



***Phytophthora* Dieback Management Plan**

Eneabba Operations

March 2016

Document Control

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1. INTRODUCTION

1.1 Project Description and Background

Eneabba Mineral Sands mining operations (Eneabba operations) are located in the Midwest region of Western Australia (WA) approximately 150 kilometres (km) south-southwest of Geraldton and 30 km inland. Eneabba operations occur on the eastern edge of the Swan Coastal Plain section of the central Perth Basin which extends from Gingin to Geraldton (**Figure 1**) (Kern 1997).

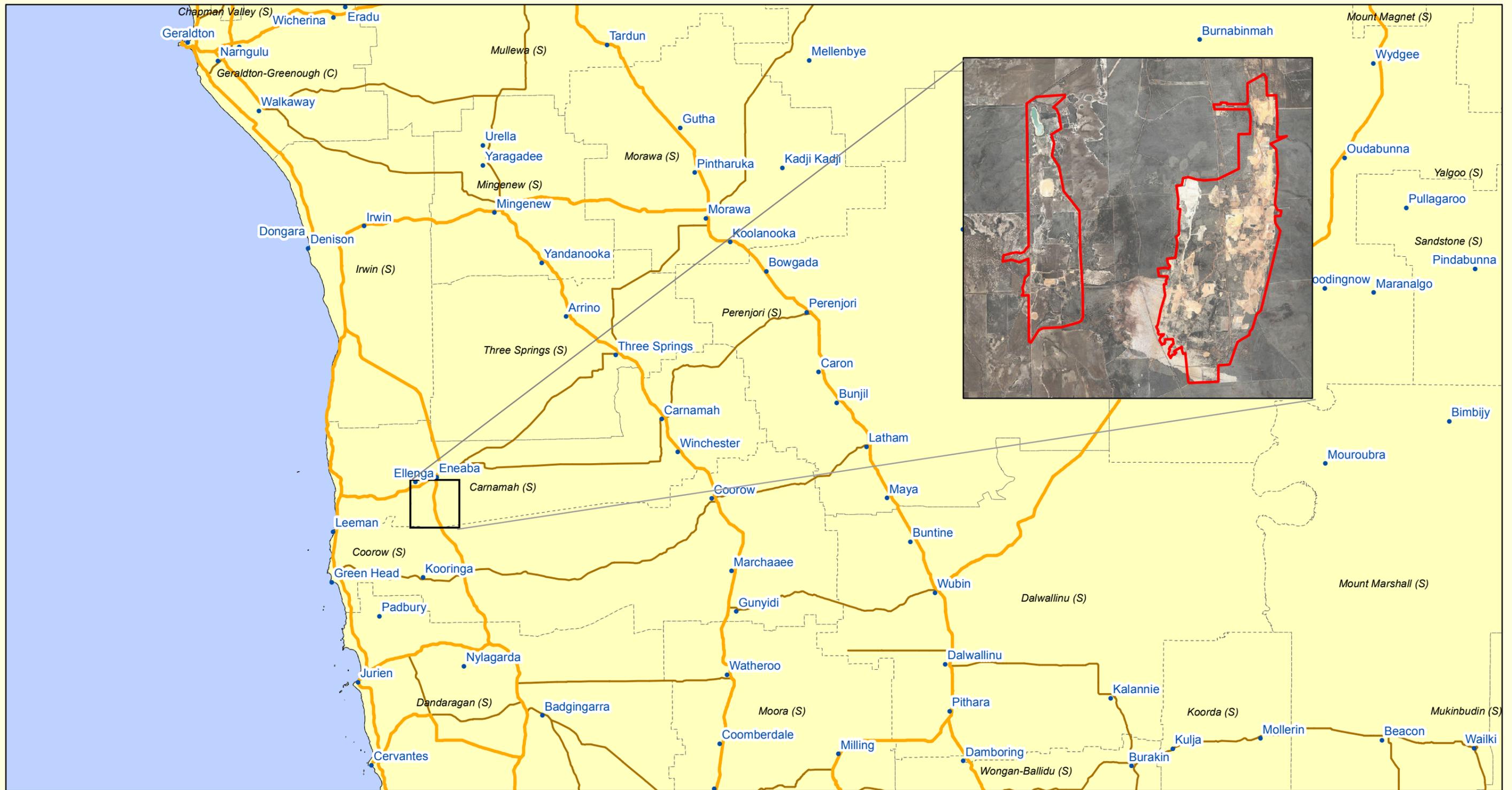
The mining area is located on the Eneabba Plain, a northward extension of the Bassendean Dune System of the Swan Coastal Plain, between the coastal belt and the Gingin Scarp. The landscape in the mining area typically consists of dunes or low hills with alluvial plains with shallow to deep siliceous sands. The vegetation on the Eneabba Plain is known as Kwongan vegetation and consists primarily of closed heaths and low open woodlands (Western Australian Planning Commission 2000).

Mineral sands have been mined at Eneabba since the early 1970s. Originally, multiple mineral sand mines were operated in the Eneabba area by different companies. Through a series of mergers and acquisitions, Iluka has become the current single owner/operator since 1998.

The Eneabba deposits lie within the Shires of Carnamah and Three Springs and are situated adjacent to the town of Eneabba. The mine site is surrounded by both agricultural farmland and native vegetation. Mining mineral sands is relatively benign because explosives, crushing or milling is not used, and aggressive physicochemical processes are not required. Only gravity separation techniques are used to extract the Heavy Mineral Concentrate. The mining process used at the site began with vegetation clearing and topsoil stripping. Overburden was then removed by heavy mobile equipment and stockpiled or placed directly into pits which have been previously mined. Sand containing ore was then screened by mining units to remove rocks and gravel (oversize material). It was then slurried and pumped to a concentrator plant where the heavy mineral component is removed by gravity separation. The sand and clay components remaining after ore separation were mixed and co-disposed back into the mined pits and dried prior to rehabilitation. Oversize material was returned to mining pits or used for soil stabilisation and road construction.

Vegetation cleared prior to mining was mulched and applied to rehabilitation areas primarily as a seed source as well as for soil stabilisation. Topsoil stripped prior to mining was either transferred directly onto new rehabilitation areas or stockpiled for later use.

Mining operations were idled in early 2013 and the mine site is now undergoing rehabilitation. Subsequently the focus of activities has moved from production to landform restoration and rehabilitation.

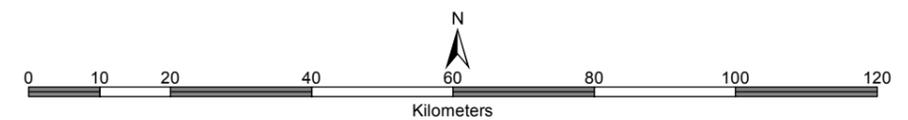


LEGEND

- Towns
- Road (Primary Distributor)
- Road (Regional Distributor)
- - - Local Government Areas
- ▭ Disease Risk Area (DRA) boundaries



PROJECT LOCATION
Iluka Resources Eneabba Minesite Dieback Assessment



Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994, Units: Meter

Scale @ A3: 1:1,000,000

Prepared: J Botterill

Project No: TS14012

Date: 30/10/2014

Checked: N King

Figure 1

Revision: Rev B

Reviewed: J Grehan



1.2 Purpose and Scope

Phytophthora Dieback is the common name for a devastating disease in native plants caused by the pathogen *Phytophthora cinnamomi*. Prior to publication of the *Best Practice Guidelines-Management of Phytophthora Dieback in Extractive Industries* (Dieback working Group, 2005b) most documents relating to the management of *Phytophthora* Dieback have only referred to *Phytophthora cinnamomi*. This document uses the term *Phytophthora* Dieback (Dieback) to refer to *Phytophthora cinnamomi*, which is by far the most virulent and destructive of the *Phytophthora* species occurring at Eneabba, but it also includes the other species of *Phytophthora* that have been recorded in the area.

This *Phytophthora* Dieback Management Plan relates to the monitoring and management of Dieback at Iluka's Eneabba West Mine and Eneabba East Mine former operational areas only. The purpose of this document is to communicate the responsible management of Dieback at Iluka's Eneabba operations, and this applies to all Iluka staff, contractors, and suppliers.

This current version of the *Phytophthora* Dieback Management plan has been updated to address the operational status of the Eneabba mine site, which is currently idled. The plan has been updated to reflect an increased focus on rehabilitation activities rather than mining. The plan has also been updated to reflect comprehensive mapping of Dieback occurrence within 2107.8 hectares (ha) of rehabilitated areas completed in 2013.

1.3 Related Documents

The documents related to *Phytophthora* Dieback management at Eneabba are detailed in **Table 1**.

Table 1 Documents related to *Phytophthora* Dieback management at Eneabba

Document Title
Eneabba <i>Phytophthora</i> Dieback Assessment of Rehabilitation Areas (Terratree 2013)
IPL North Dieback Risk Management-Operations Access and Hygiene Plan (Terratree 2013)
West Mine Operations - Ministerial Statement 81
Exploration Clearing Permit CPS 389/1
Depot Hill/Brandy Flat Clearing Permit CPS 2362/2
Adamson West Clearing Permit CPS 2680/2
Twin Hills Clearing Permit CPS 5445/1
Yellow Dam Clearing Permit CPS 6467/1
South Tails Rehabilitation Clearing Permit CPS 6915/1

1.4 Regulatory context

This *Phytophthora* Dieback Management plan is required under Ministerial Statement 81 for the Eneabba West Mineral Sands Project. Condition 3 states:

Prior to the commencement of both construction and mining, the proponent shall prepare and implement dieback hygiene programmes in consultation with the Department of Conservation and Land Management, to the satisfaction of the Minister for Environment on advice of the Environmental Protection Authority. The approved programmes shall be available for public information.

The previous revision of this *Phytophthora* Dieback Management plan was approved by the Department of Environmental Conservation (DEC) (now Department of Parks and Wildlife (DPaW)) in June 2009 and by the Office of the Environmental Protection Authority (OEPA) in October 2010.

Phytophthora Dieback management at Eneabba is also required under the following regulatory mechanisms:

- operations within the Eneabba South Nature Reserve – regulated under the *Conservation and Land Management Act* (1984) for activities undertaken on DPaW Managed Land;
- new mining projects – through the *Environmental Protection Act* (1986) and the *Mining Act* (1978) which require DPaW and/or Department of Mines and Petroleum to comment on Dieback management and provide these agencies with the right to impose conditions to new approvals;
- all operations – *Phytophthora* Dieback is listed as a Key Threatening Process with the Federal Government under the *Environmental Protection and Biodiversity Conservation Act* (1999); and
- *Environmental Protection Act* (1986) Part V Section.50A “Serious Environmental Harm” provisions.

1.5 Environmental Setting

Eneabba is located approximately 30 km inland, on the eastern edge of the Swan Coastal Plain section of the Northern Perth Basin which extends from Gingin to Geraldton (Kern 1997). The mine is located on the Eneabba Plain, a northward extension of the Bassendean Dune System of the Swan Coastal Plain, between the coastal belt and the Gingin Scarp. The landscape in the mining area typically consists of dunes or low hills with alluvial plains with shallow to deep calcareous and siliceous sands. The vegetation on the Eneabba Plain is known as Kwongan vegetation and consists primarily of closed heaths and low open woodlands (Western Australian Planning Commission 2000).

1.5.1 Biogeography

At a regional scale, Eneabba is situated within the Geraldton Sandplains Interim Biogeographic Regionalisation of Australia Region (Shepherd *et al.* 2002). The Eneabba ore bodies follow mineral sands deposits that run in a north-south orientation associated with ancient coastal landforms typical of the Geraldton Sandplains Bioregion. Some of the mine lease extends eastward onto shallow sands over laterite on rising ground that form part of the

Gingin Scarp. The scarp area is intersected with ephemeral watercourses that have distinctive vegetation assemblages associated with them. Elsewhere, wetlands occupy the lower-lying points on the Sandplains, collecting surface water and supporting floristically distinct vegetation communities. A significant area of the Geraldton Sandplains Bioregion has been cleared for agriculture, some of which is mined by Iluka as part of the Eneabba operations.

1.5.2 Climate

Eneabba has a Mediterranean type climate with hot summers and wet winters. Average maximum temperatures range 19 to 36 degrees Celsius (°C), with average minimum temperatures ranging 9 to 19° C. The warmest months are January and February, with most rain usually falling in the cooler months of June and July. It is not unusual for Eneabba to record amongst the highest temperatures in the state (a feature which helps suppress the growth of *Phytophthora Dieback*). Surface soil temperatures in excess of 60°C are not uncommon at Eneabba during summer, with soil temperatures at 20 centimetres (cm) depth recording a relatively high 30°C (Bunny 1996). The long term average annual rainfall for Eneabba is 510 millimetres (mm). Since 2000 annual rainfall at Eneabba has averaged approximately 80 mm lower (**Figure 2**).

Undertaking *Phytophthora Dieback* assessments during drought conditions can be problematic due to the difficulty in distinguishing drought deaths from those caused by the pathogen or a combination of both. In addition, the risk of getting false negative sample results in extremely dry and hot summer conditions is high. Therefore sampling for *P. cinnamomi* needs to be undertaken during optimal conditions when there is sufficient soil moisture present and soil temperatures are 23 to 30°C.

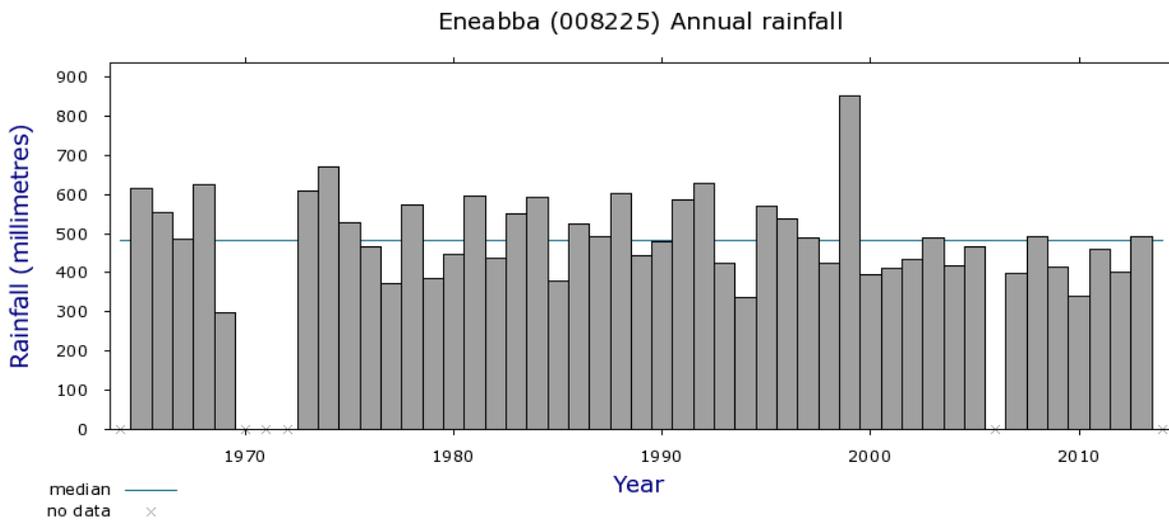


Figure 2: Annual Rainfall at Eneabba Since 1965 (Bureau of Meteorology)

1.5.3 Flora and Vegetation

The vegetation within Iluka’s Eneabba mining lease is associated with the Geraldton Sandplain 3 vegetation community (Lesueur Sandplain subregion), which generally comprises of proteaceous heaths and scrub-heaths on sands and lateritic sandplains with some Eucalypt woodlands in drainage lines or outwash areas (Desmond and Chant 2001). The vegetation in this area is also known by the Aboriginal name “Kwongan”. Plant species of the Proteaceous family, which are highly susceptible to Dieback, play an important structural role

in Kwongan vegetation communities by comprising a large proportion of projective foliage cover (Bunny 1996).

