CHRISTMAS ISLAND
PHOSPHATES

Part A - Clearing Permit Application

"Case-by-Case Areas"

March 2018

Range to Reef ENVIRONMENTAL

Prepared for Phosphates Resources Limited

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Prepared for Phosphate Resources Limited (trading as Christmas Island Phosphates)

Executive Summary

Phosphate Resources Limited (PRL), trading as Christmas Island Phosphates (CIP) proposes to clear ten blocks within Mining Lease MCI 70/1A, totalling 51.5 ha, on Christmas Island for the purposes of phosphate mining. The blocks under application have been previously cleared and fall within areas approved for mining under the *Environment Protection (Impact of Proposals) Act 1974 (Cth)* in 1997.

Portions of the blocks under application have been the subject of previous applications CPS 3472 and CPS 4506. Some of these blocks were deferred to a 'case-by-case' assessment or were approved for exploration which has now been completed.

The key environmental issues which have arisen in assessment of the proposed clearing are the proximity of some blocks to the Christmas Island National Park, the presence of nests of the Threatened Abbott's booby in adjacent rainforest and the use of proposed clearing areas by the keystone species the Christmas Island red crab and other commonly found threatened fauna species.

Undisturbed Christmas Island rainforest vegetation is naturally resistant to weed invasion (Green, Lake and O'Dowd 2004) so the proposal is unlikely to impact National Park. No physical damage to Abbott's booby nest trees will occur as a result of the proposal. Completion of mining in these areas would enable the relinquishment of the important enclaves within the National Park and allow for rehabilitation under the Christmas Island Minesite to Forest Rehabilitation Program and incorporation into the Park. This is a priority recommended by the Abbott's booby recovery plan. The level of clearing is unlikely to have significant impacts on red crabs.

An assessment of the proposed clearing against the ten principles outlined in Schedule 5 of the *Environmental Protection Act 1986 (WA) (CI)*, taking into account the previous negotiations with Government officers, indicates that the clearing is not likely to be at variance to the clearing principles.

This report makes several recommendations for approval and management of the proposed clearing.

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1 Introduction

Phosphate Resources Limited (PRL) commissioned Range to Reef Environmental to undertake a constraints analysis and assess impacts against the ten clearing principles for eleven areas (74.3 ha) within mining lease 70/1A. On consideration of the environmental constraints, PRL reduced the application area to 10 areas totalling 51.5 ha to address issues identified.

Some of the proposed clearing areas in this application are of strategic importance as they facilitate access to other areas on the mining lease that are already approved for clearing under CPS 3472 and CPS 4501 which would otherwise be inaccessible to mining equipment.

1.1 Background and Purpose

Christmas Island is an Indian Ocean territory of Australia, located approximately 2,600 km north-west of Perth. Phosphate Resources Limited (PRL) operates phosphate mining, processing and shipping operations from Christmas Island under the trading name of Christmas Island Phosphates (CIP). PRL were provided with a mining lease and environmental approval to mine in 1997 and operated under this basis until the application of Western Australian legislation required the company to apply for clearing permits under the *Environmental Protection Act 1986 (WA) (CI)* (EP Act) for all future clearing. PRL have progressively applied for and obtained approval for clearing in target sites over mining lease 70/1A. This current application will cover all remaining areas of interest and no further clearing applications are likely on this lease once this application is resolved.

The Island is predominantly National Park (63%) in recognition of its unique and sensitive environment with major seabird colonies, special land crab populations, marine habitats and many endemic species. The boundaries of the original mining lease (MCI 70/1A) were determined from the previously cleared and mined areas, including low grade stockpile dumps, visible in aerial photography. The areas within the lease have all been previously cleared and under the lease conditions no primary rainforest can be cleared for mining operations.

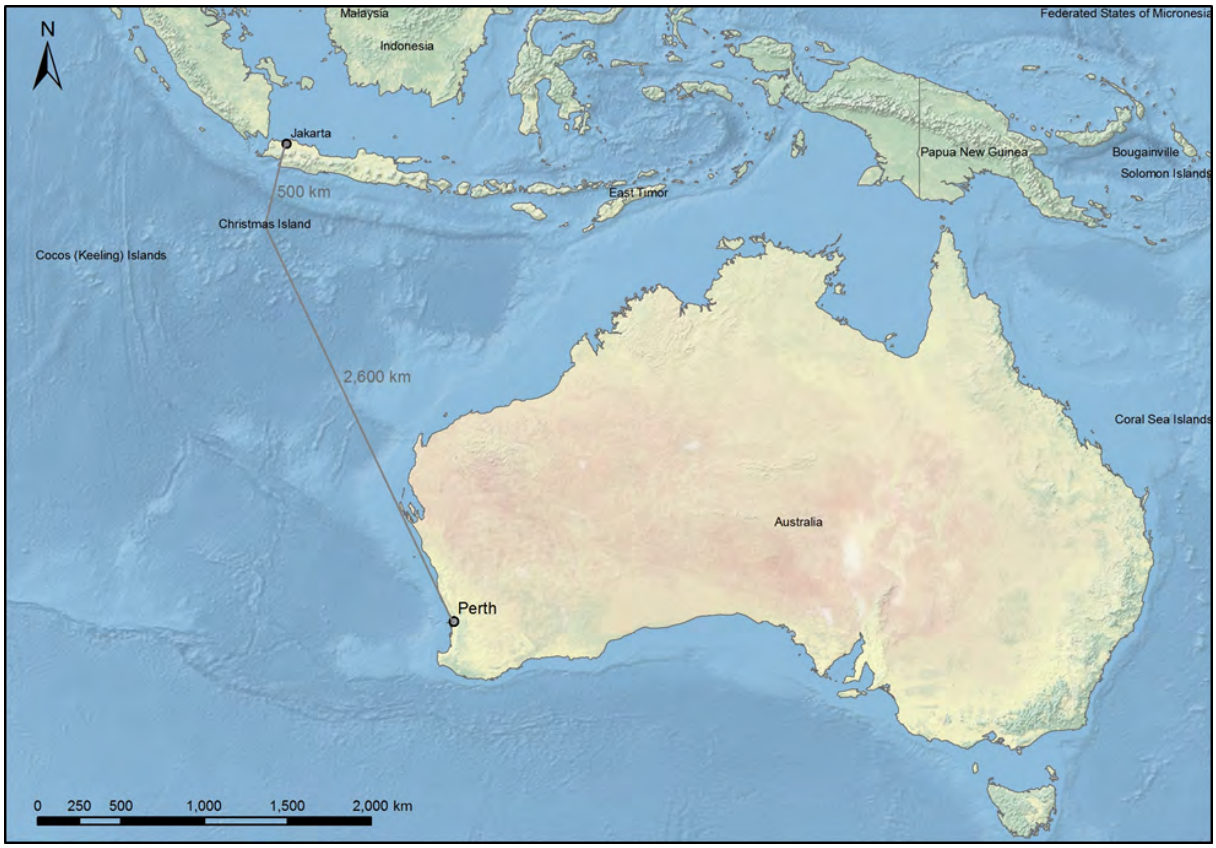

Figure 1. Location of Christmas Island

This application covers remaining areas in MCI 70/1A that PRL wish to undertake mining within which are not covered by existing clearing permits. Some of the areas included in this application have been applied for previously by PRL (mainly under CPS 3472) and the remainder represent outstanding blocks that had not been previously applied for. CPS 3472 was approved in 2009 but the permit deferred most areas to a 'case-by-case assessment'. There were several iterations where 'case-by-case' areas were applied for and considered (discussed further in Section 1.2). The 2013 amendment (CPS 3472/4) addressed most of the outstanding areas, however, the Commonwealth did not give approval to several areas of strategic importance for the company. These areas facilitate access to areas already approved and hence are critical to the company accessing resources on its mining lease. PRL contend that the reasons provided for not approving these areas were not justified, that the decisions were inconsistent with previous agreements, and inconsistent with the approval of similar areas under other clearing permit applications.

A key factor that complicates clearing approvals and mine operations is the historical location of the boundaries of the mining lease. Unlike many mining operations, the mining lease boundaries reflect past clearing and mining on the Island, which occurred in isolated pockets based on the location of phosphate resources. The National Park was subsequently established over primary (uncleared) forest which surrounded previously mined areas. The result is a convoluted boundary, mining enclaves and extensive boundary interaction between the mining lease and National Park. The imposition of buffers as a condition of clearing approvals is often impractical and problematic due to the narrow nature of mining envelopes with small and narrow enclaves becoming inaccessible if buffers are imposed (and requirements for battering of edges). A significant component of this application lies in the central area of the mining lease which is surrounded by National Park. Approval of the areas in this application is essential to facilitate access to other areas within MCI 70/1A that have already been approved for

clearing under CPS 4506 and CPS 3472. The central enclave (ML 109/110) contains significant phosphate resources and represents a major component of the company's future resources. A significant reduction in mine life will occur if access to this area cannot be facilitated.

PRL's operations continue to be the mainstay of the Island's private enterprise economy and support the activities of numerous small Island businesses. Mining makes a fundamental contribution to the Island's economic prosperity and provides a foundation for the long-term sustainability of the island (Commonwealth of Australia 2013).

The major mining lease provided to CIP (Mining Lease No. 70/1A) extends to 2034. This clearing permit application provides a critical component of phosphate resources within MCI 70/1A. and without access to these resources the life of the mine will be significantly reduced.

The purpose of this clearing permit application is to apply for permission to clear lands already approved for mining under the *Environment Protection (Impact of Proposals) Act 1974 (Cth)* (EPIP Act) in 1997. The proposed clearing will facilitate an extension of the mine life and support the Island's economy.

1.2 History of Application

A significant proportion of the areas included in this application have been applied for previously by PRL but was deferred to case by case assessment. The history is complicated by the fact that boundaries have been amended through various negotiations, have been assessed by different Government officers, and been the subject of many discussions, correspondence and agreements between the company and the Commonwealth. A summary of the history is provided below for context to this application.

The original CPS 3472 application covered 106 areas totalling 305.5 ha.

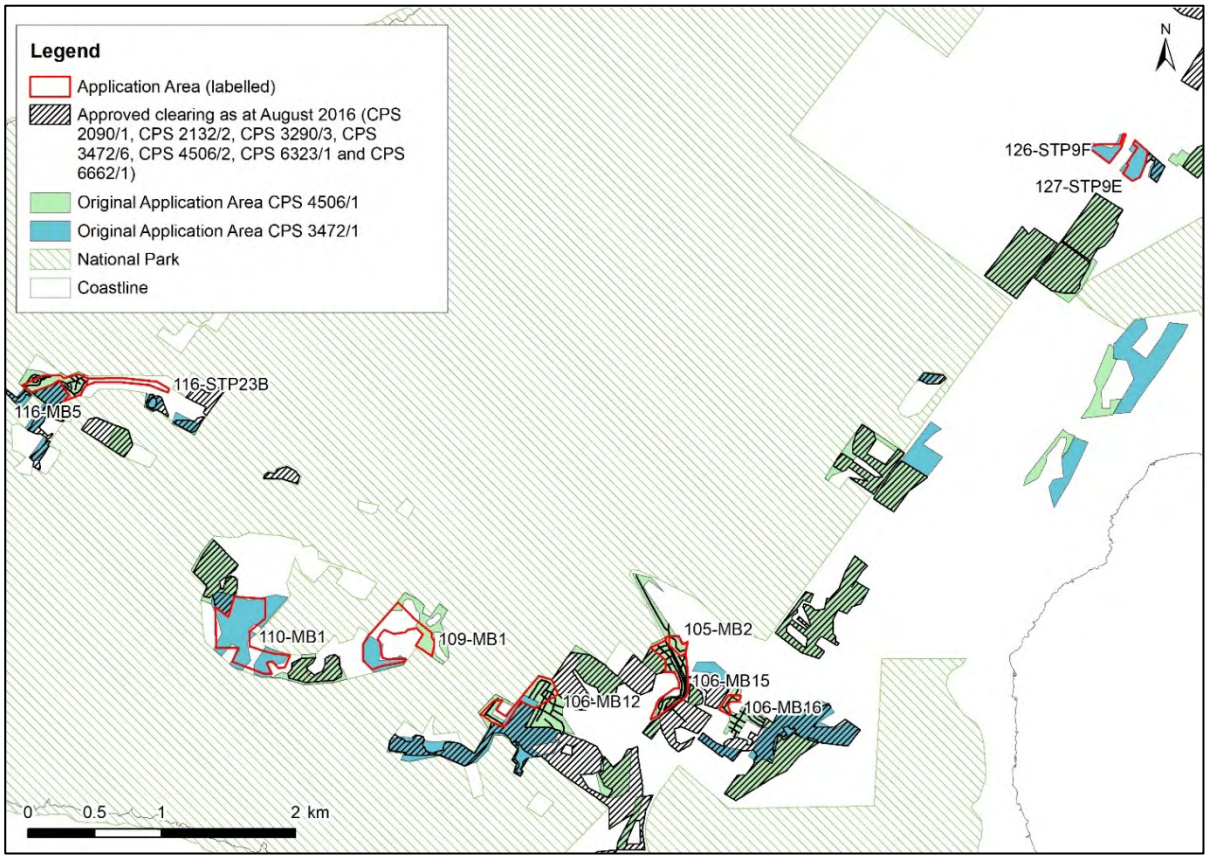

Figure 2. Application history

CPS 3472/1 was granted on 15 December 2009 approving only 32 areas, with 74 of the 106 areas, deferred to a 'case-by-case' assessment where clearing could not occur without approval of the Commonwealth.

A request to clear some of these 'case-by-case' areas was lodged on 13 May 2010 and CPS 3472/2 was granted on 13 July 2010 approving a further four areas with the remaining 70 of the 106 areas remaining as approval on a 'case-by-case' assessment.

A request to clear a further 16 of the outstanding case-by-case areas was submitted in August 2010 (i.e. application for CPS 3472/3). From 24-26 August 2010, Leah Stratford (Environmental Officer, Indian Ocean Territories, Department of Environment and Conservation (DEC)) visited the island to inspect 'case-by-case' areas under application CPS 3472/3. The report said that special clearing conditions would be granted on a case-by-case basis for areas in ML 116, ML 133, ML 109 and ML 110.

On 28 January 2011 a request was submitted to Department of Regional Australia, Regional Development and Local Government by PRL for approval to clear 16 case by case areas. CPS 3472/3 was approved on the 7 April 2011 however only approved seven of the 16 case by case areas applied for.

In August 2011 the Department of Regional Australia, Regional Development and Local Government advised of the intention to approve the clearing of a further 2.99 ha but that the majority of the requested 19.95 ha would remain as 'case by case'. The refusal to approve clearing permits over areas already environmentally approved under the EPIP Act, effectively negated the approval and prevented access to large areas of PRL's reserves. This triggered a range of discussions and correspondence between PRL and the Government.

On 6 September 2011 PRL wrote to Julian Yates (First Assistant Secretary, Local Government and Territories Division, Department of Regional Australia, Regional Development and Local Government, delegate under Section 51 of the EP Act (WA) (CI)) to express concern over the intention not to approve areas under the application CPS 3472/3 and requested that the Minister undertake a review of the decision, taking into account socio-economic factors and the low environmental impacts of the proposed clearing. On 27 September 2011 PRL wrote to Julian Yates and provided the results of an environmental risk-assessment of the areas applied for in January 2011.

Delays in the issuing of clearing permits were causing significant concern for PRL with potential for this to cause early closure of the mine. In response to this situation meetings were requested to resolve a way forward. On 16 November 2011, Dale Stanton (DEC), Julian Yates and Jadranka Matijas (Department of Regional Australia, Regional Development and Local Government), Kevin Edwards (PRL) and Andrew Hill (Range to Reef Environmental) met on Christmas Island to seek a way forward to address PRL's resource needs. The meeting focussed on the case by case areas applied for (i.e. CPS 3472/3) and a new application (CPS 4506) to enable access to resources in the mining lease.

The importance of these areas for future mine security, access and environmental issues were discussed to determine potential compromises and strategies to minimise impacts and allow restricted access to the areas. An approach for the new application (CPS 4506) was agreed upon, and there was an in-principle agreement that a permit would be approved to access five of the case by case areas in CPS 3472 subject to a number of boundary changes and conditions. Areas 109-MCP-STP20B, 110-MCP-MB2, 110-MCP-STP20A, 110-MCP-STP20L and 110-MCP-STP20M were given in-principle support on a 'stockpile only' basis with a 5m buffer which would limit impacts to the National Park and allow for rapid vegetative recovery, as well as facilitate future rehabilitation by Parks.

PRL applied for a new clearing application applying the principles and approach negotiated with Julian Yates at the 16 November 2011 meeting. On 16 March 2012 Clearing Permit CPS 4506/1 covering 222.61 ha was issued for areas across the island. The decision report stated that the proposal was not at variance to clearing principle (a) (*Native vegetation should not be cleared if it comprises a high level of biological diversity*) because due to previous clearing, degradation and weediness, the land was disturbed and therefore not considered to hold high biological diversity. The application areas were said to be unlikely to be at variance with principle (h) (*Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area*) because weed management conditions would be placed on the permit to mitigate potential impacts.

On 9 November 2012, Julian Yates wrote to PRL to advise that a request for an amendment to CPS 3472/3 should be submitted addressing all outstanding case by case areas in CPS 3472 and would be assessed consistent with the approach undertaken for CPS 4506/1.

On 12 November 2012, Stephen Clay (Director, Strategic Policy and Projects, Department of Regional Australia, Regional Development and Local Government) met with company representative to discuss the assessment of outstanding case-by-case areas and identified some further information that was required, which was subsequently provided in January 2013.

On 21 June 2013 a revised permit (CPS 3472/4) was issued addressing the outstanding 'case-by-case' areas and approving clearing of 246.28 ha. Several proposed clearing areas were not approved under this permit or conditions imposed (i.e. buffers) that effectively precluded access for mining. The decision report for CPS 3472/4 cited variances against clearing principles (a), (b) and (h) (biological diversity, significant fauna habitat and nearby conservation areas). The decision also erroneously applied principle (a) to the impact of the clearing on fauna habitats. PRL believed these decisions were unjustified, inconsistent with the approaches taken for CPS 4506, and inconsistent with a negotiated agreement with the Commonwealth in November 2011 for specific case by case areas in the Central Area. PRL had the option of appealing the decision at this time, however believed it would be in the best interests of all parties to accept the permit to allow PRL to undertake clearing of the approved areas, but to revisit the areas denied through a new application in due course.

This clearing permit application addresses outstanding 'case-by-case' areas from CPS 3472/4 considered critical to the operation plus some additional areas not previously applied for. Some areas have been removed where these were deemed to present potential issues in respect to the ten clearing principles. PRL believes this application should be approved based on precedents in CPS 4506, previous negotiations and agreements, and the significant social and economic positives of allowing access to these areas. The application areas are essential to enable access to the Central Enclave (ML109/110) which contains areas that have been approved for clearing under CPS 4506. Without approval of this application, PRL will be excluded from a significant portion of its approved Mining Lease as well as areas already assessed and approved for clearing. The denial of these areas has the impact of reducing mining life by an estimated three years based on the resources and current throughput, with the associated impact on Island employment, loss of export income and loss of potential royalties and conservation levies.

Note: CPS 3472 was further amended in April 2016 (CPS 3472/5) to remove a buffer condition for one stockpile and to correct the total approved area to 227.85 ha to match the shapefiles and then again in July 2017 (CPS 3472/6) to extend the expiry date to 2025. CPS 4506 was also extended to 2025 at this time, becoming CPS 4506/2.

1.3 Socio-economic Factors

The community of Christmas Island has a colonial past based on phosphate mining with all of the hardship and inequity that such a history implies. The formation of the Union of Christmas Island Workers in 1974 led to wage justice for the island's workers and, following the closure of the Commonwealth's mining operations in 1987, the ultimate emergence of the current phosphate mining company in which many of the island's residents were the original shareholders. The population of the island at the last published Census data (2016) was 1,843 (ABS 2017). This does not include residents at the Christmas Island Detention Centre.

The principal economic activity on the island has historically been phosphate mining, which provided 48% of the Island's Gross Product in 2005-6 and employed 181 people (ACIL Tasman, 2009). Other key employers are Government administration and small business. Phosphate mining has a wide impact on the economy, with the impact of mining stopping on the Island estimated at 280 full time equivalent jobs (ACIL Tasman 2009). The construction of the Christmas Island Detention Centre altered the economy of the island and provided alternate employment opportunities (AECOMM 2012) but the centre is scheduled to close in 2018 (Australian Border Force 2017). In 2016 Public Administration and Safety was the largest employment sector on the Island, with 225 employees identified by the 2016 census, with mining being the second largest employment sector with 148 direct employees (ABS 2017). Current economic predictions are based on a presumption that phosphate mining will continue to 2034.

The historic reliance on a single economic driver has meant that the island's economic outlook lacked flexibility to change (Shire of Christmas Island 2012a). Diversification of activities on the island increased with the construction of the Immigration Detention Centre, however, this will close in 2018 and therefore the economy is still heavily reliant on phosphate mining.

Mining on Christmas Island is essential for ongoing employment and support of the island's economy. Environmental Approval for mining in Mining Lease 70/1 was granted in 1997 under the EPIP Act. In order for phosphate mining to continue until the expiry of the mining lease in 2034, reserves already approved will need to be accessed. This will necessitate the clearing of areas proposed in this application.

Approval of eight key areas in the Central Area from the CPS 3472 application was deferred in 2013. Estimates of the impact of these decisions in 2013 are shown below in Table 1.

Table 1. Economic impacts estimated in 2013 of denying access in eight areas from the CPS 3472 application (NB based on 2013 phosphate prices)

	Resource Lost - direct and indirect (wet tonnes)	Resource Lost dry tonnes (conversion factor 1.35)	Estimated loss of Export Income (@ $150/dry tonne)	Reduction in Mine Life (& associated jobs, economic impacts on CI)	Conservation Levy Forgone (@$2.40/dry tonne)
Eight Areas Denied in CPS 3472	2,014,000	1,491,852	$223,777,778	2.5	$3,580,444

Supply of fresh food on Christmas Island is limited to high-cost imported goods, with horticulture on the island being limited to the Hidden Garden Sustainable Farms and the Mine to Plant Enterprise (MINTOPE) agricultural trials. Nearly all fresh foods are imported to Christmas Island by sea and air and supply is not always reliable due to weather constraints. A key objective identified by the *Indian Ocean Territories Regional Plan* (Regional Development Australia 2012) and the *Local Planning Strategy* (GHD 2015) was to

make fresh food more accessible and affordable by supporting food production initiatives. With this in mind, cleared mining areas on the east of the island were zoned as 'rural' under LPS2 to allow the development of a post-mining horticulture industry which would both diversify the economy and help to alleviate the Island's fresh food supply issues. Some of the blocks included in this application are proposed as rural use post mining.

1.4 Legislative Framework

The legislative framework for Christmas Island is complex. The *Christmas Island Act 1958* outlines the governance arrangements for the island. Sections 8A and 8E of the Act make provision for the laws of Western Australia and the Commonwealth to apply in Christmas Island. The Minister lists selected Western Australian laws to be applied in the *Applied Laws (Implementation) Ordinance 1992*. The island is governed under Commonwealth legislation and administered by the Department of Infrastructure, Regional Development and Cities (DIRDC). Applied Western Australian laws are administered by the relevant Commonwealth Minister, by Commonwealth officers acting under ministerial delegations, or by State officers exercising delegated power and acting pursuant to inter-government service agreements under Section 8h of the Act. The community is represented in the Federal Parliament by the Member for Lingiari in the House of Representatives and the two Senators for the Northern Territory in the Senate with local Government (i.e. Shire of Christmas Island) utilising Western Australia legislation.

An overview of PRL's governance arrangements is provided in Table 2.

Table 2. Overview of Environmental Governance

Activity	Responsibility	Program Elements
Access and overall governance	Department of Industry, Regional Development and Cities (DIRDC)	• Lease administration & amendments • New leases • Administration of the conservation levy • Overall administration of Clearing Permits processes (utilising DWER)
Management Requirements	CIP	• To operate in accordance with the Environmental Management Plan (EMP) approved by the Minister in accordance with the Mining Lease (Most recent approval in 2012-2017)
New Approvals	Department of the Environment and Energy	• Environmental assessment for new operations via the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
Regulation	Department of Water and Environmental Regulation (DWER) And Department of Mines, Industry Regulation and Safety (DMIRS)	• Licence for Prescribed Premises under the *Environmental Protection Act 1986 (WA) (CI)* (EP Act) • Compliance with Mining Lease conditions and applicable provisions of the *Mining Act 1978 (WA) (CI)* • Payment of a conservation levy to fulfil rehabilitation requirements • Review of annual monitoring and audit reports • Random inspections • Responses to public complaints • Advice to the proponent
Monitoring	CIP	• In accordance with requirements of the Licence for Prescribed Premises under the EP Act including Sulphur emissions, Dryer stack dust emissions & Dryer stack pollution control equipment. • Other monitoring as set out in the EMP

Reporting	CIP	• Provision of an *Annual Monitoring Report* and an *Annual Audit Compliance Report* to DWER with copy to DIRDC • Provision of an *Annual Environmental Report* to DMIRS with copy to DIRDC
Day to day Operational Management	CIP	• Undertake management in accordance with CIP's environmental management system • Mine site management, transportation, processing and ship loading • Hydrocarbon storage and pollution control • Waste generation and disposal • Dangerous goods storage • Occupational health and safety • Site remediation (make safe) under the *Mining Act 1978 (WA) (CI)*

1.4.1 Environmental Approvals and Mining Lease

In 1990 CIP was granted approval to re-mine and/or remove existing stockpiles of low grade ore over 1,900 hectares (14% of the Island) of previously cleared areas outside the National Park by a lease with the Commonwealth issued under the Lands Ordinance 1987.

In 1995, the Company issued a Notice of Intent under the EPIP Act to extend the lease. The Commonwealth Environment Protection Agency assessed the proposal and accepted the Notice of Intention subject to the preparation and approval of an Environmental Management Plan (EMP) prior to the issue of a lease.

Mining Lease 70/1 was granted to PRL by the Commonwealth in 1997 under the *Mining Act 1978 (WA) (CI)* following approval under the EPIP Act. This is the principal lease for the Christmas Island operation and covered 2,054 ha when signed. As at November 2017 the lease covered 1,666 ha due to areas relinquished since 1997. The lease outlines conditions that must be met by Phosphate Resources Ltd and includes the payment of royalties, rainforest protection, mine management and road maintenance and lease Covenant 8.3, which requires that the Lessee '*shall undertake to comply with all the requirements of the Environmental Management Plan*'. The EMP was revised in 2008, 2012, and in 2017 a revised plan was submitted to the Commonwealth for approval. The lease is administered by Department of Infrastructure and Regional Development and expires in 2034.

In June 2013, MCI 70/1A was extended until 2034 as part of a rewriting of the mining lease undertaken largely to clarify and update the royalty and conservation levy provisions and rehabilitation obligations.

The South Point area was approved for mining under the EPBC Act referral (2012/6653) in 2014. Mining Leases MCI 70/17, 70/18 and 70/19 were granted to PRL by the Commonwealth in July 2015.

Further approvals under EPBC Act are not required for the proposed clearing areas as they have been assessed and approved under the *Environment Protection (Impact of Proposals) Act 1974 (Cth)*.

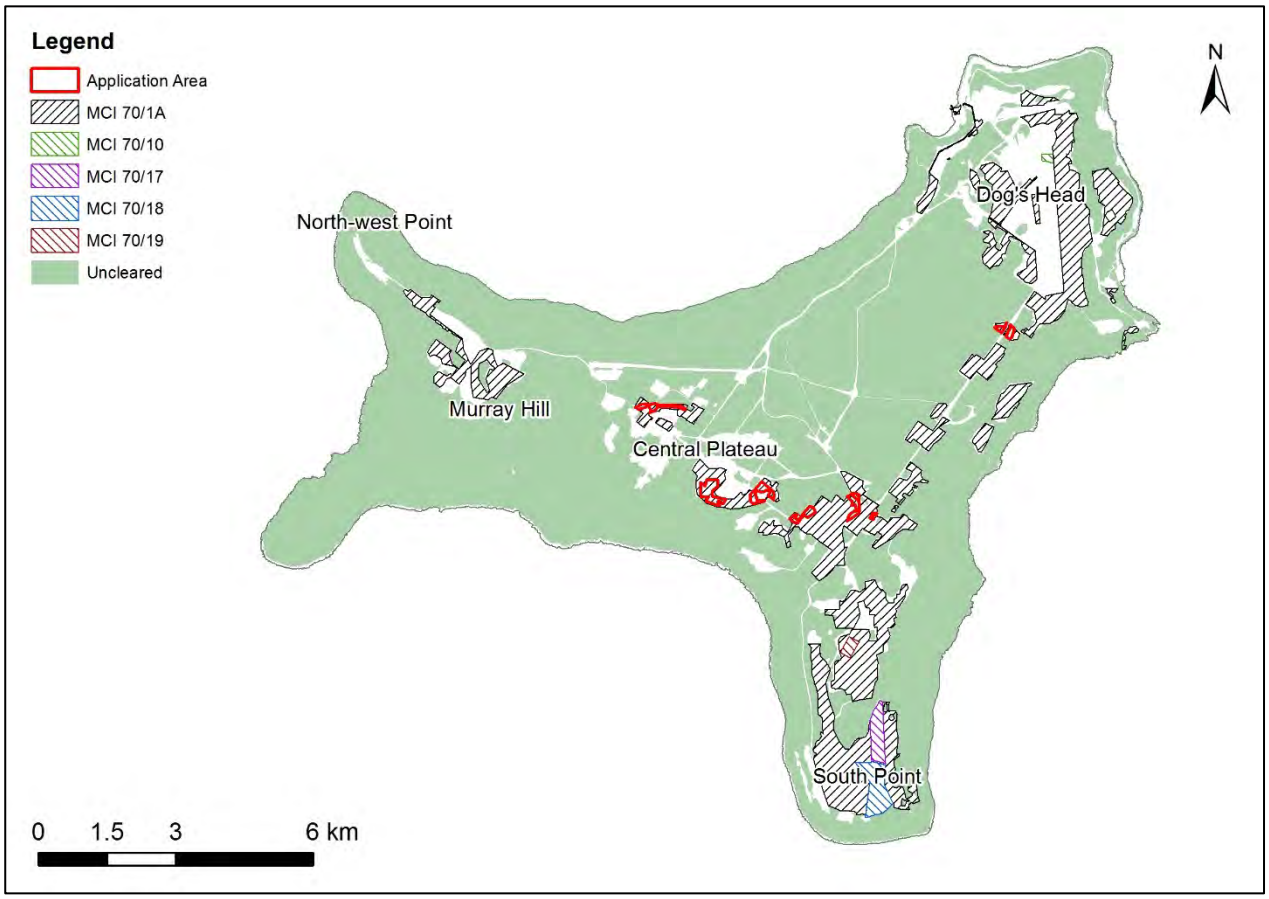

Figure 3. Historically cleared areas and current mine leases

1.4.2 Conservation Levy

The rehabilitation of former mining areas is undertaken as part of the Christmas Island Minesite to Forest Rehabilitation Program. The program is funded by a conservation levy paid to the Territory Administration by Phosphate Resources Limited as a provision of mining leases. The program is operated by Parks Australia under a Memorandum of Understanding between the Director of National Parks and the Territory Administration. The conservation levy is paid on all lease areas for all rock and dust exported. The levy payable is $2.40 per tonne of dry phosphate exported. On 660,000 tonnes per annum this equates to $1,584,000 per year.

1.4.3 Regulation of Operations under the Environmental Protection Act 1986 (WA) (CI) - Licence

CIP operations (mining, processing, transport and ship loading) are regulated through a Licence for Prescribed Premises issued under the *Environmental Protection Act 1986 (WA) (CI)* (EP Act). The licence specifies monitoring and reporting requirements. There is a strong emphasis placed on dust control, and the management of pollution and emission.

Clearing of native vegetation is regulated under provisions in the EP Act (Section 51) and under current governance arrangements any clearing within Mining Lease No. 70/1A must be assessed and approved under this legislation. It should be noted that the area within Mining Leases MCI 70/17, 70/18 and 70/19 approved under the EPBC Act do not require clearing permit approval due to the environmental impacts assessment process undertaken under the EPBC Act.

2 Proposal

Christmas Island Phosphates proposes to clear a total of 51.5 ha for the purposes of phosphate mining (Figure 1). The proposed clearing is comprised of ten separate areas, ranging from 0.93 ha to 15.27 ha, which have already been approved for mining under the *Environment Protection (Impact of Proposals) Act 1974* in 1997. All of the proposed clearing would be undertaken in previously cleared areas within Mining Lease No. 70/1A.

2.1 Applicant

Phosphate Resources Limited, trading as *Christmas Island Phosphates*
Registered Address: 6 Thorogood Street, Burswood, WA 6100

2.2 Clearing Area

Areas proposed for clearing are presented in Figure 4. Ten areas (Table 3) are proposed to be cleared as part of this application, totalling 51.5 ha. Of this, approximately 41 ha has been mapped as regrowth vegetation, 0.02 ha has been mapped as rehabilitation and the remainder is degraded land mapped as bare ground, fern field, infrastructure, **Leucaena leucocephala* dominant, mining or mixed weed & pioneer species (Geoscience Australia, 2014). Nearly all regrowth is below 20 m height, with the majority being below 15 m height.

Table 3. The vegetation in proposed clearing areas as mapped by Geoscience Australia (2014)

Block	Rehab-ilitation	Other*	Regrowth						Total (ha)
			5-10m	10-15m	15-20m	20-25m	25-30m	Total	
105-MB2		0.28	0.30	0.65	0.03			0.97	1.25
106-MB12		0.71	2.37	2.82	0.35	<0.01	0.01	5.56	6.27
106-MB15		2.08	3.21	1.41	0.15	0.01		4.78	6.86
106-MB16		0.20	0.43	0.25	0.05			0.73	0.93
109-MB1	0.02	1.98	4.65	2.92	0.06	<0.01		7.64	9.64
110-MB1	<0.01	2.65	4.65	5.85	2.11			12.61	15.27
116-MB5		1.56	1.07	1.41	0.29			2.76	4.33
116-STP23B		0.75	0.57	0.62	0.15			1.34	2.09
126-STP9F		0.29	0.22	1.02	0.26	0.25		1.74	2.03
127-STP9E		0.12	0.72	1.37	0.36	0.27		2.71	2.83
Total (ha)	0.02	10.64	18.19	18.31	3.80	0.52	0.01	40.84	51.50

**Degraded land mapped as bare ground, fern field, infrastructure, *Leucaena leucocephala dominant, mining or mixed weed & pioneer species*

2.3 Clearing Method

Clearing will be accomplished by mechanical removal using a bulldozer or loader.

2.4 Required Permit Duration

The clearing is proposed to be undertaken from June 2018 to December 2028.

Table 4. Recent Application History.

Block	Recent Permit History[1]
105-MB2	Approved for exploration under CPS 4506/1
106-MB12	Approved for exploration under CPS 4506/1
106-MB15	Approved for exploration under CPS 4506/1
106-MB16	Approved for exploration under CPS 4506/1
109-MB1	This is a new polygon. It includes parts of areas previously applied for. Stockpile recovery was not approved under CPS 4506/1 and CPS 3472/4 (applied for as ML109 MB1, ML109 STP 20B 20C and ML109 STP20D), with the decision reports citing possible conflicts with clearing principles (a) biodiversity, (b) fauna habitat and (h) conservation areas.
110-MB1	This is a new polygon. It includes parts of areas previously applied for. Under CPS 3472 areas 110-MCP-MB2 and 110-MCP-STP20I/L/M were applied for, but not approved with the decision report citing possible conflicts with clearing principles (a) biodiversity. Stockpile only access was granted for 110-MCP-STP20K but because surrounding areas were not approved, there was no way to access this area.
116-STP23B	Approved for exploration under CPS 4506/1 (applied for as area 116-MB3).
116-MB5	Approved for exploration under CPS 4506/1 (applied for as area 116-MB3).
126-STP9F	Not approved under CPS 3472, with the decision reports citing possible conflicts with clearing principles (a) biodiversity,
127-STP9E	Not approved under CPS 3472, with the decision reports citing possible conflicts with clearing principles (a) biodiversity,

1. Note that boundaries in areas in this application are not the same as those in applications CPS3472 and CPS4506.

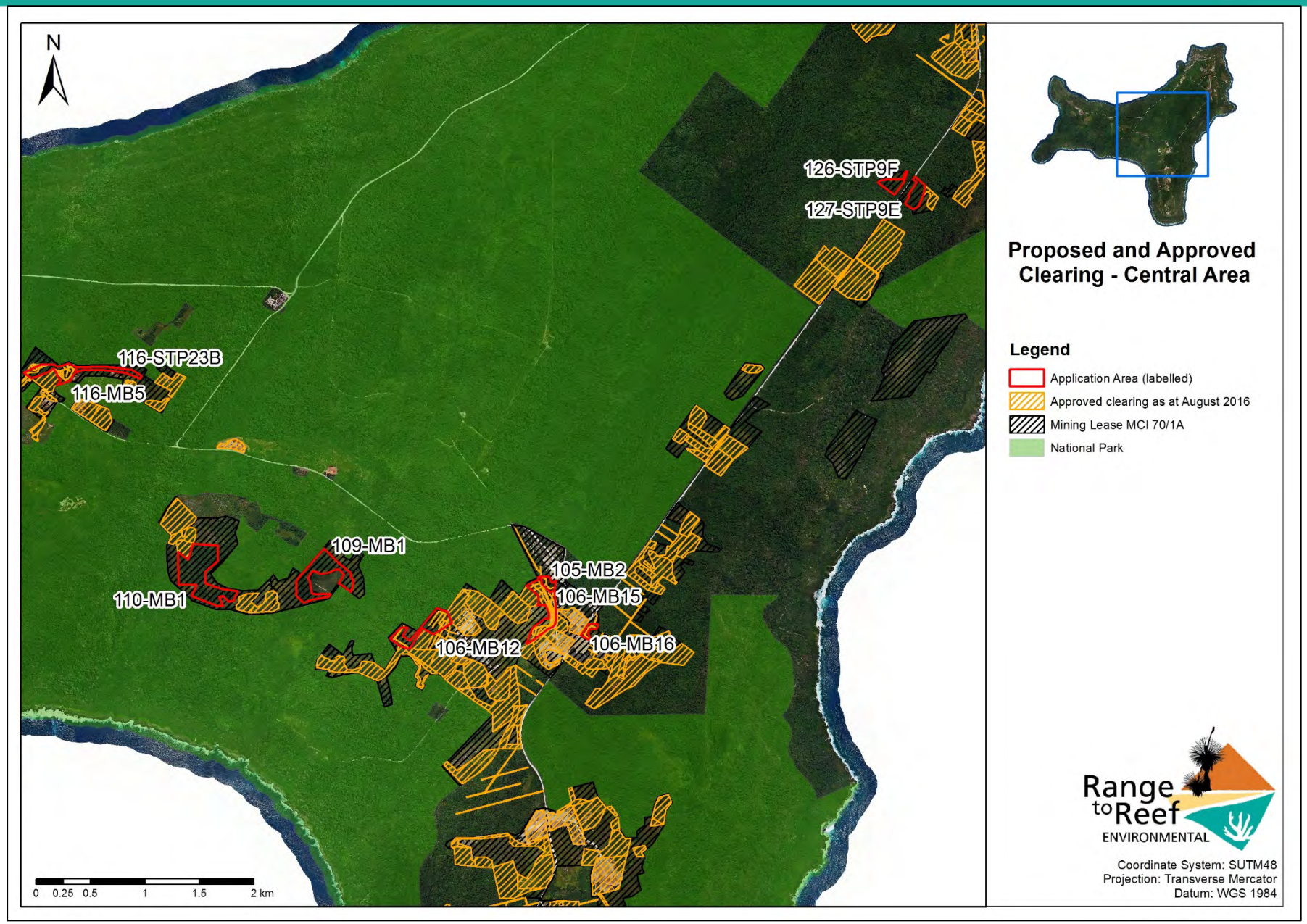

Figure 4. Proposed and Approved Clearing - Central Area

3 Description of land parcels (blocks)

Below follows a description of the key features of each of the blocks which comprise the application (Figure 5). Additional photographs, maps and detailed site data are included in Part B – Flora Survey and Fauna Assessment and

Appendix 1 - ENV-SOP-009.2017 Vegetation ClearingA.

