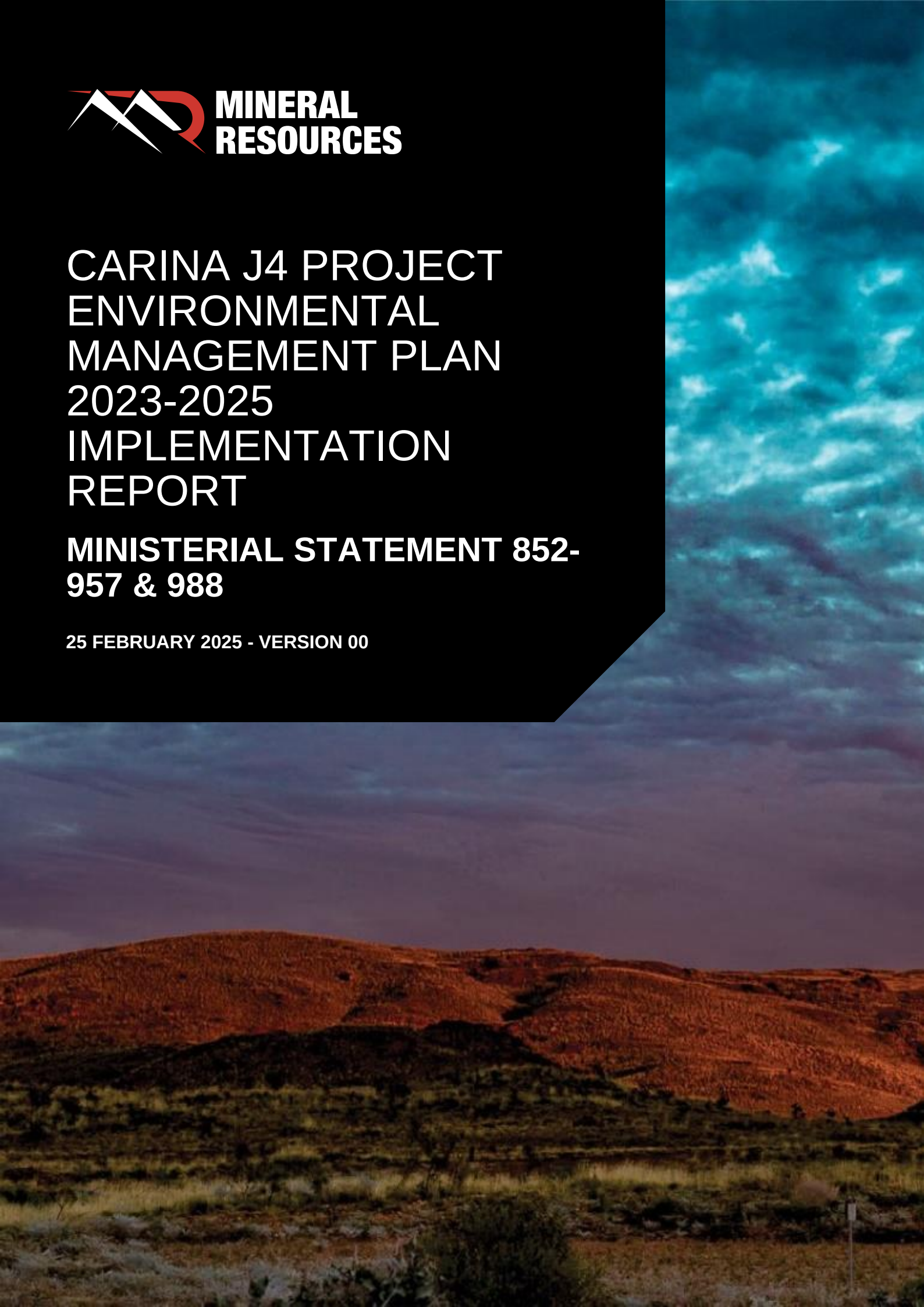




CARINA J4 PROJECT ENVIRONMENTAL MANAGEMENT PLAN 2023-2025 IMPLEMENTATION REPORT

**MINISTERIAL STATEMENT 852-
957 & 988**

25 FEBRUARY 2025 - VERSION 00



DOCUMENT INFORMATION

Contact

Peter De San Miguel
Environment Manager
E. peter.desanmiguel@mrl.com.au
P. +61 8 9329 3600

20 Walter Drive,
Osborne Park, WA 6017]

Erol Ozoglu
Senior Environmental Advisor
E. erol.ozoglu@mrl.com.au
M. 0488 726 131

Postal address
Locked Bag 13
Osborne Park DC, WA, 6916

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Acknowledgement of Country

MinRes is committed to reconciliation and recognises and respects the significance of Aboriginal and Torres Strait Islander peoples' communities, cultures, and histories. MinRes acknowledge and respect Aboriginal and Torres Strait Islander peoples as the traditional custodians of the land.

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Appendix A – Carina J4 Project Environmental Management Plan (PEMP, Rev5)
Appendix B – Carina and J4 2023 Weed Control and Management Report (Workpower)
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Appendix D – Carina and J4 2023 Dieback Assessment (Great Southern Biologic)
Appendix E – Carina and J4 2024 Dieback Assessment (Great Southern Biologic)

ABBREVIATIONS

Abbreviation	Definition
Carina	The Carina Iron Ore Project
J4	The J4 Iron Ore Project
Polaris	Polaris Metals Pty Ltd
PEMP	Project Environmental Management Plan
MinRes	Mineral Resources Limited
DE	Development Envelope
GDA	Geocentric Datum of Australia
WA	Western Australia
WONS	Weeds of National Significance
WHC	Weed Hygiene Certificate
CAR	Compliance Assessment Report
CEO	Chief Executive Officer
DWER	Department of Water and Environment Regulation
DEC	Department of Environment and Conservation
EPA	Environment Protection Agency
OEPA	Office of the Environmental Protection Authority
DBCA	Department of Biodiversity Conservation and Attractions
EP Act	Environmental Protection Act
MS852-957	Ministerial Statement 852-957
MS988	Ministerial Statement 988
DSO	Direct Shipping Ore
LAP	Land Activity Permit
AMS	Approvals Management System
EMS	Environmental Management Systems
DEMIRS	Department of Energy, Mines, Industry Regulation and Safety

1. INTRODUCTION

The Carina Iron Ore Project (Carina, the Project) is owned and operated by Polaris Metals Pty Ltd (Polaris), a wholly owned subsidiary of Mineral Resources Pty Limited (MinRes). The Project is located in the south-west of the Goldfields region of Western Australia (WA), approximately 100 kilometers (km) northeast of the town of Southern Cross (**Figure 1**).

Carina is a direct ship ore (DSO) project, consisting of two operational areas:

1. Northern Operations: The mine and associated infrastructure.
2. Southern Operations: The crushing plant and rail siding, connected by a 48 km bitumen haul road (**Figure 2**).

An accommodation village is situated approximately 3 km north of the rail siding and is serviced by a power line corridor.

In 2006, Polaris acquired iron ore tenements in the region, and subsequent exploration drilling identified the Carina deposits as suitable for mining. During the environmental approvals process, the Project was referred to the Environmental Protection Authority (EPA) for assessment under Part IV of the *Environmental Protection Act 1986* (WA) (EP Act). A Public Environmental Review was conducted, and the report, titled *Public Environmental Review Carina Iron Ore Mine: Yilgarn Region WA*, was submitted to the EPA in March 2010. Approval for the Project was granted on 28 January 2011, with the granting of Ministerial Statement 852.

Since then, four amendments have been made to MS852 under the Section 45C process, approved in June 2012, October 2013, December 2013, and September 2016. Additionally, a Section 46 amendment resulted in the removal of Condition 5-2, approved as MS957 on 11 December 2013.

The J4 Iron Ore Project (J4), also owned and operated by Polaris, is located about 100 km north-northeast of Southern Cross and 60 km north-northeast of Koolyanobbing. Both projects have currently (as of 31/12/2024) entered a state of operational pause.

1.1 Project Overview

Per Condition 9-4 of Ministerial Statement (MS) 852-957, Polaris Metals Pty Ltd (Polaris) is providing information regarding the implementation of the Project Environmental Management Plan (PEMP, **Appendix A**) for the Carina Iron Ore project (Carina).

This implementation report covers the period from 28 January 2023 to 27 January 2025. The latest revision of the PEMP (Revision 5) was submitted to DWER on 3 December 2023, as part of the triennial review required under Condition 9-3. This revision is currently awaiting approval from the Environmental Protection Authority (EPA).

Due to the close proximity of the Jackson 4 (J4) operation, managed under the MS 988, the connection of the two projects via the Carina-Jackson Haul Road, and the similar environment and MS Conditions of each project, the environmental management activities at J4 are aligned to those identified in the PEMP.

The projects are located approximately 105 km north-east of Southern Cross, in the Yilgarn Region of Western Australia (**Figure 1**, **Figure 2**). The project area consists of the following:

- **Carina Northern Operations:**
 - Two depleted open cut pits (Carina and Carina Extended)
 - Two Waste Rock Landforms (Carina and Carina Extended) – currently under rehabilitation

- A Run of Mine (ROM)
- Infrastructure area
- **Carina Southern Operations**
 - Accommodation camp
 - East Jaurdi Aerodrome (not approved under MS 852-957 or MS 988)
 - A ROM
 - Dry crushing and screening plant
 - Stockyard with associated Stacker and Reclaimers
 - Train loader and rail loop
 - Associated support infrastructure (Offices, Laboratory, Workshops)
 - A bitumen haul road, approximately 50 km in length
- **J4**
 - Two depleted open cut pits (East and West Pits)
 - Two Waste Rock Landforms (East and West WRL's) – currently under rehabilitation
 - A ROM
 - Infrastructure area (Office, workshop, magazine area and bulk explosives area decommissioned and removed from site)
 - A bitumen haul road, approximately 70 km in length

1.2 Ministerial Statements

The Carina project was referred to the EPA on 15 September 2008 and approved via MS 852-957 on 27 January 2011. The J4 project was referred to the EPA on 23 December 2013 and approved via MS 988 on 24 October 2014. Condition 9 of MS 852-957 defines the requirement for a Project Environmental Management Plan to guide environmental actions relating to the project, **Table 1**.

The purpose of the PEMP, per EPA Factors and Guidance, is to protect:

- flora and vegetation so that biological diversity and ecological integrity are maintained,
- terrestrial fauna so that biological diversity and ecological integrity are maintained,

and to maintain the variety and integrity of significant physical landforms so that environmental values are protected.

Table 1 MS852-957 PEMP Conditions

Condition	Project Environmental Management Plan
9-1	Prior to ground disturbing activities the proponent shall prepare a Project Environmental Management Plan to the satisfaction of the DEC. The objectives of the plan are to ensure that the adverse impacts from mining and associated activities do not unnecessarily threaten conservation values within the mining lease and prevent impacts outside of the mining lease. The project environmental management plan will address:

Condition	Project Environmental Management Plan
	• Hygiene management measures to prevent the introduction of weeds and dieback disease • Management of feral animals • Company protocols to authorise disturbance and clearance of vegetation • Limiting and authorising access to areas within the mining lease • Fire prevention and response • Management and monitoring of saline water used for dust suppression
9-2	The proponent shall implement the Project Environmental Management Plan required by condition 9-1
9-3	The proponent shall review and revise the Project Environmental Management Plan required by condition 9-1 at intervals not exceeding three years
9-4	The proponent shall report to the CEO on implementation of the Project Environmental Management Plan every two years from the date of commencing ground disturbing activities
9-5	The proponent shall make the Project Environmental Management Plan required by condition 9-1 publicly available in a manner approved by the CEO

1.3 Project Status

J4 operations resumed in October 2023 following the approval of Department of Energy, Mines, Industry Regulation and Safety (DEMIRS) Mining Proposal Reg ID: 117948. Mining at J4 entered an operational pause in June 2024.

As of 31 December 2024, the Carina site has paused operations, with a reduced workforce and essential facilities being maintained to support ongoing site requirements.

1.4 Project Environmental Management Plan

There are several key provisions in the PEMP identified to delineate management actions to meet specific EPA objectives and management targets, including:

- Hygiene Management
- Feral Animal Management
- Disturbance and Vegetation Clearing Management
- Access Management
- Fire Management
- Saline Dust Suppression Water Management Provisions
- Surface Water Flow Management

Management actions, targets, monitoring, and reporting requirements are described in the PEMP. Further operational guidance to meet these objectives is provided in the Yilgarn Operations Environment Management Systems (EMS), including:

- Weed Management Plan
- Land Clearing Management Plan
- Land Activity Permit Procedure
- Fire Management Plan
- Yilgarn Operations Bushfire Management Plan

- Yilgarn Operations Emergency Management Plan
- Dust Management Plan

The above documentation, and any other documentation from the Yilgarn Operations EMS, will be provided to the Office of the Environmental Protection Authority (OEPA) on request.

In accordance with Condition 9-3 of Ministerial Statement 852, the PEMP must be reviewed and revised every three years. The updated PEMP was submitted to the Department of Water and Environmental Regulation (DWER) on 3 December 2023 (**Appendix A**). No significant updates were made to the plan, and all conditions and management actions remain unchanged from the previous reporting period.



Figure 1 Carina MS852-957 Project Location

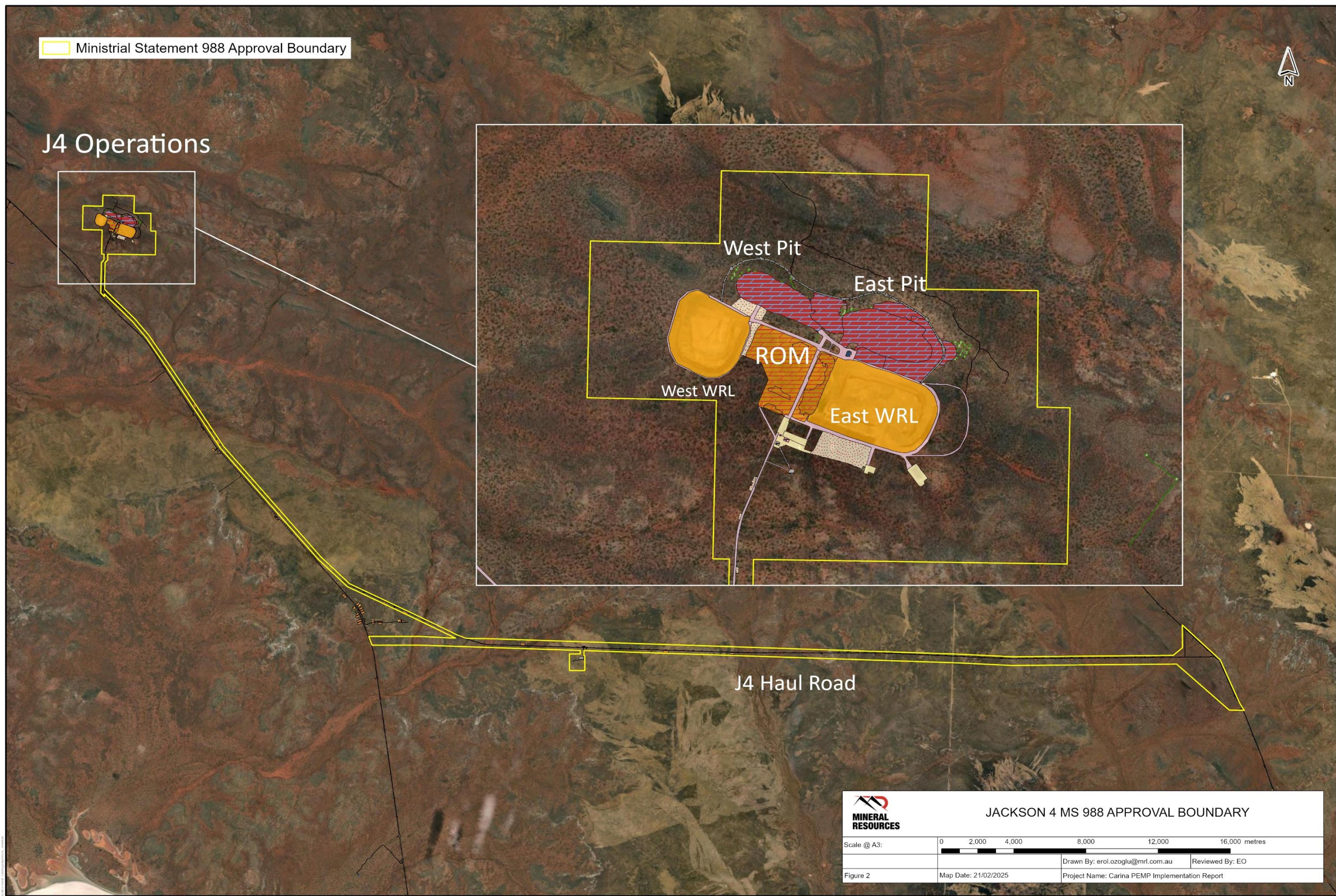


Figure 2 J4 MS988 Project Location

2. MANAGEMENT ACTIONS

To ensure the EPA's key factors and environmental objectives are achieved, the PEMP outlines key provisions that define the required management actions. Induction and training are consistently included as provisions across various management aspects. Below is a summary of activities undertaken during the reporting period, along with a review of the management actions specified for each condition of the PEMP.

2.1 Hygiene Management Provisions

The key provisions of Hygiene Management include:

- Weed hygiene certificate for high-risk operations
- Annual spring weed survey
- Targeted weed survey and chemical control during the March – September period
- Annual assessment of dieback by an accredited assessor

A comprehensive annual assessment strategy is implemented to ensure weed hygiene is maintained across the project. During the report period, annual surveys for weed and chemical control were undertaken in 2023 and 2024 period by Workpower (**Appendix B** and **Appendix C**).

Four separate weed control and data collection trips were conducted by Workpower for the Carina and J4 sites during the 2023 and 2024 reporting period as detailed below.

- Targeted weed survey and chemical control trip 1 – August 2023
- Targeted weed survey and chemical control trip 2 – September 2023
- Targeted weed survey and chemical control trip 3 – July 2024
- Targeted weed survey and chemical control trip 4 – September 2024

During visits, Workpower staff applied herbicide to various weed species using vehicle-mounted spray units and knapsack sprayers, with a focus on Weeds of National Significance (WONS). Data was also collected to document the weed control activities and the presence of weeds across the sites.

In 2023 the Carina and J4 tenements showed minor weed coverage across most sites, with moderate weed abundance observed primarily around the Carina camp. Weeds were predominantly found in areas were water pools and near buildings or equipment. Some locations within the Carina sites were not attended as a result of weather conditions, access limitations, or lower prioritisation in areas with minor weed populations. No new weed species were identified within the Carina tenements during the 2023 program.

In 2024, weed control efforts significantly reduced weed coverage and abundance across the Carina project sites. This improvement was reflected in weed control reports and feedback from technicians during the second trip. The Carina Camp and Carina Extended Waste Dump sites remain the areas with the highest weed populations within the Carina-J4 tenements. At the Carina Camp, sow thistle (*Sonchus oleraceus*) and other common weeds were widespread, however, it was noted that weed coverage decreased by over 50% following the first trip. The Carina Extended Waste Dump showed a consistent level of weed presence across both trips, with a few patches of Ruby dock (*Rumex vesicarius*) observed on the waste rock layers during the second visit. The haul road showed notable improvement compared to previous years, with only two patches of Sow thistle reported.

An annual assessment of dieback by an accredited third-party assessor, Great Southern Biologic (see **Appendix D** and **E** for full reports) was conducted during the reporting period (2023 and 2024). Since the project area lies outside the vulnerable zone for *Phytophthora*, receiving less than 400 mm of rainfall annually, the risk of *Phytophthora spp.*

is considered low. As a result, the assessment focused on areas of disturbance, such as haul roads, water-gaining sites, and drainage lines.

The project area was initially assessed in 2021 and rechecked in January 2023. As *Phytophthora* Dieback disease occurrence data remains valid for three years with annual rechecks, the recheck was deemed an appropriate approach for the current assessment. However, given the site's location in a low-rainfall region beyond the typical range of the disease, signs of disease activity were anticipated to be subtle and challenging to detect.

Between 1 August and 8 August 2023, vegetation potentially susceptible to *Phytophthora* Dieback was visually assessed for signs of decline consistent with the disease. Visual diagnosis focused on identifying deaths of susceptible species in patterns typical of disease spread, such as radiating from a known vector. Plant deaths caused by *Phytophthora* are typically rapid and complete, rather than partial.

Three of the eight affected areas were first identified and mapped in 2021 and have now undergone three annual sampling programs. In 2024, a total of 24 samples were collected from these areas, with five confirmed recoveries of *Phytophthora* spp. The high proportion of negative samples (79.1%) suggests that many of the observed plant deaths previously used to map *Phytophthora* extent are not directly associated with the disease. While *Phytophthora* is present, other factors likely contribute to vegetation decline at these sites, and the actual extent of the disease is smaller than indicated on current and previous maps.

Following an annual assessment conducted by Great Southern Biologic between 11 June and 19 June 2024, the classification of infested vegetation increased to 13 distinct areas now identified as infested, with two new *Phytophthora* species, *P. boodjera* and *P. sp. Aus 4F*, detected across the survey area. Both species are previously described members of the *Clade 4* group of *Phytophthora* spp., which are native to Australia.

Further review of the Hygiene management actions are provided in **Table 2**.

Table 2 Hygiene Management Actions

PEMP Management Action	Implementation Review
Weed Hygiene Certificate (WHC) for medium to high-risk situations. WHC requires cleaning of equipment to remove seeds, plant material and soil/mud and suitable disposal of material. Equipment to be inspected on arrival prior to use.	Where medium to high-risk situations are identified, a WHC is required to be completed by the operator prior arrival and use. All WHCs are provided to the Environment team and recorded. Weed Hygiene Certifications were completed as part of preparations for J4, which became operational in October 2023. As such equipment was relocated from multiple sites, including Parker Range, Windarling, and Koolyanobbing, to support infrastructure installations and mining operations at J4.
Employees and contractors are required to participate in the site induction, which will provide an awareness of weeds, including risk species, and an overview of the weed hygiene process.	All employees and contractors must complete site induction which includes an environmental component. The environmental component includes information on weed hygiene procedures and documentation. All personnel mobilized to site undertook appropriate Site Inductions and received awareness training on weed in the report period.

PEMP Management Action	Implementation Review
Employees and contractors who are involved with movement or operation of earthworks equipment, off-road vehicles, and land clearing will be specifically trained in weed hygiene procedures and documentation.	All employees and contractors must complete site induction which includes an environmental component. The environmental component includes information on weed hygiene procedures and documentation. For personnel involved with undertaking clearing works, further clearing induction is provided. All employees and contractors involved with clearing works in the project received further clearing inductions as required during the report period.
Annual weed control informed by results of weed surveys (Condition 10-1(3) of MS 852-957 and Condition 6-2 of MS 988) with control methods comprising manual, mechanical and chemical control as required.	The annual weed survey and control works as required under MS 852-957 and 988 are completed by an external contractor, Workpower. Weed control surveys were undertaken in both 2023 and 2024. The program in 2023 included an initial pre-season visit 3-11th August, and a post-season visit 11-16th September, by Workpower. The program in 2024 included an initial visit in July and post-season visit in September, by Workpower.

2.2 Feral Animal Management Provisions

The key provisions of Feral Animal Management include:

- Feral animal attractants fenced, i.e. landfill, water sources
- Record feral animal sightings
- Annual camera trapping program

Feral animal management practices are carried out under the greater Koolyanobbing project feral fauna control program. The program has been carried out and adapted over time since first being introduced by DEC-Cliffs, circa 2006. The program covers the Carina and J4 project areas, as well as Koolyanobbing, Windarling/Deception, and recently Parker Range.

Vernon Farming are currently contracted to undertake feral fauna control and allocate 3 days a month at the project to control feral cats, rabbits, wild dogs and other large herbivores. Ad hoc sightings are also notified to Vernon Farming, to mobilise and bait the identified area. The animal control and baiting statistics for the period of the implementation report are provided below, in **Table 3 and Table 4**.

Fauna control numbers show relative stability from 2023 to 2024 with some variations. Feral dog controls increased from 5 to 6, and feral cat controls increased from 14 to 18. Feral fox and large feral herbivore (camels) controls remained constant at 3 each year. Monthly patterns indicate higher feral cat controls in March and August, while other controls were more sporadic. Overall, cat controls increased slightly, while other measures remained stable **Figure 3**.

In 2024, MinRes began deploying Felixers at various sites in the Yilgarn. Currently, seven Felixers are in place across the Koolyanobbing site as part of a trial. Camera traps have been set up to collect data on high-traffic areas for feral cats and identify hotspots. A similar management program is being considered for future deployment at the Carina and J4 sites.

Further review of the Feral Animal management actions is provided in **Table 5**.

Table 3 Feral Fauna Control Statistics

Month	Dogs		Cats		Fox		Large Herbivores	
	2023	2024	2023	2024	2023	2024	2023	2024
January		1	2	1				1
February	1		1	1			2	
March		1		3				1
April			2	2				
May	1		1	1	1			
June				1		1		
July			1	2	1	1		
August		1	1	3	1			
September	2	2	2	2				
October			2	1		1		
November	1	1					1	
December			2	1				1
Total	5	6	14	18	3	3	3	3

Table 4 Approximate Number of Baits Deployed

Month	Koolyanobbing		Windarling/ Deception		Mt Jackson		Parker Range		Carina	
	2023	2024	2023	2024	2023	2024	2023	2024	2023	2024
January	4	2	3	2	3	2	2	2	2	2
February	2	2	3	2	4	2	2	2	3	2
March	2	3	4	3	3	3	2	2	2	3
April	3	4	3	3	3	3	3	2	2	3
May	3	4	3	3	4	3	3	2	2	3
June	3	3	3	4	4	4	2	3	3	3
July	4	3	4	5	4	3	3	3	3	4
August	4	4	4	3	4	2	3	2	3	3
September	4	4	4	3	5	4	3	2	3	4
October	5	4	4	4	5	2	2	3	2	3
November	4	4	4	3	4	3	2	3	2	2
December	3	4	3	3	4	2	2	2	2	2
Total	41	41	42	38	47	33	29	28	29	34

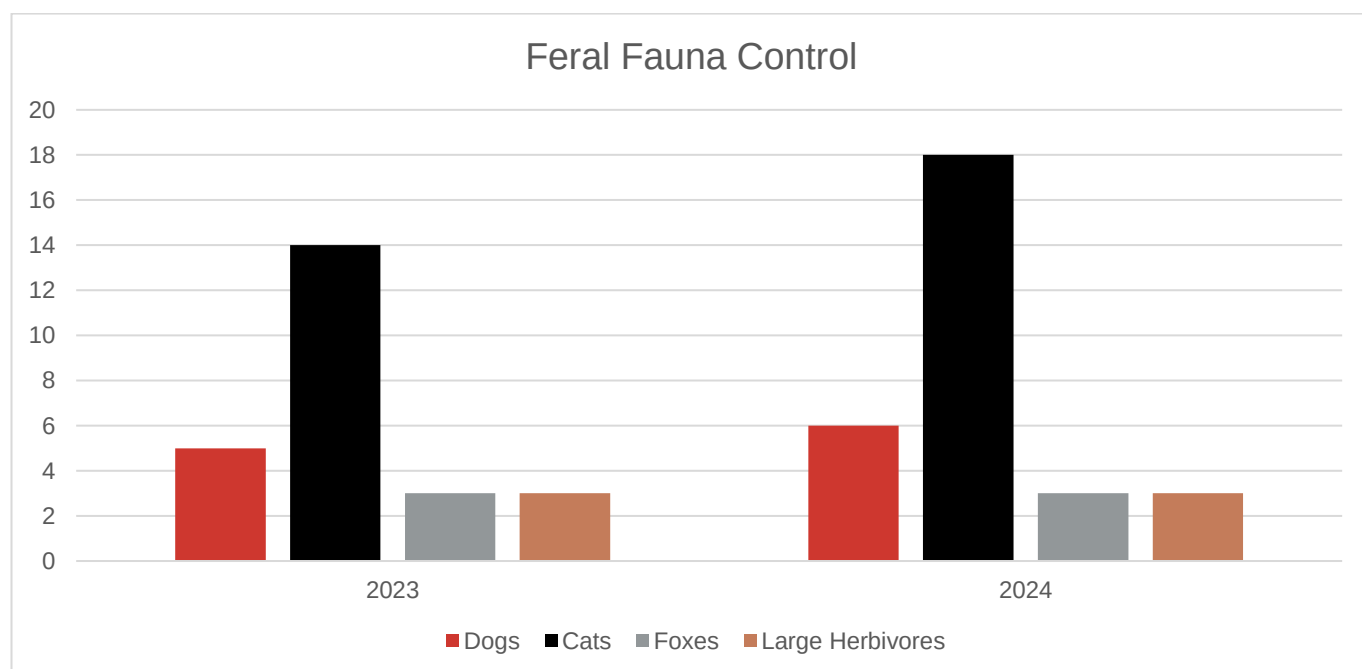


Figure 3 Feral Fauna Control Program Statistics

Table 5 Feral Animal Management Actions

PEMP Management Action	Implementation Review
Environmental Induction to provide information on introduced predators and pest species, discouragement of feeding of fauna and protection of native fauna.	All employees, contractors and visitors must complete site induction which includes an environmental component. The environmental component includes information on introduced predators and pest species, discouragement of feeding of fauna and protection of native fauna.
Waste to be placed in covered bins, collected regularly and transferred to the landfill.	All bins are covered and collected as required, no longer than one week without collection. As there is currently no landfill in use at the project, and there is minimal waste production through reduced operations, the waste is collected and transported to the adjacent Koolyanobbing Operations landfill.
Fencing to be maintained around the landfill.	There is currently no landfill area active at the project.
Fencing to be maintained around water holding facilities containing stock quality or better within the project area.	All water ponds/dams are appropriately fenced. Regular inspections of the water holding facilities by the environment team ensure any damage to fences are repaired.
Implement system to record and quantify introduced species.	The site fauna register is used to record all fauna sightings reported to the environment department, including feral animals. The environment team regularly distribute material regarding reporting feral animal sightings, and hold toolbox talks with teams as required to ensure sightings are reported.
Implement feral animal control program if numbers of feral animals increase significantly (currently use local pastoralist).	During the operational pause, Polaris are continuing feral fauna control measures under the greater Koolyanobbing Project feral fauna control program. Additionally, Polaris maintain a camera trapping program in conjunction with the feral fauna control program to monitor feral species on the lease.

2.3 Disturbance and Vegetation Clearing Management Provision

The key provisions of Disturbance and Vegetation Clearing Management include:

- Implement Land Activity Procedure
- All vehicles, plant and equipment restricted to within the previously disturbed areas and approved transport corridors.

Disturbance and vegetation clearing at the project is managed under the Land Activity Permit (LAP) Procedure. All personnel are provided this mandatory training on the procedure as part of their Site Induction training. The training highlights that no ground clearing can be carried out unless an approved LAP is in place. Guidance on the application, review, approval, mark out, and adherence to undertaking any disturbance and vegetation clearing is provided in the LAP. The environment team regularly inspect LAP work areas to ensure compliance with the conditions of the permit.

As the project pits are in operational pause, and further activity is carried out on existing infrastructure, further clearing works are expected to be minor and infrequent. During the reporting period, one primary clearing activity was completed, covering 1.87 hectares for the construction of two service bays for the autonomous truck trials. All disturbance activities were approved under respective LAPs, pegged by the Survey team and signed off by the Environment team, and final closeout inspections were completed after disturbance was carried out.

Following the approval of *Mining Act 1978* Mining Proposal Reg ID: 117948 on 20th October 2023, preparatory activities were undertaken to resume mining at J4. These activities included site clearing, the re-establishment of infrastructure, the pre-stripping of waste rock from the cutback area, and the deposition of this material on the J4 West waste rock landform. During the brief operational phase of J4, a total of 12.893 hectares of vegetation was cleared within the MS988 Development Envelope. Mining at J4 ceased in June 2024 after the announcement that the greater Yilgarn Operations would enter an operational pause, effective 31 December 2024.

Following an audit of stockpiled topsoil in 2022, recommendations including the placement of topsoil signage across the project area in 2023 were implemented. These signs were installed to clearly designate the location of these stockpiles, ensuring compliance with project requirements and improving overall topsoil management.

Further review of the Disturbance and Vegetation Clearing management actions is provided in **Table 6**.

Table 6 Disturbance and Vegetation Clearing Management Actions

PEMP Management Action	Implementation Review
Review proposed works and existing clearing to maximise utilisation of previously disturbed areas.	All submitted spatial data is assessed against current disturbance footprint, Ministerial Statement boundary, and other relevant approval layers to maximise utilisation of previously disturbed areas when considering new clearing. Minor ground clearing was undertaken during the reporting period, primarily for the construction of two service bays at near Carina Pit.

PEMP Management Action	Implementation Review
Early stage planning to minimise footprint required for infrastructure and mining landforms.	With the project experiencing a pause in operations, there is minimal further disturbance expected as the operations footprint is already established. During the operational phase of J4 mining, all clearing was carried out under the latest Mining Proposal (Reg ID: 117948) which falls within the development envelope of the approved MS988. Additional activities supporting the proposal occurred within existing disturbance areas across the broader project tenure and boundaries defined by various miscellaneous licenses, held by Polaris Metals. Clearing activities undertaken following the approval of the Mine Proposal included: • Expansion (cutback) of the J4 pit to the east and the waste rock landform to the west • Clearing of pads for hydrological drilling • Clearing for dewatering infrastructure All clearing data is assessed and presented in the MS988 ACAR, which was submitted on 24/01/2025.
Implement Land Activity Permit Procedure.	The Land Activity Permit (LAP) Procedure is in place across the project for all proposed disturbance activity. Disturbance applications are managed by the Approvals Management System (AMS) to ensure all approved works flow through to completion and any closure requirements are carried out.
Trim vegetation by hand where only a portion is affected by works. For example, if the trunk of a tree is outside the clearing boundary.	Clearing of large trees is avoided where possible for all LAPs approved for the project. Where possible disturbance footprints within the LAP will be redesigned to ensure trees can be avoided in clearing activity.
Vehicles, plant, and equipment restricted to within the clearing limits.	Site Induction training for all personnel includes information on clearing activity, and vehicle, plant, and equipment restrictions. Any vehicle activity outside of clearing limits constitutes a reportable incident to be investigated by the site management team, with appropriate actions taken. No such incidents were identified in the reporting period.
Observers and spotters will be used when working near sensitive sites, e.g., near Priority flora, or when clearing boundaries may not be readily visible (for example due to dense vegetation).	Where sensitive sites are identified in proximity to a LAP application, further measures will be identified to ensure no risks to flora. This will include spotters for sensitive areas, survey demarcation, or additional controls when clearing boundaries may not be readily visible. No disturbance works were undertaken near sensitive sites during the reporting period.

PEMP Management Action	Implementation Review
Environmental Induction to provide information on Land Activity Permit.	Site Induction training for all personnel includes information on LAP procedure. Further clearing inductions are provided to personnel prior to undertaking clearing works, and each operator must be signed off before they can carry out the work.
Recover topsoil and stockpile to a maximum of 2 m to preserve the soil physical/chemical properties and seed bank. Where required, recover subsoil and stockpile to a height of 4 m.	Where topsoil stockpiling is required as part of a LAP, location, height of stockpiles, and other requirements are included as conditions that must be agreed to by the applicant.
Signpost stockpiled topsoil and subsoil to prevent accidental use or degradation of soil resources.	Topsoil stockpile information is recorded by the environment department to ensure appropriate signage is maintained, and material quality analysis is completed regularly to ensure degradation of soil resources does not occur. The Topsoil Stockpile reconciliation works conducted in the previous reporting period found the majority of stockpiles to have no signposting. Following this topsoil signage was installed in 2023 throughout the project area. These signs were installed to clearly identify the location ensuring compliance with project requirements.

2.4 Access Management Provisions

The key provisions of Access Management include:

- Block off minor tracks that access the project site in consultation with Department of Biodiversity Conservation and Attractions (DBCA) Kalgoorlie
- The access road to the mine will be signposted and all visitors are to report to the mine office

Access management has remained relatively consistent across the report period, with signage in place to ensure public safety is maintained in the vicinity of the project, primarily through 'Danger Active Mine-site No Entry' and 'Reduce Speed' signage where appropriate.

Further review of Access management actions is provided in **Table 7**.

Table 7 Access Management Actions

PEMP Management Action	Implementation Review
Install 'Danger Active Mine-site No Entry' signs at access points.	Signs are installed at access points to the mine as required.
Traffic management chicanes used on higher traffic public tracks to reduce vehicle speed leading up to active haul roads.	Traffic management is implemented for all public tracks to reduce vehicle speed leading up to active haul roads, including reduce speed signage, chicanes, any other appropriate methods.
Minor tracks that access the project site will be blocked off, in consultation with DBCA Kalgoorlie.	Where minor access tracks are identified to connect to the project site, they will be blocked off in consultation with DBCA.
The access road to the mine will be signposted and all visitors are to report to the mine office.	Access road to the mine is signposted and visitors are instructed to visit the mine office before entering any active areas.

2.5 Fire Management Provisions

The key provisions of Fire Management include:

- Implement hot work permit system
- On-site emergency response team on site and trained

Fire Management is primarily governed at the project under the Yilgarn Bushfire Management Plan. The latest revision of the plan was finalised in April 2023. The purpose of the plan is to detail the risks and strategy for prevention, preparedness, response, and recovery from bushfires across the Yilgarn operations mining lease.

The prevention strategy of the plan is developed to minimise the risk of fire through the management of key risk areas, including:

Bushfire assessment, pre-season inspection conducted by Emergency Service Officers to ensure adequate preparations have been made and required action plans are developed,

Hot works permits, ensure all hot works are carried out within hot work areas established in workshops with dedicated risk assessment, hazard and control measures necessary to prevent fire events,

- Designated smoking areas, to ensure risk of smoking is controlled. Designated areas include cigarette butt disposal containers, signage and require firefighting equipment. A strict no smoking policy outside these areas.

Due to the high level of risk associated with the project, installed firebreaks are permitted to be maintained year-round, under an approved LAP. In certain circumstances, under approval from the Site Senior Executive, and Shire of Yilgarn further clearing may be approved when a bushfire appears imminent.

Further review of the Fire management actions is provided in **Table 8**.

Table 8 Fire Management Actions

PEMP Management Action	Implementation Review
Environmental Induction to provide information on the prevention and management of fires.	Site Induction training for all personnel includes information on the prevention and management of fires.
Firefighting equipment maintained in buildings and vehicles.	Firefighting equipment is maintained in an ongoing basis through regular inspections of work areas, administration offices, and vehicles.
Flammable materials appropriately stored and segregated from ignition sources.	Flammable materials are stored in designated cabinets, with relevant Material Safety Data Sheets (MSDS) on hand and updated at minimum every 5 years. Inspections are regularly conducted by both the environment and health & safety teams across the project to ensure flammable materials are stored appropriately and segregated from ignition sources.
General mine vehicles not permitted to leave access tracks or cleared areas.	Site Induction training for all personnel includes information on the requirement for all mine vehicles to remain on access tracks or cleared areas.
Cigarette smoking restricted to designated smoking areas with appropriate disposal facilities.	Smoking is restricted to designated areas across the project, with appropriate disposal facilities available for used cigarettes.
Fire breaks maintained around infrastructure.	Fire breaks are regularly maintained around infrastructure. The Yilgarn Operations Bushfire Management Plan provides guidance for the ongoing management of firebreaks in the project.
Implementation and adherence with a hot work permit system.	Hot works permit system is in place to ensure all relevant works are undertaken in adherence to the hot work permit. Site Induction training for all personnel includes information on Critical Risk Management, including hot work permits.
Induction includes information re fire safety and is provided to all personnel.	Site Induction training for all personnel includes information on fire safety, including prevention and management of fires, general vehicle requirements, fire breaks, hot work permits, and other information as required.
Emergency response team on site during operations.	The Emergency Response Team (ERT) is on site during operations. The ERT maintained presence on site during the report period and have been building the number of team members by training personnel who nominate to join the team throughout the report period.

PEMP Management Action	Implementation Review
Up to date fire preparedness and evacuation plan and ERT regularly trained to implement plans.	ERT training drills are organised on a weekly basis. ERT members are also required to complete their Cert 3 in Mines Rescue. Bushfire Preparedness inspections are regularly completed by the OHP Manager and ESO Officer.

2.6 Saline Dust Suppression Water Management Provisions

The key provisions of Saline Dust Suppression Water Management include:

- Saline water pipelines located within bunds
- Spray bar calibrated to road width and appropriate pressure to reduce overspray
- Maintain 300mm freeboard in turkeys nest
- Pre-start inspections and scheduled maintenance of water carts

Saline dust suppression water management is implemented to prevent the degradation or loss of native vegetation and flora, by leak or spill of saline water, from water management infrastructure, or from overspray of saline water used for dust suppression.

Minimal dust suppression activity is carried out at the project, as all Pits has paused operations, and the Carina-Jackson Haul Road is bituminised. Dust suppression is carried out at the Carina Southern Operations, primarily within the ROM and processing areas.

All saline water pipeline infrastructure went unchanged during the report period, with regular inspection and maintenance as required the primary activity. Infrastructure is constructed according to engineering requirement, including to maintain 300mm of freeboard in turkeys' nests, pipes located within bunds, etc.

During the reporting period, four (4) separate occurrences of Turkey's Nest (TN1) overflow were recorded on 15 November 2023, 12 February 2024, 20 October 2024, and 29 November 2024 respectively. In each instance, saline water dispersed into the surrounding native, vegetated areas. Following the initial overflow event, the impacted vegetation area was GPS-surveyed, and vegetation condition assessment points were established. Photo monitoring and condition rating were conducted monthly over the subsequent 12 months to identify any potential impacts on vegetation health. To date, no negative impacts or declines in vegetation health have been observed.

Further review of the Saline Dust Suppression Water management actions is provided in **Table 9**.

Table 9 Saline Dust Suppression Water Management Actions

PEMP Management Action	Implementation Review
Saline water pipelines located within bunds.	All saline water pipelines and relevant infrastructure are located within bunds.
Saline water or hazardous materials pipelines incorporate isolation valves at appropriate intervals.	Isolation valves are installed at appropriate intervals along the saline water pipelines.
Catch pits or sumps constructed along above ground saline water or hazardous materials pipeline corridors maintained to collect leaks or spillage.	Sumps are installed along the saline water pipelines to collect leaks or spillage.

