disposed in accordance with Department of Sustainability and Environments handling of *Phytophthora cinnamomi* infected wood.

vii. It is recommended that all trees in the gardens should have chlorophyll fluorescence readings completed. "Finger prints" of these reading should be made for ongoing reference. Ongoing monitoring should be completed; this will allow for early detection of pathogens and or stresses within the tree and allow time for controls to be put in place to assist in preserving the trees health.

viii. It is recommended that all trees on the site have mulch applied under the canopy's drip line to help prevent the movement of soil and increase organic matter.

11. FUTURE MANAGEMENT PLAN

The future Total *Phytophthora cinnamomi* Management Plan is to ensure that this site is managed correctly while being developed ensuring no contaminated soils are relocated to areas which are not currently contaminated. The Management Plan must also incorporate procudures to ensure the spread of *Phytophthora cinnamomi* does not occur.

The plan must include comprehensive work procedures including a complete hygiene management and operational plans and procedures. This plan should also incorporate a section which explains how emergency works can be completed on essential services if required.

i. It is recommended that a Total *Phytophthora cinnamomi* Management Plan is establish prior to the 2006-2007 Summer season explaining how the site will be managed in future years. After this period no excavation works should be completed unless the plan has been fully implemented. This plan must clearly define how the developer / contractor will ensure the *Phytophthora cinnamomi* is monitored and not moved by human intervention while construction of the site is being completed. The plan should also explain how the site will be monitored after the area is developed. The plan must also have a comprehensive hygiene procedure ensuring all person involved with work on this site are adequacy trained in the correct cleaning of all tools and equipment. A wash bay may need to be installed for larger equipment.

ii. It is recommended that the developer / contractor incorporates in the management plan how they will undertake soil testing of all areas to be excavated prior to the commencement of excavation and how they will manage areas that are identified with *Phytophthora cinnamomi* prior to excavation.

iii. It is recommended that the developer / contractor include in their Total *Phytophthora cinnamomi* Management Plan how future drainage of areas will be managed to ensure water logging does not occur, how over irrigation of soil will not occur and how underground drains will be inspected to ensure crack pipes are rectified to ensure the spread of *Phytophthora cinnamomi* does not occur.

iv. It is recommended that the developer strategically plant locator trees through the site, these are species of trees that are highly susceptible to *Phytophthora cinnamomi*.

v. It is recommended that the developer incorporate and adopt best practices for the treatment of areas identified with *Phytophthora cinnamomi*. This should not be limited to areas already infected with *Phytophthora cinnamomi,* but should also incorporate strategies to proactively prepare areas which have not been affected to strengthen the resistance to *Phytophthora cinnamomi*.

12. CONCLUSION

Tree decline is often not a single problem. This report has identified a number of scenarios that would lead to this trees decline. The fungus *Phytophthora cinnamomi* may well be associated with the decline of the tree as it has been identified in the ground around the root plate. However there is no direct scientific correlation or evidence that this species is susceptible to *Phytophthora cinnamomi.*

I recommend that the recommendations in Section 10 "Immediate Recommendation" are implemented immediately and further expanded. This will minimise the risk of *Phytophthora cinnamomi* being spread unknowingly.

I recommend that the recommendations in Section 11 "Future Management Plan" are adopted, further expanded and implemented by the 2006-2007 Summer.

If the recommendations are incorporated to the overall future management of this site it will ensure the risk of spreading *Phytophthora cinnamomi* is minimise to ensure the susceptible tree species have the best chance to survive and live out their useful life.

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14 LIMITATION OF LIABILITY

ENSPEC Pty Ltd and their employees are tree specialists who use their qualifications, education, knowledge, training, diagnostic tools and experience to examine trees, recommend measures to enhance the beauty and health of trees, and attempt to reduce the risk of living near trees. Clients may choose to accept or disregard the recommendations of this assessment and report.

ENSPEC Pty Ltd and their employees cannot detect every condition that could possibly lead to the structural failure of a tree. Trees are living organisms that fail in ways the arboriculture industry does not fully understand. Conditions are often hidden within trees and below ground. Unless otherwise stated observations have been visually assessed from ground level. ENSPEC Pty Ltd cannot guarantee that a tree will be healthy or safe under all circumstances, or for a specified period of time. Likewise, remedial treatments cannot be guaranteed.