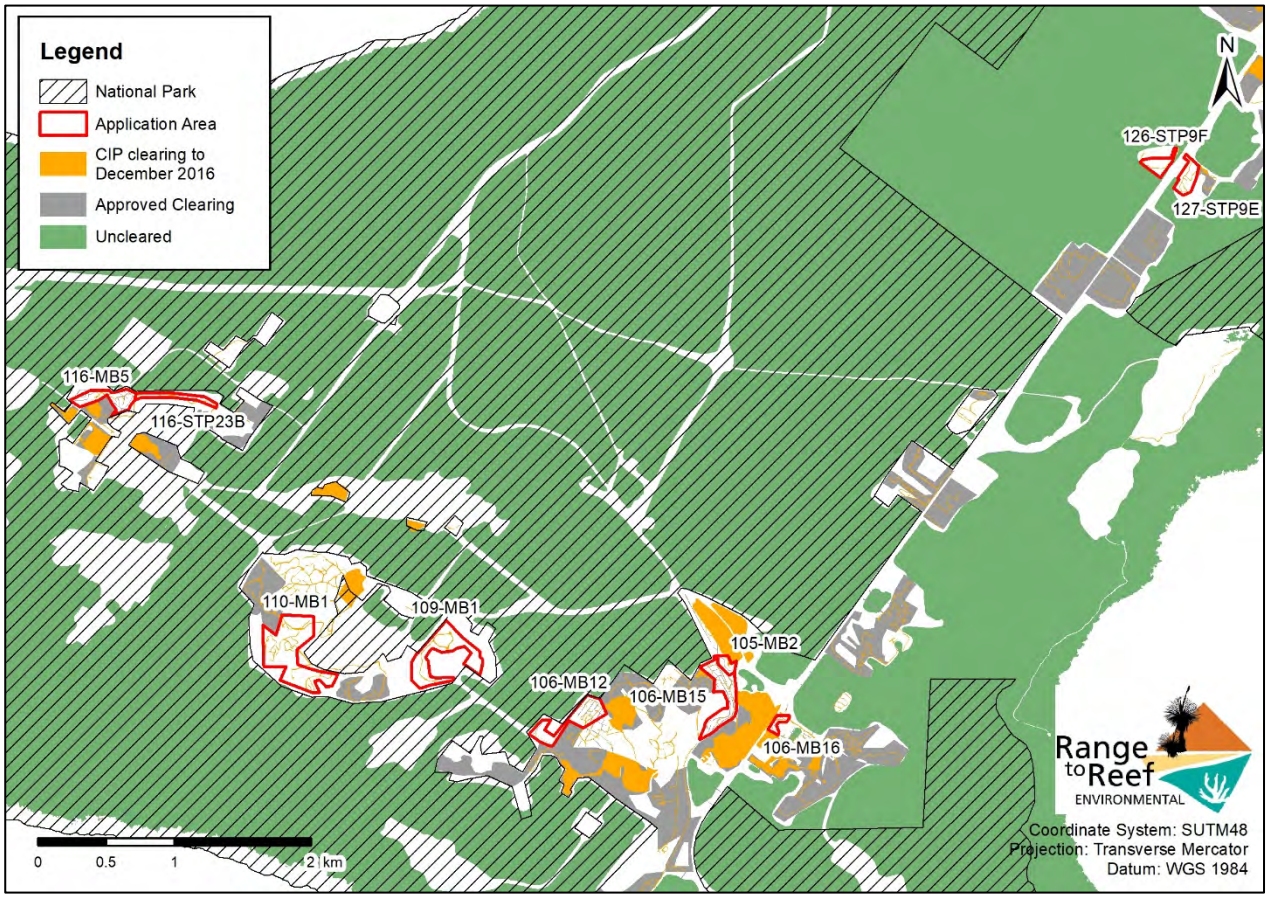

Figure 5. Quick-reference to land parcels comprising the application area

3.1 Blocks 105-MB2 and 106-MB15

Size: 1.3 ha and 6.9 ha

Zoning under TPS 2: Rural

Clearing History: Exploration lines were cleared in 2013 under CPS 4506/1 and whole of the area was cleared prior to 1976. The north-eastern edge of 106-MB2 was cleared in 2001 and 2011.

Description: Blocks 105-MB2 and 106-MB15 adjoin each other and are located on the western side of the road to The Blowholes. To the north-west lies National Park, separated from the 106-MB15 by a 5 m buffer and from 105-MB2 by a 20 m buffer. The southern portion of 106-MB15 is surrounded by legacy minefields covered by ferns and pinnacles. To the east of Blowholes Road and to the west of 106-MB15 lie areas approved for clearing under CPS 4506/1 and areas which have already been cleared. Buffers of 5 m have typically been applied in the surrounding area under previous permits. Vegetation was mapped

for the reports for ML106 MB7 and ML105 MB1. Vegetation condition in the two blocks in 2010/2011 ranged from Degraded to Very Good/Excellent, with most of the block being in Good to Very Good condition and typically ranging from 5-15 m in height.

Area 106-MB15 had been subject to exploration clearing in early 2013 under CPS 4506/1 but the exploration tracks had little regrowth on them due to highly compacted, chalky soils (Figure 6). At the time of the June 2017 field survey, the area was very weedy and had few natural attributes remaining. Old industrial debris such as pipes were scattered throughout the area.

Figure 6. 2013 drill lines (left) and historical debris (right) in 106-MB15.

The two areas included an access road leading to a small temple which is actively used by the islanders. The area surrounding the temple was mainly grassed with numerous taller weed species at the edges. Three coconut trees south of the temple had attracted several large robber crabs.

Area 105-MB2 was a very small patch of good quality, taller regrowth wedged between a temple and cleared areas. The terrain was uneven, with soil pushed up in the regrowth surrounding the temple.

Figure 7. Survey site CI07 in area 105-MB2 facing south-west (left) and north/north-east (right). In either direction clearing is visible beyond the vegetation, showing the narrowness of the regrowth.

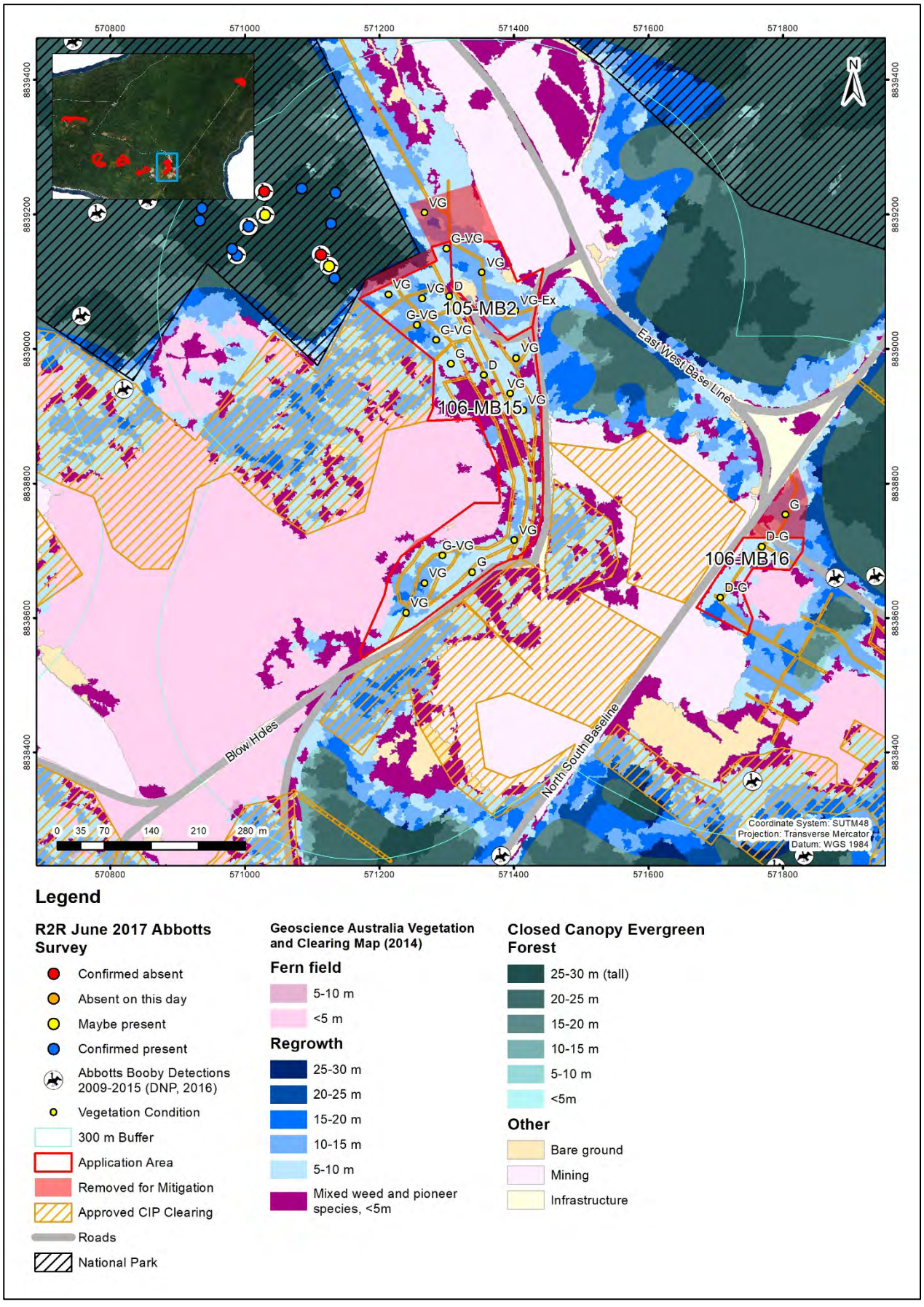

Figure 8. Vegetation and Fauna Map for 105-MB2 and 106-MB15

Block 106-MB12

Size: 6.3 ha

Zoning under TPS 2: Rural

Clearing History: Exploration lines were cleared in 2005, and in 2013 under CPS 4506/1, and the whole of the area was cleared prior to 1976.

Description:

Block 106-MB12 lies in the central area of the island, immediately to the north of an old mine access road which leads to block 109-MB1 and 110-MB1 through National Park. The block shares a long boundary with National Park to the north-west, so the edge of the proposed clearing has been brought in to provide a buffer of at least 5 m to National Park. Within the National Park boundary, an additional buffer of roughly 20 m of regrowth vegetation protects the primary rainforest. Areas to the south of the block have been approved for clearing under CPS 3472. To the east lie active mining areas and pinnacle fields.

In CPS 3472, CIP applied to clear stockpile 106-MCP-STP18Q, which falls within 106-MB12. The application was not approved under principles (a) and (b) due to the proximity to Abbott's booby nest sites. CIP later applied for an exploration permit for the area and was granted one under CPS 4506/1.

Vegetation in 106-MB12 was mapped for ML106 F18MB9 and ML106 MB8. The vegetation was generally in Degraded to Good condition and typically ranged from 5-15 m in height.

At the time of the June 2017 field survey, vegetation in the southern part of the block, near National Park and where no in-situ mining had occurred (around 0.5 ha) was in Excellent condition (Figure 9). Exploration lines cleared in 2013 were virtually indistinguishable.

The northern part of the area and its boundary along the F20 track were highly degraded by weeds, though around 0.8 ha near the National Park boundary remained in better condition.

A grove of tall Pandanus, with little to no understory, separated the northern and southern portions of the area. These trees can be distinguished in the 2011 aerial photography.

The proposal would remove approximately 50-60 m of taller vegetation on the north-eastern boundary of the area, but the remaining parts of the block have been subject to at least some in-situ mining in the past, with the topography lowered. Areas to the south and south-east are approved for clearing under CPS 3472, and the southern portion of the block surrounds a pinnacle field. These more degraded areas do not contain vegetation tall enough to contribute a buffer to Abbott's booby nests north-west of the block.

Figure 9. Open, Excellent quality *Regrowth* at site CI13 (left) and Degraded-Good *Mixed Weeds and Pioneer Species* at CI15.

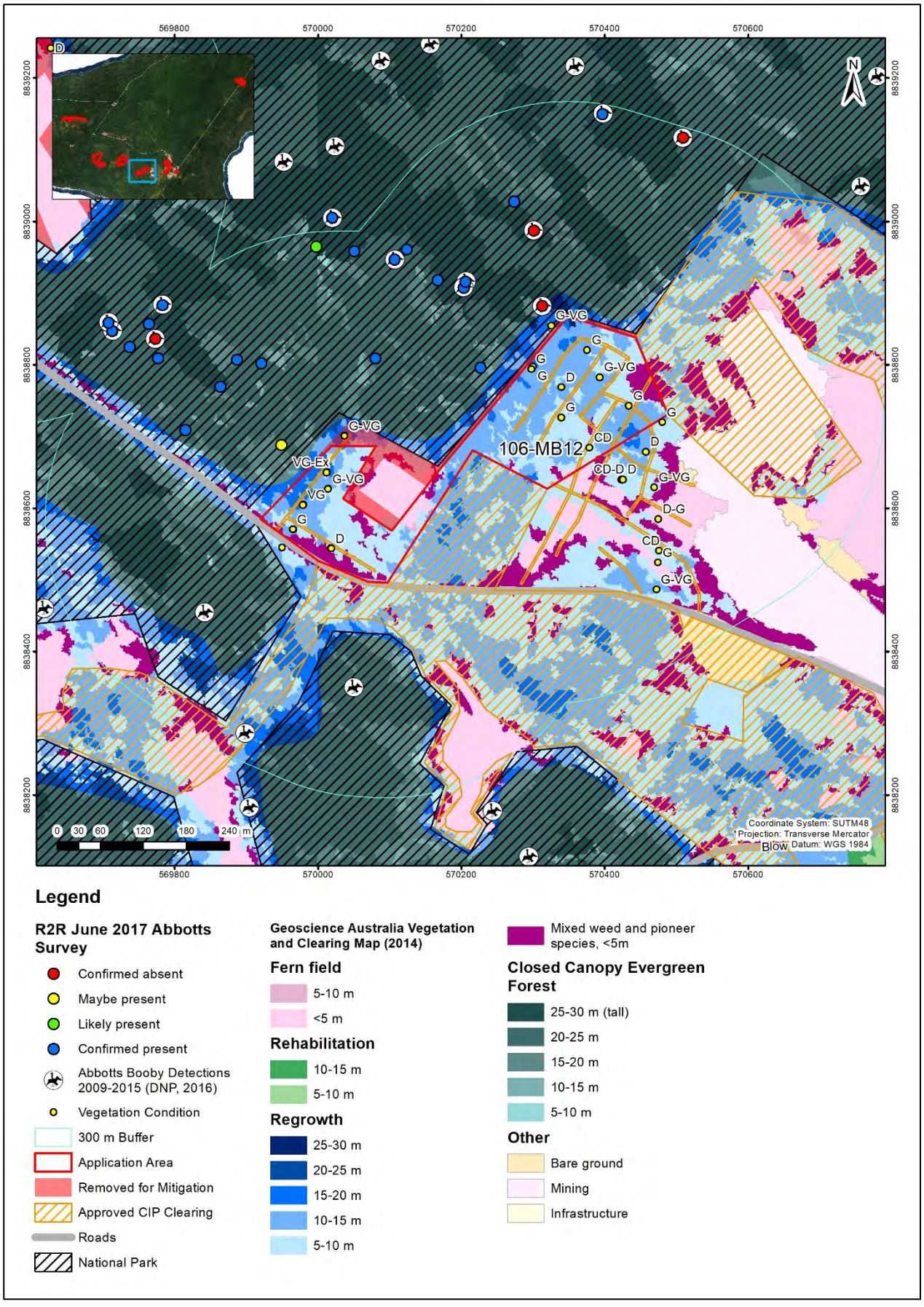

Figure 10. Vegetation and Fauna Map for 106-MB12

3.2 Block 106-MB16

Size: 0.9 ha

Zoning under TPS 2: Rural

Clearing History: Exploration lines were cleared in 2013 under CPS 4506/1 and the whole of the area was cleared prior to 1976.

Description:

The block lies to the south-east of the north-south baseline road. The surrounding area has been heavily disturbed for mining, with areas to the south and west having been cleared in 2006. Exploration was undertaken in 2013 under permit CPS 4506/1 and CIP now wishes to proceed with mining of the area. The block does not abut National Park and no Abbott's booby nest sites are known to occur downwind of the proposal area. The proposal enlarges current adjoining mining areas by around 50 m.

Vegetation in 106-MB16 was mapped for ML106 F15MB5. The majority of the block contained weedy regrowth vegetation in the 0-15 m range. Condition assessments for the block indicate that the vegetation is in Degraded to Good condition.

Following the 2017 field survey, the size of this block was reduced by 0.9 ha and consequently the vegetation site to the north is no longer within the proposal area. The site is very small and contains few environmental values. No photographs were taken at this site.

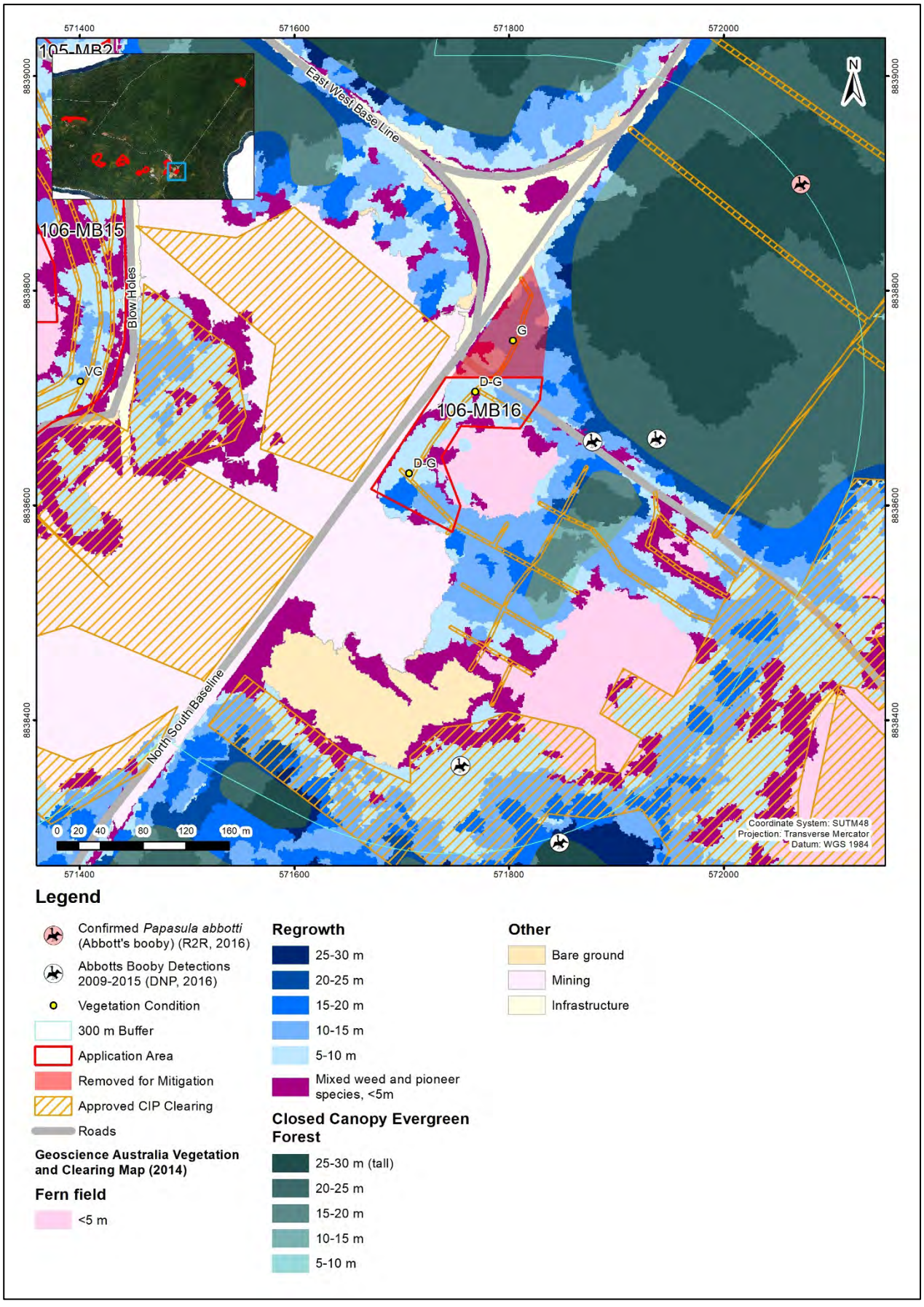

Figure 11. Vegetation and Fauna Map for 106-MB16

3.3 Block 109-MB1

Size: 9.6 ha

Zoning under TPS 2: Crown Reserve

Clearing History: Exploration lines were cleared in 2000 and the whole of the area was cleared prior to 1976.

Description:

109-MB1 lies in the central area of the island, surrounded by National Park and itself surrounds a pocket of rehabilitation. The area including 109-MB1 was exempted from inclusion in National Park to allow the recovery of remaining phosphate product. Immediately to the west and in pockets to the east of 109-MB1 lies fernfields cleared before 1976. Further to the west lies approved clearing under CPS 4506/1. Some clearing in 109-MB1 will be required to access these areas.

In CPS 4501/1 and CPS 3472/4, CIP applied to clear for the recovery of stockpiles in this area, but the four areas applied for were not approved at the time. The specific reasons why areas 109-MB1 and 109-STP20D were not approved was not recorded in the permit decision report for CPS 4506/1, however, during meetings with DEC, advice was received that the areas were unlikely to be supported due to their proximity to National Park (principle (h)). The decision report for CPS 3472/4 advised that 109-MCP-STP20B was or may be at variance to principle (a) due to its proximity to a known Abbott's booby nest site and was at variance to principle (b) due to being within what was considered to be an important red crab migration pathway. 109-MCP-STP20C was not mentioned in the decision report but was not approved. Meetings with DEC indicate that the reasons for decision were similar to those for 109-MCP-STP20B.

Vegetation in 109-MB1 was mapped for reports ML109 MB1, ML109 STP 20B 20C and ML109 STP20D. The majority of the block contains weedy regrowth vegetation in the 0-15 m range. Condition assessments for the block indicate that the vegetation is in Degraded to Good condition. During the 2017 field survey, the condition of the site had not improved, and the four survey sites contained Good to Degraded vegetation.

Though 109-MB1 abuts national Park, it does not abut primary rainforest, with a buffer of 20-40 m of regrowth vegetation lying within the boundary of National Park. It is recommended that a 'stockpile only condition be applied to this area to mitigate edge effects and facilitate revegetation and rehabilitation. No studies confirming the advice that the block is in an "important red crab migration pathway" could be found (refer to Appendices A and B). Red crab burrow densities within 109-MB1 have been recorded as 21-50 per 100 m^2.

Figure 12. Sites CI19 (left) and CI20 (right); Candlenut is visible overhanging the photo at CI19.

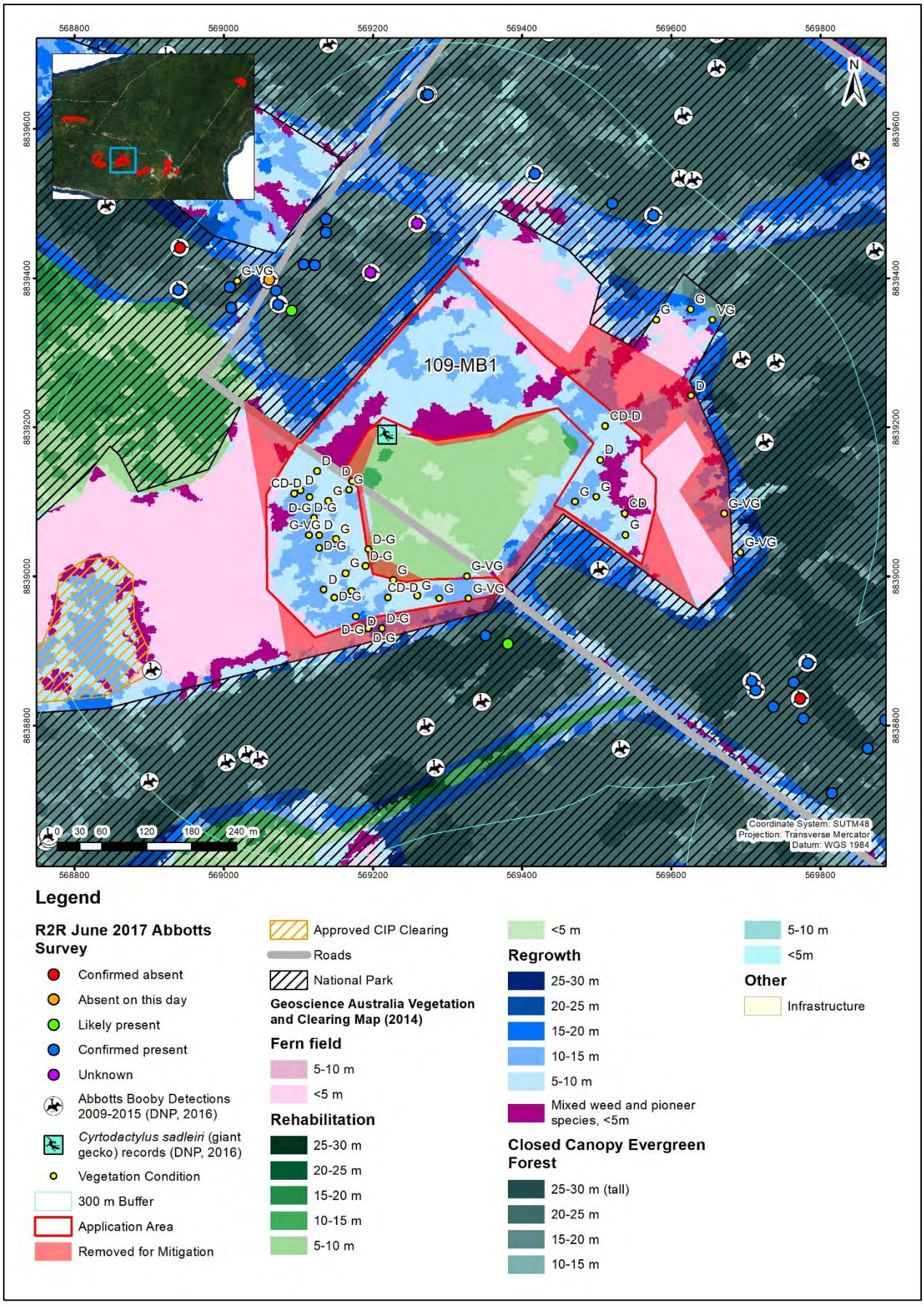

Figure 13. Vegetation and Fauna Map for 109-MB1

3.4 Block 110-MB1

Size: 15.3 ha

Zoning under TPS 2: Crown Reserve

Clearing History: Exploration lines were cleared in 2009 and the whole of the area was cleared prior to 1976.

Description:

110-MB1 lies in the central area of the island, surrounded by National Park. The area including 110-MB1 was exempted from inclusion in National Park to allow the recovery of remaining phosphate product. Immediately to the west and north of 110-MB1 lies fernfields cleared before 1976. In the east lies rehabilitation. Further to the west lies National Park. In the north-west and further to the east lie approved clearing under CPS 4506/1, but these areas cannot be accessed unless permission is granted to clear 109-MB1 and 110-MB1.

Vegetation in 110-MB1 was mapped for reports for:

- ML110 MB2
- ML110 STP 20M 20S 20T 20L 20I 20A
- ML110 STP20K
- ML110 STP20R

The majority of the block contains weedy regrowth vegetation in the 0-15 m range, with some in the 15-20 m range. Condition assessments for the block indicate that the vegetation is in Degraded to Good condition. Several pockets in the south of the block are fernfield which is Completely Degraded.

In CPS 3472/4, CIP applied to clear for the recovery of stockpiles in this area, but four areas applied for were left un-approved. 110-MCP-STP20K was approved for stockpile access only, but because surrounding areas were not approved, there is no way to access this area. In the decision report for CPS 3472/4, 110-MCP-MB2 and 110-MCP-STP20I/L/M were said to be at variance to principles (a) and (b) due to being within what was considered to be an important red crab migration pathway. It is recommended that a 'stockpile only condition be applied to this area to mitigate edge effects and facilitate revegetation and rehabilitation.

No studies confirming the advice that the block is in an "important red crab migration pathway" could be found (refer to Appendices A and B). Red crab burrow densities around 110-MB1 have been recorded as 1-20 or 21-50 per 100 m^2. The greatest densities lie to the south of the proposed clearing area and downhill towards the ocean.

A substantial pinnacle field lies to the west of the block, between the proposal area and the nearest north-western Abbott's booby nests.

The site varied in condition and was fragmented and weedy. Survey sites were selected from the better vegetation in the area. Survey site CI24 was in the best condition, being Very-Good to Excellent, but this site also contained numerous **Spathodea campanulata*, a Priority weed which is shade tolerant and has potential to invade National Park. Large tracts of the block were Completely Degraded pinnacle fields.

Figure 14. Sites CI21 (left) and CI22 (right) at the south-eastern end of the site.

Figure 15. Site 23 in the north of the site.

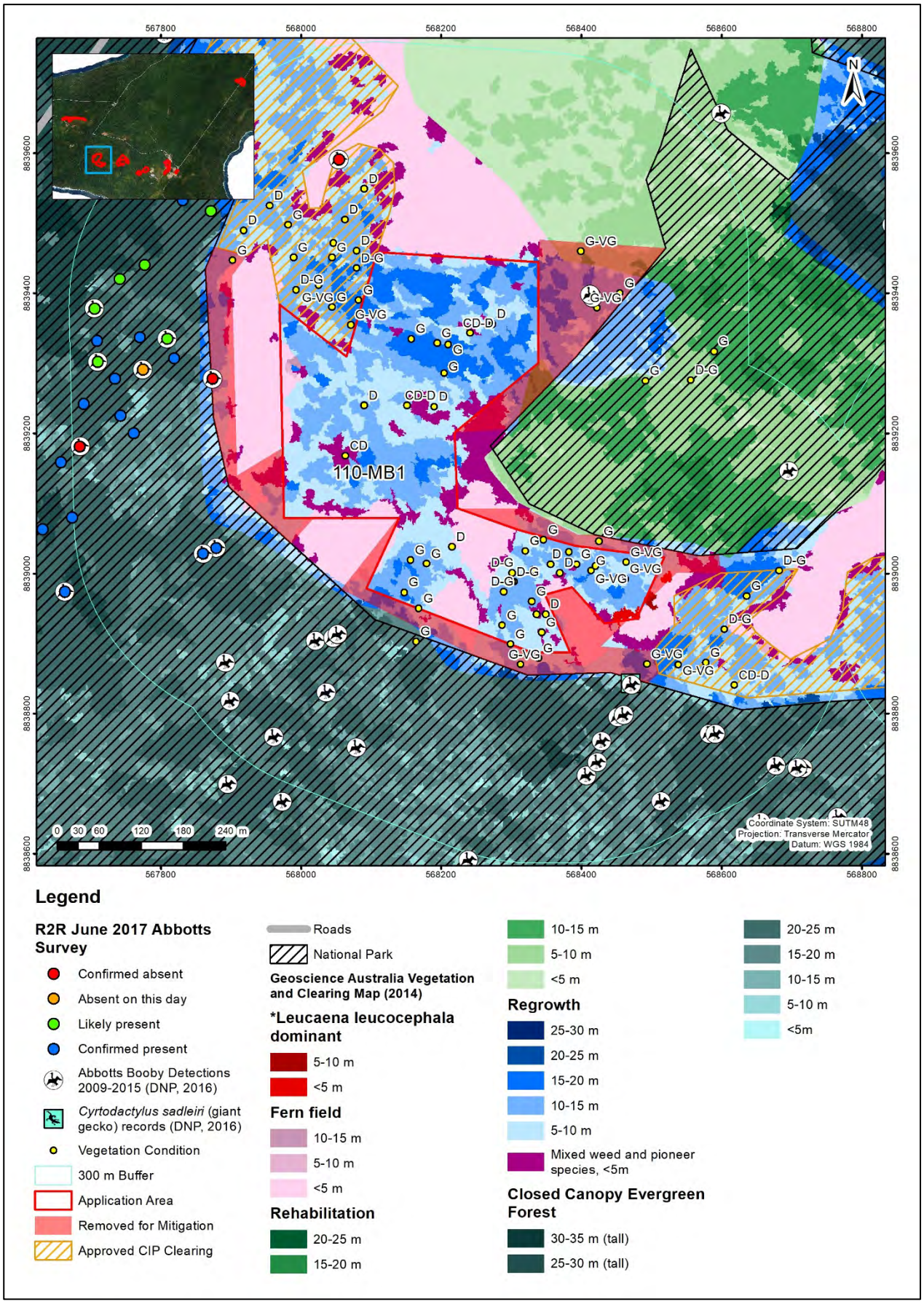

Figure 16. Vegetation and Fauna Map for 110-MB1

3.5 Blocks 116-MB5 and 116-STP23B

Size: 4.3 ha and 2.1 ha

Zoning under TPS 2: Crown Reserve

Clearing History: Exploration lines were cleared in 2013 under CPS 4506/1 (applied for as area 116-MB3) and the whole of the area was cleared prior to 1976.

Description:

116-MB5 is a small area to be cleared for mining, with an adjacent connecting strip (116-STP23B) for the purposes of accessing already approved clearing areas to the east. Clearing for exploration purposes was approved in 116-MB5 (named 116-MB3 in CPS4506/1) under permit CPS4506/1. Areas 116-MCP-STP23A to the south-west and 116-MCP-STP23C and 116-MCP-STP23F to the east were approved under CPS 3472/4 for stockpile only access. 116-STP23B would provide access to these areas.

National Park lies to the north and there are numerous Abbott's booby nest sites in the National Park adjacent to the block. However, the proposal would extend the existing clearing by less than 100 m to the north-east and vegetation heights within the proposal area are already significantly lower than in National Park to the North. The majority of vegetation in 116-MB5 and 116-STP23B is in the 0-10 m range, with significant areas of fern field and mixed weed and pioneer species <5 m tall. The National Park south of the proposed clearing areas is rehabilitation in the 0-10 m height range.

Vegetation in part of the area was mapped for the report for area ML116 MB3. In 2010/2011, the vegetation in the north of 116-MB5 was in Good to Very Good condition, but vegetation in the south was Completely Degraded fernfield.

Area 116-MB5 was explored in late 2013 under CPS 4506/1, however this block developed a dense cover of weeds on exploration lines. Exploration lines were not walked during the 2017 survey due to uneven terrain hidden by the dense creepers *_Asystasia gangetica_* and *_Mimosa_* (Figure 17). Area 116-STP23B was not surveyed because of active mining areas adjacent which made it unsafe to enter.

Figure 17. Drill lines in 116-MB5, cleared in 2013 and covered with dense regrowth of weeds, dominated by *_Asystasia gangetica_* and *_Mimosa._

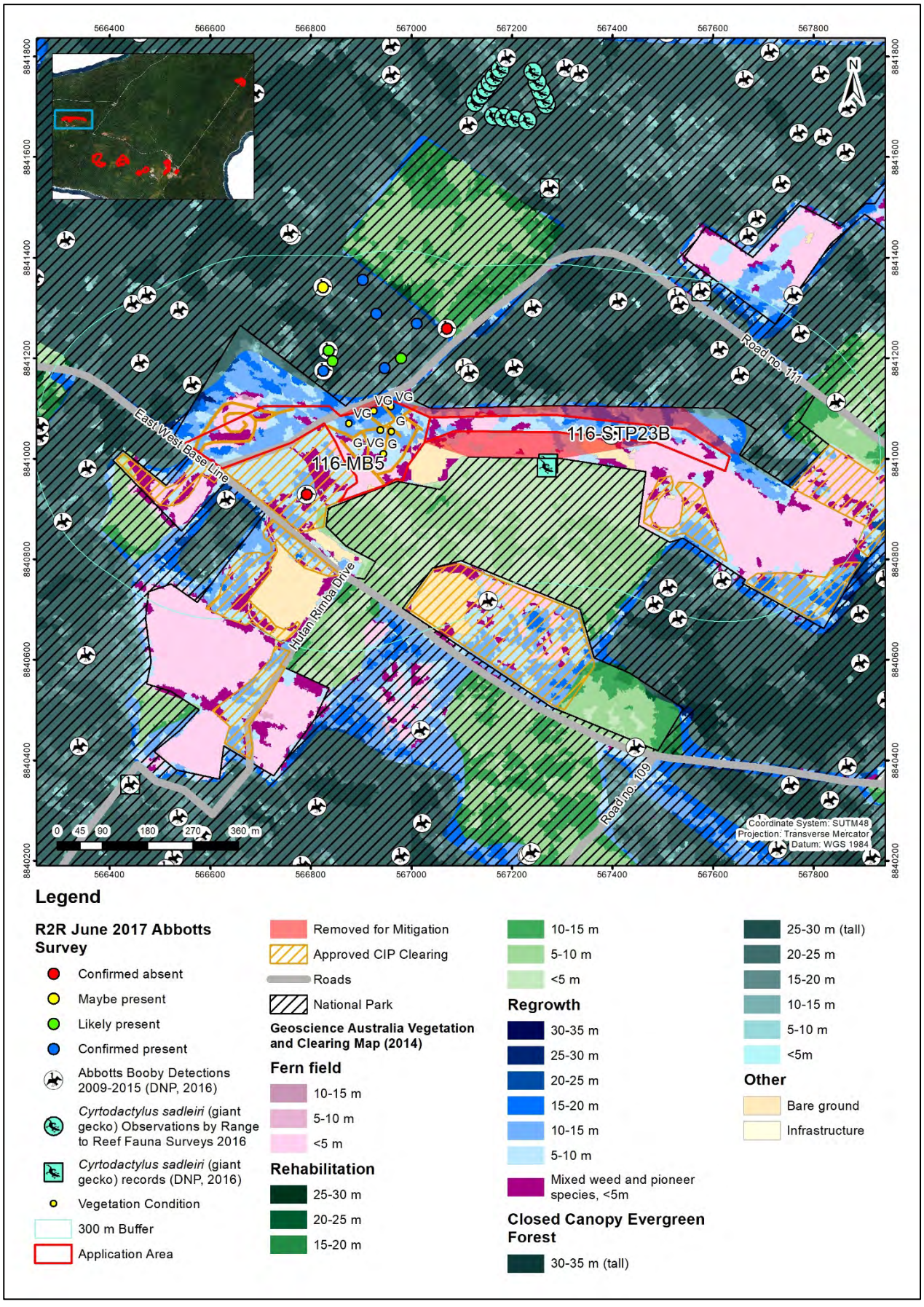

Figure 18. Vegetation and Fauna Map for 105-MB2 and 106-MB15

3.6 Blocks 126-STP9F and 127-STP9E

Size: 2.1 ha and 2.8 ha

Zoning under TPS 2: Rural

Clearing History: Exploration lines were cleared in 2005 and 2008 and the whole of the area was cleared in 1982.

Description: 126-STP9F and 127-STP9E lie to the west and east of the North-South Baseline Road respectively. These areas were previously rejected under CPS 3472 due to their proximity to Abbott's booby nests.

When surveyed in 2010/2011 these areas were generally in Good to Very Good condition, with some degraded areas.

Areas 126-STP9F and 127-STP9E (Figures 14 and 15) were explored in 2008 and have recovered well with relatively few weeds. Both areas only contain narrow areas of taller regrowth (mostly 10-15 m height) between pinnacle fields and roads. Access to the top of the stockpile in 126-STP9F was difficult due to steep slopes (Figure 20). Numerous Abbott's booby were audible from 126-STP9F, consistent with the results of the Abbott's booby survey undertaken downwind. The vegetation condition rating of sites selected for the vegetation survey was Very Good, consistent with previous surveys. These sites were selected over areas in poorer condition to improve our knowledge of native species present within the survey area. Pinnacle fields within the survey area were still in Completely Degraded condition.

The pinnacle field which lies north-east of 126-STP9F is more than 50 m across, so it is reasonable to assume that Abbott's booby nest sites to the north-east are already impacted by turbulence.

No National Park surrounds the block and around much of the block there is a buffer of regrowth vegetation between the block and primary rainforest.

Figure 19. Survey site CI01, facing north towards the pinnacle field (left) and CI02 facing towards primary forest (right) in 126-STP9F.

Figure 20. The steep embankment in 126-STP9F (left) and regrowth vegetation at CI03 in 127-STP9E (right).