PEMP Management Action	Implementation Review
Regular inspections and maintenance of pipelines and water holding facilities.	Regular inspections are carried out on pipelines and water holding facilities as part of ongoing inspections completed by the environment and non-process infrastructure teams. During the reporting period, four (4) Turkey's Nest (TN1) overflows occurred on 15/11/2023, 12/02/2024, 20/10/2024, and 29/11/2024, dispersing saline water into surrounding vegetated areas. The impacted areas were GPS-surveyed, with monthly photo monitoring and condition assessments conducted for 12 months. No negative impacts on vegetation health have been observed.
All pipelines, bunds and storage facilities will be designed to required engineering specifications (e.g. liners).	All pipelines, bunds and storage facilities are designed and installed to meet relevant engineering specifications.
Decommission saline water holding facilities when not in use.	Any unused saline water holding facilities are decommissioned when not in use for an extended period. No infrastructure was decommissioned during the report period.
Spills are cleaned up appropriately if they occur.	Spill kits are available in all workshop and admin areas. Spill kits are also available on appropriate vehicles, such as service kits. Site Induction training for all personnel includes information on spill management, including reporting all spills to the environment department to assess further clean up requirements.
Implement an incident reporting system and train personnel in its use.	INX is used across operations as an incident reporting system and all personnel are trained in its use.
Calibrate water trucks spray bar to road width only.	Water truck spray bars are calibrated to road width.
Manage water pressure in the spray bar on tracks and narrower roads to minimise likelihood of overspray.	Water pressure is managed to ensure overspray activity is minimised. Roads are bunded to further prevent likelihood of overspray.
Ensure water truck operators are appropriately trained and competent.	All water truck operators must complete competency training and assessment prior to operating water trucks.
Pre-start inspections and scheduled maintenance of water carts.	Pre-start inspections are carried out at shift change with records and service requirements provided to the Asset Management Group. Regular maintenance is carried out on equipment as required.
Dust suppression water to be applied at the minimum rate required.	Dust suppression techniques are demonstrated to water cart operators to minimise water use as part of competency training and assessment for personnel prior to operating water trucks.

PEMP Management Action	Implementation Review
Wet areas not to be resprayed until dry.	All water truck operators must complete competency training which includes ensuring wet areas are not to be resprayed until they are dry.
Maintain minimum freeboard of 300 millimetres (mm) within turkeys nest and other saline water ponds/dams at all times.	Daily checks of turkeys nest and other saline water ponds/dams ensure that a minimum freeboard of 300 mm is maintained at all times. During the reporting period, four (4) Turkey's Nest (TN1) overflows occurred on 15/11/2023, 12/02/2024, 20/10/2024 and 29/11/2024, dispersing saline water into surrounding vegetated areas. The impacted areas were GPS-surveyed, with monthly photo monitoring and condition assessments conducted for 12 months. No negative impacts on vegetation health have been observed.
Operator to remain present during filling of turkeys nest and other saline water ponds/dams.	Operators are present only during the initial filling of the Turkey's Nest, while ongoing dewatering activities are monitored through float levels or telemetry systems capable of automatically shutting down pumps. During water cart filling from the Turkey's Nest standpipe, operators are on-site to monitor and prevent any potential overflow.

2.7 Surface Water Flow Management

The key provisions of Surface Water Flow Management include:

- Installation of culverts and flood ways
- Cross-flow haul road drains will be maintained to minimise alteration and impacts on the natural surface water drainage systems

Project infrastructure is inspected regularly to ensure infrastructure integrity, and annual vegetation condition survey is conducted to assess any potential impacts on the surrounding environment from effects of surface water flow due to the project footprint.

Further review of the Surface Water Flow management actions are provided in **Table 10**.

Table 10 Surface Water Flow Management Actions

PEMP Management Action	Implementation Review
Installation of culverts and flood ways.	Culverts and flood ways are installed across operations where required.
Cross-flow haul road drains will be maintained to minimise alteration and impacts on the natural surface water drainage systems.	Inspections to determine infrastructure integrity and maintenance is carried out as required.

3. DISCUSSION

This implementation report covers the period 28 January 2023 to 27 January 2025. During the report period management actions were carried out largely in accordance with the Carina J4 Project Environmental Management Plan.

During the reporting period, four (4) Turkey's Nest (TN1) overflows occurred on 15 November 2023, 12 February 2024, 20 November 2024, and 29 November 2024, dispersing saline water into surrounding vegetated areas. The impacted areas were GPS-surveyed, with monthly photo monitoring and condition assessments conducted for 12 months (from 15th of November 2023). No negative impacts on vegetation health have been observed. In response to these incidents, a review of telemetry and supporting infrastructure was undertaken, resulting in system improvements to enhance high level alarms/ notifications.

All four events were reported to DWER under a Section 72 notification for the unauthorized discharge of saline water into the surrounding vegetation, in accordance with the conditions of Part V Licence L8837/2014/1.

No other incidents or events have been identified as reportable under this implementation report.

I trust this report provides you with sufficient information on the implementation of the Project Environmental Management Plan over the past 2 years. Please contact the Yilgarn Environmental Department via yilgarn.environmental@piha.com.au if you have further queries in relation to the report.

Regards,



John Brazil

Mining Manager – Yilgarn

4. APPENDICES

Appendix A – Carina J4 Project Environmental Management Plan (PEMP, Rev5)

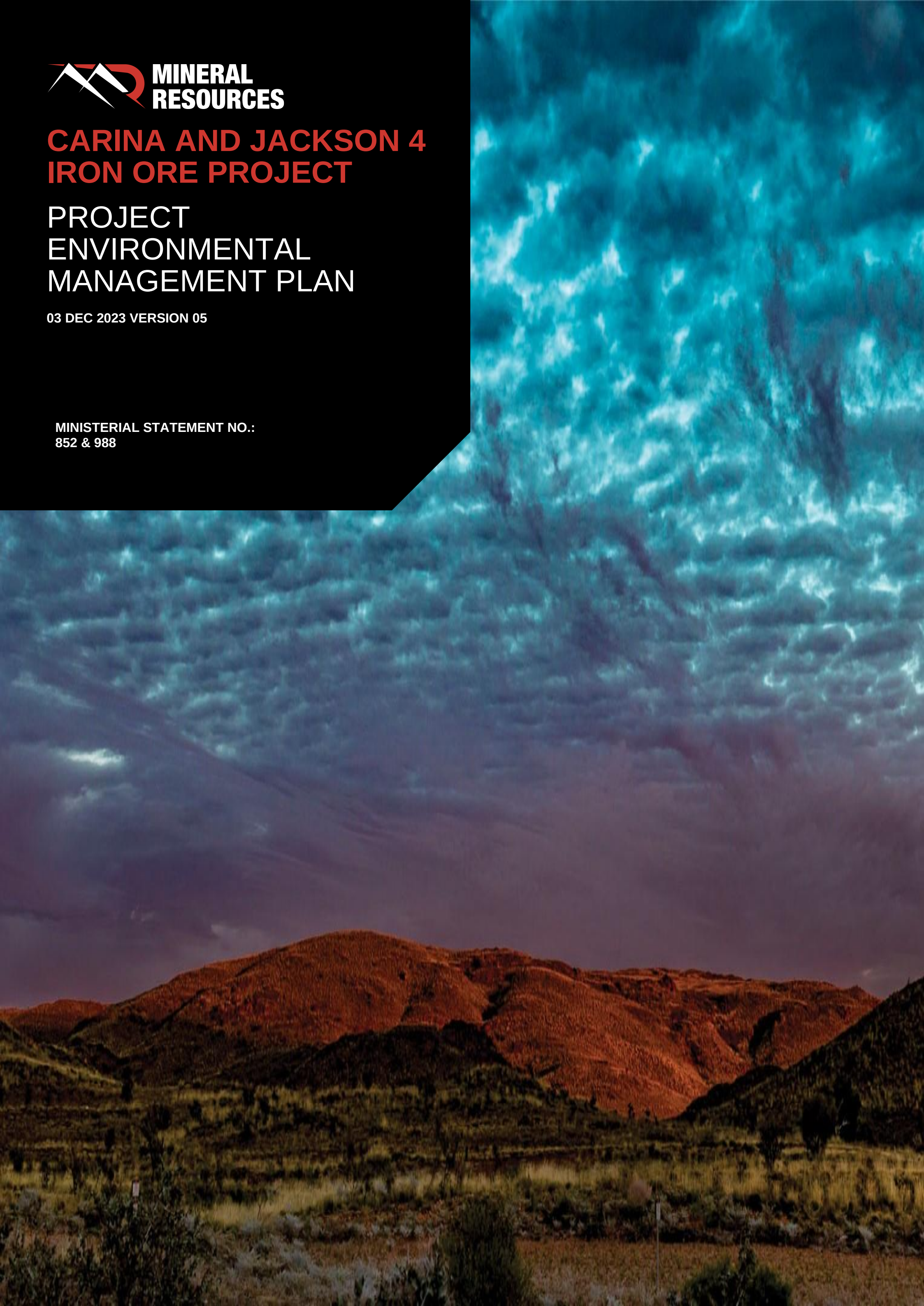


CARINA AND JACKSON 4 IRON ORE PROJECT

PROJECT ENVIRONMENTAL MANAGEMENT PLAN

03 DEC 2023 VERSION 05

MINISTERIAL STATEMENT NO.:
852 & 988



DOCUMENT INFORMATION

Contact

Graham Morgan
General Manager Yilgarn
E. graham.morgan@mrl.com.au
P. +61 8 9315 8647

20 Walters Drive, Osborne Park
Western Australia 6017

Postal address
Locked Bag 13, Osborne Park DC
Western Australia 6916

Revision History and Document Review

Rev	Issue Date	Prepared by	Reviewed By	Approved By
Draft	03/04/2020	Leo Boynton (MBS)	Elizabeth Mason (MBS)	Elizabeth Mason (MBS)
00	30/04/2020	Elizabeth Mason (MBS)	Kristy Sell (MBS)	Kristy Sell (MBS)
01	06/07/2020	Leo Boynton (MBS)	Elizabeth Mason (MBS)	Elizabeth Mason (MBS)
02	24/07/2020	Kyle Hodgson	Craig Holness	Craig Holness
03	29/07/2020	Kyle Hodgson	Craig Holness	Craig Holness
04	03/12/2020	Kyle Hodgson	Craig Holness	Craig Holness
05	03/12/2023	Erol Ozoglu	Nick Learoyd	Matthew Blacklow

Approvals

Version	Approval Requirements and Regulatory Agency	Approved by	Date
04	Department of Water and Environmental Regulation	Hans Jacop	08/01/2021
05	Department of Water and Environmental Regulation	TBA	

Acknowledgement of Country

MinRes is committed to reconciliation and recognises and respects the significance of Aboriginal and Torres Strait Islander peoples' communities, cultures, and histories. MinRes acknowledge and respect Aboriginal and Torres Strait Islander peoples as the traditional custodians of the land.

1. EXECUTIVE SUMMARY

This Project Environmental Management Plan (PEMP) is submitted by Polaris Metals Pty Ltd (Polaris) for the overarching management of the Carina and Carina Extended (Carina), and Jackson 4 (J4) projects (the Project) approved under Ministerial Statements (MS), MS 852 and MS 988, respectively. The two mines operate in close proximity, in similar environments and have similar MS Conditions in relation to environmental management, therefore the administration of the two projects is appropriate under this PEMP.

Table ES-1 and **Table ES-2** present the relevant EPA Factors, condition objectives and environmental management target/s to assess compliance with and efficacy of the conditional environmental objective that must be met through implementation of this Condition PEMP.

Table ES-1: PEMP Purpose, Environmental Factors and Conditions Objectives for MS 852

Title of Proposal	Carina Iron Ore Project
Proponent	Polaris Metals Pty Ltd
Ministerial Statement	852
Purpose of this Condition EMP	The revised Carina and J4 PEMP (this document) are submitted to fulfil the requirements of Conditions 9-1 and 9-3 of MS 852.
EPA's Key Factors and Environmental Objectives	Flora and Vegetation: To protect flora and vegetation so that biological diversity and ecological integrity are maintained. Terrestrial Fauna: To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.
MS 852 Conditions	9-1: Prepare Project Environmental Management Plan to ensure that the adverse impacts from mining and associated activities do not unnecessarily threaten conservation values within the mining lease and prevent impacts outside of the mining lease. 9-3: The proponent shall review and revise the Project Environmental Management Plan required by condition 9-1 at intervals not exceeding three years. 9.4 The proponent shall report to the CEO on implementation of the Project Environmental Management Plan every two years from the date of commencing ground disturbing activities. 9.5 The proponent shall make the Project Environmental Management Plan required by condition 9-1 publicly available in a manner approved by the CEO.
Key Provisions	As there are several provisions for each of the PEMP aspects, a summary of key provisions is provided. Induction and training are a common provision across the management aspects. Hygiene Management: • Weed hygiene certificate for high-risk operations. • Annual Spring weed survey. • Targeted weed survey and chemical control during March – September period. • Annual assessment of dieback by an accredited assessor. Feral Animal Management: • Feral animal attractants fenced, i.e., landfill, water sources. • Record feral animal sightings. • Annual camera trapping program. Disturbance and Vegetation Clearing Management: • Implement Land Activity Permit procedure. • All vehicles, plant and equipment restricted to within the clearing limits.

	Limit Unauthorised Access: - Block off minor tracks that access the project site in consultation with Department of Biodiversity Conservation and Attractions (DBCA) Kalgoorlie. - The access road to the mine will be signposted and all visitors are to report to the mine office. Fire Prevention and Response: - Implement hot work permit system. - On-site emergency response team on site and trained. Saline Dust Suppression Water Management: - Saline water pipelines located within bunds. - Spray bar calibrated to road width and appropriate pressure to reduce overspray. - Maintain 300mm freeboard in turkeys' nest. - Pre-start inspections and scheduled maintenance of water carts. Reporting - Report to the implementation of the Project Environmental Management Plan every two years. - Project Environmental Management Plan to be made publicly available.
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Table ES-2: PEMP Purpose, Environmental Factors and Conditions Objectives for MS 988

Title of Proposal	Jackson 4 (J4) Iron Ore Project
Proponent	Polaris Metals Pty Ltd
Ministerial Statement	988
Purpose of this Condition EMP	The revised Carina and J4 PEMP (this document) are submitted to fulfil the requirements of Conditions 6-2 of MS 988.
EPA's Key Factors and Environmental Objectives	Flora and Vegetation: To protect flora and vegetation so that biological diversity and ecological integrity are maintained. Landforms: To maintain the variety and integrity of significant physical landforms so that environmental values are protected.
MS 988 Conditions	6-2: The proponent shall ensure that the design, construction, and operation of the Haul Road does not impact the surrounding environment and existing infrastructure from the effects of surface water flow impedance, dust, use of saline water, weed encroachment and fire.
Key Provisions	As there are several provisions for each of the PEMP aspects, a summary of key provisions is provided. Induction and training are a common provision across the management aspects. Hygiene Management: - Weed hygiene certificate for high-risk operations. - Annual Spring weed survey. - Targeted weed survey and chemical control during March – September period. - Annual assessment of dieback by an accredited assessor. Disturbance and Vegetation Clearing Management: - Implement Land Activity Permit procedure. - All vehicles, plant and equipment restricted to within the clearing limits. Fire Prevention and Response: - Implement hot work permit system. - On-site emergency response team on site and trained. Saline Dust Suppression Water Management: - Saline water pipelines located within bunds.

- Spray bar calibrated to road width and appropriate pressure to reduce overspray.
- Maintain 300mm freeboard in turkeys' nest.
- Pre-start inspections and scheduled maintenance of water carts.

Surface Water Flow Management:

- Installation of culverts and flood ways
- Crossflow haul road drains will be maintained to minimise alteration and impacts on the natural surface water drainage systems.

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ABBREVIATIONS

Definition	Definition
DEC	Department of Environment and Conservation
DBCA	Department of Biodiversity, Conservation and Attractions
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
DMIRS	Western Australian Department of Mines, Industry Regulation and Safety
DWER	Western Australian Department of Water and Environmental Regulation
ED	Environment Department
EMP	Environmental Management Plan
EMS	Environmental Management System
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
EP Act	<i>Environmental Protection Act 1986</i>
EPA	Western Australian Environmental Protection Authority
GL	Gigalitre
GLpa	Gigalitre per annum
ha	Hectare
km	Kilometre
m	Metre
MCP	Mine Closure Plan
Mining Act	<i>Mining Act 1978 (WA)</i>
MinRes	Mineral Resources Limited
MS	Ministerial Statement
Mt	Million tonnes
Mtpa	Million tonnes per annum
No.	Number
P	Priority
Polaris	Polaris Metals Pty Ltd
Proponent	Mineral Resources Ltd
RIWI Act	<i>Rights in Water and Irrigation Act 1914</i>
LAP	Land Activity Permit
SRE	Short-range Endemic
T	Threatened
PEMP	Project Environmental Management Plan
WA	Western Australian

2. CONTEXT, SCOPE, AND RATIONALE

2.1 Project

The two projects are owned and operated by Polaris Metals Pty Ltd (Polaris) which is a wholly owned subsidiary of Mineral Resources Limited. Carina is located approximately 60 kilometres (km) northeast of Koolyanobbing and 100 km northeast of Southern Cross (**Figure 1**). J4 is approximately 70 km west of the Carina northern operations and is accessed via the Carina haul road. Both projects are within the Goldfields region of Western Australia. The Project areas consist of the below.

Carina (MS 852):

- Carina Northern Operations:
 - Two depleted open cut pits (Carina and Carina Extended).
 - Two Waste Rock Landforms (Carina and Carina Extended) – Currently under rehabilitation.
 - A Run of Mine (ROM).
 - Infrastructure area.
- A bitumen haul road, approximately 50 km in length links Carina to the Mt Walton Rail Siding which is connected to the trans Australian railway.
- Carina Southern Operations:
 - Accommodation camp.
 - East Jaurdi Aerodrome (Not approved under MS 852 and MS 988).
 - A ROM
 - Dry crushing and screening plant.
 - Stockyard with associated Stacker and Reclaimers.
 - Train loader and rail loop.
 - Associated support infrastructure (Offices, Laboratory, Workshops)

J4 (MS 988):

- Two depleted open cut pits (East and West Pit's).
- Two Waste Rock Landforms (East and West WRL's) – Currently under rehabilitation.
- A ROM.
- Infrastructure area (Office, workshop, magazine area and bulk explosives area decommissioned and removed from site.)
- A bitumen haul road, approximately 70 km in length.

The projects are located in the Coolgardie 2 Bioregion (COO2 – Southern Cross subregion) as defined by the Interim Biogeographical Regionalisation for Australia (IBRA). The region is east of the wheat belt and although it has a long history of pastoral, historic woodcutting, and mining land uses, it remains largely uncleared. Carina is approximately 20 km from both the existing Mt Manning Nature Reserve (to the north) and the Helena and Aurora Conservation Park (to the west), while J4 mine lies approximately 9 km south of a proposed Conservation and Mining Reserve (the ex. Mt Jackson lease) and 2.5 km south-west of the Mt Manning Helena and Aurora Conservation Park's south-west border. J4's haul road extends from the J4 ore body tracking south-east along shared infrastructure through just under 14 km of the southwest corner of the Helena and Aurora Conservation Park, into Unallocated Crown land and through approximately 8 km of the proposed extension of the Yilgarn conservation reserve system to connect to the north-south travelling Carina haul road (**Figure 1**).

The Carina project is located on the former Jaurdi Pastoral Station in the proposed extended Yilgarn conservation reserve system. The proposed Jaurdi Conservation Park is recognised for inclusion in the State's conservation reserve system based on landscape and biodiversity values which are currently poorly represented, including flora and fauna of conservation significance. The former Jaurdi pastoral station has not yet been converted into a Crown reserve, of any category nor vested in the Conservation Commission under the *Land Administration Act 1997*.

The areas are known for their biodiversity; however, the location of the project is not recognised as having the highest conservation significance (EPA Bulletin 1256) for A class reservation, and mining is considered compatible with both the existing and proposed land use.

The Carina project was referred to the West Australian Environmental Protection Authority (EPA) on 15 September 2008. On 3 November 2008, the EPA published its decision to assess the project at a Public Environmental Review (PER) level of assessment, with a four-week review period. The project was approved via the grant of Ministerial Statement 852 on 27 January 2011. A Section 46 application was made to remove Condition 5-2 of MS 852 and was approved via the grant of Ministerial Statement 957 on date 11 December 2013. The conditions of approval include several provisions for managing conservation values of the adjacent environment to be administered through a PEMP (Condition 9-1 and 9-3).

The J4 project was referred to the EPA on 23 December 2013 and was advertised for public comment from 7 to 13 January 2014. J4 was approved under Ministerial Statement 988 on 24 October 2014 which included conditions regarding the design, construction and closure of the haul road, and the management and mitigation of haul road related impacts to adjacent environmental values (Condition 6-2).

Table 1 Key Project Characteristics

Aspect	Description (MS 852)
Project	Carina
Components	Two open pits, two mine waste landforms and ancillary mine infrastructure.
Mineral resource	Direct shipping ore (DSO) – hematite / goethite.
Processing type	Dry crushing and screening.
Date of commencement	January 2011.
Life of mine	5 – 10 years.
Date of completion	Drill and blast mining at Carina ceased in May 2016 followed by Carina Extended which ceased in March 2018. Haulage of remaining stockpiles is on-going. East Jaurdi Aerodrome and Carina haul road is used to transport FIFO personnel to adjacent Koolyanobbing operations. Key infrastructure such as the Carina Village, Crusher and Train Load Out will be used to facilitate the export of ore from MRL's network of mines in the region.
Aspect	Description (MS 988)
Project	Jackson 4
Components	Two open pits, two mine waste landforms, ROM pad, ancillary mine infrastructure and haul road.
Mineral resource	Direct shipping ore (DSO) – hematite / goethite.
Processing type	Dry crushing and screening.
Date of commencement	January 2015.
Life of mine	5 years.
Date of completion	Drill and blast mining ceased in November 2017. Mining re-commenced in November 2023 for a 18-month period.

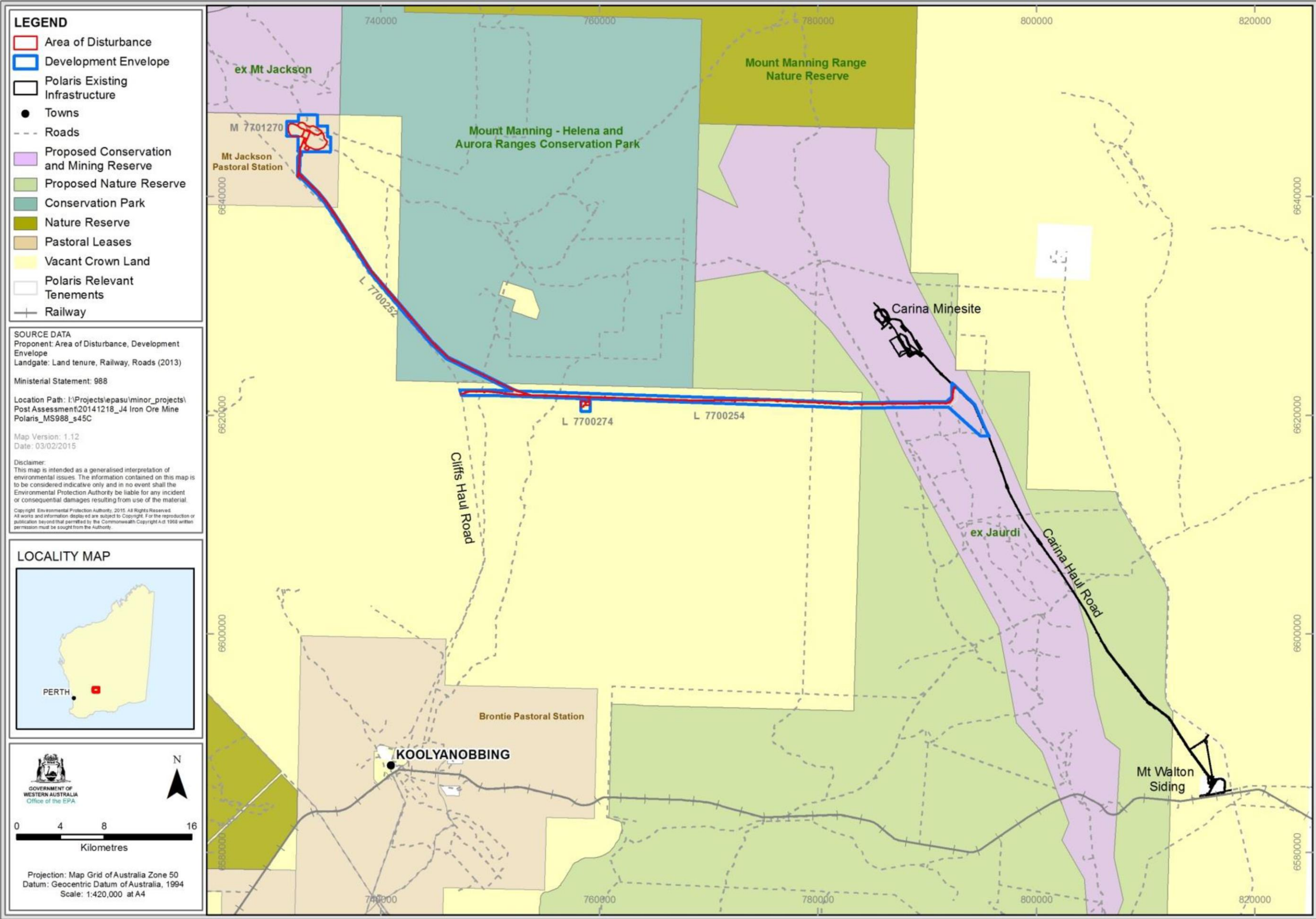


Figure 1: Carina and J4 Project Location

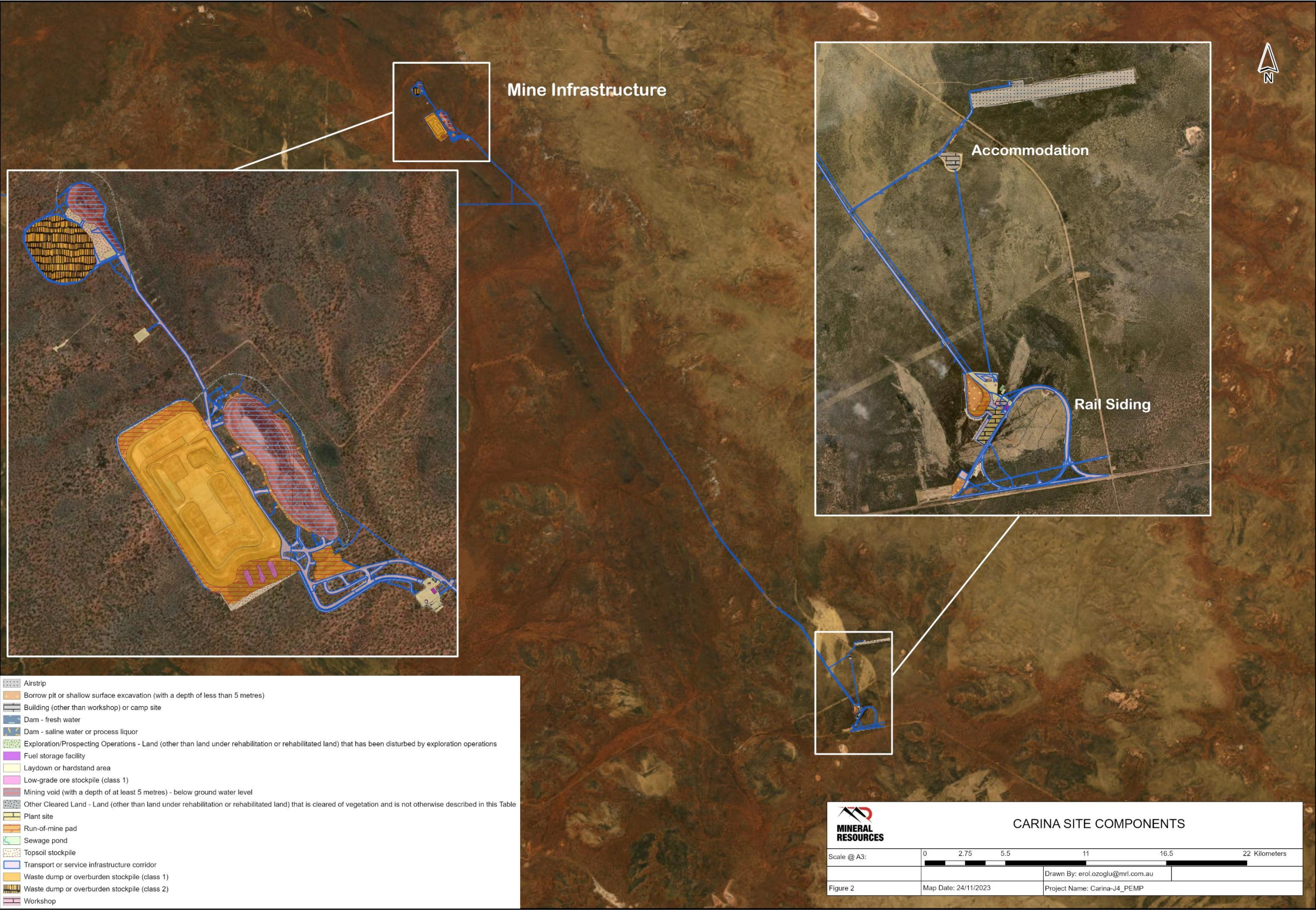


Figure 2: Carina Site Components

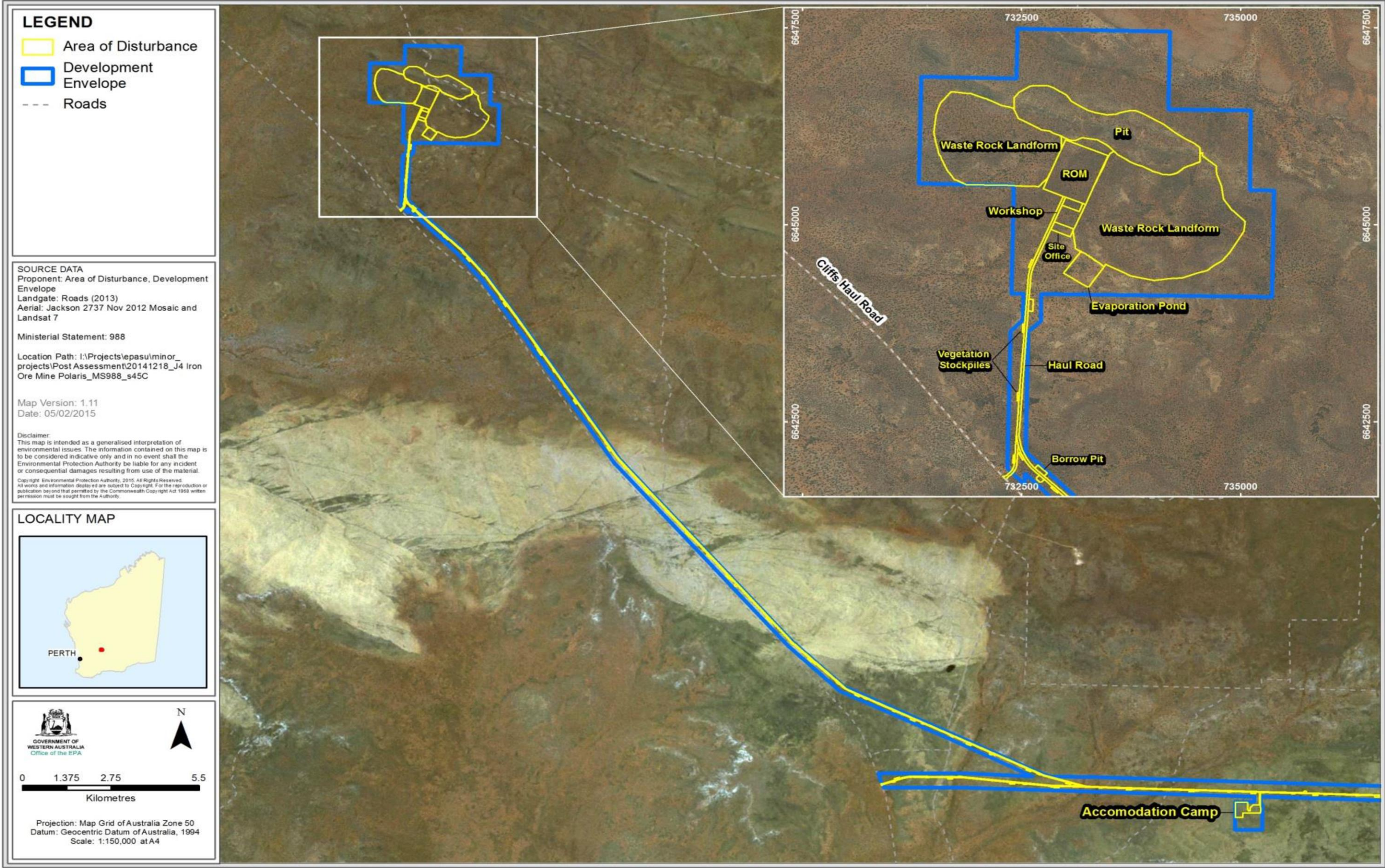


Figure 3: J4 Site Components

2.2 Purpose and Objectives

This Project Environmental Management Plan (PEMP) is submitted by Polaris Metals Pty Ltd (Polaris) to holistically manage the Carina and Carina Extended (Carina), and Jackson 4 (J4) projects (collectively referred to as the Project). These projects obtained approval under Ministerial Statements (MS), MS 852 and MS 988, respectively. Operating in close proximity and within similar environments, both mines are subject to comparable MS Conditions related to environmental management.

The purpose of the PEMP is to support the Project's Environmental Management System (EMS), by providing detailed management and mitigation measures that will be implemented to protect key environmental factors from potential direct and indirect impacts during construction and operation of the Project. The PEMP has been prepared in accordance with the State Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans (EPA 2020).

The overarching management objective for the Project under the Environmental Protection Act 1986 (EP Act) is to minimize direct and indirect impacts of the Project construction and operation activities on flora and fauna. This PEMP outlines the management actions, management targets, monitoring and contingency actions designed to meet the environmental objectives for the protection of the key environmental factor during the implementation of the Project (see Section 2.4). The purpose of the PEMP under the EP Act is to manage:

- Hygiene
- Feral animal
- Disturbance and vegetation clearing
- Access
- Fire
- Saline dust suppression and water
- Surface water flow

2.3 Key Environmental Factors

Key Environmental Factors have been identified by the EPA.

Carina:

- Terrestrial Fauna: EPA Objective - To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.
- Flora and Vegetation: EPA Objective - To protect flora and vegetation so that biological diversity and ecological integrity are maintained.

Jackson 4:

- Flora and Vegetation: EPA Objective - To protect flora and vegetation so that biological diversity and ecological integrity are maintained.
- Landforms EPA Objective: To maintain the variety and integrity of significant physical landforms so that environmental values are protected.

2.4 Condition Requirements

This revised PEMP is submitted in accordance with Condition 9-1, Condition 9-3, Condition 9-4 and Condition 9-5 of Ministerial Statement 852 and Condition 6-2 of Ministerial Statement 988. Details of the requirements of these Conditions are provided in **Table 2** and are addressed within this PEMP.

Table 2: Requirements of Relevant Conditions

No	Condition	Section in PEMP
Ministerial Statement 852		
9-1	Prior to ground disturbing activities the proponent shall prepare a Project Environmental Management Plan to the satisfaction of the DEC. The objectives of the plan are to ensure that the adverse impacts from mining and associated activities do not unnecessarily threaten conservation values within the mining lease and prevent impacts outside of the mining lease. The project environmental management plan will address:	Section 1
	- Hygiene management measures to prevent the introduction of weeds and dieback disease	Section 2.5.3.1.1 and Table 6 .
	- Management of feral animals.	Section 2.5.3.1.2 and Table 7
	- Company protocols to authorise disturbance and clearance of vegetation.	Section 2.5.3.1.3 and Table 8
	- Limiting and authorising access to areas within the mining lease.	Section 2.5.3.1.4 and Table 9
	- Fire prevention and response.	Section 2.5.3.1.5 and Table 10
	- Management and monitoring of saline water used for dust suppression.	Section 2.5.3.1.6
9-3	- The proponent shall review and revise the Project Environmental Management Plan required by Condition 9-1 at intervals not exceeding three years.	Section 6
9-4	- The proponent shall report to the CEO on implementation of the Project Environmental Management Plan every two years from the date of commencing ground disturbing activities.	Section 6
9-5	- The proponent shall make the Project Environmental Management Plan required by condition 9-1 publicly available in a manner approved by the CEO.	Section 6
Ministerial Statement 988		
6-2	The proponent shall ensure that the design, construction, and operation of the Haul Road does not impact the surrounding environment and existing infrastructure from the effects of surface water flow impedance, dust, use of saline water, weed encroachment and fire.	Section 2.5.4
	- Weed encroachment	Section 2.5.3.1.1 and Table 6
	- Fire	Section 2.5.3.1.5 and Table 10
	- Dust	Section 2.5.3.1.6
	- Use of saline water	Section 2.5.3.1.6 and Table 11
	- Surface water flow impedance	Section 2.5.3.1.7 and Table 12

2.5 Rationale and Approach

Results of baseline surveys, vegetation monitoring and a number of assumptions and uncertainties inform the management approach for meeting the environmental objectives stated in **Table 1** and **Table 2**. Key data which inform the rationale and management approach for meeting the environmental objectives are:

- Baseline flora and fauna surveys (Section 2.5.1.1 and 2.5.1.4).
- Baseline surface water flow assessment (Section 2.5.1.5).
- Results and observations from annual vegetation monitoring carried out to meet the requirements of Condition 5-3 of MS 852 (Section 2.5.1.2).
- Results and observations from annual vegetation monitoring carried out to meet the requirements of Condition 6-2 of MS 988 (Section 2.5.1.2).
- Assumptions and uncertainties from baseline surveys and monitoring (Section 2.5.2).

Results from baseline flora, vegetation and fauna surveys and previous rehabilitation outcomes, as well as key assumptions and uncertainties are documented in following sections.

2.5.1 Survey and Study Findings

2.5.1.1 Baseline Flora Studies

The Carina project is situated in the proposed Jaurdi Conservation Park and the J4 project is distributed in the Mt Jackson Pastoral Station. Both are located in the Southern Cross subregion (COO02) of the Coolgardie Bioregion (Department of the Environment and Energy 2016). The Southern Cross subregion is described as having a subdued relief, comprising gently undulating uplands dissected by broad valleys with bands of low greenstone hills and chains of saline playa-lakes (Cowan, Graham, and McKenzie 2001).

Vegetation in the Southern Cross subregion is described as diverse eucalypt woodlands (*Eucalyptus salmonophloia*, *E. salubris*, *E. transcontinentalis* and *E. longicornis*), rich in endemic eucalypts, which occur around the salt lakes, on the low greenstone hills, valley alluvials and broad plains of calcareous earths. The salt lake surfaces support dwarf shrublands of samphire. The granite basement outcrops at mid-levels in the landscape and supports swards of *Borya constricta*, with stands of *Acacia acuminata* and *Eucalyptus loxophleba*. Upper parts of the landscape are the eroded remnants of a lateritic duricrust yielding sandplains and breakaways.

Mallee (*E. leptopoda*, *E. platycorys* and *E. scyphocalyx*) and scrub-heath (*Allocasuarina corniculata*, *Callitris preissii*, *Melaleuca uncinata* and *A. beauverdiana*) occur on these uplands, as well as on sand lunettes associated with playas along the broad valley floors and sand sheets around the granite outcrops. The scrubs are rich in endemic acacias and Myrtaceae (Cowan, Graham, and McKenzie 2001).

Several flora and vegetation baseline studies have been carried out over Carina and J4, these are displayed in **Table 3**. Some have been targeted surveys or for drilling programs, while others have been detailed surveys. The surveys have mapped the entire mining tenement and haul road.

Table 3: Previous Flora and Vegetation Studies

Source	Published	Description
Mattiske Consulting Pty Ltd.	Oct 2007	Flora and vegetation survey of drill hole sites in exploration tenement E77/1115 Carina Prospect.
	Mar 2008	Flora and vegetation survey of proposed access route exploration tenement E77/1115 Carina Prospect.
	Mar 2008a	Flora and vegetation survey of infill drill sites in exploration tenement E77/1115 Carina Prospect.
	Jul 2008	Flora survey of the proposed gravel pit within exploration tenement E77/1115 Carina Prospect.
	Aug 2008	Flora and vegetation survey of proposed Carina transport route: Darrine siding.
	Sep 2008	Flora and vegetation survey of the Carina exploration lease area.
	Apr 2009	Declared rare and priority flora survey: Carina mine tenement M77.1244A.
	Oct 2009	Flora and vegetation survey of proposed Carina transport route: Carina mine to Mt Walton road siding.
	Oct 2012	Flora and vegetation survey of the J4 mine and haul road study area.
	Apr 2013	Flora and vegetation survey of the J4 mine and haul road study area.
Recon Environmental	Feb 2010	Carina iron ore project: Mt Walton siding vegetation. Report for Polaris Metals NL

Pre-disturbance vegetation mapping by Mattiske Consulting (2008a, 2008b, 2009) identified 35 vegetation communities at Carina, within the MS 852 project boundary. At J4, 28 vegetation communities were mapped within the MS 988 project boundary (Ecologia, 2014).

2.5.1.2 Project Flora and Vegetation Summary

Carina

Key results of the Carina vegetation and flora surveys are:

- Vegetation communities are broadly divided into two major groups:
 - A sclerophyllous Eucalypt woodland of *Eucalyptus salmonophloia* and *Eucalyptus salubris*, together with a range of other Eucalypt species, over an understorey composed predominantly of *Acacia* sp., *Eremophila* sp. and *Atriplex* sp.
 - Acacia dominated scrub and thicket communities.
- A total of 237 taxa from 103 genera and 45 families were recorded. These taxa are typical of the Coolgardie District.
- No Threatened Flora have been recorded in the project area.
- Eleven Priority taxa in total were identified, all of which were found in the haul road, siding and village areas. Two species were recorded in the mine area. Known Priority species in the project area are summarised in **Table 4**. The largest populations of Priority flora in the project area include:
 - 87 *Daviesia purpurascens* (P4) plants recorded in 22 separate locations. Regionally, approximately 850 plants are known outside the project tenements.
 - 330 *Grevillea georgeana* (P3) plants recorded in two separate populations.
- 14 weed species have been identified at the project since commencement (including baseline surveys), none of which are declared plants under the Biosecurity and Agricultural Management Act 2007 or are considered weeds of national significance.