Vegetation and floristic characteristics of the Eneabba lease areas and immediate surroundings have been surveyed by Hopkins and Hnatiuk (1981), Ekomin Pty Ltd (1982 1984), Elkington (1988) and Landcare Services Pty Ltd (1998). More recently, plant community mapping has been undertaken by Woodman Environmental Consulting (WEC) (WEC 2002, 2005a, 2005b, 2007). In 2008, the Eneabba vegetation database was consolidated and reassessed using approved DPaW, statistical methods. The revised assessment covered approximately 30,000ha and described 36 distinct Floristic Community Types (FCTs), which include 940 taxa belonging to 74 plant families (G. Woodman pers.comm. 2008)). The plant communities in the Eneabba region include many rare and threatened plant species (Landcare Services Pty Ltd 1998). Surveys of Iluka's Eneabba tenement areas have recorded eight Declared Rare Flora (DRF) species and 76 Priority Flora species (WEC 2012b).

Two Threatened Ecological Communities (TECs) are known within the region. Only one of these, *TEC 72 Ferricrete floristic community (Rocky Springs type)* is within the boundary of the *Phytophthora* Dieback assessment area.

Native vegetation highly susceptible to *Phytophthora cinnamomi* includes the plant families Proteaceae, Ericaceae, Myrtaceae and Fabaceae (CALM 2003). The Eneabba region is dominated by these plant families, with *Banksia*, *Leucopogon*, *Eucalyptus*, and *Daviesia* species being common (Hopkins and Hnatiuk 1981; WEC 2002, 2005). The plant communities in the Eneabba region include many rare and threatened plant species (Landcare Services Pty Ltd 1998; WEC 2005), some of which are susceptible to *Phytophthora* Dieback.

1.6 Current Status

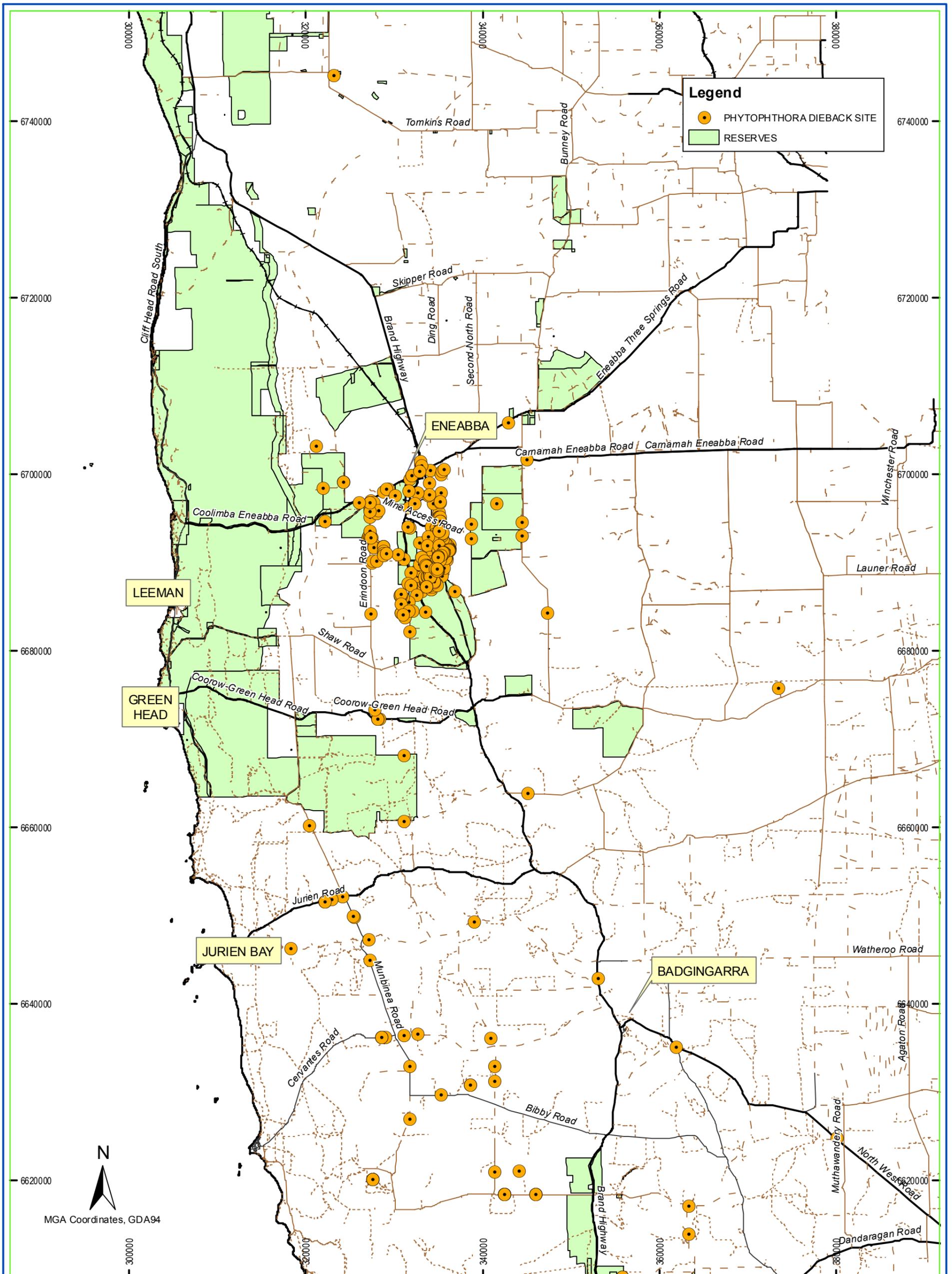
The status of *Phytophthora* Dieback in the Northern Sandplains is described in Section 1.6.1 with context of the changes to Dieback categories given in Section 1.6.2 and the updated status of *Phytophthora* Dieback at Eneabba discussed in Section 0.

1.6.1 *Phytophthora* Dieback in the Northern Sandplains

The Geraldton Sandplains Bioregion was thought to be too dry for the establishment of *Phytophthora* Dieback up until 1989 when infestations were discovered by the Department of Conservation and Land Management (CALM) north of Cataby. Prior to that date it was thought that the pathogen could not survive the harsh climatic conditions of the Northern Sandplains region. Subsequently infestations have since been mapped as far north as Kalbarri (**Figure 3**).

Disease expression in the Northern Sandplains region has been described as episodic rather than progressive (Glevan Consulting 2007) as a result of the regional fluctuations in rainfall, hot dry summer months and free-draining soils. This has resulted in a mosaic of infestation areas with isolated spot infections (E. Brown Glevan Consulting pers. comm. 2007).

While mining commenced at Iluka's Eneabba operations in 1975, the occurrence of *Phytophthora* Dieback was not discovered until 1990. No hygiene management measures were implemented to control non-autonomous spread of the pathogen during the period prior to the disease being identified on site. Active management of the disease first occurred on site in 1991 when a *Phytophthora* Dieback Management Plan was developed and hygiene management measures implemented on site.



PHYTOPHTHORA DIEBACK OCCURRENCE in the Northern Sandplains Region



1.6.2 Recent Changes to Phytophthora Dieback Occurrence Categories

The updated *Phytophthora* Dieback Interpreters Guidelines, *FEM047: Phytophthora Dieback Interpreter's Manual for lands managed by the Department, Forest and Ecosystems Management* were released by the DPaW in March 2015. The updated guidelines now categorise land that has been cleared of native vegetation as 'Excluded' from assessment. Non-vegetated areas that are Excluded from assessment include pasture, pits, easements, development, large roads (sealed and unsealed), permanently flooded areas and parkland tree stands. Excluded areas are distinguished from 'Temporarily Uninterpretable' areas by the fact that they cannot regenerate naturally and eventually become Mappable. The Keighery vegetation disturbance scale presented in **Table 2** was used to determine the assessability of disturbed areas (DPaW 2015).

Table 2 Keighery Vegetation Disturbance Scale and Assessability (DPaW 2015)

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

Table 3 presents the assessability of vegetated and non-vegetated areas, which includes the Excluded category (DPaW 2015). The Temporarily Uninterpretable category is allocated to areas of native vegetation which have been disturbed, but will recover over time and become Interpretable and therefore mappable. Examples of Temporarily Uninterpretable areas include vegetation that has been impacted by fire, grazing, timber harvesting, flooding or mining and rehabilitation. Recovery in Temporarily Uninterpretable areas may take longer than three years (DPaW 2015).

The vegetation of Uninterpretable areas can range from Pristine to Very Good; however, whether the pathogen is present in resistant hosts or as zoospores in permanent water bodies is indeterminable. Uninterpretable areas that meet the protocols for identifying Protectable Areas (DPaW 2015) are managed as being both Infested and Uninfested so that the pathogen is neither imported into, nor exported from, these areas.

Table 3 Phytophthora occurrence categories, impacts and syndromes (DPaW 2015)

Vegetation Condition	Phytophthora occurrence category	Typically present	May be present
Naturally vegetated areas. Keighery disturbance rating 3 or less. <i>Phytophthora</i> occurrence categorisation is or will be possible. Small un-vegetated areas can exist and may be included in the assessment area considering total environmental context	INFESTED	Dead and dying reliable indicator species	Healthy reliable indicator species. Indicator Species Deaths (ISDs) that have been killed by other agents
	UNINFESTED	Healthy reliable indicator species	ISDs that have been killed by other agents
	UNINTERPETABLE	Very few reliable indicator species	Occasional reliable indicators, but too few for <i>Phytophthora</i> Dieback interpretation
	NOT YET RESOLVED	Usually reliable indicator species in an environment not favourable to disease development	Negative sample results for all <i>Phytophthora</i> species

Vegetation Condition	<i>Phytophthora</i> occurrence category	Typically present	May be present
<p>Vegetation structure temporarily altered.</p> <p><i>Phytophthora</i> occurrence assessment will be possible when vegetation structure recovers. Recovery times will be variable depending on severity and type of disturbance</p>	TEMPORARILY UNINTERPRETABLE	Indicator species masked by disturbance. Keighery disturbance rating of 4 or greater. Disturbance typically from; fire, harvesting, temporary flooding. Should recover (become interpretable) in 3 years or less	Occasional reliable indicator species, but disturbance prevents accurate placement of <i>Phytophthora</i> occurrence boundaries. Recovery time may be longer than 3 years
Road disturbance area	DISEASE RISK ROAD	Unformed track with shoulders of interpretable vegetation	Shoulders and batters with regenerated vegetation. Incipient infestation
<p>Vegetation structure severely altered. Keighery disturbance rating 5 or greater.</p> <p><i>Phytophthora</i> occurrence assessment is not possible. Can be determined by desktop assessment (aerial photo).</p> <p>Small vegetated areas can exist and may be Excluded from the assessment area considering total environmental context</p>	EXCLUDED	Pasture, pits, easements, infrastructure, large roads (sealed and unsealed) permanent flooding, plantations, parkland tree stands	Sporadic reliable indicator species

1.6.3 *Phytophthora* Dieback at Eneabba

The Eneabba area has been surveyed extensively for *Phytophthora* Dieback (Hart Simpson and Associates Pty Ltd 1991, 1992a, 1992b, 1993; Ecos Consulting 1996; Glevan Dieback Consultancy Services 2001; Glevan Consulting 2007 and Terratree 2013). The Dieback Occurrence Mapping (**Figures 4 & 5**) is based on disease status 'categories' as defined in *FEM047 Phytophthora Dieback Interpreter's Manual for lands managed by the Department, Forest and Ecosystems Management*, DPaW, 5 March 2015.

Nine species of *Phytophthora* have been identified at the Iluka's Eneabba operations in surveys conducted since 1991. One species, *Phytophthora cinnamomi*, (P.c) has been identified as having the greatest impact on native vegetation communities and is the focus of regional management initiatives.

The vector for the infestations is presumptive, but is believed to have occurred pre-mining with the introduction of earth moving machinery for road construction and pastoral clearing, and since mining with increased earth moving traffic and soil mobilisation (Hart Simpson and Associates Pty Ltd 1992a). In 1999 a tropical depression caused by cyclone Vance resulted in widespread regional flooding which further extended the range of *Phytophthora* Dieback infestations in the Eneabba region.

The 2007, the assessment area extended outside of Iluka tenements to include a TEC Reserve south of Rocky Springs Road which is subject to the DPaW Interim Recovery Plan 154. Inclusion of this area in the 2007 assessment was undertaken to assist DEC (now DPaW) with point 9 and 14 of the Recovery Actions described in Interim Recovery Plan 154.

The 2013 assessment undertaken by Terratree covered 2107.8ha of native vegetation within rehabilitated areas, at Iluka's Eneabba mine site. In total, 97 soil and tissue samples were taken during this assessment however only three positive results for *P. cinnamomi* and 11 positive results for *P. affin. arenaria* (Type 2) were reported. Four areas located in the East Mine and two areas in the West Mine have been interpreted and mapped as infested as well as several infestation sites identified outside the Iluka lease area including Eneabba townsite, along Brand Highway and several primary and secondary roads (**Figure 4**).

The area mapped as infested with *P. cinnamomi* during the 2013 assessment represented a 126 percent increase in the area previously mapped as infested in 2010. A positive sample result for *P. cinnamomi* provided conclusive evidence that the West Mine infestation south of the mine void has been extended by over 500 metres (m) since previous disease mapping (**Figure 5**). The rate of spread of the disease has been difficult to estimate due to several years of below average rainfall. Infestations along public roads including the Coolimba Eneabba and Erindoon Roads lie outside the scope of this document.