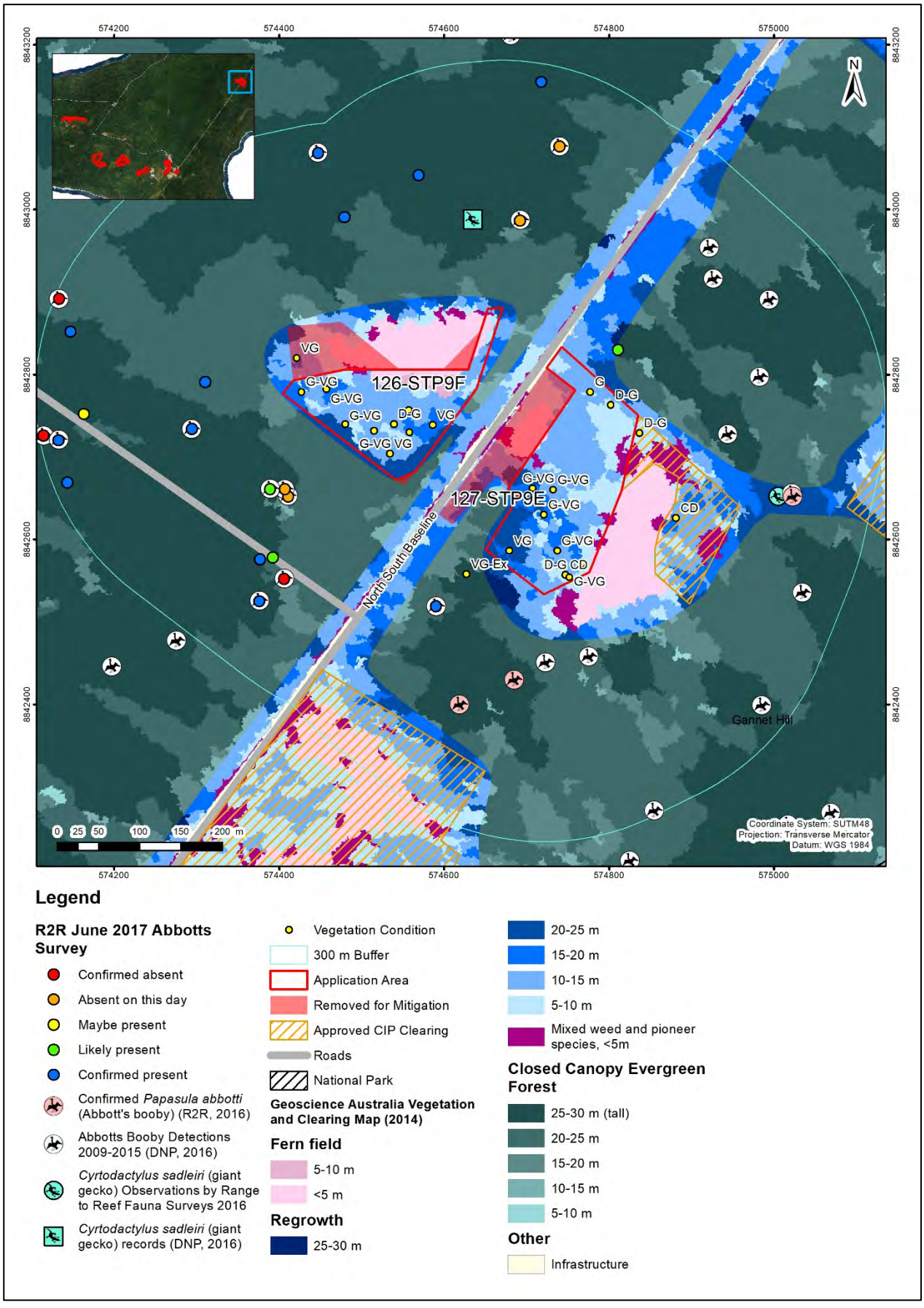

Figure 21. Vegetation and Fauna Map for 105-MB2 and 106-MB15

4 Impacts and Mitigation

4.1 Potential Impacts

The proposal has the potential to affect flora and vegetation values through:

- **Clearing of vegetation** for the mine pit, access roads and laydown areas.
- **Introduction and spread of weeds** due to edge effects and spread of propagules by machinery. Opening the forest up can cause germination from the soil seedbank, with many weed species already having abundant propagules in regrowth forest. Propagules of these can then spread into surrounding forest.
- **Edge drying effects** caused by microclimate changes.
- **Fragmentation** could be increased minimally by the proposal, though these areas are already cleared and abut cleared areas.

The proposal may affect fauna and fauna habitat through:

- **Minor Reduction in habitat** due to clearing.
- **Degradation of surrounding habitat** caused by changes to dust, wind turbulence and weed introduction.
- **Impacts on** red-crab habitats and migration.
- **Land crab deaths** caused by clearing and machinery movements.

The proposal will not intercept ground water, so no drawdown impacts could occur. Soils on Christmas Island are highly permeable, so surface flows rarely occur on the island and erosion should not be impacted.

4.2 Likely Direct and Indirect Impacts

Clearing would remove 51.5 ha of vegetation. The vegetation has all been previously cleared and, in some cases, mined. The vegetation varies in condition with most of the area to be removed being significantly degraded by past land clearing and earthworks. The majority of the vegetation to be removed is below 15 m height (47.2 ha) and 10.6 ha of this is Completely Degraded as mapped by Geoscience Australia (2014). Only 4.33 ha of vegetation is above 15 m height and only 0.53 ha is above 20 m height (Geoscience Australia 2014). The flora and vegetation assessment (Part B – Flora Survey and Fauna Assessment) did not find any species of conservation significance and all species identified within the proposal areas are well represented within the Christmas Island National Park.

The Island's rainforest is remarkably resistant to weed invasion (Green, Lake and O'Dowd 2004) so minimal impacts are anticipated as a consequence of the proposal, impacting only the immediate edge of surrounding vegetation, with little likelihood of weeds spreading further into the forest or pushing back the edge of the forest.

A buffer of uncleared vegetation would be left between the proposal area and National Park or primary rainforest to mitigate edge drying effects, so these are unlikely to significantly impact habitat.

The proposed clearing areas are within areas which have already been cleared and are frequently immediately adjacent to recent or approved clearing. Some red crabs will be impacted by the removal of blocks which are in better condition both by removal of their immediate habitat and by increasing open areas on the island which increases the likelihood of desiccation during the migration.

Highly mobile conservation significant bird species such as the Christmas Island thrush (Part B – Flora Survey and Fauna Assessment) may utilise the proposal area for foraging or even nesting, however, these

species are habitat generalists and do not rely solely upon the habitats in the proposed clearing areas and can relocate into nearby rainforests and other habitats.

Potential increases in turbulence on adjacent forests has been considered as they relate to Abbott's booby nest trees in the North West arc adjacent to proposed clearing. Measuring and assessing changes in turbulence due to clearing is complex and difficult to measure and estimate. Importantly the proposed clearing areas have all been previously cleared and sit within mine lease that have been cleared and mined. Therefore, whilst original clearing of primary forest in the early days of mining would have caused turbulence changes from the natural norm, this proposed clearing is unlikely to significantly change the canopy and turbulence profiles as the adjacent mine lease is generally 100% cleared. The impact of these minor changes in canopy, subsequent increases in turbulence, and then whether this increase has any negative effects on Abbott's nesting use and success is difficult to quantify.

Raupach et al. (1987) modelled loss of primary forests in an undisturbed scenario but did not model the effect of clearing small pockets of vegetation with low canopy heights.

In some circumstances boobies have consistently nested in the area immediately downwind of a pinnacle field suggesting conditions are suitable for nest use and turbulence is not deterring selection and use of these sites. However, it should be noted that nesting success at these locations has not been measured. The population is thought to be stable at around 2,500 breeding pairs (Yorkston and Green 1997), though Range to Reef 2017 land-based surveys and recent research indicate that numbers could be significantly higher in some areas than previously estimated from helicopter surveys (Part B – Flora Survey and Fauna Assessment and Christina Lipka pers. comm.).

4.3 Mitigation Applied

To address potential impacts identified, the following mitigation has been applied in developing this proposal or will be applied during clearing and mining:

- Total removal of some areas proposed for clearing from the application due to vegetation condition and/or adjacent nest sites.
- Reduction of the proposed clearing footprint on some areas to remove the areas of highest impact and to provide a buffer to primary rainforest and National Park.
- Areas in the central enclave (ML 109 and 110) are proposed to be mined on a 'stockpile only' condition which means after mining they will be left at the natural ground level with a soil profile. This would be consistent with approval of clearing under CPS 4506 for the ML 109 and 110 areas. If mined to pinnacles no vegetative recovery could be expected unless formally rehabilitated by Parks. A stockpile only condition will allow for vegetative growth and natural seeding from the adjacent national park primary forests. It will also leave the site prepared for formal rehabilitation by Parks therefore reducing costs and time for rehabilitation in this enclave which is considered a high priority area for rehabilitation.
- Implementation of Weed Management commitments post clearing as outlined in the CIP Environmental Management Plan (2018-2023), following final approval by Commonwealth and DWER of the updated Environmental Management Plan.
- Implementation of the CIP Red Crab Management Plan 2017 (ENV-REFDOC-017.2017)
- Implementation of relevant CIP procedures under the EMP, including:
  - ENV-SOP-009.2017: Vegetation Clearing (Appendix A)
  - ENV-SOP-015.2017: Exotic Species Monitoring and Control
  - ENV-SOP-016.2017: Weed Management – Vehicle Hygiene

Additional mitigation measures are proposed in Section 6.1 (recommendations).

5 Assessment Factors

5.1 Application of the Ten Clearing Principles

Ten clearing principles have been developed under Section 5 of the *Environmental Protection Act 1986* for the purposes of determining the impact of clearing. These are considered when a decision to grant or refuse a clearing permit is required. An assessment of the potential impacts of clearing, against the ten clearing principles, is outlined in Table 5 below.

Table 5. Application of the Ten Clearing Principles

Principle No.	Native Vegetation Should Not be Cleared if ...	Is the Proposed Project at Variance?
(a)	...it comprises a high level of biological diversity.	Proposal is not likely to be at variance to this Principle.
Comments: Christmas Island is home to approximately 420 species of vascular plants, including 177 introduced species and 242 species thought to be indigenous to the island. Eighteen species are known to be endemic to Christmas Island, with the other flora being more widely distributed through the Indo-Malayan and Malesian regions, or throughout the tropical Indo-Pacific. No Priority Flora species are listed for Christmas Island. Areas of the island which are previously uncleared and retain high biodiversity have been reserved as National Park, including the island's two Ramsar wetlands. Areas which have been previously cleared have been allocated to the Shire of Christmas Island for future development, or to Mining Lease for future mining. All areas proposed for clearing have been previously cleared, though some of these have regrowth vegetation that is up to 30 years old. Condition of regrowth varies, with some blocks being very weedy. Blocks have been assessed on a case by case basis to determine whether they are representative of natural vegetation. Given that there are no special habitats or species that are found solely in these areas, and all areas proposed for clearing have been previously cleared, the proposal is not at variance to this principle.		
(b)	...it comprises the whole or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	Proposal is not likely to be at variance to this Principle.
Comments: Christmas Island provides habitat for several species of fauna indigenous to the island including fourteen native bird species and nine species of seabird which use the island for breeding. Four seabird taxa and nine land bird taxa are endemic to the island. A further 108 migratory or vagrant bird species have been recorded on the island. Six of the island's endemic birds are listed as threatened under the EPBC Act 1999. Five endemic native mammals have been recorded on Christmas Island with only one, the Christmas Island flying-fox, now known to remain. Christmas Island has six species of native terrestrial reptiles, five of them endemic. Mammal and reptile species indigenous to the island have undergone a significant decline since human settlement, largely as a consequence of the introduction of the Yellow Crazy Ant, cats and rodents. Christmas Island supports 20 terrestrial and intertidal crab species of which three have been identified as conservation significant; the red crab, blue crab and robber crab. Blue crabs have a restricted distribution and do not occur within the areas proposed for clearing. Red crabs are numerous (last Island estimate 40-50 million) and common throughout the island and are considered a keystone species in the island's ecology. Robber crabs are numerous and found across the Island. Robber crabs were present in proposed clearing areas but in low numbers. A risk assessment has been undertaken to assess the potential for impacts on threatened and conservation significant fauna (See Part B – Flora Survey and Fauna Assessment). Key considerations in assessing impacts is that; • The majority of the Island's forest have never been cleared and are securely held in national park. These provide high quality remnant virgin forest habitat for the Island's fauna. • In comparison, the areas proposed to be cleared have all been cleared previously for mining and in some cases, landforms have been significantly modified by past mining. The vegetation is a mix of weed dominated shrublands, ferns and regrowth. Whilst these vegetation types will provide habitat for some species, they are depauperate compared to the uncleared primary forests and have much lower fauna values that the primary forests. • There are several species (e.g. the Christmas Island thrush) which, although listed as threatened species under the EPBC Act due to their endemic status, are found across the whole Island, are common and habitat generalist who recolonise disturbed areas. Whilst there is potential for these species to be in the proposed clearing areas, the small localised clearing is unlikely to have significant impacts for these species and the risk of species impacts is very low.		

- The Island fauna species that are of particular conservation concern due to low population numbers or special risks (Abbott's booby, Listers gecko, forest skink, Pipistrelle bat, Christmas Island shrew and the Christmas Island blind snake) have not been found in the proposed clearing areas.
- There are no unique or special fauna habitats found on the proposed clearing sites.
- There are no fauna species that rely solely upon habitat in areas proposed to be cleared.

The sizes of the individual clearing areas are small (0.93 to 15 ha of regrowth) compared to the habitat that remains (10,123 ha of primary forest) and much of this (7,769 ha of primary forest) is securely protected in national park.

- Fauna of the Island is supported by the surrounding extensive, intact vegetation and therefore the clearing is unlikely to be at variance with this principle.
- Red crabs are ubiquitous and common, estimated to be between 40-50 million and their preferred habitat is in undisturbed rainforest, most of which is protected in the Christmas Island National Park. The density of red crab burrows within the proposal area is relatively low. It is not possible to undertake clearing without some localised, albeit small, impact. The key consideration is that any impacts will be minor compared to the large and well protected existing population and following rehabilitation it would be expected that red crabs would recolonise these areas and they would again become productive red crab habitat. Therefore, any localised impacts on red crabs are likely to be insignificant to the Island population.
- There are no Abbott's nest trees found within the proposed clearing areas.
- There are known Abbott's nest trees in the adjoining national parks however indirect impacts due to turbulence created by clearing is considered a low risk (this is discussed in more detail below).

Given the degraded nature of the habitat caused by past clearing, it does not meet the tests for being a whole or part of a significant habitat for indigenous fauna, however, it may be questioned whether the proposal areas are '*necessary for the maintenance of, a significant habitat for fauna'*. When this is considered, the potential for edge effects, including weeds and wind turbulence on surrounding fauna habitat must be taken into consideration. The Christmas Island rainforest is remarkably resilient to weed invasion due to shading effects caused by the dense canopy and seedling herbivory by red crabs (Green, Lake and O'Dowd 2004). A suitable buffer to prevent weed incursions into National Park has been incorporated into the proposal and the proposal areas, when cleared, would be subject to the Commonwealth approved Weed Management strategies (contained within the CIP EMP) which would require control of priority weed species that have the potential to invade adjacent forests.

Turbulence impacts on Abbott's booby nesting have been hypothesised based on modelling of the hypothetical removal of a primary rainforest. This is based on removal of a natural undisturbed canopy which would be the maximum change and impact due to clearing activities. The impacts due to increased turbulence in adjoining forest areas from the clearing as proposed would not be at this level, as the forest to be cleared is already disturbed and turbulence effects would already have been experienced on the adjoining forest when the site was originally cleared (circa 1970's). The anticipated change in turbulence will vary for different sites as they have different dimensions, different canopy heights and vegetation. Some clearing is expected to have minimal increased turbulence due to the extent of existing clearing in the area (i.e. the effective change in the canopy will be minimal). Turbulence impacts will also only be realised if Abbott's booby nest trees are situated within the ten canopy heights downwind of the cleared areas (Raupach, Bradley and Gadiri 1987). A notional 300 m distance is often quoted but it should be noted that this is based on the forest having a 30 m canopy height. In this particular case canopy heights of vegetation to be cleared are relatively low with 91% being less 15 m, with weed and fernfields being generally less than 5 m.

In all cases, the proposal areas contain regrowth trees which are lower than the surrounding primary forest, so some impacts will already be present. In some blocks, Abbott's booby is nesting downwind of a nearby pinnacle field, which lies between the proposal area and primary rainforest (e.g. block 110-MB1 or 126-STP9F), suggesting these birds can adapt to, or at least are not deterred by, changes in turbulence patterns due to clearing. In other areas, the proposed clearing will only extend existing clearing by perhaps 50 m and the trees to be removed are significantly lower than primary rainforest (e.g. block 116-STP23B).

Given that these clearing areas will be rehabilitated post mining, effects of turbulence will be temporary with the growth of rehabilitation progressively diminishing turbulence affects. Only a small number of individuals relative to the population on Christmas Island are adjacent to the clearing area and the species is currently considered to be stable. Range to Reef 2017 assessments suggest that there may be an improvement in the number of breeding pairs of the species (Part B – Flora Survey and Fauna Assessment) in the areas surveyed. We conclude therefore that increase in turbulence will be low, and the resultant risk to Abbott's booby is negligible and reversible over time with rehabilitation after mining.

In conclusion, the proposal is not likely to be at variance to this principle.

(c)	...it includes, or is necessary for the continued existence, or rare flora.	Proposal is **not likely to be at variance** to this Principle.

Comments: There are three species listed as Threatened under the EPBC Act 1999. These are *Asplenium* §*listeri* (Christmas Island Spleenwort), which is listed as Critically Endangered, *Tectaria devexa* var. §*minor*, which is listed as Endangered and *Pneumatopteris truncata* which is listed as Critically Endangered. Flora surveys of the proposed clearing sites have not located any of these species. The Christmas Island Spleenwort occurs in limestone rock crevices in dry, exposed areas on Christmas Island and these habitats are not found in the proposed clearing blocks. *Pneumatopteris truncata* is known from two sites at Christmas Island. Neither location is within the proposed clearing areas. *Pneumatopteris truncata* grows in permanently moist sites in semi-deciduous closed forest. Given the habitat preferences for these two species, neither are likely to be found in the clearing sites. *Tectaria devexa* grows colonially, mainly on the plateau, in primary rainforest (tall and largely undisturbed), above 80 metres elevation; both in deeper soils and as a lithophyte (on mossy pinnacles at the base of a slope, a wet site). Ten populations of *Tectaria devexa* have been identified at Christmas Island, with the majority of these occurring in the National Park. No known populations of *Tectaria devexa* have been identified at proposed clearing locations and it is unlikely to be found on these sites. However, as habitat requirements are similar, additional pre-clearing checks may be proposed for *Tectaria devexa.*		
(d)	...it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.	Proposal is **not at variance** to this Principle.
Comments: There are no listed Threatened Ecological Communities on Christmas Island. Therefore, the clearing as proposed is not at variance to this principle.		
(e)	...it is significant as a remnant of native vegetation in an area that has been extensively cleared.	Proposal is **not at variance** to this Principle
Comments: Approximately 75% of Christmas Island has never been cleared and 84% of this (63% of total island area) is protected within National Park. The proposed clearing occurs on land that has previously been cleared for phosphate mining and consists of regrowth vegetation with some native species common on the island. The vegetation under application is not part of the island's original forests and the vegetation for many of the application areas is in a degraded condition and no longer representative of rainforest structural values. The vegetation within the application area is not considered to be a significant remnant of vegetation as it is not located in an extensively cleared landscape and therefore is not at variance to this principle.		
(f)	...it is growing in, or in association with, an environment associated with a watercourse or wetland.	Proposal is **not at variance** to this Principle.
Comments: None of the proposed clearing is associated with or adjacent to a watercourse or wetland. Perennial surface water features on Christmas Island are limited to spring fed streams on coastal or sloping areas of the island. All of the area under application is situated on the plateau and not within wetland areas. This proposal is not at variance to this principle.		
(g)	...the clearing of the vegetation is likely to cause appreciable land degradation.	Proposal is **not likely to be at variance** to this Principle.
Comments: The interior of the island is slightly undulating plateau, from about 160-360 m above sea level. The area under application is situated on the plateau with relatively little relief, and above the terraces. Due to the nature of phosphate mining top soil will be removed in areas for insitu mining and all other areas will be mined to ground level. All areas that are mined insitu will be left as limestone boulders. The land is currently approved for mining, so its land capability will not be impacted by clearing. No wind erosion, water erosion, salinity, eutrophication or waterlogging is expected as a result of the clearing, so this proposal is not likely to be at variance to this principle.		
(h)	...the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	Proposal is **not likely to be at variance** to this Principle.
Comments: The key interaction with conservation areas with this application is the potential effects on the Christmas Island National Park which borders many of the application areas. The Ramsar wetlands (Hosnie's Springs and The Dales) are distant from the proposed clearing areas and not relevant. The key issues in respect to impacts on adjacent conservation areas relate to potential ingress of priority weed species and edge drying effects due to clearing. The majority of areas under application are highly disturbed and unlikely to be acting as an effective buffer to the adjacent conservation areas. The clearing of some blocks as proposed may result in adjacent conservation areas being exposed to minor edge effects but these are not likely to have a significant impact on the environmental values of any conservation areas impacted. In some cases, the proposed clearing boundary has been reduced to provide some buffer between clearing and the national park boundary, and/or to protect from clearing better developed regrowth on the border of national park.		

It was noted by Green et al. (2004) that undisturbed Christmas Island rainforest vegetation was naturally resistant to weed invasion. However, there are some shade tolerant species that can spread into forested areas. Following clearing PRL will implement the weed management approach endorsed by the Commonwealth Government to ensure that the development does not result in the localised introduction and spread of priority weed species into the national park. A strategy that has been implemented in the past to minimise impacts on adjacent national park is the use of 'stockpile only' removal conditions. This involves returning the ground level to its original natural level (as opposed to in situ mining to limestone pinnacle). This approach has the advantage of retaining the original soil profile which facilities vegetative growth and rehabilitation activities. The rapid return of vegetation will be beneficial in ameliorating edge effects to the adjoining national park and allowing recovery of the site. This condition is proposed for ML 109 and 110 areas in this application. In summary this proposal is not likely to be at variance to this principle.		
(i)	...the clearing of the vegetation is likely to cause deterioration on the quality of surface or underground water.	Proposal is **not likely to be at variance** to this Principle.
Comments: Due to the high natural rate of infiltration at Christmas Island, erosion and sedimentation is generally localised to compacted areas such as roads and stockpiles. There is no potential for deterioration of underground water as a consequence of clearing. Due to the location of the areas proposed to be cleared, it is unlikely that the clearing of native vegetation for phosphate mining will cause deterioration in the quality of surface water or groundwater within the local area. Therefore, this proposal is not likely to be at variance to this principle.		
(j)	...the clearing of the vegetation is likely to cause, or exacerbate, incidence or intensity of flooding.	Proposal is **not at variance** to this Principle.
Comments: Christmas Island's soils and karstic limestone rocks are generally highly permeable so clearing on the island does not cause or exacerbate flooding. As the clearing as proposed is not likely to cause or exacerbate waterlogging or flooding and as the water features on Christmas Island are not close to the applied area, the clearing as proposed is not likely to be at variance to this principle.		

5.2 Planning Instruments

5.2.1 Indian Ocean Territories Regional Plan

The Indian Ocean Territories (IOT) Regional Plan Summary (Regional Development Australia, 2012) was published in October 2012. Building the capacity of the community and business to transition from a mining-based economy to a diverse and broad-based economy is a focus of the Regional Plan. The sectors identified for growth are tourism, food production and education and research. The care and management of the natural environment is also critical because if the natural environment is not well managed and protected, it also puts at risk the possibility of establishing a new tourism-based economy.

A key objective identified by the regional plan was to make fresh food more accessible and affordable by supporting food production initiatives such as the community garden and agricultural research activities like the "Mining to Plant Enterprise" project. Nearly all fresh foods are imported to Christmas Island by sea and air and supply is not always reliable due to weather constraints. The Christmas Island "Mining to Plant Enterprise" agricultural trial, jointly sponsored by the Commonwealth, Christmas Island Phosphates and Murdoch University, started in October 2012. The trial examines the potential for larger scale food production as an alternative to forest regeneration on former mine sites on Crown Land.

> *"Improving access to affordable fresh food*
>
> *The IOT rely almost entirely on imported fresh fruit, vegetables and meat. Food is brought in by air and freighted by sea to the Islands. Freight charges impact on the cost of every item and fresh food particularly is very expensive e.g. a lettuce can cost between $10 and $15. There are also concerns in the community about the amount supermarkets charge for food; that is the costs seem high even after accounting for freight charges. An increasing number of people in the IOT arrange to have fresh food delivered using the weekly air freight services. Anecdotally this is providing more choice to consumers and access to more affordable and better quality food than is being supplied in supermarkets. The impact of high food prices is felt differently across the Island communities. Workers on the Islands being paid allowances can absorb the costs more easily than those on fixed or low incomes – and this affects disadvantaged and older people particularly. The support for the existing growers and the development of new horticultural activities on*

the Islands is a priority. Food production trials on both Christmas and the Cocos (Keeling) Islands and other initiatives to improve the development of a sustainable food industry are a necessary part of the sustainable future for the IOT."

Source: Indian Ocean Territories Regional Plan (Regional Development Australia 2012)

5.2.2 Town Planning Scheme

The Shire of Christmas Island *Local Planning Strategy* was endorsed in May 2015. The strategy makes provision for the conversion of the existing mining leases to horticultural land to reduce the island's dependency on imported fresh produce (GHD 2015). Areas proposed for horticulture are on the eastern side of the island, outside of the current National Park but within current mining leases.

Local Planning Scheme No. 2 received approval in accordance with the requirements of the *Planning and Development Act 2005* (WA) (CI) in February 2016. The new scheme includes a stated objective "*to enhance and diversify the island's economic base through the provision of land for a range of economic activities,*" (Shire of Christmas Island 2016). Under Local Planning Scheme No. 2 (LPS 2), much of the land proposed for clearing is zoned rural (Table 6, Figure 3), "*to facilitate the development of productive land through agriculture, horticulture, aquaculture or other similar activities for the benefit of the Christmas Island economy*," with the intention that the land be available for farming following mining (WAPC 2016, GHD 2015, Shire of Christmas Island 2016).

Areas in the centre of the island which are zoned as Crown Reserve under LPS 2 are considered to be high priority areas for amalgamation into the National Park following completion of mining (GHD 2015). To facilitate this, it is recommended that mining of these areas be progressed as soon as possible so that these areas can be relinquished to Parks Australia for rehabilitation.

Table 6. Future proposed land use under LPS 2 within clearing permit application areas (hectares).

Application Area	Crown Reserve	No Zone	Rural	Total (Ha)
105-MB2	-	0.1	1.2	**1.3**
106-MB12	-	-	6.3	**6.3**
106-MB15	-	0.4	6.4	**6.9**
106-MB16	-	0.1	0.8	**0.9**
109-MB1	9.6	-	-	**9.6**
110-MB1	15.3	-	-	**15.3**
116-MB5	4.3	-	-	**4.3**
116-STP23B	2.1	-	-	**2.1**
126-STP9F	-	-	2.0	**2.0**
127-STP9E	-	-	2.8	**2.8**
Total	**31.3 (60.8%)**	**0.6 (1.2%)**	**19.59 (38.0%)**	**51.5**

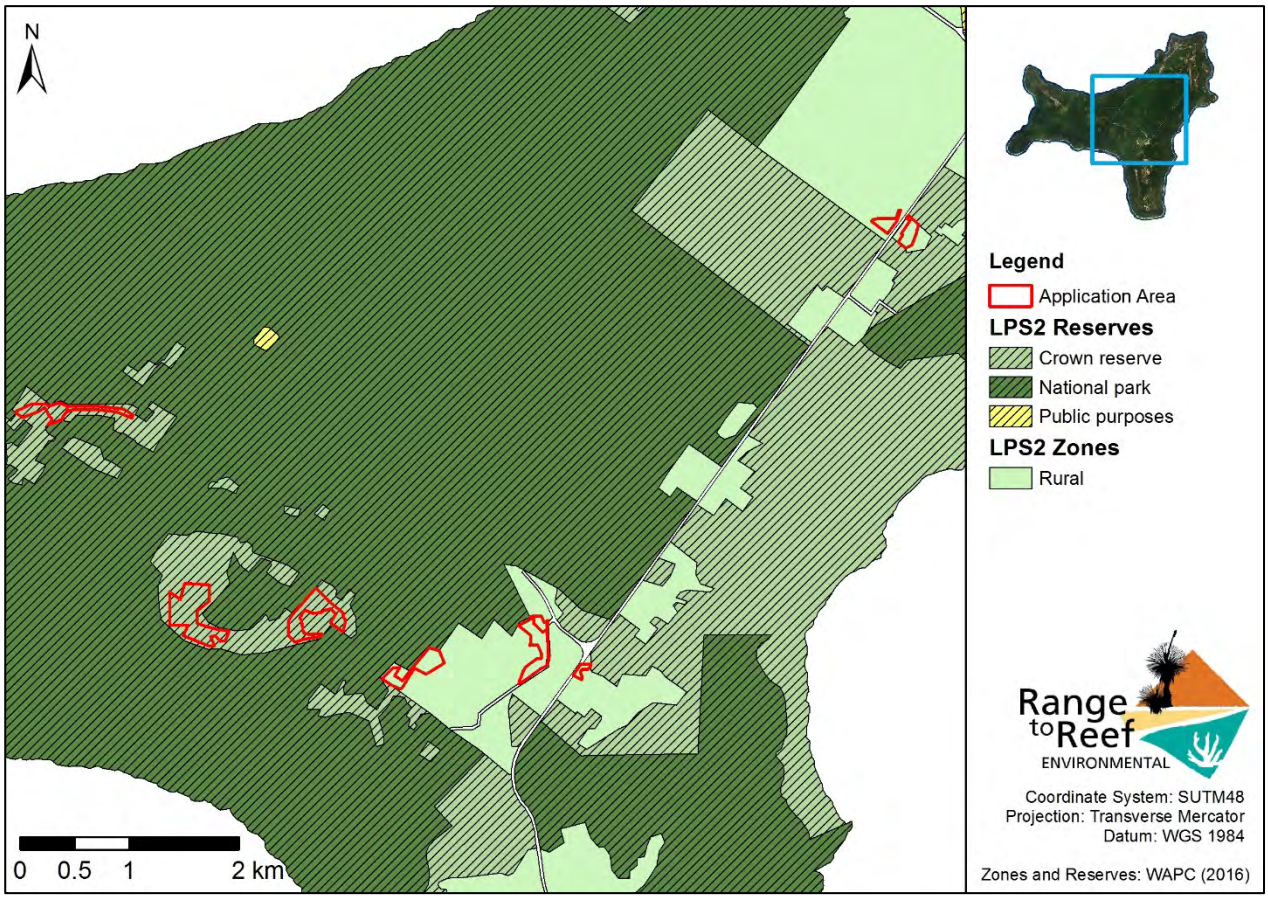

Figure 22. Local Planning Scheme 2 Zones and Reserves – Central Area

5.3 Other Relevant Matters

5.3.1 Land Use Impacts

The economy of Christmas Island has historically been almost solely dependent on phosphate mining. The historic reliance on a single economic driver has meant that the island's economic outlook lacked flexibility to change (Shire of Christmas Island 2012a). Notwithstanding a brief diversification of activities on the island with the construction of the Immigration Detention Centre (IDC), the economy is still heavily reliant on phosphate mining. The IDC is scheduled to close in 2018 (Australian Border Force 2017). Tourism on the island is hampered by a lack of reliable flights and all industries are impacted by a lack of safe harbourage for shipping.

The clearing application will not impact negatively on other land uses and will facilitate potential post mining use for agriculture and rehabilitation activities.

5.3.2 Previous Decisions

1. EPBC Act referral for proposed phosphate mining in South Point, Christmas Island (Ref: 2012/6653)
2. Previous clearing permit decisions:

- CPS2090/1 (CIP) refused
- CPS2132/2 (CIP) exp. 11 November 2022
- CPS2373/1 (CIP Exploration Permit) permit surrendered
- CPS2376/1 (CIP Exploration Permit) permit surrendered
- CPS2870/1 (CIP) permit surrendered
- CPS3290/3 (CIP) exp. 31 August 2025

- CPS3472/6 (CIP) exp. 11 January 2025
- CPS4506/2 (CIP) exp. 16 March 2025
- CPS6124/1 (Parks Australia) exp. 21 July 2019
- CPS6104/1 (Hidden Garden Sustainable Farms) exp. 3 January 2017
- CPS6323/1 (CIP) exp. 31 December 2024
- CPS6662/1 (CIP Exploration Permit) exp. 31 December 2018
- CPS6920/1 (CIP Exploration Permit) exp. 3 June 2021
- CPS7040/1 (CIP Exploration Permit) exp. 13 August 2021

3. EPBC Act referral for proposed exploration drilling in VCL Areas (Ref: 2016/7779) pending

5.3.3 Legislative Requirements

Mining Lease MCI 70/1 was granted to CIP by the Commonwealth in 1997 under the *Mining Act 1978 (WA) (CI)* following approval under the EPIP Act. The lease was extended until 2034 in June 2013.

There are no Aboriginal Sites of significance or Native Title Claims on the Island.

The EPBC Act applies on Christmas Island. Mining was approved within MCI 70/1 in 1997 under the EPIP Act and does not require further approvals under the EPBC Act. The Western Australian Environmental Protection Authority does not make decisions on Christmas Island.

The *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* apply to Christmas Island under the *Applied Laws (Implementation) Ordinance 1992* and are administered by the Department of Water and Environmental Regulation.

CIP have a Part V prescribed premises licence issued to them under the EP Act for the control and abatement of pollution from the loading and unloading activities and processing activities (beneficiation of metallic or non-metallic ore).

5.3.4 Necessity

Mining on Christmas Island is essential for ongoing employment and support of the island's economy. The *Christmas Island Local Planning Strategy* notes that "*if mining activities were to cease, the economy of the island would shrink dramatically and the island would experience de-population as there would not be enough jobs to sustain the current population*" (GHD 2015).

Environmental Approval for mining in Mining Lease MCI 70/1 was granted in 1997 under the EPIP Act. For phosphate mining to continue until the expiry of the mining lease in 2034, phosphate reserves already approved for mining will need to be utilised. This will necessitate the clearing of areas proposed in this application. Areas with a high risk of environmental impacts have been excluded from this application and only high priority areas remain.

5.4 Environmental Protection Policies

There are no Environmental Protection Policies developed under Part III of the EP Act that apply to Christmas Island.

5.5 Agreements to reserve, conservation covenants and soil conservation notices

There are no agreements to reserve, conservation covenants or soil conservation notices under the *Soil and Land Conservation Act 1945* applicable to the proposal.

6 Conclusions and Recommendations

An assessment of any proposed native vegetation clearing against each of the ten principles outlined in Schedule 5 of the *Environmental Protection Act 1986*, has identified that the proposal is **not likely to be at variance** to the clearing principles.

The boundaries of the National Park and those of the original lease were determined from aerial photography and this essentially excluded from the National Park all cleared and mined areas including low grade stockpile dumps. This process was undertaken to ensure that stockpiles and mined areas were accessible for mining, in acknowledgement of the importance of phosphate mining to the island's economy.

In many cases, stockpiles are present adjacent to, or straddling, the National Park boundary. Due to the proximity to the National Park and the need to maintain safe batter angles, accessing resources on the edge of National Park is difficult. Given the small mining parcels (which are often very narrow), the imposition of buffers to the National Park will in some cases make the resources inaccessible or the retrieval of these resources uneconomic.

From an environmental perspective, the height and density of undisturbed canopy vegetation typically results in edge effects that dwindle very rapidly as you enter the National Park. In recognition of this, historically, buffers have been applied that have been as narrow as 5 m (CP3472/4). Edge effects surrounding mining can be easily managed and the environmental values of the National Park preserved without the need for additional buffers. It is proposed that PRL's approved Weed Management Plan will provide adequate protection for the environmental values of adjacent National Park.

Revegetation activities funded by the Conservation Levy and undertaken under the Christmas Island Minesite to Forest Rehabilitation Program ensures that lands which have been mined and are subsequently relinquished to Parks Australia can be returned to a vegetated state with some habitat value for wildlife.

Growth of vegetation on the island is rapid and tracks cleared in a previous year are often unidentifiable within two years of clearing. Where sufficient soil is present to sustain canopy species and weeds are managed, pioneer species quickly reach forest heights. The flora and vegetation assessment field survey undertaken in July 2014 identified canopy heights of up to 25 m in areas cleared as recently as 1982.

Historically there has been a tendency to place great value on the mapped height of regrowth vegetation, without consideration of rainforest structural values or biodiversity. Thus, vegetation of low diversity and showing few environmental values other than height has sometimes been excluded from clearing permits on the grounds of its providing significant habitat for fauna indigenous to the Island. With respect to the proposed clearing areas in this application, many are small and or degraded and could not be justified as being "significant" as fauna habitat, given the size of fauna populations within or adjacent to proposed clearing areas compared to those present in habitat protected within National Park.

Mining areas in the centre and west of the island (those nearest to high densities of Abbott's nests) have been identified as priority areas for relinquishment (Director of National Parks 2014b). Completion of mining in these areas will enable relinquishment of the areas to Parks Australia for rehabilitation using the conservation levy contributed by Phosphate Resources Limited.

The assessment suggested that the risk posed to conservation significant species from the proposed mining activity would be low and not significant in the context of species conservation. The general

absence of natural habitat and low biodiversity value of the area suggested limited habitat important for the lifecycle of listed species.

6.1 Recommendations

- Approval of areas proposed for clearing in this application subject to the application of conditions relating to management commitments as set out in the CIP Environmental Management Plan 2018-2023.
- Implementation of the Commonwealth approved Weed Management approach (as outlined in the Environmental Management Plan 2018-2023).
- Buffers are not recommended. Given the small footprint for clearing, imposition of buffers is impractical. Note that application boundaries have been set at least 5 m from the edge of Closed Canopy Evergreen forest.

7 References

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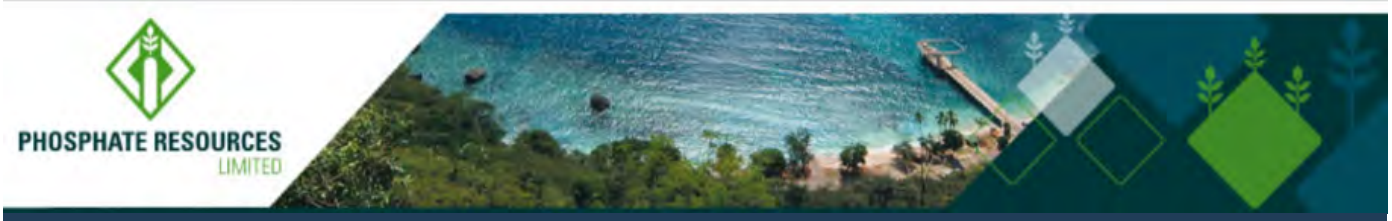
Appendix 1 - ENV-SOP-009.2017 Vegetation Clearing



ENV-SOP-009.2017 Vegetation Clearing

Created Oct 11, 2017 Updated Oct 11, 2017 No upcoming events

ALL CLEARING PERMIT CONDITIONS ENVIRONMENT DEPARTMENT ENVIRONMENTAL REPORTING SHARED TERRESTRIAL HABITATS AND VEGETATION

Purpose

To ensure compliance with CIP policies and the regulatory requirements relating to vegetation clearing.

Scope

This procedure relates to

ALL

vegetation clearing within CIP Lease areas.

Procedure Details

Type:

Site Specific

Procedure

The following process must be used for ALL vegetation clearing being undertaken within CIP Lease Areas:

- Meetings to be held between the Mining, Technical Services and Environmental Departments to plan required clearing for mining and exploration programs and other nominated areas requiring clearing.
-

ENV-FORM-026.2017 CIP Mines Works Permit

is to be completed step by step by all relevant Departments – this may be undertaken as a group meeting to discuss all requirements.

Documentation

Copies of all documentation are to be maintained by the Mining Department and made available on request.

Related Documents and Forms

ENV-REFDOC-002.2017 Licence for Prescribed Premises - Licence Number L8846/2014/1

ENV-REFDOC-007.2017 Clearing Permit 2123

ENV-REFDOC-008.2017 Clearing Permit 3290

ENV-REFDOC-009.2017 Clearing Permit 3472

ENV-REFDOC-011.2017 Clearing Permit 4506

ENV-REFDOC-015.2017 Environmental Management Plan 2012-2017

ENV-REFDOC-019.2017 Clearing Permit 6323

ENV-REFDOC-020.2017 Clearing Permit 6662

ENV-REFDOC-024.2017 Clearing Permit 6920

ENV-FORM-026.2017 Mine Works Permit

CHRISTMAS ISLAND PHOSPHATES

Part B - Flora Survey and Fauna Assessment

‘Case-by-Case’ Areas 2018

March 2018

Range to Reef ENVIRONMENTAL

Prepared for Phosphates Resources Limited

Name	Task	Version	Date
Flora and Fauna Assessment 'Case-by-Case' Areas 2018	R2R Draft	0.0	31/01/2018
Part B - Flora and Fauna Assessment 'Case-by-Case' Areas 2018	Client Draft	1.0	08/03/2018
Part B - Flora and Fauna Assessment 'Case-by-Case' Areas 2018	Final	1.0	21/03/2018

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Prepared for Phosphate Resources Limited (trading as Christmas Island Phosphates)

Executive Summary

Range to Reef were commissioned to undertake a re-assessment of flora and vegetation of proposed clearing areas, and a survey of Abbott's booby nesting trees adjacent to the clearing areas in the central plateau of Christmas Island. Most of the proposed clearing areas were surveyed for flora in 2010 and 2011 by other consultants, with 42 native flora species found (none conservation significant) and nine introduced.