- Surveys indicated the low relief ridge of the Carina deposit does not appear to contain the high level of diversity and endemism characterised by other surveys of some major BIF ranges in the Midwest and Yilgarn regions.

Jackson 4

Key results of the J4 vegetation and flora surveys are:

- 28 floristic community types are within the project footprint, with seven correlating to the BIF PEC.
- A total of 359 taxa from 179 genera and 57 families were recorded.
- No Threatened Flora have been recorded in the project area.
- 14 Priority taxa are known to occur within the project area. Known Priority species in the project area are summarised in **Table 4**.
- Neither floristic community types nor Priority flora are endemic to the disturbance footprint and are found outside of the project area.
- 7 weed species are known to occur in the project area, none of which are declared plants under the Biosecurity and *Agricultural Management Act 2007* or are considered Weeds of National Significance.

A list of total Priority Flora identified in the project areas are included below in **Table 4**.

Conservation values of the project and surrounding areas are shown in **Figure 1**.

Table 4: Priority flora species within project area

Project Area	Species	Status at time of Survey
Carina		
Mine	<i>Grevillea georgeana</i>	P3
	<i>Daviesia purpurascens</i>	P4
Haul Road, Accommodation Village and Siding	<i>Acacia adinophylla</i>	P1
	<i>Calytrix creswellii</i>	P1
	<i>Homalocalyx grandiflorus</i>	P1
	<i>Stylidium choreanthum</i>	P2
	<i>Acacia crenulata</i>	P3
	<i>Acacia formidabilis</i>	P3
	<i>Grevillea georgeana</i>	P3
	<i>Mirbelia ferricola</i> sp. (previously <i>M. sp. Helena & Aurora Range</i>)	P3
	<i>Lepidosperma lyonsii</i>	P3
	<i>Spartothamnella</i> sp. Helena & Aurora Range	P3
	<i>Daviesia purpurascens</i>	P4
Jackson 4		
Inside disturbance area	<i>Banksia arborea</i>	P4
	<i>Calytrix ?creswellii</i>	P3
	<i>Grevillea georgeana</i>	P3
	<i>Melichrus</i> sp. Bungalbin Hill (F.H. & M.P. Mollemans 3069)	P3
	<i>Neurachne annularis</i>	P3
	<i>Acacia crenulate</i>	P3

Project Area	Species	Status at time of Survey
Outside the disturbance area	<i>Baeckea sp. Bungalbin Hill (B.J. Lepschi & L.A. Craven 4586)</i>	P3
	<i>Beyeria rostellata</i>	P1
	<i>Gompholobium cinereum</i>	P3
	<i>Hibbertia lepidocalyx subsp. tuberculata</i>	P3
	<i>Leptospermum macgillivrayi</i>	P1
	<i>Mirbelia ferricola</i>	P3
	<i>Sowerbaea multicaulis</i>	P4
	<i>Stenanthemum newbeyi</i>	P3

2.5.1.3 Vegetation Condition and Weed Monitoring

Carina

Monitoring of vegetation condition and weed status in unmined areas surrounding the Carina project is completed as required under Conditions 5-3 and 10-3 of MS 852 to assess the impact of the project on the surrounding vegetation. Monitoring is carried out as per the Draft Carina and J4 – Vegetation and Rehabilitation Monitoring Plan (Astron 2018).

The results of the most recent monitoring by Astron (2019b) for Carina found no difference in plant health between analogue (no impact) and buffer zone (potential impact) areas, indicating there has not been any negative impact on vegetation from operational activities. No significant decrease in plant health has been found at analogue or buffer transects since monitoring commenced in 2013, however changes in floristic composition have been noted over time and are considered to be the result of natural fluctuations, and broad-scale natural processes. Changes appear to be similar for both impact and non-impact areas (Astron 2018).

A total of 14 weed species have been identified at the project since project commencement, none of which are classified as Weeds of National Significance or Declared Pests (Astron 2019a). Six of these species were recorded during pre-disturbance flora and vegetation surveys and have not been recorded since. The remaining eight species have been recorded at the site during operations (Astron 2019a). Dense weed populations have been recorded along the Carina haul road, with the densest occurrence approximately 20 km north of the southern operations. The most abundant and widespread species are **Centaurea melitensis* and **Sonchus oleraceus*, which have been recorded at the project area since 2013.

No weed species were recorded in the 2019 vegetation condition monitoring (Astron 2019b). In previous years, (2016, 2017 and 2018) **Sonchus oleraceus* (common sowthistle) has been recorded within the buffer zone of the mine area. The absence of this annual weed species in 2019 is most likely due to dry seasonal conditions with below-average monthly rainfall recorded in the four months prior to the field survey (Astron 2019b).

Carina weed survey information (Condition 10-1(3)) is reported in the annual vegetation condition monitoring reports submitted to DWER, however, a review of data collected and reported in 2018 by Polaris, and feedback from DBCA on the 2017 draft PEMP identified that it was unclear that the requirements of condition 10-1(3) had been met. Polaris will ensure that weed monitoring and reporting is clearly reported and submitted as required by Condition 10-1(3).

Following non-compliance with conditions 9-4, 10-1(1), 10-1(4), 11-1(7) and 11-1(8) of MS 852 in July 2019, Polaris issued Astron to conduct a gap analysis of weed hygiene measures. In line with Astron's recommendations and DWER request, Polaris will ensure that weed monitoring is conducted annually in addition to at least one weed survey and chemical control conducted during March and September during conditions promoting weed germination and growth (i.e., post significant rainfall). This monitoring is to be reported to achieve weed management objectives.

Vegetation monitoring conducted by Astron in September 2022, states that compliance with condition 5-3 of Ministerial Statement 852 continues to be maintained, as no impacts to vegetation from mining operations have been detected.

Jackson 4

J4 monitoring of vegetation condition is conducted as required under Condition 6-2, and where triggered Condition 6-4. Monitoring is undertaken as per the Jackson 4 Flora and Vegetation Conditions Monitoring Plan (Astron 2019c).

A monitoring program aligned to the Carina survey methodology and frequency was established for J4. The most recent results of monitoring by Astron (2022) for J4 found no evidence to indicate that the construction and operation of the J4 haul road has had a negative impact on the flora and /or vegetation between 2018 and 2022. Overall, there was no significant variance in species richness and cover between the analogue and buffer zones during this period..

2.5.1.4 Baseline Fauna Surveys

Carina

The Carina project is located on the intersection of the Eremaean and Southwest botanical provinces and as such is a diverse habitat which supports a diverse faunal assemblage, of which many species are at their extents. J4 on the other hand does not include such a fauna population whereby fauna risks are most relevant to the trenching of the haul road construction which are addressed by Condition 7 of MS 988. A terrestrial fauna survey was completed at the project area and predominantly Carina's surrounds by Ninox Wildlife Consulting in 2009. Key findings of the survey were:

- A total of 22 reptile species were recorded, of which one skink (*Cyclodomorphus melanops elongatus*) is considered to be of conservation significance as it appears to be specific to Banded Ironstone Formations (BIF) outcrop habitat which is found both within and surrounding the project area.
- A total of 59 species of bird were recorded, none of which are currently conservation significant. One disused Malleefowl (*Leipoa ocellata*) mound was found nearby, but outside the Carina tenement.
- Four species of non-volant native mammals were recorded, none of which are conservation significant. The remains of several Stick-nest Rat (*Leporillus apicalis*) nests were found in caves and overhangs in BIF outcropping.
- Eight species of bat were recorded, one of which may be a Priority 4 species, but could not be determined from call recordings.
- No frogs were recorded.

Jackson 4

The J4 mine and haul road (impact area) was assessed and surveyed concurrently with sites in the Helena Aurora Range adjacent to the mine and haul road to provide additional information about the distribution of species recorded from inside the impact area. Key findings of the survey were:

- Five habitat types (rocky ridge, Mallee woodland on rocky plain and foot slopes, mixed eucalypt woodland, sandy plain with shrubland and drainage line) are present within the J4 disturbance footprint.
- A total of 10 native and two introduced mammal species, 46 bird and 28 reptile species were recorded in the J4 footprint. In addition, seven native and one introduced mammal species, 44 bird species, 20 reptile species and two species of frog were recorded from the surrounding area.
- Four species of conservation significance were sighted within the footprint: Crested Bellbird, Shy Heathwren, Major Mitchells' Cockatoo and Rainbow Bee-eater. Malleefowl was also recorded through secondary evidence (fresh tracks and old mounds) within the footprint. The Fork-tailed Swift and Peregrine Falcon were recorded in the area surrounding J4 and secondary evidence of either the Australian Bustard or the Bush Stone-curlew was recorded.
- A total of 40 potential short-range endemics (SRE), four likely SREs and five confirmed SRE species are known to occur in the area.

2.5.1.5 Baseline Surface Water Assessment

The project lies within the upper reaches of two large surface water systems, one of which drains west toward Hamersley Lake while the other drains south toward Lake Deborah East and Lake Eva. These lakes

are large, intermittent salt lakes that are generally dry through most years and only fill following periods of significant rainfall i.e., every 10 years or more. The mine area and part of the north-south oriented portion of the haul road are situated within the Lake Hamersley catchment. The majority of the haul road is situated in the Lake Deborah/Lake Eva catchment (Figure 4).

Hydrological responses to rainfall are characterised by highly ephemeral stream, creek and drainage networks with surface water runoff events occurring in response to significant storm events or following the infrequent prolonged periods of rainfall.

Surface water flow occurs in defined channels where there are sufficient convergence of flows and increases in flow velocities sufficient to promote scour and channel formation. In smaller drainage systems surface water flows predominantly occur as sheet flow in a broad, shallow front in response to infiltration of excess rainfall prior to channel initiation.

The mine itself is located on a local high point that forms a catchment divide between a northern and southern surface water system.

2.5.2 Key Assumptions and Uncertainties

It is assumed that investigations and studies undertaken, and management plans implemented have adequately:

- Identified the flora, vegetation and faunal conservation values present within and surrounding the project.
- Mapped vegetation communities within the project area and understood local and regional scale of surroundings to ensure potential direct and indirect impacts are accurately determined for the project.
- Identified and ranked the risk of impact to the surrounding environment from the project, and
- Addressed annual vegetation health (Condition 5-3) and weed monitoring (Condition 10-1(3)) of MS 852 and provided for a determination against Condition 6-2 of MS 988, so that the assessments provide an accurate representation of impacts of the project on the vegetation immediately surrounding the project.

2.5.3 Management Approach

Polaris has prioritised management provisions using a risk-based approach informed by baseline flora and fauna survey data and vegetation health monitoring data as detailed in Section 2.5.1.

Management actions detailed in this PEMP focus on the minimisation of impacts to conservation significant flora and fauna within and adjacent to the project area, through operational management actions.

Management targets have been designed around the SMART principle as detailed in DMIRS Mine Closure Plan (2020) and are specific, measurable, achievable, relevant and time bound. The BACI principle of understanding impacts through before/after and control/impact analysis has been used through monitoring and adaptive management.

Management targets reflect the environmental objectives specified in MS 852 and MS 988, where provided and deemed appropriate as targets.

2.5.3.1 Rationale for Provisions

Management targets have been developed using baseline surveys, knowledge from vegetation health monitoring as detailed in Section 4.4 the assessed risks for the project in the Public Environmental Review (PER) for Carina and ERD for J4, and commitments made to mitigate these risks. Appropriate management will ensure that the EPA factor objectives are met and as such, provisions reflect the key risks of the project to the local area and the operational mechanisms through which they are likely to occur.

The provisions appropriately address the intensity, duration, and magnitude of the project in terms of potential impacts. The rationale for provisions are detailed in the following sections.

2.5.3.1.1 Hygiene Management

Weeds can have a significant impact on the biodiversity of an area due to their ability to outcompete native species and eventually dominate. Hygiene management provisions have been specified to prevent any new weed species becoming established on site and prevent or minimise the spread of existing weed populations. Vehicles working in one particular area are at a lower risk of spreading weeds and have less stringent management actions. Where vehicles are moving between work areas more stringent hygiene measures are specified to reflect the risk. Where

weeds are found to have established, provisions for control/management have been included to assist in restoring the ecosystem.

A gap analysis on the effectiveness of weed hygiene management measures detailed in the approved PEMP was carried out in October 2019 (Astron 2019a). Known populations of weeds in the region and transportation of weeds via native and introduced carriers were considered in the gap analysis in addition to Carina's proximity to the former Jaurdi Pastoral Station and J4's location within the Mt Jackson Pastoral Station. The gap analysis found that the historic/current weed hygiene and management measures have been effective in ensuring where practicable, that weed species distribution and occurrence within the project areas remain comparable to surrounding areas and similar land uses (Astron 2019a). Continued implementation and a recommendation of an additional weed survey and control during March to September as specified in **Table 6** should result in further positive outcomes in the project area.

The risk of dieback in the project area is considered to be low. This is based on the average rainfall (being between 200 and 300 mm), no known historic cases of dieback at Carina / J4 or MRL's adjacent Koolyanobbing operations and the mine being located in a low-risk area. PEMP provisions for the management of hygiene (weeds and dieback) are provided in **Table 6**.

2.5.3.1.2 Management of Feral Animals

The project is located in the former Jaurdi pastoral lease (Carina) and Mt Jackson Pastoral Station (J4) which was purchased by CALM/ DPaW (DBCA) and has been destocked (Jaurdi for over 20 years). There are no active pastoral stations adjacent to the former Jaurdi station area that could be a source of migrating stock and as such, there are minimal stock in the local area. DBCA manages feral animal control in the wider area. Two feral animal species, the camel and rabbit are known to occur in the area. Rabbits are present in high numbers and may have a significant effect on ground level vegetation.

Feral cats and dogs may be present in the area and are often present where freshwater ponds and where putrescible waste is stored in landfill or in bins. Provisions for the management of this type of feral animal are focused on eliminating attractants such as water and food and to minimise human to feral animal interactions through ensuring employees and contractors do not feed feral animals. Provisions also include feral animal control as required. The regime of feral animal control is informed by the number of feral animals noted through the reporting system.

PEMP provisions for the management of feral animals are provided in **Table 7**.

2.5.3.1.3 Disturbance and Vegetation Clearing

Land clearing for exploration, mining and infrastructure is the most significant environmental impact Polaris is likely to have and it is required to be managed effectively and have the commitment from senior management through to site operators and the environment department (ED). Strict control of ground disturbance, inspection and reporting is achieved through the implementation of a land activity permit (LAP) for land clearing and vegetation disturbance as well as other provisions to ensure clearing is minimised and that topsoil and vegetation from cleared areas is stored such that it is maintained at an optimum state for use in rehabilitation. An overview of the LAP is provided below:

- Applicant to consult with the ED prior to completing form to ensure there is no obvious impediment to site disturbance proceeding.
- Once confirmed, LAP is created, and contains following information:
- All tenements affected.
- Comprehensive description of the proposed activity.
- Drawing or drawings showing the location of all proposed disturbance.
- Total area to be disturbed (ha).
- The volume of topsoil to be recovered and stockpiled (cubic metres).
- Machinery to be used for the activity.
- LAP submitted through the LAP portal.
- ED to assess proposed clearing to ensure it is within approved area and identify any constraints to clearing and ensure sufficient buffer has been allowed. ED will apply conditions if required.

- The application is then assessed by the site manager to ensure it is consistent with project planning. If so, it can be approved and implemented.
- Once clearing has been completed, the cleared area and topsoil and vegetation stockpiles is surveyed, and spatial information forwarded to the ED for storage.
- ED will conduct an inspection of the cleared area to ensure compliance with LAP conditions.

A representative from the ED will inspect topsoil and vegetation stockpiles to ensure they are signposted to prevent inadvertent use for unapproved purposes. ED to maintain records of the areas cleared and the resources available for future rehabilitation works (topsoil, subsoil, woody debris).

PEMP provisions for disturbance and vegetation clearing are provided in **Table 8**.

2.5.3.1.4 Limiting and Authorising Access

The project is located approximately equidistant from the towns of Southern Cross and Coolgardie, in a wider land precinct of existing and proposed reserves. Access for the Carina mine is off the Great Eastern Highway, on an unsealed road approximately 95 km east of Southern Cross. All mine traffic uses this unsealed road from the highway to the rail siding, which is approximately 45 km from the Great Eastern Highway turnoff. For safety reasons, all active mine areas and worksites are not open to public access and appropriate signage and safety information is required under legislation, warning the public of heavy vehicle traffic and active operational areas. Designated public crossing points on haul roads will be adequately sign posted. Public tracks crossing the site's general access road to the Great Eastern Highway, (the DTF road), such as the Ryan's Find Road may be inadvertently or otherwise accessed by the public which creates a significant safety issue.

Provisions target accidental access to the site by ensuring minor tracks that access the project site are blocked off, (in consultation with DBCA Kalgoorlie) and that major roads are well signposted. Additionally, the risk of unauthorised access is reduced by requiring all visitors to report to the mine office. Provisions limit employee and contractor access offsite to limit interaction with third parties and the public. Some personnel such as environmental staff undertaking monitoring and surveys in the surrounding area and exploration geology personnel undertaking exploration work will be using tracks outside the project footprint where interaction with third parties could occur and normal safe driving practices are expected from all personnel.

PEMP provisions for limiting and authorising access are provided in **Table 9**.

2.5.3.1.5 Fire Prevention and Response

The project is located in a remote semi-arid zone of WA. As with most areas of native vegetation within the state, the risk of natural bush fires is high due to lightning strikes from storm events. These are natural processes which have occurred throughout history and may positively impact native vegetation through increased germination of some species. The project could alter natural fire regimes through a change in the structure and composition of vegetation communities via clearing, the extinguishing of natural fires where presenting hazards to human life and project infrastructure, and fires directly caused by project activities. Bushfires present a significant safety issue to mine sites and must be protected against in addition to prevented if anthropogenic.

Provisions for fire prevention and response are two-fold as described above, preventing the spread of natural bushfire to the mine site through emergency preparedness and preventing fires occurring as a result of the project.

PEMP Provisions for fire prevention and response are detailed in **Table 10**.

2.5.3.1.6 Saline Dust Suppression Water Management and Monitoring

Dust generation from unsealed roads is a key environmental issue over the project areas and is common to most mining operations. In addition to dust generation through mining the haul roads present linear sources of dust generation through various environments. Road watering is used to suppress dust using local groundwater as the site is too remote to obtain alternative water supplies. As the groundwater used for the project is characterised as saline to hypersaline, there is a risk of overspray or run-off impacting adjacent land, flora, and vegetation.

A rainfall study was carried out to investigate rates of mobilisation of sodium bicarbonate from compacted soil surfaces simulating an unsealed road (Loch & Squires 2010) which found that particularly for mine sites, the use of saline water in dust suppression on unsealed roads is unlikely to significantly impact the wider surrounding environment. This is primarily because the flush of salts in run-off from the roads occurs very early in the run-off event when none of the surrounding area would have commenced to run off. Consequently, the relatively small volume of run-off produced directly by the road could be expected to predominantly infiltrate in the table drain adjoining the road. The initial flush of saline water would then be leached to depth or diluted by the less saline run-

off generated from the road in the latter part of the run-off event, or by non-saline run-off from the surrounding catchment (Loch & Squires 2010).

Provisions include operational measures which can be used to limit the potential for overspray and run-off from areas of dust suppression. Additional measures can also be used to reduce the likelihood of a spill or leak of saline water from water management infrastructure.

PEMP provisions for saline dust suppression water management and monitoring are provided in **Table 11**.

2.5.3.1.7 Surface water flow impedance

A surface water risk assessment for the project was undertaken by Golder Associates in 2013, as well hydrological modelling in proximity to the mine area.

The mine area (e.g., pits, ROM) are located on high ground between small, local surface water systems. There is little to no risk of flood inundation or flood flows from adjacent drainage systems within the extent of the mine, based on hydraulic modelling (Golder 2013a).

The mine area is located more than 1 km from the 100-year ARI flood extent and approximately 10–12 m above the associated modelled peak flood level. Surface water management for the mine primarily requires drainage from incidental rainfall falling directly on the site rather than inflows from surrounding catchments (Golder 2013b). Runoff will be captured in earth sediment ponds prior to discharge to the environment as necessary.

The haul road and road networks to support the mine has been designed to cater for a 100-year ARI peak event. The north-south aligned portion of the haul road (L77/250) does not cross any significant surface water drainage systems (Golder 2013c). Sheet-flow generated by significant storm events are managed via the strategically placed culverts that allow sheet-flow to drain to downslope areas.

The east-west aligned portion of the haul road (L77/254) crosses two major surface water drainage systems, with contributing catchment areas of approximately 187 km² and 197 km² respectively (Golder 2013a). Cross flow road drainage in the form of environment culvert crossings have been installed as required to minimise the impact of up gradient ponding and reduce the extent of any potential downslope drainage shadows. The infrastructure has been constructed to minimise alteration and impacts on the natural surface water runoff regimes in the local area.

PEMP provisions for surface water flow management and monitoring are provided in **Table 12**.

3. EMP PROVISIONS

Management-based provisions identify management actions that will be implemented to mitigate and manage potential impacts to surrounding flora, vegetation, and fauna to a specific management target. Monitoring is specified to measure performance in relation to the management targets, and reporting mechanisms for each management action are also specified.

The majority of Conditions specified in the below provisions are relevant to both Carina and J4, although there are provisions relevant to Carina only, such as those relating to feral animal and unauthorised access. This is due to some of the hazards relevant to construction, such as trenching, are not applicable at this stage of the project (i.e., operational).

Table 5: PEMP Management Based Provisions Table

Condition	Table No.
Hygiene management measures to prevent the introduction of weeds and dieback disease.	Table 6
Management of feral animals.	Table 7
Company protocols to authorise disturbance and clearance of vegetation.	Table 8
Limiting and authorising access to areas within the mining lease.	Table 9
Fire prevention and response.	Table 10

Condition	Table No.
Management and monitoring of saline water used for dust suppression.	Table 11
Management of surface water.	Table 12

Table 6: Hygiene Management Provisions

Purpose:	To meet the legal requirements of Condition 9-1 clause 1 of MS 852 and Condition 6-2 of MS 988.		
EPA Factor:	Flora and Vegetation.		
EPA Objective:	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.		
Key Environmental Values:	Ex-pastoral station (Jaurdi) acquired by DBCA for the purposes of conservation (proposed Jaurdi Nature Reserve). Known Priority Flora (PF) populations. BIF PEC associated floristic community types. Helena and Aurora Ranges Conservation Park.		
Key Impacts:	Introduction of weeds and dieback disease.		
Key Risks:	Loss or reduction in species and populations of native species.		
Management Action	Management Target	Monitoring	Reporting
Objective: No increase in weed species diversity, extent or abundance and/or introduction of dieback due to project activities.			
Carina and J4			
Weed Hygiene Certificate (WHC) for medium to high-risk situations. WHC requires cleaning of equipment to remove seeds, plant material and soil/mud and suitable disposal of material. Equipment to be inspected on arrival prior to use. Employees and contractors are required to participate in the site induction, which will provide an awareness of weeds, including risk species, and an overview of the weed hygiene process. Employees and contractors who are involved in movement or operation of earthworks equipment, off road vehicles, and land clearing will be specifically trained in weed hygiene procedures and documentation. Annual weed control informed by results of weed surveys (Condition 10-1(3) of MS 852 and Condition 6-2 of MS 988) with control methods comprising manual, mechanical and chemical control as required.	Carina - Species and extent of weed cover within the proposal area shall not exceed that identified in the baseline survey identified in Condition 10-1(2) or exceed that existing on comparable, nearby land, determined by Condition 10-1(3) which has not been disturbed during implementation of the proposal, whichever is less. - No introduction of dieback into the project area. J4 - Species and extent of weed cover within the Haul Road and in surrounding environment shall not exceed that identified in the baseline survey or exceed that existing on comparable, nearby land, determined by Condition 6-2. No introduction of dieback into the project area.	Carina - Annual Spring weed monitoring carried out to satisfy Condition 10-3 of MS 852 (refer to Section 3 for details). - One additional weed survey and control between March and September to satisfy Condition 10-3 of MS 852 (refer to Section 3 for details). - Annual assessment of dieback by an accredited assessor. J4 - Annual Spring weed monitoring carried out to satisfy Condition 6-2 of MS 988 (refer to Section 3 for details). - One additional weed survey and control between March and September to satisfy Condition 6-2 of MS 988 (refer to Section 3 for details). Annual assessment of dieback by an accredited assessor.	Carina - Annual vegetation condition reporting. - Annual Compliance Assessment Report (CAR) (MS 852) J4 - Annual vegetation condition reporting. - Annual Compliance Assessment Report (CAR) (MS 988)

Table 7: Feral Animal Management Provisions

Purpose: To meet the legal requirements of Condition 9-1 clause 2 of MS 852.			
EPA Factor: Terrestrial Fauna			
EPA Objective: To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.			
Key Environmental Values: Ex-pastoral station (Jaurdi) acquired by DBCA for the purposes of conservation (proposed Jaurdi nature reserve).			
Key Impacts: Increase in feral animal species and populations.			
Key Risks: Loss or reduction of native species and populations.			
Management Action	Management Target	Monitoring	Reporting
Objective: Control of feral animals, focusing on rabbits, camels, feral cats, and dogs in the project area.			
Carina and J4			
Environmental Induction to provide information on introduced predators and pest species, discouragement of feeding of fauna and protection of native fauna.	- Feral animal attractants fenced. - No increased observation of feral animals at landfill, WWTP, water storage ponds and accommodation camp.	- Annual assessment of feral - Animal sighting records. - Annual camera trapping program.	- Fauna sighting and incident reporting. - Compliance Assessment Report (CAR) (MS 852).
Waste to be place in covered bins, collected regularly, and transferred to the landfill.			
Fencing to be maintained around the landfill.			
Fencing to be maintained around water holding facilities containing stock quality or better within the project area.			
Implement system to record and quantify introduced species.			
Implement feral animal control program if numbers of feral animals increase significantly (currently use local pastoralist).			

Table 8: Disturbance and Vegetation Clearing Management Provisions

Purpose:	To meet the legal requirements of Condition 9-1 clause 3 of MS 852 and Condition 6-2 of MS 988.		
EPA Factor:	Flora and Vegetation		
EPA Objective:	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.		
Key Environmental Values:	Ex-pastoral station (Jaurdi) acquired by DBCA for the purposes of conservation (proposed Jaurdi nature reserve). Known PF populations. BIF PEC associated floristic community types. Helena and Aurora Ranges Conservation Park.		
Key Impacts:	Unapproved or unnecessary loss of native vegetation and biodiversity.		
Key Risks:	Unauthorised clearing or clearing excessive to project requirements.		
Management Action	Management Target	Monitoring	Reporting
Objective: Minimise clearing to that essential for project activities			
Carina and J4			
Review proposed works and existing clearing to maximise utilisation of previously disturbed areas.	- No clearing outside of approved clearing area. - Clearing compliant with approved total areas (MS 852 and 988 respectively). - No bare unused areas indicating excessive clearing.	Annual review of LAPs, cleared areas as surveyed and approved clearing areas.	- Annual Compliance Assessment Audit and Report (CAR) (MS 852 and 988 respectively). - Annual Environmental Report (AER) to DMIRS.
Early-stage mine planning to minimise footprint required for infrastructure and mining landforms.			
Implement Land Activity Permit procedure.			
Trim vegetation by hand where only a portion is affected by works. For example, if the trunk of a tree is outside the clearing boundary.			
Objective: Prevent accidental clearing			
Carina and J4			
Vehicles, plant, and equipment restricted to within the clearing limits.			Annual Compliance Assessment Audit and Report (CAR) (MS 852 and 988 respectively).
Observers and spotters will be used when working near sensitive sites, e.g., near Priority flora, or when clearing boundaries may not be readily visible (for example due to dense vegetation).			
Environmental Induction to provide information on Land Activity Permit.			

Purpose: To meet the legal requirements of Condition 9-1 clause 3 of MS 852 and Condition 6-2 of MS 988.

EPA Factor: Flora and Vegetation

EPA Objective: To protect flora and vegetation so that biological diversity and ecological integrity are maintained.

Key Environmental Values: Ex-pastoral station (Jaurdi) acquired by DBCA for the purposes of conservation (proposed Jaurdi nature reserve). Known PF populations. BIF PEC associated floristic community types. Helena and Aurora Ranges Conservation Park.

Key Impacts: Unapproved or unnecessary loss of native vegetation and biodiversity.

Key Risks: Unauthorised clearing or clearing excessive to project requirements.

Management Action	Management Target	Monitoring	Reporting
Objective: Minimise loss of topsoil or degradation of land			
Carina and J4			
Environmental Induction to provide information on Land Activity Permit.	Clearing undertaken less than one month prior to proposed use.	Annual review of topsoil and subsoil stockpiles.	- Incident reporting. - Annual Compliance Assessment Audit and Report (CAR) (MS 852 and MS 988 respectively). - Annual Environmental Report (AER) to DMIRS.
Recover topsoil and stockpile to maximum height of 2 m to preserve the soil physical/chemical properties and seed bank. Where required, recover subsoil and stockpile to a height of 4 m.	Topsoil and subsoil are recovered and stored to maximise viability.		
Signpost stockpiled topsoil and subsoil to prevent accidental use or degradation of soil resources.			

Table 9: Access Management Provisions

Purpose:	To meet the legal requirements of Condition 9-1 clause 4 of MS 852.		
EPA Factor:	Flora and Vegetation, Terrestrial Fauna.		
EPA Objective:	To protect flora and vegetation so that biological diversity and ecological integrity are maintained, and to protect terrestrial fauna so that biological diversity and ecological integrity are maintained.		
Key Environmental Values:	Ex-pastoral station (Jaurdi) acquired by DBCA for the purposes of conservation (proposed Jaurdi Nature Reserve). Known Priority Flora (PF) populations.		
Key Impacts:	Degradation or loss of native vegetation, native fauna and/or biodiversity, spread of weeds and safety concerns.		
Key Risks:	Unauthorised access to mining operations.		
Management Action	Management Target	Monitoring	Reporting
Objective: Limit unauthorised access to the mine			
Carina and J4			
Install 'Danger Active Mine-site No Entry' signs at access points.	- All access points signposted and signs clearly visible and maintained. - All minor track access points blocked.	- Monthly checks of access points for signage/ blocked access. - Monthly inspection of signs.	Annual Compliance Assessment Audit and Report (CAR) (MS 852).
Traffic management chicanes used on higher traffic public tracks to reduce vehicle speed leading up to active haul roads.			
Minor tracks that access the project site will be blocked off, in consultation with DBCA Kalgoorlie.			
The access road to the mine will be signposted and all visitors are to report to the mine office.			

Table 10: Fire Management Provisions

Purpose:	To meet the legal requirements of Condition 9-1 clause 4 of MS 852.		
EPA Factor:	Flora and Vegetation, Terrestrial Fauna.		
EPA Objective:	To protect flora and vegetation so that biological diversity and ecological integrity are maintained, and to protect terrestrial fauna so that biological diversity and ecological integrity are maintained.		
Key Environmental Values:	Ex-pastoral station (Jaurdi) acquired by DBCA for the purposes of conservation (proposed Jaurdi Nature Reserve). Known Priority Flora (PF) populations.		
Key Impacts:	Degradation or loss of native vegetation, native fauna and/or biodiversity, spread of weeds and safety concerns.		
Key Risks:	Unauthorised access to mining operations.		
Management Action	Management Target	Monitoring	Reporting
Objective: No net increase in fire frequency within the project area.			
Carina and J4			
Environmental Induction to provide information on the prevention and management of fires.	- No unplanned fires attributable to project activities. - No spread of natural fires attributable to project activities or lack of response.	- Annual inspection of firebreaks. - Regular review of incident reports. - Annual training exercise for ERT team.	- Annual Compliance Assessment Audit and Report (CAR) (MS 852 and MS 988 respectively). - Incident reporting.
Firefighting equipment maintained in buildings and vehicles.			
Flammable materials appropriately stored and segregated from ignition sources.			
General mine vehicles not permitted to leave access tracks or cleared areas.			
Cigarette smoking restricted to designated smoking areas with appropriate disposal facilities.			
Fire breaks maintained around infrastructure.			
Implementation and adherence with a hot work permit system.			
Induction includes information re fire safety and is provided to all personnel.			
Emergency response team on site during operations.			
Up to date fire preparedness and evacuation plan and ERT regularly trained to implement plans.			

Table 11: Saline Dust Suppression Water Management Provisions

Purpose: To meet the legal requirements of Condition 9-1 clause 6 of MS 852 and Condition 6-2 of MS 988.			
EPA Factor: Flora and Vegetation.			
EPA Objective: To protect flora and vegetation so that biological diversity and ecological integrity are maintained.			
Key Environmental Values: Ex-pastoral station (Jaurdi) acquired by DBCA for the purposes of conservation (proposed Jaurdi Nature Reserve). Known Priority Flora) populations. BIF PEC associated floristic community types. Helena and Aurora Ranges Conservation Park.			
Key Impacts: Degradation (poor health) or loss of native vegetation and flora.			
Key Risks: Spill or leak of saline water from water management infrastructure, and/or overspray of saline water used for dust suppression.			
Management Action	Management Target	Monitoring	Reporting
Objective: Prevent impacts on surrounding vegetation from saline dust suppression water spills			
Carina and J4			
Saline water pipelines located within bunds.	No vegetation death due to saline water spillages from Project activities.	Daily inspection of saline water infrastructure.	- Annual Compliance Assessment Audit and Report (CAR) (MS 852 and MS 988 respectively). - Incident reporting.
Saline water or hazardous materials pipelines incorporate isolation valves at appropriate intervals.			
Catch pits or sumps constructed along above ground saline water or hazardous materials pipeline corridors maintained to collect leaks or spillages.			
Regular inspections and maintenance of pipelines and water holding facilities.			
All pipelines, bunds and storage facilities will be designed to required engineering specifications (e.g., liners).			
Decommission saline water holding facilities when not in use.			
Spills are cleaned up appropriately if they occur.			
Implement incident reporting system and train personnel in its use.			

Purpose: To meet the legal requirements of Condition 9-1 clause 6 of MS 852 and Condition 6-2 of MS 988.

EPA Factor: Flora and Vegetation.

EPA Objective: To protect flora and vegetation so that biological diversity and ecological integrity are maintained.

Key Environmental Values: Ex-pastoral station (Jaurdi) acquired by DBCA for the purposes of conservation (proposed Jaurdi Nature Reserve). Known Priority Flora) populations. BIF PEC associated floristic community types. Helena and Aurora Ranges Conservation Park.

Key Impacts: Degradation (poor health) or loss of native vegetation and flora.

Key Risks: Spill or leak of saline water from water management infrastructure, and/or overspray of saline water used for dust suppression.

Management Action	Management Target	Monitoring	Reporting
Objective: Prevent Overspray of Saline Water			
Carina and J4			
Calibrate water trucks spray bar to road width only.	No decline in cover or productivity greater than 25% due run off of saline dust suppression water (Condition 5-4 of MS 852 and Condition 6-2 of MS 988).	Annual vegetation condition survey as required by Condition 5-3 of MS 852 and Condition 6-2 of MS 988) (refer to Section 4).	- Annual Compliance Assessment and Report (CAR) (MS 852 and MS 988 respectively). - Incident Reporting.
Manage water pressure in the spray bar on tracks and narrower roads to minimise likelihood of overspray.			
Ensure water truck operators are appropriately trained and competent.			
Pre-start inspections and scheduled maintenance of water carts.			
Objective: Prevent Runoff of Saline Dust Suppression Water			
Carina and J4			
Dust suppression water to be applied at the minimum rate required.	No decline in cover or productivity greater than 25% due to saline dust suppression water run off (Condition 5-4 of MS 852 and Condition 6-2 of MS 988).	Annual vegetation condition survey as required by Condition 5-3 of MS 852 and Condition 6-2 of MS 988) (refer to Section 4).	- Annual Compliance Assessment and Report (CAR) (MS 852 and MS 988 respectively). - Incident Reporting.
Wet areas not to be resprayed until dry.			
Water truck operators to be appropriately trained and competent.			
Objective: Prevent Overtopping of Saline Turkeys nest and other Saline water ponds/dams.			
Carina and J4			
Maintain minimum freeboard of 300 millimetre (mm) within turkeys’ nests and other saline water ponds/dams at all times.	No decline in cover or productivity greater than 25% due run off of	Annual vegetation condition survey as required by	

Purpose: To meet the legal requirements of Condition 9-1 clause 6 of MS 852 and Condition 6-2 of MS 988.

EPA Factor: Flora and Vegetation.

EPA Objective: To protect flora and vegetation so that biological diversity and ecological integrity are maintained.

Key Environmental Values: Ex-pastoral station (Jaurdi) acquired by DBCA for the purposes of conservation (proposed Jaurdi Nature Reserve). Known Priority Flora) populations. BIF PEC associated floristic community types. Helena and Aurora Ranges Conservation Park.

Key Impacts: Degradation (poor health) or loss of native vegetation and flora.

Key Risks: Spill or leak of saline water from water management infrastructure, and/or overspray of saline water used for dust suppression.

Management Action	Management Target	Monitoring	Reporting
Operator to remain present during filling of turkeys' nests and other saline water ponds/dams.	saline dust suppression water (Condition 5-4 of MS 852 and Condition 6-2 of MS 988).	Condition 5-3 of MS 852 and Condition 6-2 of MS 988) (refer to Section 4).	- Annual Compliance Assessment and Report (CAR) (MS 852 and MS 988 respectively). - Incident Reporting.

Table 12: Surface Water Flow Management

Purpose: To meet the legal requirements of Condition 6-2 of MS 988. EPA Factor: Surface water flow impedance. EPA Objective: Protect surrounding environment and existing infrastructure from the effects of surface water flow impedance. Key Environmental Values: Ex-pastoral station (Jaurdi) acquired by DBCA for the purposes of conservation (proposed Jaurdi Nature Reserve). Known Priority Flora) populations. BIF PEC associated floristic community types. Helena and Aurora Ranges Conservation Park. Key Impacts: Degradation of surrounding environment and existing infrastructure. Key Risks: Altered surface water flows.			
Management Action	Management Target	Monitoring	Reporting
Objective: Prevent impacts on infrastructure and surrounding vegetation from altered surface water flows.			
Carina and J4			
Installation of culverts and flood ways. Cross-flow haul road drains will be maintained to minimise alteration and impacts on the natural surface water drainage systems.	No significant impact on the environment and existing infrastructure from surface water flow impedance (Condition 6-2 of MS 988).	- Annual vegetation condition survey as required by Condition 6-2 of MS 988) (refer to Section 4). - Inspections to determine infrastructure integrity and maintenance as required.	- Annual Compliance Assessment and Report (CAR - MS 988). - Incident Reporting.

4. VEGETATION CONDITION AND WEED MONITORING

Adequately designed vegetation monitoring is required to determine whether the management actions are being undertaken and whether current mitigation measures are effective with respect to the relevant targets and objectives being achieved. The methodology for monitoring specified in the above Provisions tables, which is not self-explanatory e.g. such as visual inspection of pipelines, signage, water storages etc., is documented in the following sections. This primarily relates to vegetation condition and weed monitoring.

Vegetation condition monitoring is used to assess the state of flora and vegetation and to determine impacts of the project on surrounding vegetation primarily from saline overspray and dust, primarily as a means of chronological condition comparison. Vegetation condition is used as an indicator of the level of impact on the local vegetation and fauna habitat to satisfy Condition 5-3 of MS 852 and Condition 6-2 of MS 988. The vegetation condition monitoring program was originally approved by DWER in 2013 as documented in the Carina Iron Ore Project Flora and Vegetation Condition Monitoring Plan (Astron 2013) and this method has been adopted for J4.

A revision to the monitoring plan was developed in 2018 by Astron and submitted to DBCA in November 2018. The revised Carina and J4 Vegetation and rehabilitation Monitoring Plan includes the following changes:

- The monitoring design of the Plan is based on previous monitoring conducted in 2015, 2016 and 2017 (Ecologia Environment and Soilwater Group 2015; Astron Environmental Services 2017b, 2017a).
- Monitoring of the impact on the surrounding environment of the J4 Haul Road as required under Condition 6-2 of Ministerial Statement 988 has been included, the methods align with the vegetation monitoring successfully established, monitored, and analysed for potential impact associated with the Carina Mine and infrastructure (Astron Environmental Services 2013, 2014, 2016, 2017c, 2018).
- Photo points have been modified to consist of sampling quadrats, accompanied by photo points.
- The number of transects and quadrats have been increased to ensure that valid statistical tests can be performed to compare rehabilitation or potential impact sites with reference sites, and to quantify change across time. Proposed sites will be finalised during this year's monitoring activities
- The structure of the plan has been modified to facilitate better understanding and application of the methods described.

Weed monitoring is used to assess changes to weed species and populations in the project area and surrounds as a result of the direct and indirect impacts of the Project to satisfy Condition 10-1(3) of MS 852 and Condition 6-2 of MS 988. The annual spring survey is carried out concurrently with the vegetation condition monitoring at the same transect locations for Carina and J4 (along the haul road) and an additional weed monitoring and control event is undertaken between March and September in conditions optimal for weed germination and growth as per DWER request (correspondence to Polaris, dated 25 March 2020).

Weed monitoring conducted by Astron in September 2022, found the 2022 weed control and mapping program demonstrated compliance with MS 852 condition 10-1 with no new species of weeds introduced into the proposal area as a result of the implementation of the proposal.

4.1 Location

The Carina project is divided into four areas based on operational activities; accommodation village, haul road, mine and railway siding. Within these operational areas, two or more pairs of monitoring transects

have been established which include one monitoring transect in the 'buffer' zone (potential area of impact) and another in the 'analogue' zone (no potential impact). A buffer and its analogue transect as referred to as a single block. There are a total of 19 blocks for Carina (including Carina Extended) totalling 28 transects, although a block 7 is no longer monitored (i.e., 26 transects are monitored). Each transect within a block lies within the same vegetation unit and is located to maximise similarity in total cover and relative abundance of species within the block.