Each infested area has been assigned a 'variable buffer width' that is related to the risk of spread given local topography and vegetation type (Glevan Consulting 2007). The annual rate of spread of the disease is likely to reduce during unfavourable environmental conditions, however poor disease expression associated with low soil moisture makes it difficult to accurately map the distribution of the disease. The buffer zones were increased in 2007 as a precautionary measure to compensate for the lack of disease expression caused by the below average rainfall since 2005.

The increase in soil moisture due to above average rainfall makes it easier to map the spread of the pathogen due to clearer expression in terms of disease pattern and chronology. Conversely during drought affected years disease expression in sandy soils is cryptic as many susceptible species are affected by drought and there is usually little evidence of an active disease front. Several isolations made in the early 1990's failed to express disease in

the field or yield positive samples for *Phytophthora* Dieback since the original date of diagnosis having been reassessed in 2001, 2007 and 2013.

In 2015, Terratree undertook a boundary recheck of all protectable Uninfested areas and also a comprehensive assessment of four small areas that were not surveyed during the 2013 assessment. **Table 4** presents the total area in hectares for each *Phytophthora* Dieback occurrence category and estimates the percentage each category comprises within the study area.

Table 4 Proportion of Each Dieback occurrence Categories within the 2013 Study Area

Dieback Occurrence Category	Area (ha)	Percentage Area
Infested	824.14	21.69
Uninfested	309.44	8.14
Uninterpretable	160.96	4.24
Temporarily Uninterpretable	244.93	6.44
Excluded	2,260.67	59.49
Total	3,800.13	100

Infested Areas

In total, approximately 824ha (21.7 percent) of the study area is infested with *P. cinnamomi*. The West Mine area has four discrete infested areas comprised of two large areas which includes the mine void area and a drainage line south of the void. The smaller infestations in or adjacent to the West Mine area include a rehabilitated area and a small infestation along Erindoon Road. The East Mine infestation is a single large area that has developed along drainage lines.

Infested areas identified outside the Iluka mining lease area include areas along the Leeman Coolimba Road and Erindoon Road, the Eneabba town site, Woodada Gas project access road (part of Eneabba Creek extension into Lake Logue Nature Reserve) and sections of Brand Highway (Hart Simpson and Associates Pty Ltd 1992a; Glevan Dieback Consultancy Services 2001; Glevan Consulting 2007).

Isolated infestations have also been identified on surrounding pastoral properties as part of regional mapping conducted by Ray Hart in the early 1990's (Hart Simpson and Associates Pty Ltd 1992a, 1992b). Infestations outside of mining lease areas are beyond the scope of this document, however this information can be made available upon request.

Uninfested Areas

Large areas of uninfested native vegetation remain within the mining lease area at Eneabba. In total 309ha or 8.1 percent of the overall study area is Uninfested. Some of these areas have been identified as Protectable Areas and are discussed further in Section 4.2.2. The disease status of these areas will be monitored through a biennial *Phytophthora* Dieback site

assessment in addition to regular targeted and opportunistic sampling. Section 5 refers to the *Phytophthora* Dieback Monitoring Program.

Uninterpretable Areas

Uninterpretable areas are defined in **Table 2** as areas with occasional reliable indicators, but too few for *Phytophthora* Dieback interpretation (DPaW 2015). Most of the uninterpretable areas within the mining lease are areas that have been rehabilitated and currently uninterpretable due to :

- insufficient disease indicator species presence; and / or
- the vegetation is not yet established therefore the cause of plant mortality cannot be determined.

Uninterpretable areas comprise 161ha, or 4.2 percent, of the study area. Uninterpretable areas were generally dominated by the colonising species *Acacia blakelyi* (*A. blakelyi*). Although these areas couldn't be assessed due to a lack of disease indicator species, it appears that the areas dominated by *A. blakelyi* will undergo successional change as several susceptible species were observed in the understorey. Some wetland areas, both within and outside the study area, are uninterpretable due to predominance of species not susceptible to *P. cinnamomi*, or have some resistance to the pathogen and therefore are not good indicators of disease.

Temporarily Uninterpretable Areas

The Temporarily Uninterpretable category is allocated to areas of native vegetation which have been disturbed, but will recover over time. *Phytophthora* occurrence assessment will be possible when vegetation structure recovers and becomes Interpretable. Examples of Temporarily Uninterpretable areas include vegetation that has been impacted by fire, grazing, timber harvesting or flooding. Recovery in Temporarily Uninterpretable can be variable depending on severity and type of disturbance and may take longer than three years (DPaW 2015).

A bushfire in spring 2012 has rendered a 245ha or 6.5 percent of the study area in the South Mine area as Temporarily Uninterpretable. This is expected to have regenerated sufficiently for reassessment in 2016.

Excluded Areas

Excluded areas are areas where vegetation structure has been severely altered and vegetation condition is Degraded (5) or Completely Degraded (6) (Keighery et al).

Excluded areas typically include pits, cleared areas, pasture, easements, roads (sealed and unsealed), where *Phytophthora* occurrence assessment is not possible (DPaW 2015). These open areas (areas not yet rehabilitated with native vegetation) have been classified as Excluded, given the history of soil disturbance that occurred prior to the discovery of *Phytophthora* Dieback at Eneabba. These areas will be managed as a separate entity until such a time that they have regenerated sufficiently to be interpretable.

These areas pose a moderate to minor risk of harbouring the pathogen; the level of risk will depend on the following factors:

- location in relation to known infestations;

- topographical location of area, i.e. is the area in a water gaining site;
- soil disturbance history;
- source of the material used to construct the area; and
- past and present hygiene management.

In total, 2,261ha or 59.5 percent of the study area is Excluded . Areas categorised as Excluded due to disturbance have a vegetation condition rating of 5 or more on the Keighery scale (**Table 3**). Vegetation within the study area was categorised as Excluded for the following reasons:

- poor rehabilitation has resulted in shallow and impenetrable soil profiles which have impacted vegetation health and cover making disease mapping too difficult; and
- open areas that have not yet undergone rehabilitation.

If an Excluded area receives drainage from an Infested area, or is downslope of an area with positive sample results for *P. cinnamomi*, then the area is usually classified as Infested. In total 170.8ha of Excluded area is included in areas mapped as Infested by *P. cinnamomi*.

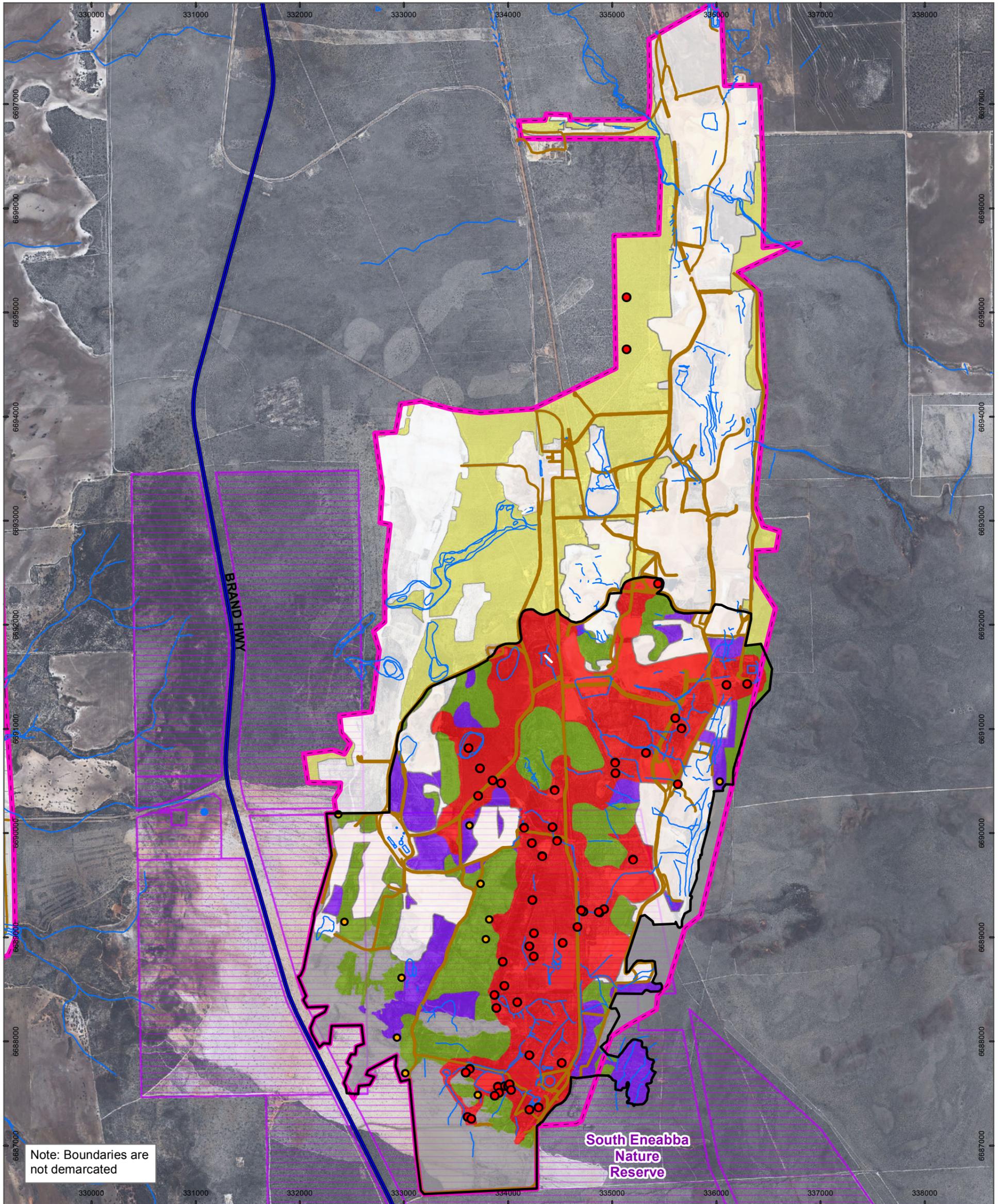
An assessment of surface water flows is undertaken as part of rehabilitation planning. This is to determine if areas down gradient of infested areas can be protected from dieback by development of surface water management infrastructure.

High Risk Areas

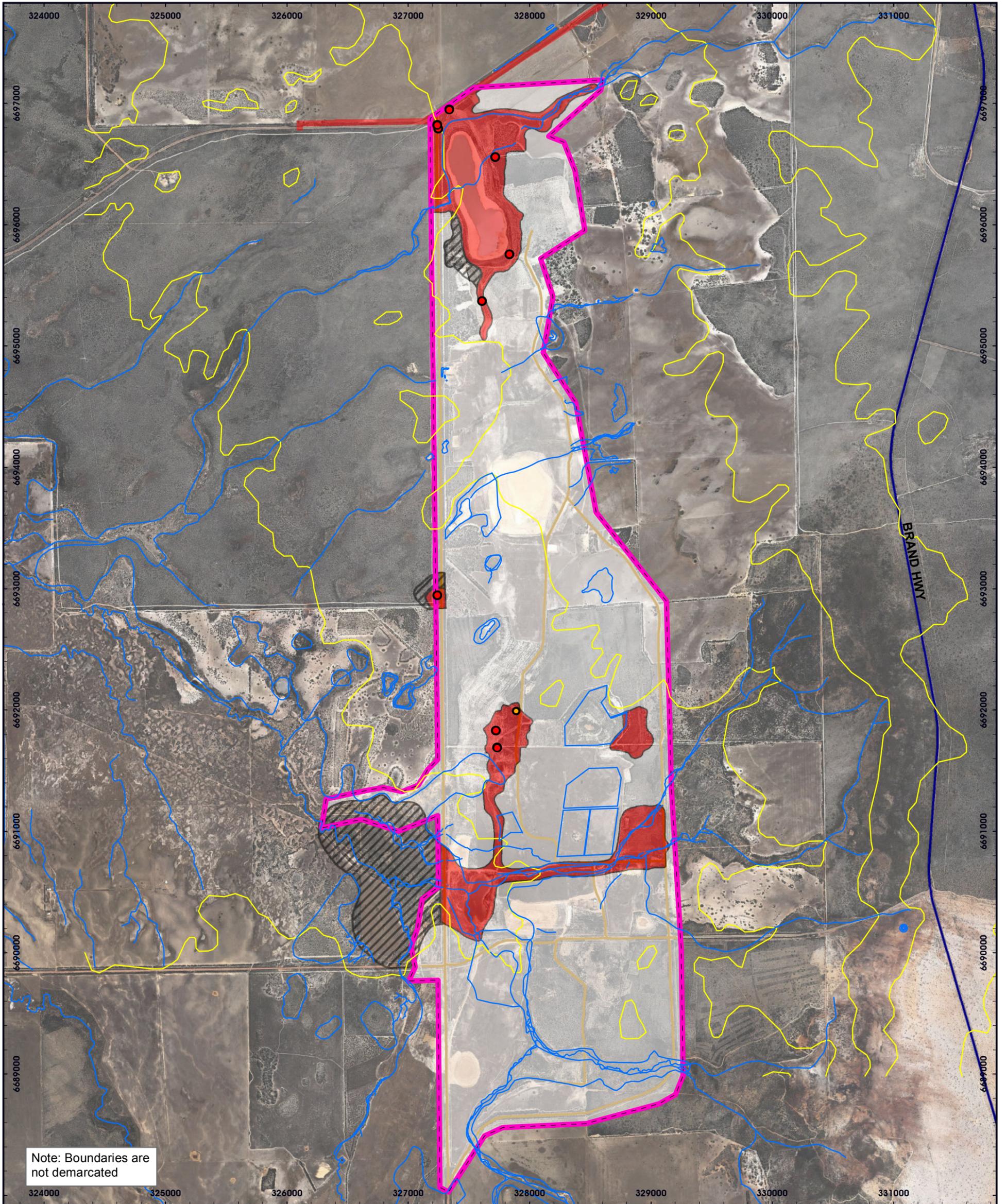
In addition to mapping actual *Phytophthora* Dieback occurrence, the 2013 assessment identified an additional 500.3ha or 23.5 percent of the study area that is considered to be at high risk of becoming infested (**Table 4**). These areas are at a high risk of becoming infested with *P. cinnamomi* for the following reasons:

- low-lying wetland areas receiving drainage from an area some distance upslope that is confirmed to be infested with *P. cinnamomi*;
- areas intersected by possible disease vectors such as haul roads that pass through known infestations, and then increase the risk of new disease establishment within the area down slope of the road;and
- some Excluded areas are part of a single mining/rehabilitation area with portions mapped as infested. During the earthworks for mining/rehabilitation activity, disease may have been spread from infested areas to other parts of the same operation. However, there is insufficient evidence available to categorise this as Infested due to the Excluded status and position in the landscape and drainage from an infested site.