The survey areas are impacted by previous activities, having been previously cleared and in some cases earthworks/mining has also occurred on the site. The vegetation on these sites was originally closed canopy rainforest however after historic clearing now comprises Regrowth and weed dominated vegetation of varying condition. The vegetation within the assessment areas ranged in condition from Completely Degraded to Excellent, with average vegetation condition at survey sites being Good.

Uncleared closed canopy rainforest is well represented throughout the plateau covering 48% of the island, and most of this being reserved in the Christmas Island National Park. Seventy-seven flora taxa (from 45 families and 69 genera) were identified within the assessment areas, including 24 introduced and three endemic flora taxa. No flora taxa of conservation significance were found.

The Abbott's booby survey confirmed that there were no nest trees or use of the proposed clearing areas. The survey focussed on areas adjacent to the proposed clearing envelopes, and found an average of 0.68 Abbott's per hectare within the area 300 m downwind of the clearing areas. This included numerous new records not previously recorded in Parks Australia surveys. Many of the new records were closer to existing clearings and/or closer to the boundaries of the assessment areas. A number of previously identified nest trees had clear crown damage, presumably caused by the 2014 cyclone or natural attrition.

In addition to Abbott's booby, the conservation significant fauna species Christmas Island goshawk (En), Christmas Island thrush (En), Christmas Island emerald dove (En), Christmas Island imperial pigeon, Christmas Island white-eye, Christmas Island red crab and Robber crab were identified within the proposed clearing areas. These species are generally widespread and highly mobile and unlikely to be significantly impacted by removal of vegetation within the assessment areas. Abbott's booby, the Christmas Island red crab and robber crabs, however would need to be considered during clearing activities.

A number of recommendations were made as a result of these surveys including:

- Removal of block 122-MB2 from any proposal due to the proximity of Abbott's booby nests and the absence of any mitigating factors.
- Boundary amendments due to forest condition and boundary issues
- Implementation of additional buffers to National Park in the centre of the Island.
- Implementation of relevant CIP management plans to any clearing areas proposed.

Contents

Figures

Tables

1 Introduction

Phosphate Resources Limited (PRL) has commissioned Range to Reef Environmental to undertake a constraints analysis of eleven areas, totalling 74.3 ha, in the centre of Christmas Island to support a clearing application. Following initial assessments, the area was reduced to 62.8 ha, most of which was then surveyed for flora and vegetation values and areas adjacent to and downwind from known Abbott's booby nests. One area (116-STB23B) was not surveyed due to time constraints and safety concerns relating to proximity to active mining. The assessment was to determine

1.1 Background and Purpose

Christmas Island is an Indian Ocean territory of Australia, located approximately 2,600 km north-west of Perth. Phosphate Resources Limited (PRL) operates phosphate mining, processing and shipping operations from Christmas Island under the trading name of Christmas Island Phosphates (CIP). PRL were provided with a mining lease and environmental approval to mine in 1997 and operated under this basis until the application of Western Australian legislation required the company to apply for clearing permits under the *Environmental Protection Act 1986 (WA) (CI)* (EP Act) for all future clearing. PRL have subsequently been provided with several permits to clear areas within its mining lease. The Island is predominantly National Park (63%) in recognition of its unique and sensitive environment with major seabird colonies, special land crab populations, marine habitats and many endemic species. The boundaries of the original mining lease (MCI 70/1A) were determined from the previously cleared and mined areas, including low grade stockpile dumps, visible in aerial photography. The areas within the lease have all been previously cleared and under the lease conditions no primary rainforest can be cleared for mining operations.

CIP applied to clear a number of areas in the centre of the Island under CPS 3472 and 4506 in 2009 and 2011. CPS 3472 was approved in 2009 but the permit deferred most areas to a 'case-by-case assessment'. There were several iterations where 'case-by-case' areas were applied for and considered in the intervening years. This assessment reviews the final outstanding areas and some areas which were not included in any previous clearing permit application. The purpose of this assessment is to provide up to date information on the flora and fauna of the survey areas to support the clearing application.

2 Existing Environment

Christmas Island was the subject of what some authors claim to be the world's first baseline environmental study (James and McAllen 2014), when staff of the British Museum attended the Island in 1897-1898 to make an inventory of species present and to examine the Island's geology (Andrews 1900). The study aimed to document the Island's environment before the Island was substantially altered by phosphate mining. The authors identified the threat introduced species would pose to the Island and recommended that all care be taken not to introduce cats. Regrettably cats did make their way to the Island and are now entrenched in the rainforest and subject to an eradication program. Since 1900, numerous environmental studies have been undertaken and the Island's existing environment is well documented.

2.1 Location and Land Uses

Christmas Island is located in the Indian Ocean, 10°30' South, 105°40' East, and approximately 2,600 km north-west of Perth, Western Australia. Christmas Island is 500 km south of the Indonesian capital Jakarta (Figure 1).

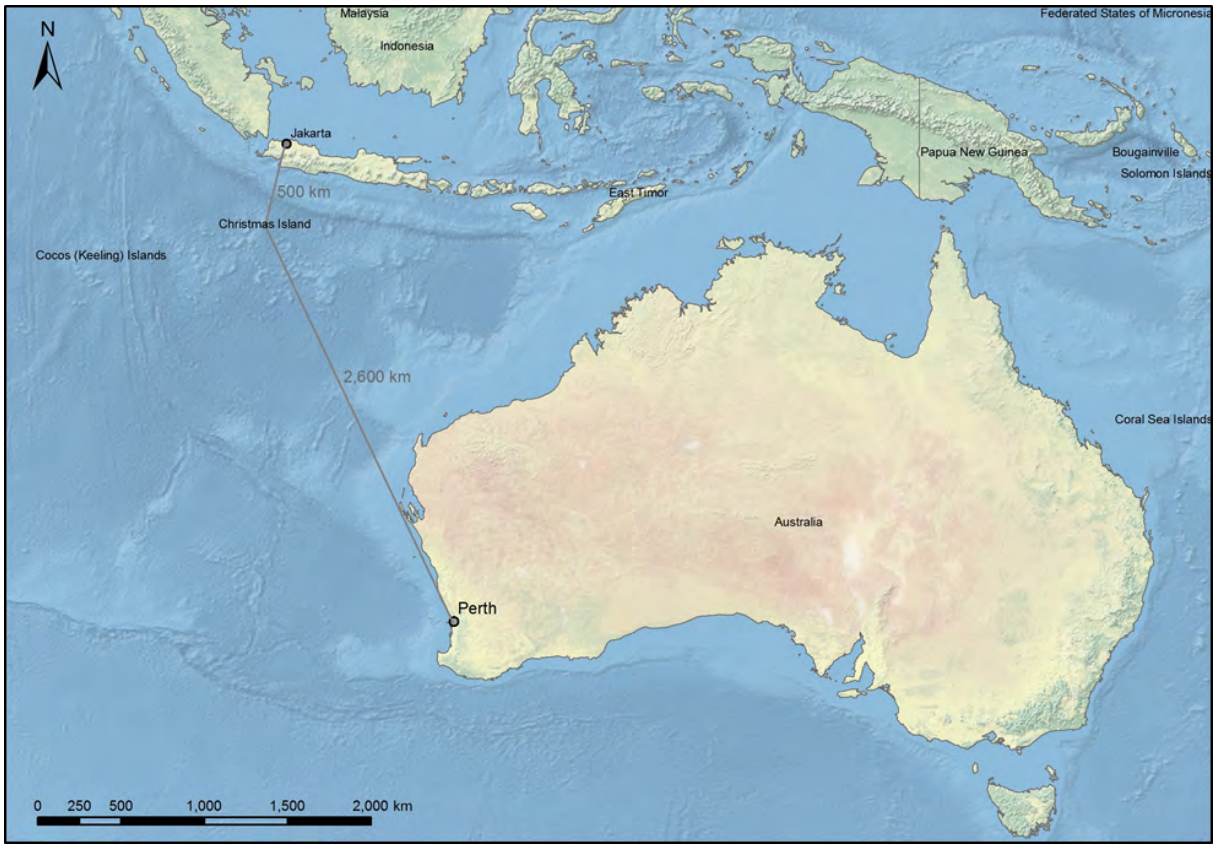

Figure 1. Location of Christmas Island

Christmas Island was originally uninhabited and in 1888 was declared part of the British Dominion. Phosphate mining was the principal reason for settlement with the first commercial phosphate shipment from the Island in 1895. Mining historically was driven by governments with the workforce imported from Asia. Mining and export of phosphate ore reserves has been carried out on Christmas Island for over 110 years.

Immigration detention facilities were established on Christmas Island at Phosphate Hill in late 2001 and a second, larger and more secure facility was constructed on a 40 ha site, formerly a phosphate mining lease, at the north-western end of Christmas Island. This centre is scheduled to close in 2018.

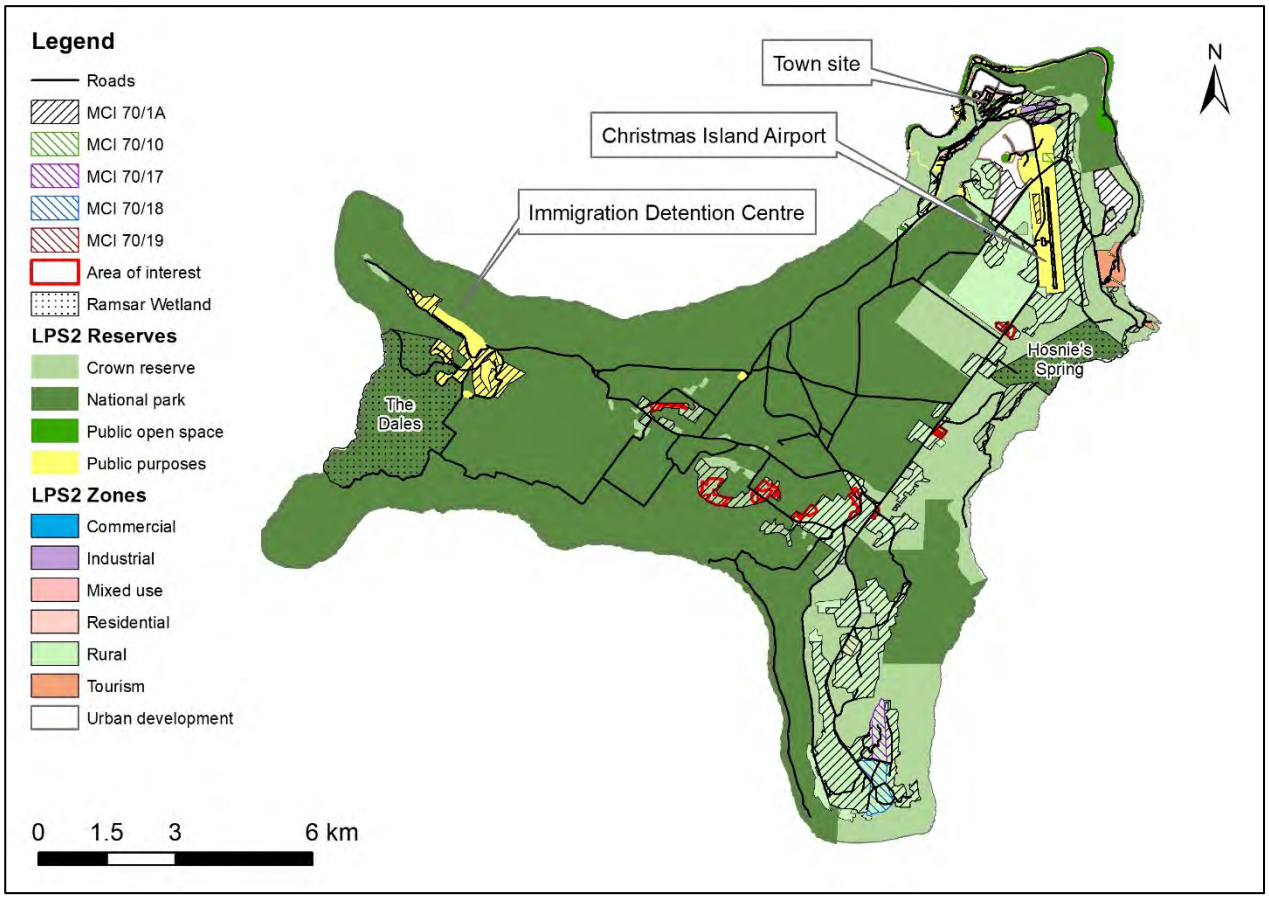

Figure 2. Land uses on Christmas Island
Source: WAPC (2016)

There are a range of other land uses on Christmas Island, with the largest land use by area being nature conservation in the form of the Christmas Island National Park, which occupies 63% of the Island. Other land uses include residential housing, tourism, recreation (e.g. golf course), transport and the provision of utility services. Numerous businesses and services have been developed on the Island to support the phosphate mine, detention centre, tourism industry and the Island population, including: construction, retail/hospitality, training/education, Government services, maritime services, agriculture, sport/recreation, maintenance, arts and the airport.

The assessment areas lie within undeveloped parts of the Island, within which the surrounding land uses are mining, National Park and vacant crown land.

2.2 Climate

Christmas Island lies on the southern edge of the inter-tropical convergence zone and the climate is dominated by a low-pressure trough that seasonally circles the equator. The Island has a tropical monsoonal climate with distinct wet and dry seasons and little seasonal variation in temperature.

The dry season (May to November) is dominated by low and sporadic rainfall (see Figure 3) with consistent south-east trade winds. The wet season generally occurs from December to April with the Island receiving most of its rainfall during this period. Christmas Island's average annual rainfall since 1973 is 2,117 mm but may vary considerably from year to year with the Island's lowest recorded annual rainfall being 1,066.9 mm in 1987 and the highest before 2016 being 3,715 mm (BOM 2016). In 2016 the Island received record rainfall (5,121 mm) with rainfall exceeding previous annual records by 1,406 mm (Figure 3).

Temperatures remain relatively uniform throughout the year, with an average daily maximum of 28°C in March/April and average daily minimum of 22°C in August/September. The Island has high humidity (80-90%) throughout the year and frequent dews and heavy mists may occur during the wet season.

During the wet season, Christmas Island is subject to the influence of north-west monsoons, which typically cause high swells and high winds, with gusts of over 100 km/h. Many cyclones have passed nearby the Island, resulting in strong winds and heavy rainfall on the Island. Cyclone Gillian caused significant damage to rainforest communities in March 2014, with trees blown over and foliage stripped from many areas.

The Island does have distinct microclimates due to the Island's geography, with rainfall measurements indicating that there are significant variations in rainfall (Falkland 1999). Average rainfall at Rocky Point (Settlement), Jedda Cave and South Point (1,931, 2,375 & 1,907 mm respectively) for example shows the significant variation across the Island (Puhalovich, et al. 2003). Daily evaporation typically exceeds rainfall between July and October (Puhalovich, et al. 2003).

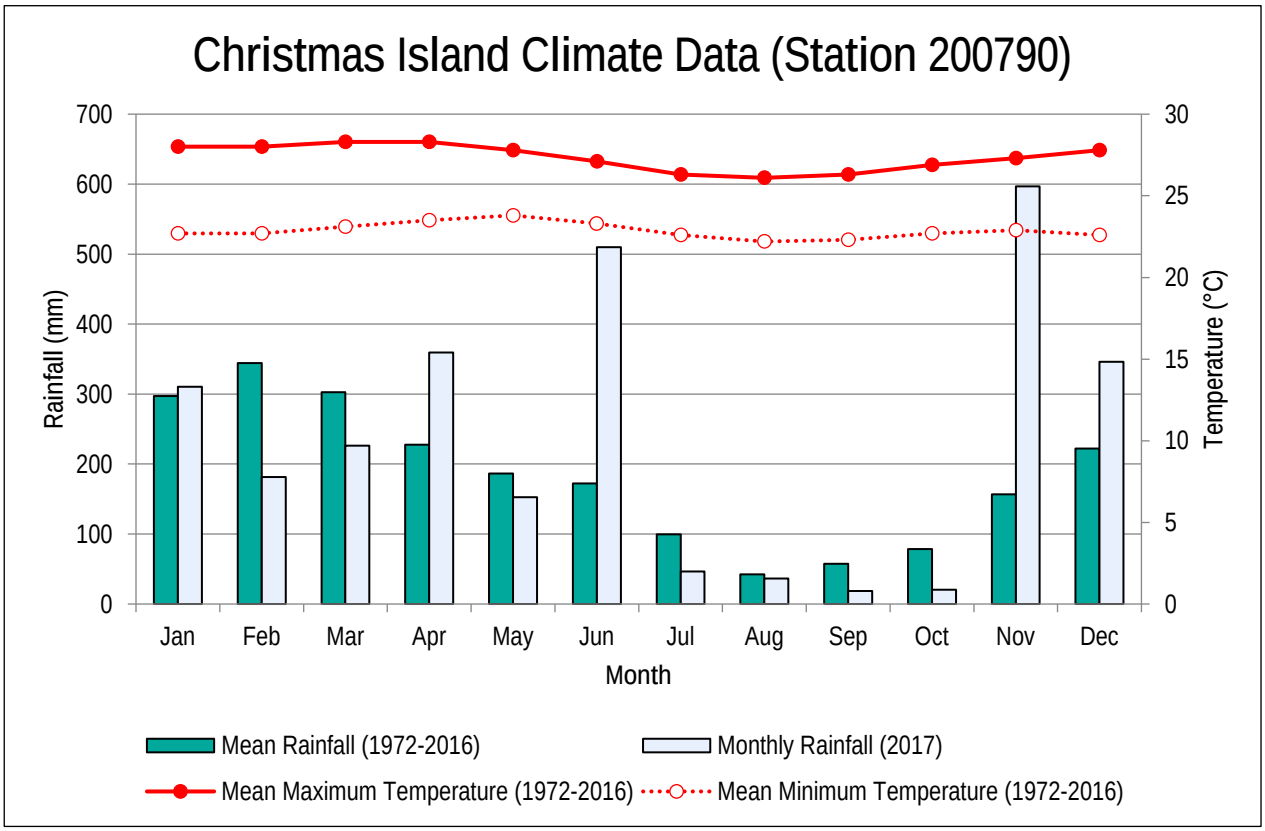

Figure 3. Climate Averages and Rainfall (Airport Station 200790)
Source: Bureau of Meteorology (2017)

2.3 Geological and Physiographic Context of the Application Area

2.3.1 Geology and Soils

Christmas Island is one of a series of submarine seamounts that rise above the 5,500 m deep abyssal areas of the West Australian Basin. At the core of the Island are volcanic rocks, mainly composed of basalt with a layer of limestone generally covering these volcanic rocks, with occasionally outcrops, particularly along the present coastline.

The Island is characterised by sea cliffs that rise via a series of terraces to a central plateau (Figure 4) which peaks at approximately 361 m above sea level. The shoreline is dominated by cliffs and extensive shore platforms with a few small beaches and Flying Fish Cove, which has a relatively large beach and shallow platform, being the only safe harbour for much of the year. The Island's natural landscape is dominated by karstic surface landforms and cave systems.

Terrace areas on the Island reflect the height above sea level in different geologic periods. Renewed vulcanism and a series of geological uplifts at different periods have resulted in a tiered effect. The oldest limestones near the peak of the Island formed during the Eocene period (Grimes 2001). Most the Island's limestone deposits were formed during the Tertiary (late Oligocene to mid Miocene age), with the youngest limestones deposited on the lowest terrace in the late Quaternary (Grimes 2001).

The limestone is mixed with dolomite sediments, basalts and tuffs. A layer of phosphate-rich soil material covers the limestone over about half of the Island. Marine sediments and guano deposition have formed the Island's phosphatic soils.

The red crab (*Gecarcoidea natalis*) is the principle agent of organic matter turnover and incorporation into the soil. Crab activity is a key feature of water and nutrient availability in the subsoil, with burrows also providing a preferred pathway for water drainage into the soil (Hollingsworth 2003).

2.3.2 Landforms and Topography

The Island is characterised by sea cliffs that rise via a series of terraces to a central plateau (Figure 4 and 5). The shoreline is dominated by cliffs and extensive shore platforms with a few small beaches and Flying Fish Cove which has a relatively large beach and shallow platform being the only safe harbour for much of the year. The Island's natural landscape is dominated by karstic surface landforms and cave systems (Grimes 2001).

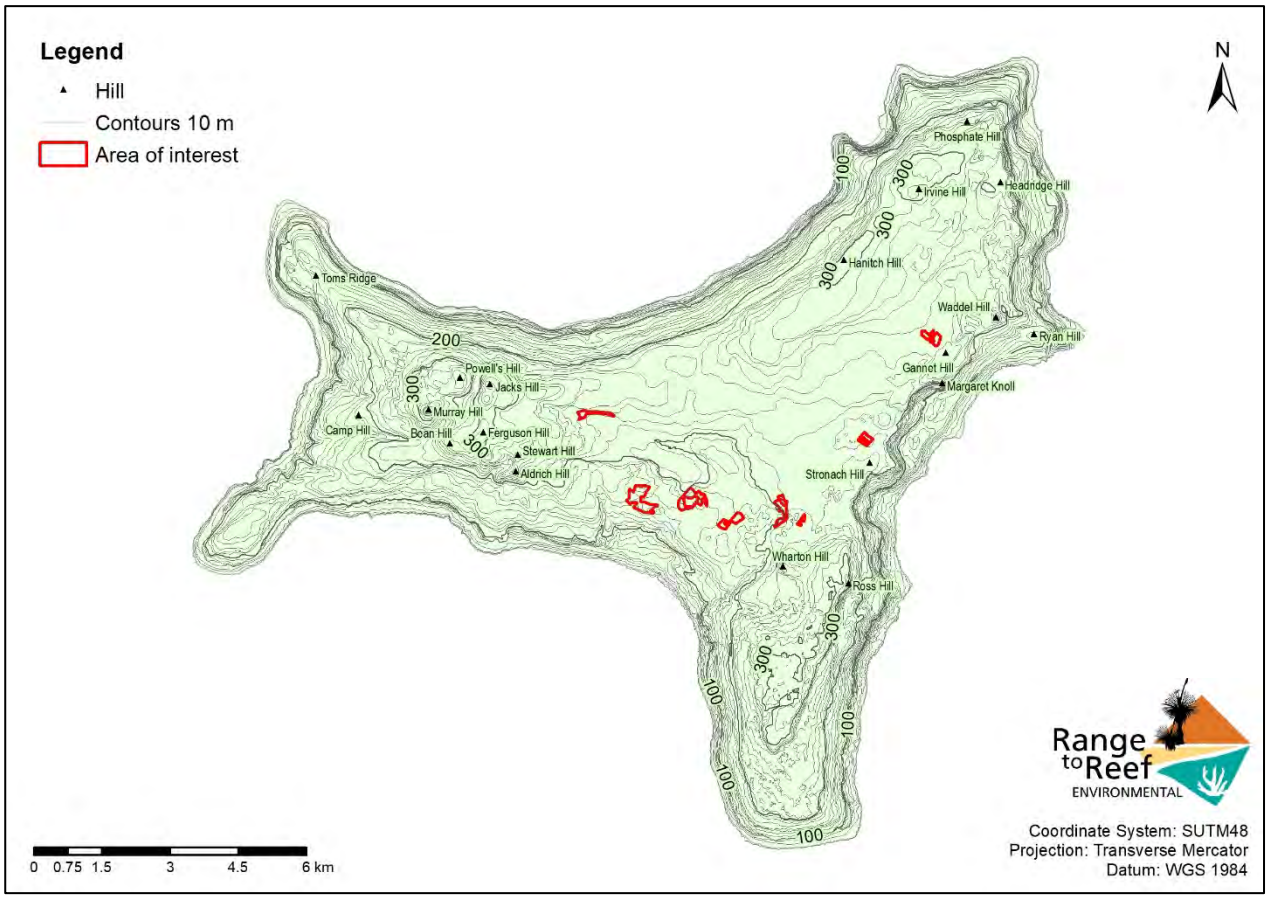

Figure 4. Topography of Christmas Island.

Source: CIGIS (Geoscience Australia 2014b)

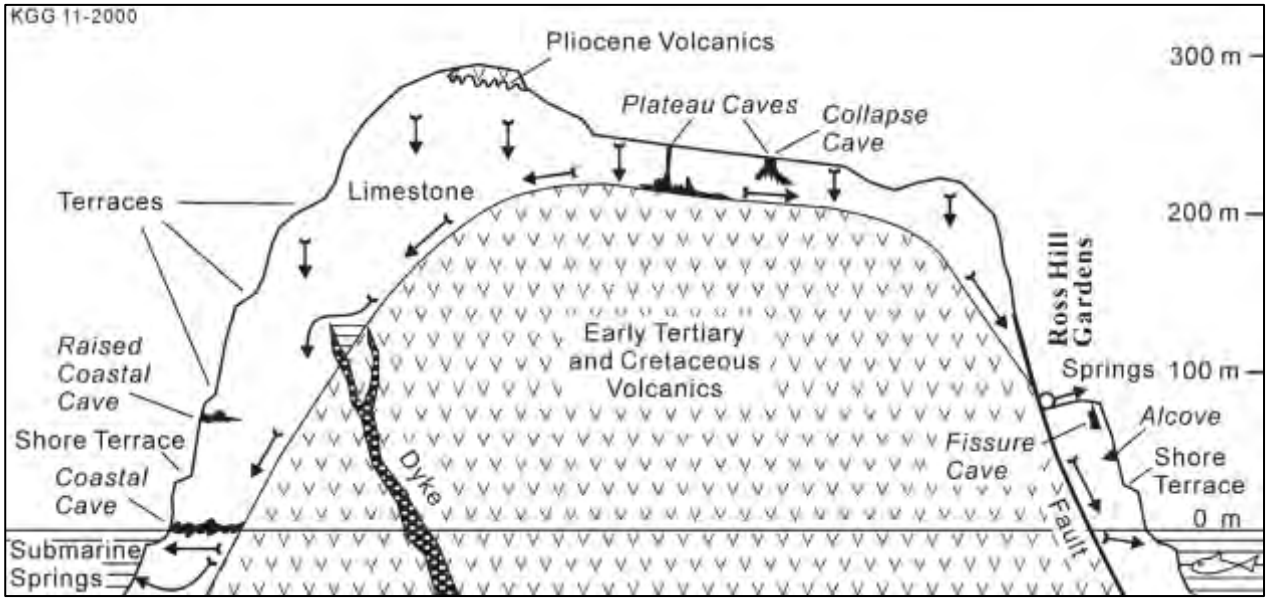

Figure 5. Diagrammatic cross-section of Christmas Island, *showing volcanic core, limestone capping, water flow lines (arrows) and typical cave development. Vertical scale is exaggerated x10.*

Source: Grimes (2001)

2.3.3 Hydrogeology and Hydrology

A major feature of the Christmas Island geomorphology is the lack of surface drainage. Rainfall mostly infiltrates the land surface and is utilised by plants, contributes to soil water stores or recharges to groundwater. There is therefore no significant surface drainage network except down gradient of springs that arise at the interface between limestone and basalt formations.

Christmas Island's soils are generally highly permeable and there is consequently little runoff or erosion (Hollingsworth 2003). In the Wet Season when the soils are saturated, runoff can occur during heavy rainfall providing some risk of erosion and sedimentation. However, given the high natural infiltration rates the risk of erosion and sedimentation is generally localised to compacted areas such as roads and stockpile pads. Infiltration tests by Puhalovich et al. (2003) indicate that soil infiltration rates are typically substantially higher than hourly rainfall intensities.

There are three key hydrogeological units on the Island; shallow, residual soils, which overlie fractured, unconfined – semi-confined aquifers within the karstic limestone rocks, which in turn overlie relatively impermeable volcanic basement rocks (Puhalovich et al., 2003). Groundwater levels on the Island are reflected by the location of the unconfined water table within the karst limestone aquifers. Limestone aquifers can be recharged when rainfall permeates through the soil zone into the underlying aquifers or by direct runoff of rainfall into karst features such as dolines and sinkholes that occur across the Island (Puhalovich et al., 2003). Assessments suggest that approximately half of all incident rainfall passes through the soil zone and recharges the underlying limestone aquifers (Hollingsworth, 2003; Falkland, 1999). Groundwater discharge occurs at surface springs such as Hosnie's Spring and offshore springs such as those found at Flying Fish Cove (Puhalovich et al., 2003). The complex behaviour and extent of weathered/fractured rock aquifers on the Island are not well understood.

Perennial (permanent) surface aquatic habitats (freshwater) on Christmas Island are limited to a number of spring-fed streams found along coastal or sloping areas of the Island. Hosnie's Spring and The Dales are both listed as a Wetland of International Importance under the Convention on Wetlands of International Importance, Water Fowl Habitat 1971 (known as the 'Ramsar Convention') and are listed in the Directory of Important Wetlands in Australia.

2.3.4 Interim Biogeographical Regionalisation of Australia (IBRA)

Christmas Island is included in the Interim Biogeographic Regionalisation of Australia (IBRA v. 7) as "Indian Tropical Islands" (Department of the Environment 2012).

2.4 Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are defined in the Western Australian Government Gazette and no sites on Christmas Island are included as Christmas Island is a Commonwealth territory. However, vegetated areas of the Island were included in the now discontinued Register of the National Estate as "Christmas Island Natural Areas". These areas could be considered as equivalent to an ESA as defined in the WA legislation.

The Ramsar listed, nationally important wetlands Hosnie's Spring and The Dales and the area covered by vegetation within 50 m of the threatened ferns *Asplenium* §*listeri* (Christmas Island Spleenwort), *Tectaria devexa* var. §*minor* and *Pneumatopteris truncata* would also be considered as equivalent to an ESA.

Most natural areas of the Island, including previously cleared lease areas are included as "Christmas Island Natural Areas." Hosnie's Spring and The Dales are not near the proposed clearing areas. *Asplenium* §*listeri* (Christmas Island Spleenwort), *Tectaria devexa* var. §*minor* and *Pneumatopteris truncata* are unlikely to be found in the proposed clearing areas which contain regrowth vegetation.

2.5 Flora and Vegetation

The Christmas Island National Park, which covers 63% of the Island, is assigned to IUCN reserve category II, most of which is uncleared primary rainforest (Director of National Parks 2014a). Some 25% of the Island's original vegetation has been cleared for mining and infrastructure (Director of National Parks 2014a, Geoscience Australia 2014a).

Three features of the ecology of the Island's native vegetation are notable (Director of National Parks 2014a):

- The occurrence of many of the widespread Indo-Malesian species in habitats that would be considered extremely atypical elsewhere in their natural ranges, and associated with this, the exceptionally large stature of some of these species;
- The low diversity of canopy and sub-canopy species and the lack of structural complexity (e.g. relatively poor development of robust woody vines and rattans, the absence of aroids and of gingers in the understorey) in the Island's rainforests; and
- The very low diversity and lack of speciation amongst plant genera that elsewhere in the region is characteristic of early successional, and frequently disturbed, rainforest environments (e.g. *Macaranga*, *Claoxylon* and *Pipturus*).

The geology, geomorphology and climate on Christmas Island create the biophysical environment and constraints for the vegetation communities. These factors determine the soil nutrient status, the seasonal availability of moisture and the degree of exposure to wind, which in turn control the distribution, structure and functioning of the natural vegetation (Reddell and Zimmermann 2003).

2.5.1 Floristic composition of the survey areas

Christmas Island is occupied by a suite of species that are derivatives of colonisers from distant land masses following dispersal by air, ocean currents or by avifauna (Du Puy 1993). The isolation of the Island and the nature of the colonisation process have resulted in a unique flora, which has been further evolved by the complex relationships with land crabs. In similarity to other isolated oceanic Islands populations usually have little genetic heterogeneity and form unique ecological communities. The terrestrial vegetation communities of Christmas Island comprise several types of rainforest and coastal forest, dominated by plants that are pan-tropical species (Beeton, et al. 2009) The flora has very strong taxonomic relationships with those of the Indo-Malayan and Malesian regions with some species (e.g. *Terminalia catappa*, *Inocarpus fagifer* and *Gyrocarpus americanus*) being elements of a more widely distributed tropical Indo-Pacific littoral flora that extends as far east as the Islands of Polynesia (Du Puy 1993). The presence of approximately eighteen endemic plant species (denoted by §) contributes to the Island's significance for understanding evolutionary relationships.

The taxonomic status and affinities of the Island flora are well known but detailed records of population distributions across the Island (and its range of habitats) are limited for many species, particularly conservation significant species. More recent assessments vary slightly in terms of total species numbers, exotic species and endemics with the most recent review (Director of National Parks 2014b) describing a native flora of 240 species, 17 of which are endemic.

Flora and vegetation surveys were undertaken in 2010 and 2011 by Mark Bennett and CIP Environmental Staff as part of a broader series of surveys for CPS 3472 and CPS 4501. Survey sites were very close together, in some cases separated by as few as two to three canopy trees. Site data for 147 survey points which fell within eleven of the preliminary assessment areas was examined during the desktop review. From these survey points, 52 flora species were identified including nine weeds (Table 1). Additional introduced flora ("Weed sp.") were identified as present but genus and species were not recorded. None of the species identified were listed under the EPBC Act. Early successional tree species such as *Macaranga tanarius, Tristiropsis acutangula* and *Dysoxylum gaudichaudianum* were recorded in all

areas. The introduced **Leucaena leucocephala* was also found in ten of the eleven blocks surveyed with **Cordia curassavica* and **Psidium guajava* (guava) being the next most common introduced species, found in six of eleven blocks.

Table 1. Flora taxa identified from the assessment areas in 2010 and 2011

Taxa	105-MB2	106-MB12	106-MB15	106-MB16	109-MB1	110-MB1	116-MB5	122-MB2	126-STP9F	127-STP9E	116-STP23B
Aidia racemosa	+	+	+	+	+		+				n/a
Alchornea rugosa	+	+	+		+		+				n/a
**Aleurites moluccana*		+									n/a
Allophyllus cobbe		+	+		+	+	+				n/a
Ardisia colorata		+			+		+				n/a
§*Arenga listeri*	+	+	+	+	+	+	+	+	+	+	n/a
Asplenium nidus	+	+	+		+	+	+	+	+	+	n/a
Barringtonia racemosa		+	+		+	+	+	+	+	+	n/a
Caesalpinia bonduc			+								n/a
**Calopogonium caeruleum*				+							n/a
**Capsicum frutescens*							+				n/a
**Carica papaya*						+					n/a
Cayratia japonica			+								n/a
Cayratia trifolia		+									n/a
Celtis timorensis						+					n/a
Claoxylon indicum	+	+	+	+	+	+	+				n/a
Cocos nucifera			+								n/a
Combretum acuminatum		+	+		+		+				n/a
**Cordia curassavica*	+	+	+	+	+		+				n/a
Corymborkis veratrifolia		+	+								n/a
Cryptocarya nitens		+		+	+		+				n/a
Davallia denticulata		+			+	+					n/a
Davallia solida						+		+			n/a
Dendrocnide sinuata			+								n/a
Dysoxylum gaudichaudianum	+	+	+	+	+	+	+	+	+	+	n/a
Ficus microcarpa		+				+					n/a
Guettarda speciosa						+	+				n/a
Hernandia ovigera		+									n/a
Inocarpus fagifer		+					+				n/a
Leea angulata	+	+	+	+	+	+	+	+			n/a
**Leucaena leucocephala*	+	+	+		+	+	+	+	+	+	n/a
Macaranga tanarius	+	+	+	+	+	+	+	+	+	+	n/a
Maclura cochinchinensis	+	+	+	+	+	+	+	+	+	+	n/a
**Melia azedarach*			+								n/a
Melochia umbellata		+	+	+	+	+					n/a
Microlepia speluncae			+				+				n/a

Taxa	105-MB2	106-MB12	106-MB15	106-MB16	109-MB1	110-MB1	116-MB5	122-MB2	126-STP9F	127-STP9E	116-STP23B
Microsorum scolopendria	+	+	+		+	+					n/a
**Muntingia calabura*			+		+	+		+		+	n/a
Nephrolepis biserrata	+	+	+	+	+	+	+	+	+	+	n/a
§Pandanus elatus		+	+	+	+	+	+	+	+	+	n/a
Pipturus argenteus			+	+		+				+	n/a
Pisonia grandis		+					+				n/a
Pittosporum nativitatis	+		+	+			+				n/a
Planchonella nitida	+	+	+	+	+	+	+	+		+	n/a
**Psidium guajava*		+	+	+	+	+		+			n/a
Schefflera elliptica	+	+	+		+	+		+	+	+	n/a
Spondias cytherea										+	n/a
Syzygium nervosum	+		+		+		+			+	n/a
**Tecoma stans*		+	+	+	+						n/a
Tectaria dissecta						+					n/a
Tristiropsis acutangula	+	+	+	+	+	+	+	+	+	+	n/a
Urena lobata		+									n/a
**Weed* sp.					+	+		+	+	+	n/a
Number of sites	3	14	16	3	31	39	6	14	10	11	n/a
Native taxa	16	30	28	15	23	23	24	13	10	14	n/a
Introduced taxa	2	4	6	4	≥6	≥5	3	≥3	≥2	≥3	n/a

2.5.2 Previous vegetation mapping

Vegetation mapping of the Island was initially undertaken by Mitchell (1985) for the Australian Nature Conservation Agency. This mapping had limited use due to its broad scale and spatial inaccuracy. Flora of Australia Volume 50 (Du Puy 1993) listed eight vegetation types for the Island. A vegetation mapping project was undertaken from 2011 to 2014 to attempt to map vegetation with better spatial accuracy, to determine height categories and to apply these consistently across the Island. Additional categories were added to include wetland vegetation and regrowth in cleared areas. The Christmas Island Vegetation and Clearing Map was developed through a collaborative project by Geoscience Australia, Christmas Island Phosphates, Christmas Island National Park and the Commonwealth Department of the Environment (Geoscience Australia 2014a). The map classified the full extent of Christmas Island into vegetation and land cover classes (Figure 6 and Table 1). Flora of Australia's vegetation types, which are still referred to in some documents, were recategorized thus:

- 'Primary rainforest' became *closed canopy evergreen forest*
- 'Marginal rainforest' became *semi-deciduous forest*
- 'Areas with surface water' became *perennial wetland forest*
- 'Open forest, scrubby forest and vine forest' and 'inland cliffs' became *semi-deciduous scrub*
- 'Coastal fringe' and 'shore cliffs and spray zone' became *coastal fringe vegetation*
- 'Mined areas' became *rehabilitation*, *regrowth* and *weed dominated veg and pioneer regrowth*

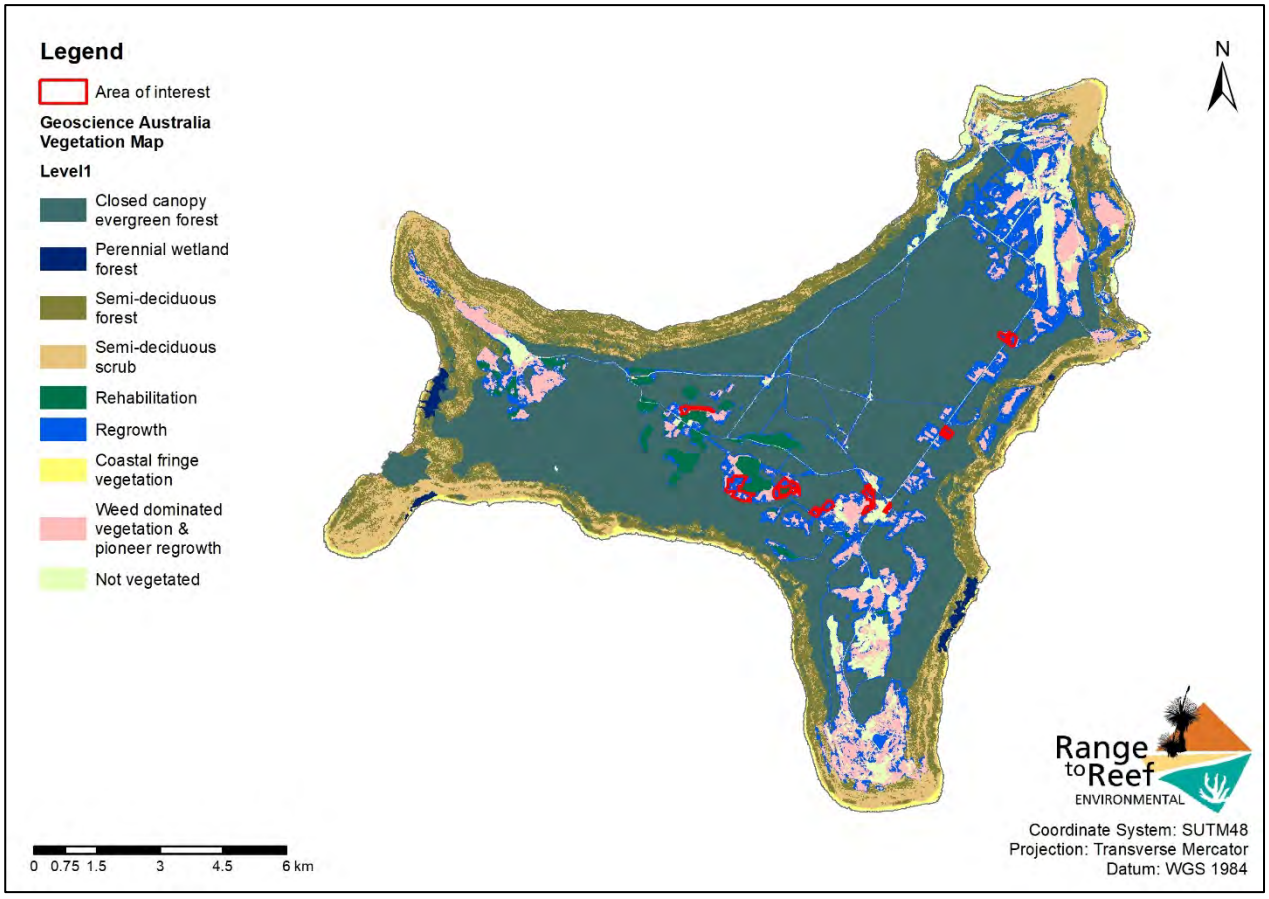

Figure 6. Vegetation of Christmas Island

Source: Geoscience Australia (2014a)