At J4, the monitoring locations are distributed along the haul road. There are 20 transects across seven vegetation units with at least a 'buffer' or 'analogue' zone in each. The buffer transects are located within 100 metres (m) of the project disturbance boundary while the analogue are located between 100 m and 1000 m from the disturbance boundary. As per at Carina, transects are located in the same vegetation units and located to match similarities in total cover and species abundance.

Locations of vegetation condition monitoring transects, marked trees and priority flora as documented by Astron are shown in **Figure 5, Figure 6, Figure 7, and Figure 8**. These transects are also used for weed monitoring as required by Condition 10-1(3) of MS 852 for Carina and Condition 6-2 of MS 988 for J4, whereby Polaris are required to establish "weed reference sites on undisturbed land (not impacted by the proposal) at each of the mine, haul road, rail siding and accommodation facilities" for Carina and along the haul road for J4.

4.2 Methodology

Each transect is 20 m long and 2 m wide and consists of 10 contiguous 2 m by 2 m quadrats. To monitor overstorey species at Carina, designated monitoring trees and tall shrubs ('marked trees') have been selected at each transect and photo-points for each tree are pegged. At J4, five trees adjacent to each transect have been marked to monitor overstorey species. These marked trees are photographed, and dust and health scores recorded at both Carina and J4 sites. Marked trees belong to five common species: *Allocasuarina corniculata*, *Callitris preissii*, *Acacia resinimarginea*, *Eucalyptus oleosa subsp. oleosa*, and *Melaleuca nematophylla*.

All perennial plants in each 2 m by 2 m quadrat, excluding overstorey species that would generally grow to more than 1.5 m in height, are identified to species or subspecies (taxa) level where possible. For each taxon in a quadrat, percentage cover is visually estimated to the nearest 1%, and dust and plant health scores are recorded. Conservation significant flora and weed species and population numbers in transects are recorded; presence of these taxa outside transects are recorded opportunistically.

Vegetation condition and weed monitoring are carried out annually during spring as required for vegetation condition monitoring. This is more frequent than Condition 10-1(3) of MS 852 'weed monitoring' which is only required once every 2 years. The requirement of Condition 6-2 of MS 988 is not specified but weed assessment frequency and methodology was proposed in the Carina and Jackson 4 Weeds Assessment in (Astron 2019a) in response to a non-compliance and has been accepted by DWER. No weed species have been recorded in the 2019 or 2018 vegetation condition monitoring (Astron 2019a).

4.3 Data assessment

Using permutation-based multivariate analysis of variance (PERMANOVA), differences between the analogue and buffer zones, between 2013 (pre-impact baseline), and each consecutive monitoring year are compared using the following factors: time (year) and treatment (analogue, buffer). Data for each of the four areas (accommodation village, haul road, mine, and railway siding) are also analysed separately for Carina while this is not necessary for J4. Variables tested include:

- Floristic composition (species and cover).
- Mean dust score
- Mean health score.
- Native species richness.
- Mean native cover.

- Mean percentage weed cover (if present)

Prior to analysis of floristic composition, the percentage foliar cover of each species in each quadrat is square-root transformed and similarity between each pair of quadrats calculated using Bray-Curtis similarity index. For all other variables, Euclidian distance is calculated. To test for differences in site level species compositional changes, a dendrogram is produced, using the Bray Curtis similarity index. The Simprof test is then used to detect significant clusters of sites based on their species composition.

4.4 Management Response

No noticeable decline in vegetation condition has been noted to date, however if a decline of greater than 25% in cover or productivity of native vegetation is found, investigation into the cause of the degradation would be initiated in consultation with DWER and appropriate management actions implemented as per Condition 5-4 and 5-5 of MS 852 for Carina and Condition 6-4 of MS 988 for J4. This may include a review of current practices (e.g., dust monitoring) and investigations into alternatives.

As recommended in Astron (2019a) in response to non-compliances with conditions 9-4, 10-1(1), 10-1(4) 11-1(7) and 11-1(8) of Statement 852, annual weed control between March and September when seasonal conditions are optimal for weed germination and growth, is carried out additional to the spring weed survey.

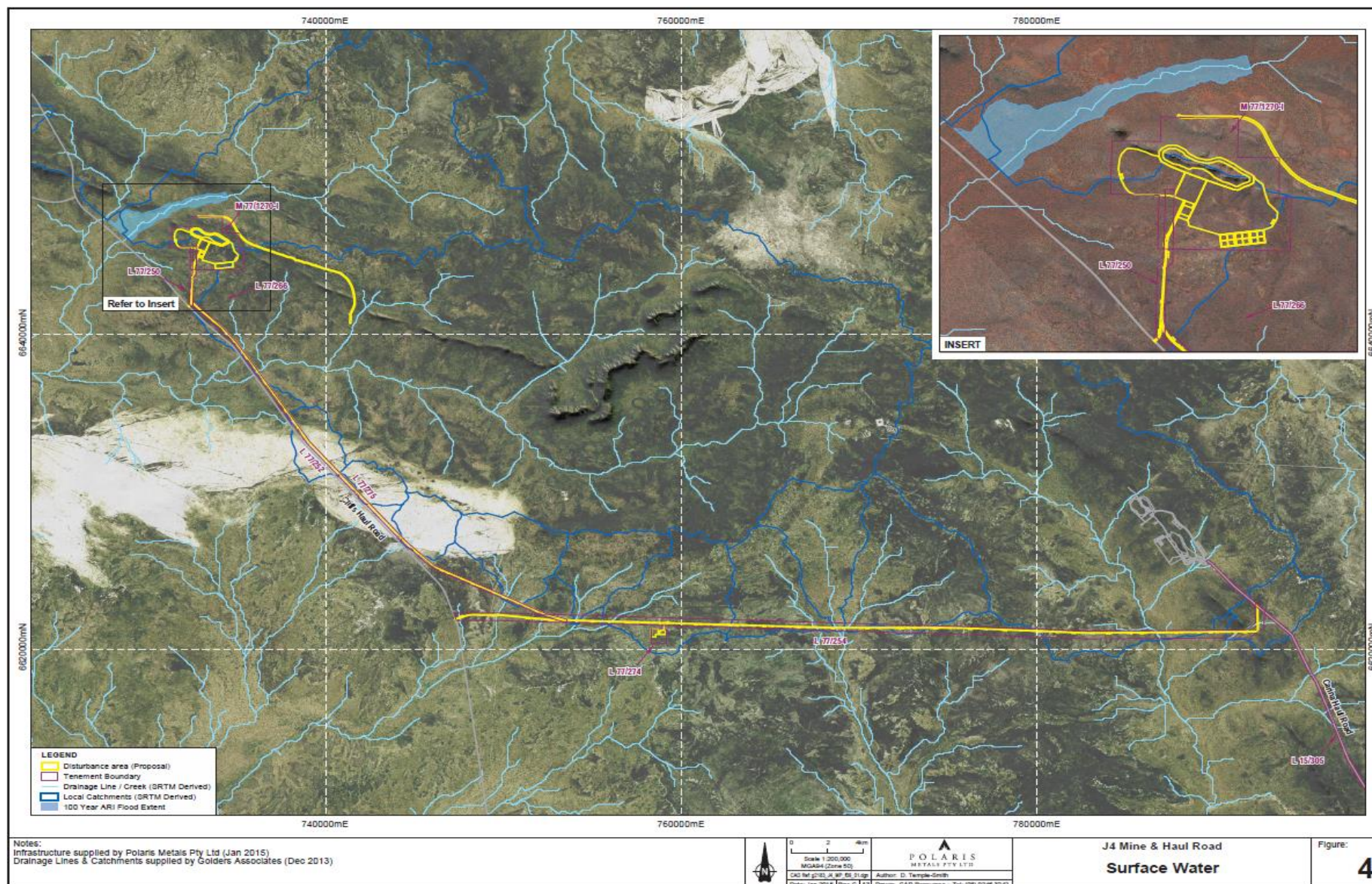


Figure 4: J4 Surface Water

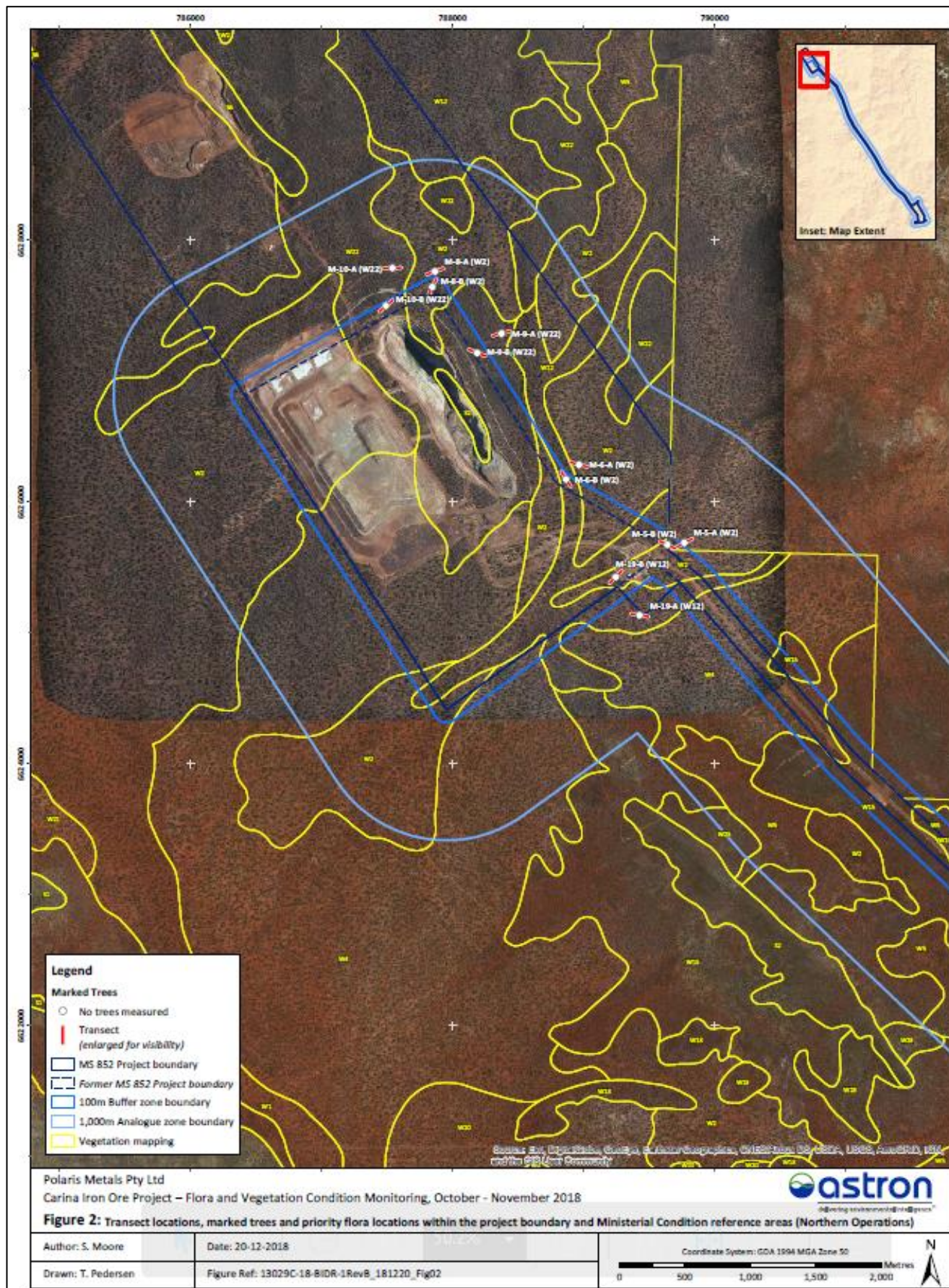


Figure 5: Carina Flora and Vegetation Monitoring Transect Location (North)

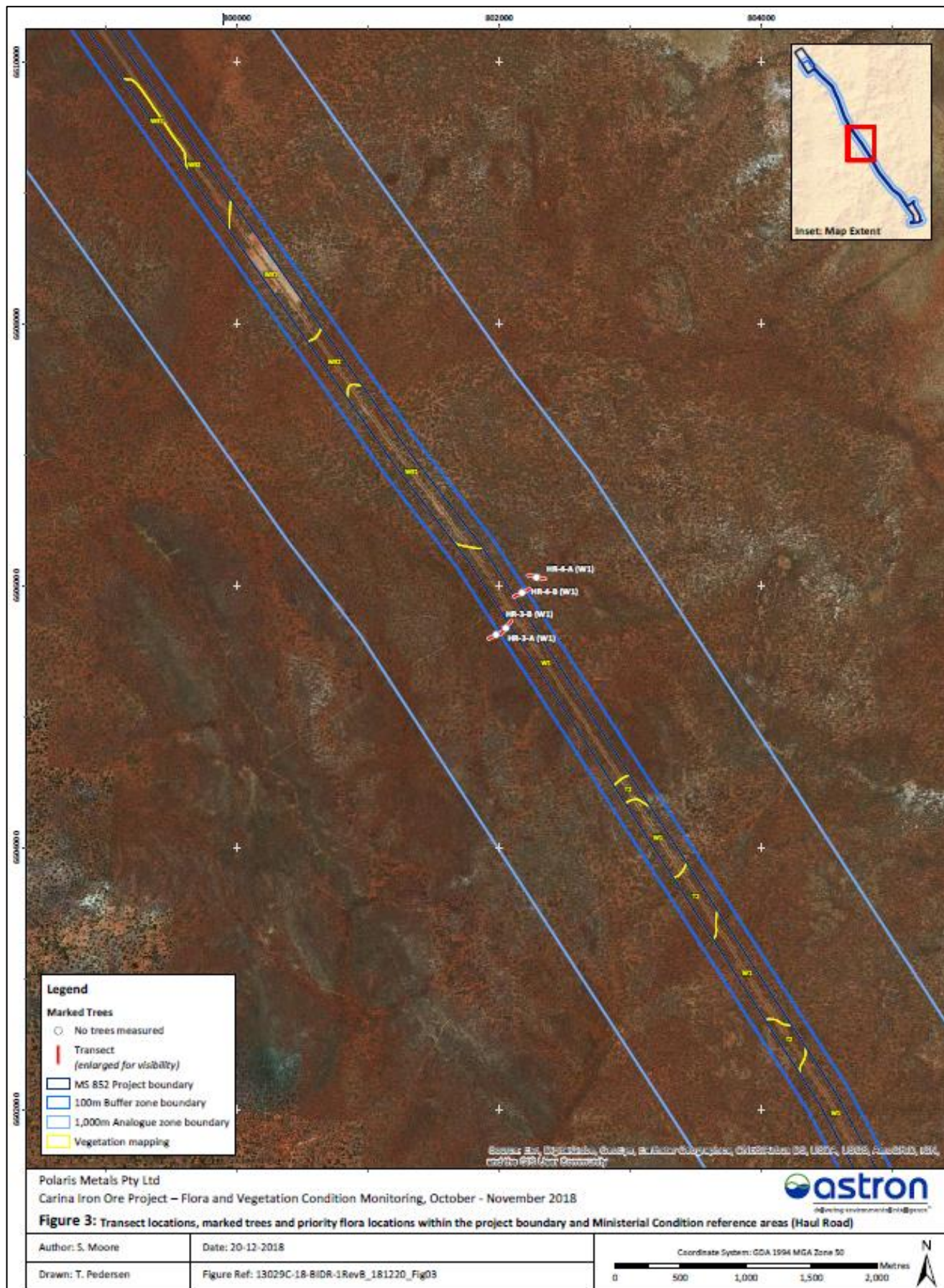


Figure 6: Carina Flora and Vegetation Monitoring Transect Location (Central)

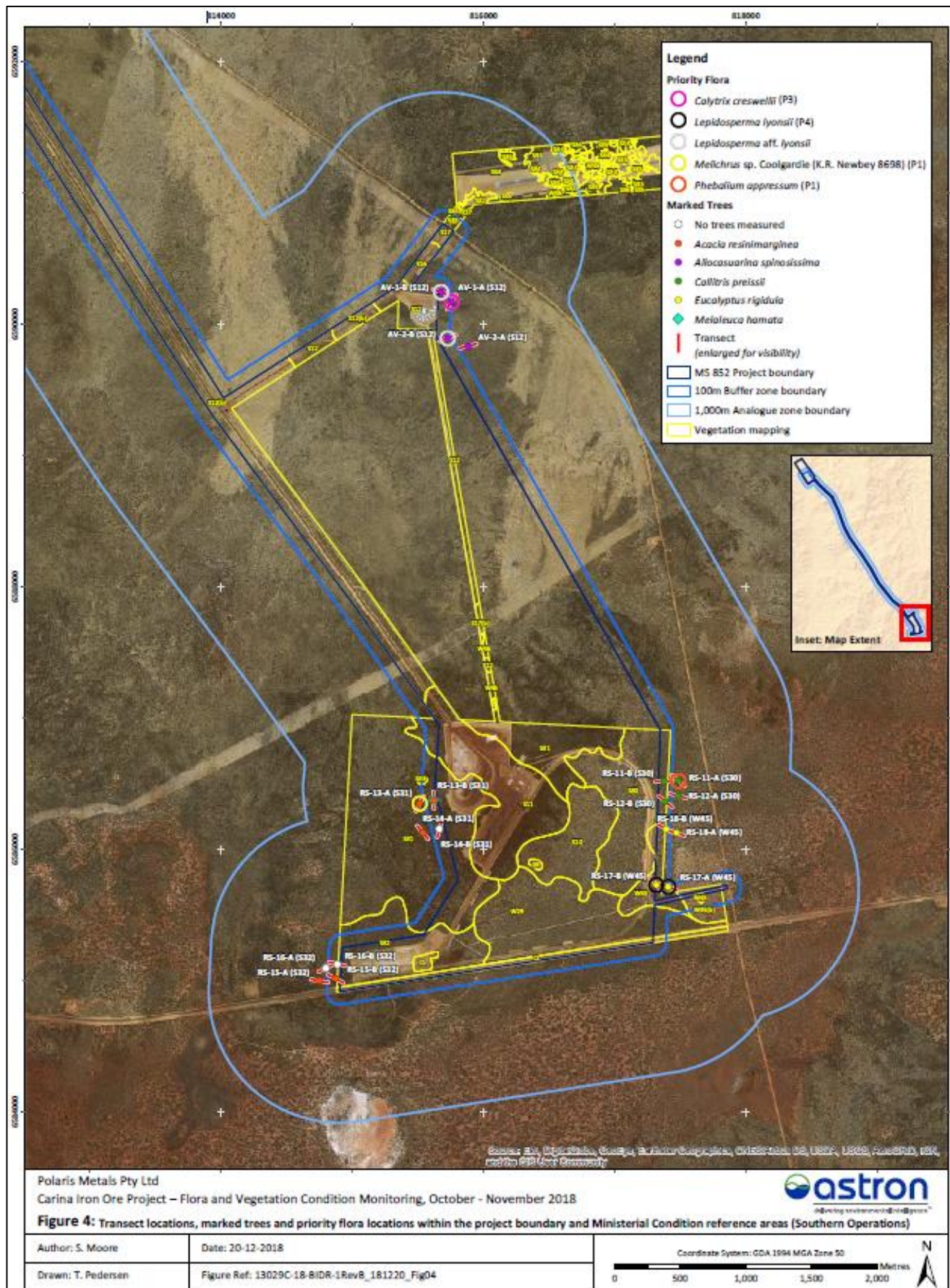


Figure 7: Carina Flora and Vegetation Monitoring Transect Location (South)

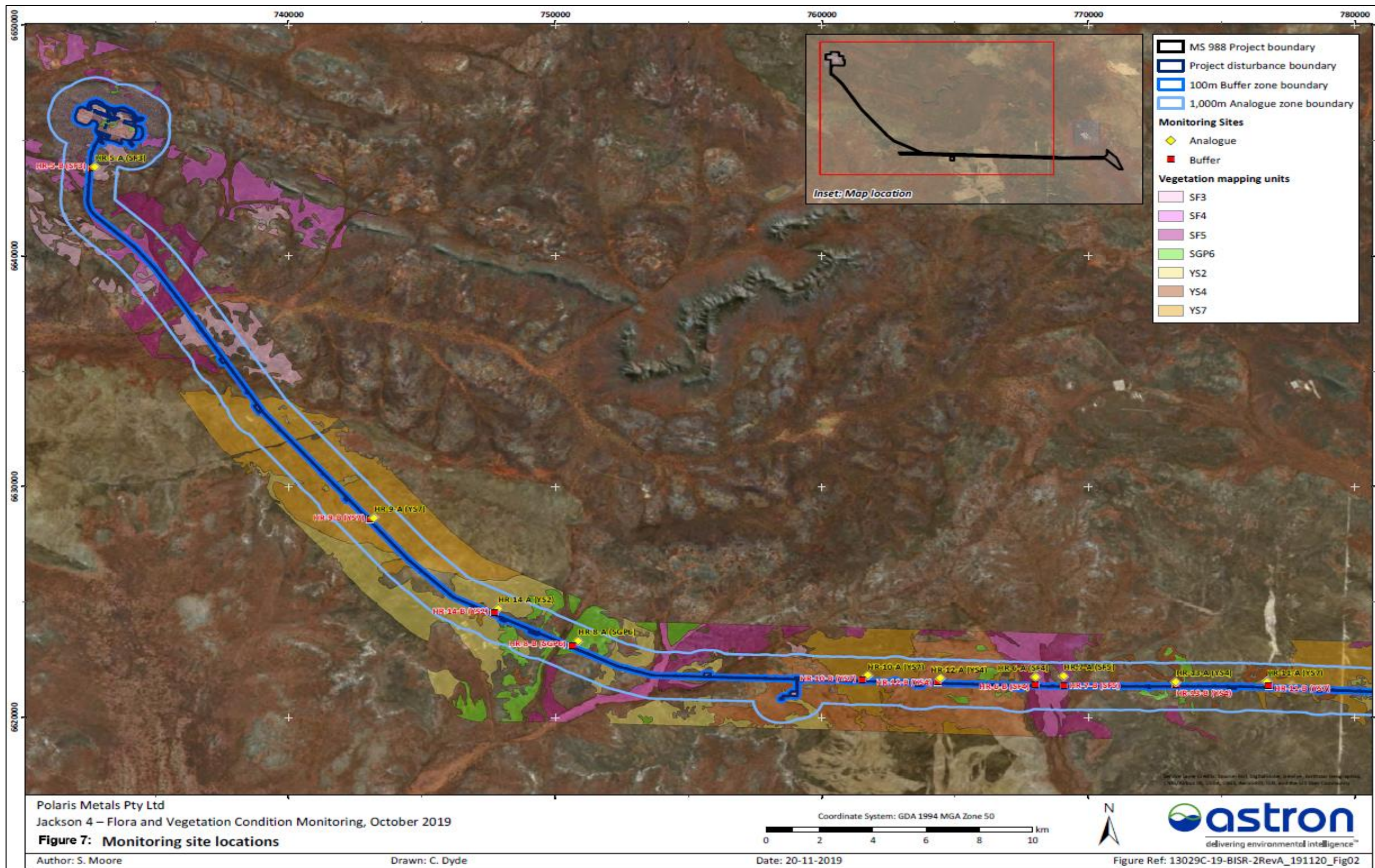


Figure 8: J4 Flora and Vegetation Monitoring Transect

5. ADAPTIVE MANAGEMENT AND REVIEW

Polaris will assess compliance with this PEMP as part of the annual compliance review required by Condition 4-6 of MS 852 and MS 988 and submit an annual Compliance Assessment Report (CAR) to DWER separately for the Carina and J4 (as annual reporting is approval-date based) unless otherwise approved by DWER. The CAR will document any exceedances or failure to achieve management targets and amendments to or inclusion of additional management actions to management targets.

Where a management target is not met, Polaris will review and revise the management actions and identify additional management actions and implement as required to meet the management target and the condition environmental objective as per Condition 5-4 and 5-5 of MS 852 for Carina and 6-4 of MS 988 for J4. Where necessary, management targets will be reviewed and revised. This PEMP will be reviewed every three years as required by Condition 9-3 of MS 852. Updated versions of the PEMP will be forwarded to DWER for review and approval.

Review processes for the PEMP will be based on formal dates as required by MS 852 and MS 988 and triggers such as:

- Monitoring results: If vegetation condition and/or weed monitoring results indicate that management targets are not being achieved.
- Changes in knowledge: If additional information about the flora, vegetation or fauna of the region is received that would better inform management approaches.
- Significant changes to the project: The relevance and effectiveness of management measures would be considered.

If management targets for weed status, feral animals, or vegetation condition as a result of impacts from saline dust suppression, inadequate hygiene, unauthorised access or excessive or accidental clearing, Polaris will implement an appropriate management response which will involve review of data to identify potential causes. If necessary, appropriate remedial actions will be developed and implemented.

6. REPORTING

To address Condition 9-3, Condition 9-4 and Condition 9-5 of Ministerial Statement 852 refer to **Table 13**.

Table 13: Reporting Obligations

Condition	Action	Time Frame
9-3	Polaris will review and revise the Project Environmental Management Plan	Intervals not exceeding three years.
9-4	Polaris will report to the CEO on implementation of the Project Environmental Management Plan	Every two years from the date of commencing ground disturbing activities
9-5	Polaris will make the Project Environmental Management Plan publicly available in a manner approved by the CEO.	Within seven days of receiving a request for information from a stakeholder.

7. STAKEHOLDER CONSULTATION

Polaris have undertaken stakeholder engagement to ensure internal and external communications are maintained to facilitate effective environmental management and ensure open and constructive dialogue with stakeholders.

This PEMP is an update to the 2017 PEMP and includes updates based on feedback. Previous versions of the PEMP were approved in 2011 and 2014. This version of the PEMP (2020) includes the J4 project environmental management and monitoring relevant to Condition 6-2 of MS 988, but it does not represent a significant change to the current management actions on site or the existing PEMP.

The key stakeholders for the update of this PEMP are DWER - EPA Services and DBCA – Environmental Management Branch (EMB). Polaris consulted with both EPA Services and DBCA EMB to create and implement the proposed overarching PEMP and received advice 27 February 2020 approving the combination of Carina and J4 projects.

There are limited other stakeholders in relation to environmental management for the Carina and J4 Projects and as such there has been minimal stakeholder consultation in relation to this PEMP. Those consulted during this update are limited to DWER and DBCA. Other stakeholders for the mining operation itself are listed in **Table 1**.

Table 1: Stakeholder Engagement

Condition	Action	Time Frame
Department of Biodiversity Conservation and Attractions:	- Ecological reports supplied. - Draft PEMP (2017) supplied for review and advice.	Draft PEMP (2020) updated based on written feedback
Environmental Management Branch	Submission of revised Carina and J4 Vegetation and rehabilitation Monitoring Plan – Draft to DBCA for review and comment.	No comment was received back from DBCA on draft plan. The plan was finalised in 2019.
Department of Water and Environmental Regulation	Compliance Inspection - L8596/2011/1 date, 22 November 2018	Single action to remove contaminated rainwater from single self-bundled pallet. Action closed out 6 February 2019.
	- Meetings to discuss requirements of 2020 PEMP - Draft 2017 PEMP supplied	Draft PEMP updated based on feedback
	Letter of Notice of non- compliance with Conditions 9-4, 10-1(1), 10-1(4) 11-1(7) and 11-1(8) of Statement 852 date, 15 July 2019	- Polaris letter dated, 9 August 2019 responding to actions. - Astron Consulting gap analysis on the effectiveness of weed hygiene management measures detailed in the approved Project Environmental Management Plan provided to DWER on 6 December 2019.
	Consultation with DWER to discuss the integration of the J4 into the revised Carina PEMP.	Polaris advised on 27 February 2020 to proceed and submit a revised 30 April 2020.
	Document Review Comments from DWER review of Carina and Jackson 4 Iron Ore Project's PEMP, 30 April 2020.	- Minor amendments required - DWER request to include Astron's gap analysis of Project Environmental Management Plan provided to DWER on 6 December 2019

Condition	Action	Time Frame
		and their recommendation of an additional annual weed survey and control during March – September.
	DWER review of Carina and Jackson 4 Iron Ore Project's PEMP	DWER request on 5 July 2020 to correct spelling and clarify the management action for "limiting unauthorised access to mine".
	DWER review of Carina and Jackson 4 Iron Ore Project's PEMP	DWER request on 6 July 2020 to update the Document control table date of submission
	DWER review of Carina and Jackson 4 Iron Ore Project's PEMP	DWER request on 9 July 2020 to clarify how the PEMP addresses condition 6-2: "The proponent shall ensure that the design, construction and operation of the Haul Road does not impact the surrounding environment and existing infrastructure from the effects of: surface water flow impedance."
	DWER review of Carina and Jackson 4 Iron Ore Project's PEMP	DWER request on 28 July 2020 to include a section on reporting requirements.
	DWER review of Carina and Jackson 4 Iron Ore Project's PEMP	DWER request on 18 November 2020 to revise PEMP monitoring of dieback and feral animal to meet SMART principles and update management actions for saline water management.
The Department of Mines, Industry Regulation and Safety	Approval of Carina Mine Closure Plan (MCP) dated, 5 January 2018.	- Condition of approvals outlined the requirement to submit a revised combined J4 and Carina MCP in 2019. - Submission of revised Mine Closure Plan date, 5 May 2019.
	Environmental inspection dated, 4 April 2018.	No Actions
	Environmental inspection dated, 29 May 2019.	- Provide evidence to close out identified general housekeeping actions. - Prepare Care and Maintenance plan (Submitted, 13 September 2019)
	District Inspector of Mines inspection dated, 9-10 October 2019	Close out actions identified in audit through DMIRS – SRS online system on-going.
	Submission of consolidated Carina Yilgarn MCP to address DMIRS 2018 approval conditions. MCP submitted 03 May 2019.	MCP still under assessment.

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Mineral Resources Limited

20 Walters Drive
Osborne Park Perth 6017

Locked Bag 13, Osborne Park DC, WA 6916

P +61 8 9329 3600

E reception@mineralresources.com.au

W www.mrl.com.au

Appendix B – Carina and J4 2023 Weed Control and Management Report (Workpower)

Mineral Resources

Carina Operations Weed Management Report

January 2024

Workpower





Workpower Environmental Services

784 Forrest Road
Forestdale WA 6112

Phone: 9375 4950

Email: environmental@workpower.asn.au

Workpower acknowledges and respects the Traditional Owners of country throughout Australia, and their connection to land, sea, and community.

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Executive Summary

Workpower undertook the weed control and data collection program on the Carina tenements on two separate periods in July and September 2023. During these trips our staff undertook spraying of various weed species using ute mounted spray units and backpack sprayers to control weeds across the sites and collect data into this weed control activities and weeds presence. Weed species abundance and presence data was collected using a custom app on the Fulcrum platform which recorded several attributes on their species, abundance, location etc. This data was provided to Mineral Resources Environmental staff with this report so that the abundance of these weed species can be tracked over time.

Weed abundance and severity were recorded as minor across most of the Carina sites with only the Carina camp showing moderate weed abundance. Continued weed control and data collection at all the sites in the Carina tenement will ensure that these weed abundance levels remain minor and not increase size or location. Continued focus of weed control efforts in areas of high traffic (such as offices, camps, and workshops) will reduce the risk of weed seeds spreading to other areas of the Carina tenements.

Introduction

Workpower was contracted by Mineral Resources in April 2023 to undertake the Carina Operations Weed Management Plan Annual Monitoring, Control and Reporting contract for the Carina operations in the Carina, Mt Jackson Haul and J4 locations.

This scope of work would cover the following site locations:

- Carina North
- Carina South – including Camp, ROM, Train loader, East Jaurdi Aerodrome and associated infrastructure
- J4 operations
- Carina and Mt Jackson haul roads

The Scope of Work comprises the following assessment and reporting activities:

- Planning and undertaking (a minimum of two) field programs consisting of monitoring and control actions for targeted and identified weed occurrences across the project boundary
- Incorporate weed species distribution data and control activities with the Weed Register
- Review and update of the Yilgarn Operations Weed Management Plan
- Where relevant, supply and maintenance of consumables, monitoring equipment, and modelling software required for the Services
- Provision and management of all Personnel required for the Services
- Provision of safety, environmental and quality assurance plans (if required), and
- Attendance at meetings and provision of progress reports as the Services are carried out.

Workpower undertook two weed control and data collection trips (using these staff) for the Carina package which included from:

- 3rd to 11th of August 2023 (Chris Rollings and William McAlpine)
- 11th to 16th of September 2023 (Chris Rollings and Kieran Bunter).

Methodology

Data Collection

As part of the scope of work, Workpower undertook the data collection of weed species across the site and records of weed treatment as part of the contract. This involved the collection of data on weed species using an app developed using the Fulcrum platform. This program is an online app which allows the creation of customised worksheets within the app to be used to collect data on weed control activities, weed species present and weed plant abundance counts/estimations. Using this app, field workers record a GPS location and several parameters (Table 1) related to the work being carried out using an Android or Apple phones. This information was stored offline and synchronised with the database (in Fulcrum data cloud) when internet connectivity was available. Each individual record contains all the parameters listed (Table 1), though some parameters may be left blank. Data collected while treating weeds at the Yilgarn and Carina MRL project areas includes the following details, with a brief description of each parameter provided.

Table 1: Data parameters recorded in Fulcrum app with description of parameters.

Data Parameter	Description
Record Creator:	The app user who made the report
Latitude:	Spatial information
Longitude:	Spatial information
Package:	Project information
Area:	Project information
Work Site:	Project information
Operators:	The field workers at the work site
Date:	Project information
Observed Weeds:	Each identified weed species observed
Weed abundance:	Binned weed counts/estimates (e.g. 1-10 weeds=1)
S22:	Declared pest status
Treatment Method:	Treatment information
Herbicide:	Chemical information
Formulation:	Chemical information
Other Information:	Optional extra space for reporting
Presence of previously reported weeds:	Weeds known from previous years
Photos:	Photos of weeds/weed treatment

A status may also be set which identifies whether the weed control is a first application or a follow up treatment and whether weeds have been successfully controlled from previous treatments. Photos taken using the app may be attached to each individual record, providing visual information about the weeds in the treatment area. This data set is stored in Fulcrum's database (via syncing app which uploads data to Fulcrum cloud when phone or wifi signal is available onsite) and then downloaded into Workpower's servers after each trip. This dataset and attached photos are provided to Mineral Resource staff along with the Weed Management Report with the monitoring report. Weed abundances were recorded using codes (Table 2), with the weed abundance counts/estimates were grouped into ranges. These weed abundance ranges were also subjugated into infestation classes (Table 2) which were referred to in the document as minor, moderate or major infestations. Chemicals used for the control of weeds were also recorded in the app using different codes which are listed in Workpower quote document.

Table 2: Weed data entry codes, their associated abundance ranges and infestation classes

Code	Weed abundance ranges	Weed infestation classes
1	<10	Minor
2	11-50	Minor
3	51-100	Moderate
4	>100	Moderate
5	>500	Moderate
6	>1000	Major
7	>5000	Major
8	>10 000	Major

Data analysis

Data collected onsite using the Fulcrum app has been extracted and packaged as an excel spreadsheet and one ESRI shapefile per work site. Maps of each work area (Appendix 1) have been produced with ArcGIS pro using the data collected from the Workpower weed control app powered by Fulcrum.

Analysis of this data was completed by Workpower staff to look at the following attributes:

- Presence of previously unrecorded weed species
- Effectiveness of weed treatments
- Abundance and intensities of weed species per site location, and
- Locations of weed species and possible movement or spread of weeds across the sites.

Mapping

Data collected while controlling weeds is represented graphically. A map is produced for each work site (Appendix 1) which shows locations of weeds, species identified and abundance of each weed (abundance ranges described in Table 2) in the area where the observation is made. The ESRI ArcGIS online platform is used for map production.

Weed Control Implementation

Weed control on the Mineral Resources sites were carried out using a Landcruiser ute with a Quickspray® Twinspray unit mounted on the tray. Backpack sprayers were also used for areas not practical to spray using spray unit hoses. All weed control operators had current pest management licenses and are trained in plant identification, chemical application, mixing and transportation. Each vehicle had Safety Data Sheets (SDS) files containing specific information about all the chemicals used on the program and fully stocked chemical spill kits on board.

Workpower staff undertook daily meetings (either in the office or via phone calls) with Mineral Resource site Environmental staff to discuss priorities for weed control for the day, site access for different zones, expected weather not suitable for spraying, safety documentation (risks of different areas) and travel management through remote areas. These meetings ensured that the weed control and data collection program was undertaken in an efficient and safe manner in accordance with Mineral Resources safety procedures.

Chemicals used to treat weeds onsite during the program included glyphosate, metsulfuron, penetrant and indicator dye. Glyphosate was initially applied at a rate of 1%, with 0.1% penetrant (Pulse) and 0.2% red chemical dye. In the second weed control trips in Spring, the chemical rates were changed slightly (to provide better knockdown rates), with glyphosate applied at a 1.5% rate, with 0.1% pulse, 12g metsulfuron/500 L and blue chemical indicator. The use of Pulse® in the Yilgarn and Pilbara regions as a penetrant for herbicide has been shown to be particularly successful for control of weeds such as Kapok and Ruby Dock (Anthony and Dixon 2006). The use of Pulse ensures an adequate delivery of the Glyphosate and metsulfuron chemicals into the weed plants vascular system through improved uptake into the leaves through stomatal flooding and penetration.

Glyphosate is a non-selective herbicide which does not persist in the soil and is effective at killing weed species while not being highly toxic to the operators. Pulse penetrant aids herbicides effectiveness by increasing the permeability of the plant's surfaces. Metsulfuron is a herbicide used for control of weeds with the ability to resprout and has minor pre-emergent weed control effectiveness, suppressing weed growth for weeks after it is applied. Chemical indicator dye does not contribute to weed control and is used to mark weeds which have been treated. The red dye was changed to blue dye in the Spring trips due to the colour blue able to be seen easier than the red dye with the background of the red soil across the sites.

The application of chemicals on the contract was undertaken using a hose pressure application that was kept to a level that prevents excessive spray drift, thus avoiding damage to surrounding vegetation via spray drift. Extreme care was taken during works to avoid off-target damage to trees, shrubs, and other native vegetation.

Spraying of weeds ceased immediately under the following weather conditions (unless given approval by the client):

- Wind stronger than 15km per hour
- Temperatures greater than 34 degrees Celsius
- Rain
- When there is the possibility of rain within 4 hours (this time limit can be reduced to 45mins with the use of Pulse)
- If the Delta T reading is below 2 and above 10 degrees Celsius.

Workpower technicians have extensive experience in identifying native and introduced plant species which is extremely important when undertaking weed control activities in bushland habitats.

The following operating procedures and processes are employed to apply herbicides:

- Ensure weather conditions are suitable for the spray technique, site and chemicals to be used
- Erect suitable signage (approved health department caution signs) at all major entrances and access ways prior to spraying
- Select the least toxic chemical to perform the work and the most suitable chemical for the weed species to be controlled
- Use measuring containers for all liquid herbicides and scales for accurately measuring granulated herbicides
- Ensure the identity of any priority species known to occur in the area is clear
- Ensure the presence/absence of susceptible, non-target species is known prior to commencing work
- Ensure the locations of sensitive habitats are known, and
- Ensure all SWMS or other safety documentation have been completed before work commences onsite.

Manual weed control was undertaken in several locations around the Koolyanobbing camp for the control of *Opuntia stricta* by cutting off smaller saplings as close to the ground as possible with either loppers or hand saws and spraying chemical mix to the stump of the shrubs/trees and to branches and leaves cut off and left in situ.

Vegetation material cut during the process of woody weed control remained in situ (as there were no options for removal of weed species from site) and follow up weed control visits to this cut material would need to be undertaken to ensure there has been no regrowth of this material in the future.

Results

A summary of the results (Table 3) of the weed control and data collection program for each site tenements for the Carina contract is provided which includes:

- Site and tenement location
- Weed infestations abundance
- Weeds recorded in the tenement
- New weed infestations for tenements and contract area, and
- Comments and observations of the weed control and data collection program.

The Carina tenements had minor weed coverage across many of the sites with only a moderate weed abundance shown to occur at the Carina camp. The majority of weeds present across all sites were recorded in areas where water pools and around buildings and equipment. A few sites in the Carina package were not visited due to weather conditions, access issues and low priority for weed control in certain areas due to known minor weed populations. No new weed species introductions to the Carina tenements were recorded during the program

Table 3: Summary of weed control activities

Site	Location	Infestation	Weeds present	New weed species introductions	Comments and observations
Carina Southern Operations	Accommodation camp	Moderate	<i>Brassica sp, Sonchus asper, Sonchus oleraceus</i>		Weeds present throughout camp
	A Run of Mine	Minor	<i>S. asper, S. oleraceus Ehrharta sp, Hypochaeris radicata</i>		Weeds present around buildings and infrastructure
	Warehouse	Minor	<i>S. asper, S. oleraceus, Conyza bonariensis</i>		Weeds present around buildings and infrastructure
Carina Northern Operations	Two large waste rock dump formations	Minor	<i>S. asper, S. oleraceus, Charictera annua and R. vesicarius</i>		Weeds found in and around catch berms and drainage features
Mt Jackson J4	Two Waste Rock Landforms (East and West WRLs)	Minor	<i>S. asper, S. oleraceus, Arctotheca calendula, Mesembryanthemum nodiflorum</i>		Weeds found in and around catch berms and drainage features
	Topsoil stockpiles	Minor	<i>R. vesicarius, A. calendula, S. asper, S. oleraceus</i>		
Carina – Mt Jackson Haul rd	Carina Southern – Carina Northern Bitumen Haul Road, approx. 50km	Minor	<i>S. asper, S. oleraceus, A. calendula</i>		Weeds located near rest stop
Carina haul road	Carina haul road	Minor	<i>R. vesicarius, S. asper, S. oleraceus A. calendula</i>		Two isolated patches of <i>R. vesicarius</i> and <i>S. asper, S. oleraceus</i> found around culverts

Discussion and Recommendations

The Carina tenement sites were shown to have minor weed populations where much of this abundance was associated with buildings or in areas where water pools. Weed populations on waste rock dumps within the carina scope were minor and similar to abundance and distribution of previous years. Workpower recommends continuing to monitor these areas for weed coverage to ensure that the weed abundance does not increase and continue weed control program in targeted areas where weeds are known to occur.