A risk-based approach was adopted to identify areas of high risk, by an assessment connectivity between areas to existing infestations through drainage and topography. This approach was discussed and agreed to with the Disease Site Officer (DSO) during the site assessment in 2013 (Peter Blankendaal pers. comm. April 2013).



LEGEND <ul style="list-style-type: none"> ● <i>P. cinnamomi</i> ● <i>P. affinis araneris</i> (Type 2) — Drainage — Brand Highway — Tracks Study Area Boundary Disease Risk Area DPaw Managed Lands 		Dieback Occurrence Category <ul style="list-style-type: none"> Infested Excluded Temporarily Uninterpretable Uninterpretable Uninfested Yet to be Interpreted 		
<p>© Talis Consultants Pty Ltd ("Talis") Copyright in the drawings, information and data recorded in this document ("the information") is the property of Talis. This document and the information are solely for the use of the authorised recipient and this document may not be used, transferred or reproduced in whole or part for any purpose other than that which it is supplied by Talis without written consent. Talis makes no representation, undertakes no duty and accepts no responsibility to any third party who may use or rely upon this document or the information.</p>		LOCALITY 	DIEBACK OCCURRENCE - EAST Iluka Resources Eneabba Minesite Dieback Assessment Scale @ A3: 1:35,000 Coordinate System: GDA 1994 MGA Zone 50, Projection: Transverse Mercator, Datum: GDA 1994 Prepared: N King Reviewed: R Cullen Checked: J Grehan Project No: TS15008 Revision: Rev D Date: 24/02/2016	



Note: Boundaries are not demarcated

LEGEND

- *P. cinnamomi*
- *P. affinis araneris* (Type 2)
- Drainage
- Brand Highway
- Tracks

Dieback Occurrence, Risk and Protectability

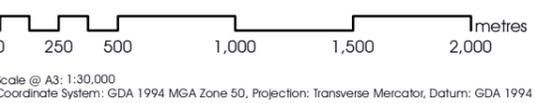
- Infested
- Excluded
- Unprotectable

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LOCALITY



DIEBACK OCCURRENCE, RISK AND PROTECTABILITY - WEST
Iluka Resources Eneabba Minesite Dieback Assessment



Prepared: N King	Terratree talis delivering solutions
Reviewed: R Cullen	
Checked: J Grehan	
Project No: TS15008	
Revision: Rev E	Figure 05
Date: 25/02/2016	

2. POTENTIAL IMPACTS

2.1 *Phytophthora cinnamomi*

Impacts from *Phytophthora cinnamomi* in the Eneabba region are localised and associated primarily with drainage channels, as this region is situated in a marginal risk area due to its relatively low rainfall and freely draining soils. Areas most at risk are those areas where groundwater remains close to the surface and water gaining sites where there is a perched water table, e.g. wetland areas.

In areas where there has been ground disturbance there is a significant risk of infected material being transported from infested to uninfested areas causing threatening irreversible damage to native vegetation. This could occur within operational areas, adjacent conservation reserves and private property. Stringent hygiene management practices are required to manage this threat.

A risk evaluation using the guidelines and definitions for risk, threat and vulnerability (*Best Practice Guidelines for the Management of Phytophthora cinnamomi* CALM (2004)) was undertaken for the Iluka Eneabba operations. For areas vulnerable to *Phytophthora* Dieback the risk of mobilising the pathogen and creating new infestations is influenced by the following factors:

- soil movement;
- water movement; and
- vegetation movement.

Without the necessary hygiene control measures, the risk of rehabilitation activities impacting biodiversity values within and adjacent to the mine site through the spread of *Phytophthora* Dieback is high (**Table 5**). This is principally due to extensive soil disturbance and vehicle movement associated with landform rehabilitation activities.

2.2 Other *Phytophthora* species

In 2012, two new species of *Phytophthora* were recorded at Eneabba and at other sites on the Northern Sandplains including *P. arenaria* and *P. affin. arenaria* (Type 2). These species of *Phytophthora* are quite distinct from *P. cinnamomi* in that they have thick walled cells and seem to be more adapted to the harsh environmental conditions found in the Northern Sandplains. It is thought that these *Phytophthora* species may be endemic due to the morphological adaptations that enable persistence in this harsh environment (Jung *et al.* 2009). Moreover, these species are often recovered in samples taken during the warmer months when *P. cinnamomi* is rarely recovered due to low levels of inoculum.

Another species, *Phytophthora multivora*, which has often been misdiagnosed for *P. citricola*, can persist in alkaline soil (Scott *et al.* 2009) which suppresses *P. cinnamomi*. *P. multivora* has been recorded in the Northern Sandplains region and a *P. morpho citricola* species, which could be *P. multivora*, has been recorded adjacent to the intersection on the Mine Access Road and the rail line. The ability of *P. multivora* to survive in alkaline soils has implications for hygiene management. Limestone has traditionally been used as sterilising road base material to counteract spread of *P. cinnamomi*. This practice may not be effective for managing *P. multivora*.

Table 5 Risk Evaluation for the Movement of Soil, Water and Vegetation

Risk Factor	Threat	Likelihood	Consequence/Potential Impact
Movement of infected soil	New infestation introduced to uninfested areas adjacent to roads, tracks, power lines, pipelines, stockpiles and work areas. (including areas used for mulch resource)	High: Significant amount of soil movement associated with vehicle traffic on and off site	Loss of susceptible plant species, potentially affecting habitat values and ecological functions of vegetation Loss of susceptible rare and endangered species or TECs Mobilisation of infestation if new area is associated with drainage line or is situated on elevated ground.
Pathogen transport through process water movement	New infestation introduced to uninfested areas via; process water lines/dams ore slurry line leaks, tailings line leaks/dams	Low: Large volume slurried material mobilised in operations but as the mine site is not operational likelihood has been reduced from High to Low	Loss of susceptible plant species down gradient of pipeline spills, potentially affecting habitat values and ecological functions of vegetation Significant increase in infested area with consequence to adjacent native vegetation Mobilization of infestation if new area is associated with drainage line or is situated on elevated ground
Pathogen transport through 'passive' water movement	New infestation introduced down gradient of infected areas, including along drainage lines.	Moderate: The relatively dry climate and sandy textured soils limit the amount of surface water movement occurring at the Iluka Eneabba operations	Loss of susceptible plant species down gradient of infection areas including areas outside of the Iluka Eneabba operations Contamination of natural drainage lines flowing west out of Iluka Eneabba operations could contaminate receiving wetland systems Loss of susceptible rare and endangered species or TECs

Risk Factor	Threat	Likelihood	Consequence/Potential Impact
Pathogen transport through movement of infected vegetative material	New infestation introduced to uninfested areas such as green waste stockpiles and rehabilitation sites.	<p>Moderate:</p> <p>Infected vegetation (roots) introduced to clean topsoil or subsoil stockpiles when stockpiles moved or combined.</p> <p>Moderate/Low:</p> <p>Out of mine-path mulching. Mulch harvest collection is conducted at least 30cm above ground height.</p>	<p>Loss of susceptible plant species in infected native vegetation, potentially affecting habitat values and ecological functions of vegetation.</p> <p>Loss of susceptible rare and endangered species or TECs</p> <p>Mobilisation of infestation if new area is associated with drainage line or is situated on elevated ground</p>

3. ENVIRONMENTAL OBJECTIVES AND PERFORMANCE INDICATORS

The objective of the *Phytophthora* Dieback Management plan is to define, control and measure responsibilities and procedures for the management of the disease at Iluka's Eneabba mine site. The overarching objectives are to:

- prevent new infestations and the non-autonomous spread of existing infestations;
- protect Uninfested and Uninterpretable areas that are Protectable; and
- protect Critical Assets (EPA 2006) outside Protectable Areas from non-autonomous spread of the pathogen.

Environmental objectives and performance indicators for this management plan are shown in **Table 6** below.

Table 6 Objectives and Performance Indicators for *Phytophthora* Dieback Management

Reference	Management Objective	Target	Performance Indicator
DB 001	Prevent the introduction of new <i>Phytophthora</i> Dieback infestations	No new infestation areas recorded (dependent on limits of detection due to cryptic nature of disease).	<i>Phytophthora</i> Dieback assessment during optimal conditions
DB 002	Prevent the non-autonomous spread of existing infestations within the Eneabba mine site leases	Existing infestations contained/managed with minimal rate of spread (dependent on annual rainfall events).	<i>Phytophthora</i> Dieback assessment during optimal conditions
DB 003	Detect, diagnose and map infestations in the field	Completion of assessment and updated field signage with new data imported into Iluka GIS. Opportunistic field surveillance to be undertaken by suitably qualified personnel.	Field signage upgrade and review of GIS database.
DB 004	Education and training	Ensure education, awareness, control measures and appropriateness for <i>Phytophthora</i> Dieback management are communicated to Iluka personnel and contractors	<i>Phytophthora</i> Dieback inclusion in induction package, participation in regional Dieback focus groups. Advanced training for key staff as required.

4. IMPLEMENTATION STRATEGY AND MANAGEMENT ACTIONS

Management controls have been developed to be consistent with best practice management techniques described in the following publications:

- *Management of Phytophthora Disease; Policy Statement 3*, DPaW (2014);
- *Management of Phytophthora Dieback in Extractive Industries Dieback Working Group* (2005b);
- *Phytophthora cinnamomi and Disease Caused by It Volume 1 Management Guidelines*, DEC 2007;
- *Managing Phytophthora Dieback in Bushland – A Guide for Landholders and Community Conservation Groups*, Edition 3', published by the Dieback Working Group (2005a);

These management controls are listed in **Table 9** with links to the Environmental Objectives (Section 3), key personnel responsibilities and reporting systems for each element.

This *Phytophthora* Dieback Management plan applies to all Iluka personnel and subcontractors who operate at Iluka's Eneabba operations. Key Iluka Eneabba operations personnel that have responsibility for implementation of the *Phytophthora* Dieback Management plan are listed in **Table 9**.

4.1 Risk Assessment

Section 4.1.1 and Section 4.1.2 define the rationale and methodology for risk assessment.

4.1.1 Rationale

A risk based approach to managing *Phytophthora* Dieback is outlined in Parts 3 & 4 of *Management of Phytophthora cinnamomi for Biodiversity Conservation* (Wilson B. *et al* 2005). This report was commissioned by the Department of Environment Heritage Water and Arts now called the Department of Environment, as one of the most important action items to be implemented from the National Threat Abatement Plan (Environment Australia 2001).

Section 3 of the DEC's *Best Practice Guidelines for the Management of Phytophthora cinnamomi* (2004) outlines best practice management methods which include:

- assessment of the threat to the conservation of biodiversity posed by *P.cinnamomi* including the threat to uninfested areas of high conservation value, to the residual conservation value of infested areas and to the commercial value of uninfested areas;
- analysis and evaluation of the risk of introduction of *P.cinnamomi* into uninfested areas; and
- identification, evaluation and application of effective and efficient risk treatment measures to limit the risk of introduction of *P.cinnamomi* into uninfested areas, including systematic planning for, and implementation of, long term restrictive entry management of uninfested areas.

Phytophthora Dieback was first detected and diagnosed at Eneabba in 1990, fifteen years after mining had commenced. Hygiene management controls and procedures necessary to prevent the non-autonomous spread of the pathogen were first implemented at Iluka's Eneabba operations in 1991. The area within and adjacent to the mining lease at Eneabba is a mosaic *Phytophthora* Dieback management categories:

- Uninfested areas of native vegetation;
- Infested areas of native vegetation;
- Infested rehabilitation areas;
- Uninfested rehabilitation areas;
- Uninterpretable rehabilitation areas;
- Excluded (disturbed) open areas including roads, mining infrastructure, areas poorly rehabilitated and pasture; and
- Temporarily Uninterpretable areas (fire).

Since 1991, *Phytophthora* Dieback management control measures implemented on site have followed hygiene rules which stipulate that all vehicles, machinery and personnel (footwear) will be:

- clean on entry into Uninfested areas;
- clean on exit from infested and Excluded areas; and
- clean on entry and exit from all Uninterpretable areas.

While this approach has been reasonably effective in limiting the non-autonomous spread of the pathogen in the past, a more accurate assessment of the risks posed by each of the Dieback management categories is achieved by incorporating the history of disturbance and hygiene management since mining commenced on site. In addition to assessing the risks associated with each of the management categories listed above, the risk assessment also facilitates mapping that delineates a Disease Risk Area (DRA) and identifies Protectable areas within that. A risk assessment of each management category will achieve better outcomes in terms of the overall management of the disease on site for the following reasons:

- the level of risk associated with each management category will be more accurately defined. Example: An Uninterpretable area whose disease status was unknown prior to clearing that may have been mined without the necessary hygiene control measures is at higher risk of being infested than an uninterpretable area whose disease status was known to be uninfested prior to clearing and was mined with the necessary hygiene control measures being implemented;
- the identification of DRAs which delineate areas of catastrophic, major and moderate risk from Protectable areas will simplify and improve the implementation of hygiene control measures and access management on site;

- the risk assessment and delineation of a DRA will enable development of a hygiene management map which will:
 - identify tracks that pose a major or moderate disease vector risk;
 - identify tracks to be closed;
 - determine the best location for fixed vehicle and machinery wash down points; and
 - determine where mobile wash down facilities may be required.

A risk based approach to managing *Phytophthora* Dieback is consistent with the best practice guidelines and is being adopted in the interest of *Phytophthora* Dieback management at Iluka's Eneabba mine site.

4.1.2 Methodology

A risk assessment was undertaken to determine the risk that each *Phytophthora* Dieback management category poses in terms of its potential for both autonomous and non-autonomous spread. The risk assessment also identifies Protectable areas within and adjacent to the mine site.

The level of risk associated with each *Phytophthora* Dieback management category is presented in **Table 7** and has been determined through a likelihood/consequence matrix (see Risk Tables and Matrix in **Appendix 1**). Keeping in mind that hygiene control measures were first implemented on site in 1991, answers to the following key questions informed the level of risk associated with each area.

- What is the current disease status of the area in question?
- Was the disease status of the area known prior to clearing/mining?
- Were soil disturbing activities undertaken hygienically?
- Are there susceptible flora or vegetation in the area?
- Is the area in question adjacent to any known infestations?

Uninterpretable Areas

The level of risk attributed to Uninterpretable areas depends on the answers to questions above which determine the level of risk. If the area in question has a long history of soil disturbance prior to 1991 when the first *Phytophthora* Dieback Management plan was implemented on site, and the disease status was unknown before ground disturbing activities commenced then the residual risk is major. Conversely, if the area was only disturbed after 1991, and ground disturbing activities were undertaken with the necessary hygiene control measures being implemented then the risk will be moderate.