Table 2. Vegetation of Christmas Island

Level 1	Level 2	Description
Closed canopy evergreen forest	Closed canopy evergreen forest (tall or moderate)	Generally found on the plateau and terraces, with a closed uneven canopy up to 40 m in height. Some trees emerge up to 10 m above the canopy. Often supports ferns and orchids, young palms and lilies in the understory. Indicator species: *Bolbitis heteroclita, Syzygium nervosum, Hernandia ovigera, Planchonella nitida, Pisonia umbellifera, Corymborkis veratrifolia, Ehretia javanica*
Semi-deciduous forest	Semi-deciduous forest	Generally found on the slopes and terraces down to the coast - and some plateau areas. Higher occurrence of semi-deciduous trees compared to Closed Canopy Evergreen, which lose a portion of leaves during the dry season. Tree height generally 10-25 m. Indicator species: *Terminalia, Gyrocarpus, Erythrina variegata, Premna serratifolia, Pisonia grandis, Ochrosia ackeringae*
Semi-deciduous scrub	Semi-deciduous scrub	Found on the terraces, steep slopes and inland cliffs. Semi-deciduous canopy with vines and shrub understory Tree height generally <10 m. Indicator species: §*Colubrina pedunculata, Canavalia cathartica, Carmona retusa*, Cycads
Perennial wetland forest	*Inocarpus fagifer* dominant	Areas of fresh water runoff on the lower terraces dominated by *Inocarpus fagifer*. Indicator species: *Inocarpus fagifer*
	Hibiscus tiliaceus dominant	Areas of fresh water runoff on the shore terrace dominated by *Hibiscus tiliaceus*. Indicator species: *Hibiscus tiliaceus*
	Bruguiera dominant	A single patch of vegetation dominated by *Bruguiera* at Hosnie's Spring. Occurring in an area of fresh water runoff on the shore terrace. Indicator species: *Bruguiera gymnorhiza*
Coastal fringe vegetation	Coastal herbland	Found between the coastal scrub and coastal cliffs in exposed areas. Class is dominated by low-lying herbs, sedges and grasses. Indicator species: *Portulaca tuberosa,* §*Ischaemum nativitatis, Oplismenus compositus, Sporobolus virginicus*
	Coastal shrubland	Dense salt-tolerant vegetation growing between the coastal herbland and the terrace cliffs. Indicator species: §*Pandanus christmatensis, Scaevola, Pemphis, Argusia argentea, Cordia cordata, Guettarda*
Rehabilitation	Rehabilitation	Areas where forest rehabilitation has taken place. The standard of forest varies depending on the type of rehabilitation completed, species planted and management regime. Indicator species: A mix of up to 30 native tree species when initially planted, dependent on characteristic of the site and year of rehabilitation. *Macaranga, Dysoxylum, Calophyllum, Tristiropsis*
Regrowth	Regrowth	Generally well-developed regrowth vegetation over 5 m mean tree height. May include some introduced or weed species. Indicator species: Various species – dependent on adjacent vegetation
Weed dominated veg and pioneer regrowth	**Leucaena leucocephala*	Monoculture of **Leucaena leucocephala*. Often occurring as regrowth in previously cleared areas. Indicator species: **Leucaena leucocephala*
	Fern field	Expanse of low-lying ferns often growing on limestone pinnacles. Indicator species: *Nephrolepis biserrata*, *Microsorum scolopendria, Psilotum nudum*
	Mixed weed and pioneer regrowth	Regrowth vegetation with a mean tree height of <5 m. Can vary between native and introduced species depending on the location and time since clearing. Tends to have a higher occurrence of weed species compared to the 'Regrowth' category. Indicator species: **Muntingia calabura, *Psidium* sp. (guava), **Mimosa*, Passionfruit, *Macaranga*

Sources: Du Puy (1993) *and Geoscience Australia* (2014a)

There are seven major structural types of secondary vegetation (i.e. vegetation that has established in areas that have been cleared of the original natural forest) on Christmas Island (Figure 7). The occurrence of these secondary vegetation types in specific disturbed areas on Christmas Island reflects the influence of four main factors:

- The areal extent and the severity/intensity of the original disturbance (especially whether the soil profile has been disrupted or removed);
- Proximity to the nearest forest boundaries and/or to weed-infested areas;
- The subsequent disturbance or management history of the area (especially the frequency and intensity of further disturbances including fire); and,
- The time since the last major disturbance occurred.

Whether or not the soil profile has been removed or disturbed, the proximity to forest and/or to weed infested areas and the occurrence of further disturbance are the major environmental determinants of secondary vegetation type and successional pathways. There are four main successional pathways:

- Arrested successions dominated by ferns;
- Stagnant successions dominated by thickets of exotic shrubs and vines;
- Reconstructive successions dominated by *Macaranga tanarius*; and
- Retrogressive successions leading to fernlands.

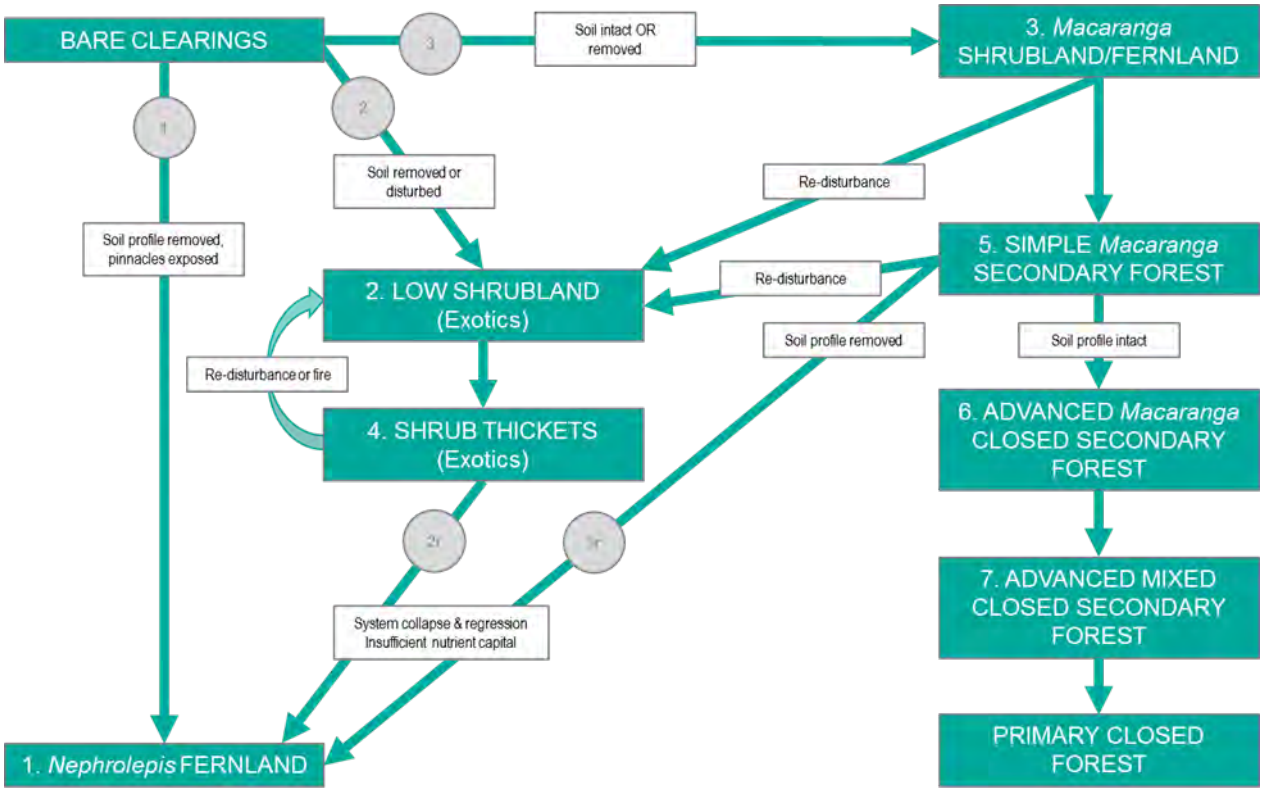

Figure 7. The seven major secondary (regrowth) structural types occurring on Christmas Island.

Source: adapted from Bennett (2010)

The survey areas contain regrowth vegetation of varying quality. Areas with particularly shallow soil, containing fern field make up 11% of the assessment areas and mixed weed and pioneer species a further 10% (Geoscience Australia 2014a). These areas are particularly difficult to traverse, with vine thickets and dense Pandanus regrowth. In areas containing dense regrowth, the merits of undertaking

comprehensive traverses must be weighed against the damage done to vegetation which can only be traversed with the aid of a machete.

Most of the assessment areas was comprised of Regrowth, with 34% being under 10 m height and 35% from 10-15 m (Geoscience Australia 2014a).

2.5.3 Vegetation condition

During the desktop review, site photographs and field data from 2010 and 2011 were compared to the vegetation condition assessment ratings outlined in Section 3 (Table 8) and a condition rating was assigned to each survey point. The average condition of each of the areas during previous surveys are presented in Table 3. The average condition score across all blocks was 5.1 (Good), indicating multiple causes of degradation such as weediness, poor species richness and land disturbance.

Table 3. Vegetation condition during previous surveys

Block	Samples	Average Condition Rating*	Native taxa	Introduced taxa**
105-MB2	3	3.8	16	2
106-MB12	14	5.0	30	4
106-MB15	16	4.5	28	6
106-MB16	3	5.3	15	4
109-MB1	31	5.5	23	6
110-MB1	39	5.3	23	5
116-MB5	6	4.4	24	3
122-MB2	14	5.1	13	3
126-STP9F	10	4.5	10	2
127-STP9E	11	5.1	14	3
116-STP23B	0	n/a	n/a	n/a

**Standard condition ratings after Keighery (1994) with the numerical ranking for Northern Australia applied: Pristine (2), Excellent (3), Very Good (4), Good (5), Degraded (6), Completely Degraded (7)*

***Minimum number of introduced taxa; some species were not recorded.*

2.5.4 Conservation Significant Flora

Three terrestrial flora species which occur on Christmas Island were listed as Threatened Species under the EPBC Act at the time this report was prepared (Table 4). Christmas Island Spleenwort is listed as Critically Endangered and is endemic to Christmas Island. *Tectaria devexa* var. *minor* is listed as Endangered and occurs in Sri Lanka as well as Christmas Island. *Pneumatopteris truncata*, which is listed as Critically Endangered, has a fragmented distribution over Asia and Malaysia as well as being known from two sites on Christmas Island.

Table 4. Conservation significant flora species potentially occurring within the vicinity of the assessment areas

Genus (& Family)	Conservation Status (EPBC Act)	Habitat	Description	Distribution
§*Asplenium listeri* (Aspleniaceae)	Cr	Limestone rock crevices in dry, exposed areas.	A lithophytic fern with short erect fronds, 3.5–9 cm long, which grow in a crown.	Christmas Island.
Tectaria devexa var. *minor* (Dryopteridaceae)	En	Primary rainforest (tall and largely undisturbed), above 80 metres elevation; both in deeper	A small, tufted, terrestrial fern with pale green fronds.	Christmas Island and Sri Lanka.

		soils and as a lithophyte (on mossy pinnacles at the base of a slope, a wet site).		
Pneumatopteris truncata (Thelypteridaceae)	Cr	Permanently moist sites in semi-deciduous closed forest.	A large terrestrial fern with an erect rhizome and fronds growing in a crown to 120 cm long. The fronds have aerophores (respiratory structures) at the base of the pinnae.	Fragmented distribution over Asia and Malaysia and two sites on Christmas Island.

Source: Department of the Environment and Energy (2017)

Figure 8. (from left to right) Christmas Island Spleenwort (§*Asplenium listeri*), *Tectaria devexa* var. *minor* and *Pneumatopteris truncata*

Sources: Khaliesha Amin, Butz (2004), http://www.phytoimages.siu.edu/

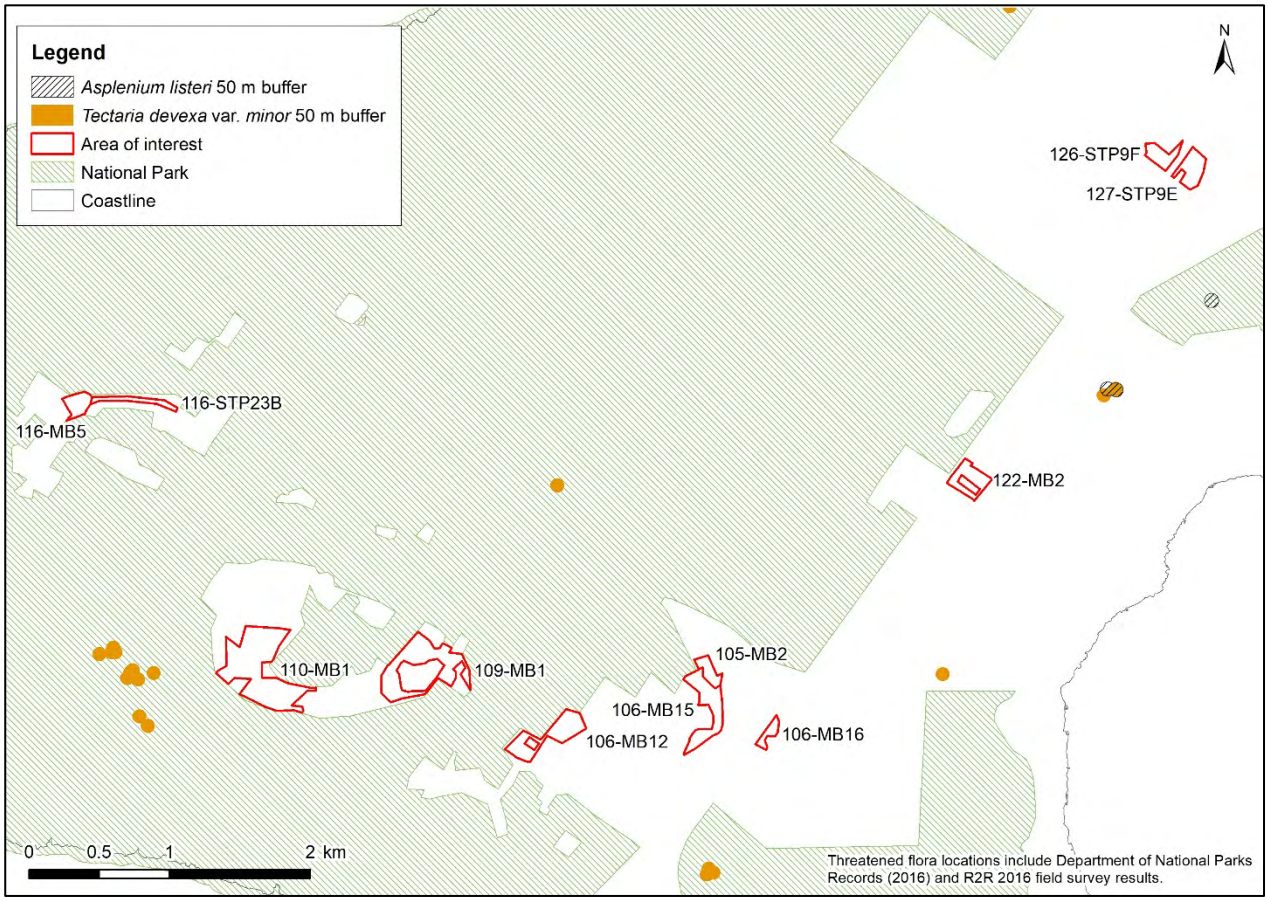

Figure 9. Conservation significant flora species in the central plateau

Source: Department of National Parks (2016)

***Asplenium listeri* (Christmas Island Spleenwort)**

The Christmas Island Spleenwort grows colonially on limestone rocks and cliffs in marginal rainforest between 110 and 255 metres above sea level, growing mainly beneath or near Ficus microcarpa (Holmes and Holmes 2002).

A review of the taxonomy and conservation status of *Asplenium listeri* was undertaken by Ohlsen et al. (2014), with indications that the taxon is more widespread and common across its range than previously thought, and that its EPBC listing needs to be reassessed. The review also cast doubts on the taxonomic status of *A. listeri* as a separate species because of similarities to the more widespread *Asplenium polyodon*, with recommendations for further surveying of other populations on the Island to accurately assess species demographics. Ohlsen et al (2014) indicate that the limestone dwelling *A. listeri* (on Christmas Island, Vanuatu and New Caledonia) are genetically more closely related to *A. polyodon* on Christmas Island than to any other accessions of *A. polyodon* sampled. Their study suggests that consistent genetic markers from limestone plants across a broad geographic range may represent a different species from *A. polyodon* from the Island.

The differences between *A. listeri* and *A. polyodon* are therefore very limited, and Ohlsen et al (2014) draw attention to the size of the fertile pinnae and substrate as the discriminating morphological characteristics. Anecdotal information received from taxonomic experts recommend further testing by comparison of additional genetic markers and more sequencing of samples from Christmas Island (of both *A. polyodon* and *A. listeri*) and from *A. polyodon* from the Indo-Pacific region (D. Fell pers. comm. 2016). More samples for both molecular and morphological comparison from the Island are therefore required to better understand the features that can distinguish the two species.

Christmas Island Spleenwort occurs in limestone rock crevices in dry, exposed areas on Christmas Island and these habitats are not found in the proposed clearing blocks. This species was not found in the flora survey and the likelihood of Christmas Island Spleenwort being found in, or impacted by clearing, within the assessment areas is **negligible** due to an absence of suitable habitat in the central plateau.

Tectaria devexa* var. *minor

Tectaria devexa var. *minor* grows colonially, mainly on the plateau, in primary rainforest (tall and largely undisturbed), above 80 metres elevation; both in deeper soils and as a lithophyte (on mossy pinnacles at the base of a slope, a wet site). Numerous populations of *Tectaria devexa* have been identified on Christmas Island, with the majority of these occurring in the National Park. No known populations of *Tectaria devexa* have been identified within the proposed clearing areas and it is unlikely to be present. The likelihood of *Tectaria devexa* being impacted by clearing within the assessment areas is **possible**. though additional management measures may be proposed to mitigate against the possibility of *Tectaria devexa* being identified during the clearing process.

Pneumatopteris truncata

Pneumatopteris truncata is known from two sites at Christmas Island (Department of National Parks 2016). Neither location is within the assessment areas, which all occur within regrowth closed canopy evergreen forest, excepting one site which is on the boundary of evergreen and semi-deciduous forest. *Pneumatopteris truncata* grows in permanently moist sites in semi-deciduous closed forest. Due to the small number of known populations, its habitat requirements are not known.

This species has not been in flora surveys and is unlikely to be present. The likelihood of *Pneumatopteris truncata* being impacted by clearing within the assessment areas is **negligible** due to the areas occurring on the plateau in mining regrowth.

Bruguiera gymnorhiza, B. sexangula

Bruguiera gymnorhiza and *B. sexangula* are mangrove species which on Christmas Island grow in relict populations on the terrace, isolated from the shore by a series of geological upthrusts. These species do not occur on the plateau and there is **no risk** of impact to these species by a proposal within the assessment areas.

2.5.5 Introduced flora

Christmas Island was first settled in 1888 and with settlement came the introduction of many food, fodder and ornamental plants. Many species were also introduced to the Island incidentally as there were no quarantine measures in the early days of settlement. Rubber bearing trees were planted on the Island shortly after settlement with the intention of developing a rubber industry and immigrants from the tropics brought with them many exotic tropical rainforest species which have now become environmental weeds. Several introduced species were used to rehabilitate old mining areas, with numerous approaches to rehabilitation throughout the Island's history. Christmas Island is now home to more than 177 species of introduced flora and these are widespread throughout the Island. Species such as pawpaw, guava and chilli can be found growing wild in the rainforest.

In an approach endorsed by the Commonwealth, the CIP Weed Management Plan focuses on the following 23 'Priority' weed species which have the potential to invade undisturbed rainforest or to cause quarantine issues and for which there is a reasonable prospect of successful management:

1. **Adenanthera pavonia* (red bead tree)
2. **Aleurites moluccana* var. *moluccana* (candlenut)
3. **Antigonon leptopus* (coral vine)
4. **Castilla elastica* (panama rubber)
5. **Ceiba pentandra (*kapok)
6. **Chromolaena odorata* (Siam weed)
7. **Clausena excavata* (false curry leaf)
8. **Delonix regia* (poinciana/flame tree)
9. **Ficus elastica* (Indian rubber tree)
10. **Hevea brasiliensis* (para rubber tree)
11. **Jatropha curcas* (physic nut)
12. **Manihot glaziovii* (Ceara rubber)
13. **Mucuna albertisii* (D'Albertis' creeper)
14. **Parthenium hysterophorus* (parthenium weed)
15. **Piper aduncum* (spiked pepper)
16. **Pithecellobium dulce* (Madras thorn)
17. **Pterocarpus indicus* (angsana)
18. **Ricinus communis* (castor oil plant)
19. **Schefflera actinophylla* (umbrella tree)
20. **Spathodea campanulata* (African tulip tree)
21. **Syzygium cumini* (Java plum)
22. **Syzygium grande* (sea apple)
23. **Syzygium jambos* (rose apple)

Parks Australia Island Wide Survey results indicate that the following Priority weed species are found within and around the assessment areas (Department of National Parks 2016):

- **Aleurites moluccana* var. *moluccana*
- **Castilla elastica*
- **Clausena excavata*
- **Delonix regia*
- **Spathodea campanulata*
- **Syzygium* sp.

Previous vegetation mapping undertaken in 2010-2011 did not comprehensively assess introduced flora but the following species were recorded:

- **Aleurites moluccana* var. *moluccana* (candlenut)
- **Calopogonium caeruleum* (caeruleum calopo)
- **Capsicum frutescens* (chili)
- **Carica papaya* (paw paw)
- **Cordia curassavica* (black sage)
- **Leucaena leucocephala* (coffee bush)
- **Melia azedarach* (Cape lilac)
- **Muntingia calabura* (Jamaican cherry)
- **Psidium guajava* (guava)
- **Tecoma stans* (yellow bells)

2.6 Fauna

2.6.1 Land Crabs

Christmas Island is noted for its land crab populations, including the conservation significant Christmas Island blue crab (*Discoplax celeste*), Christmas Island red crab (*Gecarcoidea natalis*) and robber crab (*Birgus latro*) (Director of National Parks 2014b). There are approximately 40-100 million red crabs on the Island and they are considered a keystone species (Director of National Parks 2014a). Red crabs alter seedling recruitment through selective herbivory and are the principle agent of organic matter turnover and incorporation into the soil. Crab activity is a key feature of water and nutrient availability in the subsoil, with red crab burrows also providing a preferred pathway for water drainage into the soil (Hollingsworth 2003).

A study was undertaken of the routes red crabs take during the migration by Adamczewska and Morris (2001), however it focussed on the north-east area of the Island. The study found that crabs generally walk in a straight line to the ocean, preferring to walk to the north-west coast rather than the nearest coast. No studies have been undertaken of migration routes in the central plateau, or if they have, they have not been made public. The existing maps of "red crab migration routes" available from Geoscience Australia in the CIGIS, appear to be interpolations based on watershed maps.

The assessment areas do not contain habitat for blue crabs, which occupy wetland areas on the terraces, but red crabs and robber crabs both occupy the plateau vegetation.

2.6.2 Birds

Christmas Island has 14 species of breeding land birds, and nine regular breeding seabirds with at least 108 vagrant or migrant bird species (Director of National Parks 2014b, James and McAllen 2014). Christmas Island is of international conservation significance as a seabird rookery and because many of its bird species are endemic, with seven endemic land bird taxa (three species and four subspecies) and four endemic seabird taxa (three species and one subspecies) (James and McAllen 2014). The endangered and endemic Abbott's booby now occurs only on Christmas Island (an example of paleo-endemism), and nests on tall emergent trees of the western and southern plateau rainforest (Director of National Parks 2014b). The other three endemic seabirds are the great frigatebird (*Fregata minor*), Christmas Island frigatebird (*Fregata andrewsi*) and the white-tailed tropicbird or golden bosun (*Phaethon lepturus fulvus*) (Director of National Parks 2014b, James and McAllen 2014). The red-footed booby (*Sula sula*) is the most numerous of the Island's seabirds which nests in tree colonies on the shore and inland terrace, and the brown booby (*Sula leucogaster*) nests on the ground at the edge of the sea cliff and inland cliffs (Director of National Parks 2014b). Other important seabirds breeding on Christmas Island include the red-tailed tropicbird (*Phaethon rubricauda*), lesser frigatebird (*Fregata ariel*), and common noddy (*Anous stolidus*) (Director of National Parks 2014b).

Land based bird species include the Christmas Island swiftlet (*Collocalia linchi natalis*) which nests in caves or overhangs, the Christmas Island imperial pigeon feeds mainly on fruits from the rainforest and settled areas, the emerald dove, Christmas Island white-eye and thrush, and the Christmas Island hawk-owl and goshawk which feed on small mammals, birds, reptiles and invertebrates (Director of National Parks 2014b). The resident bird fauna includes a number introduced species (including the Nankeen kestrel (*Falco cenchroides*) and the white-faced heron (*Egretta novaehollandiae*) self-established from Australia since settlement and utilise open habitats created by vegetation clearing (Director of National Parks 2014b).

Parks Australia's Island Wide Survey results indicate that the following bird species may be encountered in and around the assessment areas (Department of National Parks 2016):

- Abbott's booby
- Christmas Island goshawk
- Golden bosun
- Christmas Island thrush
- Christmas Island white-eye
- Christmas Island imperial pigeon
- Christmas Island emerald dove

The Christmas Island hawk-owl has been recorded within 300 m pf the assessment areas, though they do occupy the plateau vegetation (Department of National Parks 2016).

2.6.3 Mammals

Christmas Island was home to five native mammal species, including three endemic species, and several introduced mammals (cats, two species of rat, and mice; dogs, formerly introduced, have been eradicated from the Island). The two native rat species are declared Extinct and it is highly likely that the Endangered shrew and Critically Endangered pipistrelle bat are extinct, leaving the Critically Endangered flying fox as the only native mammal species on the Island (Director of National Parks 2014b).

Native mammal and reptilian fauna have suffered population decline, and in some cases extinction, since settlement and there have been several exotic reptiles and mammals introduced. Introduced fauna are considered likely responsible for the demise of the Island's native reptiles and mammals.

The Christmas Island flying fox is the only native mammal which might be encountered on Christmas Island, however, these occupy known roosts and only utilise other locations for foraging. Few flying foxes have been recorded near the assessment areas (Department of National Parks 2016).

2.6.4 Reptiles

There were six native reptile species on Christmas Island, of which five were endemic (Director of National Parks 2014b). Another five species are introduced reptiles (Smith, et al. 2012), and there are two marine turtles that breed on the Island. The populations of all native terrestrial reptiles, with the possible exception of the Endangered giant gecko, have declined (Smith, et al. 2012, Woinarski, et al. 2016, Andrew, et al. 2016), with the forest skink being declared Extinct and the Critically Endangered Lister's gecko and blue-tailed skink considered extinct in the wild. The coastal skink no longer occurs on Christmas Island but occurs elsewhere in the tropics. The Christmas Island blind snake, listed as Vulnerable, is an elusive, subterranean species which has only been located sporadically.

The giant gecko is the only native reptile whose current known range includes the plateau vegetation (Department of National Parks 2016). Range to Reef undertook distance sampling surveys for the Christmas Island giant gecko (*Cyrtodactylus sadleiri*) in 2016 over Unallocated Crown Lands and reference sites in the National Park. From these surveys an Island wide population estimate was calculated, and distribution and abundance patterns investigated. The results of this work are in the process of being published. Key learnings are that the Island wide population is significant, estimated at approximately 159,000 geckos, however status (i.e. increasing, decreasing, stable) would require further surveys. There were clear patterns in abundance observed with highest numbers in the 'north-east', lowest numbers in the 'west', and moderate numbers across the 'south-east' and 'central' zones) (R2R, unpublished).

2.6.5 Invertebrates

The inventory of the Island's invertebrate fauna is incomplete however 20 terrestrial and intertidal crabs (of which 13 are regarded as true land crabs depending on the ocean only for their larval development), one freshwater prawn, 14 snails, several butterflies, some 70 moths, 90 beetles, 30 spiders, one scorpion, five false scorpions and one amblypygid have been described (Environment Australia 2002). Most of the described terrestrial invertebrates also occur in adjacent tropical areas of south-east Asia

(Environment Australia 2002). There are many introduced terrestrial invertebrate species, including honeybees, one centipede, one cockroach, two termites, four fruit flies, several spiders, one snail, and the Yellow Crazy Ant (*Anoplolepis gracilipes*), whose supercolonies throughout the Island have major adverse implications for the management of the Christmas Island ecosystem (Environment Australia 2002).

2.6.6 Conservation significant fauna

The Draft Christmas Island Biodiversity Conservation Plan (Director of National Parks 2014b) lists five criteria for determining the significance of fauna on the Island and identified 22 fauna species as significant (Table 5). For the purposes of the plan, a significant species was defined as a native terrestrial species which meets one or more of the following criteria:

1. A species listed (or under consideration for listing) as threatened under the EPBC Act.
2. A species with an important or 'keystone' role in maintaining the Island's ecology or which characterises a significant ecosystem.
3. Species which are of conservation concern (those which have a substantial decline on Christmas Island) but not listed as threatened.
4. An endemic vertebrate.
5. A species of international conservation significance with strong community support for its conservation.

Of these, four are thought to be extinct (the Christmas Island shrew, Christmas Island pipistrelle bat, forest skink and coastal skink) and two are considered extinct in the wild (Lister's gecko and the blue-tailed skink). The Christmas Island blind snake has not been seen since 2012. Many of the Island's conservation significant forest bird species are habitat generalists and are likely to forage in the assessment areas but are unlikely to be dependent on these areas. The Christmas Island flying fox may also forage in the assessment areas but its known roost sites are elsewhere. Land crabs and forest birds are still abundant on Christmas Island but some seabirds rely on the Island for nesting habitat and are not known to nest elsewhere.

A detailed risk assessment of conservation significant fauna species is included in Section 4. The risk assessment suggested that two species, Abbott's booby and red crabs, were the most likely to be impacted by clearing within the survey areas. Further information about Abbott's booby and red crabs is outlined below.

There are several significant threats to the integrity and sustainability of ecological processes on Christmas Island. These threats include the yellow crazy ant; common wolf snake and Asian house gecko; cats, rats and mice; introduced birds; weed species; and potentially long-term climate change (Director of National Parks 2014b, Beeton, et al. 2009).

Table 5. Terrestrial Fauna species of Christmas Island identified as significant by the draft Biodiversity Conservation Plan

Species		Criteria	EPBC/IUCN Status[1]
Seabirds			
Fregata §*andrewsi*	Christmas Island frigatebird	1,4	Endangered; Marine; Migratory (CAMBA)/Critically Endangered
Papasula abbotti	Abbott's booby	1,4	Endangered; Marine/Endangered
Phaethon lepturus §*fulvus*	golden bosun, white-tailed tropicbird	4	Endangered; Marine/Not Assessed
Forest birds			
Accipiter hiogaster §*natalis*	Christmas Island goshawk	1,4	Endangered/Not Assessed
Chalcophaps indica §*natalis*	Christmas Island emerald dove	1,4	Endangered/Not Assessed
Collocalia linchi §*natalis*	Christmas Island swiftlet	4	Not Listed/Not Assessed
Ducula §*whartoni*	Christmas Island imperial pigeon	2,4	Not Listed/Near Threatened
Ninox §*natalis*	Christmas Island hawk-owl	1,4	Vulnerable/Vulnerable
Turdus poliocephalus §*erythropleurus*	Christmas Island thrush	1,4	Endangered/Not Assessed (locally abundant)
Zosterops §*natalis*	Christmas Island white-eye	2,4	Not Listed/Near Threatened (locally abundant)
Mammals			
Crocidura §*trichura*	Christmas Island shrew	1,4	Endangered/Critically Endangered (considered extinct)
Pipistrellus §*murrayi*	Christmas Island pipistrelle	1,4	Critically Endangered/Extinct
Pteropus melanotus §*natalis2*	Christmas Island flying-fox	1,2,4	Critically Endangered/Vulnerable
Reptiles			
Cryptoblepharus §*egeriae*	blue-tailed skink	1,4	Critically Endangered/Extinct in the Wild
Cyrtodactylus §*sadleiri*	giant gecko	1,4	Endangered/Endangered (locally abundant)
Emoia atrocostata	coastal skink	3	Not Listed/Not Assessed (locally extinct)
Emoia §*nativitatis*	forest skink	1,4	Critically Endangered/Extinct
Lepidodactylus §*listeri*	Lister's gecko	1,4	Critically Endangered/Extinct in the Wild
Ramphotyphlops §*exocoeti*	Christmas Island blind snake	1,4	Vulnerable/Endangered (status unknown)
Land crabs			
Birgus latro	robber crab	5	Not Listed/Data Deficient (locally abundant)
Discoplax §*celeste*	Christmas Island blue crab	2	Not Listed/Not Assessed
Gecarcoidea §*natalis*	Christmas Island red crab	2,3,5	Not Listed/Not Assessed (locally abundant)

[1] EPBC and IUCN conservation categories are defined in Appendix D

[2]Taxonomy indeterminate, currently listed as *P. melanotus* (Department of the Environment and Energy 2017)

Sources: Director of National Parks (2014b)*, Department of the Environment and Energy Species Profile and Threats Database* (2017)*, IUCN Red List of Threatened Species* (2017)

Table 6. Conservation significant fauna and likelihood of occurrence of in the assessment areas.

Species	Status	Description	Distribution, Habitat and Likelihood of Occurrence
Birds			
Papasula abbotti Abbott's booby	En Listed Marine	A large sea bird about 80 cm from beak to tail, with off-white plumage; black panda-like eye patches; black wings, flank marks and tails; and black outer ends to its blue webbed feet. Males have pale grey bills, tipped black and females have black-tipped pink bills (Pizzey and Knight 1997).	Tall rainforest of the Island is the only remaining breeding habitat of the Abbott's booby (*Papasula abbotti*) which is listed as Endangered under the EPBC Act 1999. Abbott's booby is a marine species. It spends much of its time at sea and builds nests in tall rainforest trees primarily in the western, central and northern portions of Christmas Island. Most nest trees are associated with uneven terrain created by gullies, hill-sides or cliffs and are located in uneven canopy containing emergent trees. It prefers nest sites with a clear area below and immediately downwind to facilitate take-off and landing. South-east trade winds prevail between April and November, thus emergent trees which can be approached from the north-west are most often used as nest sites (Director of National Parks 2014b). Nest sites for Abbott's booby have been mapped by helicopter and Island wide surveys, and R2R undertook ground surveys in 2017 to ensure accurate data on location of nest trees. No nest sites occur within the assessment areas. Some blocks proposed for clearing may be near nesting sites for the Abbott's booby, but there will be no clearing of primary rainforest and surveys have confirmed that no Abbott's booby nest sites occur in these areas. Therefore, Abbott's booby is **absent** from the clearing areas.
Chalcophaps indica natalis Christmas Island emerald dove	En	A small pigeon about 23 to 26 cm long, with a mass of about 80 to 135 g. It is mostly purplish-brown or red-brown with iridescent dark-green wings, dark brown irides, an orange bill (with a darker base) and red or purple-red legs and feet. The male differs from the female in having a grey crown, white forehead, white stripe above each eye, narrow white line across each shoulder, and dark grey (rather than red-brown) lower back, rump and tail (Department of the Environment and Energy 2017).	The Christmas Island emerald dove is endemic to Christmas Island, where it is widespread and common in areas of rainforest. It is estimated that more than 60% of the population occurs within the boundaries of the National Park. It is most common in tall closed evergreen rainforest and open semi-deciduous rainforest, especially on the terraces that surround the central plateau of the Island, but is also regularly observed in deciduous scrub, disturbed vegetation such as thickets of weeds and secondary regrowth (including areas dominated by **Muntingia calabura*), and settled areas (on lawns, in gardens and around houses), and on forest tracks (Department of the Environment and Energy 2017). It is **likely** that the Christmas Island emerald dove will be present in areas proposed for clearing.
Fregata andrewsi Christmas Island frigatebird	En	A very large seabird with a mainly black body, a glossy green sheen to the feathers of its head and back, and varying patches of white on the underbody. It has slender, long wings, a deeply forked tail and a long bill with a hooked tip. Its legs are dull pink, and its feet are black above with pale soles. Adult males have a large, red gular (throat) pouch which can be inflated (Department of the Environment and Energy 2017).	The Christmas Island frigatebird is a pelagic, marine species that frequents tropical waters of the Indian Ocean. Breeding colonies are currently confined to shore terraces of Christmas Island. The three recorded breeding colonies are known as the golf course, cemetery and dryers colonies. The EPBC listing for the species was upgraded from Vulnerable to Endangered in December 2016 due to declines in range and population size. Clearing **will not affect any breeding habitat** and it is **unlikely** that the Christmas Island frigatebird would be present in the proposed clearing areas.
Accipiter hiogaster natalis Christmas Island goshawk	En	A large hawk with a dark grey head and upperparts, mostly rufous underparts with fine and sometimes almost imperceptible white barring, yellow irides, yellow eyelids, greenish-yellow cere, yellow legs and feet and black talons. Females are larger than	The Christmas Island goshawk is an endemic, territorial resident of Christmas Island. It occurs in all forest types on the Island, but is commonly seen in secondary forest, settlements or rehabilitated habitat. The Christmas Island goshawk nests in tall trees in forest patches of more than 1.5 ha in area. Its nest sites are often near cleared land, possibly because these sites

		males and the throat of the female has a rufous-brown wash while the throat of the male is white with grey spots. Adults weigh from 200-490 g and are around 40 cm length. The Christmas Island goshawk feeds on large insects, small birds, mammals and reptiles (Department of the Environment and Energy 2017).	provide better visibility and access to food (Department of the Environment and Energy 2017). Primary and Marginal Rainforest have been identified as critical habitat for the species and it is understood that regrowth vegetation may also be critical habitat for the species, though the quality of regrowth necessary has not yet been identified (Hill, National Recovery Plan for the Christmas Island Goshawk Accipiter fasciatus natalis 2004a). It is possible that the Christmas Island goshawk will be present in the assessment areas but these areas area unlikely to be significant habitat or used for nesting.
Ninox natalis Christmas Island hawk-owl	Vu	A small owl is about the size of a common pigeon (26 to 29 cm and weighing approximately 140 to 210 g) but with a barred breast. It has an unmistakeable boo-book call. Unlike other raptors, including many owls, there is little difference in size between males and females with females being only slightly larger than the male. The hawk-owl feeds mainly on large insects and sometimes on small vertebrates. It is nocturnal, feeding mainly in the understorey of primary forest, or in secondary vegetation along roadsides (Department of the Environment and Energy 2017).	This species is confined to Christmas Island in the Indian Ocean. This species occupies permanent territories in all forest types on the Island, with highest densities in primary forest and lowest in post-mining regrowth. Breeding does not occur in secondary growth because trees there are not old enough to have developed hollows. Habitat critical to the survival of the Christmas Island hawk-owl is defined as all Primary and Marginal rainforest, and all secondary growth rainforest that provides suitable habitat. Suitable secondary growth forest has not been identified (Hill 2004b). It is possible that the Christmas Island hawk-owl will forage in the assessment areas but these areas are unlikely to be significant habitat or used as nesting.
Turdus poliocephalus erythropleurus Christmas Island thrush	En	A subspecies of Island thrush, 21 to 22 cm long, with a mass of 44 to 68 g. It has brown to dark-grey upperparts, a white chin and throat, a grey-brown to grey breast, dull orange flanks, and a belly that is dull orange on the sides and white in the centre. It has dark brown irides, a prominent ring of yellow to orange-yellow skin around each eye, a yellow to orange bill, and yellow to orange-yellow legs and feet (Department of the Environment and Energy 2017).	The Island thrush (Christmas Island) is endemic to and common in most habitats on Christmas Island, including tall closed evergreen rainforest, open semi-deciduous rainforest, secondary regrowth, thickets of weeds and semi-deciduous vines, settled areas (where it forages on lawns and nests on buildings), and on the Christmas Island golf course. It is most common in tall closed evergreen rainforest and open semi-deciduous rainforest on the coastal and higher terraces and plateau of Christmas Island. It is least common in disturbed habitats (such as urban areas, regrowth and post-mining wasteland) and in suboptimal endemic vegetation such as thickets of *Pandanus* and patches of low vegetation in coastal areas (Department of the Environment and Energy 2017). No habitat has been identified as critical to the subspecies (Director of National Parks 2014b). It is likely that the Christmas Island thrush will be present in the assessment areas as it is a habitat generalist occurring in numerous of the Island's habitats and commonly found in disturbed habitats.
Phaethon lepturus fulvus White-tailed tropicbird/golden bosunbird	En	A medium sized, whitish-golden seabird with long central tail-feathers and a yellow bill and black wing-bars on its upper wings. The Christmas Island white-tailed tropicbird is considered to be a subspecies of the more widespread *Phaethon lepturus lepturus* which lacks the golden colouring, but the colour of the Christmas Island variant is variable and there is some dispute over whether it is a separate subspecies (Department of the Environment and Energy 2017).	The golden bosun is a poorly censused seabird endemic to Christmas Island where it breeds exclusively, nesting in cliffs and occasionally tree hollows. Widely distributed across the Island but listed in late 2014 as Endangered due to its restricted area of occupancy in which there is a suspected decline in the number of mature individuals, due to a range of threats (primarily predation by invasive species). It is considered unlikely that any white-tailed tropicbirds will be present in the assessment areas, which are in less mature regrowth which is unlikely to have developed hollows suitable for nesting.
Collocalia linchi natalis Christmas Island swiftlet	Not listed	A small, glossy, black bird (9-11 cm long), dark grey below, with a prominent white abdominal patch (TSSC 2005).	The CI swiftlet is endemic to Christmas Island where it nests primarily deep in caves in inland limestone cliffs (TSSC 2005). They feed over most habitats on Christmas Island (TSSC 2005).