Keeping areas where people and vehicles pass through clear of weeds will help to reduce the amount of weed seed introduced into other work areas. These areas include mine camps, workshops, rest stops on haul roads and ROMs (if accessible). Continued data collection on all sites (regardless of if weeds are present) will ensure that the weed abundance is tracked over time to ensure that weeds have not spread or increased.

References

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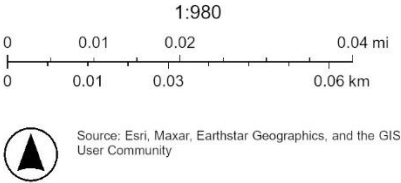
Appendix 1: Figures



08/01/2024
Carina Camp

- Weed Species
- Sonchus spp
 - Conyza bonariensis, Sonchus spp
 - Arctotheca calendula, conyza bonariensis

- Weed Abundance
- <10
 - <100
 - >500
 - >1000





08/01/2024

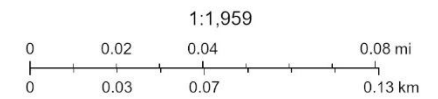
Carina CSI & ROM

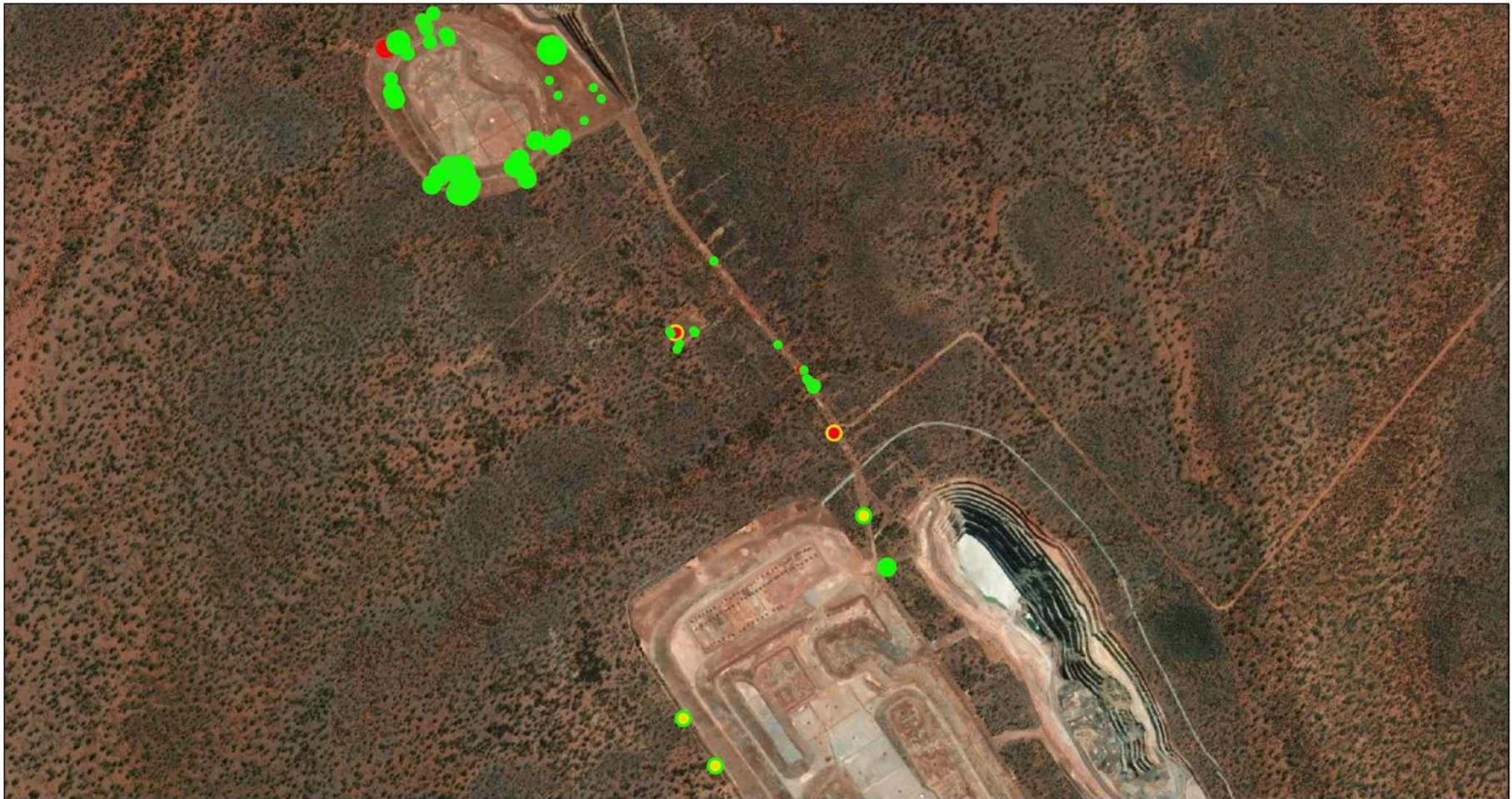
Weed Species

- Sonchus sps, Ehrharta sp
- Sonchus sp
- Ehrharta sp
- Arctotheca calendula, Ehrharta sp
- Conyza bonariensis, Ehrharta sp

Weed Abundance

- <10
- <50
- <100
- >100





08/01/2024

Carina East WRD

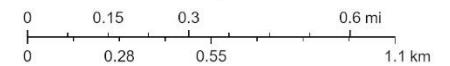
Weed Species

- Rumex vesicarius
- Rumex vesicarius, Solanum hystrix
- Sonchus spp
- Solanum hystrix, Sonchus spp

Weed Abundance

- <10
- <50
- >50
- >500

1:15,673



Maxar



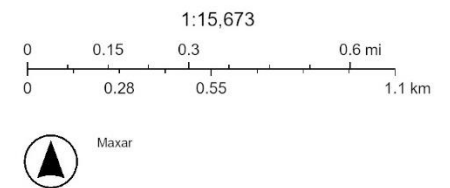
08/01/2024
Carina WRD

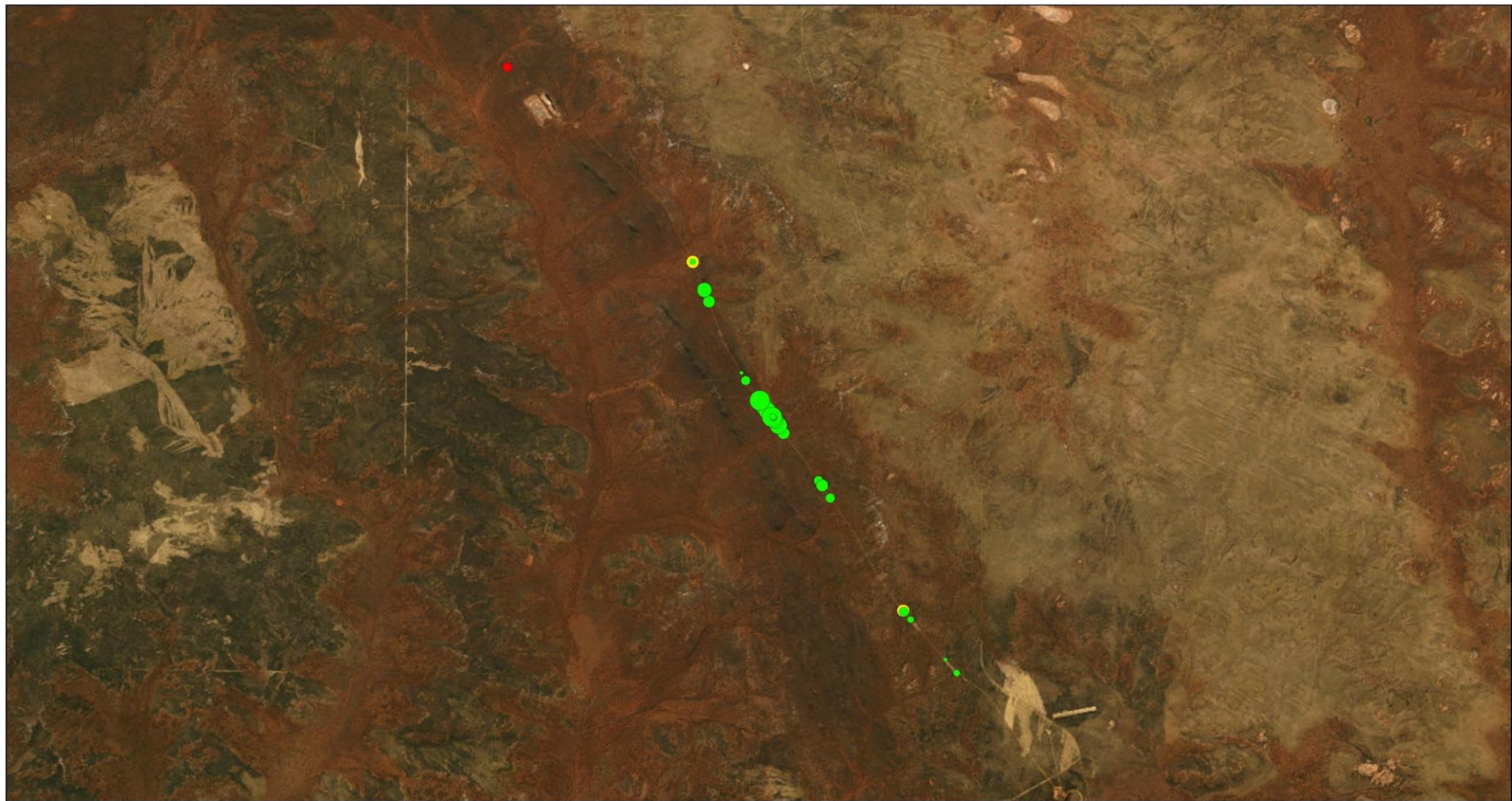
Weed Species

- Sonchus sps
- Arctotheca calendula, Sonchus sps

Weed Abundance

- <10
- <50
- > 50
- >1000





08/01/2024

Carina Haul Road

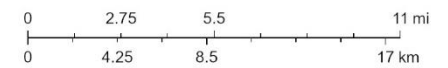
Weed Species

- Rumex vesicarius
- Sonchus sps, Arctotheca canlendula
- Sonchus sps, Solanum hystrix

Weed Abundance

- <10
- <100
- >500
- >1000

1:250,772



Earthstar Geographics



08/01/2024

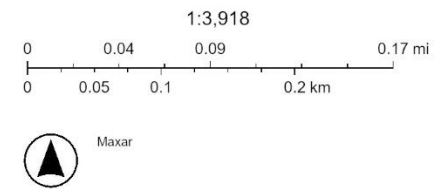
Carina Southern Operations Yard

Weed Species

- Sonchus spp
- Sonchus spp , Conyza bonariensis

Weed Abundance

- <50
- <100
- >100





08/01/2024

J4 Haul Rd

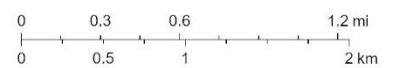
Weed Species

- *Arctotheca calendula*, *Sonchus* sps
- *Sonchus* sps

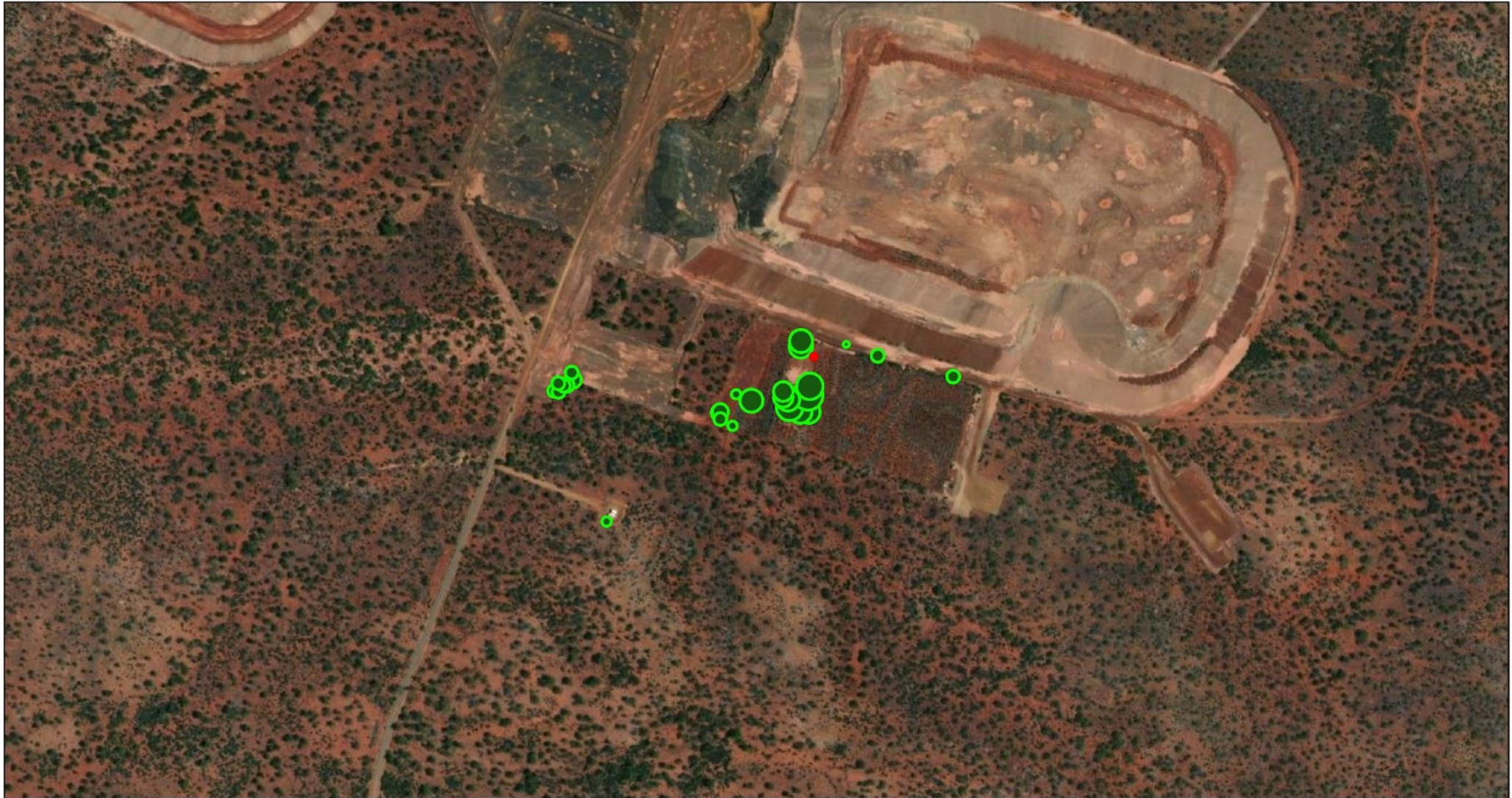
Weed Abundance

- <10
- <50
- > 50
- >1000

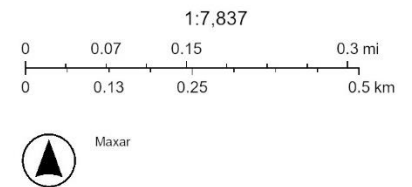
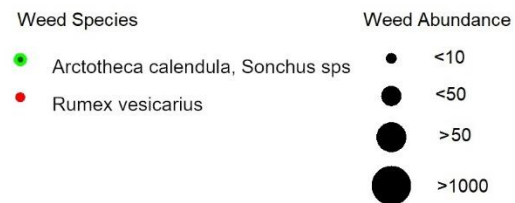
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Earthstar Geographics



08/01/2024
J4 Topsoil Stockpiles





08/01/2024

J4 WRD E

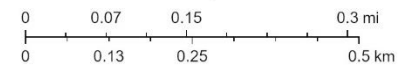
Weed Species

- Sonchus oleraceus
- Mesembryanthemum nodiflorum
- Mesembryanthemum nodiflorum, Sonchus oleraceus

Weed Abundance

- <10
- <50
- >100
- >1000

1:7,837



Maxar



08/01/2024
Mount Jackson WRD W

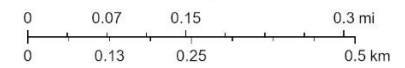
Weed Species

- Mesembryanthemum nodiflorum
- Sonchus sps
- Mesembryanthemum nodiflorum, Sonchus sps

Weed abundance

- <10
- <50
- > 50
- >1000

1:7,837



Workpower

9375 4950

socialenterprises@workpower.asn.au

workpower.com.au

Appendix C – Carina and J4 2024 Weed Control and Management Report (Workpower)

Mineral Resources

Carina J4 Operations

Weed Control & Reporting – Final Report

August & September 2024 Field Trips

Report Submission November 2024

Workpower





Workpower Environmental Services

784 Forrest Road
Forestdale WA 6112

Phone: 9375 4950

Email: environmental@workpower.asn.au

Workpower acknowledges and respects the Traditional Owners of country throughout Australia, and their connection to land, sea, and community.

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Executive Summary

Workpower undertook the weed control and data collection program associated with the Mineral Resources Carina Site in August 2024 with a follow-up visit in September 2024. During both trips our staff undertook spraying of various weed species using a combination of vehicle mounted spray unit and knapsack sprayers focusing on Weeds of National Significance (WONS) across the site in conjunction with collecting data detailing the weed control activities and weeds presence.

Data on weed species density and presence was collected using an app developed on the Fulcrum platform which recorded several attributes on their species, abundance, location etc. This data was provided to Mineral Resources environmental staff with this report so that the abundance of these weed species can be tracked over time.

Introduction

Workpower was contracted by Mineral Resource to undertake the Weed Management Plan, Annual Monitoring, Weed Control and Reporting contract for control of *Rumex vesicarius* and other weed species at the Carina Project which is located 115 kms west of Kalgoorlie.

This Scope of Works included:

- Undertaking weed control and mapping field work across the Carina Operations,
- Targeting Weeds of National Significance (WONS) identified at Carina including: *Tamarix aphylla* (Athel pine) and *Solanum elaeagnifolium* (Silverleaf nightshade),
- Targeting known infestations of *Rumex vesicarius* (Ruby dock),
- Carrying out broad weed survey and control efforts on disturbed areas across the operations, including Camp, Workshop and laydown yards, Waste Dumps, road networks, and all associated mine infrastructure, and
- Providing a report on the activities carried out.

The assessment and reporting activities undertaken included:

- Planning and undertaking of two field programs consisting of monitoring and control actions for targeted and identified weed occurrences across the project boundary,
- Incorporating weed species distribution data and control activities with the Weed Register,
- Where relevant, supply and maintenance of consumables, monitoring equipment, and modelling software required for the services,
- Provision and management of all Personnel required for the services, and
- Provision of safety, environmental and quality assurance plans (if required)

Areas allocated to scope of works;

- Carina Northern Operations
 - Two depleted open cut pits
 - Two Waste Rock Landforms
 - Infrastructure areas
 - Sealed haul road – 50km
- Carina Southern Operations

- Accommodation Camp
- East Jaurdi Aerodrome
- Dry Crushing and screening plant
- Stockyard with associated Stacker and Reclaimers
- Train loader and rail loop
- J4
 - Two active open cut pits
 - Two waste rock landforms
 - Infrastructure areas
- Carina – Jackson Haul Road
 - Carina Southern – Carina Northern Bitumen Haul Road, 50km
 - Carina – Jackson Bitumen Haul Road, 70km

The first field trip took place from the 2nd of August till the 5th of August and was undertaken by Workpower field technicians Christopher Rollings and leesia O’Conner.

The second field trip took place from the 1st of September to the 4th of September and was carried out by Workpower field technicians Brittany Hatchett and leesia O’Conner.

Methodology

Data Collection

Workpower weed control operators mapped locations of weed species across the site and recorded the weed treatment locations during both trips. This involved the collection of data on weed species using a custom app running on the Fulcrum™ platform. Fulcrum™ is an online platform that allows the creation of GIS data collection apps and includes an online database. The Workpower Fulcrum™ app provides customised forms to be used to collect data on weed control activities, weed species present and spray operator estimates of weed abundance. Using this App on an Android or Apple device, weed control operators record a GPS location, and several parameters (Table 1) related to the work being carried out. This information is stored offline and synchronised with the database (in Fulcrum™ data cloud) when internet connectivity is available. Each individual record contains all the parameters listed (Table 1), however some parameters may be left blank if necessary. Data collected while treating weeds on Mineral Resources project areas includes the following details, with a brief description of each parameter in the table below:

Table 1: Data parameters recorded in Workpower app

Data Parameter	Description
Record Creator:	The app user who made the report
Latitude:	Spatial information
Longitude:	Spatial information
Package:	Project information
Area:	Project information
Work Site:	Project information
Operators:	The field workers at the work site

Date:	Project information
Observed Weeds:	Each identified weed species observed
Weed abundance:	Weed count range estimates (e.g. 1-10 weeds=1)
S22:	Declared pest status
Treatment Method:	Treatment information
Herbicide:	Chemical information
Formulation:	Chemical information
Other Information:	Optional extra space for reporting
Presence of previously reported weeds:	Weeds known from previous years
Photos:	Photos of weeds/weed treatment

A status may also be set within the form which identifies whether the weed control is a first application or a follow up treatment and whether weeds have been successfully controlled from previous treatments. Photos taken using the app are automatically attached to each individual form, providing visual information about the weeds in the treatment area. Data is stored in Fulcrums database via the syncing app which uploads data to Fulcrum cloud when phone or Wi-Fi signal is available on site and the data is then downloaded into Workpower's servers after each trip. This dataset and attached photos are provided to Mineral Resource staff along with the Weed Management Report. Weed abundances were recorded using codes (Table 2), with the estimated weed abundance grouped into ranges. Chemicals used for the control of weeds were also recorded in the app using different codes which are listed in Workpower quote document.

Table 2: Weed data entry codes, their associated abundance ranges

Code	Weed abundance ranges
1	From 1 to 10 weeds
2	11 to 50 weeds
3	51 to 100 weeds
4	101 to 500 weeds
5	501 to 1000 weeds
6	More than 1000 weeds
7	Other

Data analysis

Data collected onsite using the Fulcrum app has been extracted and packaged as an excel spreadsheet and one ESRI shapefile per work site. Maps of each work area (Appendix 2) have been produced with ArcGIS online using the data collected from the Workpower weed control app.

Analysis of this data was completed by Workpower staff to look at the following attributes:

- Presence of previously unrecorded weed species,
- Effectiveness of weed treatments,
- Abundance and intensities of weed species per site location, and
- Locations of weed species and possible movement or spread of weeds across the sites.

Mapping

Data collected during weed control visits is represented graphically. A map is produced for each work site (Appendix 2) which shows locations of weeds and species identified. ESRI ArcGIS online is used for map production.

Weed Control Implementation

An ISUZU mine spec 4WD Ute with a mounted Quickspray Twin spray unit was used by Workpower to control weeds at Carina J4 Operations. Backpack/Knapsack sprayers are also used for areas that are not practical or unable to be reached to spray using spray unit hoses/Lines (which have a maximum length of approximately 100m).

All weed control operators have current pest management licenses through the Department of Health and are trained in plant identification, chemical application, mixing and transportation. The vehicle has Safety Data Sheet (SDS) files containing specific information about all the chemicals used on the program and fully stocked chemical spill kits.

Chemicals used to treat weeds onsite during the program included glyphosate, metsulfuron methyl, penetrant and indicator dye. Glyphosate is applied at a 1.5% rate, with 0.1% pulse, 12g metsulfuron/500 L and blue chemical indicator dye.

The use of Pulse® in this region as a penetrant for herbicide has been shown to be particularly successful for control of weeds such as Kapok and Ruby Dock (Anthony and Dixon 2006). The use of Pulse ensures an adequate delivery of the Glyphosate and metsulfuron chemicals into the weed plants vascular system through improved uptake into the leaves through stomatal flooding and penetration

Glyphosate is a non-selective herbicide which does not persist in the soil and is effective at killing weed species while not being highly toxic to the operators. Pulse penetrant aids herbicides effectiveness by increasing the permeability of the plant's surfaces. Metsulfuron is a granule herbicide used for control of weeds with the ability to resprout and has minor pre-emergent weed control effectiveness, suppressing weed growth for weeks after it is applied. Chemical indicator dye does not contribute to weed control and is used to mark weeds which have been treated. Blue dye is used to contrast with the background of the red soil across the sites.

The application of chemicals on the contract is undertaken using a low-pressure/ larger droplet application that prevents excessive spray drift, thus avoiding damage to surrounding vegetation via spray drift. Extreme care was taken during works to avoid off-target damage to trees, shrubs, and other native vegetation.

Spraying of weeds would cease immediately under the following weather conditions:

- Wind stronger than 15km per hour
- Rain
- When there is the possibility of rain within an hour (this time limit can be reduced to 45mins with the use of Pulse)
- If the Delta T reading is below 2 and above 10 degrees Celsius.

Workpower technicians have extensive experience in identifying native and introduced plant species which is extremely important when undertaking weed control activities in bushland habitats.

The following operating procedures and processes are employed to apply herbicides:

- Ensure weather conditions are suitable for the spray technique, site and chemicals to be used,
- Erect suitable signage when possible (approved health department caution signs) at all major entrances and access ways of control area prior to spraying,
- Select the least toxic chemical to perform the work and the most suitable chemical for the weed species to be controlled,
- Use measuring containers for all liquid herbicides and scales for accurately measuring granulated herbicides,
- Ensure the identity of any priority species known to occur in the area is clear,
- Ensure the presence/absence of susceptible, non-target species is known prior to commencing work,
- Ensure the locations of sensitive habitats are known, and
- Ensure all SWMS or other safety documentation have been completed before work commences onsite.

Workpower staff attended daily meetings with Mineral Resource site Environmental staff to discuss priorities for weed control for the day, site access for different zones, weather forecasts and weather suitability for spraying, safety documentation and travel management through remote areas. These meetings ensure that the weed control and data collection program is undertaken in an efficient and safe manner in accordance with Mineral Resources safety procedures.

Results

Workpower Field App data has been used to map the distribution and abundance of weeds within the Carina tenement. Summaries of the field data are presented in table format for each trip and work area.

Carina J4 Operations - Trip 1 (Aug)	
Weed genus and species	Common name
<i>Sonchus sp.</i>	Sow thistle
<i>Rumex vesicarius</i>	Rubydock
<i>Arctotheca calendula</i>	Capeweed
<i>Mesembryanthemum nodiflorum</i>	Slender ice plant
<i>Solanum hystrix</i>	Afghan thistle
<i>Hordeum leporinum</i>	Barley grass
<i>Sisymbrium irio</i>	London rocket
<i>Brassica sp.</i>	Brassica
<i>Conyza bonariensis</i>	Fleabane
<i>Ehrharta calycina</i>	Veldt grass
<i>Carthamnus lanatus</i>	Saffron thistle

Carina J4 Operations - Trip 1 (Aug)		
Work Area	Average Weed Abundance per treatment area	Areas Weed Treated
Camp Average	From 11 to 50 Weeds	94
Carina extended waste dump Average	From 11 to 50 Weeds	41
Haul road Average	From 101 to 500 Weeds	3
j4 comms Average	From 11 to 50 Weeds	7
Office Average	From 1 to 10 Weeds	1
ROM Average	From 51 to 100 Weeds	7
Southern operations around warehouse Average	From 101 to 500 Weeds	8
Topsoil stockpiles Average	From 51 to 100 Weeds	5
Waste dump Average	From 11 to 50 Weeds	16
Wrd Average	From 11 to 50 Weeds	8
WRDE Average	From 51 to 100 Weeds	13
Grand Average	From 11 to 50 Weeds	202

Weed control works were recorded at 202 locations on the first Carina visit in August. Out of this total, 94 records were from the camp and 41 were from the Carina extended waste dump. Average weed abundance was 11-50 weeds per patch at the Camp and 11-50 per patch at the Carina Extended Waste dump.

Carina J4 Operations - Trip 2 (Sept)	
Weed genus and species	Common name
<i>Sonchus sp.</i>	Wards Weed
<i>Mesembryanthemum nodiflorum</i>	Prickly sow thistle
<i>Arctotheca calendula</i>	slender ice plant
<i>Rumex vesicarius</i>	Ruby dock
<i>Hordeum leporinum</i>	Barley grass
<i>Centaurea melitensis</i>	Maltese cockspur
<i>Solanum nigrum</i>	Blackberry nightshade

Carina J4 Operations - Trip 2 (Sept)		
Work Area	Average Weed Abundance per treatment area	Areas Weed Treated
Camp	From 11 to 50 Weeds	20
Carina extended waste dump Average	From 51 to 100 Weeds	40
Haul road Average	From 51 to 100 Weeds	5
ROM	From 1 to 10 Weeds	10
Grand Average	From 51 to 100 Weeds	75

On the second Carina visit, weed control works were recorded at 75 locations. Out of this total, 20 records were from the Camp and 40 were from the Carina extended waste dump. Average weed abundance was 11-51 weeds per patch at the Camp and 51-100 per patch at the Carina Extended Waste Dump. Patches of *Rumex vesicarius*, common name Ruby Dock were found around the Carina Extended Waste Dump on both trips.

Discussion and Recommendations

Weed control operations have reduced weed coverage and abundance across the Carina Sites, indicated by a decrease in reported weed control activities and by feedback from weed control technicians on the second trip. The Carina Camp and Carina Extended waste dump sites continue to have the largest weed populations in the Carina J4 tenement.

The camp has Sow thistle and other common weeds throughout, with a more than 50% reduction in weed coverage after the first trip. The Carina Extended Waste dump had a similar number of weeds reported between the two trips and has a few patches of *Rumex vesicarius* on the waste rock layers on the second trip.

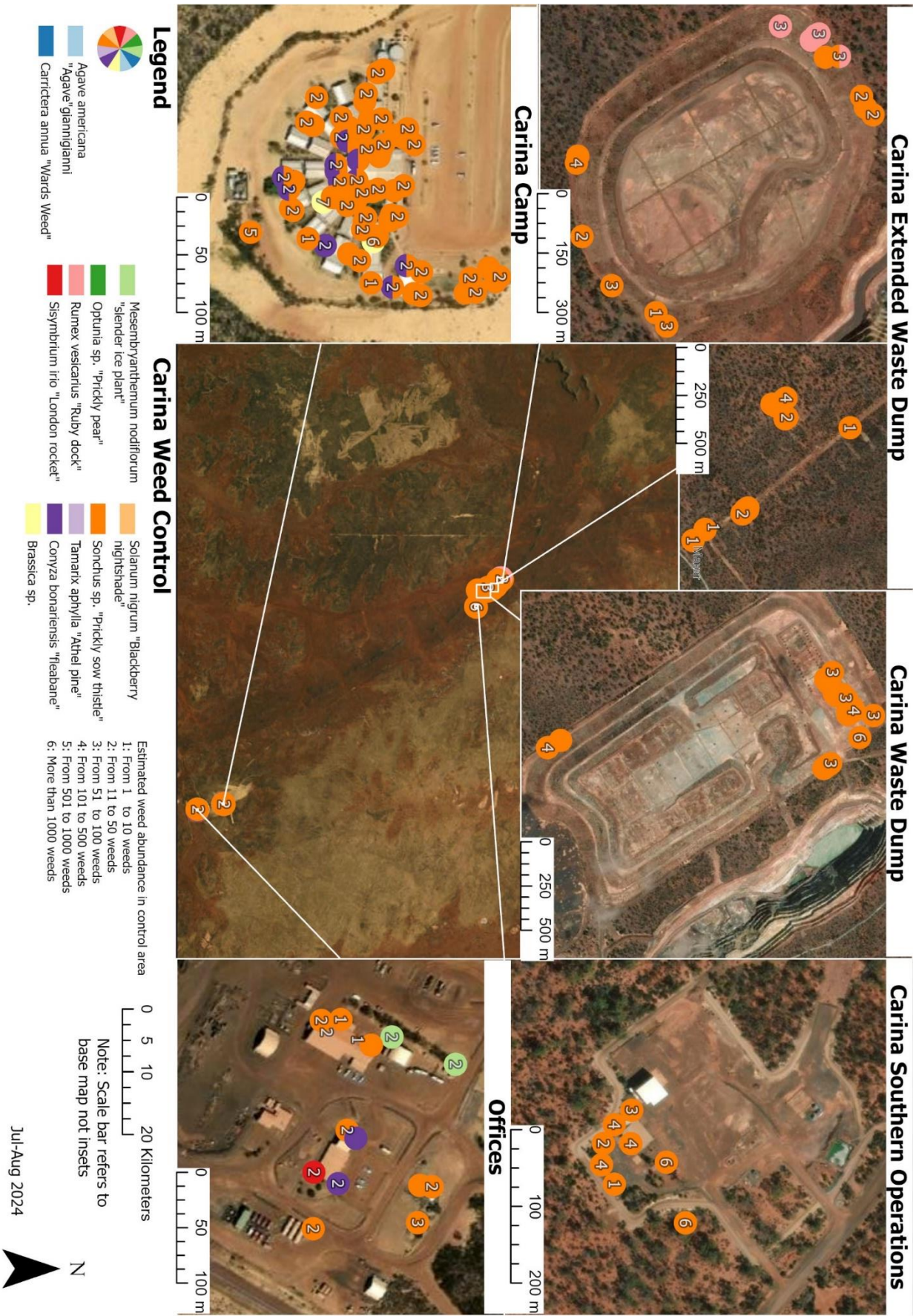
The haul road has improved on previous years with only two reported patches of Sow thistle.

Workpower would recommend continued future weed control applications targeting any regrowth of the mapped weeds to keep the weed density at a minimum. The mapped data of the controlled weeds helps increase efficiency of future weed control events. Bi-annual weed control in August and September is recommended to maintain consistency.

References

Janet M. Anthony and I. R. (Bob) Dixon (2006) Research and development for integrated control of *Acetosa vericaria* (ruby dock) in the Pilbara region of Western Australia. DBCA website: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://library.dbca.wa.gov.au/static/FullTextFiles/063672.pdf

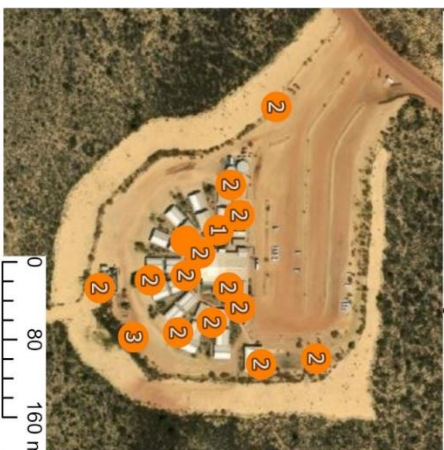
Appendix 1 maps showing the location, species and estimated weed abundance:



Carina Extended Waste Dump



Carina Camp



Haul Road



ROM



Legend

- Agave americana "Agave"
 - Carictera annua "Wards Weed"
 - Mesembryanthemum nodiflorum "Slender ice plant"
 - Optunia sp. "Prickly pear"
 - Rumex vesicarius "Ruby dock"
 - Sisymbrium irio "London rocket"
 - Solanum nigrum "Blackberry nightshade"
 - Sonchus sp. "Prickly sow thistle"
 - Tamarix aphylla "Athel pine"
 - Coryza bonariensis "Elebane"
 - Brassica sp.

Carina Trip 2

- Estimated weed abundance in control area
- 1: From 1 to 10 weeds
 - 2: From 11 to 50 weeds
 - 3: From 51 to 100 weeds
 - 4: From 101 to 500 weeds
 - 5: From 501 to 1000 weeds
 - 6: More than 1000 weeds

0 5 10 20 Kilometers

Note: Scale bar refers to base map not insets

Sept 2024



Appendix D – Carina and J4 2023 Dieback Assessment (Great Southern Biologic)



Phytophthora Dieback Occurrence Survey

Mineral Resources Operations

Carina & J4



Tel: 0400 113 093 • PO Box 5573, Albany, WA, 6332 • Email: info@gsbiologic.com.au • www.gsbiologic.com.au

Phytophthora Dieback Occurrence Survey

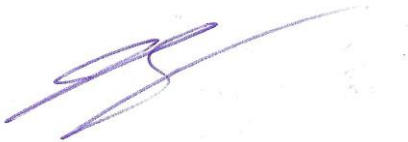
Mineral Resources Operations – Carina and J4

13 December 2023

Produced For Mineral Resources Ltd
20 Walters Drive
Osbourne Park
WA 6017

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Written and submitted by



Jeremy Spencer

Senior Environmental Scientist

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EXECUTIVE SUMMARY

Mineral Resources Limited (MinRes) currently undertake mineral exploration and mining activities at multiple sites across the Shire of Yilgarn and Shire of Menzies. These operations are performed under the guidance of Environmental Management Plans (EMP) designed to satisfy various Ministerial Statements and associated conditions. Operations at the Carina and J4 operations are subject to conditions specified in Ministerial Statements 852, 957 and 988. Specifically, Ministerial Statement 852 requires annual survey for the plant pathogen *Phytophthora Dieback*. Accordingly, surveys have been performed annually since 2021 and this report details the findings from the current 2023 survey.

Phytophthora Dieback is the common name for the disease in native ecosystems caused by plant pathogens from the genus *Phytophthora* (DBCA, 2020). Over 40 species of *Phytophthora* have been detected including *P. cinnamomi*, which is considered one of the greatest threats to plant biodiversity.

The Carina and J4 operations are outside the known occurrence for *P. cinnamomi*, the species generally referred to in Western Australian Government management guidelines and practices. The Vulnerable Zone for *Phytophthora Dieback* includes all areas south of the 400 mm rainfall isohyet.

P. cinnamomi has not been detected during the three *Phytophthora* surveys to date that have now collected a cumulative total of 65 soil and tissue samples. However, there have now been a total of ten recoveries of three *Phytophthora* spp, including two undescribed species, from the 65 samples. All recoveries originate from the *Phytophthora* Clade 4, representing a group of similar *Phytophthora* isolates with slightly varied DNA sequencing. Among isolates recovered from Western Australia there are currently 9 sequence variations within Clade 4 and a multigene phylogeny will be required to determine if these species are actually separate species or if they represent geographic variations of the same species.

P. sp. Aus 4B and *P. sp. Aus 4E* are yet to be formally described and neither have been previously recorded beyond the Survey Area. Additional research including phylogeny assessment and morphological description is required to name and describe these species, and make determinations regarding pathogenicity and status as either native or introduced.

Observations from within the areas classified as infested by these species commonly identify single plant deaths in areas of otherwise healthy vegetation, however, there are three larger areas where there is significant, localised vegetation decline. These areas have now been extensively sampled resulting in a very low rate of recovery of additional positive samples. This may suggest that other factors are causing the vegetation decline, and potentially increasing the impact of the pathogen upon susceptible species present.

There is a requirement to undertake additional work into the assessment of species' susceptibility to these newly identified *Phytophthora* species to determine their potential impact upon native ecosystems in the region. There is also a need to understand the origins of these species as being either introduced or native. From the distribution of the species' however, it does appear that, whether introduced or native, they are being spread along haul roads by MinRes activities.

Accordingly it is important that relevant management strategies be developed and applied to mitigate the risk of further spread of *Phytophthora* spp. while the ongoing assessment and survey is undertaken to understand the nature and origin of these pathogens.



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- Figure 2: Phytophthora Dieback Occurrence showing Sample Locations and Results
-Overview Study Area
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- Appendix A: CPSM Laboratory Certificate

1 INTRODUCTION

Mineral Resources Limited (MinRes) currently undertake mineral exploration and mining activities at multiple sites across the Shire of Yilgarn and Shire of Menzies. The Yilgarn Operations are located approximately 47 km north east of Southern Cross in the Yilgarn Region of Western Australia (Figure 1). The Yilgarn Operations comprise six discrete mine sites: Koolyanobbing, Carina, Mt Jackson, Windarling, Deception, and Parker Range. Ore processing occurs at both Koolyanobbing and Carina, with road and rail transport between these operations and the Port of Esperance where the processed ore is shipped to international customers. Additional exploration tenements are considered part of the operations, with minimal activity occurring at each location.

These operations are performed under the guidance of Environmental Management Plans (EMP) designed to satisfy various Ministerial Statements and associated conditions. Operations at the Carina and J4 operations are subject to conditions specified in Ministerial Statements 852, 957 and 988. Specifically, Ministerial Statement 852 requires annual survey for the plant pathogen *Phytophthora Dieback*. This condition is included in the Project EMP, Condition 9.

Phytophthora Dieback is the common name for the disease in native ecosystems caused by plant pathogens from the genus *Phytophthora* (DBCA, 2020). Over 40 species of *Phytophthora* have been detected including *P. cinnamomi*, which is considered one of the greatest threats to plant biodiversity. It is an introduced soil borne plant pathogen that affects up to 40% of native plant species within Western Australia. Most commonly the disease is caused by the species *Phytophthora cinnamomi*, however, other species can also have significant impact under specific environmental conditions. It is important to note that there are many species of *Phytophthora*, distributed globally, including some species that are believed to be endemic or native to Australia.

Phytophthora Dieback is commonly introduced to an area through infested soils carried as basic raw materials or as soil on vehicles, plant and machinery. In favourable conditions the pathogen can result in the collapse of entire vegetation communities. Once introduced to an area, *Phytophthora Dieback* will spread through further human vectoring and also via water movement and root to root contact, resulting in extensive infestations which may cause significant impact to native vegetation communities. There is currently no practical method to eradicate the pathogen.

The risk of *Phytophthora Dieback* in the project area is considered to be low. This is based on the average rainfall (being between 200 and 300 mm), however a new species of *Phytophthora Dieback* (*Phytophthora* sp. AUS 4B) was identified during surveys undertaken in 2021. Further investigations will be required to describe the species, the risk to the environment and the potential of the pathogen to spread.

1.1 Objectives

The objectives of the 2023 *Phytophthora Dieback* Occurrence survey are to:

- accurately identify and, where possible, map *Phytophthora Dieback* occurrence within the tenement boundaries as shown on Figures 1 and 2, and
- Initiate classification and identification of the *Phytophthora* species recovered during previous annual assessments

1.2 Scope of Works

To achieve the project objectives, the following scope of works was undertaken.