As the residual risk will be either major or moderate, all uninterpretable areas will be contained within the DRA under the precautionary assumption that they are infested. This approach is supported in the *Management of Phytophthora Dieback in Extractive Industries - Best Practice Guidelines* which states that:

“In some instances, uninterpretable sites may be easier considered as Dieback infected with emphasis placed on management of the topsoil” (Dieback Working Group 2005b, Page 29).

Excluded and Temporarily Uninterpretable Areas

Areas may be Temporarily Uninterpretable depending on whether they can recover from disturbance and become mappable. For example, areas of native vegetation that are Temporarily Uninterpretable due to fire may recover in the short to medium term and become mappable. Areas that are Excluded due to disturbance including but not limited to clearing, degradation, poor rehabilitation or pasture are unlikely to become mappable again and are therefore excluded from assessment. Areas are categorised as Excluded where the vegetation condition is 5 or greater (Degraded and Completely Degraded) on the Keighery vegetation condition scale (**Table 3**).

The level of risk attributed to Excluded areas depends on answers to questions which determine the level of risk. Excluded areas traversing or adjacent to known infested areas will be attributed a higher level of risk (major) than Excluded areas that are not adjacent to and do not traverse known infested areas (minor).

As a precautionary measure all Excluded areas that are located within the DRA are managed separately from both Protectable and Infested areas. Management measures for excluded areas within the DRA include:

- Restricting vehicle movements and earthmoving activity to dry soil conditions only;
- Topsoil management and final placement for rehabilitation is considered carefully in the context of its dieback status being unknown;
- Development of surface water management infrastructure in rehabilitation areas to contain and direct surface run-off to prevent potential spread; and
- Vehicle hygiene procedures apply

Excluded areas outside the DRA are assessed to have a lower level of risk (Minor) and for the most part are assumed to be uninfested. All vehicles, machinery and personnel (footwear) will be 'Clean on Entry' into areas outside the DRA. Excluded areas outside the DRA, specifically tracks and roads will be scrutinised to determine if areas exist that require specific risk management measures. Examples of such measures include:

- reforming sections of road to contain and direct and contain surface run-off to prevent potential spread; surface sterilisation; and
- vehicle and machinery wash down points.

Table 7 Assessment Determining Level of Risk for *Phytophthora* Dieback Management Areas

<i>Phytophthora</i> Dieback Management area	Area Description	Current Control Measures	Residual Risk			
			Likelihood	Consequence	Weight	Rank
Infested areas of native vegetation	Areas that have returned positive sample results and are currently mapped as being infested.	All Infested areas are identified within a Disease Risk Area (DRA). Vehicles, machinery and personnel (boots) to be Clean on Exit from DRA. Hygiene control measures will be enforced at washdown points and mobile wash down facilities before exiting the DRA. Infested areas will be clearly signposted and subject to on-going monitoring	4	6	24	MAJOR
Infested rehabilitation areas	Rehabilitation areas that were mapped as infested during the 2013 assessment	All Infested areas are identified within a Disease Risk Area (DRA). Vehicles, machinery and personnel (boots) to be Clean on Exit from DRA. Hygiene control measures will be enforced at fixed and mobile wash down points before exiting the DRA. Infested areas will be clearly signposted and subject to on-going monitoring	4	6	24	MAJOR

Phytophthora Dieback Management area	Area Description	Current Control Measures	Residual Risk			
			Likelihood	Consequence	Weight	Rank
Uninfested areas of native vegetation	Areas of native vegetation with susceptible species that are currently mapped as uninfested	Risk associated with adjacent disturbed areas better defined and managed through the delineation of DRA. More comprehensive mapping of disease occurrence due to 2013 mapping. The 2013 <i>Phytophthora</i> Dieback survey of rehabilitation areas mapped disease using sample evidence and Dieback interpretation based on proximity to infested areas, drainage, topography and vectors	2	6	12	MINOR
Uninfested areas of rehabilitation	Areas of rehabilitation with susceptible vegetation that area currently mapped as uninfested	Risk associated with adjacent disturbed areas better defined and managed through the delineation of DRA. More comprehensive mapping of disease occurrence due to 2013. The 2013 <i>Phytophthora</i> Dieback survey of rehabilitation areas mapped disease using sample evidence and Dieback interpretation based on proximity to infested areas, drainage, topography and vectors	2	6	12	MINOR

Phytophthora Dieback Management area	Area Description	Current Control Measures	Residual Risk			
			Likelihood	Consequence	Weight	Rank
Uninterpretable areas where the disease status was unknown prior to clearing	Insufficient disease indicator species present to determine the disease status of these management areas	All Uninterpretable areas will be within the DRA. Therefore the risk these areas pose to uninfested areas will be managed. Uninterpretable areas that are deemed Protectable will be revegetated using susceptible species and their disease status monitored	4	6	24	MAJOR
Uninterpretable areas that were assessed as being uninfested prior to clearing and were mined hygienically	Insufficient disease indicator species present to determine the disease status of these management areas. Includes some areas rehabilitated to native vegetation	All uninterpretable areas will be within the DRA. Therefore the risk these areas pose to uninfested areas will be managed. Uninterpretable areas that are deemed Protectable will be revegetated using susceptible species and their disease status monitored	3	6	18	MODERATE

Phytophthora Dieback Management area	Area Description	Current Control Measures	Residual Risk			
			Likelihood	Consequence	Weight	Rank
Excluded areas that traverse or are adjacent to known infestations.	Areas sufficiently disturbed so that <i>Phytophthora</i> Dieback disease occurrence is not possible at the time of inspection. Includes burnt native vegetation, open areas of mining infrastructure, roads and pasture.	All the major and moderate risk areas adjacent to Excluded areas will be contained within the DRA. All vehicles, machinery and personnel (footwear) to be Clean on Exit from DRA. A Hygiene Management Map (Figure 7) identifies and recommends control measures for all roads and tracks intersecting DRA that are to remain open	3	6	16	MODERATE
Excluded areas that do not traverse and are not adjacent to any known infestations.	Areas sufficiently disturbed so that <i>Phytophthora</i> Dieback disease occurrence is not possible at the time of inspection. Includes burnt native vegetation, areas of mining infrastructure, roads and pasture.	Excluded areas outside the DRA will be managed under the assumption that they are uninfested with stringent hygiene control measures. A Hygiene Management Map (Figure 7) identifies and recommends control measures for all roads and tracks intersecting the DRA that are to remain in use	2	6	12	MINOR

4.2 Management Strategy

The Eneabba site is entirely in the rehabilitation and closure phase. There are no mining activities and hence management of *Phytophthora* Dieback and the risk of spread is simplified by the presence of rehabilitation operations only. All vehicle movement is restricted during wet conditions.

Section 4.2.1 to Section 4.2.7 describe the *Phytophthora* Dieback management strategies to be implemented across the Project Area to prevent new infestations, monitor and manage existing infestations. The overarching objective is the protection of Critical Assets and Protectable Areas. The management actions for *Phytophthora* Dieback are presented in **Table 8**.

4.2.1 Disease Risk Area

A Disease Risk Area is defined in the Conservation and Land Management Act 1984 as “any area of public land where the Executive Director considers that the earth, soil or trees may be, or may become infected with a forest disease”. From this definition, a DRA is an area that **may be, or may become** infested with a plant disease such as *Phytophthora* Dieback.

Iluka has adopted the DRA concept and applied it to areas identified through the risk assessment process that are likely to be infested with *Phytophthora* Dieback. Therefore the DRA will include areas where the residual risk of being infested, after management control measures have been applied, is assessed as major or moderate. The majority of the area within the DRA poses a major or moderate residual risk to the environment because it is likely to be infested and this could potentially lead to the pathogen being spread into areas of minor and insignificant risk outside the DRA.

Access outside of the DRA will be controlled at wash down points to ensure that all necessary hygiene controls measures are followed. All Iluka personnel and sub-contractors will be inducted into the site hygiene obligations and procedures and these will be clearly signposted at all wash down stations.

East Mine DRA

The East Mine DRA has been delineated after undertaking a risk assessment of the entire area for the presence of *Phytophthora* Dieback (**Figure 4**). The majority of the area within the DRA is comprised of major and moderate residual risk areas with 12 discrete Protectable areas identified within the DRA boundary. A Hygiene Management Map has been developed (**Figure 7**) which assesses all the access tracks and roads intersecting the DRA. This has included an evaluation of which roads and tracks will be closed, which ones will remain open and where hygiene will be controlled through the installation of lockable gates. Some tracks and roads will remain open without gates but will have wash down procedures applied to all vehicles, machinery and personnel (footwear) exiting the DRA or entering Protectable areas within the DRA via these routes.

West Mine DRA

The West Mine ceased operations in 1999 and has been fenced to prevent unauthorised access. A risk assessment has been undertaken of the West Mine area and a DRA has been delineated which includes areas of major and moderate residual risk (**Figure 5**).

Pasture areas are considered to pose a minor risk of being infested due to the absence of susceptible species. Some areas that have been rehabilitated to pasture are included in the DRA as there are no biodiversity values to protect and the risk of the pathogen being able to survive in these areas is considered low due to the absence of susceptible species.

Only Iluka environmental and rehabilitation personnel are permitted into native vegetation in the West Mine area. Entry to the area is avoided during wet soil conditions and all vehicles, machinery and personnel (footwear) must be clean down vehicles and machinery at the East Mine wash-down bay prior to re-entering the site. Known infested areas within the DRA are monitored on a regular basis

Areas adjacent to both the Coolimba Eneabba Road and Erindoon Road are infested. It is likely that the infested areas in the West Mine originated along these public roads. Erindoon Road dissects the West Mine area, however the rehabilitated mining areas either side of Erindoon Road are fenced to prevent unauthorised access. Both roads are public roads and have not been included into the West Mine DRA because Iluka cannot control vehicular traffic along public roads.

Infested areas to the west of Erindoon Road and along Coolimba Eneabba Road pose a considerable risk of spreading the pathogen into Lake Logue Nature Reserve.

Eneabba Town Site

There are several known infestations around the Eneabba town site. While vehicle hygiene cannot be enforced on public roads, Iluka liaises with the Shire of Carnamah to prevent unauthorised public access to the mine site from tracks leaving the town site. This is achieved through closing or controlling public access to tracks east of the town site which are considered a major risk of being infested.

4.2.2 Protocols for Identifying Protectable Areas

According to *Phytophthora* Dieback Interpreters Guidelines (DPaW 2015), the following primary criteria are used to define 'Protectable Areas' as those that:

- have been determined to be free of the pathogen *Phytophthora spp.* by a registered *Phytophthora* Dieback Interpreter (all susceptible indicator plant species are healthy and no plant disease symptoms normally attributed to *Phytophthora* Dieback are evident);
- consist of areas where human vectors are controllable (e.g. not an open road, private property) (DPaW 2013, pp 101 - 102); and
- are positioned in the landscape and are of sufficient size (e.g. > 4 ha with axis >100 m) such that a qualified Interpreter judges that the pathogen will not autonomously engulf them in the short term (a period of a few decades); or
- include areas of high conservation and/or socio-economic value (for example, a small Uninfested area with a known population of a susceptible species of Threatened flora).

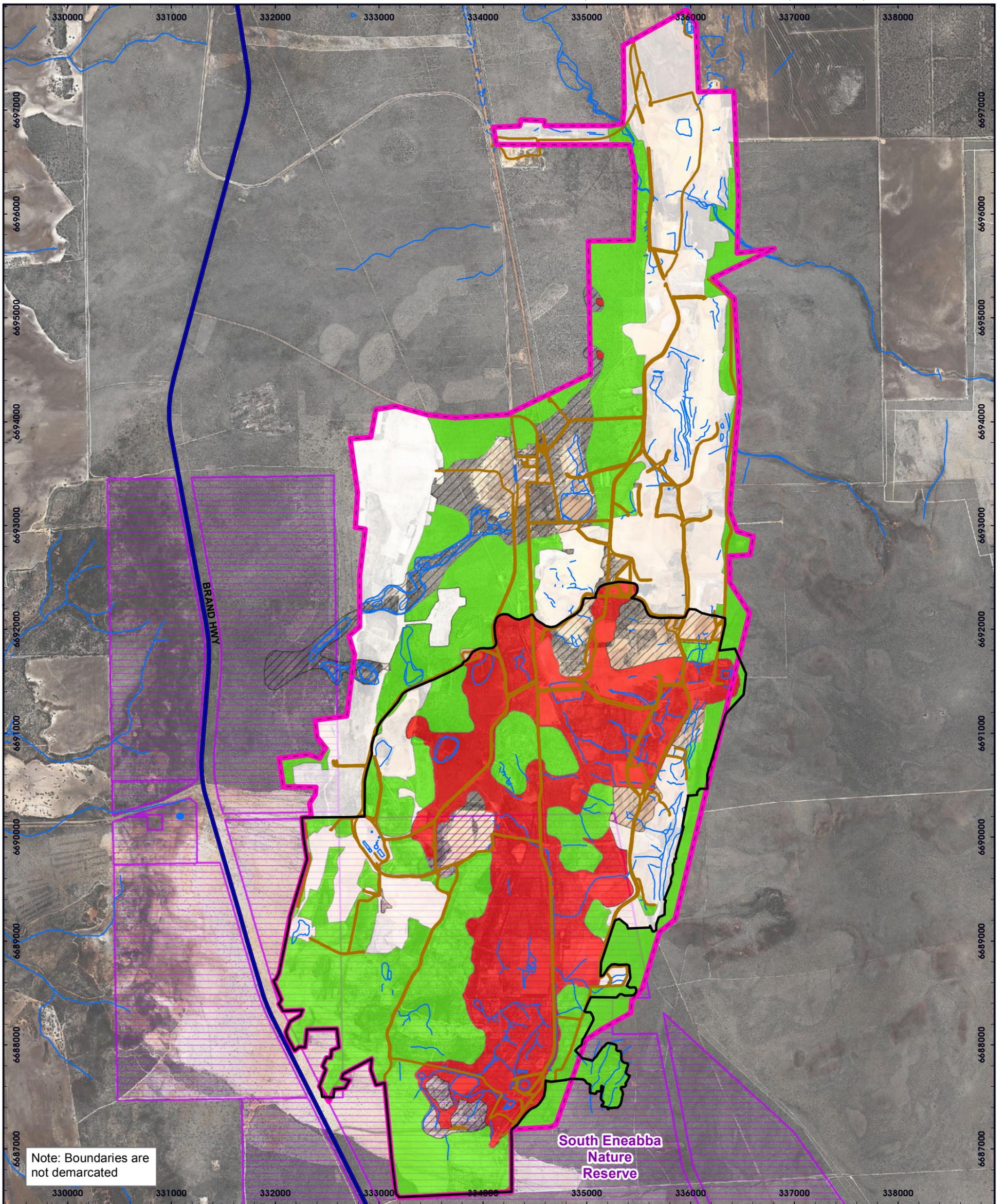
Protectable areas within the DRA have been identified using the DPaW's criteria (**Figure 6**) and are signposted so hygiene control measures can be applied to any vehicles, machinery and/or personnel entering these areas. All areas outside the DRA will be protected from non-autonomous spread of the pathogen from infested areas within the DRA through the implementation of stringent hygiene control measures. Some uninfested areas are not

protectable from autonomous spread of the pathogen in the long term due to their size, proximity to, or topographical location in relation to infested areas.