			The species is very unlikely to descend into the forest to obtain food and hence is likely to be **absent** from the assessment areas, though they may feed in the air above the road.
Ducula whartoni Christmas Island imperial pigeon	Not listed	A large (39 cm), grey-black pigeon with a purplish, greenish or reddish-brown iridescent sheen on the upperparts and breast. Males and females are similar (IUCN 2017).	Endemic to Christmas Island, the CI imperial pigeon inhabits both rainforest and regrowth vegetation with a preference for feeding on the fruit of the introduced Jamaican cherry **Muntingia calabura* (TSSC 2006). The CI pigeon is **likely** to be present in the assessment areas, which contains the introduced Jamaican cherry which is a food source.
Zosterops natalis Christmas Island white-eye	Not listed	A small, greenish bird with a distinctive white ring around the eye (TSSC 2009).	Endemic to Christmas Island, the CI white-eye can now also be found in the Cocos Keeling Islands (TSSC 2009). The CI white-eye utilises all areas of the Island (TSSC 2009) and is commonly found in secondary and disturbed habitats so is **likely** to be in the assessment areas.
Mammals			
Crocidura attenuata trichura Christmas Island shrew	En	A small mouse-like, insectivorous mammal with a distinctly pointed muzzle, short legs and reddish-brown to dark slate grey colouring. It weighs between 4.5 and 6 g (Department of the Environment and Energy 2017).	The Christmas Island shrew was widespread prior to the 1900s in rainforest extending from shoreline to plateau and endemic to Christmas Island (Andrews 1900). The last observations of the species in 1985 were on the western portion of the Island but no confirmed sightings occurred from 1908 to 1985, indicating that the species is elusive and may be extinct (TSSC 2016). Evergreen tall closed forest and semi-deciduous closed forest are considered to be critical habitat for the species, should any individuals remain. It is considered **unlikely** that any individuals of the Christmas Island shrew occur in the assessment areas due the likelihood that this species is extinct.
Pipistrellus murrayi Christmas Island pipistrelle	Cr	A small insectivorous bat with dark brown fur, and at 3-4.5 g is Australia's smallest species of bat. The Christmas Island pipistrelle is an edge specialist where it forages nocturnally on a variety of flying insects, in particular moths and beetles (Department of the Environment and Energy 2017).	Thought to be extinct since 2009, the Christmas Island pipistrelle was once common in primary and secondary rainforest and endemic to Christmas Island. The last observations of the species were on the western portion of the Island (TSSC 2016). The pipistrelle roosted under loose bark, dead fronds of palm and *Pandanus*, hollows in large live trees and under strangler figs. Both primary rainforest and regrowth vegetation are considered to be critical habitat for the species, should any individuals remain. It is considered **unlikely** that any individuals of the Christmas Island pipistrelle occur in the assessment areas due to the likelihood that this species is extinct.
Pteropus melanotus natalis Christmas Island flying fox	Cr	The Christmas Island flying fox is small, compared to most Australian *Pteropus* species, weighing on average 350 g when fully grown (Department of the Environment and Energy 2017). The subspecies is described as having uniformly long, black fur, giving a 'chubby' appearance. A faint reddish collar of fur exists on some individuals. The subspecies forages during the day as well as at night (Department of the Environment and Energy 2017).	The Christmas Island flying fox is endemic to Christmas Island. Three major roost sites are known and the entire Island is used for foraging, with suitable fruit and nectar being found in most vegetation types. All recorded roosts have been located on the coastal terrace or around the first land cliff and semi-deciduous forest. All previously uncleared vegetation is considered critical foraging habitat. Mined areas are not considered critical habitat for this species. It is **unlikely** that the Christmas Island flying fox will be present in the assessment areas given that these areas are not known roost sites.
Reptiles			
Ramphotyphlops exocoeti	Vu	A brown snake growing to 35 cm, with a pale brown belly, rounded snout, scales in 20 rows at mid-body and an oval scale at the tip of the snout (Department of the Environment and	The Christmas Island blind snake is endemic to Christmas Island. The few records with information on locality or habitat suggest that this species occurs primarily where the deeper soils and primary rainforests occur on the Island's central plateau. The Christmas Island blind

Christmas Island blind snake		Energy 2017). The Christmas Island blind snake almost certainly preys on the eggs, larvae and pupae of ants and termites.	snake is a fossorial snake found in the sub-surface soil and surface litter of the forest floor. It is usually active on the surface only at night (Department of the Environment and Energy 2017). No specimens have been found since 2009 so it is considered **unlikely** that the species will occur in the assessment areas.
Lepidodactylus listeri Lister's gecko	Cr	A brown reptile growing to 5 cm with a broad, pale fawn/grey vertebral stripe which expands to cover the top of the head and matches the colour and pattern of the tail, scattered darker-brown flecks/blotches on the back, whitish belly and body covered with small, smooth scales. Eats a broad spectrum of small invertebrates, with termites, small beetles, bugs and slaters predominating (Department of the Environment and Energy 2017).	Endemic to Christmas Island, where it has been found to be most abundant on the plateau area. Lister's gecko is least abundant on terraces and absent from mined areas. It does not utilise areas revegetated after mining activities (Department of the Environment and Energy 2017) so it is considered **unlikely** that the species will occur in the assessment areas.
Emoia nativitatis Christmas Island forest skink	Cr	A moderately robust skink around 80 mm in length (snout to vent) and 10 g in weight. Rich metallic-brown colour, paler on flanks with numerous irregularly scattered paler and darker scales (Department of the Environment and Energy 2017).	Thought to be extinct since the last three died in captivity in 2014 (Woinarski, et al. 2016). The forest skink was also recorded as widespread across Christmas Island in the early 1980s (Cogger and Sadlier 1981). Like the blue-tailed skink, the forest skink's distribution contracted in the years that followed, until the last known individual was collected from Egeria Point in 2010 (Smith, et al. 2012). Extensive biennial surveying by PANCI has failed to detect any individuals, and while a captive breeding population was established in 2009 (Director of National Parks 2014b), the last individual of that population died in 2014 (Andrew, et al. 2016). It is considered **unlikely** that any individuals of the forest skink occur in the assessment areas due to the likelihood that this species is extinct.
Emoia atrocostata atrocostata Christmas Island coastal skink, mangrove skink	Not listed	A moderately robust skink from 57-98 mm in length (snout to vent). Females are somewhat smaller than males. Greyish-green to tan dorsal colour with a sometimes indistinct blackish band along the upper lateral surface (Brown 1991).	The Christmas Island coastal skink is not listed under the EPBC Act as the Island's population was not considered a valid subspecies (TSSC 2013c). Elsewhere in its range, *Emoia atrocostata* inhabits beach and mangrove margins (Brown 1991). The species is now considered to be locally extinct (Andrew, et al. 2016). It is considered **unlikely** that any individuals of the Christmas Island coastal skink occur in the assessment areas due to the likelihood that this species is locally extinct.
Cryptoblepharus egeriae Christmas Island blue-tailed skink	Cr	A small, slender skink around 40-50 mm in length (snout to vent) with a brown-black coloured body and a distinctive bright blue tail which may be shed to distract predators (Department of the Environment and Energy 2017).	Extinct in the wild, but a number of individuals are held in a captive breeding program by Department of National Parks. The blue-tailed skink was recognised as extremely common, even in the town site, as recently as 1979 (Cogger, et al. 1983, Smith, et al. 2012). However, from approximately the late 1980s the species contracted westwards, and by 2008 it was known to occur in only two locations; Egeria Point and North-west Point (Schulz and Barker 2008). It has since disappeared from both these locations and no wild populations are currently known to occur (Director of National Parks 2014b, TSSC 2013a). It is considered **unlikely** that any individuals of the blue-tailed skink occur in the assessment areas due to the likelihood that this species is extinct in the wild.
Cyrtodactylus sadleiri Giant gecko	En	A large gecko, around 8-10 cm from head to vent, with an average body weight of 15 g. The species is dark grey, brown or blackish in colour, flecked with a mixture of darker and lighter patches, with obscure paler bands across the dorsal side. It has	Endemic to Christmas Island. Found in all Island habitats, except for areas lacking trees and shrubs, including formerly mined areas with dense regrowth. Evergreen tall closed forest is considered critical habitat for this species (Director of National Parks 2014b). Numbers of giant geckos recorded during targeted surveys have markedly declined but given that the species

		a long slender tail with alternating cream and grey-brown bands. The giant gecko is a nocturnal predator of small invertebrates. (TSSC 2013b).	utilises revegetated mining areas, it is considered **possible** that the species may be present in the assessment areas but if so in relatively low numbers.
Crustaceans			
Gecarcoidea natalis Red crab	Not listed	A land crab with distinctive red colouring and an adult carapace measuring up to 11.6 cm across. Males are larger than females but females have a much broader abdomen and usually have smaller claws than males. Red crabs are diurnal and their diet consists mainly of fallen leaves, fruits, flowers and seedlings. They are not solely vegetarian and will eat other dead crabs, birds, the introduced giant African snail and palatable human refuse (Department of the Environment and Energy 2017).	Endemic to Christmas Island, the red crab is abundant but critical to the ecology of the Island (Director of National Parks 2014b). They are a keystone species in the forest ecology, influencing the structure and function of the rainforest by selectively consuming seeds and seedlings and leaf litter, turning over the soil and spreading seeds by burrowing, and fertilising soil with their droppings (Department of the Environment 2014). Habitat critical to their survival occurs throughout the whole Island (Director of National Parks 2014b). It is **likely** that the red crab will be present in the assessment areas.
Birgus latro Robber crab/coconut crab	Not listed	The largest terrestrial crustacean in the world with a weight of up to 4 kg and a leg span up to 1 m. The robber crab is related to the hermit crab but does not carry a shell. They are semi-nomadic and omnivorous, feeding on fruit, coconut, carrion and other crabs, including the red crab (Krieger, et al. 2012).	The robber crab is widespread on islands of the Pacific and Indian oceans. It has been extensively hunted for food. Christmas Island hosts the largest populations of the species and is significant as a sanctuary. The species is a habitat generalist and all areas of previously uncleared rainforest are considered critical to the species. All uncleared rainforest is considered critical habitat (Director of National Parks 2014b). It is considered **likely** that the species may be present in the assessment areas.
Discoplax celeste Blue crab	Not listed	A large crab with a deep and rounded carapace with a width of 45 mm or more. Adults are overall blue to bluish-white (Ng and Davie 2012).	Endemic to Christmas Island, with a restricted distribution in perennially wet/moist areas and seepages of the coastal terraces and below, though they may range further during the wet season. The species is considered to be of conservation significance because it characterises a significant ecosystem. All spring and wetland areas are considered critical habitat (Director of National Parks 2014b). The species will be **absent** from the assessment areas which are confined to the upper terraces.
Listed Migratory Species			
Fregata minor Great frigatebird	CAMBA JAMBA Listed Marine	A large sea bird. Males are an all-over glossy black with hints of brown on the wings, dull pink feet and a bright red gular sac. Females are larger than males differ in lacking the gular sac and have a white breast and pinkish bill and eye ring. Juveniles are similar to those of other frigate bird species and hence are not easy to differentiate (Pizzey and Knight 1997).	Inhabits tropical and subtropical seas, coastlines and islands, roosting in shrubs or trees. The great frigatebird breeds on small, remote tropical and sub-tropical islands, nesting in a platform of sticks in mangroves, shrubs or trees and occasionally on the ground. The species feeds primarily at sea, on the wing, with flying fish composing a large part of the bird's diet. The species is also known to take chicks of other species and will from time to time chase other birds, causing them to regurgitate, which the frigatebird will then eat (BirdLife International 2016a, Pizzey and Knight 1997). It is **unlikely** that the species will be present in the assessment areas which are confined to the upper terraces.
Phaethon rubricauda Red-tailed tropicbird	CAMBA JAMBA Listed Marine	A white seabird, sometimes with a pinkish sheen, with long red central tail-feathers and a red bill and black wing-bars on its upper wings. The Christmas Island white-tailed tropicbird is considered to be a subspecies of the more widespread *Phaethon lepturus lepturus* which lacks the golden colouring, but	Inhabits tropical and subtropical seas, coasts and islands, though its range extends to the seas of South Australia. Rarely found near land except at nest sites. Nesting occurs during most months in the tropics and nest sites are a scrape in shaded cavities in cliffs or under bushes near the shore (Pizzey and Knight 1997). It is **unlikely** that the species will be present in the assessment areas which are confined to the upper terraces.

		the colour of the Christmas Island variant is variable and there is some dispute over whether it is a separate subspecies (Department of the Environment and Energy 2017).	
Sula leucogaster Brown booby	CAMBA JAMBA ROKAMBA Listed Marine	A small member of the booby family, deep brown in colour on the back, upper breast, upper wing, head and throat, with white undersides. The iris may be cream, yellow, grey or deep brown. The bill is creamy-grey and males have a deep blue base (close to the head). There is little other difference between the sexes though female may be slightly larger. Legs and feet are yellow (Department of the Environment and Energy 2017).	Inhabits pantropical oceans and islands, nesting all year round in scrapes along the coast or cliffs and roosting on coral cays, buoys, trees and ships rigging. The species breeds colonially and roosts communally with other brown boobies or other species. At sea, the brown booby flies and feeds individually or in flocks. Diet is primarily flying fish and squid with prey caught on the wing or by plunge-diving (Birdlife International 2016c, Pizzey and Knight 1997, Department of the Environment and Energy 2017). It is **unlikely** that the species will be present in the assessment areas which are confined to the upper terraces.
Sula sula Red-footed booby	CAMBA JAMBA Listed Marine	A slender bird with conspicuous red feet, long tail and a bill that can be blackish to pale blue. The eye is grey to grey-green and skin around the eye can vary from dark grey to blue to purplish in colour. Plumage colouring is varied from white to ash brown with brown to black flight feathers. Females are slightly larger than males (Department of the Environment and Energy 2017).	Inhabits tropical seas, coastlines and islands, feeding on flying-fish and squid by plunge diving and will also take prey on the wing. Breeds throughout the year, nesting and roosting mainly in trees (BirdLife International 2016b, Pizzey and Knight 1997). It is **unlikely** that the species will be present in the assessment areas which are confined to the upper terraces.

*Likelihood of Occurrence:

Present – Observed within the block.
Likely – Suitable habitat present, species recently recorded in the region.
Possible – Suitable habitat present, limited species records in the region.
Unlikely – Absence of suitable habitat, known distribution outside the block.
Absent – Species recognised as Extinct (Ex/S2) or habitat completely incompatible (e.g. land vs sea).

Abbott's Booby

Abbott's booby (*Papasula abbotti*) formerly bred on many islands in the Indian and Pacific oceans but since the early 1900s is only known to breed on Christmas Island. Surveys in 1991 and 2002 indicate that the population is stable at approximately 2,500 breeding pairs.

The breeding cycle is approximately 504 days with breeding normally being biennial. Most eggs are laid between mid-May and mid-July and incubated for 55 days before hatching. This is followed by a 151-day fledging period and 230 days of post-fledging feeding (Nelson and Powell 1986). Most young take their first flight in December or January and during this period they are particularly at risk from clumsy landings (Nelson and Powell 1986). In the event of a failed landing, the young booby may fall below the canopy where they will starve. In any given period, breeding success averages between 26.5 and 33.3% (Nelson and Powell 1986).

Abbott's booby nests in tall rainforest trees, mostly in uneven canopy containing emergent trees. The nest of Abbott's booby is placed on branches 10 to 40 m above the ground. Nest sites are largely restricted to areas above 150 m elevation, mostly on the sides of northwest facing slopes that are not impacted by windshear. Several emergent tree species (including *Hernandia ovigera, Planchonella nitida*, *Syzygium nervosum*, *Tristiropsis acutangula* and *Celtis timorensis*) provide nesting sites for Abbott's booby. Nest sites on the lee side of slopes and gullies with a clear area below and immediately downwind to facilitate take-off and landing are preferred (Nelson and Powell 1986). Southeast trade winds prevail for eight to nine months of the year so emergent trees that can be approached from the northwest are frequently used. Most nests face north-west, which allows birds to land into the wind during the period when visits to the nest are most frequent (Nelson and Powell, The breeding ecology of Abbott's booby 1986). Nest trees are often associated with uneven terrain which provides variation in the canopy suitable for take-off and landing (Department of the Environment and Heritage, 2004).

Forested areas downwind of cleared areas suffer much greater wind turbulence in the canopy due to clearing of adjacent forested areas, which may result in decreased breeding success and increased adult and fledgling mortality (Department of the Environment, 2014). Turbulence will progressively diminish from the cleared area, over a distance of up to 300 m based on clearing of a nominal 30m forest canopy height (i.e. 10 times canopy height). It is not known at what stage wind turbulence upwind of clearings is ameliorated to such an extent that breeding success and survival of Abbott's booby is not compromised. Development of a wind turbulence model for Abbott's booby breeding habitat was proposed under the National Recovery Plan for the Abbott's booby (Department of the Environment and Heritage 2004) but the model has not yet been developed (Department of the Environment and Energy 2017).

Abbott's booby has a high fidelity to nest sites and may only relocate after multiple failed breeding cycles (Nelson and Powell, The breeding ecology of Abbott's booby 1986). With south-easterly trade winds prevailing for much of the year, nests to the north-west of clearings are at risk for nine months of the year. Rehabilitation of previously cleared mining areas adjacent to nest sites is considered to be a priority for the management of the species.

Parks Australia has 4,710 records of Abbott's booby at 2,227 discrete locations from 2009 to 2015 collected from a variety of surveys including a 2009 helicopter survey and 2011, 2013 and 2015 Island Wide Surveys. Of these records, 4,293 (91% of records and 89% of discrete locations) occurred within the Christmas Island National Park (Department of National Parks 2016).

Given the cessation of clearing of Primary Rainforest in the centre and west of the Island (the preferred nesting location for Abbott's booby) and retention of most of the current Abbott's habitat as National

Park, the current greatest threat to the Abbott's booby is the Yellow Crazy Ant due to the ant's effect on ecosystem function, and other invasive species (Director of National Parks 2014b).

Numerous records of Abbott's booby (Figure 10) occur in the area surrounding the assessment areas so a detailed field survey for Abbott's booby was undertaken as part of this assessment.

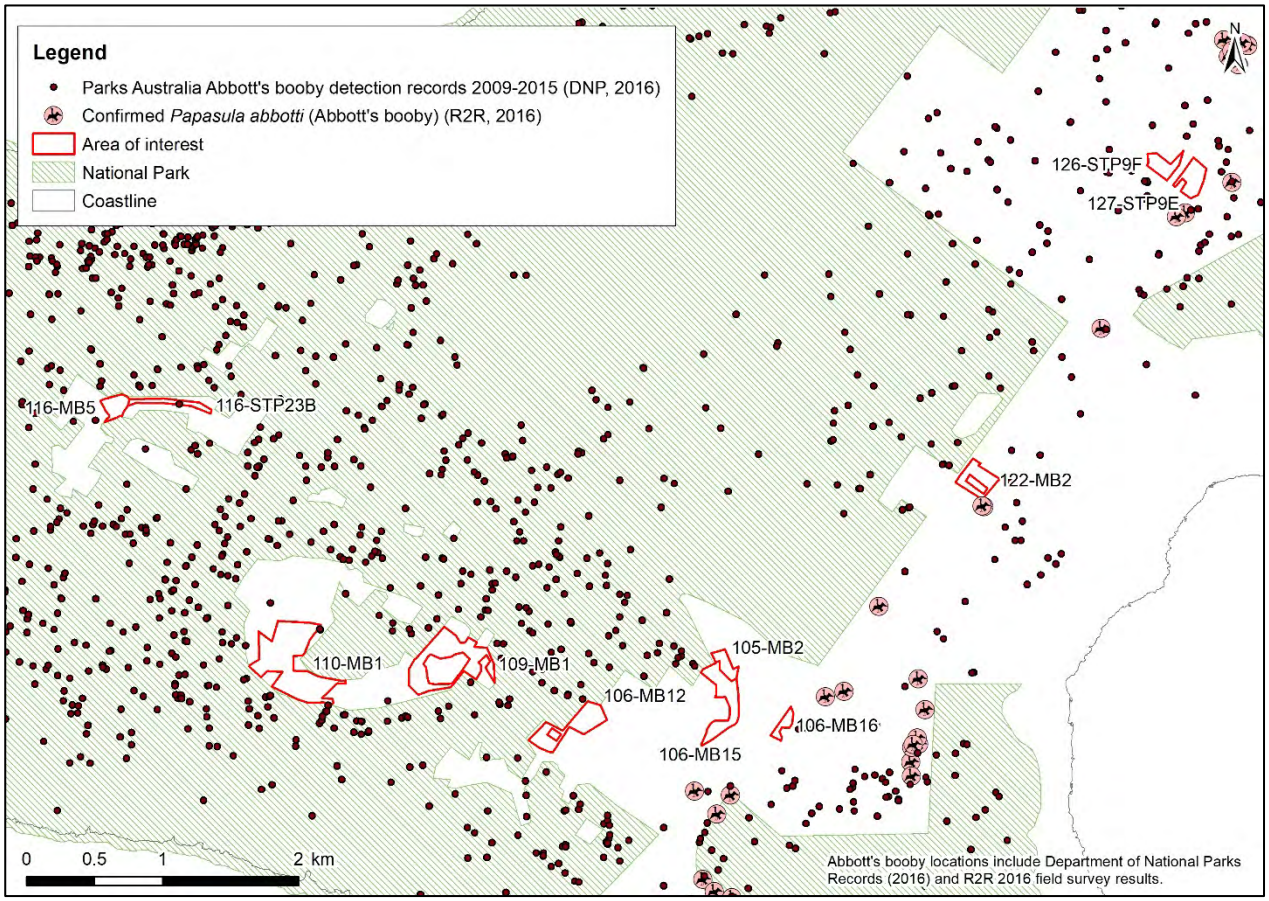

Figure 10. Abbott's booby detections in the central plateau

Source: Department of National Parks (2016)

Red Crabs

The red crab (*Gecarcoidea natalis*) is endemic to Christmas Island, though a small population exists on North Keeling Island where it is very rare and may have been accidentally introduced. Red crabs are widespread across Christmas Island and abundant, with population estimates ranging from 45 to 120 million (Director of National Parks 2014b). Adults are land dwelling but mass-migrate to the sea for breeding in one of the most striking events in the animal kingdom. Red crabs live in burrows and karst areas in forest and shaded areas, with the highest densities in closed canopy evergreen forest (Director of National Parks 2014b).

Habitat critical to their survival occurs across the whole Island (except for areas of land devoid of vegetation and/or soil such as bare mine fields and houses/buildings) and particularly includes previously uncleared rainforest vegetation (Director of National Parks 2014b).

Red crabs are considered to have a major role in the ecological functioning of the Island's forests. Red crabs are omnivorous, and a major portion of their diet is fruits, seeds, and seedlings as well as leaf litter. They influence the structure and function of the rainforest by selectively consuming seeds and seedlings

and leaf litter, turning over the soil and spreading seeds by burrowing, and fertilising soil with their droppings. Crabs also prey on the invasive giant African land snail. Where red crabs have been removed by crazy ants there has been a significant impact on the forest ecology (Director of National Parks 2014b).

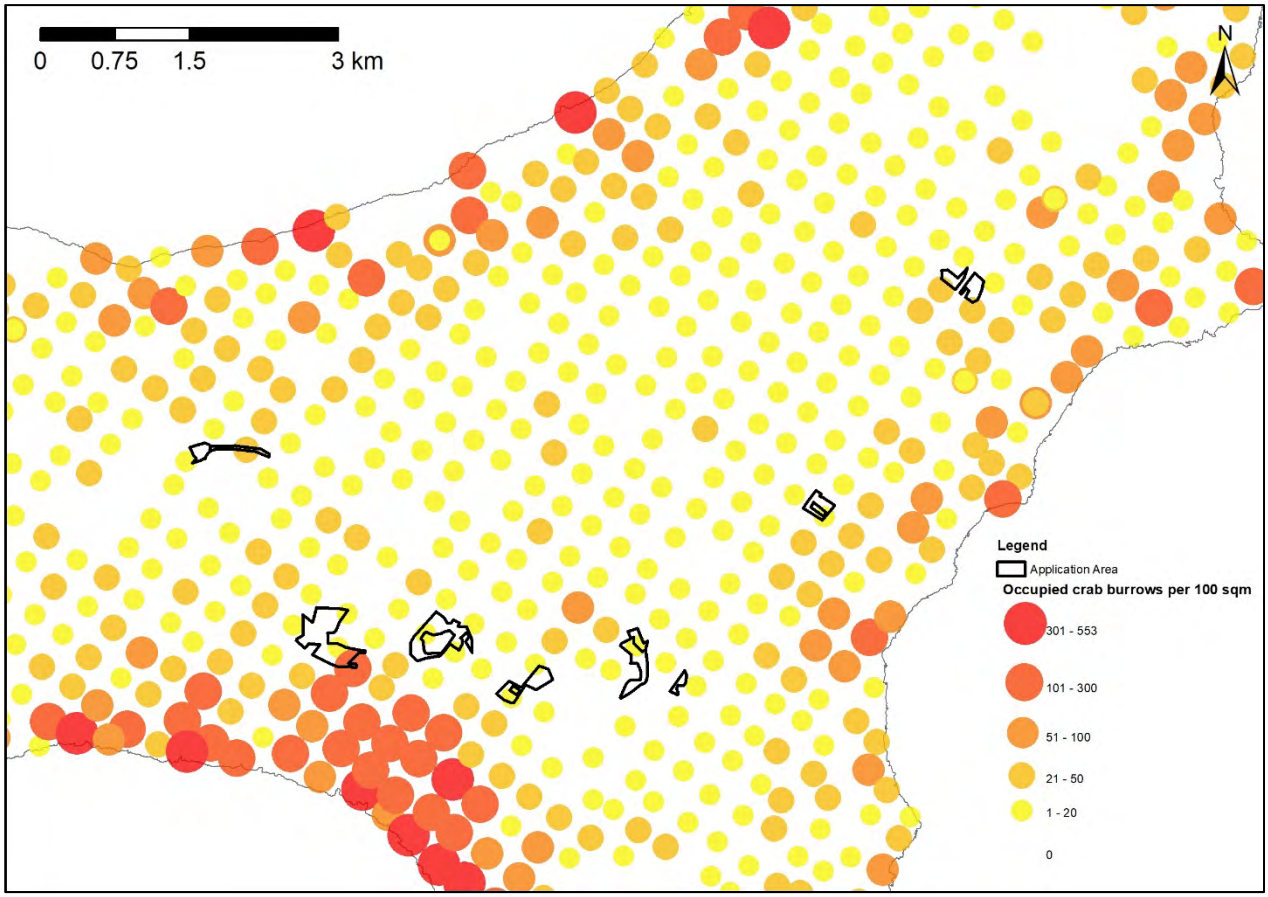

Figure 11. Red Crab Burrow Densities on Christmas Island

Source: Department of National Parks (2016)

3 Methods

A survey of the assessment areas and their surrounds was undertaken from 17-24 June 2017 during the dry season. There were two components to the survey; a flora and vegetation assessment within the assessment areas and a survey of Abbott's booby nests within 300 m downwind of the assessment areas.

Wet season surveys are not practical on Christmas Island as recommended by EPA (EPA 2016) for the Northern Botanical Province. During the monsoon, there is a higher likelihood of tree fall and the red crab migration and return also occur during the wet season, restricting vehicle access. Fruiting and flowering are often not seasonally dependant in the wet tropics so most species can be identified year round. Some species on Christmas Island are deciduous and dormant in the dry season but this is often an aid to identification rather than an impediment.

Abbott's booby begin nest construction in March and laying may occur at any time between April and October. Abbott's breed only once every two years at most so at any given time, a high proportion of birds will not be present at nest sites. Nest sites are understood to be most common along the crests of gullies and west-facing slopes. The DEWHA *Survey guidelines for Australia's threatened birds*

recommends 20 hours of land-based searching or transects be undertaken for Abbott's booby for sites up to 10 ha.

The flora and vegetation survey was undertaken by:

- Rachael Pratt (Environmental Consultant, Range to Reef), a botanist with 16 years' experience in flora and vegetation assessments including two field surveys on Christmas Island between 2014 and 2015 and three years' experience in data analysis and reporting relating to the flora and vegetation of Christmas Island;

The Abbott's booby survey was undertaken by:

- Jeff Turpin (Director, Kingfisher Environmental Consulting), a zoologist with 16 years' experience in fauna investigation design and implementation with specialisation in use of motion sensitive cameras, bird census and acoustic detectors;
- Sophie Arnall (Environmental Consultant, Range to Reef), a zoologist and PhD candidate with 7 years' experience in field survey work including seven trips to Christmas Island;

3.1 Flora and Vegetation Assessment

3.1.1 Desktop Assessment

A desktop assessment of the assessment areas was undertaken prior to commencing the risk assessment. The desktop assessment consisted of a review of existing contextual data, reports or surveys undertaken in the vicinity of the assessment areas. This included EPBC Act Protected Matters Search Tool (PMST) and Species Profile and Threats Database (SPRAT) searches, and Geoscience Australia (2014a) vegetation mapping. Previous surveys conducted on Christmas Island include:

- A flora survey carried out by Sinclair Knight Merz (SKM 1999) for the APSC project.
- Targeted Block 2 flora surveys undertaken by CIP environmental staff.
- Christmas Island Wide Survey (IWS) data conducted by Parks Australia (Parks) every 2 years (Department of National Parks 2016).
- Holmes & Holmes (2002) report; Conservation Status of the Flora of Christmas Island, Indian Ocean.
- A range of studies undertaken in 2002 for the EIS submission (Phosphate Resources Limited, EWL Sciences Pty Ltd and Tallegalla Consultants Pty Ltd 2005).
- A targeted fauna and flora survey undertaken by Range to Reef Environmental following submission of the South Point Referral in 2013 to provide additional information for the assessment process.
- A flora survey undertaken for CPS 6323/1 in 2014 by Range to Reef Environmental (Range to Reef Environmental 2014).
- Previous flora surveys of proposed clearing areas undertaken in 2010 and 2011 by Mark Bennett and CIP environmental staff.
- Extensive flora and fauna surveys undertaken by Range to Reef in 2016 (Range to Reef Environmental 2017).

Likelihood of presence of conservation significant species within assessment areas was estimated and the potential for significant impact to the species was examined.

Aerial photography (Geoscience Australia 2011a), Geoscience Australia (2014) vegetation mapping and 2010-2011 field data were examined to determine appropriate locations for survey sites.

The results of the desktop assessment were reported in Section 0 *Existing Environment*.

3.1.2 Field Survey

The field survey was undertaken from 18th to 23th June 2017, with 22 sites assessed over 62.8 ha. The survey was undertaken by Rachael Pratt, a botanist with >16 years' experience in flora and vegetation assessments including three years' experience in the flora of Christmas Island.

Quaternary (relevé) sites were assessed at a density of approximately one per 1-2 hectares of regrowth. A structural and floristic summary description was prepared for the area falling within a 25 m radius of each site (roughly equivalent to a 50x50 m quadrat). No quadrats were established due to access constraints, difficulty of carrying in pickets and difficulty in establishing a 50 m straight edge in rainforest vegetation. Height, cover and basal area data were collected for each strata and each species. Opportunistic sampling was undertaken during traverses.

Most flora species were identified in the field. Where the canopy was too high for a clear view of leaves, fruits or flowers, identification of large trees utilised Pentax 12x50 binoculars and bark characteristics. Indeterminate specimens were collected or photographed and identified on Christmas Island, using *Flora of Australia Volume 50 Oceanic Islands 2* (Du Puy, 1993) and *Native Plants of Christmas Island* (Claussen 2005). Site and species photographs were captured and geotagged using an Olympus digital camera.

The flora assessment methods utilized were compatible with those defined by the Western Australian Environmental Protection Authority (EPA 2016) and adopted aspects of Neldner *et al*. (2017) as applicable to tropical rainforest ecosystems in Queensland.

Table 7. Methods and tools

Measure	Methodology/Tool
Location	Garmin Monterra GPS (WGS84, Zone 48L).
Photographs	Three photographs were taken from the centre of each site, facing in different directions using an Olympus TG3 digital camera with GPS (degrees, minutes and digital seconds).
Landform and Landscape Position	Selected from: Plateau, Plateau Margin, Terrace, Pinnacles and Stockpile. Slope and aspect were visually estimated.
Height	Nikon clinometer.
Cover	Visual estimate.
Basal Area	Bitterlich stick method as described by Neldner et al. 2017, single sweep with a Basal Area factor of 1 (10 mm at 500 mm distance).
Vegetation Condition	Refer below.

Vegetation Condition

Site photographs and field data from 2010 and 2011 were compared to the vegetation condition assessment ratings developed for CPS6323/1 and a condition rating was assigned to each survey point. These points were mapped against Geoscience Australia vegetation mapping (2014a). Vegetation condition assessment was based on the condition rating scale developed by Keighery (1994) and described in Bush Forever (Government of Western Australia 2000) but adapted for use in the rainforest. The adapted scale examines regrowth development, retention of structural features present in undisturbed rainforest, weediness and landform disturbance. The vegetation condition rating scale is provided in Table 8. The areas were revisited in 2017 to assess successional changes over a 6-7 year period.

Table 8. Vegetation condition rating scale

Condition Rating	Keighery (1994)	Adapted scale
P (2) Pristine	Pristine or nearly so, no obvious signs of disturbance.	Mature, undisturbed rainforest or very advanced secondary regrowth. Disturbance is limited to cyclone damage occurring in February 2014. Climax species dominate and full structural complexity is present with epiphytic orchids and ferns, terrestrial orchids and ferns, *Pandanus*, palms, buttressing and woody lianes. 
Ex (3) Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.	Little to no weed species and a largely intact landform with few signs of disturbance. The vegetation structure is beginning to develop the full complexity and diversity expected in rainforest, with climax species present and a range of features included such as buttressing, palms, ferns, epiphytes and orchids, but the canopy is likely to be more open than in undisturbed rainforest. 
VG (4) Very Good	Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.	Low diversity vegetation with few signs of disturbance or moderately diverse vegetation on a disturbed landform, a canopy dominated by pioneer species, though recruitment of climax species may be evident, an open canopy or poor structural complexity. Few weeds present or weeds are limited to less aggressive species. 

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Condition Rating	Keighery (1994)	Adapted scale
G (5) Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.	Multiple signs of disturbance or with low diversity and no structural complexity. Typically displays little to no recruitment of climax tree species. Numerous weeds present or a dense understory dominated by one or two native fern species. 
D (6) Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.	Vegetation at very early successional stages with a canopy of one to two species and an understory dominated by ferns or weeds, typically adjacent to completely degraded land. May have the potential to develop into better quality vegetation as the canopy develops if weeds are managed. 
CD (7) Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often referred to as parkland cleared with the flora composing weed or crop species with isolated native trees or shrubs.	The structures of primary rainforest are no longer present and native species are limited to only a few species, for example, weed dominated shrubland with sparse emergent *Macaranga* or a near monoculture *Nephrolepis biserrata* fernland. The landscape may be highly disturbed, often with significantly reduced soil and pinnacles exposed. Predominantly lacking a native canopy and with little to no potential to develop one due to dense groundcover or shallow soil. 

3.1.3 Constraints and Limitations

Possible constraints and limitations identified in the EPA's *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016) have been addressed in Table 9.

A discrepancy was noted between the Garmin Monterra and the Olympus TG3 digital camera with photos for a site appearing to be in a slightly different location than the coordinates recorded by the Garmin GPS. This is likely to reflect the GPS accuracy of the two devices. We assume the Garmin Monterra is the more accurate of the two devices given the placement of some photos more than 100 m from where they were taken.

The most notable constraint of the investigation was access to pre-selected survey sites. In many instances dense weed thickets or steep terrain impeded access to certain areas and added considerably time to how long it took to arrive at a survey site. The dense nature of the canopy also impacted on the accuracy of GPS units and therefore some spatial margin of error was experienced.

Table 9. Constraints and limitations

Potential Limitation	Constraint (Yes/No); Significant, Moderate or No Constraint	Comment
Availability of contextual information for the Project at a regional and local scale	No constraint	Contextual information for the application area is readily available, and was utilised where necessary during the preparation of this report. This includes review of previous flora survey reports and island wide vegetation mapping. Christmas Island has been the subject of numerous flora and vegetation surveys and assessments and has a dedicated volume of Flora of Australia (Volume 50), (Du Puy 1993).
Competency/experience of the team carrying out the survey, including experience in the bioregion investigated	No constraint	The lead botanist Rachael Pratt has over 16 years' experience in flora and vegetation assessments including three years' experience in the flora of Christmas Island. EPA technical guidelines (2016) recommend a minimum of five years' experience in the bioregion, however, given that the flora of Christmas Island is well known, with native flora restricted to some 240 taxa, and low diversity in the Closed Canopy Evergreen Forest vegetation unit, and given that the areas had been previously surveyed, three years may be considered adequate.
Proportion of flora recorded and/or collected, any identification issues	No constraint	Identification of most flora was readily achieved in the field using field experience and assisted by available reference guides (Claussen 2005 and Du Puy 1993). Specimens of any unknown or difficult to identify species were photographed and referred to tropical botanist David Fell for advice. Epiphytic orchids situated high in canopy trees were difficult to assess due to poor visibility in the canopy. As such there is the possibility that the endemic epiphytic orchids including *Flickingeria nativitatis* and *Phreatia listeri* or epiphytic fern species such as *Huperzia phlegmaria, Selaginella alutacia* and *Crepidomanes saxifragoides* were not recorded, though these are substantially less likely to be present in regrowth vegetation than in primary forest. Discrepancies between flora species identified in this survey vs past surveys of the same area give an indication that the proportion of the flora missed may be quite high. Refer to Section 0 for further discussion.
Survey effort and extent	Yes; Moderate	Quaternary vegetation sampling (relevés) was deemed appropriate given that the vegetation sampled was all regrowth and had been previously surveyed. Access was difficult with dense weed thickets in regrowth areas and young Pandanus in primary rainforest. Some blocks were constrained by steep embankments or pinnacle fields which prevented access to some areas for survey. 23 sites were surveyed within the 62 ha survey area, equivalent to one site per 2.7 ha. The EPA's technical guidance for flora surveys (EPA 2016) recommends that a minimum of three quadrats be sampled per vegetation unit and that the total number of quadrats be proportional to the size of the survey area. The intensity of the survey was adequate to meet the requirements of the scope of works and to assess the flora and vegetation values against the ten clearing principles within the *Environmental Protection Act 1986.* One site was not surveyed due to adjacent active mining.