1.2.1 Phytophthora Dieback Occurrence Survey

- completion of a detailed desktop assessment of all existing access tracks and unsealed roads within the associated mining tenements.
- Phytophthora Dieback survey along all existing access tracks and unsealed roads within the associated mining tenements.
- a soil and tissue sampling program to verify field interpretation decisions. All samples were transported to the Centre for Phytophthora Science and Management (CPSM) in Perth for analysis, and
- collection of field data using a hand held GPS unit. Field data includes disease evidence points, sample locations, disease status markers and survey effort track files.

1.2.2 Phytophthora species Identification

All collected samples from the assessment were sent to the CPSM undertake analysis of the samples and report on specie identified. It will be recommended that CPSM also perform a phylogenetics assessment of the species identified during the current and previous surveys. This process will enable a professional opinion regarding endemism to be offered, however, further testing and assessment of the species will be required to classify the nomenclature of the species, assess pathogenicity and determine whether the species is native or introduced.

1.3 Site Characteristics

The MinRes operations subject to the annual Phytophthora Dieback surveys include:

- Carina northern operations
- Carina southern operations
- Carina- Jackson haul road
- J4.

Current activities at the project site include the transport of ore to Carina from Parker Range for crushing and loading to rail carts to be shipped to the Port of Esperance. There is currently no mining activity at Carina, Carina Extended and J4. The Carina - Jackson Haul Road sees minimal use as the road is not primarily utilized for transport of ore.

1.3.1 Survey Area

The Survey Area relates to the Linear survey area shown on Figures 1 and 2 and includes all areas of native vegetation within the mining tenements subject to annual Phytophthora Dieback survey conditions. The tenement areas are associated with approximately 120 km of sealed haul road believed to have been constructed around 2011, depleted open cut pits, waste rock dumps, mine runs and various infrastructure. All of the areas are set within remnant vegetation that has experienced very limited historical disturbance.

2 PHYTOPHTHORA DIEBACK REGULATION AND MANAGEMENT

2.1 Legislative Framework

The Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) lists Phytophthora Dieback as a key threatening process that poses a significant threat to biodiversity values within Australia. Policy prepared under the EPBC Act includes the national *Threat Abatement Plan for disease in natural ecosystems caused by Phytophthora cinnamomi* (TAP) (Commonwealth of Australia (CoA) 2018), and recovery plans for threatened flora species and threatened ecological communities that include Dieback management considerations.

The TAP (CoA 2018) establishes a national framework to guide and coordinate Australia's response to Phytophthora Dieback. This identifies research, management and other actions to mitigate impact of the pathogen to natural values.

In Western Australia, Phytophthora Dieback management is regulated by the Department of Biodiversity Conservation and Attractions (DBCA) through implementation of the *Biodiversity Conservation Act* (2016) and the *Conservation and Land Management Act* (1984). The DBCA also has certain statutory obligations under the *Biosecurity and Agriculture Management Act* (2007) concerning biosecurity matters generally, including *Phytophthora*.

2.2 Current Western Australian Management

In Western Australia, assessment and management of Phytophthora Dieback is overseen by the DBCA who regulate standards, implementation of hygiene and maintain a registration system for appropriately qualified Phytophthora Dieback Interpreters. The DBCA's primary tools for the management of Phytophthora Dieback in WA include the *Phytophthora Dieback Interpreters Manual for lands managed by the Department* (DBCA 2015) and the *Phytophthora Dieback Management Manual* (DBCA 2020).

The DBCA (2015, 2020) define the Vulnerable Zone for susceptibility to Phytophthora Dieback as all areas in the south west with average annual rainfall above 400 mm. Disease occurrence in the Vulnerable Zone is further refined in the 400 mm to 600 mm rainfall zone, as suitable environmental conditions in this lower rainfall zone will only occur where natural or manmade features such as creek lines, drains and soaks that collect water exist, i.e., where water gaining sites occur.

The Dieback Working Group also contributes to Phytophthora Dieback management in Western Australia through the development and distribution of management guidelines for community and industry groups. *Standard Dieback Signage - protocols for use* (Project Dieback, 2008) guides standardised signage across tenures to raise awareness and mitigate disease spread.

2.2.1 Phytophthora Dieback Assessment

The *Phytophthora Dieback Interpreters Manual for Lands managed by the Department* (DBCA 2015) presents defined Phytophthora Dieback assessment methodologies. It identifies several assessment methods that provide for either linear or non-linear assessment. Assessment methods may vary depending on the project type, disturbance activity and objectives of the assessment.

While this document refers to lands managed by the DBCA, it is recognised in Western Australia as Industry best practice and is routinely applied to both State agency and private estate.

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

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

The six possible disease categories are listed and described below:

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

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

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

- have greater than 600 mm of annual rainfall or are water gaining sites in the 400 mm - 600 mm rainfall zone.
- are determined to be free from *Phytophthora cinnamomi* by a DBCA registered disease interpreter. Uninterpretable areas may be classified as protectable.
- comprehensive transect survey areas that are positioned in the landscape and are of sufficient size that they will not be engulfed by *Phytophthora* via autonomous spread. Such an area is defined as being greater than 4 ha with a minimum axis greater than 100 m, and not down slope of an infested area.
- linear assessment areas longer than 100 m after the application of appropriate disease category buffers.

- have controllable human vectors and/or
- include high conservation and/or socio-economic values.

3 METHODS

3.1 Desktop Interpretation

The Survey Area was subject to an initial desktop assessment involving a review of available previous assessment reports and spatial data, the Vegetation Health Service (VHS) *Phytophthora* sample database and examination of available aerial imagery to assess:

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

3.2 Field Survey

The project area was originally assessed in 2021 and then rechecked in January 2023. As *Phytophthora* Dieback disease occurrence data is valid for a period of three years with annual re-checks, a further recheck was considered appropriate methodology for the current assessment. However, due to the site location being in the low rainfall region beyond the typical extent of the disease, it was anticipated that any disease activity would be subtle and difficult to identify. Therefore, while the previously assessed areas of known infestation were subject to a recheck assessment, the remainder of the area was subject to a Broad Area survey with higher intensity ground coverage in specific target areas where there was evidence of water pooling or high levels of disturbance. A summary of key survey activities is provided below.

All surveys were undertaken by a DBCA registered disease interpreter with qualifications to undertake assessments in areas of low interpretability (Reg. No. DPW-PDI-018), between 1 August and 8 August 2023. Vegetation considered to be potentially susceptible was visually assessed for evidence of decline that may be consistent with impact by *Phytophthora* Dieback. Visual diagnosis involves identification of susceptible species deaths occurring in patterns consistent with disease spread, such as radiating from an identified vector. Plant deaths associated with *Phytophthora* are rapid and complete rather than partial. Further, the disease presents a chronologic pattern of deaths, with the oldest deaths closest to the disease vector and most recent deaths further from the vector, forming a disease front.

Visual diagnosis can be confirmed through the collection and analysis of representative soil and tissue samples collected from a sub-set of indicator species deaths. Positive sample recoveries used to determine disease presence may include historic positive *Phytophthora* recoveries with direct influence over a site. The extent of disease occurrence is mapped using topography and visual evidence consistent with expression associated with positive sample recoveries.

Field data including disease presence and vegetation interpretability information was collected using a hand-held GPS unit and converted to ArcGIS™ shapefiles. Collected field data includes point files recording uninfested vegetation, unsusceptible vegetation and identified individual plant deaths attributed to *Phytophthora*.

All survey methods used are defined in detail in the DBCA guideline, *Phytophthora Dieback Interpreters Manual for Lands Managed by the Department*, (DBCA, 2015). Due to the mobility of the disease

through autonomous spread and human vectoring, all operational scale disease occurrence data has a limited life of 12 months.

3.3 Sampling Program

Visual diagnosis has been supported by laboratory assessment of soil and tissue samples. As defined in *Phytophthora Dieback Interpreters Manual for lands managed by the Department* (DBCA 2015), soil and tissue samples are to be collected from representative individual disease indicator species deaths located across the site. Sample results may then be used to inform the likely cause of death of other disease indicator species exhibiting similar symptoms in similar vegetation units across the assessment area.

Sampling for *Phytophthora Dieback* involves the collection of soil and tissue material from fresh deaths of plants considered to be reliable indicator species of *Phytophthora* expression and representative of plant deaths across the assessment area. Where suspicious deaths were identified, soil and root tissue material were collected into heavy duty plastic bags and forwarded to the CPSM laboratory for analysis.

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

3.3.1 CPSM sample analysis method

The method used by CPSM for analysis of material is described below.

1. Extraction of suitable root material and soil from sample for use for recovery of *Phytophthora*
2. Baiting of sample material in 750 ml tubs.
3. When observed, baits showing signs of likely attack by *Phytophthora* were plated onto NARPH medium (sans PCNB). For samples with asymptomatic baits, a selection of baits were plated out after about 7-10 days.
4. Samples where no *Phytophthora* were recovered in the first round of baiting were dried down, reflooded and re-baited at least once.

Where *Phytophthora* or *Phytophthora*-like growth was observed (based on micro-morphology), clean isolates for DNA sequencing were produced by serial sub-culture.

4 DISEASE OCCURRENCE SURVEY RESULTS AND DISCUSSION

The MinRes Carina and J4 regional location is shown in Figure 1 while Figures 2-1 to 2-5 present the results of the disease occurrence survey including results from the 2023 soil and tissue sampling program. All associated spatial data is provided as shapefiles.

4.1 Desktop

4.1.1 Previous Surveys

Two previous surveys have been undertaken across the survey area. The first was performed in June and September of 2021 while the second was performed in January 2023.

The first survey, undertaken by Terratree Pty Ltd (2021), resulted in the initial discovery of the *Phytophthora* species referred to as P. sp. Aus 4B, a species previously unrecovered in Australia. The species was identified from three samples out of a total of 31 collected across the entire survey area. The survey subsequently mapped three separate areas of vegetation that were classified as being impacted by this species of *Phytophthora*.

The second survey was a sampling program only and appears to have been specifically targeted at vegetation previously classified as infested. i.e., this assessment did not appear to survey the full project area. The sampling only program included the collection of 10 soil and tissue samples yielding two positive recoveries of P. sp. Aus 4B.

The two combined assessments have collected a total of 41 samples across the Survey Area, with a total of five positive recoveries, all of P. sp. Aus 4B. Of the 41 samples, 13 have been collected from within the areas classified as infested, bearing 5 positive recoveries, all collected from *Allocasuarina acutivalvis*. This suggests that while this species is susceptible to the pathogen, the observed deaths may not all be attributable to it. It is possible that the actual extent of the disease on ground is not as great as that depicted in the 2021 report mapping (Terratree, 2021).

4.1.2 Climate

The Bureau of Meteorology (The Bureau) broadly classifies the climate across the Yilgarn and Menzies Shires as hot dry summers with cold winters. The Bureau maintains a network of weather stations across Australia to record weather data, with the nearest stations to the Survey Area being Koolyanobbing to the south and Windarling to the north. The long-term average annual rainfall data from each site is 266 mm and 274.3 mm respectively. Interestingly, the average monthly rainfall figures for both sites show a relatively consistent average rainfall across all months despite the broad climate description of hot dry summers. A more detailed assessment of the rainfall data shows many of the summer months do experience very low rainfall, however, there are regular high rainfall events experienced occasionally at both monitoring stations.

These are important figures as the accepted distribution of *Phytophthora Dieback* is generally restricted by the 400 mm isohyet with distribution in the 400-600 mm/yr zone considered possible in sites with high summer rainfall averages or associated with water gaining sites. Based on the Bureau climate classification and rainfall data, the MinRes site is outside of the accepted range for *Phytophthora Dieback* occurrence, however, the episodic nature of the rainfall data does suggest that the area experiences suitable climatic conditions for *Phytophthora* species to exist.



4.1.3 Vegetation

The MinRes Survey Area is situated within the Southwestern Interzone Botanical Province, between the Eremaean and Southwest provinces. The vegetation of the area is part of the Coolgardie Botanical District (Beard 1990). The available vegetation mapping, from the National Vegetation Information System (NVIS), identifies five vegetation complexes within the Survey Area (DAWE 2020). These are listed below.

- Eucalyptus woodlands with a shrubby understorey – NVIS ID 80640
- Heathlands – NVIS ID 81100
- Acacia tall open shrubland and shrublands – NVIS ID 81104
- Acacia tall open shrubland and shrublands – NVIS ID 81239
- Low closed forest or tall closed shrublands – NVIS ID 81098

There have been no known pathogen susceptibility trials for species that occur within the vegetation complexes above, however, plants from genera that include susceptible species are found across the Survey Area, including Banksia, Grevillea and Eucalyptus, and Allocasuarina. It is noted, however, that *Phytophthora* has previously only been recovered from a single species of Allocasuarina, being *Allocasuarina acutivalvis*.

4.1.4 Land use

Land use across the region has been limited to historic exploration and mining activities. Specifically, across the survey area there are no mining activities at Carina, Carina Extended and J4. The Carina - Jackson Haul Road sees minimal use as the road is not primarily utilized for transport of ore. Current activities include transportation of ore to Carina from Parker Range for crushing and loading to rail carts to be shipped to the Port of Esperance.

Evidence of historic activities include the creation and extraction of material from borrow pits, stockpiling of topsoil associated with borrow pits and general site maintenance.

4.2 Disease Occurrence Assessment Results

4.2.1 Vegetation

Detailed vegetation descriptions were not available for review and the vegetation descriptions below are intended as general descriptions only and are not botanically comprehensive descriptions of vegetation complexes occurring across the survey area. Instead, the vegetation descriptions are intended to identify potential disease indicator species and possible susceptibility to *Phytophthora* Dieback.

As defined in Section 4.1.2, vegetation structure varies from woodlands to shrublands and heaths. This regional vegetation classification is consistent with observations across the survey area which identified a varying mosaic of vegetation structures consistent with the NVIS descriptions.

As the Survey Area is situated outside the defined vulnerable zone for *Phytophthora* Dieback, there has been limited research into the susceptibility of species that occur across the region. From the previous three sampling events within the Survey Area it is known that both *Allocasuarina acutivalvis* and *Grevillea excelsior* are susceptible to *Phytophthora* spp. During the current sampling program, *Phytophthora* was also recovered from recent deaths of two species that did not have any diagnostic

characteristics available for identification. Despite being unidentified, these unknown species deaths confirm the pathogen's range of susceptible species extends beyond *Allocasuarina* and *Grevillea*. Further assessment of species' susceptibility will be required through sampling to identify other susceptible species during future survey activities.

In addition to species known to be susceptible, other species identified across the survey area that are anticipated to be susceptible include:

- *Allocasuarina cristata*
- *Astroloma serratifolium*
- *Banksia elderiana*
- *Grevillea acacioides*
- *Grevillea acuarina*

These species are listed as occurring in the NVIS vegetation complexes presented in Section 4.1.3 and are from genera that are known to include susceptible species occurring within the vulnerable zone.

4.2.2 Disease Occurrence and Hygiene Categories

Following the completion of the 2023 *Phytophthora* Dieback survey, the classification of infested vegetation has increased and now includes eight discrete areas classified as infested. A second previously undescribed species has been identified and is referred to as *P. sp. Aus 4E*. The revised occurrence of *Phytophthora* infestation is shown Figures 2-1 through to 2-5 and includes:

- Four *P. sp. Aus 4E* infestations
- One *Phytophthora arenaria* infestation
- Three *P. sp. Aus 4B* infestations

The four *P. sp. Aus 4E* infestations and the *P. arenaria* infestation have been newly identified during the August 2023 survey.

All remaining vegetation within the survey area has been classified as uninterpretable on the basis that known susceptible species are either absent or present in insufficient numbers to allow for detection and mapping of the disease in accordance with DBCA definitions as described in Section 2.2.1.

4.2.3 Disease Expression

Disease expression observed across the infested vegetation was cryptic, limited to isolated and scattered deaths of susceptible species, though often occurring in areas of significant vegetation decline potentially associated with other causes of plant death. This was evidenced by the high proportion of samples returning a negative result for *Phytophthora* Dieback in these heavily sampled areas. The nature of vegetation decline, combined with multiple negative samples from previous assessments, made visual observation of disease expression and patterning difficult to accurately determine and define.

4.2.4 Disease Sampling

A total of 24 samples were collected from within the Survey Area during the current survey and from these there were five recoveries of *Phytophthora* spp. and a single sample was inconclusive. Recovered species include:

- *P. arenaria*
- *P. sp. Aus 4E*

There were no recoveries of *P. sp. Aus 4B* which was recovered from samples collected during the previous surveys. The five positive recoveries from the current 2023 survey bring the total number of positive records of *Phytophthora* spp. within the survey area to 10. With the exception of Sample SM1 from the sampling program conducted in January 2023, all positive recoveries are located within 5 m of the vegetation clearing associated with either the J4 or Carina haul roads.

4.2.5 Topsoil Stockpiles

Multiple stockpiles of topsoil were noted along the alignment of each haul road. Some of the stockpiles occur in areas that have been classified as infested. Stockpiles within infested vegetation represent a source of inoculum that will result in movement of the pathogen if the infested soils are transported to uninfested areas.

4.3 Discussion of Results

The disease categories shown on Figures 2-1 through to 2-5 represent areas classified as infested. Infested areas with multiple positive sample recoveries are mapped through extrapolation of confirmed disease occurrence data across areas of associated vegetation decline. Infested areas consisting of a single positive sample recovery but no evidence of wider vegetation decline have been mapped with a 20 m buffer around the single infested point. It is acknowledged that the actual areas of infestation may be smaller than portrayed in the disease occurrence figures, however, because of the cryptic nature of expression, the new and undescribed *Phytophthora* spp., and limited knowledge of the pathogen's behaviour beyond the prescribed "vulnerable zone", it is considered appropriate to apply significant buffers to contain all known occurrences within defined boundaries.

Three of the eight infested areas were originally identified and mapped in 2021, meaning these areas have now been subject to three sampling programs, which cumulatively have collected 22 samples with 5 confirmed recoveries of *Phytophthora* spp. As mentioned in 4.2.3, this high proportion of negative samples (77%) suggests that many of the observed deaths previously used to map the extent of *Phytophthora* occurrence are not associated with impact by *Phytophthora*. It is likely that, while *Phytophthora* is present, factors other than *Phytophthora* are contributing to vegetation decline at these sites and the actual extent of the disease is less than that shown in current and previous disease occurrence maps.

Four of the five new infested areas are associated with a single plant death only. These infested areas have been buffered by 20 m to allow for possible root to root disease spread that was not detectable at the time of survey.

Typically, *Phytophthora* Dieback is most active in warm, moist conditions and, typically, rates of disease spread in higher rainfall areas is between 0.5 m – 1 m per year. While there has been no research into



the occurrence and behaviour of *Phytophthora* in the Yilgarn region, it is anticipated that disease activity and the rate of spread would be lesser due to reduced rainfall activity. Therefore, any positive samples that occur in previously undisturbed vegetation not associated with or in near proximity to historic human activity are most likely to be an occurrence of a naturally occurring pathogen. Conversely, positive samples associated with/in proximity to human activity are potentially a result of disease introduction through the movement of infested soil.

With the exception of Sample SM1 from the sampling program conducted in January 2023, all positive recoveries are located within 5 m of the vegetation clearing associated with either the J4 or Carina haul roads. Many of the negative samples collected during the current and previous surveys were collected from susceptible species deaths occurring up to 50 m from the nearest disturbance site.

With consideration of the previous site disturbance and an understanding of typical rates of spread in low rainfall areas, the location of the previous sample SM1, being approximately 30 m from the J4 haul road, suggests that this positive recovery is not associated with the haul road construction but is a pre-existing occurrence. The sample was identified as the species *P. sp. Aus 4B* which is yet to be formally described and may be a native *Phytophthora* species.

However, the distribution of the remaining positive and negative sample results in relation to the haul roads suggests that while *Phytophthora* spp. may occur naturally in the environment, the high proportion of positive samples situated on the edge of haul roads identifies the haul road construction as the likely vector that has spread the pathogens' across the area. Further, the topsoil stockpiles occurring along the haul road alignments also represent potential sources of inoculum that will result in further spread of the pathogen if they are redistributed along the alignment or to other areas external to the Survey Area.

From the cumulative sampling programs conducted since 2021, there have been 3 species of *Phytophthora* recovered. These are:

- *P. arenaria*
- *P. sp. Aus 4B*
- *P. sp. Aus 4E*

All recovered species are part of the *Phytophthora* Clade 4, representing a group of similar *Phytophthora* isolates with slightly varied DNA sequencing. Among isolates recovered from WA there are currently 9 sequence variations within Clade 4 and a multigene phylogeny will be required to determine if these species are actually separate species or if they represent geographic variations of the same species (pers. comm. Treena Burgess, CPSM).

P. sp. Aus 4B and *P. sp. Aus 4E* are yet to be formally described and neither have been previously recorded beyond the Survey Area. Additional research including phylogeny assessment and morphological description is required to name and describe these species and make determinations regarding pathogenicity and status as either native or introduced.

P. sp. Aus 4B is considered to be closely related to *P. arenaria*. *Phytophthora arenaria* is believed to be a native pathogen and is not known to have significant impact on native vegetation. It has been previously isolated from vegetation occurring on the northern sandplains of WA which are warm and dry and appears to be morphologically and physiologically well adapted to the ecosystems in which it occurs (Rea et. al. 2011).



P. sp. Aus 4E is considered to be closely related to *Phytophthora boodjera*. *P. boodjera* is closely related to *P. arenaria* but is faster growing and has a higher optimal growth temperature than *P. arenaria*. The pathogen has been found in association with declining and dying *Agonis flexuosa*, *Banksia media*, *B. grandis*, *Corymbia calophylla*, *Eucalyptus* spp., and *Xanthorrhoea preissii* in disturbed ecosystems and urban tree plantings. Extensive sampling from natural ecosystems in southwest of Western Australia resulted in only a few recoveries of *P. boodjera* and it is now thought to be an introduced species (Simamora 2012).

4.4 Recommendations

- Infested vegetation and adjoining unsealed ground is not to be traversed during moist or wet soil conditions.
- Topsoil stockpiles within infested vegetation must not be used or spread outside of the infested areas they are occurring in.
- Future surveys should include assessment of topsoil stockpiles occurring in vegetation currently classified as uninterpretable.
- Future surveys to include focus on increasing the knowledge of species that are susceptible to the pathogen in the region. This can be done by increasing the range of sampled species, targeting any plant deaths that present as potential *Phytophthora* impact, regardless of plant species.
- Further research to describe and understand the potential pathogenicity of the species identified across the Survey Area is the next important step in determination of appropriate management required across the Survey Area. This process has been discussed with Mineral Resources and it has been agreed that the required phylogeny assessment will be undertaken. The CPSM have commenced this work, however, results were not available at the time of reporting.
- In Western Australia, assessment and management of *Phytophthora* Dieback is overseen by the DBCA who regulate standards, implementation of hygiene and maintain a registration system for appropriately qualified *Phytophthora* Dieback Interpreters. This registration system acknowledges the need for specific skills and experience when performing *Phytophthora* survey in low rainfall areas due to the reduced activity and detectability of the pathogen. It is a regulatory requirement that only *Phytophthora* Dieback Interpreters registered to undertake assessments in areas of low interpretability perform assessments across the Survey Area.
- Importantly, the term *Phytophthora* Dieback relates to *P. cinnamomi* and other introduced *Phytophthora* species responsible for causing impact to natural ecosystems. The associated management of *Phytophthora* Dieback is also typically focussed within the defined Vulnerable Zone, which does not include the Survey Area. Despite being beyond the scope of the current management guidelines, it would be appropriate to develop and apply relevant management and associated hygiene protocols to all works within the Survey Area in order to mitigate further vectoring of disease.

5 REFERENCES

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Terratree (2021): *Carina and Jackson 4 Plant Pathogen Assessment 2021*, unpublished report for Mineral Resources Pty

6 REPORT DISCLAIMER

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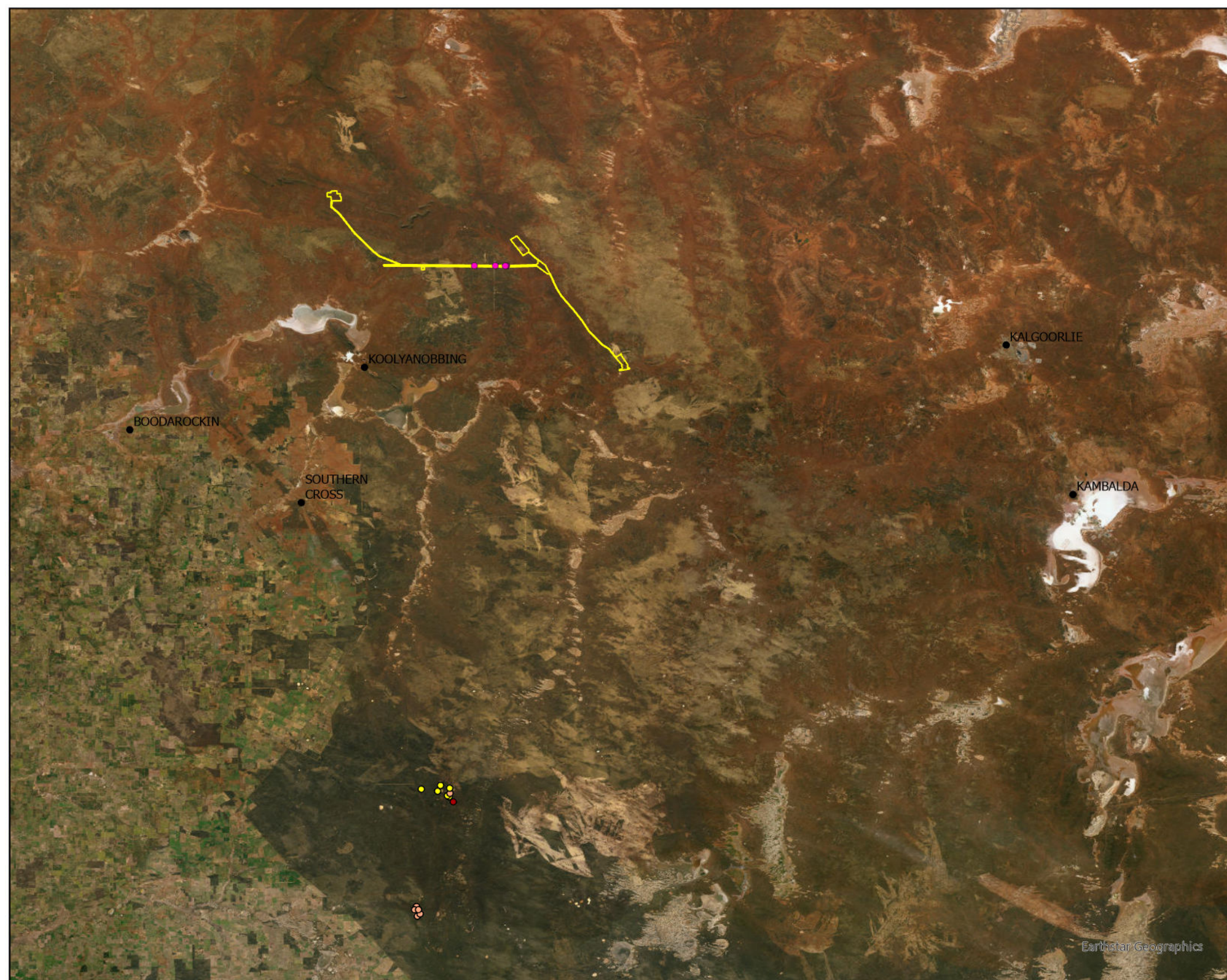
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Figures

Phytophthora Dieback Occurrence Survey

– MinRes Operations Carina and J4





Survey Area

Historic *Phytophthora* spp.

- *P. arenaria*
- *P. boodjera*
- *P. nicotianae*
- *P. PAUS4B*

Environmentally Sensitive Areas DWER

Legislated Lands and Waters DBCA

Phytophthora Dieback occurrence as at August, 2023. Recheck required from August, 2024.
PDI Jeremy Spencer. Registration No. DPW PD018

Phytophthora Dieback Occurrence Survey - Mineral Resources Operations Carina & J4 prepared for Mineral Resources, December, 2023

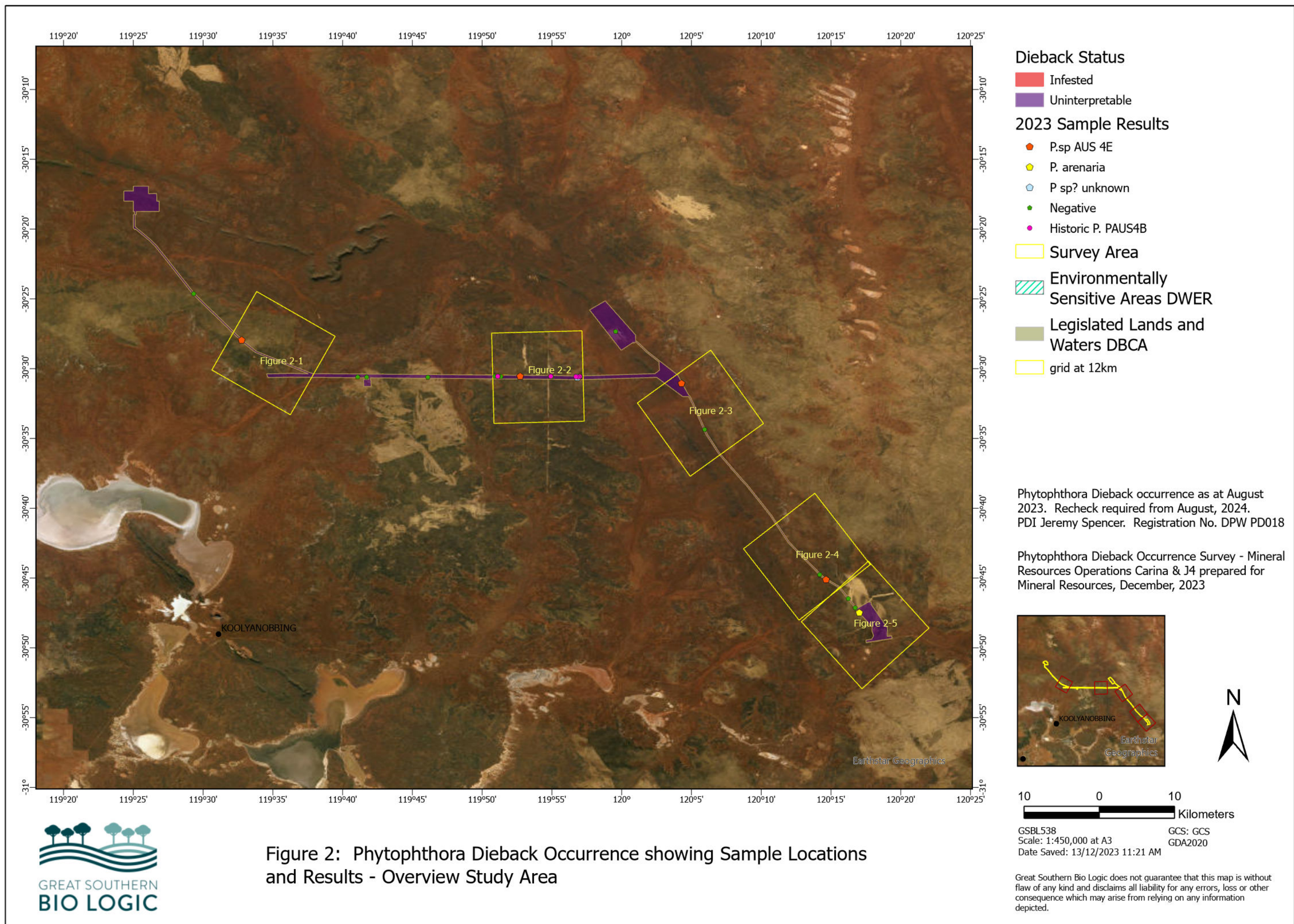


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Figure 1: Regional Location





Dieback Status

- Infested
- Uninterpretable

2023 Sample Results

- P. sp AUS 4E
- P. arenaria
- P. sp? unknown
- Negative
- Historic P. sp AUS 4B
- Survey Area
- Environmentally Sensitive Areas DWER
- Legislated Lands and Waters DBCA

Phytophthora Dieback occurrence as at August 2023. Recheck required from August, 2024.
PDI Jeremy Spencer. Registration No. DPW PD018

Phytophthora Dieback Occurrence Survey - Mineral Resources Operations Carina & J4 prepared for Mineral Resources, December, 2023

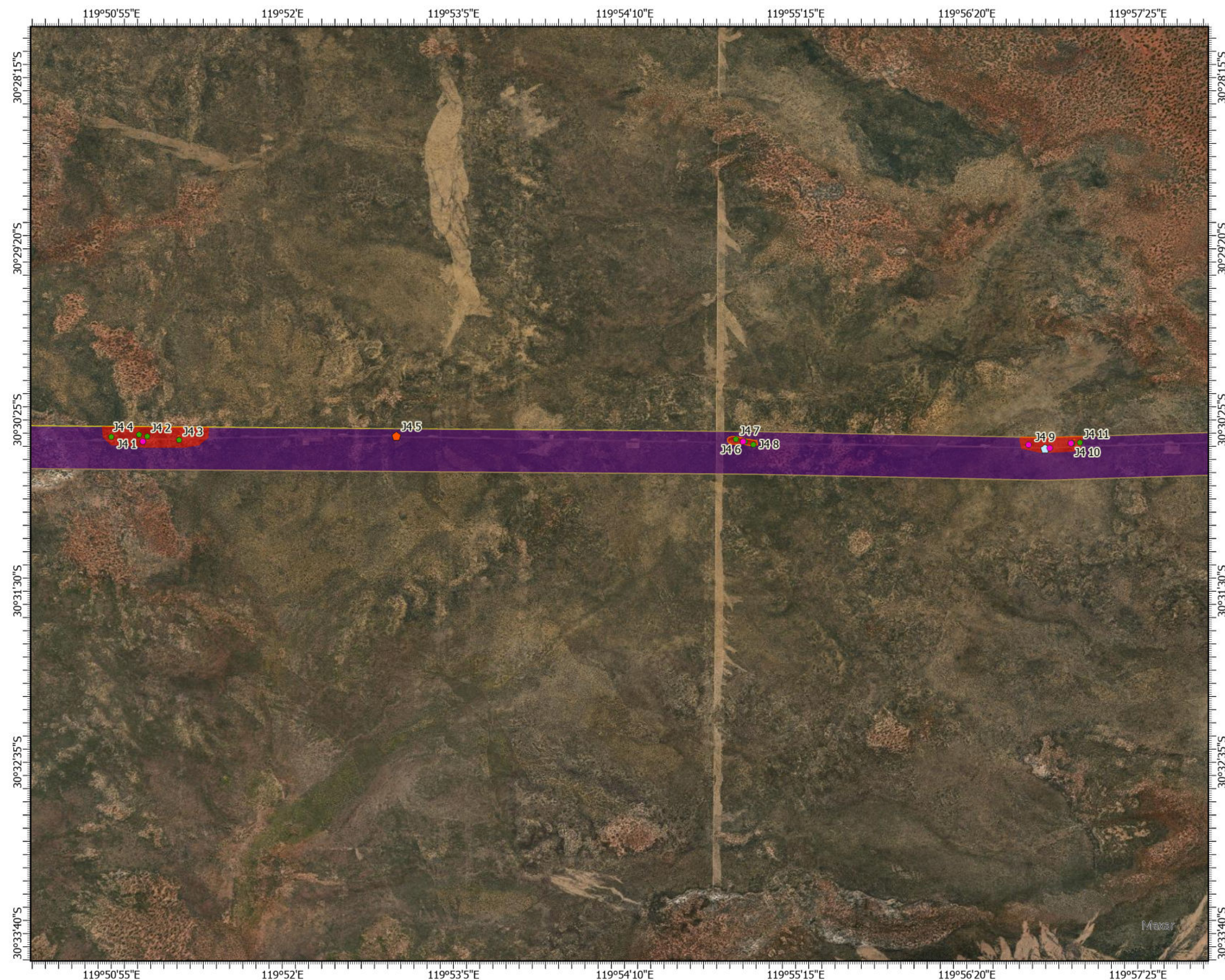


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Figure 2-1 Phytophthora Dieback Occurrence showing Sample Locations and Results



Dieback Status

- Infested
- Uninterpretable

2023 Sample Results

- P. sp AUS 4E
- P. arenaria
- P. sp? unknown
- Negative
- Historic P. sp AUS 4B

Survey Area

Environmentally Sensitive Areas DWER

Legislated Lands and Waters DBCA

Phytophthora Dieback occurrence as at August, 2023. Recheck required from August, 2024.
PDI Jeremy Spencer. Registration No. DPW PD018

Phytophthora Dieback Occurrence Survey - Mineral Resources Operations Carina & J4 prepared for Mineral Resources, December, 2023



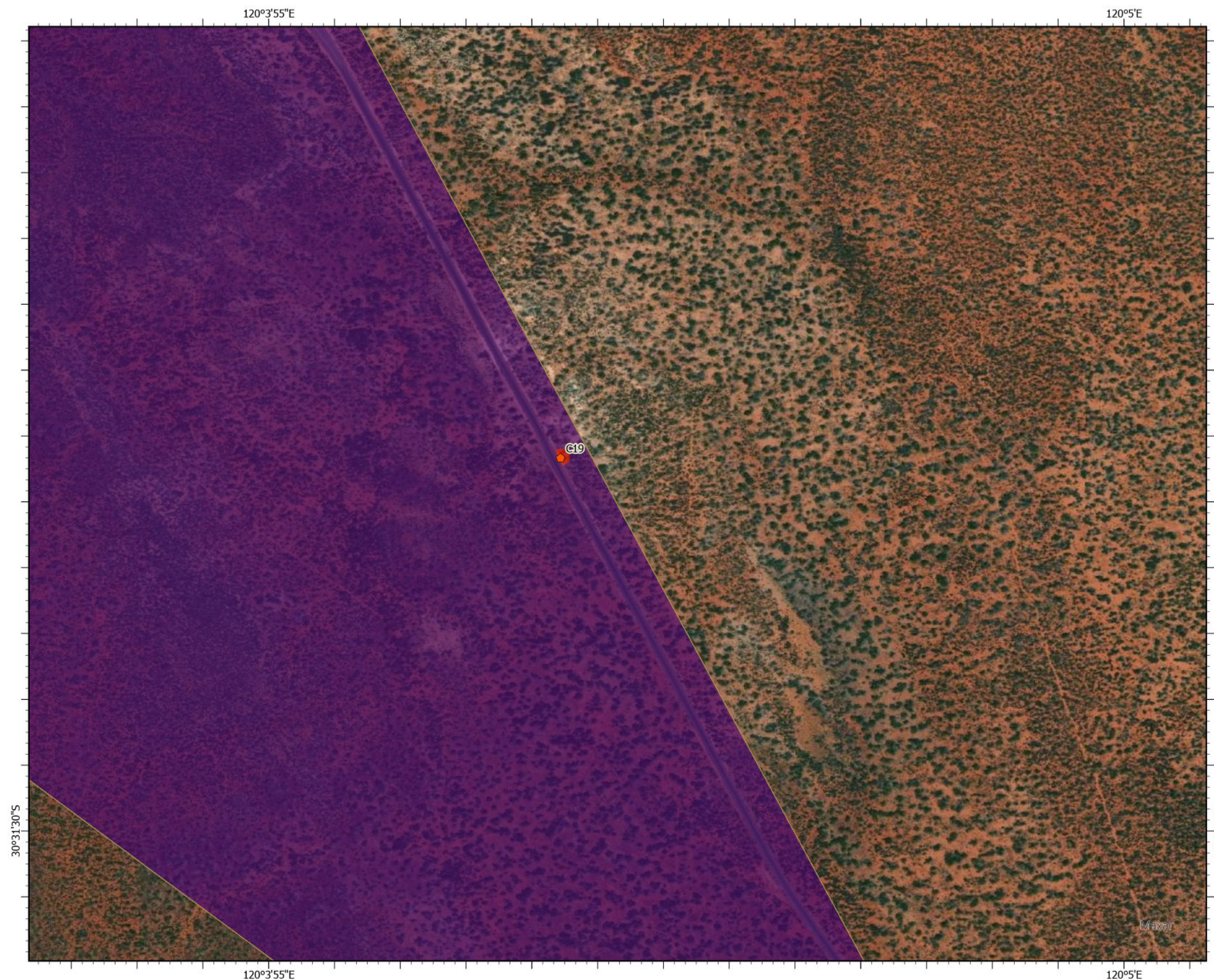
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Figure 2-2 Phytophthora Dieback Occurrence showing Sample Locations and Results



Dieback Status

- Infested
- Uninterpretable

2023 Sample Results

- ◆ P. sp AUS 4E
- ◆ P. arenaria
- ◆ P. sp? unknown
- ◆ Negative
- ◆ Historic P. sp AUS 4B
- Survey Area
- Environmentally Sensitive Areas DWER
- Legislated Lands and Waters DBCA

Phytophthora Dieback occurrence as at August, 2023. Recheck required from August, 2024.
PDI Jeremy Spencer. Registration No. DPW PD018

Phytophthora Dieback Occurrence Survey - Mineral Resources Operations Carina & J4 prepared for Mineral Resources, December, 2023



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Figure 2-3 Phytophthora Dieback Occurrence showing Sample Locations and Results



Dieback Status

- Infested
- Uninterpretable

2023 Sample Results

- P. sp AUS 4E
- P. arenaria
- P. sp? unknown
- Negative
- Historic P. sp AUS 4B
- Survey Area
- Environmentally Sensitive Areas DWER
- Legislated Lands and Waters DBCA

Phytophthora Dieback occurrence as at August 2023. Recheck required from August, 2024.
PDI Jeremy Spencer. Registration No. DPW PD018

Phytophthora Dieback Occurrence Survey - Mineral Resources Operations Carina & J4 prepared for Mineral Resources, December, 2023



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Figure 2-4 Phytophthora Dieback Occurrence showing Sample Locations and Results