Management actions to ensure that Protectable areas remain free of *Phytophthora* Dieback are presented in **Table 8**.

Table 8 Management Actions for Protectable Areas

Objectives and Controls	Description	Key Iluka Personnel responsible	Timing	Reporting System
Demarcation	To clearly identify Protectable Areas through signage	Environmental Specialists	ASAP	Annual Environmental Report(AER) <i>Phytophthora</i> Dieback Management Plan (PDMP)
<i>Phytophthora</i> Dieback Mapping	To reassess identified Protectable areas for the presence of <i>Phytophthora</i> Dieback	Environmental Specialists	Biennial site assessment	AER PDMP
Access management	Access to Protectable areas must be approved by the Mine Manager or Environmental Superintendent	Environmental Superintendent	As required	Ground Disturbance Permit
	Access to all areas during wet conditions will be restricted. Inundated and wet roads will be closed.	Midwest Rehabilitation Manager Native Vegetation Superintendent	As required	Lost control card
Hygiene facilities	Ensuring that mobile wash down units are deployed to Protectable areas prior to vehicles entering Protectable Areas	Environmental Specialist	As required	Vehicle Hygiene Inspection Sheet
Hygiene procedures	Ensuring that all vehicles, machinery and personnel (footwear) are 'Clean on Entry' to Protectable Areas and that the Vehicle Hygiene inspection Sheet has been completed and checked	Environmental Specialist	As required	Vehicle Hygiene Inspection Sheet



LEGEND

Drainage	Excluded
Tracks	Infested
Brand Highway	Protectable
Study Area Boundary	Unprotectable
Disease Risk Area	
DPaW Managed Lands	

Dieback Protectability

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PROTECTABLE AND UNPROTECTABLE AREAS

Iluka Resources Eneabba Minesite Dieback Assessment

Scale @ A3: 1:35,000
Coordinate System: GDA 1994 MGA Zone 50, Projection: Transverse Mercator, Datum: GDA 1994

Prepared: N King	
Reviewed: R Cullen	
Checked: J Grehan	
Project No: TS15008	
Revision: Rev H	Figure 06
Date: 16/03/2016	

4.2.3 Conservation Significant Flora

Occurrences of conservation significant flora have been recorded through targeted searches of specific areas and do not represent the total known distribution of these taxa within the DRA. One Threatened (Declared Rare) species known to occur within the DRA, *Leucopogon obtectus*, is known to be susceptible to *Phytophthora cinnamomi*, however susceptibility of the other three Threatened (Declared Rare) species, *Paracaleana dixonii*, *Tetratheca nephelioides* and *Eucalyptus johnsoniana* is unknown and these will be managed under the precautionary assumption that they are susceptible to the pathogen.

The risk of Threatened flora populations located outside Protectable areas becoming infested with *Phytophthora* Dieback, through the non-autonomous introduction of the pathogen, will be minimised through the management measures outlined in the Hygiene Management Map and **Table 9**. The health of all Threatened flora populations within Iluka's mining lease areas are monitored regularly by qualified botanical consultants. In particular it should be noted that all off-road access must be approved by the Midwest Rehabilitation Manager, Native Vegetation Superintendent or Environmental Specialists.

4.2.4 Hygiene Management Strategy

A Hygiene Management Map has been developed, the purpose of which is to:

- identify all roads and tracks intersecting the DRA;
- determine which tracks or roads will be:
 - closed permanently;
 - remain open but have gates installed; or
 - remain open with fixed wash down or mobile wash down points at the exit point from the DRA with the necessary equipment to ensure that vehicles and equipment are free of soil and vegetative materials.

Figure 7 shows all the roads and tracks intersecting the East Mine DRA and the access management measures that have been prescribed to control vehicles and machinery exiting the DRA. All vehicles, machinery and personnel (footwear) will be 'Clean on Exit' from the DRA and 'Clean on Entry' into Protectable areas. This will be achieved through fixed and mobile wash down facilities at the exits from the DRA and the deployment of mobile vehicle wash down units for all vehicles, machinery and personnel (footwear) entering Protectable areas within the DRA.

Entry to the West Mine DRA is limited to Iluka personnel and all vehicles and machinery need to be cleaned down at the East Mine wash bay prior to re-entering the site. Controlling unauthorised access to the mine site from tracks east of the Eneabba town site will be discussed with the Shire of Carnamah. Similarly Iluka will engage with the relevant authorities in relation to the management of access for the purpose of hygiene control along infrastructure corridors such as the rail and pipeline.

All contractors accessing Iluka's mining lease, including by utility managers (Western Power contractors) are required to contact Iluka to ensure compliance with mine site requirements, specifically this *Phytophthora* Dieback Management Plan.

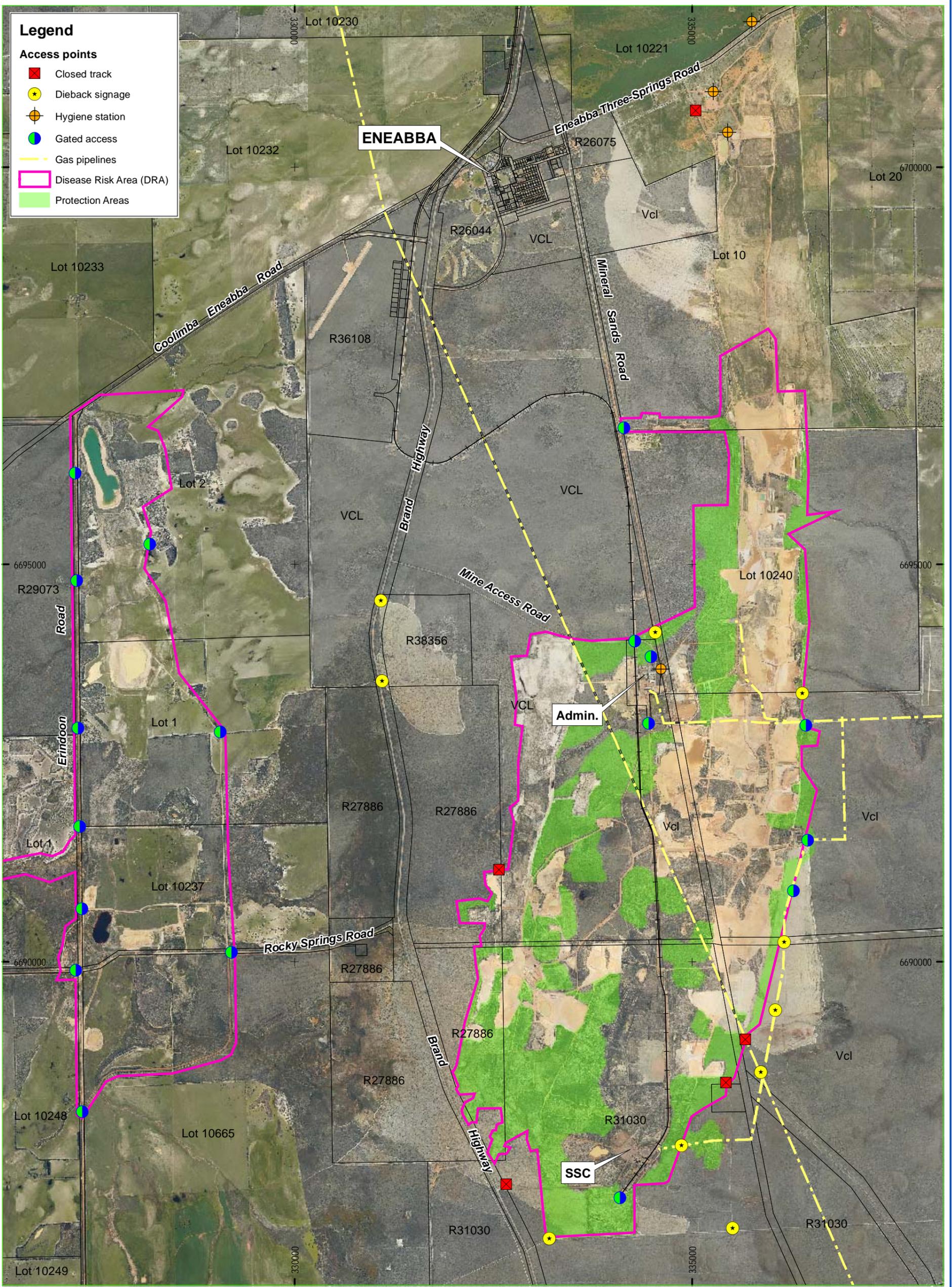
Phytophthora Dieback signage was changed in 2009 to reflect changes in the state wide *Phytophthora* Dieback Signage System introduced through the collaborative work of Project Dieback and the federally funded Natural Resource Management Group for WA.

All off-road access must be approved by the Midwest Rehabilitation Manager, Native Vegetation Superintendent or Environmental Specialist.

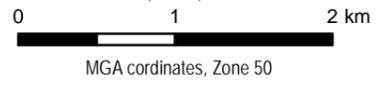
Legend

Access points

- ❑ Closed track
- ⊙ Dieback signage
- ⊕ Hygiene station
- Gated access
- Gas pipelines
- ▭ Disease Risk Area (DRA)
- Protection Areas



Aerial Photography flown;
3 Sept. 2015



ENEABBA
DIEBACK MANAGEMENT PLAN
DRA ACCESS MANAGEMENT STRATEGY



4.2.5 Hygiene Control Measures

All vehicles and machinery arriving on site will be required to go directly to a specified quarantine area for inspection and cannot leave that area until such a time as they have been inspected and certified as being clean of soil and vegetative material.

Iluka has a Vegetation Clearing Procedure which ensures that no ground disturbance activity (clearing activity) can commence within Eneabba tenements prior to the completion of a Ground Disturbance Permit (GDP). The GDP identifies activities to be undertaken in native vegetation and rehabilitation areas, and identifies both biological and safety risks. The permit is reviewed by environmental and rehabilitation personnel prior to approval by the site manager. Records of GDPs are kept for auditing compliance against clearing permit conditions.

A fixed vehicle and machinery wash down station is located near the administration building (**Figure 7**) while mobile wash down facilities will be used for all other tracks and roads which exit the DRA and are to remain open.

All wash down facilities should be sited on a hard, well-drained surface (e.g. road) away from native vegetation (Dieback Working Group 2005b). Any wash down effluent should be collected in a sump and must not be allowed to drain into native vegetation. Dry cleaning techniques, such as stiff brushes, should be used in preference to water cleaning wherever possible. The Eneabba Heavy Vehicle Hygiene Procedures is provided in **Appendix 2**. A Vehicle Inspection Field Sheet must accompany any vehicle exiting a field hygiene facility (**Appendix 3**).

All the areas known to be infested with *Phytophthora* Dieback are within the DRA therefore mining/rehabilitation within these areas will be undertaken in accordance with hygiene control protocols for the DRA. In addition, the infested worksite must be clearly demarcated with designated entry and exit points and in-field hygiene stations established. No equipment may leave the assessment area without inspection and completion of the Vehicle Inspection Field Sheet.

4.2.6 Managing *Phytophthora* Dieback in Rehabilitation

The management of Dieback in areas being rehabilitated will be addressed in the rehabilitation planning for the site. Final landform and the selection of species for rehabilitation will consider:

- whether the disease status of the area was known prior to disturbance;
- soil disturbance history of the area being rehabilitated;
- where the topsoil and subsoil have been stockpiled; and
- whether the area being rehabilitated is Protectable from infestation through autonomous spread.

Design of final landform will consider proximity and topographical location in relation to known infestations to avoid low risk areas becoming infested through autonomous spread of the pathogen. Rehabilitation will consider species selection for sites that are likely to be infested to promote ecological function and the development of a stable, self-sustaining vegetation community. Rehabilitation areas that pose a moderate risk of being infested will be revegetated using suitable species and monitored for *Phytophthora* Dieback.

4.2.7 Future Proposed Mining Areas

The *Phytophthora* Dieback Management plan and Hygiene Management Map will be adopted to ensure that the pathogen is not introduced into new mining areas or areas to be re-mined. In addition, any existing infestations as well as areas of major and moderate risk will be managed to prevent non-autonomous spread of the pathogen.

The proposed IPL North project area is outside the DRA and therefore will be subject to a separate risk-based *Phytophthora* Dieback Management plan.