Potential Limitation	Constraint (Yes/No); Significant, Moderate or No Constraint	Comment
Survey timing, rainfall and season of survey	No Constraint	The investigation was undertaken in June 2017 during the dry season. June received unseasonal high rainfall, with 338 mm being received above the June average. Notwithstanding this, the weather was fine and mild during the survey period with limited rainfall (8 mm fell at station 200790 during the survey period). Most tree species were readily identified using leaf, trunk and bark features. All other flora life forms, including epiphytic and terrestrial ferns, were within the growing season and in full leaf.
Access restrictions within the survey area	Yes; Moderate	The assessment areas are located on Christmas Island in dense tropical rainforest vegetation with some areas of dense regrowth and areas of disturbance from cyclones. In a limited number of instances, the density of vegetation prevented the investigation botanist from walking directly to selected investigation sites. Dense vegetation also inhibits walking in straight lines during traverse searches for Tectaria. One site was not surveyed due to adjacent active mining.
Disturbance that may have affected the results of the survey, such as fire, flood or clearing	Yes; Moderate	The majority of the assessment areas contained regrowth rainforest with old exploration lines and access roads, which have previously been cleared for these activities. Some areas contained pinnacle fields which prevented access but also limited the species likely to be present to weed and fern species with an occasional Macaranga.

3.2 Fauna assessment

3.2.1 Desktop

A desktop assessment of the potential clearing areas was undertaken prior to commencing the risk assessment. The desktop assessment consisted of a review of existing contextual data, reports or surveys undertaken in the vicinity of potential clearing areas. Past surveys conducted on Christmas Island include:

- A fauna survey conducted by Bamford Consulting Ecologists in 1999 (SKM 2000) for the APSC project.
- Christmas Island Wide Survey (IWS) data conducted by Parks Australia (Parks) every 2 years (Department of National Parks 2016).
- A range of studies undertaken in 2002 for the EIS submission (Phosphate Resources Limited, EWL Sciences Pty Ltd and Tallegalla Consultants Pty Ltd 2005).
- A targeted fauna and flora survey undertaken by Range to Reef Environmental following submission of the South Point Referral in 2013 to provide additional information for the assessment process.
- Extensive flora and fauna surveys undertaken by Range to Reef in 2016 (Range to Reef Environmental 2017).
- Field studies undertaken for scientific research published in a number of journals and other media (Yorkston and Green 1997, Nelson 1971, Nelson and Powell 1986, Department of the Environment and Heritage 2004, Hennicke and Weimerskirch 2014, Raupach, et al. 1987, Reville, et al. 1990).

Likelihood of presence of conservation significant species within the assessment areas was estimated and the potential for significant impact to the species was examined.

Range to Reef Environmental and Parks Australia records (Department of National Parks 2016) were examined to identify conservation significant fauna near the assessment areas. Abbott's booby was identified as occurring within 300 m of the assessment areas so a targeted survey for Abbott's booby was planned as part of the assessment.

The results of the desktop assessment were reported in Section 2.

3.2.2 Field Survey

Prior to beginning the field survey, a 300 m buffer of the assessment areas was examined in ArcGIS to determine whether any Abbot's booby had been recorded by Parks Australia or Range to Reef. Abbott's booby records were then uploaded to a Garmin Monterra GPS.

The field survey was undertaken from 18th to 26th June 2017, with 163.2 ha covered over 7.5 days. The survey was undertaken by:

- Lead zoologist: Jeff Turpin (>16 years' experience, including prior fieldwork on Christmas Island)
- Sophie Arnall (PhD zoology student with seven years' experience, including eight prior field trips to Christmas Island)

In the field, the north-west quadrant of the 300 m buffer of the assessment areas was traversed in intervals of 100 to 200 m. Any Abbott's booby calls heard, or scat accumulations, were followed up with a closer search for nest sites. Scats (Figure 12) and other observations were recorded, and waypoints supplied by Parks Australia were checked for current inhabitants. At each new location, a GPS waypoint was created, and notes were made for historic waypoints supplied by Parks Australia.

At each GPS waypoint, the immediate location was classified into one of the following categories (Table 10).

Table 10. Categories assigned to Abbott's booby records

Category	Circumstances
True	- Nest seen - Scat pile concentration indicative of nest - Two or more individuals seen or heard calling from tree
Likely	- Some scats or background scat scatter indicative of important area (e.g. roost trees) - One individual seen or heard calling from tree with no other signs
Maybe	- General area of a call heard, feathers, or trace scats but record inconclusive or imprecise
Confirmed False	- Helicopter survey tree with crown damage - Historic waypoint record with no clear tree at location - IWS "heard" points (= none heard at tree; if calls heard from tree these were located and logged as new points)
False on this Day	- Tree located at waypoint but no signs of Abbott's booby
Unknown	- Unable to verify at location

Figure 12. Example of scat pattern consistent with a nest location (verified in this instance by visualisation of the nest directly above).

3.2.3 Risk Assessment

A risk assessment of the likely consequences upon conservation significant fauna was undertaken using knowledge of the species presence in the area, the likely impacts and a standardised risk assessment matrix (Table 11). Species which do not occur within the proposal area (Table 6) were not considered in the risk assessment as the risk to these species is negligible.

Risk management categories are as follows:

- ***High:*** *Immediate changes to design or procedures needed*
- ***Medium****: Risk reduction measures and monitoring required*
- ***Low:*** *Acceptable risk, monitoring activity and manage as required*
- ***Negligible:*** *Risks are acceptable, no further management*

Table 11. Standardised Risk Assessment Matrix

	Consequence				
Likelihood	Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	Negligible	Low	High	High	High
Likely	Negligible	Low	Medium	High	High
Possible	Negligible	Low	Low	Medium	High
Unlikely	Negligible	Negligible	Low	Medium	Medium
Rare	Negligible	Negligible	Negligible	Low	Medium

Table 12. Definitions of Likelihood as used in the Risk Assessment

Descriptor	Level	Definition
Rare	1	The species will be absent/not impacted in most circumstances.
Unlikely	2	The species should be absent/not impacted in most circumstances.
Possible	3	The species may be present/impacted in some circumstances.
Likely	4	The species should be present/impacted in most circumstances.
Almost Certain	5	The species will be present/impacted in most circumstances.

Table 13. Definitions of Consequence as used in the Risk Assessment

Descriptor	Level	Definition
Insignificant	1	Short term, localised and insignificant impact on the species. Recovery in days to months.
Minor	2	Incidental changes to the species. Weeks to months to recover.
Moderate	3	Impact cause detectable changes to the species. Months to years to recover.
Major	4	Adverse effect on the species. Years to decades to recover.
Catastrophic	5	Loss of the species at the regional scale, adverse effect on species (abundance, age, fecundity). Decades to recover if any recovery possible.

3.2.4 Constraints and Limitations

Table 14. Constraints and limitations

Potential Limitation	Constraint; Significant, Moderate or No Constraint	Comment
Availability of contextual information for the Project at a regional and local scale	No constraint	Contextual information for the survey area is readily available, and was utilised where necessary during the preparation of this report. This includes Parks Australia's spatial data of Abbott's booby records from 2009-2015.
Competency/experience of the team carrying out the survey, including experience in the bioregion investigated	No constraint	The lead zoologist Jeff Turpin has over 16 years' experience in fauna surveys and assessments including experience in the tropics and prior surveys on Christmas Island. Jeff was supported by PhD (zoology) student Sophie Arnall who has undertaken eight trips to Christmas Island in 2016-2017 for both flora and fauna surveys.
Proportion of fauna recorded and/or collected, any identification issues	Yes; Moderate	Australia's guidelines for survey of threatened bird species (DEWHA 2010) recommends a minimum of 20 hours of survey per 10 ha over four days for Abbott's booby. Sites were only visited on two days with a survey effort of approximately 6.43 hours per 10 ha. Time spent was restricted by budget and contractor availability. Refer to Section 4.2.1 for further discussion of the impact of this upon results. Abbott's booby nest once per two years. One adult remains to guard the nest at all times, while the other departs for foraging trips which may take up to six days (Hennicke and Weimerskirch 2014). Some pairs begin nesting later in the season than the survey period, and an adult is only guaranteed to be present at the nest during incubation and chick rearing. At other times scat may provide evidence of nesting activity but this is easily missed if there's no previous record of nesting at a site, and rainfall washes away scat so it won't persist through the wet season. For these reasons it is highly likely that nest sites have been missed.
Survey effort and extent	Yes; Moderate	163.2 hectares was surveyed over 7.5 days (105 man-hours). This included 62 historic Abbott's booby records. The survey focussed on the area downwind of potential clearing areas, that being the north-west quadrant of a 300 m buffer of potential clearing areas. Where a pre-existing >50 m gap existed between potential clearing and primary rainforest, the area downwind of this was NOT surveyed as it is assumed that turbulence effects already exist (refer to desktop review for references).
Survey timing, rainfall and season of survey	Yes; Moderate	The investigation was undertaken in June 2017 during the dry season. - Survey conditions were ideal at the beginning of the trip, with a dry June month preserving scats. However, rain and wind towards the end of the field survey hindered detection, with a notable decline in calling individuals. Scats were also more difficult to detect during these times. Areas affected by rain were generally surveyed twice with at least one day in good conditions, with the exception of the area surrounding blocks 116-MB5 and 116-STB23B which was affected by rain and wind on both survey days. This area is likely to have more Abbott's than were recorded during the survey effort.
Access restrictions within the survey area	Yes; Moderate	The survey areas are located on Christmas Island in dense tropical rainforest vegetation with some areas of dense regrowth and areas of disturbance from cyclones. Lack of time (light) prevented two points in 109-MB1, and two points in 122-MB2 from being verified. These were at the outer margins of the survey area. Dense pandanus prevented access to within ~25 m of two historic nest sites. These were recorded as "unknown."

Potential Limitation	Constraint; Significant, Moderate or No Constraint	Comment
Disturbance that may have affected the results of the survey, such as fire, flood or clearing	No Constraint	A cyclone in 2014 had created many canopy gaps and a number of trees previously recorded as Abbott's booby nest locations had lost their crown. These sites were recorded as 'confirmed false.' At several sites nests were recorded nearby old sites and may represent nesting-pairs relocating following minor tree damage caused by the cyclone.

3.3 Licenses

All fieldwork was conducted ethically, and the flora survey was undertaken with permits issued under Section 23C and 23F of the *Wildlife Conservation Act 1950:*

- Licence for Scientific or Other Prescribed Purposes SL011927 (exp. 29 September 2017); and
- Permit to take Declared Rare Flora #47-1617 (exp. 31 September 2017).

No fauna were collected or trapped for the purposes of this survey. A single adult Abbott's booby was rescued from the rainforest floor and delivered to Parks Australia for release.

4 Results and Discussion

4.1 Flora and vegetation

4.1.1 Flora found in the survey area

The survey identified 77 flora taxa (from 45 families and 69 genera) within the survey area, from 23 survey sites and opportunistic collections. This included 24 introduced and three endemic flora taxa. Previous 2010-2011 surveys identified 42 native flora taxa and nine or more introduced flora taxa within the survey areas. This included 29 native flora taxa in common with the June 2017 survey and eight introduced taxa. Full site data is included in Appendix A and a species list is included in Appendix B.

The 2010-2011 surveys encountered 52 flora taxa from 147 survey sites. The 2017 survey identified an additional 20 native flora taxa and 16 introduced flora taxa within the survey area. Eleven native flora taxa and one introduced taxa were not reencountered during the 2017 survey, which did not cover exactly the same ground as the 2010-2011 surveys. The 2010-2011 survey data included few epiphytes, which may indicate progression of successional processes or may indicate observer bias. Weeds were also under-reported in 2010-2011 with a note simply being made indicating "Weed sp."

The most common native flora taxa, found in most assessment areas were:

Trees

- *Dysoxylum gaudichaudia*num (all sites)
- *Macaranga tanarius* (all sites)
- *Planchonella nitida* (all sites)
- *Tristiropsis acutangula* (all sites)
- *Arenga* §*listeri* (all sites)
- *Claoxylon indicum* (all sites)
- *Pandanus* §*elatus* (9 of 10 sites)
- **Leucaena leucocephala* (9 of 10 sites)
- *Barringtonia racemosa* (8 of 10 sites)

Epiphytes

- *Asplenium nidus* (all sites)
- *Pyrrosia lanceolata* (all sites)

Understory

- *Nephrolepis biserrata* (all sites)
- **Cordia curassavica* (8 of 10 sites)

Climbers

- *Maclura cochinchinensis* (9 of 10 sites)
- *Schefflera elliptica* (9 of 10 sites)

None of the three conservation significant flora species known to occur on the plateau were identified within the assessment areas, however, a targeted search for Threatened flora was not undertaken due to the difficulty of finding these species in dense regrowth vegetation and the low likelihood of the three Threatened Flora occurring in regrowth vegetation.

The introduced flora within the survey area included four Priority Weed species listed in the CIP Weed Management Plan (Range to Reef Environmental 2017):

- **Aleurites moluccana* var. *moluccana* (candlenut)
- **Clausena excavata* (false curry-leaf)
- **Manihot glaziovii* (Ceara rubber)
- **Spathodea campanulata* (African tulip)

Other noteworthy introduced flora species, identified under Northern Australian Quarantine Strategy (NAQS), International Union for Conservation of Nature (IUCN) or State noxious weed listings, found within the survey area included:

- **Asystasia gangetica* (NAQS, NSW, WA)
- **Stachytarpheta cayennensis* (NSW, WA, NT)
- **Tecoma stans* var. *stans* (NSW, WA, QLD)

- **Cordia curassavica* (NAQS)
- **Senna occidentalis* (WA, NT)
- **Sida acuta (*WA, NT)
- **Hyptis capitata* (TAS, NT)
- **Leucaena leucocephala* (IUCN)
- **Mikania micrantha* (NAQS, IUCN, WA, QLD, NT)
- **Mimosa invisa* (NAQS)
- **Mimosa pudica* (NAQS, WA, NT)

4.1.2 Vegetation of the survey area

Vegetation Type

All vegetation within the survey area was mapped by Geoscience Australia as Regrowth or Weed Dominated Vegetation and Pioneer Regrowth. The mapped height of vegetation was typically in the 5-15 m range, with occasional trees to 20 m. Areas 126-STP9F and 127-STP9E had some taller vegetation to 25 m on their south-west boundaries. Among the regrowth were patches of Weed Dominated Vegetation and Pioneer Regrowth, typically thickets of **Cordia curassavica*, native vines and *Pandanus*. Of note were a small area of dense bird's nest ferns (*Asplenium nidus*) in 127-STP9E (survey site CI04) and a grove of mature *Pandanus* in 106-MB12 (Figure 13). The vegetation was otherwise unremarkable regrowth of Closed Canopy Evergreen Forest, with areas of pinnacle field containing fern species. Vegetation maps are included in Appendix C.

When all survey areas were considered together, averaging heights, total cover and considering the most common species, using the NVIS structural categories (ESCAVI 2003), the regrowth encountered was an example of:

Medium, open forest of: *Macaranga tanarius, Barringtonia racemosa*, *Planchonella nitida, Ficus microcarpa, and Pandanus elatus* over

Low, open forest of: *Dysoxylum gaudichaudianum, Claoxylon indicum, Barringtonia racemosa, Arenga listeri, Pisonia umbellifera* and *Pandanus elatus*, over

Medium, open shrubland/vineland/fernland of: *Nephrolepis biserrata, Maclura cochinchinensis, Arenga listeri, Asplenium nidus, Schefflera elliptica* and **Cordia curassavica, over*

Sparse, low fernland of: *Nephrolepis biserrata*, **Cordia curassavica, Microsorum scolopendria, Schefflera elliptica, Asplenium nidus and* seedlings.

The presence of some species in multiple structural layers is indicative of the successional process active in regrowth vegetation. In primary forest, some early colonisers such as Macaranga are only present in canopy gaps and at forest margins, and some of the tree species are usually confined to the canopy or understory depending on their growth range. In primary forest, the canopy is also more closed and the understory, shrub layer and ground cover very sparse due to shading and the activity of red crabs.

Vegetation composition and condition varied greatly over a short distance, with a marked distinction between regrowth and primary rainforest. Photographs taken on the boundary of 109-MB1 show the rapid transition from regrowth to primary forest (Figure 14).

Vegetation Condition

The average condition of vegetation at locations selected for survey was 4.75 (slightly better than Good) , with a median of 5 (Good) and a mode of 4 (Very Good). This did not include poorer vegetation which was not surveyed, some of which was Completely Degraded fernfield or weed thickets, so the average vegetation condition throughout the assessment areas should range from Degraded to Good. Generally speaking, the condition fairly closely mirrors the height of vegetation encountered, with the tallest vegetation indicating well established canopy trees which are capable of producing the shade necessary to prevent many weed species. Tall canopy species are also indicative of deeper, less compacted soils which are associated with better vegetation recovery after clearing.

Bioregional representation of the vegetation

The National Objectives and Targets for Biodiversity Conservation 2001-2005 recognises that a retention of 30% or more of the pre-clearing extent of each ecological community is necessary if Australia's biological diversity is to be protected (ANZECC 2000). It is recognised that biodiversity conservation presents greater challenges in an island environment, which is particularly susceptible to biodiversity losses.

Approximately 75% of Christmas Island has never been cleared and 77% of this is protected within the Christmas Island National Park (IUCN[1] reserve category II) (Geoscience Australia 2014, Director of National Parks 2014a). Based on the National Objectives and Targets for Biodiversity Conservation 2001-2005, the vegetation complex is adequately reserved (i.e. greater than 30% of pre-clearing extent) within the Shire of Christmas Island and at a regional, State and National level.

With respect to the Closed Canopy Evergreen Forest vegetation type which the assessment areas represent regrowth of, 6,537 hectares (48.18% of the Island) has never been cleared and most of this is reserved in the Christmas Island National Park. The survey areas covered 62.8 ha of regrowth vegetation and do not risk breaching biodiversity targets.

Conservation Significant Vegetation Types

There are no Threatened Ecological Communities listed for Christmas Island.

[1] International Union for Conservation of Nature (IUCN) protected area management categories classify protected areas according to their management objectives. The categories are recognised by international bodies such as the United Nations and by many national governments as the global standard for defining and recording protected areas and as such are increasingly being incorporated into government legislation.

Category II (National Park) protected areas are large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible, spiritual, scientific, educational, recreational, and visitor opportunities.

Source: https://www.iucn.org/theme/protected-areas/about/protected-areas-categories

Figure 13. Bird's nest ferns at survey site CI04 in area 127-STP9E (left) and *Pandanus* in 106-MB12 (right).

Figure 14. Photographs of regrowth (left) and primary forest (right) taken from the same location near the boundary of historic clearing, but facing opposite directions.

4.2 Fauna

4.2.1 Abbott's booby survey

Several databases exist for Abbott's booby nest trees. To ensure an accurate and up to date picture of Abbott's use of these areas, a survey was undertaken within the north-western quadrant of a 300 m buffer of potential clearing areas to confirm the presence/absence of Abbott's booby. This data was then used to assess the nature of potential risks due to increased turbulence due to proposed clearing, and to refine proposed clearing areas to decrease potential risks to established nest sites.

Australia's guidelines for survey of threatened bird species (DEWHA 2010), updated in April 2017, recommends a minimum of 20 hours of survey per 10 ha over four days for Abbott's booby. For the purposes of this survey, sites were only visited on one to two days with a survey effort of approximately 6.43 hours per 10 ha. Survey effort was restricted by budget and contractor availability. Additional time spent surveying would likely have recorded additional nest sites. In future, this would best be tackled with a second survey later in the breeding season. Notwithstanding this, significant additional Abbott's

booby were recorded above and beyond known records, indicating a healthy population and suggesting that the survey, though geographically restricted, was more comprehensive than any undertaken to date. Full maps of the survey areas and findings are included in Appendix E.

Historic Records

Historic records of Abbott's booby were supplied by Parks Australia in 2016. These included a 2009 helicopter survey and Island Wide Survey (IWS) records from 2011, 2013 and 2015. IWS records were collected by two methods. Specific grid locations throughout the Island were assessed for presence/absence of Abbott's booby and records were categorised as either 'call' or 'visual.' Additional waypoints were recorded during transit between grid locations but these were not categorised. Some waypoints were occupied by Abbott's over multiple years of the IWS survey. The 2017 Abbott's booby survey found varying levels of reliability among the helicopter, IWS call, IWS visual and transit records.

Of the 62 historic records, just under half were confirmed as Abbott's trees (42%; 26 waypoints). A further 8 waypoints fell into the 'likely' and 'maybe' categories, giving a total of **55%** (34 waypoints) that **could be conservatively confirmed as Abbott's nest trees**.

The majority of confirmed waypoints were from the 2009 helicopter survey (21/34; 62%), and in general, helicopter records were much more reliable than the IWS records. Out of the 33 helicopter records verified, only 6 were 'confirmed false'. These trees showed extensive (presumably age and cyclone related) crown damage, and were not concentrated in any one survey area. An additional four trees were intact but had no signs of Abbott's at the times surveyed.

By contrast, the IWS points were highly variable in their reliability. Approximately half of the island wide survey points were conservatively true (i.e. fell into the 'true', 'likely' or 'maybe' categories; n=13/29) and the remainder were confirmed false (n=13/29) or false on the day surveyed (n=3/29).

IWS 'heard' locations (n=8) all resulted in a 'confirmed false' outcome. In some instances (n=5/8), no calls could be heard from these locations, and in other instances (n=3/8) calls could be heard up to two hundred meters away. Calling individuals were subsequently tracked and marked as new Abbott's locations. IWS 'heard' locations are unlikely to be of much value for gauging important Abbott's trees because of the imprecise nature of the records (e.g. calls may have come from any distance or direction, and may not have necessarily come from nesting individuals).

IWS 'transit' locations yielded mixed results. Often (n=16/29), a clear tree could be identified at the waypoint location, and in 13 instances these were scored as 'true'. However, in 13 of 29 instances the waypoint location was within a fern field, or within low vegetation, and as such had no clear emergent tree associated with it. It is unclear what the IWS transit waypoints relate to, and so these should be interpreted with caution when determining the presence of Abbott's in an area based on these records.

Based on historic records, there was an average of **0.22 (± 0.03) true historic Abbott's records per hectare** of effective survey area.

New Records

The number of new records outweighed historic records by 10, and there were more Abbott's booby in the survey area than were detected during the June survey effort (e.g. a minimum of five more individuals were noted but not recorded due to lack of time).

On average, there were **0.49 new records per hectare** of effective survey area. This was relatively consistent across the survey areas (standard error 0.044; range 0.25 – 0.65 new records/ha).

The minimum number of new records for any survey area was six, and the highest was 16. Higher numbers of new records generally coincided with larger survey area sizes, but not always (e.g. '126-STP9F + 127-STP9E' had the largest survey area size, but third lowest number of new Abbotts locations; though note weather may have had an effect).

General Findings

In total, there was an average of **0.68 true Abbott's records per hectare** of effective survey area (standard error 0.078; range 0.37 – 0.90 true records/ha).

In 43 of 85 true records (50.6%), a nest was visualised. A total of 46 individuals were also seen, but these did not necessarily coincide with nest locations.

Abbotts nested almost exclusively in *Syzygium nervosum* (n = 66) or *Planchonella nitida* (n = 44) trees. Nesting in *Dysoxylum gaudichaudianum* was recorded only once. Interestingly, two nests were seen in the *Dysoxylum*, with three individuals (one on each nest, and one on the peripheral branches). This was the only instance where more than one nest was recorded in a single tree Figure 15.

Some areas had evidence of considerable cyclone damage in pockets, with many fallen trees and few intact emergents (e.g. adjacent to 109-MB1). However, this did not seem to impact the nesting of Abbotts, who still utilised many trees within these areas (e.g. the forest adjacent to 109-MB1 had a higher than average number of true Abbotts records within the survey area; 0.77/ha).

The number of conservative confirmed Abbotts records (i.e. 'true', 'likely' and 'maybe' classified waypoints) per area is provided in Table 15.

Table 15. Number of Abbott's found in forest adjacent to proposed clearing areas

Area ID	05-MB2 and 106-MB15	106-MB12	106-MB16[1]	109-MB1	110-MB1	116-MB5 and 116-STB23B[2]	122-MB2	126-STP9F and 127-STP9E
Survey Area (ha)	13.8	28.4	n/a	22.4	24.5	12.9	21.8	39.4
Number of Historic Records	7	12	0	10	11	5	4	13
Number of New Records	7	15	n/a	11	16	6	7	10
Total (Conservative) Confirmed	11	23	n/a	17	22	9	8	16
Confirmed/ha	0.8	0.81	n/a	0.76	0.9	0.7	0.37	0.41

[1] *Not surveyed due to an absence of Abbott's booby records to the north-west and the presence of extensive clearing to the north-west.*

[2] *Partial survey only due to safety concerns caused by proximity to active mining.*

Figure 15. Typical Abbott's booby nest as visualised from the ground. A second nest can be seen on the right.

The survey results indicate that there are significant numbers of Abbott's booby within 300 m downwind of potential clearing areas and that they are nesting closer to existing pinnacle fields than current knowledge of their habitat requirements suggests should be possible. Measurement of nesting success at sites in close proximity to an upwind pinnacle field was outside of the scope of this project but would be a sensible research project to be undertaken in the future given that there are ample examples of Abbott's nesting with 300 m of upwind clearings.

4.2.2 Other fauna observed within the survey area

The flora and vegetation portion of the survey also observed the following conservation significant fauna species within or immediately adjacent to the assessment area:

- Abbott's booby (En, Marine)
- Christmas Island goshawk (En)
- Christmas Island thrush (En)
- Christmas Island emerald dove (En)
- Christmas Island imperial pigeon
- Christmas Island white-eye
- Christmas Island red crab
- Robber crab

These observations were consistent with Parks Australia IWS results, with the only IWS bird species occurring in the area which was not seen during the survey being the golden bosun. All of the conservation significant birds other than Abbott's booby are highly mobile, likely to relocate during clearing and have large areas of undisturbed habitat protected within National Park.

4.2.3 Conservation Significant Fauna Risk Assessment

A risk assessment was undertaken to determine the risk to those conservation significant fauna species which may suffer direct or indirect impacts from any clearing within the assessment areas. Fauna which were identified as unlikely to be present in the areas due to a lack of habitat (Table 6) are excluded from this risk assessment.

Under the ten clearing principles, clearing is likely to be at variance to the principles if it comprises the whole or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia. The assessment of risk, therefore depends on whether the proposed clearing areas are a ***significant*** habitat for conservation significant species.

Following risk assessment (Table 16), three species are at moderate to high risk of impact from any proposal to clear within the assessment areas. These are the Abbott's booby, red crab and robber crab. With the application of mitigation strategies, such as the CIP Red Crab Management Plan, it should be possible to lower the risk to these species. For the risk matrix used and definitions of likelihood and consequence, please refer to Section 3.2.3.

Table 16. Conservation Significant Fauna Risk Assessment

Species	Activity	Aspect	Impact	Inherent Risk			Management or Mitigation	Residual Risk		
				Likelihood	Consequence	Risk		Likelihood	Consequence	Risk
Gecarcoidea natalis Red crab	Clearing for Mining/Stockpile Recovery	Removal of vegetation	Loss of habitat	Almost certain	Moderate	Medium	Implement CIP Red Crab Management Plan.	Almost certain	Minor	Low
		Removal of vegetation	Loss of habitat	Almost certain	Moderate	Medium		Almost certain	Minor	Low
Birgus latro Robber crab/coconut crab	Clearing for Mining/Stockpile Recovery	Loss of habitat	Loss of vegetation	Almost certain	Moderate	Medium	Manual removal of robber crabs before clearing.	Possible	Insignificant	Negligible
		Bulldozer movements	Crab deaths	Almost certain	Moderate	Medium		Possible	Insignificant	Negligible
Papasula abbotti Abbott's booby	Clearing for Mining/Stockpile Recovery	Removal of vegetation	Loss of habitat	Rare	Moderate	Negligible	No management action required.			
		Reduction in vegetation height adjacent nesting habitat	Increased turbulence at nest sites as an indirect impact of clearing	Possible[2]	Moderate	Low	Increase the distance between known nest sites and the upwind edge of clearing where possible.			
Chalcophaps indica natalis Christmas Island emerald dove	Clearing for Mining/Stockpile Recovery	Removal of vegetation	Loss of habitat	Likely	Insignificant	Negligible	No management action required.			
Accipiter hiogaster natalis Christmas Island goshawk	Clearing for Mining/Stockpile Recovery	Removal of vegetation	Loss of habitat	Likely	Insignificant	Negligible	No management action required.			
Ninox natalis Christmas Island hawk-owl	Clearing for Mining/Stockpile Recovery	Removal of vegetation	Loss of habitat	Possible	Insignificant	Negligible	No management action required.			
Turdus poliocephalus erythropleurus Christmas Island thrush	Clearing for Mining/Stockpile Recovery	Removal of vegetation	Loss of habitat	Likely	Insignificant	Negligible	No management action required.			
Phaethon lepturus fulvus White-tailed tropicbird/golden bosunbird	Clearing for Mining/Stockpile Recovery	Removal of vegetation	Loss of habitat	Rare	Insignificant	Negligible	No management action required.			
Ducula whartoni Christmas Island imperial pigeon	Clearing for Mining/Stockpile Recovery	Removal of vegetation	Loss of habitat	Likely	Insignificant	Negligible	No management action required.			
Zosterops natalis Christmas Island white-eye	Clearing for Mining/Stockpile Recovery	Removal of vegetation	Loss of habitat	Likely	Insignificant	Negligible	No management action required.			
Pteropus melanotus natalis Christmas Island flying fox	Clearing for Mining/Stockpile Recovery	Removal of vegetation	Loss of habitat	Possible	Insignificant	Negligible	No management action required.			
Ramphotyphlops exocoeti Christmas Island blind snake	Clearing for Mining/Stockpile Recovery	Removal of vegetation	Loss of habitat	Rare	Moderate	Negligible	No management action required.			
		Bulldozer movements	Soil compaction	Rare	Moderate	Negligible	No management action required.			
Cyrtodactylus sadleiri Giant gecko	Clearing for Mining/Stockpile Recovery	Removal of vegetation	Loss of habitat	Possible	Minor	Low	No management action required.			

[2] For the purposes of assessing Abbott's booby indirect impacts, the likelihood has been set at "possible," though no Abbott's booby will be present *within* the clearing area.

6 Conclusions and Recommendations

Range to Reef were commissioned to undertake a flora and vegetation assessment and Abbott's booby survey of areas which might be impacted by a clearing proposal in the central areas of Christmas Island.

The survey areas were comprised of Regrowth vegetation of varying condition and species found within the survey areas are well represented throughout the plateau. The vegetation generally consisted of an open canopy of *Macaranga tanarius, Barringtonia racemosa*, *Planchonella nitida, Ficus microcarpa, and Pandanus elatus, with Dysoxylum gaudichaudianum, Claoxylon indicum, Arenga listeri and Pisonia umbellifera* in the subcanopy and an understory of *Nephrolepis biserrata, Maclura cochinchinensis, Asplenium nidus, Schefflera elliptica* and **Cordia curassavica.*

The vegetation within the assessment areas ranged in condition from Completely Degraded to Excellent, with average vegetation condition at survey sites being 4.75, with a median of 5 (Good) and a mode of 4 (Very Good). Sites were preferentially selected in better condition vegetation, so the overall condition of the assessment areas is Degraded to Good.

Seventy-seven flora taxa (from 45 families and 69 genera) were identified within the assessment areas, including 24 introduced and three endemic flora taxa. Surveys undertaken from 2010-2011 within the same areas identified 42 native flora taxa and nine or more introduced flora taxa. This included 29 native flora taxa in common with the June 2017 survey and eight introduced taxa. An additional 20 native flora taxa and 16 introduced flora taxa were identified in 2017, while eleven native flora taxa and one introduced taxa were not re-encountered.

No flora taxa of conservation significance were found. The vegetation within the survey areas was not representative of a vegetation type which has been significantly cleared, with uncleared closed canopy vegetation on the plateau covering 48% of the island, and most of this being reserved in the Christmas Island National Park.

The Abbott's booby survey of primary forest adjacent to the proposed clearing has accurately mapped nest trees and provides a key and accurate dataset for the clearing application. This highlighted inadequacies and inaccuracies in past mapping. The survey found an average of 0.68 Abbott's per hectare within the area 300 m downwind of the assessment areas. This included 0.49 new records per hectare surveyed, indicating that there are more birds present than historical records suggest, and that the birds are in new locations, with some old nest sites abandoned. In some cases, this was quite evident due to the loss of the crown of a canopy tree, or tree fall, possibly caused by the 2014 cyclone. Many of the new records were closer to existing clearings and/or closer to the boundaries of the proposed clearing areas.

In addition to Abbott's booby, the conservation significant fauna species Christmas Island goshawk (En), Christmas Island thrush (En), Christmas Island emerald dove (En), Christmas Island imperial pigeon, Christmas Island white-eye, Christmas Island red crab and Robber crab were identified within the assessment areas. The majority of bird species encountered (excepting Abbott's booby) are highly mobile and unlikely to be significantly impacted by removal of vegetation within the assessment areas. Abbott's booby, the Christmas Island red crab and robber crabs, however would need to be considered during clearing activities.

A risk assessment of potential impacts to the conservation significant fauna taxa which might be impacted by any clearing within the assessment areas found an elevated inherent risk to land crabs.

A number of recommendations were made as a result of these surveys including:

- Removal of block 122-MB2 from any proposal due to the proximity of Abbott's booby nests and the absence of any mitigating factors.
- Boundary amendments due to forest condition and boundary issues
- Implementation of additional buffers to National Park in the centre of the Island.
- Implementation of relevant CIP management plans such as the Red Crab Management Plan to any clearing areas proposed.

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Appendix A – Field Data

Field Data

Date: 6/18/2017 **Recorders:** RP **Location:** Area 126-STP9F **Site Number:** CI01
Coordinates: 574542 mE, 8842735 mN (WGS84, Zone 48) **Landform:** Stockpiles **Aspect:** NE **Slope:** - **Altitude:** 259 (m) **Comments**:

Geoscience Australia (2014) Vegetation Classification: Regrowth **Height (m):** 10-15m
Vegetation Structural and Floristic Description: Advanced secondary forest of *Dysoxylum gaudichaudianum*, *Planchonella nitida* and *Macaranga tanarius* with occasional *Tristiropsis acutangula* over *Arenga listeri* and *Claoxylon indicum* with **Leucaena leucocephala*, with a sparse understory. **Canopy Height (m):** 15-20

Strata	E (m)	T1 (m)	T2 (m)	T3 (m)	S1 (m)	G (m)
Heights/Ranges		12-17	7-10	4-6	0.5-1.5	0-0.5

Vegetation Condition: Very Good **Last Cleared:** 2008/1982 **Source of degradation:** Approaching excellent; senescing **Leucaena*; Expl. Track cleared 2008
Threatened Flora: 0 **Conservation Significant Fauna:** Red crab, White Eye **Comments:**
Species: 14 (natives); 3 (weeds)

Species	Cover (%)						
	E	T1	T2	T3	S1	G	Epi
Tristiropsis acutangula	0	1.5	0	0	0	<1	0
Macaranga tanarius	0	15	0	0	0	0	0
Dysoxylum gaudichaudianum	0	30	1	0	0	<1	0
Planchonella nitida	0	25	4	0	0	0	0
**Leucaena leucocephala*	0	0	<1	<1	0	0	0
Arenga listeri	0	0	0	4	0	0	0
Claoxylon indicum	0	0	0	10	0	0	0
Syzygium nervosum	0	0	0	<1	0	0	0
Pandanus elatus	0	0	0	0	1	0	0
Schefflera elliptica	0	0	0	0	<1	0	0
Maclura cochinchinensis var. *cochinchinensis*	0	0	0	0	<1	0	0
**Capsicum frutescens*	0	0	0	0	<1	0	0
Allophyllus cobbe	0	0	0	0	<1	0	0
Microlepia speluncae	0	0	0	0	0	<1	0
**Stachytarpheta cayennensis*	0	0	0	0	0	<1	0
Asplenium nidus	0	0	0	0	0	<1	1
Pyrrosia lanceolata	0	0	0	0	0	0	1

N/A = Not Applicable; n/a = Not Assessed.

Field Data

Date: 6/18/2017 **Recorders:** RP **Location:** Area 126-STP9F **Site Number:** CI02
Coordinates: 574441 mE, 8842783 mN (WGS84, Zone 48) **Landform:** Plateau **Aspect:** N **Slope:** 0 **Altitude:** 268 (m)
Comments:

Geoscience Australia (2014) Vegetation Classification: Regrowth **Height (m):** 10-15m
Vegetation Structural and Floristic Description: Secondary regrowth forest of *Dysoxylum gaudichaudianum* with *Macaranga tanarius, Tristiropsis acutangula* and occasional *Arenga listeri* over *Barringtonia racemosa* and *Claoxylon indicum* with abundant *Nephrolepis biserrata* in the understory. **Canopy Height (m):** 10-15

Strata	E (m)	T1 (m)	T2 (m)	T3 (m)	S1 (m)	G (m)
Heights/Ranges		12-15	7-10	4-6	1-2	0-1

Vegetation Condition: Very Good **Last Cleared:** 2008/1982 **Source of degradation:** Expl. Track cleared 2008
Threatened Flora: 0 **Conservation Significant Fauna:** Red crab **Comments:** Abbott's booby heard
Species: 14 (natives); 1 (weeds)

Species	Cover (%)						
	E	T1	T2	T3	S1	G	Epi
Arenga listeri	0	1	0	0	0	0	0
Macaranga tanarius	0	10	0	0	0	0	0
Tristiropsis acutangula	0	5	0	1	0	0	0
Dysoxylum gaudichaudianum	0	60	18	4	0	0	0
Pandanus elatus	0	0	2	5	0	0	0
Barringtonia racemosa	0	0	10	2	0	0	0
Claoxylon indicum	0	0	0	30	0	0	0
Schefflera elliptica	0	0	0	0	3	0	0
Maclura cochinchinensis var. *cochinchinensis*	0	0	0	0	2	0	0
**Leucaena leucocephala*	0	0	0	0	1	0	0
Nephrolepis biserrata	0	0	0	0	0	30	0
Asplenium nidus	0	0	0	0	0	3	1
?Manihot seedling	0	0	0	0	0	<1	0
Davallia solida	0	0	0	0	0	0	1
Pyrrosia lanceolata	0	0	0	0	0	0	1

N/A = Not Applicable; n/a = Not Assessed.

Field Data

Date: 6/18/2017 **Recorders:** RP **Location:** Area 127-STP9E **Site Number:** CI03
Coordinates: 574712 mE, 8842603 mN (WGS84, Zone 48) **Landform:** Plateau **Aspect:** **Slope:** 0 **Altitude:** 259 (m)
Comments: Border with 10-15m regrowth on the map. Pinnacle field visible through the trees.

Geoscience Australia (2014) Vegetation Classification: Regrowth **Height (m):** 5-10m
Vegetation Structural and Floristic Description: Secondary regrowth forest of *Dysoxylum gaudichaudianum* with *Macaranga tanarius* over *Inocarpus fagifer, Syzygium nervosum* and *Claoxylon indicum* with *Pandanus* and seedlings in the understory. **Canopy Height (m):** 15-20

Strata	E (m)	T1 (m)	T2 (m)	T3 (m)	S1 (m)	G (m)
Heights/Ranges		12-15	9-11	5-8	2-4	0-1

Vegetation Condition: Very Good **Last Cleared:** 2008/1982 **Source of degradation:** Expl. Track cleared 2008
Threatened Flora: 0 **Conservation Significant Fauna:** CI Thrush **Comments:**
Species: 12 (natives); 1 (weeds)

Species	**Cover (%)**						
	E	**T1**	**T2**	**T3**	**S1**	**G**	**Epi**
Macaranga tanarius	0	20	5	0	0	0	0
Dysoxylum gaudichaudianum	0	50	0	0	<1	0	0
Syzygium nervosum	0	1	10	10	0	2	0
Tristiropsis acutangula	0	1	0	0	0	<1	0
Inocarpus fagifer	0	0	5	5	0	0	0
Celtis timorensis	0	0	0	<1	0	0	0
Claoxylon indicum	0	0	0	20	2	0	0
Pandanus elatus	0	0	0	0	5	0	0
Maclura cochinchinensis var. *cochinchinensis*	0	0	0	0	2	0	0
Arenga listeri	0	0	0	0	1	0	0
**Stachytarpheta cayennensis*	0	0	0	0	0	<1	0
Pyrrosia lanceolata	0	0	0	0	0	0	1
Asplenium nidus	0	0	0	0	0	0	1

N/A = Not Applicable; n/a = Not Assessed.