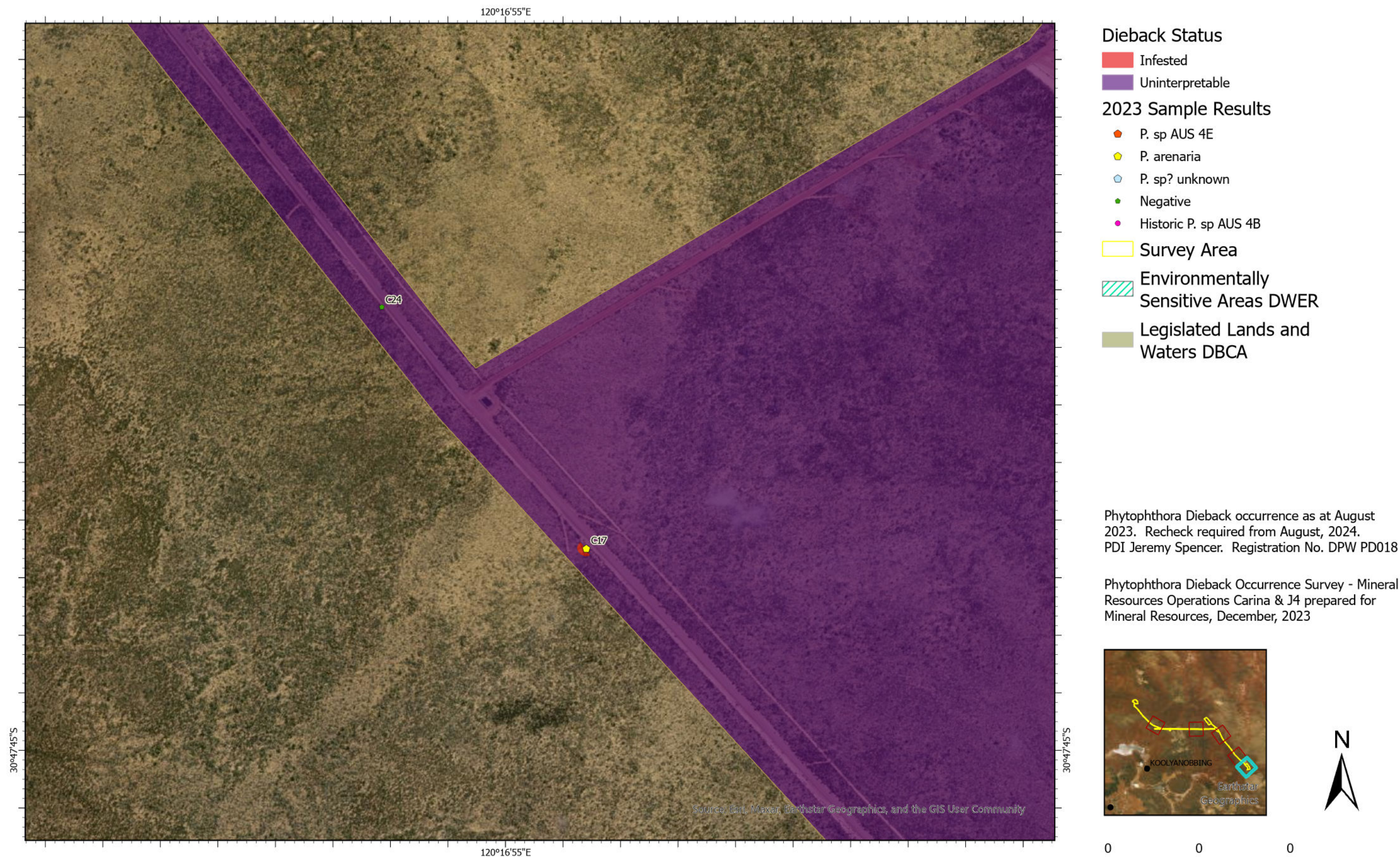


Figure 2-5 Phytophthora Dieback Occurrence showing Sample Locations and Results

Appendix A

CPSM Certificate of Sample Analysis

Murdoch University - Plant Health Laboratories Analysis report

Batch Details

Analysis Fee

Delivery date

Registered by Jeremy Spencer

Organisation Bio-Logic

Address :

Phone Number:

Email Address:

Sample Information

Sample	Sample Label	Date Collected	Plant Species Sampled	Species of Interest	Sample Type	Species Isolated
1	J4 Sample 1a		Allocasuarina acutivalis	Phytophthora sp	Soil and Root	Negative
2	J4 Sample 2a		Allocasuarina acutivalis	Phytophthora sp	Soil and Root	Negative
3	J4 Sample 3a		Allocasuarina acutivalis	Phytophthora sp	Soil and Root	Negative
4	J4 Sample 4		Allocasuarina acutivalis	Phytophthora sp	Soil and Root	Negative

Plant Health Laboratories

Biological Science and Biotechnology

Contact: Diane White 0419943382

E-mail d.white@murdoch.edu.au

Web www.cpsm-phytophthora.org

Murdoch University - Plant Health Laboratories Analysis report

5	J4 Sample 5	Allocasuarina acutivalis	Phytophthora sp	Soil and Root	Phytophthora sp AUS 4E
6	J4 Sample 6	Allocasuarina acutivalis	Phytophthora sp	Soil and Root	Negative
7	J4 Sample 7	Allocasuarina acutivalis	Phytophthora sp	Soil and Root	Negative
8	J4 Sample 8	Allocasuarina acutivalis	Phytophthora sp	Soil and Root	Negative
9	J4 Sample 9	Allocasuarina acutivalis	Phytophthora sp	Soil and Root	Unable to isolate, Phytophthora?
10	J4 Sample 10	Allocasuarina acutivalis	Phytophthora sp	Soil and Root	Negative
11	J4 Sample 11	Allocasuarina acutivalis	Phytophthora sp	Soil and Root	Negative

Murdoch University - Plant Health Laboratories Analysis report

12	J4 Sample 12	Allocasuarina acutivalis	Phytophthora sp	Soil and Root	Negative
13	J4 Sample 13	Grevillea excelsior	Phytophthora sp	Soil and Root	Phytophthora sp AUS 4E
14	J4 Sample 14	Grevillea excelsior	Phytophthora sp	Soil and Root	Negative
15	J4 Sample 15	Grevillea excelsior	Phytophthora sp	Soil and Root	Negative
16	J4 Sample 16	Grevillea excelsior	Phytophthora sp	Soil and Root	Negative
17	Carina Sample 17	Unknown	Phytophthora sp	Soil and Root	Phytophthora arenaria
18	Carina Sample 18	Allocasuarina acutivalis	Phytophthora sp	Soil and Root	Negative

Murdoch University - Plant Health Laboratories Analysis report

19	Carina Sample 19	Allocasuarina acutivalis	Phytophthora sp	Soil and Root	Phytophthora sp AUS 4E
20	Carina Sample 20	Eucalyptus sp	Phytophthora sp	Soil and Root	Negative
21	Carina Sample 21	Allocasuarina acutivalis	Phytophthora sp	Soil and Root	Negative
22	Carina Sample 22	Unknown	Phytophthora sp	Soil and Root	Phytophthora sp AUS 4E
23	Carina Sample 23	Grevillea excelsior	Phytophthora sp	Soil and Root	Negative
24	Carina Sample 24	Allocasuarina acutivalis	Phytophthora sp	Soil and Root	Negative

Appendix E – Carina and J4 2024 Dieback Assessment (Great Southern Biologic)



Phytophthora Dieback Occurrence Survey

Mineral Resources Operations

Carina & J4 - 2024



Tel: 0400 113 093 • PO Box 5573, Albany, WA, 6332 • Email: info@gsbiologic.com.au • www.gsbiologic.com.au

Phytophthora Dieback Occurrence Survey

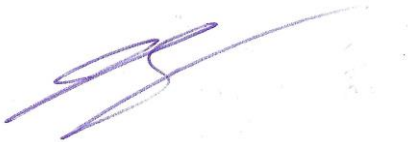
Mineral Resources Operations – Carina and J4

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Written and submitted by



Jeremy Spencer

Senior Environmental Scientist

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EXECUTIVE SUMMARY

Mineral Resources Limited (MinRes) currently undertake mineral exploration and mining activities at multiple sites across the Shire of Yilgarn and Shire of Menzies. These operations are performed under the guidance of Environmental Management Plans (EMP) designed to satisfy various Ministerial Statements and associated conditions. Operations at the Carina and J4 operations are subject to conditions specified in Ministerial Statements 852, 957 and 988. Specifically, Ministerial Statement 852 requires annual survey for the plant pathogen *Phytophthora* Dieback. Accordingly, surveys have been performed annually since 2021 and this report details the findings from the current 2024 survey.

Phytophthora Dieback is the common name for the disease in native ecosystems caused by plant pathogens from the genus *Phytophthora* (DBCA, 2020). Over 40 species of *Phytophthora* have been detected including *P. cinnamomi*, which is considered one of the greatest threats to plant biodiversity.

The Carina and J4 operations are outside the known occurrence for *P. cinnamomi*, the species specifically referred to in the National Threat Abatement Plan and Western Australian (WA) Government management guidelines and practices. Current WA guidelines only apply to the known range of the pathogen, defined as the Vulnerable Zone for *Phytophthora* Dieback which includes all areas southwest of the 400 mm rainfall isohyet.

P. cinnamomi has not been detected during the four Carina and J4 *Phytophthora* Dieback surveys to date, which have now collected a cumulative total of 156 soil and plant tissue samples. However, there have now been a total of 25 recoveries of five *Phytophthora* spp., including three undescribed species, from the 156 samples. All recoveries originate from *Phytophthora* Clade 4, a group of similar *Phytophthora* isolates with slightly varied DNA sequencing all believed to be naturally occurring *Phytophthora* species.

Phytophthora sp. Aus 4B, *P. sp. Aus 4E* and *P. sp. Aus 4F* are yet to be formally described and neither *P. sp. Aus 4B* or *4E* have been previously recorded beyond the Survey Area. *Phytophthora* sp. Aus 4F is previously known from the Mt Manning region which is in relatively close proximity to the Survey Area.

Observations from within the areas classified as infested by these species commonly identify single plant deaths in areas of otherwise healthy vegetation. However, there are three larger areas where there is significant, localised vegetation decline. These areas have now been extensively sampled resulting in a very low recovery rate of *Phytophthora* Dieback. This may suggest that other factors are causing or contributing to the vegetation decline, and potentially increasing the impact of the pathogen upon susceptible species present.

While the identified species occurring across the Survey Area are believed to be native, they are included under relevant legislative documents that define *Phytophthora* Dieback as “a *destructive disease caused by the pathogen Phytophthora cinnamomi and other Phytophthora species*”. Accordingly it is important that relevant management strategies be developed and applied to mitigate the risk of further spread of *Phytophthora* spp.. It is however recommended that future works look at monitoring disease occurrence, as required by existing Ministerial Conditions but also include assessment of the species impact on the natural environment.

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1 INTRODUCTION

Mineral Resources Limited (MinRes) undertake mineral exploration and mining activities at multiple sites across the Shire of Yilgarn and Shire of Menzies. The Yilgarn Operations are located approximately 47 km north east of Southern Cross in the Yilgarn Region of Western Australia (Figure 1). The Yilgarn Operations comprise six discrete mine sites: Koolyanobbing, Carina, Mt Jackson, Windarling, Deception, and Parker Range. Ore processing occurs at both Koolyanobbing and Carina, with road and rail transport between these operations and the Port of Esperance where the processed ore is shipped to international customers. Additional exploration tenements are considered part of the operations, with minimal activity occurring at each location.

These operations are performed under the guidance of Environmental Management Plans (EMPs) designed to satisfy various Ministerial Statements and associated conditions. Operations at the Carina and J4 operations are subject to conditions specified in Ministerial Statements 852, 957 and 988. Specifically, Ministerial Statement 852 requires annual survey for the plant pathogen *Phytophthora Dieback*. This condition is included in the Project EMP, Condition 9.

Phytophthora Dieback is the common name for the disease in native ecosystems caused by soil borne plant pathogens from the genus *Phytophthora* (DBCA, 2020). Over 40 species of *Phytophthora* have been detected worldwide including *P. cinnamomi*, which is considered one of the most aggressive species and of the greatest threat to plant biodiversity. *P. cinnamomi* affects up to 40% of native plant species within Western Australia and is the species specifically referenced in Western Australian and Australian Government legislation and associated policy and guidelines. Other introduced *Phytophthora* species can also have significant impact under specific environmental conditions. It is also important to note that some species of *Phytophthora* are believed to be endemic or native to Australia.

Phytophthora Dieback is commonly introduced to an area through infested soils carried as basic raw materials or as soil on vehicles, plant and machinery. In favourable conditions the pathogen can result in the collapse of entire vegetation communities. Once introduced to an area, *Phytophthora Dieback* will spread through further human vectoring and also via water movement and root to root contact, resulting in extensive infestations which may cause significant impact to native vegetation communities. There is currently no practical method to eradicate the pathogen.

The risk of *Phytophthora Dieback* in the project area is considered to be low. This is based on the average rainfall, which is between 200 and 300 mm, being below the accepted requirements for the pathogen to exist. However, since survey within the project area began in 2021, there have been several recoveries of *Phytophthora* species including several species that have not been previously identified and described.

Following the 2023 survey, Murdoch University's Centre for *Phytophthora* Science and Management (CPSM) were engaged to undertake a phylogenetic assessment of these species and determined that all *Phytophthora* spp. recovered from the project area are from the Clade 4 group of *Phytophthora* spp. that include *P. arenaria* and *P. boodjera*. The CPSM phylogenetic assessment concluded that the *Phytophthora* spp. occurring in Clade 4 are most likely to be native to Australia and endemic to the vegetation communities within the project area.

1.1 Objectives

As per previous years, the objective of the 2024 Carina and J4 Phytophthora Dieback Occurrence survey was to identify and, where possible, map Phytophthora Dieback occurrence within the tenement boundaries as shown on Figures 1 and 2.

1.2 Scope of Works

To achieve the project objectives, the following scope of works was undertaken.

- Completion of a detailed desktop assessment of all existing access tracks and unsealed roads within the associated mining tenements.
- Phytophthora Dieback survey along all existing access tracks and unsealed roads within the associated mining tenements.
- Completion of a soil and tissue sampling program to verify field interpretation decisions together with representative soil and tissue samples collected on and around topsoil stockpile areas associated with known and suspected Phytophthora infestation, to evaluate presence of Dieback and other potential pathogens in rehabilitation and restoration materials. All samples were transported to the Centre for Phytophthora Science and Management (CPSM) in Perth for analysis.
- Collection of field data using a handheld GPS unit. Field data includes disease evidence points, sample locations, disease status markers and survey effort track files.
- Evaluation of the potential risk that the potentially novel *Phytophthora* spp. may pose to the local environment, provision of advice on the extent to which mine site closure and other management activities may result in its transmission and establishment, and recommendations for hygiene and management across the sites.
- Development of an annual Phytophthora Dieback survey report.

1.3 Site Characteristics

The MinRes operations subject to the annual Phytophthora Dieback surveys include:

- Carina northern operations
- Carina southern operations
- Carina- Jackson haul road
- J4.

Current activities at the project site include the transport of ore to Carina from Parker Range for crushing and loading to rail carts to be shipped to the Port of Esperance. At the time of field survey there was no mining activity at Carina, Carina Extended and J4. The Carina - Jackson Haul Road sees minimal use as the road is not primarily utilized for transport of ore.

1.3.1 Survey Area

The Survey Area relates to the linear Survey Area shown on Figures 1 and 2 and includes all areas of native vegetation within the mining tenements subject to annual Phytophthora Dieback survey conditions. The tenement areas are associated with approximately 120 km of sealed haul road believed to have been

constructed in 2011, depleted open cut pits, waste rock dumps, mine runs and various infrastructure. All the areas are set within remnant vegetation that has experienced very limited historical disturbance.

2 PHYTOPHTHORA DIEBACK REGULATION AND MANAGEMENT

2.1 Legislative Framework

The Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) lists *Phytophthora cinnamomi* and infection by the pathogen, as a key threatening process that poses a significant threat to biodiversity values within Australia. Policy prepared under the EPBC Act includes the national *Threat Abatement Plan for disease in natural ecosystems caused by Phytophthora cinnamomi* (TAP) (Commonwealth of Australia (CoA) 2018), and recovery plans for threatened flora species and threatened ecological communities that include Dieback management considerations.

The TAP (CoA 2018) establishes a national framework to guide and coordinate Australia's response to Phytophthora Dieback. This identifies research, management and other actions to mitigate impact of the pathogen to natural values.

In Western Australia, Phytophthora Dieback management is regulated by the Department of Biodiversity Conservation and Attractions (DBCA) through implementation of the *Biodiversity Conservation Act* (2016) and the *Conservation and Land Management Act* (1984). Phytophthora Dieback is defined in the TAP as; "a destructive disease caused by the pathogen *Phytophthora cinnamomi* and other *Phytophthora* species". The DBCA also has certain statutory obligations under the *Biosecurity and Agriculture Management Act* (2007) concerning biosecurity matters generally, including *Phytophthora*.

2.2 Current Western Australian Management

In Western Australia, assessment and management of Phytophthora Dieback is overseen by DBCA who regulate standards, implementation of hygiene and maintain a registration system for appropriately qualified Phytophthora Dieback Interpreters. DBCA's primary tools for the management of Phytophthora Dieback in WA include the *Phytophthora Dieback Interpreters Manual for lands managed by the Department* (DBCA 2015) and the *Phytophthora Dieback Management Manual* (DBCA 2020). These documents define Phytophthora Dieback as "the common name for the disease in native ecosystems caused by plant pathogens from the genus *Phytophthora*".

DBCA (2015, 2020) define the Vulnerable Zone for susceptibility to Phytophthora Dieback as all areas in the south west with average annual rainfall above 400 mm. Disease occurrence in the Vulnerable Zone is further refined in the 400 mm to 600 mm rainfall zone, as suitable environmental conditions in this lower rainfall zone will only occur where natural or manmade features such as creek lines, drains and soaks that collect water exist, i.e., where water gaining sites occur.

The Dieback Working Group also contributes to Phytophthora Dieback management in Western Australia through the development and distribution of management guidelines for community and industry groups. *Standard Dieback Signage - protocols for use* (Project Dieback, 2008) guides standardised signage across tenures to raise awareness and mitigate disease spread.

2.2.1 Phytophthora Dieback Assessment

The *Phytophthora Dieback Interpreters Manual for Lands managed by the Department* (DBCA 2015) presents defined Phytophthora Dieback assessment methodologies. It identifies several assessment methods that provide for either linear or non-linear assessment. Assessment methods may vary depending on the project type, disturbance activity and objectives of the assessment.



While this document refers to lands managed by DBCA, it is recognised in Western Australia as Industry best practice and is routinely applied to both State agency and private estate.

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

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

The six possible disease categories are listed and described below:

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

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

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

- have greater than 600 mm of annual rainfall or are water gaining sites in the 400 mm - 600 mm rainfall zone.
- are determined to be free from *Phytophthora cinnamomi* by a DBCA registered disease interpreter. Uninterpretable areas may be classified as protectable.
- comprehensive transect survey areas that are positioned in the landscape and are of sufficient size that they will not be engulfed by *Phytophthora* via autonomous spread. Such an area is defined as being greater than 4 ha with a minimum axis greater than 100 m, and not down slope of an infested area.
- linear assessment areas longer than 100 m after the application of appropriate disease category buffers.

- have controllable human vectors and/or
- include high conservation and/or socio-economic values.

3 METHODS

3.1 Desktop Interpretation

The Survey Area was subjected to an initial desktop assessment involving a review of available previous assessment reports and spatial data, the Vegetation Health Service (VHS) *Phytophthora* sample database and examination of available aerial imagery to assess:

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

3.2 Field Survey

Historic survey includes assessment undertaken in 2021, with a recheck in January 2023 and again in August 2023. The current survey undertaken between 11 June and 19 June 2024.

Due to the size of the project area, the Broad Area survey method has been applied, however, in areas of known disease occurrence, linear transects have been traversed through infested areas and adjoining vegetation to assess for disease expression. The survey method in these areas is consistent with the Linear Survey method. A summary of key survey activities is provided below.

All surveys were undertaken by a DBCA registered disease interpreter with qualifications to undertake assessments in areas of low interpretability (Reg. No. DPW-PDI-018). Vegetation considered to be potentially susceptible was visually assessed for evidence of decline that may be consistent with impact by *Phytophthora* Dieback. Visual diagnosis involves identification of susceptible species deaths occurring in patterns consistent with disease spread, such as radiating from an identified vector. Plant deaths associated with *Phytophthora* are rapid and complete rather than partial. Further, the disease presents a chronologic pattern of deaths, with the oldest deaths closest to the disease vector and most recent deaths further from the vector, forming a disease front.

Visual diagnosis can be confirmed through the collection and analysis of representative soil and tissue samples collected from a sub-set of indicator species deaths. Positive sample recoveries used to determine disease presence may include historic positive *Phytophthora* recoveries with direct influence over a site. The extent of disease occurrence is mapped using topography and visual evidence consistent with expression associated with positive sample recoveries.

Field data including disease presence and vegetation interpretability information was collected using a hand-held GPS unit and converted to ArcGIS™ shapefiles. Collected field data includes point files recording uninfested vegetation, unsusceptible vegetation and identified individual plant deaths attributed to *Phytophthora*.

All survey methods used are defined in detail in the DBCA guideline, *Phytophthora Dieback Interpreters Manual for Lands Managed by the Department*, (DBCA, 2015). Due to the mobility of the disease through autonomous spread and human vectoring, all operational scale disease occurrence data has a limited life of 12 months.

3.2.1 Susceptible species flora list

During the field surveys, specimens were collected (Licence. FB62000763) from species either believed to be from susceptible genera or unknown species confirmed as susceptible through positive recoveries during the August 2023 survey. Where possible, these specimens were identified during post survey works and a list of potential and known susceptible species occurring across the project area has been developed.

It is important to note that to enable plant identification a specimen needs certain taxonomic features to be present. These may include flowers or fruits. Many plants lacked identifying features at the time of survey and so some potentially susceptible species remain unknown.

3.3 Sampling Program

Visual diagnosis has been supported by laboratory assessment of soil and tissue samples. As defined in *Phytophthora Dieback Interpreters Manual for lands managed by the Department* (DBCA 2015), soil and tissue samples are to be collected from representative individual disease indicator species deaths located across the site. Sample results may then be used to inform the likely cause of death of other disease indicator species exhibiting similar symptoms in similar vegetation units across the assessment area.

Sampling for *Phytophthora Dieback* involves the collection of soil and tissue material from around the stem and root system of fresh plant deaths considered to be reliable indicator species of *Phytophthora* expression and representative of plant deaths across the assessment area. Root material is located by excavating down the stem of the dead plant to find the location of lateral or vertical root systems. Sampling depth is dependent on the morphological features of the sampled species root system. Sample material is collected from around the large roots, assuming fine root hairs will be contained with the collected soil. Large woody tissue is not generally collected. Where suspicious deaths were identified, soil and root tissue material were collected into heavy duty plastic bags and forwarded to the CPSM laboratory for analysis.

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

3.3.1 CPSM sample analysis method

The method used by CPSM for analysis of material is described below.

1. Extraction of suitable root material and soil from sample for use for recovery of *Phytophthora*
2. Baiting of sample material in 750 ml tubs.
3. When observed, baits showing signs of likely attack by *Phytophthora* were plated onto NARPH medium (sans PCNB). For samples with asymptomatic baits, a selection of baits were plated out after about 7-10 days.
4. Samples where no *Phytophthora* were recovered in the first round of baiting were dried down, reflooded and re-baited at least once.

Where *Phytophthora* or *Phytophthora*-like growth was observed (based on micro-morphology), clean isolates for DNA sequencing were produced by serial sub-culture.

4 DISEASE OCCURRENCE SURVEY RESULTS AND DISCUSSION

The MinRes Carina and J4 regional location is shown in Figure 1 while Figures 2-1 to 2-5 present the results of the disease occurrence survey including results from the 2024 soil and tissue sampling program. Associated 2024 survey spatial data is provided as shapefiles.

4.1 Desktop

4.1.1 Previous Surveys

Three previous surveys have been undertaken across the Survey Area. The first was performed in June and September of 2021, the second in January 2023 and the third in August 2023.

The first survey, undertaken by Terratree Pty Ltd (2021), resulted in the initial discovery of the *Phytophthora* species referred to as *P. sp. Aus 4B*, a species previously unrecovered in Australia. The species was identified from three samples out of a total of 31 collected across the entire Survey Area. The survey subsequently mapped three separate areas of vegetation that were classified as being impacted by this species of *Phytophthora*.

The second survey was a sampling program only and appears to have been specifically targeted at vegetation previously classified as infested. i.e., this assessment did not appear to survey the full project area. The sampling only program included the collection of 10 soil and tissue samples yielding two positive recoveries of *P. sp. Aus 4B*.

The third *Phytophthora* Dieback survey, covering the entire Survey Area, recovered *Phytophthora* from five samples out of a total of 24. A sixth sample was considered to be a *Phytophthora* spp., however, the laboratory were unable to isolate a species from the available material. The results identified two *Phytophthora* species including *Phytophthora arenaria* and a second previously undescribed species identified as *P. sp. Aus 4E*. The positive recoveries from the August 2023 survey resulted in the number of known infested areas increasing from 3 discrete areas to eight.

The three combined assessments have collected a total of 65 samples across the Survey Area, with a total of 10 positive recoveries, including *P. sp. Aus 4B*, *P. sp. Aus 4E* and *P. arenaria*. Of the 65 samples, 27 have been collected from within the areas classified as infested bearing the 10 positive recoveries. This means 63% of the sampled plant deaths within areas of vegetation decline mapped as infested in the original 2021 report (Terratree, 2021) were not actually caused by *Phytophthora*. It is therefore possible that the actual extent of the disease on ground is not as great as that depicted in the disease occurrence figures. Due to survey limitations, cryptic disease expression and a lack of pathogenicity information for the *Phytophthora* species present, previous disease extents have not been amended.

Following the August 2023 survey and analysis of samples, the CPSM were engaged to undertake a Phylogenetic assessment of the species identified across the Survey Area at that time (CPSM 2024). The CPSM report was provided separately and identified that all species found across the Survey Area up to August 2023 were members of the Clade 4 group of *Phytophthora* spp. None of the Clade 4 group have been previously identified outside of Australia. This, along with the ability of this group to exist in the particularly low rainfall areas beyond the defined rainfall zone associated with introduced *Phytophthora* species, resulted in the CPSM concluding the Clade 4 group are almost certain to be native pathogens, potentially endemic to the vegetation communities occurring across the Survey Area.



4.1.2 Climate

The Bureau of Meteorology (BoM) broadly classifies the climate across the Yilgarn and Menzies Shires as hot dry summers with cold winters. BoM maintains a network of weather stations across Australia to record weather data, with the nearest stations to the Survey Area being Koolyanobbing to the south and Windarling to the north. The long-term average annual rainfall data from each site is 266 mm and 274.3 mm respectively. Interestingly, the average monthly rainfall figures for both sites show a relatively consistent average rainfall across all months despite the broad climate description of hot dry summers. A more detailed assessment of the rainfall data shows many of the summer months do experience very low rainfall, however, there are regular high rainfall events experienced occasionally at both monitoring stations.

These are important figures as the accepted distribution of *Phytophthora Dieback* is generally restricted by the 400 mm isohyet with distribution in the 400-600 mm/yr zone considered possible in sites with high summer rainfall averages or associated with water gaining sites. Based on BoM climate classification and rainfall data, the MinRes site is outside of the accepted range for *Phytophthora Dieback* occurrence, however, the episodic nature of the rainfall data does suggest that the area experiences suitable climatic conditions for *Phytophthora* species to exist.

4.1.3 Vegetation

The MinRes Survey Area is situated within the Southwestern Interzone Botanical Province, between the Eremaean and Southwest provinces. The vegetation of the area is part of the Coolgardie Botanical District (Beard 1990). The available vegetation mapping, from the National Vegetation Information System (NVIS), identifies five vegetation complexes within the Survey Area (DAWE 2020). These are listed below.

- Eucalyptus woodlands with a shrubby understorey – NVIS ID 80640
- Heathlands – NVIS ID 81100
- Acacia tall open shrubland and shrublands – NVIS ID 81104
- Acacia tall open shrubland and shrublands – NVIS ID 81239
- Low closed forest or tall closed shrublands – NVIS ID 81098

There have been no known pathogen susceptibility trials for species that occur within the vegetation complexes above, however, plants from genera that include susceptible species are found across the Survey Area, including *Allocasuarina*, *Banksia*, *Eucalyptus*, *Grevillea*, and *Persoonia*. As discussed in Section 4.2.1 below, positive recoveries have also been recovered from species in the *Melaleuca* and *Callitris* genera.

4.1.4 Land use

Land use across the region has been limited to historic exploration and mining activities. Specifically, across the Survey Area there are currently no mining activities at Carina, Carina Extended and J4. The Carina - Jackson Haul Road sees minimal use as the road is not primarily utilized for transport of ore. Current activities include transportation of ore to Carina from Parker Range for crushing and loading to rail carts to be shipped to the Port of Esperance.

Evidence of historic activities include the creation and extraction of material from borrow pits, stockpiling of topsoil associated with borrow pits and general site maintenance.

4.2 Disease Occurrence Assessment Results

4.2.1 Vegetation

The vegetation descriptions below are intended as general descriptions only and are not botanically comprehensive descriptions of vegetation complexes occurring across the Survey Area. Instead, the vegetation descriptions are intended to identify potential disease indicator species and possible susceptibility to *Phytophthora* Dieback.

As defined in Section 4.1.2, vegetation structure varies from woodlands to shrublands and heaths. This regional vegetation classification is consistent with observations across the Survey Area which identified a varying mosaic of vegetation structures consistent with the NVIS descriptions.

As the Survey Area is situated outside the defined vulnerable zone for *Phytophthora* Dieback, there has been limited research into the susceptibility of species that occur across the region. From the previous three sampling events within the Survey Area, it is known that both *Allocasuarina acutivalvis* and *Grevillea excelsior* are susceptible to *Phytophthora* spp. During the June 2024 survey, plant specimens were collected from both unknown species sampled in the current survey and from unknown species sampled in 2023 that returned a positive sample result. Post survey flora identification has confirmed that multiple *Grevillea* spp., *Persoonia leucopogon*, an unknown *Melaleuca* sp. and an unknown *Callitris* sp. are also susceptible to the *Phytophthora* spp occurring across the Survey Area.

In addition to species known to be susceptible, other species identified across the Survey Area that are anticipated to be susceptible include plants from the following genera:

- *Allocasuarina*
- *Astroloma*
- *Banksia*
- *Callitris*
- *Grevillea*
- *Isopogon*
- *Persoonia*

4.2.2 Disease Occurrence and Hygiene Categories

The revised occurrence of *Phytophthora* infestation is shown on Figures 2-1 through to 2-5. Following the completion of the 2024 *Phytophthora* Dieback survey, the classification of infested vegetation has increased and now includes 13 discrete areas classified as infested. Two additional *Phytophthora* species have also been identified across the Survey Area. These are *P. boodjera* and *P. sp. Aus 4F*, both of which are previously described and are part of the Clade 4 group of *Phytophthora* spp, previously determined to be native to Australia.

Several of the infested areas have been classified on the basis of two or more positive recoveries, however, during the 2024 survey multiple *Phytophthora* species have been identified within the same infested area and some samples have yielded more than one species of *Phytophthora* in the laboratory DNA identification process.

All vegetation not classified as infested within the Survey Area has been classified as uninterpretable on the basis that known susceptible species are either absent or present in insufficient numbers to allow for detection and mapping of the disease in accordance with DBCA definitions as described in Section 2.2.1.

4.2.3 Disease Expression

Disease expression observed across the infested vegetation was cryptic, limited to isolated and scattered deaths of susceptible species, though often occurring in areas of observable vegetation decline and potentially associated with other causes of plant death. This is supported by the high proportion of samples returning a negative result for *Phytophthora* Dieback in areas classified as infested.

The scattered and cryptic nature of vegetation decline, combined with multiple negative samples from previous assessments, made visual observation of disease expression and patterning difficult to accurately determine and define.

4.2.4 Disease Sampling

The laboratory report for the samples collected during the current assessment is presented as Appendix A while the sample locations and results are presented visually on report figures. 2-1 to 2-5. A total of 91 samples were collected from within the Survey Area during the current 2024 survey, representing a significant increase from previous sampling efforts. From these 91 samples there were 15 recoveries of *Phytophthora* spp. Recovered species include:

- *P. arenaria*
- *P. boodjera*
- *P. sp. Aus 4B*
- *P. sp. Aus 4E*
- *P. sp. Aus 4F*

Results from two samples identified two species of *Phytophthora* from the same sample material including:

- *P. sp. Aus 4B* and *P. sp. Aus 4E* – 1 result
- *P. sp. Aus 4B* and *P. sp. Aus 4F* – 1 result

In addition to the recoveries of *Phytophthora* species from the sample group, there were also three recoveries of *Globisporangium aff heterothallicum*, a pythium species that is regularly identified from soil across Western Australia (pers comm – Treena Burgess, CPSM). Pythium species are not typically associated with vegetation decline and are not anticipated to be a direct cause of vegetation decline across the Survey Area. Two results identifying the pythium species also identified *P. boodjera* in the same sample.

The 15 positive recoveries from the current 2024 survey bring the total number of positive records of *Phytophthora* spp. within the Survey Area to 25. Of the 25 positive recoveries, six sample sites are between 35 m – 70 m from the nearest evidence of site disturbance, being either topsoil stockpiles or haul roads. The remaining 19 are within 5 m of disturbed sites. Introduced *Phytophthora* species, specifically *P. cinnamomi* which is defined as *Phytophthora* Dieback in Western Australian and Australian Legislation, is introduced through the importation of infested soil or organic material, typically through human vectoring associated with soil movement operations. *P. cinnamomi* has not been recovered from the Survey Area.

4.2.5 Topsoil Stockpiles

Multiple stockpiles of topsoil were noted along the alignment of the J4 haul road and occasional stockpiles noted on the Carina haul road. A total of 13 topsoil stockpiles associated with observed susceptible species

plant deaths were subjected to sampling. From these samples only one positive recovery (*P. sp. Aus 4B*) was reported following sample analysis. This sample is J4S4 from 2023 and is shown on Figure 2-1.

4.3 Discussion of Results

From the cumulative sampling programs conducted since 2021, there have been five species of *Phytophthora* recovered. These are:

- *P. arenaria*
- *P. boodjera*
- *P. sp. Aus 4B*
- *P. sp. Aus 4E*
- *P. sp. Aus 4F*

The disease categories shown on Figures 2-1 through to 2-5 represent areas classified as infested. Using the results of the 2024 survey, the number of infested sites within the tenement has been expanded from eight to 13. Infested areas with multiple positive sample recoveries are mapped through extrapolation of confirmed disease occurrence data across areas of associated vegetation decline. Infested areas consisting of a single positive sample recovery but no evidence of wider vegetation decline have been mapped with a 20 m buffer around the single infested point. Nine of the infested areas are only associated with a single positive result, with no visual evidence of wider infestation at the time of survey.

As discussed further below, it is likely that, while *Phytophthora* is present, factors other than *Phytophthora* are also active and contributing to vegetation decline at identified infested sites. It is acknowledged that the actual areas of infestation may be smaller than portrayed in the disease occurrence figures, however, because of the cryptic nature of disease expression, the new and undescribed *Phytophthora* spp., and limited knowledge of the pathogen's behaviour beyond the prescribed "vulnerable zone", it is considered appropriate to apply significant buffers to contain all known occurrences within defined boundaries.

Typically, *Phytophthora* Dieback is most active in warm, moist conditions and, typically, rates of disease spread are higher in rainfall areas of between 500 mm – 1000 mm per year. While there has been no research into the occurrence and behaviour of *Phytophthora* in the Yilgarn region, it is anticipated that disease activity and the rate of spread would be less due to reduced rainfall activity. Therefore, any positive samples that occur in previously undisturbed vegetation not associated with or in near proximity to historic human activity are most likely to be an occurrence of a naturally occurring pathogen. Conversely, positive samples associated with/in proximity to human activity are potentially a result of disease introduction through the movement of infested soil.

From the cumulative sampling programs that have been undertaken across the Survey Area since 2021 there have been 156 samples collected from within the tenement area. These samples have been distributed across the tenement, ranging from roadside samples to samples collected in undisturbed vegetation up to 70 m from the nearest human vector. From these 156 samples there have been 25 confirmed recoveries of five *Phytophthora* species, with six sample sites located between 35 m – 70 m from the nearest evidence of site disturbance, being either topsoil stockpiles or haul roads.

Assuming that the average rate of spread of the identified *Phytophthora* species is at least equivalent to the accepted rate of spread in wetter forest areas, the pathogen would have to have been introduced a

minimum of 35 years prior to detection in order to spread to its known extent in undisturbed vegetation. However, as the current site disturbance is believed to have commenced in 2011, the distribution of positive recoveries across the entire tenement area, not limited to disturbed areas suggests the pathogen's occurrence in the area precedes the current disturbance activities.

The pre-existence of the pathogen in the tenement is supported by the findings of the Phylogenetic assessment of the identified *Phytophthora* species (CPSM, 2023). As defined in the CPSM study, delineating a species is subjective - it is based on accumulated evidence and relies upon certain decisions being based on limited molecular evidence (narrow approach) while others require molecular, morphological, and sometimes ecological differences in behaviours to be considered before describing a new species (broad approach). Both narrow and broad decision-making approaches were considered in the CPSM study. The study concluded that based on the phylogenetic assessment approach, broad or narrow, there were minor discrepancies that either separated the identified *Phytophthora* spp into different species or grouped some of the species into a single species with morphological variations. However, it also concluded that all identified species are part of the Clade 4 group of *Phytophthora*, sharing very similar genetic composition. As the Clade 4 group is the group being recovered from Western Australian samples, and is unknown from other countries, it was also concluded that the group represents naturally occurring *Phytophthora* spp which are possibly endemic to the region.

The information developed from the various surveys and assessments suggests that the Clade 4 group of *Phytophthora* spp. occurring within the Survey Area are naturally occurring species, probably distributed widely through the environment. However, there is a definite correlation between the number of positive sample recoveries and distance from disturbance areas, specifically haul roads. From the 25 positive recoveries, 19 occur within 5 m of a haul road or associated disturbance site. This high number of positive recoveries along disturbance areas will be influenced by survey effort which does focus on areas of human vectoring as these represent the greatest risk of disease introduction to an area. The high number of positive recoveries associated with disturbance areas does also suggest that, while *Phytophthora* spp. may occur naturally in the environment, the high proportion of positive samples situated on the edge of haul roads identifies the haul road construction as the likely vector that has spread the pathogens across the Survey Area.

Further, the topsoil stockpiles occurring along the haul road alignments also represent potential sources of inoculum that will result in further spread of the pathogen if they are redistributed along the alignment or to other areas external to the Survey Area.

During the current 2024 survey, topsoil stockpiles were visually assessed for the presence of susceptible species that may allow assessment of disease presence/absence. Where susceptible plant species deaths were observed on topsoil stockpiles, a soil and tissue sample was collected. A total of 13 samples have been collected from susceptible species deaths associated with stockpiles. However, the majority of topsoil stockpiles with susceptible species on or immediately surrounding them were not associated with plant deaths. Only one of these samples has returned a positive recovery, of *P. sp. Aus 4B*.

While this confirms that specific topsoil stockpile as being infested, the assessment method is limited to the targeting of presence of susceptible species in decline or dead. As it is believed the known *Phytophthora* spp. are native species occurring across the region, it is likely that many stockpiles contain soils and organic material providing a habitat for *Phytophthora* that cannot be detected as it was not impacting vegetation at the time of survey.

4.4 Conclusion

The information developed from the various surveys and assessments suggest that the Clade 4 group of *Phytophthora* spp. occurring within the Survey Area are naturally occurring species, probably distributed widely through the environment. Despite this, the high proportion of positive samples situated on the edge of haul roads identifies the haul road construction as the likely vector that has spread the pathogens across the Survey Area. This is likely to be increasing the occurrence and range of the pathogen in the environment. The risk of additional future spread is largely associated with the potential presence of undetectable *Phytophthora* spp. occurring in topsoil stockpiles that are intended for use during post mining site rehabilitation.

It is almost certain that the currently mapped occurrence of *Phytophthora* spp. across the Survey Area does not represent the full and actual occurrence due to the Survey Area size, cryptic nature of disease expression and knowledge gaps associated with pathogen's impact on the vegetation. It is unlikely that mapping the full extent of disease occurrence across the Survey Area is achievable without a significant increase in survey effort.

The species that have been identified are not *Phytophthora cinnamomi*, which is the species listed under State and Federal legislation and the subject of the TAP. However, as the TAP defines *Phytophthora* Dieback as “a destructive disease caused by the pathogen *Phytophthora cinnamomi* and other *Phytophthora* species”, there is an implied requirement for management of all species that are having a destructive impact on the environment. This requirement flows through current Western Australian legislation and associated management guidelines, therefore, the species identified across the Survey Area should be subject to regulated management, despite being considered native species.

Given evidence that the recovered *Phytophthora* spp. are associated with deaths of native plant species and there is evidence that they are being spread widely across altered environments by mining activities, there is a need for a greater assessment of impact to determine if management to mitigate impacts is required. The impact of artificial spread of the *Phytophthora* spp. remains unclear and therefore should become one of the primary considerations for future assessments.

4.5 Recommendations

- Vegetation classified as infested, as shown of Figures 2-1 through 2-5 and adjoining unsealed ground is not to be traversed during moist or wet soil conditions.
- Topsoil stockpiles within vegetation classified as infested, as shown of Figures 2-1 through 2-5 must not be used or spread outside of the infested areas they occur within.
- Future surveys should continue to include assessment of topsoil stockpiles occurring in vegetation currently classified as uninterpretable, with a focus on sampling deaths of susceptible species.
- Future surveys to include focus on increasing the knowledge of species that are susceptible to the pathogen in the region. This can be done by increasing the range of sampled species and targeting any plant deaths that present as potential *Phytophthora* impact, regardless of plant species.
- Further research to describe and understand the potential pathogenicity of the species identified across the Survey Area is the next important step in determination of appropriate management required across the Survey Area.