Treatment, pruning and removal of trees may involve considerations beyond the scope of ENSPEC's Pty Ltd services, such as property boundaries and ownership, disputes between neighbours, sight lines, landlord-tenant matters, and related incidents. ENSPEC Pty Ltd cannot take such issues into account unless complete and accurate information is given prior or at the time of the site inspection. Likewise ENSPEC Pty Ltd cannot accept responsibility for the authorisation or non-authorisation of any recommended treatment or remedial measures undertaken.

In the event that ENSPEC recommends retesting or inspection of trees at stated intervals or installs any cable/s, bracing systems and support systems ENSPEC must inspect the system installed at intervals not great than 12 months unless other wise specified in written reports. It is the client's responsibility to make arrangements with ENSPEC to conduct the re- inspection.

Trees can be managed, but they cannot be controlled. To live or work near a tree involves a degree of risk. The only way to eliminate all risks associated with a tree is to eliminate the tree.

All written reports must be read in there entirety, at no time shall part of the written assessment be referred to unless taken in full context of the whole written report.

If this written report is to be used in a court of law or any legal situation ENSPEC must be advised in writing prior to the written assessment being presented in any form to any other party.

APPENDIX 1 TREE ROOTS

It is often forgotten and usually ignored that a trees root system is vital for a trees health, vitality and stability. The roots of a tree are frequently thought of as a different entity from the rest of the tree, in fact the trees roots; trunk and branches form one living organism.

There is much speculation on the depth and spread of tree roots. Popular articles and text books print illustrations of trees showing a tap root extending deep into the soil with lateral branch roots originating all along this root.

In reality most tree roots spread out laterally and are found in the top 600mm of the soil. It must be remembered that the plant root morphology of a tree root plate is very much dependant on environmental conditions. Site factors that influence root growth patterns included: moisture, oxygen supply, soil texture, below ground obstacles and roots from other plants.

When visualising what the tree roots system looks like below ground level a simple analogy of this to liken the tree and its roots to a wine glass placed on to a flat plate. Picture the plate and the base of the wine glass as the root system, the stem of the glass is the main trunk and the actual glass is the canopy or crown of the tree.

The root system of a tree has four main functions;

1. To support and anchor the tree in the soil
2. To absorb and conduct water
3. To absorb and conduct nutrient requirements for growth
4. To act as a storage organ for starch

The trees root system is separated into three (3) zones, these zones are;

The Critical Root Zone (CRZ) This is an area that is deemed to be of critical importance to the tree and is defined as an area that is 10 times the trunk diameter. The Critical Root Zone (CRZ) is the area under a tree where many important roots lay just millimetres beneath the ground.

Primary Root Zone (PRZ) This is the area covered by the canopy of the tree or a circle with the diameter of the tree height (Which ever is the greatest). Here vital roots collect nutrients and moisture for the tree, and must be protected in order for the tree to survive.

Auxiliary Root Zone (ARZ) An area 1.5 times the canopy area. Construction works in is area usually do not have a detrimental effect on the tree long-term health or stability. However it is strongly advised that any works in this region are discussed with a certified Arborist.

Ground works that interfere with or damage the **Critical Root Zone (CRZ**) and or **Primary Root Zone (PRZ)** will have an effect on the trees health, stability and long term viability and therefore activities in these areas must be avoided.

There are many ways to harm or kill a tree by damaging the roots. Examples are;

- Cut roots through trenching or soil scraping activities.
- Cap (cover) roots with impervious materials (Bitumen, Concrete and compacted road base materials).

- Raise the existing ground level and bury roots with over burden from site excavations or introduced soil.
- Compact the soil around a tree, through the use of the area as a storage site or vehicle-parking site.
- Poison tree roots by allowing wash and or run off from the site to seep through the ground.

The zones of roots affected by various methods of damage will reflect the severity of damage to the tree. For example damage to the auxiliary root zone area may cause little or no visible effects to the tree. However damage to the critical zone as the name suggests will have a serious effect on the tree and could well be noticeable in the immediate short term (several weeks).

Interference or destruction of a trees root system with in the crown spread of a tree will have a pronounced and visual effect on the trees health, appearance and stability, for example the dying off of limbs on the side that was injured or random death depending on the tree species, random premature leaf fall or simply the tree falling over. In urban areas where soils have become compacted or are lower in oxygen levels tree roots generally are found closer to the ground surface.

With any root damage there is a possibility of fungi entering the tree through damaged roots. Depending on the pathogen that enters the damaged root area it may take several or many years before the tree declines or fails

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