Table 9 *Phytophthora* Dieback Management Actions

Objectives and Controls	Description	Key Iluka Personnel with Responsibility for actions
Objective 1: Prevent the introduction of new <i>Phytophthora</i> infestations		
Planning	Consideration of <i>Phytophthora</i> Dieback issues in mine/rehabilitation planning and ensuring that management controls are adhered to during mining/rehabilitation operations and road transport activities	Midwest Rehabilitation Manager Native Vegetation Superintendent Senior Rehabilitation Specialist Senior Rehabilitation Planner
Vehicle and Equipment Hygiene	All vehicles and machinery arriving on site will be quarantined either at the Administration Washbay or the North Workshop prior to inspection to ensure vehicles are free of imported soil or vegetation (including roots, seeds and propagules). Heavy equipment that arrives on site in an unsatisfactory condition will be refused entry. Heavy equipment cannot leave the quarantine area without authorisation via a signed inspection sheet	Midwest Rehabilitation Manager Native Vegetation Superintendent
	Unacceptably dirty vehicles will be refused entry to any Iluka Eneabba sites	All Iluka employees and contractors
	Any vehicle used off-road must be 'Clean on Exit' from DRAs and 'Clean on Entry' to Protectable areas	All Iluka employees and contractors
	Designated wash down facilities will be maintained at all exit points from the DRA and at the site entrance. Mobile wash down facilities will be provided for all vehicles entering Protectable areas within the DRAs	Midwest Rehabilitation Manager Native Vegetation Superintendent
	All surface runoff from the quarantine inspection area and permanent wash down facilities will be directed to a collection sump with solids trap	Native Vegetation Superintendent
Import of Materials	Only soils, road base or vegetation from known <i>Phytophthora</i> -free areas are to be allowed on site. Import of these materials will be permitted provided the materials are 'certified' as <i>Phytophthora</i> free. Haulage contractors associated with transporting soils, road base or vegetation to site must certify their equipment to be <i>Phytophthora</i> free	Midwest Rehabilitation Manager
Nursery Hygiene Control	Any material imported into the Eneabba Rehabilitation Nursery precinct must be assessed as <i>Phytophthora</i> -free. The Nursery shall be a recognised quarantine area with hygiene accreditation from the Nursery and Garden Industry (WA) and incorporate appropriate footbaths and material movement control measures to prevent the importation of infested materials	Nursery Supervisor
Contractor Management	Compliance with this <i>Phytophthora</i> Dieback Management plan is to be included in contractual obligations of suppliers and contractors and will be audited for compliance	Midwest Rehabilitation Manager Contracts Manager Environmental Superintendent
Objective 2: Prevent the spread of existing <i>Phytophthora</i> Dieback infestations within the Eneabba mine site leases		
Planning	Consideration of <i>Phytophthora</i> Dieback issues in rehabilitation planning and ensuring that management controls are adhered to during rehabilitation operations	Midwest Rehabilitation Manager Senior Rehabilitation Specialist Senior Rehabilitation Planner
Vehicle and Equipment Hygiene	Vehicle movements are restricted to operational mine roads, pits and laydown areas. Access controls including warning signs and barrier fences will be erected in areas of significant vehicle use.	Midwest Rehabilitation Manager Rehabilitation Superintendent
	All off-road access must be approved by the Midwest Rehabilitation Manager, Native Vegetation Superintendent or Environmental Specialist	Midwest Rehabilitation Manager Rehabilitation Superintendent Environmental Specialists

Objectives and Controls	Description	Key Iluka Personnel with Responsibility for actions
	Access to completed rehabilitated areas must be approved by the Midwest Rehabilitation Manager or Earthmoving Superintendent	Midwest Rehabilitation Manager Native Vegetation Superintendent
	All vehicles, machinery, equipment and personnel (footwear) must be 'Clean on Entry' to the site and 'Clean on Exit' from DRAs	All Iluka employees and contractors
Hygiene	Personnel responsible for maintaining wash down facilities must have a maintenance/inspection schedule and record log to show inspections are done on a regular basis.	Midwest Rehabilitation Manager Native Vegetation Superintendent
	Accessing of Phytophthora Dieback infested areas is to be avoided during wet conditions	All Iluka employees and contractors Native Vegetation Superintendent
	Hygiene areas shall be highlighted on the Eneabba Ground Disturbance Permit and attached map prior to any new ground disturbance work	Native Vegetation Superintendent
	Mobile wash down areas will recover waste water and contain it within the Phytophthora Dieback affected area or treat the water and remove it for disposal	Environmental Specialists
Road Construction	Use only Phytophthora-Dieback free soils and gravel for road construction. Imported materials for road construction shall be certified as Phytophthora-free by a certified agency and be carted by a contractor who can demonstrate good Phytophthora Dieback hygiene	Native Vegetation Superintendent
	Roads are constructed) to ensure water does not pond on the surface, and drainage allows roads to dry out quickly with runoff collected in roadside sumps	Native Vegetation Superintendent
Clearing	Clearing or disturbance to native vegetation or native rehabilitation areas will not proceed without the completion and sign-off of an Iluka Ground Disturbance Permit	Midwest Rehabilitation Manager
	Known Phytophthora infested areas will be avoided during clearing operations If infested areas are part of operational clearing requirements, then each area will be risk-assessed prior to the commencement of clearing, and an area specific Dieback Hygiene Plan will be developed	Midwest Rehabilitation Manager Native Vegetation Superintendent Environmental Specialists
	Phytophthora infested topsoils are to be managed so that they are identified isolated and returned to Dieback infested wherever possible. Alternatively they should only be disposed in an area of equal or greater risk of being infested with Phytophthora Dieback	Native Vegetation Superintendent
Rehabilitation	In operational areas, surface drainage channels will be controlled to prevent the spread of Phytophthora Dieback from infested to non-infested sites	Native Vegetation Superintendent Senior Rehabilitation Planner
	Topography shall be considered when rehabilitating <i>Phytophthora</i> Dieback areas. Should the site enhance the spread of Phytophthora, then appropriate control strategies must be considered to contain the spread of the disease	Midwest Rehabilitation Manager Senior Rehabilitation Planner Senior Rehabilitation Specialist Environmental Specialists
	The nursery is to be quarantined and irrigation water, potting mixes and vegetative materials are to be tested for Phytophthora species. An appropriate sampling regime will be implemented and reported annually	Nursery Supervisor
Objective 3: Detect, identify and map infestations in the field		
Phytophthora Dieback Mapping and Demarcation	Eneabba regional <i>Phytophthora</i> Dieback assessments will be updated periodically using suitably qualified consultants with appropriate reporting on sampling and interpretation methods used	Environmental Specialists

Objectives and Controls	Description	Key Iluka Personnel with Responsibility for actions
	Infestation boundaries will be inspected during optimal conditions by a suitably qualified person	Environmental Specialists
	Known infestation boundaries will be identified in the field with appropriate flagging or barricading, and with signage provided at all vehicle access points	Environmental Specialists
	Maintenance of quarantine signage and supervision of surveillance activities	Environmental Specialists
	Ensure <i>Phytophthora</i> Dieback survey data contributes to regional mapping datasets which are consolidated through the Northern Agricultural Region Dieback Atlas	Environmental Specialists
Objective 4: Ensure education, awareness, control measures and appropriateness for <i>Phytophthora</i> management are communicated to Iluka personnel and contractors		
Support	Provide advice and support to rehabilitation operations to ensure implementation of appropriate <i>Phytophthora</i> Dieback management strategies	Environmental Superintendent
Training	Phytophthora awareness and site management requirements are included in induction packages for Iluka personnel and contractors. This is delivered prior to commencement of employment for all staff and contractors, with refresher training delivered annually for contractors and biennially for Iluka personnel	Environmental Specialists
	Awareness of environmental issues, including <i>Phytophthora</i> management, is communicated to rehabilitation personnel through presentations in safety meetings. Posters and maps of infestation areas are to be displayed around the site. <i>Phytophthora</i> Dieback management is discussed at daily meetings, as required	Environmental Specialists
	Where applicable, personnel attend courses, workshops, seminars and other training to ensure current knowledge and best practice information is available to enable effective <i>Phytophthora</i> management	Environmental Superintendent
Research	Iluka may conduct or fund research into the assessment or control of <i>Phytophthora</i> to maintain and improve Iluka's management effectiveness	Principal Rehabilitation Scientist
	Coordination of <i>Phytophthora</i> Dieback research and development programs	Principal Rehabilitation Scientist
Liaison	Iluka will foster open communication with government departments, research institutions and professional bodies associated with <i>Phytophthora</i> Dieback research and management	Principal Rehabilitation Scientist
	Iluka will maintain an active role in the Northern Sandplains Dieback Working Party, to contribute to regional Dieback management strategies	Environmental Superintendent
Review and Planning	Ensure that the <i>Phytophthora</i> Dieback Management Plan is reviewed regularly, or when operations change	Environmental Superintendent
	Provision for strategic planning with regular reporting to Midwest Rehabilitation Managers	Environmental Superintendent

5. MONITORING

Monitoring is required to assess the effectiveness of *Phytophthora* Dieback management controls and will be conducted according to scheduled timetables and on an as-need basis depending on rainfall events and annual climate trends. Monitoring will be undertaken by DPaW registered *Phytophthora* Dieback Interpreters where required, with Iluka personnel undertaking ongoing field surveillance throughout the year. Components of the Eneabba mine site monitoring programme are provided in **Table 10** below.

As a follow up to the 2007 assessment (Glevan Consulting 2007), a *Phytophthora cinnamomi* occurrence assessment of IPL South, as well as the East and West Mine Areas (Glevan Consulting 2009) was completed to take advantage of the improved disease expression likely from above average rainfall in Spring 2008. In autumn and spring 2013 a comprehensive assessment of 2107.8ha of rehabilitated area within the DRA was completed by Terratree and Moore Mapping.

Table 10 *Phytophthora* Dieback Monitoring Program

Parameter	Frequency	Location	Purpose	Responsibility
<i>Phytophthora</i> Dieback Assessment	Biennially or Opportunistically depending on environmental conditions	Iluka tenements and adjacent areas which may pose a risk of introduction of <i>Phytophthora</i> Dieback into uninfested areas within tenements	To undertake an assessment of High and Moderate risk areas within and adjacent to Iluka tenements and to determine if the disease status of uninterpretable areas has changed	Environmental Specialists to coordinate DPaW accredited Dieback Interpreters
Field Surveillance	Annually	Known infestation areas within Iluka tenements	To sample known infested areas and assess disease front demarcation and adjust buffer zones as required. To determine rate of spread of the pathogen (if any)	Environmental Specialists
Access controls	As required	In-field hygiene stations and signage	To ensure compliance of hygiene stations and field demarcation signage with this Management Plan	Environmental Specialists
Rehabilitation Monitoring	Annually	Rehabilitation Areas	To sample any suspected new infestations in rehabilitation blocks	Senior Rehabilitation Specialist
In-Field Assessment and Spot Sampling	As disease expression improves following rainfall events	Known or suspected infested sites	To improve demarcation of known infestation sites and ensure appropriate management strategies are in place	Environmental Specialists
Process Spot Sampling	Opportunistically following rainfall events	Within process streams	To determine if <i>Phytophthora</i> species have been accidentally introduced into the process stream	Environmental Specialists

6. CONTINGENCIES

Table 11 includes trigger values and corresponding remedial actions developed to manage risk by *Phytophthora* Dieback if monitoring indicates that the environmental objectives for Dieback management are not being met, or may not be achieved.

In some instances, contingency actions may be subject to special considerations depending on topography and natural values in the immediate risk area. Contingency plans may include reinstating drainage lines to divert them away from infested areas, or building traps to contain surface runoff from infested areas.

Table 11 Triggers and Remedial Action Should Environmental Objectives Not be Achieved

Trigger	Action	Responsibility
Non-adherence to hygiene procedure (to be recorded as Environmental Incident) e.g. vehicles not washed down as required, breaches of access controls	<ul style="list-style-type: none"> • Raise Lost Control Card • Investigate cause and assess risk to uninfested areas • Review procedures, (hygiene measures, training, signage etc) • Monitor the effectiveness of remedial actions taken 	Environmental Specialists
Observations suggest the possibility that <i>Phytophthora</i> Dieback has spread into new area	<ul style="list-style-type: none"> • Identify potential source(s) and vector(s) • Investigate through sampling and assessment if the pathogen is present (if present, determine species type) • Update operational maps if required • Review management controls, seeking further advice from relevant authorities if required • Implement revised Dieback control methods and continue monitoring 	Environmental Specialists
Evidence of <i>Phytophthora</i> Dieback spread into adjacent areas including Nature Reserves	<ul style="list-style-type: none"> • Immediately notify DPaW District and Regional offices • Immediately notify adjacent landowners and relevant authorities • Establish cause and instigate remedial measures (including vector control management) • Monitor the effectiveness of remedial actions taken 	Environmental Specialists
<i>Phytophthora</i> Dieback detected in rehabilitation areas	<ul style="list-style-type: none"> • Determine the extent of the infected area, cause and vector agent • Take action to prevent any further spread of the infection (quarantine and vector control) • Consider planting Dieback indicator species around the infected area to aid in boundary demarcation and provide a warning system for further spread 	Native Vegetation Superintendent Environmental Specialist

7. STAKEHOLDER CONSULTATION AND INVOLVEMENT

Iluka consulted with the OEPA and DPaW in revision of this plan during 2015-2016. Iluka met with DPaW on 20 January 2016 to discuss specific requirements. This included definition of Excluded Areas in the context of historical mining at Eneabba and management measures to limit risk of spread in rehabilitation areas. The meeting was attended by Disease and Hygiene Standards Officer, Ian Moore; Environmental Management Branch Area Manager (South), Daniel Coffey; and members of Iluka's rehabilitation and environmental management team. The discussed amendments have been included into Revision D of this plan.

Iluka will continue to engage in regular consultation with stakeholders regarding *Phytophthora* Dieback management, including the following:

- Department of Parks and Wildlife (DPaW);
- Office of the EPA (OEPA);
- Department of Environmental Regulation (DER);
- Northern Agricultural Catchment Council (NACC);
- Local Government Authorities;
- Industry groups;
- Centre for *Phytophthora* Science and Management (CPSM);
- The Wildflower Society; and
- Project Dieback Area Coordinator.

8. RESEARCH

Appropriate targeted research is the cornerstone to good Dieback management. Iluka has a history of supporting research and development programs since the discovery of the pathogen in the Midwest region in the early 1990's. Support has included programs such as:

- 1990 - inaugural member of the Northern Sandplains Dieback Working Party (NSDWP) which supported regional mapping, local field days, forums, PhD student support, training videos, press releases and presentations to the Minister for Environment;
- 1995 - MERIWA Project M188/M247 (Biology and ecology of *Phytophthora citricola* in native plant communities affected by mining);
- 2000 - MERIWA Project M280 (The potential of the fungicide phosphite to control *Phytophthora cinnamomi* in native plant communities associated with mining);
- 2003 - MERIWA Project M357 (A sampling strategy for *Phytophthora* for "Difficult" sites);
- 2013 - Collection of samples for a Australian Government Department of the Environment sponsored Threat Abatement Project (Climate modelling to determine the impacts of *Phytophthora cinnamomi* under future climate scenarios) conducted at the Centre for *Phytophthora* Science and Management (CPSM) at Murdoch University; 2014 - Sponsorship of the Dieback Working Group 2014 Conference 18/07/2014 (To promote dissemination of the most recent *Phytophthora* research to community groups and industry). Iluka has previously supported a range of research themes such as eradication programmes, life-cycle definition studies, and survivability of *Phytophthora cinnamomi* at depth and within typical sand mine process streams. Iluka will continue to conduct *Phytophthora* dieback studies as appropriate, with research objectives and commitments reviewed annually.

9. REVIEW, AUDITING & REPORTING

9.1 Review

This management plan will be reviewed and revised by Iluka as required, in consideration of the following:

- changes to the project or its operations;
- issues raised by stakeholders through the submission of the Annual Environmental Review;
- issues raised through stakeholders in response to any incident which results in a failure to meet any of the commitments to manage *Phytophthora* Dieback;
- monitoring results which may indicate that a change in management strategy is required; and
- the latest outcomes of both internal and external research and development programs.

When requested the plan will be made available for review by the Northern Sandplains Dieback Working Party and DPaW.

In accordance with the requirements of Ministerial Statement 81, condition 3, the plan will be made available to the public via Iluka's internet web page.

9.2 Auditing

This *Phytophthora* Dieback Management Plan will be audited regularly in compliance with the Iluka EHSMS auditing system.

9.3 Reporting

Performance Reporting

Performance against this *Phytophthora* Management Plan will be reported to the CEO of the DPaW through Iluka's AER. Survey/sampling results will be included as an appendix to the AER.