- In Western Australia, assessment and management of Phytophthora Dieback is overseen by DBCA who regulate standards and implementation of hygiene management and who maintain a registration system for appropriately qualified Phytophthora Dieback Interpreters. This registration system acknowledges the need for specific skills and experience when performing *Phytophthora* survey in low rainfall areas due to the reduced activity and detectability of the pathogen. It is a regulatory requirement that only Phytophthora Dieback Interpreters registered to undertake assessments in areas of low interpretability perform assessments across the Survey Area.
- Importantly, the term Phytophthora Dieback relates to *P. cinnamomi* and other *Phytophthora* species responsible for causing destructive impact to natural ecosystems. The associated management of Phytophthora Dieback is also typically focussed within the defined Vulnerable Zone, which does not include the Survey Area. Despite being beyond the scope of the current WA management guidelines, the species are implied in the TAP. Therefore, it is appropriate to develop and apply relevant management and associated hygiene protocols to all works associated with soil disturbance within the Survey Area, in order to mitigate further vectoring of disease.

5 REFERENCES

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Centre for Phytophthora Science and Management (CPSM) (2024): *Report on the status of Clade 4 Phytophthora isolates recovered in Western Australia*, CPSM, February 2024

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6 REPORT DISCLAIMER

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

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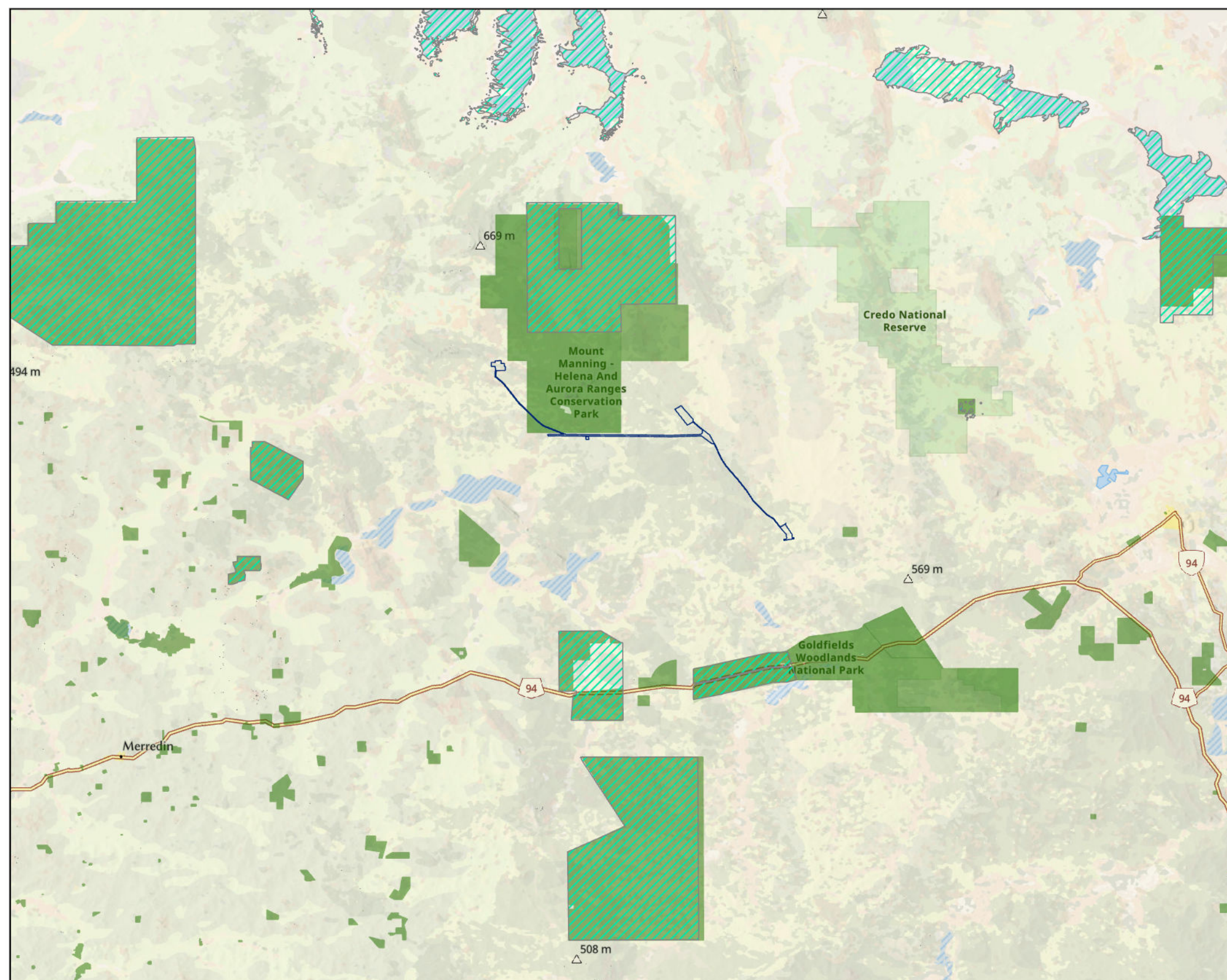
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Figures

Phytophthora Dieback Occurrence Survey- 2024

– MinRes Operations Carina and J4





- Survey Area
- Environmentally Sensitive Areas DWER
- Legislated Lands and Waters DBCA

Phytophthora Dieback occurrence as at June 2024.
Recheck required from June, 2025.
PDI Jeremy Spencer. Registration No. DPW PD018

Phytophthora Dieback Occurrence Survey - Mineral Resources Operations Carina & J4 prepared for Mineral Resources, November, 2024

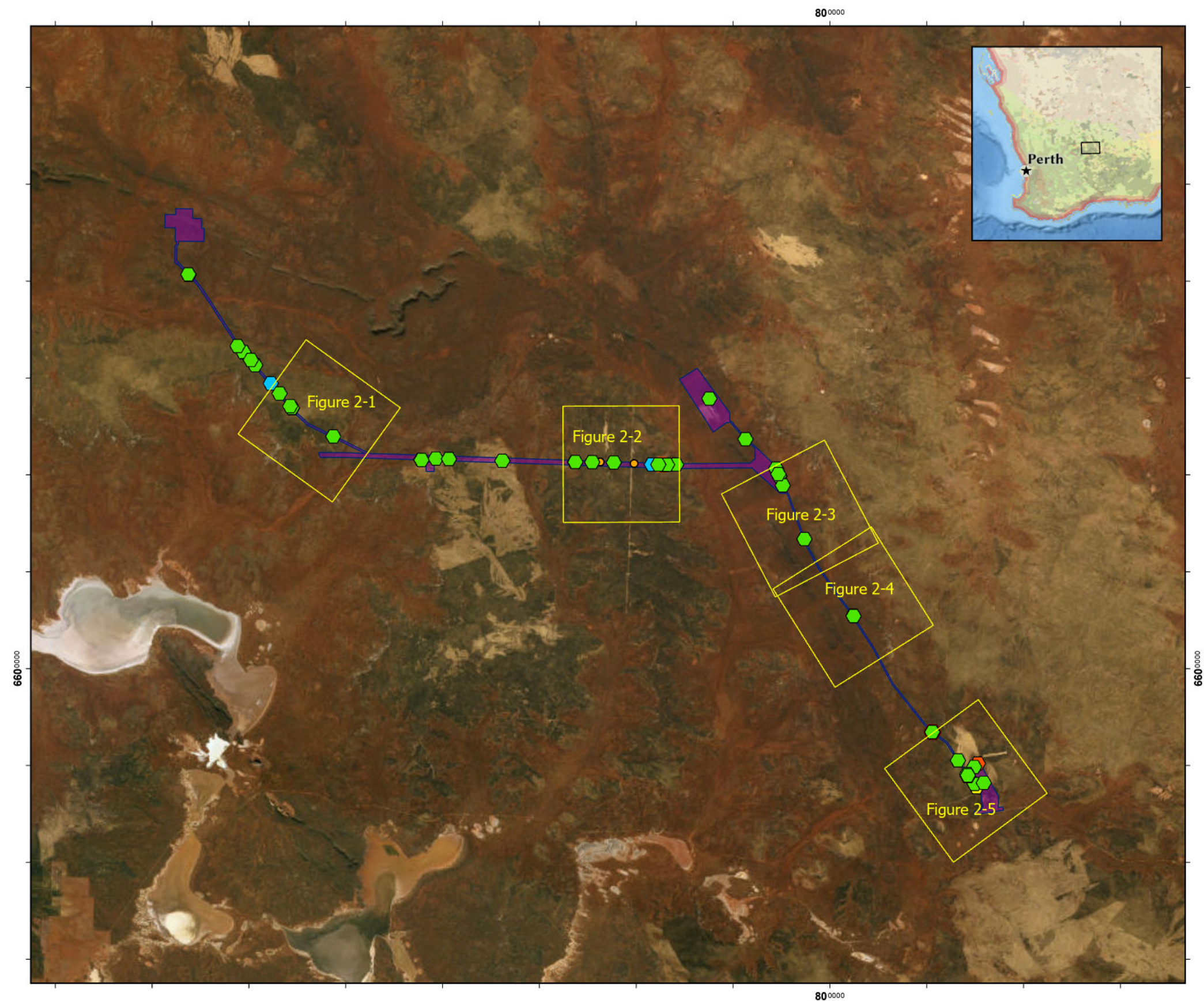


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Figure 1: Regional Location



Result

- Phytophthora arenaria
- Phytophthora boodjera
- Phytophthora sp.AUS 4B
- Phytophthora sp.AUS 4B;
Phytophthora sp.AUS 4E
- Phytophthora sp.AUS 4B;
Phytophthora sp.AUS 4F
- Phytophthora sp.AUS 4E
- Phytophthora sp.AUS 4F
- Negative

Historic Phytophthora spp.

- P. arenaria
- P. boodjera
- P.sp AUS 4B
- P.sp AUS 4E
- P sp? unknown

Status

- Infested
- Uninterpretable
- Survey Area

Phytophthora Dieback occurrence as at June 2024.
Recheck required from June, 2025.
PDI Jeremy Spencer. Registration No. DPW PD018

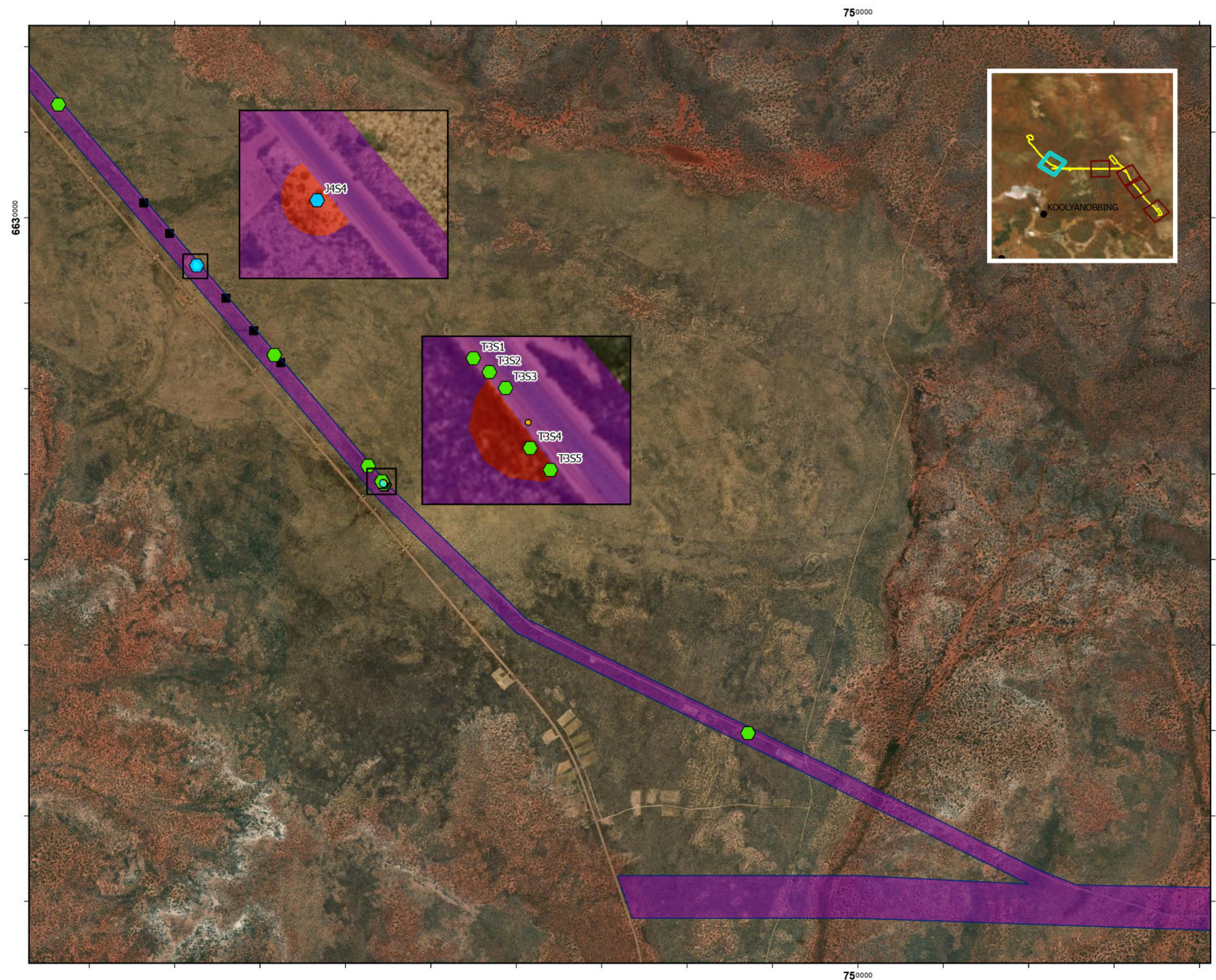
Phytophthora Dieback Occurrence Survey - Mineral
Resources Operations Carina & J4 prepared for
Mineral Resources, November, 2024

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Figure 2: Phytophthora Dieback Occurrence showing Sample Locations
and Results - Overview of Study Area



Sample Result

- Phytophthora arenaria
- Phytophthora boodjera
- Phytophthora sp.AUS 4B
- Phytophthora sp.AUS 4B;
Phytophthora sp.AUS 4F
- Phytophthora sp.AUS 4E
- Phytophthora sp.AUS 4B;
Phytophthora sp.AUS 4E
- Phytophthora sp.AUS 4F
- Negative

Historic Phytophthora spp.

- P. arenaria
- P. boodjera
- P.sp AUS 4B
- P.sp AUS 4E
- P sp? unknown
- Topsoil stockpiles

Status

- Infested
- Uninterpretable
- Survey Area

Phytophthora Dieback occurrence as at June 2024.
Recheck required from June, 2025.
PDI Jeremy Spencer. Registration No. DPW PD018

Phytophthora Dieback Occurrence Survey - Mineral
Resources Operations Carina & J4 prepared for
Mineral Resources, November, 2024

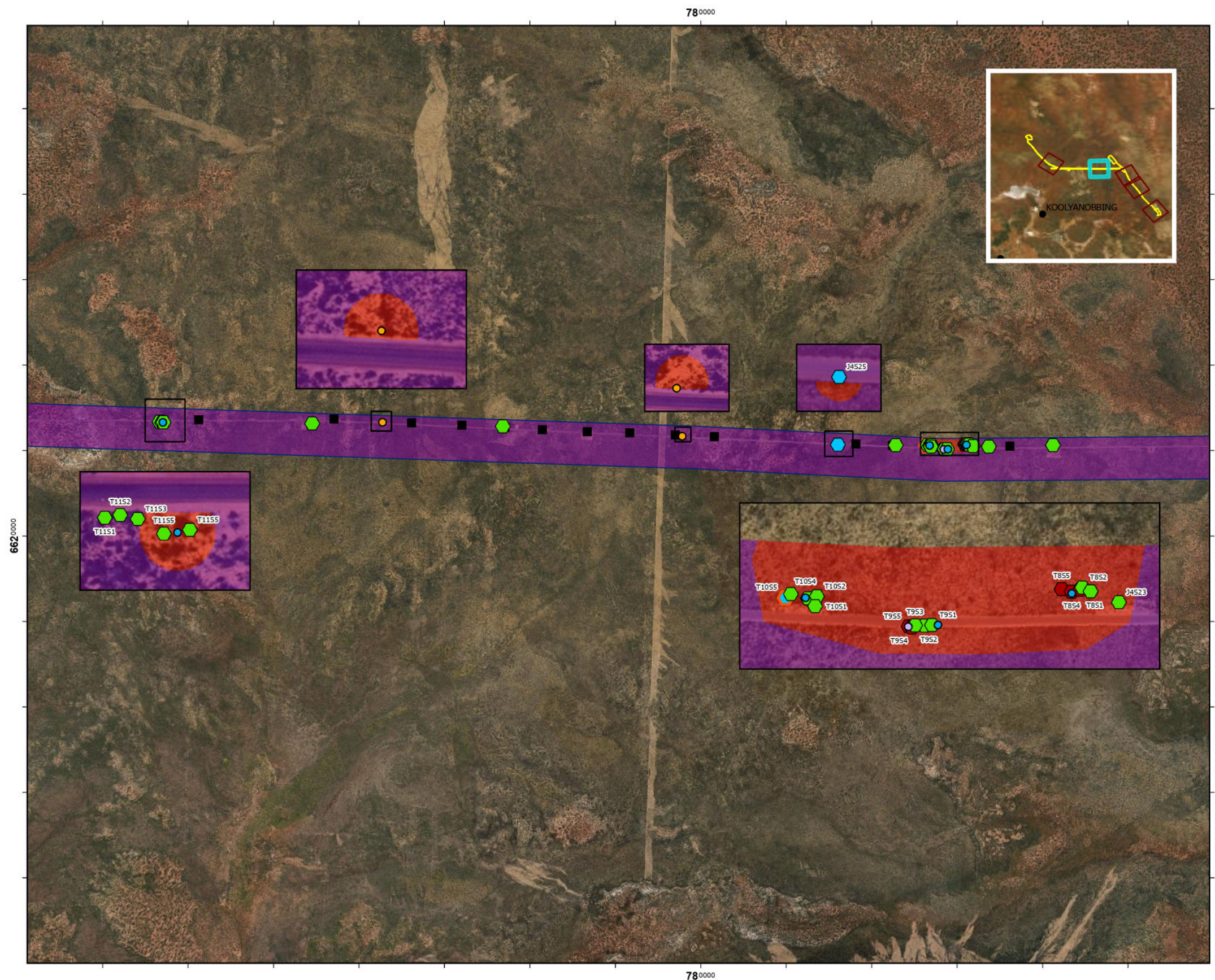
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Figure 2-1: Phytophthora Dieback Occurrence showing
Sample Locations and Results



Result

- Phytophthora arenaria
- Phytophthora boodjera
- Phytophthora sp.AUS 4B
- Phytophthora sp.AUS 4B;
Phytophthora sp.AUS 4E
- Phytophthora sp.AUS 4B;
Phytophthora sp.AUS 4F
- Phytophthora sp.AUS 4E
- Phytophthora sp.AUS 4F
- Negative

Historic Phytophthora spp.

- P. arenaria
- P. boodjera
- P.sp AUS 4B
- P.sp AUS 4E
- P sp? unknown
- Topsoil stockpiles

Status

- Infested
- Uninterpretable
- Survey Area

Phytophthora Dieback occurrence as at June 2024.
Recheck required from June, 2025.
PDI Jeremy Spencer. Registration No. DPW PD018

Phytophthora Dieback Occurrence Survey - Mineral
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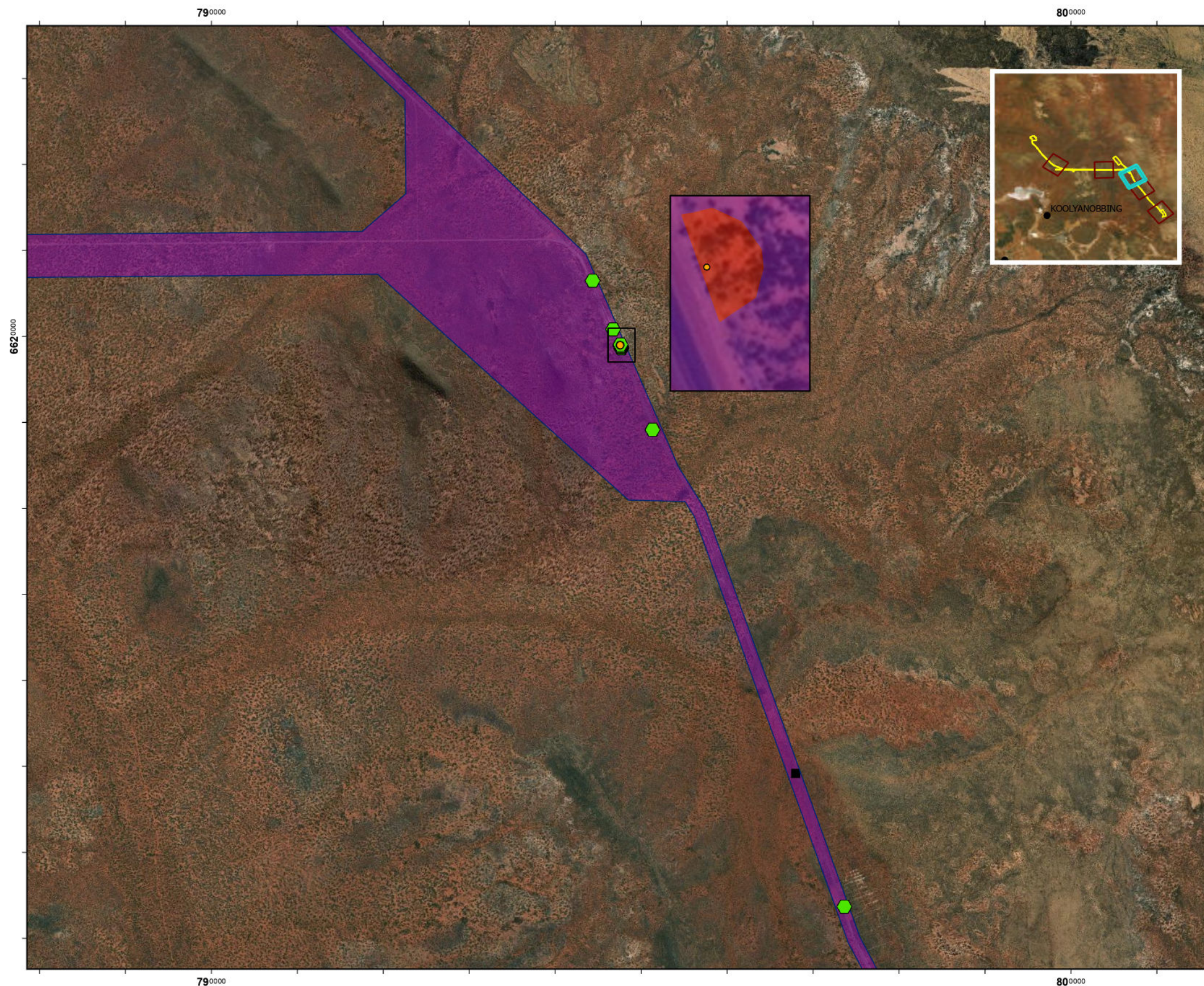
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Figure 2-2: Phytophthora Dieback Occurrence showing
Sample Locations and Results



Result

- *Phytophthora arenaria*
- *Phytophthora boodjera*
- *Phytophthora sp.AUS 4B*
- *Phytophthora sp.AUS 4B; Phytophthora sp.AUS 4E*
- *Phytophthora sp.AUS 4B; Phytophthora sp.AUS 4F*
- *Phytophthora sp.AUS 4E*
- *Phytophthora sp.AUS 4F*
- Negative

Historic *Phytophthora* spp.

- *P. arenaria*
- *P. boodjera*
- *P.sp AUS 4B*
- *P.sp AUS 4E*
- *P sp? unknown*
- Topsoil stockpiles

Status

- Infested
- Uninterpretable
- Survey Area

Phytophthora Dieback occurrence as at June 2024.
Recheck required from June, 2025.
PDI Jeremy Spencer. Registration No. DPW PD018

Phytophthora Dieback Occurrence Survey - Mineral
Resources Operations Carina & J4 prepared for
Mineral Resources, November, 2024

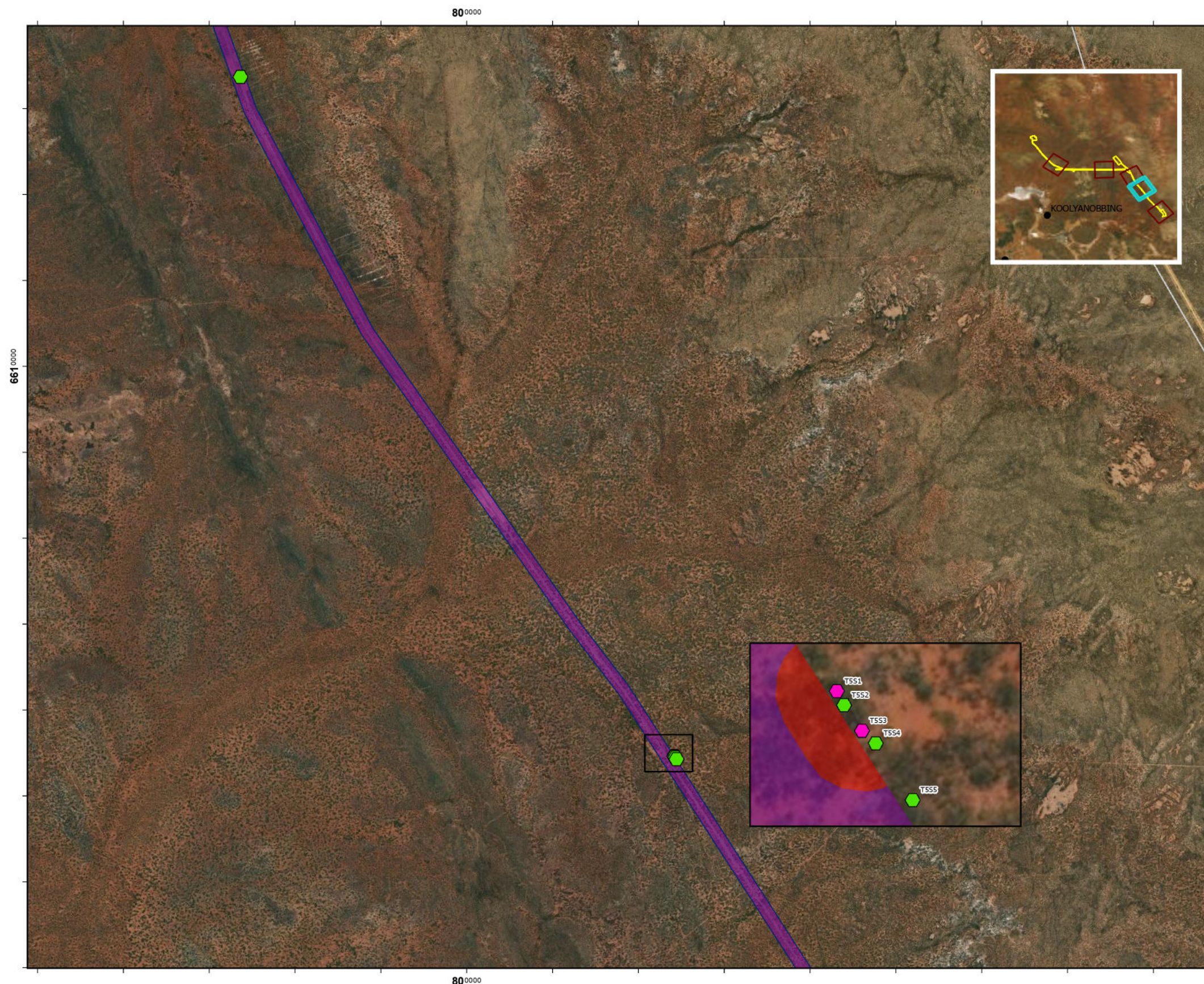
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Figure 2-3: *Phytophthora* Dieback Occurrence showing
Sample Locations and Results



Result

- Phytophthora arenaria
- Phytophthora boodjera
- Phytophthora sp.AUS 4B
- Phytophthora sp.AUS 4B;
Phytophthora sp.AUS 4E
- Phytophthora sp.AUS 4B;
Phytophthora sp.AUS 4F
- Phytophthora sp.AUS 4E
- Phytophthora sp.AUS 4F
- Negative

Historic Phytophthora spp.

- P. arenaria
- P. boodjera
- P.sp AUS 4B
- P.sp AUS 4E
- P sp? unknown
- Topsoil stockpiles

Status

- Infested
- Uninterpretable
- Survey Area

Phytophthora Dieback occurrence as at June 2024.
Recheck required from June, 2025.
PDI Jeremy Spencer. Registration No. DPW PD018

Phytophthora Dieback Occurrence Survey - Mineral
Resources Operations Carina & J4 prepared for
Mineral Resources, November, 2024

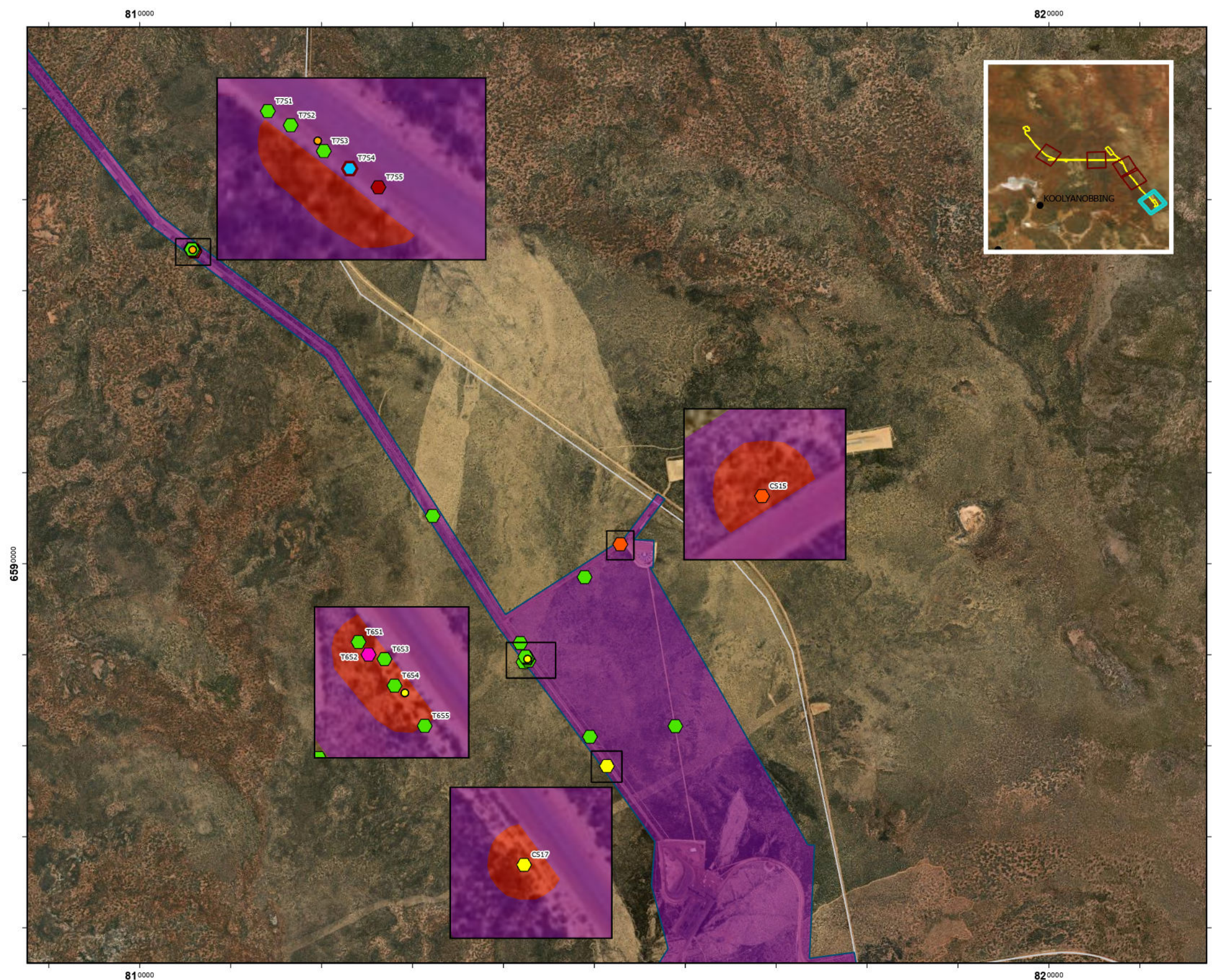
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Figure 2-4: Phytophthora Dieback Occurrence showing
Sample Locations and Results



Historic Phytophthora spp.

- P. arenaria
- P. boodjera
- P.sp AUS 4B
- P.sp AUS 4E
- P.sp? unknown

Result

- Phytophthora arenaria
- Phytophthora boodjera
- Phytophthora sp.AUS 4B
- Phytophthora sp.AUS 4B;
Phytophthora sp.AUS 4E
- Phytophthora sp.AUS 4B;
Phytophthora sp.AUS 4F
- Phytophthora sp.AUS 4E
- Phytophthora sp.AUS 4F
- Negative
- Topsoil stockpiles

Status

- Infested
- Uninterpretable
- Survey Area

Phytophthora Dieback occurrence as at June 2024.
Recheck required from June, 2025.
PDI Jeremy Spencer. Registration No. DPW PD018

Phytophthora Dieback Occurrence Survey - Mineral
Resources Operations Carina & J4 prepared for
Mineral Resources, November, 2024

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Figure 2-5: Phytophthora Dieback Occurrence showing
Sample Locations and Results

Appendix A

VHS soil and tissue sample analysis report

Murdoch University - Plant Health Laboratories Analysis report

Batch Details

Analysis Fee

Delivery date

Registered by Jeremy Spencer

Organisation Bio-Logic

Address :

Phone Number: 0400 113 093

Email Address:Jeremy@gsbiologic.com.au

Sample Information

Sample	Sample Label	Date Collected	Plant Species Sampled	Species of Interest	Sample Type	Species Isolated
1	J4S1	15/06/2024	Allocasuarina sp.	Phytophthora sp	Soil and Root	Negative
2	J4S2	15/06/2024	Allocasuarina sp.	Phytophthora sp	Soil and Root	Negative
3	J4S3	15/06/2024	A. acutivalvis	Phytophthora sp	Soil and Root	Negative
4	J4S4	15/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Phytophthora sp.AUS 4B
5	J4S5	15/06/2024	A. acutivalvis & Grevillea sp.	Phytophthora sp	Soil and Root	Negative

Plant Health Laboratories

Biological Science and Biotechnology

Contact: Diane White 0419943382

E-mail d.white@murdoch.edu.au

Web www.cpsm-phytophthora.org

Murdoch University - Plant Health Laboratories Analysis report

6	J4S6	15/06/2024	Allocasuarina sp.	Phytophthora sp	Soil and Root	Negative
7	CS7	16/06/2024	A. acutivalvis	Phytophthora sp	Soil and Root	Negative
8	CS8	16/06/2024	A. acutivavis	Phytophthora sp	Soil and Root	Negative
9	CS9	16/06/2024	Eucalyptus sp.	Phytophthora sp	Soil and Root	Negative
10	CS10	16/06/2024	A. acutivalvis	Phytophthora sp	Soil and Root	Negative
11	CS11	16/06/2024	A. acutivalvis	Phytophthora sp	Soil and Root	Negative
12	CS12	16/06/2024	unknown	Phytophthora sp	Soil and Root Soil and Root	Negative
13	CS13	17/06/2024	A. acutivalvis	Phytophthora sp	Soil and Root	Negative
14	CS14	17/06/2024	A. acutivalvis	Phytophthora sp	Soil and Root	Negative
15	CS15	17/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Phytophthora sp.AUS 4E
16	CS16	17/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Negative

Murdoch University - Plant Health Laboratories Analysis report

17	CS17	17/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Phytophthora arenaria
18	CS18	17/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Negative
19	CS19	17/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Negative
20	CS20	17/06/2024	A. acutivalvis	Phytophthora sp	Soil and Root	Negative
21	J4S21	18/06/2024	Unknown	Phytophthora sp	Soil and Root	Negative
22	J4S22	18/06/2024	A. acutivalvis	Phytophthora sp	Soil and Root	Negative
23	J4S23	18/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Negative
24	J4S24	18/06/2024	A. acutivalvis	Phytophthora sp	Soil and Root	Negative
25	J4S25	18/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Phytophthora sp.AUS 4B

Murdoch University - Plant Health Laboratories Analysis report

26	J4S26	18/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Negative
27	J4S27	18/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Negative
28	J4S28	19/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Negative
29	J4S29	19/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Negative
30	J4S30	19/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Negative
31	J4S31	19/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Negative
32	T1S1	15/06/2024	Unknown	Phytophthora sp	Soil and Root	Negative
33	T1S2	15/06/2024	Unknown	Phytophthora sp	Soil and Root	Negative

Murdoch University - Plant Health Laboratories Analysis report

34	T1S3	15/06/2024	Unknown	Phytophthora sp	Soil and Root	Globisporangium aff heterothallicum
35	T1S4	15/06/2024	Unknown	Phytophthora sp	Soil and Root	Negative
36	T1S5	15/06/2024	Unknown	Phytophthora sp	Soil and Root	Negative
37	T2S1	15/06/2024	Allocasuarina sp.	Phytophthora sp	Soil and Root	Negative
38	T2S2	15/06/2024	Allocasuarina sp.	Phytophthora sp	Soil and Root	Negative
39	T2S3	15/06/2024	Allocasuarina sp.	Phytophthora sp	Soil and Root	Negative
40	T2S4	15/06/2024	Allocasuarina sp.	Phytophthora sp	Soil and Root	Negative
41	T2S5	15/06/2024	Unknown	Phytophthora sp	Soil and Root	Negative

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42	T3S1	15/06/2024	Allocasuarina sp.	Phytophthora sp	Soil and Root	Negative
43	T3S2	15/06/2024	Allocasuarina sp.	Phytophthora sp	Soil and Root	Negative
44	T3S3	15/06/2024	Allocasuarina sp.	Phytophthora sp	Soil and Root	Negative
45	T3S4	15/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Negative
46	T3S5	15/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Negative
47	T4S1	16/06/2024	Acacia sp.	Phytophthora sp	Soil and Root	Negative
48	T4S2	16/06/2024	Allocasuarina sp.	Phytophthora sp	Soil and Root	Negative
49	T4S3	16/06/2024	Allocasuarina sp.	Phytophthora sp	Soil and Root	Negative

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50	T4S4	16/06/2024	Taxandria sp.	Phytophthora sp	Soil and Root	Negative
51	T4S5	16/06/2024	Allocasuarina sp.	Phytophthora sp	Soil and Root	Negative
52	T5S1	16/06/2024	Unknown	Phytophthora sp	Soil and Root	Phytophthora boodjera
53	T5S2	16/06/2024	Unknown	Phytophthora sp	Soil and Root	Negative
54	T5S3	16/06/2024	Unknown	Phytophthora sp	Soil and Root	A. Globisporangium aff heterothallicum B. Phytophthora boodjera
55	T5S4	16/06/2024	Unknown	Phytophthora sp	Soil and Root	Negative
56	T5S5	16/06/2024	Unknown	Phytophthora sp	Soil and Root	Negative

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57	T6S1	17/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Negative
58	T6S2	17/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	A. Globisporangium aff heterothallicum B. Phytophthora boodjera
59	T6S3	17/06/2024	Unknown	Phytophthora sp	Soil and Root	Negative
60	T6S4	17/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Negative
61	T6S5	17/06/2024	Isopogon sp.?	Phytophthora sp	Soil and Root	Negative
62	T7S1	17/06/2024	Acacia sp.	Phytophthora sp	Soil and Root	Negative
63	T7S2	17/06/2024	Melaleuca sp.	Phytophthora sp	Soil and Root	Negative
64	T7S3	17/06/2024	Unknown	Phytophthora sp	Soil and Root	Negative

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65	T7S4	17/06/2024	Melalueca sp.	Phytophthora sp	Soil and Root	A.Phytophthora sp.AUS 4B B.Phytophthora sp.AUS 4F
66	T7S5	17/06/2024	Unknown	Phytophthora sp	Soil and Root	Phytophthora sp.AUS 4F
67	T8S1	18/06/2024	A. acutivalvis	Phytophthora sp	Soil and Root	Negative
68	T8S2	18/06/2024	A. acutivalvis	Phytophthora sp	Soil and Root	Negative
69	T8S3	18/06/2024	A. acutivalvis	Phytophthora sp	Soil and Root	Phytophthora sp.AUS 4F
70	T8S4	18/06/2024	A. acutivalvis	Phytophthora sp	Soil and Root	Phytophthora sp.AUS 4F

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71	T8S5	18/06/2024	A. acutivalvis	Phytophthora sp	Soil and Root	Phytophthora sp.AUS 4F
72	T9S1	18/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Negative
73	T9S2	18/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Negative
74	T9S3	18/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Negative
75	T9S4	18/06/2024	A. acutivalvis	Phytophthora sp	Soil and Root	Phytophthora sp.AUS 4F
76	T9S5	18/06/2024	Callitris sp.	Phytophthora sp	Soil and Root	Phytophthora sp.AUS 4F

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77	T10S1	18/06/2024	Unknown	Phytophthora sp	Soil and Root	Negative
78	T10S2	18/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Negative
79	T10S3	18/06/2024	Unkown	Phytophthora sp	Soil and Root	Negative
80	T10S4	18/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Negative
81	T10S5	18/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	A. Phytophthora sp.AUS 4E B.Phytophthora sp.AUS 4B
82	T11S1	18/06/2024	A. acutivalvis	Phytophthora sp	Soil and Root	Negative
83	T11S2	18/06/2024	Unkown	Phytophthora sp	Soil and Root	Negative
84	T11S3	18/06/2024	Unkown	Phytophthora sp	Soil and Root	Negative

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85	T11S5	18/06/2024	Unkown	Phytophthora sp	Soil and Root	Negative
86	T11S5	18/06/2024	A. acutivalvis	Phytophthora sp	Soil and Root	Negative
87	T12S1	19/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Negative
88	T12S2	19/06/2024	Unkown	Phytophthora sp	Soil and Root	Negative
89	T12S3	19/06/2024	Grevillea sp.	Phytophthora sp	Soil and Root	Negative
90	T12S4	19/06/2024	Callitris sp.	Phytophthora sp	Soil and Root	Negative
91	T12S5	19/06/2024	Unknown	Phytophthora sp	Soil and Root	Negative