Incident Reporting

In accordance with the Iluka Loss Control Card reporting system, any non-compliance with this management plan will be reported to Iluka site management. Incidents will be ranked for actual and potential risk using the Iluka Risk Ranking Matrix Incidents Reports and associated actions will be entered into the Cintellate database system to track completion of actions.

Complaint Handling

Public complaints will be handled and recorded through the Iluka Community Comments and Complaints Procedures.

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APPENDIX 1– Risk Tables and Matrix

LIKELIHOOD RATING				
Rating	Descriptor	Definition	Probability	Frequency
1	Extremely remote	The event is not expected to occur in most circumstances	1-5%	Less than once in 100 years
2	Remote	The event is not expected to occur in most circumstances	6-10%	At least once in 100 years
3	Rare	The event may occur only in exceptional circumstances	11-20%	At least once in 50 years
4	Unlikely	The event could occur at some time	21-49%	At least once in 25 years
5	Possible	The event should occur at some time	50-75%	At least once in 10 years
6	Likely	The event will probably occur in most circumstances	75-90%	At least once in 2 years
7	Almost Certain	The event is expected to occur in most circumstances	91-99%	At least once per year

CONSEQUENCE RATING				
Rating	Descriptor	Environment	Reputation	Compliance
1	Insignificant	Limited damage to area of low significance	Public concern restricted to public complaint	Technical breach of legal obligations without fines or damages claims
2	Minor	Minor effects on biological or physical environment	Minor, adverse local public or media attention and complaints	Breach of legal obligations resulting in minor penalties or damages claims
3	Moderate	Moderate, short-term effects locally, but not affecting ecosystem function	Attention from media and/or heightened concern by local community. Criticism from NGOs	Breach of legal obligations resulting in moderate penalties or damages claims
4	Significant	Serious medium term environmental affects	Significant adverse national media/public/NGO attention	Breach of legal obligations resulting in significant penalties or damages claims
5	Major	Very serious, long-term environmental impairment of ecosystem function	Serious public or media outcry (international coverage)	Breach of legal obligations resulting in major penalties or damages claims, or prosecution.
6	Critical	Critical impact on highly valued species or significant impact on ecosystem function	International multi-NGO and media condemnation	Breach of legal obligations resulting in critical penalties or damages claims, prosecution of directors or senior managers, or loss of ability to operate specific operational areas.
7	Catastrophic	Catastrophic impact on highly valued species, habitat or long-term environmental impairment of ecosystem function	Prolonged international condemnation	Breach of legal obligations resulting in catastrophic penalties or damages claims, imprisonment of directors or senior managers, or loss of ability to operate multiple operational areas.

CONSEQUENCE RATING								
		1	2	3	4	5	6	7
LIKELIHOOD RATING	7	7	14	21	28	35	42	49
	6	6	12	18	24	30	36	42
	5	5	10	15	20	25	30	35
	4	4	8	12	16	20	24	28
	3	3	6	9	12	15	18	21
	2	2	4	6	8	10	12	14
	1	1	2	3	4	5	6	7
RISK RATING		DESCRIPTOR						
28 - 49		Catastrophic						
21 - 27		Major						
14 - 20		Moderate						
7 - 13		Minor						
1 - 6		Insignificant						

APPENDIX 2 – Hygiene Procedures



Functional Location	Description
	VEHICLE HYGIENE (IN FIELD) – DIEBACK
	Procedure for HEAVY vehicle clean-down when leaving Phytophthora Dieback Infested area

Protective equipment required:	
Additional Equipment / Tools	Chlorine liquid (Sodium Hypochlorite 12.2%) if required for disinfection Mobile wash-down equipment (if required) Stiff brushes, shovels, crow bar Footbath with chlorine or phytoclean for operators and tools
Hazards / Safety	Uneven surfaces, Working at height, Working under equipment, Manual handling, Trip hazard, Operating high pressure cleaner, Splash-back from hard surfaces, Slippery surface under foot, working with chemicals
Isolations	N/A

TASK	STEPS	KEY POINTS
1. Prior to leaving work area	1. Contact supervisor and/or Iluka Environmental Dept to identify appropriate hygiene equipment suited to equipment that requires clean-down and inspection. 2. Ensure a 'VEHICLE INSPECTION (FIELD SHEET)' is available. 3. Determine the level of hygiene required depending on weather conditions and soil moisture (ie: Dry brushing, high pressure cleaning or chlorine rinse). Refer to VEHICLE INSPECTION (FIELD SHEET).	<p> VEHICLES CANNOT LEAVE HYGIENE INSPECTION POINT WITHOUT AUTHORIZED "VEHICLE INSPECTION FIELD SHEET" SIGN-OFF </p>

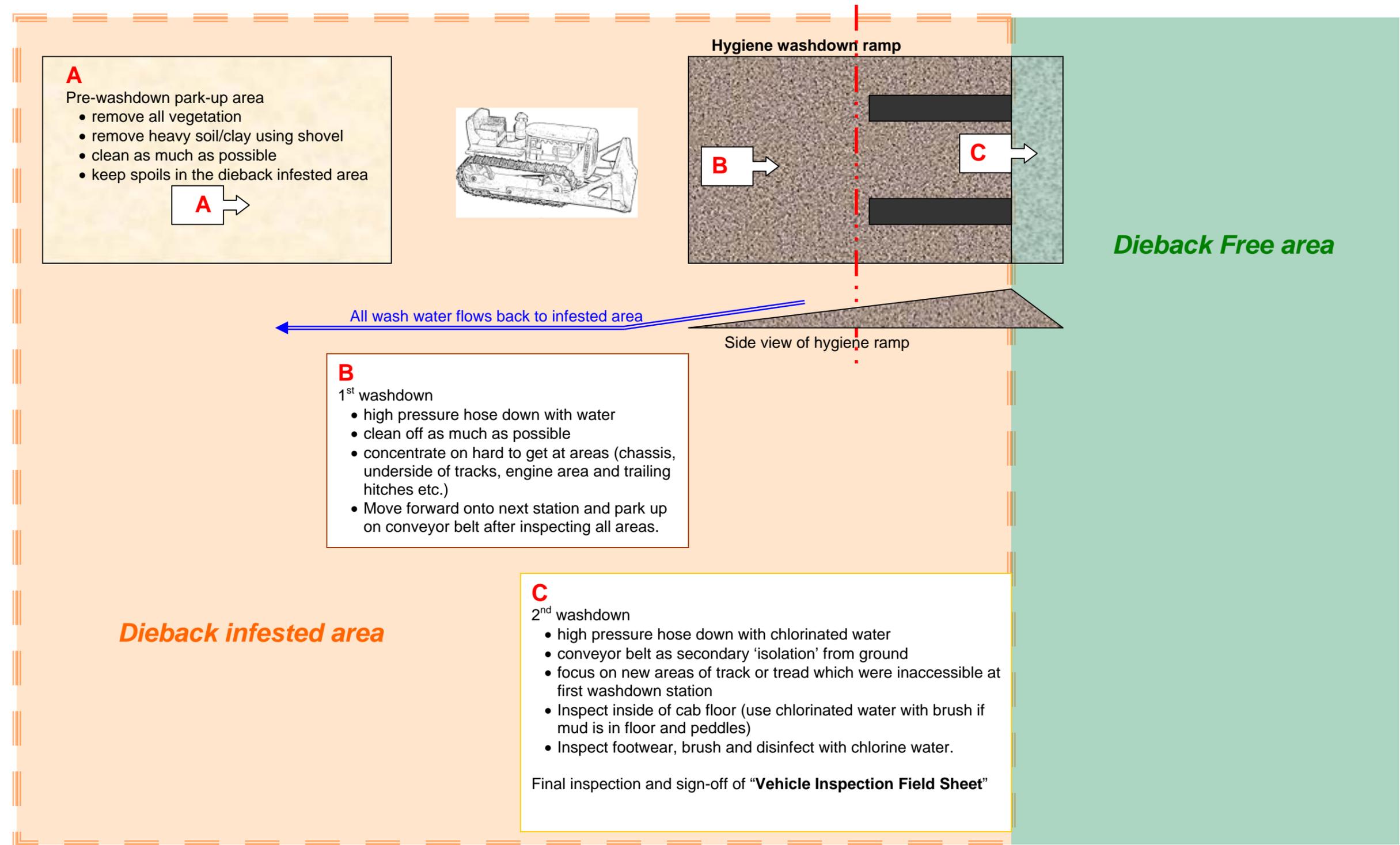


<p>2. De-mobilizing from work area</p>	<p>4. Proceed to Dieback Hygiene Point (DHP) and park up <u>in front of DHP</u> for primary inspection. 5. Standard tramping procedure when transiting work areas. 6. Vehicles must remain within Dieback infested area at all times until hygiene completed.</p>	<p> ALL VEHICLES MUST PASS HYGIENE INSPECTION BEFORE LEAVING WORK AREA</p>
<p>3. Pre-inspection</p>	<p>7. Ensure vehicle is appropriately 'isolated' before conducting inspections of running gear etc. 8. Caution: follow any vehicle specific isolations or procedures before working under, on top of, or between articulation/pinch points, transmission or hydraulic arms etc. 9. Inspect all surfaces that have come into contact with dieback contaminated soil (including inside of vehicle cabin). 10. Remove any 'heavy soiling' by shovel or other means (large clay balls, oversize, significant build-up of sand etc on transmission, chains etc). 11. Inspect all areas for vegetative material (roots, bark, branches, seeds, weeds etc) and remove. 12. All material removed must remain within the Dieback infested area.</p>	<p> Maintain proper manual handling technique if shovelling, hammering or pulling.</p>
<p>4. Primary cleaning</p>	<p>13. Advance onto the first half of the DHP ramp. (ensure all of vehicle is on the ramp). 14. Ensure vehicle is appropriately isolated and safe to prevent rolling off DHP ramp. 15. Caution: follow any vehicle specific isolations or procedures before working under, on top of, or between articulation/pinch points, transmission or hydraulic arms etc. 16. Check operational condition of wash-down unit if required (contact appropriate supervisor for instructions). 17. Using appropriate cleaning method identified at STEP 3, conduct primary cleaning of all surfaces to ensure all loose or remaining hard compacted soil is removed. 18. TRACK VEHICLES: Make sure the underside of tracks are inspected and cleaned before proceeding to the next stage.</p>	<p> Use appropriate PPE when using water cleaners or when dusty. Beware of splash-back if using high pressure cleaners.</p>
<p>5. Final wash-down</p>	<p>19. Advance onto second half of DHP ramp with additional operator or inspector checking underside of wheels tracks etc to ensure minimal contaminated material advances to the final clean-down stage. 20. Use secondary separation material such as conveyor belt if required (check with Iluka Environmental Dept). 21. Ensure vehicle is appropriately isolated and safe to prevent rolling off DHP ramp. 22. Caution: follow any vehicle specific isolations or procedures before working under, on top of, or between articulation/pinch points, transmission or hydraulic arms etc. 23. Final inspection should include (where appropriate), under engine compartment hoods, operators compartment (foot rest, pedals etc), and in extreme dust conditions, dust extractors or filter box's. 24. In moist soil conditions, final rinse with water dosed with chlorine (drinking water standard).</p>	<p> Additional PPE is required if using chlorine (refer to SWI for handling concentrated chlorine)</p>



<p>6. Vehicle inspection and sign-off</p>	<p>Prior to moving off the DHP, the operator/supervisor must complete a VEHICLE INSPECTIONS (FIELD SHEET) and have it signed-off by an authorized Iluka person</p>	
<p>EXAMPLE: Dozer at final wash-down (DHP constructed from large oversize sloping towards camera which drains back into dieback infested area)</p>		<p>Left track being cleaned, note impacted hard mud still stuck to right track which has yet to be cleaned. Dozer was moved twice to inspect underside of tracks.</p>
<p>EXAMPLE: Dozer at final wash-down</p>		<p>High pressure cleaning of impacted mud on hard-to-get joints on dozer blade</p> <p>Foot bath with chlorine on oversize DHP pad at exit point for operator hygiene while cleaning on oversize pad</p>

DIEBACK HYGIENE PAD FLOW DIAGRAM – START AT STATION ‘A’ WHICH IS IMMEDIATELY BEFORE HYGIENE PAD, AND THEN MOVE ONTO PAD TO COMPLETE STATIONS ‘B’ AND ‘C’.



IN-FIELD TEMPORARY DIEBACK HYGIENE RAMP FOR HEAVY EARTHMOVING EQUIPMENT



Hygiene ramp constructed with oversize material. Ramp section steps up immediately in front of LV with wash water returning to dieback infested area (vegetation in background)

APPENDIX 3 – Vehicle and Machinery Hygiene Inspection (Field Sheet)

VEHICLE and MACHINERY HYGIENE INSPECTION (FIELD SHEET)

Note: this sheet must be signed off by the operator of the vehicle/machinery and an Iluka supervisor.

If in doubt, call Eneabba Environmental Department (Kerri Conder 0427 389 656 or Sarah Barron 0408 093 223)



Eneabba Operations

Vehicle/Machinery Operator (Name)

Vehicle/Machinery Identification #:.....

		Vehicle/Machinery description (tick):	
1	Inspection Date:	LV	<input type="checkbox"/>
2	Location:	Dozer	<input type="checkbox"/>
3	Inspection site:	Excavator	<input type="checkbox"/>
4	Weather conditions:	Loader	<input type="checkbox"/>
5	Soil conditions:	Scraper	<input type="checkbox"/>
6	Reason for inspection :	Dump Truck	<input type="checkbox"/>
	Vehicle access to dieback free area, or new vehicle to site (CLEAN ON ENTRY).....	Mulch equipmenet	<input type="checkbox"/>
	Vehicle leaving weed or dieback site (CLEAN ON EX IT).....	Rehab machinery	<input type="checkbox"/>
	Other - (ie. pe-inspection of to move equipment)	Drill/boring equipment	<input type="checkbox"/>
	Other	<input type="checkbox"/>

Hygiene practice undertaken during inspection (forward signed sheets to Environmental Department)	
1	Was vehicle/machinery separated from contaminated soil? <input type="checkbox"/>
2	Method of separation
3	Was wash water directed back to collection sump?
4	What method of cleaning was used?
	Dry brush down <input type="checkbox"/>
	Wet hose down <input type="checkbox"/>
	Chlorine wash <input type="checkbox"/>
	High pressure rinse <input type="checkbox"/>
	Who completed this inspection?
	Name:
	Position:
	Is equipment free of soil/mud? <input type="checkbox"/> YES or NO
	Is equipment free of plant material? (seeds, weeds, roots, leaves etc)? <input type="checkbox"/>
	Signed:
	Operator:
	Inspector:

Author: M.Mannion
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