Field Data

Date: 6/18/2017 **Recorders:** RP **Location:** Area 127-STP9E **Site Number:** CI04
Coordinates: 574785 mE, 8842736 mN (WGS84, Zone 48) **Landform:** Plateau **Aspect:** Flat **Slope:** 0 **Altitude:** 264 (m) **Comments**: Border with 10-15m regrowth on the map.

Geoscience Australia (2014) Vegetation Classification: Regrowth **Height (m):** 5-10m
Vegetation Structural and Floristic Description: Secondary regrowth forest of *Barringtonia racemosa* and *Dysoxylum gaudichaudianum* with *Pandanus, Arenga* and *Planchonella nitida* over *Asplenium nidus* and occasional *Nephrolepis*.
Canopy Height (m): 15-20

Strata	E (m)	T1 (m)	T2 (m)	T3 (m)	S1 (m)	G (m)
Heights/Ranges	20	10-12	5-8		1-3	0-1

Vegetation Condition: Very Good **Last Cleared:** 2008/1982 **Source of degradation:** Expl. Track cleared 2008
Threatened Flora: 0 **Conservation Significant Fauna:** **Comments:**
Species: 14 (natives); 2 (weeds)

Species	Cover (%)						
	E	T1	T2	T3	S1	G	Epi
Macaranga tanarius	1	0	0	0	0	0	0
**Melia azedarach*	0	1	0	0	0	0	0
Barringtonia racemosa	0	20	5	0	0	<1	0
Planchonella nitida	0	5	0	0	0	0	0
Dysoxylum gaudichaudianum	0	15	5	0	0	0	0
Pandanus elatus	0	5	5	0	0	0	0
Tristiropsis acutangula	0	1	0	0	0	0	0
Arenga listeri	0	0	5	0	0	0	0
**Leucaena leucocephala*	0	0	<1	0	0	0	0
Asplenium nidus	0	0	0	0	70	<1	1
Maclura cochinchinensis var. *cochinchinensis*	0	0	0	0	<1	0	0
Allophyllus cobbe	0	0	0	0	<1	0	0
Claoxylon indicum	0	0	0	0	<1	0	0
Aidia aff. *racemosa*	0	0	0	0	<1	0	0
Nephrolepis biserrata	0	0	0	0	0	10	0
Pyrrosia lanceolata	0	0	0	0	0	0	1

N/A = Not Applicable; n/a = Not Assessed.

Field Data

Date: 6/19/2017 **Recorders:** RP **Location:** Area 122-MB2 **Site Number:** CI05
Coordinates: 573170 mE, 8840554 mN (WGS84, Zone 48) **Landform:** Plateau **Aspect:** Flat **Slope:** 0 **Altitude:** 203 (m) **Comments**: Small dip/valley in the terrain

Geoscience Australia (2014) Vegetation Classification: Regrowth **Height (m):** 10-15m
Vegetation Structural and Floristic Description: Secondary regrowth forest of *Planchonella nitida, Dysoxylum gaudichaudianum* and *Macaranga* over *Arenga* and *Pisonia umbellifera* with *Nephrolepis biserrata* and *Schefflera elliptica* abundant in the understory. **Canopy Height (m):** 15-20

Strata	E (m)	T1 (m)	T2 (m)	T3 (m)	S1 (m)	G (m)
Heights/Ranges		15-20	8-12	4-6	2-3	0-1

Vegetation Condition: Excellent - Very Good **Last Cleared:** 1982 **Source of degradation:** YCA present
Threatened Flora: 0 **Conservation Significant Fauna:** **Comments:**
Species: 14 (natives); 3 (weeds)

Species	Cover (%)						
	E	T1	T2	T3	S1	G	Epi
Macaranga tanarius	0	15	0	0	0	<1	0
Dysoxylum gaudichaudianum	0	20	15	0	0	0	0
Planchonella nitida	0	25	0	0	0	0	0
Arenga listeri	0	0	2	0	0	0	0
Pisonia umbellifera	0	0	3	0	0	0	0
Claoxylon indicum	0	0	0	1	0	0	0
Schefflera elliptica	0	0	0	2	20	0	0
Maclura cochinchinensis var. *cochinchinensis*	0	0	0	2	5	0	0
Nephrolepis biserrata	0	0	0	0	20	0	0
Asplenium nidus	0	0	0	0	1	0	1
Pandanus elatus	0	0	0	0	1	0	0
**Mimosa pudica*	0	0	0	0	<1	0	0
**Turnera ulmifolia*	0	0	0	0	1	<1	0
Tristiropsis acutangula	0	0	0	0	0	<1	0
Guettarda speciosa	0	0	0	0	0	<1	0
**Sida acuta*	0	0	0	0	0	<1	0
Pyrrosia lanceolata	0	0	0	0	0	0	1

N/A = Not Applicable; n/a = Not Assessed.

Field Data

Date: 6/19/2017 **Recorders:** RP **Location:** Area 122-MB2 **Site Number:** CI06
Coordinates: 573242 mE, 8840490 mN (WGS84, Zone 48) **Landform:** Plateau **Aspect:** Flat **Slope:** 0 **Altitude:** 211 (m) **Comments**:

Geoscience Australia (2014) Vegetation Classification: Regrowth **Height (m):** 15-20m
Vegetation Structural and Floristic Description: Secondary regrowth forest of *Macaranga tanarius* and *Dysoxylum gaudichaudianum* with *Ficus microcarpa*, over *Barringtonia racemosa* with *Schefflera elliptica* abundant in the understory. **Canopy Height (m):** 15-20

Strata	E (m)	T1 (m)	T2 (m)	T3 (m)	S1 (m)	G (m)
Heights/Ranges		15-20	10-14	4-8	1-2	0-1

Vegetation Condition: Very Good **Last Cleared:** 1982 **Source of degradation:** Landform disturbed and canopy gaps
Threatened Flora: 0 **Conservation Significant Fauna:** **Comments:**
Species: 14 (natives); 1 (weeds)

Species	Cover (%)						
	E	T1	T2	T3	S1	G	Epi
Macaranga tanarius	0	30	0	0	0	0	0
Dysoxylum gaudichaudianum	0	20	10	1	1	1	0
Ficus microcarpa	0	10	0	0	0	0	0
Tristiropsis acutangula	0	<1	0	0	<1	0	0
Arenga listeri	0	1	<1	0	0	0	0
Barringtonia racemosa	0	0	40	4	1	0	0
**Leucaena leucocephala*	0	0	0	<1	0	0	0
Combretum acuminatum	0	0	0	<1	1	0	0
Schefflera elliptica	0	0	0	0	10	25	0
Maclura cochinchinensis var. *cochinchinensis*	0	0	0	0	1	0	0
Pandanus elatus	0	0	0	0	<1	0	0
Davallia denticulata	0	0	0	0	0	1	0
Dendrocnide peltata var. *peltata*	0	0	0	0	0	<1	0
Asplenium nidus	0	0	0	0	0	0	1
Pyrrosia lanceolata	0	0	0	0	0	0	1

N/A = Not Applicable; n/a = Not Assessed.

Field Data

Date: 6/19/2017 **Recorders:** RP **Location:** Area 105-MB2 **Site Number:** CI07
Coordinates: 571340 mE, 8839118 mN (WGS84, Zone 48) **Landform:** Plateau **Aspect:** SE **Slope:** 5 **Altitude:** 206 (m) **Comments**: Very narrow strip of vegetation behind the temple. A 25 m radius site as recommended by Neldner et al. 2017 wasn't possible in this location.

Geoscience Australia (2014) Vegetation Classification: Regrowth **Height (m):** 10-15m
Vegetation Structural and Floristic Description: Secondary regrowth forest of *Dysoxylum gaudichaudianum*, *Tristiropsis acutangula* and *Planchonella nitida* with *Ficus microcarpa* dominant at this site, over *Arenga* with *Schefflera* and *Claoxylon indicum* in the understory. Weeds encroach from the clearing around the temple. **Canopy Height (m):** 15-20

Strata Heights/Ranges	E (m)	T1 (m)	T2 (m)	T3 (m)	S1 (m)	G (m)
		15-20	8-12		1-4	0-1

Vegetation Condition: Good **Last Cleared:** pre 1976 **Source of degradation:** Disturbed landform with tracks and weeds. YCA present.
Threatened Flora: 0 **Conservation Significant Fauna:** **Comments:**
Species: 12 (natives); 0 (weeds)

Species	Cover (%)						
	E	T1	T2	T3	S1	G	Epi
Dysoxylum gaudichaudianum	0	0	10	0	0	<1	0
Macaranga tanarius	0	0	0	0	0	0	0
Ficus microcarpa	0	0	0	0	0	0	0
Tristiropsis acutangula	0	0	0	0	0	1	0
Planchonella nitida	0	0	0	0	0	0	0
Arenga listeri	0	0	10	0	10	0	0
Schefflera elliptica	0	0	0	0	5	0	0
Claoxylon indicum	0	0	0	0	3	0	0
Asplenium nidus	0	0	0	0	<1	0	0
Guettarda speciosa	0	0	0	0	<1	0	0
Aidia aff. *racemosa*	0	0	0	0	2	0	0
Pyrrosia lanceolata	0	0	0	0	0	0	1

N/A = Not Applicable; n/a = Not Assessed.

Field Data

Date: 6/19/2017 **Recorders:** RP **Location:** Area 106-MB15 **Site Number:** CI08
Coordinates: 571285 mE, 8839018 mN (WGS84, Zone 48) **Landform:** Plateau **Aspect:** SE **Slope:** 5 **Altitude:** 206 (m) **Comments**: Dense vegetation; difficult to see all species; 5-10m visibility

Geoscience Australia (2014) Vegetation Classification: Regrowth **Height (m):** 10-15m
Vegetation Structural and Floristic Description: Mixed pioneer species and weeds; *Claoxylon indicum* with *Dysoxylum gaudichaudianum* and occasional *Macaranga* over a dense thicket of *Nephrolepis biserrata, *Cordia curassavica* and *Maclura*. **Canopy Height (m):** 10-15

Strata Heights/Ranges	E (m)	T1 (m)	T2 (m)	T3 (m)	S1 (m)	G (m)
		10-15	6-8		1-4	0-1

Vegetation Condition: Degraded **Last Cleared:** pre 1976 **Source of degradation:** Numerous weeds, disturbed landform, nearby exploration tracks, low diversity of native species
Threatened Flora: 0 **Conservation Significant Fauna:** CI Thrush, White eye **Comments:**
Species: 5 (natives); 2 (weeds)

Species	Cover (%)						
	E	T1	T2	T3	S1	G	Epi
Macaranga tanarius	0	2	0	0	0	0	0
Claoxylon indicum	0	0	50	0	0	0	0
Dysoxylum gaudichaudianum	0	0	10	0	0	0	0
Nephrolepis biserrata	0	0	0	0	50	0	0
**Cordia curassavica*	0	0	0	0	30	0	0
Maclura cochinchinensis var. *cochinchinensis*	0	0	0	0	20	0	0
**Leucaena leucocephala*	0	0	0	0	10	0	0

N/A = Not Applicable; n/a = Not Assessed.

Field Data

Date: 6/20/2017 **Recorders:** RP **Location:** Area 106-MB15 **Site Number:** CI09
Coordinates: 571383 mE, 8838954 mN (WGS84, Zone 48) **Landform:** Plateau **Aspect:** SE **Slope:** **Altitude:** 210 (m)
Comments: Pinnacle field starts roughly 8 m south-west.

Geoscience Australia (2014) Vegetation Classification: Regrowth **Height (m):** 5-10m
Vegetation Structural and Floristic Description: Dense thickets of mixed weeds and pioneer species on rocky and uneven terrain. **Canopy Height (m):** 10-15

Strata	E (m)	T1 (m)	T2 (m)	T3 (m)	S1 (m)	G (m)
Heights/Ranges	18	12-15	3-6		1-2	0-1

Vegetation Condition: Degraded **Last Cleared:** pre 1976 **Source of degradation:**
Threatened Flora: 0 **Conservation Significant Fauna:** CI Thrush, red crabs, robber crab **Comments:**
Species: 12 (natives); 2 (weeds)

Species	Cover (%)						
	E	T1	T2	T3	S1	G	Epi
Dysoxylum gaudichaudianum	3	5	0	0	0	0	0
Arenga listeri	0	2	<1	0	0	0	0
Pandanus elatus	0	20	10	0	0	0	0
Barringtonia racemosa	0	15	0	0	5	0	0
Syzygium nervosum	0	2	0	0	0	0	0
Macaranga tanarius	0	0	2	0	0	0	0
Claoxylon indicum	0	0	3	0	5	0	0
Maclura cochinchinensis var. *cochinchinensis*	0	0	0	0	0	0	0
Nephrolepis biserrata	0	0	0	0	5	5	0
**Cordia curassavica*	0	0	0	0	2	0	0
Schefflera elliptica	0	0	0	0	2	0	0
**Turnera ulmifolia*	0	0	0	0	0	1	0
Pyrrosia lanceolata	0	0	0	0	0	0	1
Asplenium nidus	0	0	0	0	0	0	1

N/A = Not Applicable; n/a = Not Assessed.

Field Data

Date: 6/20/2017 **Recorders:** RP **Location:** Area 106-MB15 **Site Number:** CI10
Coordinates: 571315 mE, 8838657 mN (WGS84, Zone 48) **Landform:** Plateau **Aspect:** S **Slope:** 1 **Altitude:** 206 (m)
Comments: Track cleared to west

Geoscience Australia (2014) Vegetation Classification: Regrowth **Height (m):** 5-10m
Vegetation Structural and Floristic Description: Low *Tristiropsis acutangula* and *Planchonella nitida* with *Macaranga* over *Claoxylon indicum, Arenga* and *Aidia* aff. *racemosa* with *Maclura* and weed species dominant in the understory.
Canopy Height (m): 5-10

Strata	E (m)	T1 (m)	T2 (m)	T3 (m)	S1 (m)	G (m)
Heights/Ranges		8-10	4-6		0.5-3	

Vegetation Condition: Degraded **Last Cleared:** pre 1976 **Source of degradation:** Road run-off, weeds, tree fall, tracks
Threatened Flora: 0 **Conservation Significant Fauna:** **Comments:**
Species: 10 (natives); 4 (weeds)

Species	Cover (%)						
	E	T1	T2	T3	S1	G	Epi
Macaranga tanarius	0	5	10	0	5	0	0
Tristiropsis acutangula	0	15	0	0	0	0	0
Planchonella nitida	0	10	0	0	0	0	0
Claoxylon indicum	0	0	10	0	5	0	0
**Leucaena leucocephala*	0	0	5	0	0	0	0
Dysoxylum gaudichaudianum	0	0	5	0	1	0	0
Maclura cochinchinensis var. *cochinchinensis*	0	0	1	0	10	0	0
Aidia aff. *racemosa*	0	0	10	0	2	0	0
Arenga listeri	0	0	15	0	0	0	0
**Mikania micrantha*	0	0	0	0	5	0	0
**Cordia curassavica*	0	0	0	0	5	0	0
**Turnera ulmifolia*	0	0	0	0	1	0	0
Asplenium nidus	0	0	0	0	0	0	1
Pyrrosia lanceolata	0	0	0	0	0	0	1

N/A = Not Applicable; n/a = Not Assessed.

Field Data

Date: 6/20/2017 **Recorders:** RP **Location:** Area 106-MB16 **Site Number:** CI11
Coordinates: 571814 mE, 8838744 mN (WGS84, Zone 48) **Landform:** Stockpiles **Aspect:** **Slope:** **Altitude:** 235 (m)
Comments: Wedged between road, tracks and pinnacles. 15 m veg is nearby.

No Photo.

Geoscience Australia (2014) Vegetation Classification: Regrowth **Height (m):** 10-15m
Vegetation Structural and Floristic Description: Low *Tristiropsis acutangula* and *Dysoxylum gaudichaudianum* over *Claoxylon indicum* and *Pisonia umbellata*. Seedlings dominant in the understory. **Canopy Height (m):** 5-10

Strata	E (m)	T1 (m)	T2 (m)	T3 (m)	S1 (m)	G (m)
Heights/Ranges		5-10	3-5		1-2	

Vegetation Condition: **Last Cleared:** pre 1976 **Source of degradation:**
Threatened Flora: 0 **Conservation Significant Fauna:** Red crabs **Comments:**
Species: 9 (natives); 2 (weeds)

Species	**Cover (%)**						
	E	**T1**	**T2**	**T3**	**S1**	**G**	**Epi**
Tristiropsis acutangula	0	5	15	0	3	0	0
Dysoxylum gaudichaudianum	0	5	10	0	0	0	0
Claoxylon indicum	0	0	20	0	0	0	0
Pisonia umbellifera	0	0	20	0	0	0	0
Arenga listeri	0	0	10	0	0	0	0
**Leucaena leucocephala*	0	0	5	0	0	0	0
Schefflera elliptica	0	0	0	0	1	0	0
Maclura cochinchinensis var. *cochinchinensis*	0	0	0	0	2	0	0
**Cordia curassavica*	0	0	0	0	2	0	0
Dioscorea alata	0	0	0	0	0	0	1
Asplenium nidus	0	0	0	0	0	0	1

N/A = Not Applicable; n/a = Not Assessed.

Field Data

Date: 6/20/2017 **Recorders:** RP **Location:** Area 116-MB5 **Site Number:** CI12
Coordinates: 566950 mE, 8841079 mN (WGS84, Zone 48) **Landform:** Plateau **Aspect:** East **Slope:** 6 **Altitude:** 248 (m) **Comments**: Narrow wedge of vegetation adjacent to road.

Geoscience Australia (2014) Vegetation Classification: Regrowth **Height (m):** 10-15m
Vegetation Structural and Floristic Description: Mid-level *Macaranga* and *Dysoxylum gaudichaudianum* with *Inocarpus fagifer* over *Pisonia umbellata*, *Tristiropsis and Arenga*, with *Combretum acuminatum*, *Nephrolepis biserrata* and *Maclura* in the understory. **Canopy Height (m):** 15-20

Strata	E (m)	T1 (m)	T2 (m)	T3 (m)	S1 (m)	G (m)
Heights/Ranges		15-20	8-12		1-4	0-1

Vegetation Condition: Very Good **Last Cleared:** pre 1976 **Source of degradation:**
Threatened Flora: 0 **Conservation Significant Fauna:** **Comments:**
Species: 15 (natives); 0 (weeds)

Species	Cover (%)						
	E	T1	T2	T3	S1	G	Epi
Macaranga tanarius	0	30	0	0	0	0	0
Dysoxylum gaudichaudianum	0	20	10	0	1	0	0
Inocarpus fagifer	0	10	0	0	0	0	0
Tristiropsis acutangula	0	0	10	0	0	0	0
Pisonia umbellifera	0	0	30	0	0	0	0
Arenga listeri	0	0	5	0	4	0	0
Planchonella nitida	0	0	0	0	<1	0	0
Combretum acuminatum	0	0	0	0	5	2	0
Nephrolepis biserrata	0	0	0	0	5	2	0
Pandanus elatus	0	0	0	0	1	0	0
Maclura cochinchinensis var. *cochinchinensis*	0	0	0	0	5	0	0
Corymborkis veratrifolia	0	0	0	0	<1	0	0
Asplenium nidus	0	0	0	0	0	0	1
Pyrrosia lanceolata	0	0	0	0	0	0	1
Barringtonia racemosa	0	0	0	0	0	<1	0

N/A = Not Applicable; n/a = Not Assessed.

Field Data

Date: 6/21/2017 **Recorders:** RP **Location:** Area 106-MB12 **Site Number:** CI13
Coordinates: 569976 mE, 8838628 mN (WGS84, Zone 48) **Landform:** Stockpiles **Aspect:** SW **Slope:** 1 **Altitude:** 161 (m) **Comments**:

Geoscience Australia (2014) Vegetation Classification: Regrowth **Height (m):** 15-20m
Vegetation Structural and Floristic Description: Excellent advanced secondary regrowth of *Barringtonia racemosa* with *Ficus microcarpa* over a dense subcanopy of *Barringtonia racemosa* with *Pandanus, Pisonia umbellata* and *Claoxylon indicum*, with an open understory of saplings, seedlings and the climax orchid *Corymborkis veratrifolia*.
Canopy Height (m): 15-20

Strata	E (m)	T1 (m)	T2 (m)	T3 (m)	S1 (m)	G (m)
Heights/Ranges		15-20	8-15	6-8	1-4	0-1

Vegetation Condition: Excellemt **Last Cleared:** pre 1976 **Source of degradation:** No red crabs at all which is concerning. YCA seen.
Threatened Flora: 0 **Conservation Significant Fauna:** CI Thrush and white eye **Comments:**
Species: 19 (natives); 1 (weeds)

Species	Cover (%)						
	E	T1	T2	T3	S1	G	Epi
Barringtonia racemosa	0	50	65	25	2	2	0
Macaranga tanarius	0	<1	0	0	0	0	0
Inocarpus fagifer	0	1	0	0	0	0	0
Syzygium nervosum	0	<1	0	0	0	0	0
Ficus microcarpa	0	15	0	0	0	0	0
Pandanus elatus	0	0	2	<1	3	1	0
Melochia umbellata	0	0	0	<1	0	0	0
Arenga listeri	0	0	<1	0	1	1	0
Claoxylon indicum	0	0	2	<1	2	0	0
Pisonia umbellifera	0	0	2	0	0	0	0
**Psidium guajava*	0	0	0	<1	0	0	0
Corymborkis veratrifolia	0	0	0	0	1	1	0
Maclura cochinchinensis var. *cochinchinensis*	0	0	0	0	<1	0	0
Combretum acuminatum	0	0	0	0	<1	0	0
Leea angulata	0	0	0	0	<1	0	0
Microlepia speluncae	0	0	0	0	0	<1	0
Tristiropsis acutangula	0	0	0	0	0	<1	0
Pisonia umbellifera	0	0	0	0	0	<1	0
Pyrrosia lanceolata	0	0	0	0	0	0	1
Asplenium nidus	0	0	0	0	0	0	1

N/A = Not Applicable; n/a = Not Assessed.

Field Data

Date: 6/21/2017 **Recorders:** RP **Location:** Area 106-MB12 **Site Number:** CI14
Coordinates: 570054 mE, 8838536 mN (WGS84, Zone 48) **Landform:** Plateau **Aspect:** W **Slope:** **Altitude:** 177 (m)
Comments: <10 m visibility

Geoscience Australia (2014) Vegetation Classification: Regrowth **Height (m):** 5-10m
Vegetation Structural and Floristic Description: Low, open regrowth of *Tristiropsis, Macaranga* and *Planchonella nitida* over dense **Cordia* thicket with occasional *Pandanus* saplings, *Nephrolepis biserrata* and *Asplenium nidus*
Canopy Height (m): 5-10

Strata	E (m)	T1 (m)	T2 (m)	T3 (m)	S1 (m)	G (m)
Heights/Ranges		5-8			1-3	0-1

Vegetation Condition: Degraded **Last Cleared:** pre 1976 **Source of degradation:** **Cordia* thicket
Threatened Flora: 0 **Conservation Significant Fauna:** No animals **Comments:**
Species: 11 (natives); 2 (weeds)

Species	Cover (%)						
	E	T1	T2	T3	S1	G	Epi
Tristiropsis acutangula	0	10	0	0	0	0	0
Macaranga tanarius	0	5	0	0	0	0	0
Planchonella nitida	0	5	0	0	0	0	0
Kleinhovia hospita	0	<1	0	0	0	0	0
**Cordia curassavica*	0	0	0	0	0	80	0
Asplenium nidus	0	0	0	0	0	5	2
Pandanus elatus	0	0	0	0	0	5	1
Maclura cochinchinensis var. *cochinchinensis*	0	0	0	0	0	<1	0
Claoxylon indicum	0	0	0	0	0	<1	0
Dysoxylum gaudichaudianum	0	0	0	0	0	<1	0
Nephrolepis biserrata	0	0	0	0	0	0	2
Microsorum scolopendria	0	0	0	0	0	0	<1
**Leucaena leucocephala*	0	0	0	0	0	0	<1

N/A = Not Applicable; n/a = Not Assessed.

Field Data

Date: 6/21/2017 **Recorders:** RP **Location:** Area 106-MB12 **Site Number:** CI15
Coordinates: 570306 mE, 8838692 mN (WGS84, Zone 48) **Landform:** Plateau **Aspect:** **Slope:** **Altitude:** 159 (m)
Comments:

Geoscience Australia (2014) Vegetation Classification: Regrowth **Height (m):** 5-10m
Vegetation Structural and Floristic Description: Poor quality regrowth, mostly shrubland, dominated by **Muntingia, *Leucaena, Claoxylon* and *Pandanus*, with sparse low *Planchonella nitida, Macaranga* and *Syzygium*. Weed species and *Maclura* are dominant in the understory, with *Nephrolepis biserrata*, seedlings and weeds as a ground cover.
Canopy Height (m): 10-15

Strata	E (m)	T1 (m)	T2 (m)	T3 (m)	S1 (m)	G (m)
Heights/Ranges		7-10	2-6		1-2	0-1

Vegetation Condition: Good - Degraded **Last Cleared:** pre 1976 **Source of degradation:** Lots of weeds
Threatened Flora: 0 **Conservation Significant Fauna:** **Comments:**
Species: 11 (natives); 7 (weeds)

Species	Cover (%)						
	E	T1	T2	T3	S1	G	Epi
Planchonella nitida	0	10	0	0	0	0	0
Pandanus elatus	0	15	15	0	0	0	0
Syzygium nervosum	0	5	0	0	0	0	0
Arenga listeri	0	1	0	0	0	2	0
Dysoxylum gaudichaudianum	0	1	0	0	0	0	0
Macaranga tanarius	0	2	0	0	0	0	0
**Leucaena leucocephala*	0	0	2	0	0	<1	0
**Clausena excavata*	0	0	5	0	0	0	0
Claoxylon indicum	0	0	10	0	5	0	0
**Muntingia calabura*	0	0	20	0	0	0	0
**Cordia curassavica*	0	0	0	0	<1	0	0
Maclura cochinchinensis var. *cochinchinensis*	0	0	0	0	5	0	0
**Hyptis capitata*	0	0	0	0	2	1	0
**Stachytarpheta cayennensis*	0	0	0	0	2	0	0
Nephrolepis biserrata	0	0	0	0	0	5	0
**Mimosa pudica*	0	0	0	0	0	<1	0
Asplenium nidus	0	0	0	0	0	1	0
Pisonia umbellifera	0	0	0	0	0	<1	0

N/A = Not Applicable; n/a = Not Assessed.

Field Data

Date: 6/22/2017 **Recorders:** RP **Location:** Area 109-MB1 **Site Number:** CI16
Coordinates: 569256 mE, 8839270 mN (WGS84, Zone 48) **Landform:** Plateau **Aspect:** SW **Slope:** 2 **Altitude:** 189 (m) **Comments**:

Geoscience Australia (2014) Vegetation Classification: Regrowth **Height (m):** 10-15m
Vegetation Structural and Floristic Description: Isolated *Macaranga* over *Claoxylon, Pandanus* and *Arenga*, with **Leucaena, Planchonella, Dysoxylum* and *Tristiropsis*, over tall *Nephrolepis biserrata*. **Canopy Height (m):** 5-15

Strata	E (m)	T1 (m)	T2 (m)	T3 (m)	S1 (m)	G (m)
Heights/Ranges		8-10	3-5		1-2.5	0-0.5

Vegetation Condition: Good - Degraded **Last Cleared:** pre 1976 **Source of degradation:** Cyclone damage - tree fall, weeds
Threatened Flora: 0 **Conservation Significant Fauna:** **Comments:**
Species: 12 (natives); 1 (weeds)

Species	Cover (%)						
	E	T1	T2	T3	S1	G	Epi
Macaranga tanarius	0	5	0	0	0	0	0
Claoxylon indicum	0	0	15	0	0	0	0
**Leucaena leucocephala*	0	0	5	0	0	0	0
Pandanus elatus	0	0	20	0	0	0	0
Arenga listeri	0	0	5	0	15	0	0
Planchonella nitida	0	0	3	0	0	0	0
Dysoxylum gaudichaudianum	0	0	2	0	0	0	0
Tristiropsis acutangula	0	0	2	0	0	0	0
Alchornea rugosa	0	0	1	0	0	0	0
Inocarpus fagifer	0	0	<1	0	0	0	0
Nephrolepis biserrata	0	0	0	0	45	<1	0
Maclura cochinchinensis var. *cochinchinensis*	0	0	0	0	1	0	0
Asplenium nidus	0	0	0	0	0	1	1

N/A = Not Applicable; n/a = Not Assessed.

Field Data

Date: 6/22/2017 **Recorders:** RP **Location:** Area 109-MB1 **Site Number:** CI18
Coordinates: 569324 mE, 8839309 mN (WGS84, Zone 48) **Landform:** Plateau **Aspect:** SE **Slope:** 3 **Altitude:** 191 (m) **Comments**:

Geoscience Australia (2014) Vegetation Classification: Regrowth **Height (m):** 10-15m
Vegetation Structural and Floristic Description: Isolated *Macaranga* and *Dysoxylum* over *Arenga* and *Claoxylon indicum*, with *Tristiropsis* and occasional *Planchonella* and *Pisonia umbellata*. The understory is a fernland dominated by *Microsorum scolopendria* with *Nephrolepis biserrata* and occasional *Davallia denticulata*. Scattered guava occur throughout the area and **Centrosema molle* is present climbing over the subcanopy and understory. **Canopy Height (m):** 5-10

Strata Heights/Ranges	E (m)	T1 (m)	T2 (m)	T3 (m)	S1 (m)	G (m)
		8-10	3-6		1-2	0-1

Vegetation Condition: Good **Last Cleared:** pre 1976 **Source of degradation:** Appears to be young regrowth; nearby exploration track was cleared in 2000.
Threatened Flora: 0 **Conservation Significant Fauna:** **Comments:**
Species: 14 (natives); 3 (weeds)

Species	Cover (%)						
	E	T1	T2	T3	S1	G	Epi
Macaranga tanarius	0	3	0	0	0	0	0
Dysoxylum gaudichaudianum	0	2	0	0	0	0	0
Pisonia umbellifera	0	0	<1	0	0	0	0
Claoxylon indicum	0	0	10	0	0	0	0
Arenga listeri	0	0	25	0	10	0	0
Tristiropsis acutangula	0	0	5	0	<1	0	0
Dysoxylum gaudichaudianum	0	0	2	0	<1	0	0
**Psidium guajava*	0	0	5	0	0	0	0
Planchonella nitida	0	0	1	0	0	0	0
Arenga listeri	0	0	0	0	0	0	0
**Leucaena leucocephala*	0	0	0	0	1	0	0
Maclura cochinchinensis var. *cochinchinensis*	0	0	0	0	2	0	0
Microsorum scolopendria	0	0	0	0	0	40	0
Nephrolepis biserrata	0	0	0	0	0	15	0
Davallia denticulata	0	0	0	0	0	2	0
Asplenium nidus	0	0	0	0	0	<1	0
**Centrosema molle*	0	0	0	0	0	0	Vine

N/A = Not Applicable; n/a = Not Assessed.

Field Data

Date: 6/22/2017 **Recorders:** RP **Location:** Area 109-MB1 **Site Number:** CI19
Coordinates: 569508 mE, 8839171 mN (WGS84, Zone 48) **Landform:** Plateau **Aspect:** SW **Slope:** 15 **Altitude:** 175 (m) **Comments**:

Geoscience Australia (2014) Vegetation Classification: Regrowth **Height (m):** 5-10m
Vegetation Structural and Floristic Description: Retrograde regrowth with isolated *Macaranga* over **Aleurites moluccana* and **Leucaena*, with occasional *Arenga* and *Claoxylon*, over closed tall *Nephrolepis* ferns. **Canopy Height (m):** 10-15

Strata Heights/Ranges	E (m)	T1 (m)	T2 (m)	T3 (m)	S1 (m)	G (m)
		8-10	5-7		1-3	

Vegetation Condition: Good - Degraded **Last Cleared:** pre 1976 **Source of degradation:** No climax trees, lots of ferns and *Leucaena dominant
Threatened Flora: 0 **Conservation Significant Fauna:** CI Goshawk **Comments:**
Species: 8 (natives); 2 (weeds)

Species	Cover (%)						
	E	T1	T2	T3	S1	G	Epi
Macaranga tanarius	0	10	0	0	0	0	0
**Leucaena leucocephala*	0	0	15	0	0	0	0
**Aleurites moluccana*	0	0	20	0	0	0	0
Arenga listeri	0	0	1	0	0	0	0
Claoxylon indicum	0	0	<1	0	0	0	0
Nephrolepis biserrata	0	0	0	0	95	0	0
Maclura cochinchinensis var. *cochinchinensis*	0	0	0	0	<1	0	0
Asplenium polyodon	0	0	0	0	0	<1	0
Asplenium nidus	0	0	0	0	0	0	1
Pyrrosia lanceolata	0	0	0	0	0	0	1

N/A = Not Applicable; n/a = Not Assessed.

Field Data

Date: 6/22/2017 **Recorders:** RP **Location:** Area 109-MB1 **Site Number:** CI20
Coordinates: 569101 mE, 8839125 mN (WGS84, Zone 48) **Landform:** Plateau **Aspect:** SW **Slope:** 15 **Altitude:** 196 (m) **Comments**:

Geoscience Australia (2014) Vegetation Classification: Regrowth **Height (m):** 5-10m
Vegetation Structural and Floristic Description: Low, open regrowth of *Dysoxylum gaudichaudianum* and **Leucaena* with *Claoxylon indicum* and occasional *Arenga* over dense *Nephrolepis biserrata* and *Maclura*. **Canopy Height (m):** 5-10

Strata	E (m)	T1 (m)	T2 (m)	T3 (m)	S1 (m)	G (m)
Heights/Ranges		4-10			1-3	0-1

Vegetation Condition: Good **Last Cleared:** pre 1976 **Source of degradation:** Taller trees, probably Macarangas, have died.
Threatened Flora: 0 **Conservation Significant Fauna:** CI Goshawk, CI Thrush **Comments:** Same thrush as at CI19; following me
Species: 7 (natives); 1 (weeds)

Species	Cover (%)						
	E	T1	T2	T3	S1	G	Epi
Maclura cochinchinensis var. *cochinchinensis*	0	5	0	0	10	0	0
**Leucaena leucocephala*	0	10	0	0	0	0	0
Claoxylon indicum	0	5	0	0	0	0	0
Arenga listeri	0	1	0	0	1	0	0
Dysoxylum gaudichaudianum	0	15	0	0	0	0	0
Nephrolepis biserrata	0	0	0	0	60	70	0
Asplenium nidus	0	0	0	0	0	0	1
Pyrrosia lanceolata	0	0	0	0	0	0	1

N/A = Not Applicable; n/a = Not Assessed.

Field Data

Date: 6/23/2017 **Recorders:** RP & SA **Location:** Area 110-MB1 **Site Number:** CI21
Coordinates: 568335 mE, 8839032 mN (WGS84, Zone 48) **Landform:** Plateau **Aspect:** Flat **Slope:** **Altitude:** 250 (m) **Comments**:

Geoscience Australia (2014) Vegetation Classification: Regrowth **Height (m):** 10-15m
Vegetation Structural and Floristic Description: *Dysoxylum gaudichaudianum* over *Pittosporum ferrugineum* with *Tristiropsis* and *Guettarda speciosa*, over *Arenga* with occasional *Maclura* and dense *Nephrolepis biserrata* in the understory. **Canopy Height (m):** 5-10

Strata	E (m)	T1 (m)	T2 (m)	T3 (m)	S1 (m)	G (m)
Heights/Ranges		8-10	4-6		1-4	0-1

Vegetation Condition: Very Good - Good **Last Cleared:** pre 1976 **Source of degradation:** Low diversity in the canopy
Threatened Flora: 0 **Conservation Significant Fauna:** **Comments:**
Species: 10 (natives); 1 (weeds)

Species	Cover (%)						
	E	T1	T2	T3	S1	G	Epi
Arenga listeri	0	<1	5	0	25	0	0
Dysoxylum gaudichaudianum	0	30	5	0	<1	0	0
Guettarda speciosa	0	0	2	0	0	0	0
Tristiropsis acutangula	0	0	5	0	<1	<1	0
Pittosporum ferrugineum	0	0	15	0	0	0	0
?Guettarda speciosa	0	0	<1	0	0	0	0
**Cordia curassavica*	0	0	0	0	<1	<1	0
Maclura cochinchinensis var. *cochinchinensis*	0	0	0	0	2	2	0
Nephrolepis biserrata	0	0	0	0	0	60	0
Pyrrosia lanceolata	0	0	0	0	0	0	1
Asplenium nidus	0	0	0	0	0	0	1

N/A = Not Applicable; n/a = Not Assessed.

Field Data

Date: 6/23/2017 **Recorders:** RP & SA **Location:** Area 110-MB1 **Site Number:** CI22
Coordinates: 568296 mE, 8838971 mN (WGS84, Zone 48) **Landform:** Plateau **Aspect:** SW **Slope:** 1 **Altitude:** 175 (m) **Comments**:

Geoscience Australia (2014) Vegetation Classification: Regrowth **Height (m):** 10-15m
Vegetation Structural and Floristic Description: *Macaranga* over occasional *Celtis timorensis*, *Tristiropsis* and **Leucaena*, over *Arenga* and *Pandanus* with *Maclura*. Sparse groundcover of seedlings and *Nephrolepis biserrata*.
Canopy Height (m): 10-15

Strata	E (m)	T1 (m)	T2 (m)	T3 (m)	S1 (m)	G (m)
Heights/Ranges		8-10	4-6		1-4	0-1

Vegetation Condition: Good - Degraded **Last Cleared:** pre 1976 **Source of degradation:** Weeds, nearby exploration clearing in 2009
Threatened Flora: 0 **Conservation Significant Fauna:** **Comments:**
Species: 14 (natives); 5 (weeds)

Species	Cover (%)						
	E	T1	T2	T3	S1	G	Epi
Macaranga tanarius	0	40	1	0	0	0	0
Celtis timorensis	0	0	1	0	0	0	0
Tristiropsis acutangula	0	0	2	0	<1	<1	0
**Leucaena leucocephala*	0	0	2	0	2	0	0
Guettarda speciosa	0	0	<1	0	0	0	0
**Psidium guajava*	0	0	0	0	<1	0	0
Maclura cochinchinensis var. *cochinchinensis*	0	0	0	0	5	0	0
Arenga listeri	0	0	0	0	15	<1	0
Pandanus elatus	0	0	0	0	10	0	0
Dysoxylum gaudichaudianum	0	0	0	0	<1	1	0
Combretum acuminatum	0	0	0	0	<1	<1	0
**Cordia curassavica*	0	0	0	0	<1	0	0
**Muntingia calabura*	0	0	0	0	<1	0	0
Nephrolepis biserrata	0	0	0	0	0	5	0
**Stachytarpheta cayennensis*	0	0	0	0	0	<1	0
Davallia solida	0	0	0	0	0	<1	0
Pachygone ovata	0	0	0	0	0	<1	0
Pittosporum ferrugineum	0	0	0	0	0	<1	0
Asplenium nidus	0	0	0	0	0	0	1

N/A = Not Applicable; n/a = Not Assessed.

Field Data

Date: 6/23/2017 **Recorders:** RP & SA **Location:** Area 110-MB1 **Site Number:** CI23
Coordinates: 568274 mE, 8839328 mN (WGS84, Zone 48) **Landform:** Plateau **Aspect:** NE **Slope:** 15 **Altitude:** 177 (m) **Comments**:

Geoscience Australia (2014) Vegetation Classification: Regrowth **Height (m):** 15-20m
Vegetation Structural and Floristic Description: *Macaranga tanarius* with occasional *Dysoxylum* and a nearby *Ficus microcarpa*, over *Claoxylon indicum* with occasional *Planchonella nitida*, over *Nephrolepis biserrata* and *Maclura*.
Canopy Height (m): 15-20

Strata	E (m)	T1 (m)	T2 (m)	T3 (m)	S1 (m)	G (m)
Heights/Ranges		12-18	4-6		1-3.5	0-0.6

Vegetation Condition: Good **Last Cleared:** pre 1976 **Source of degradation:**
Threatened Flora: 0 **Conservation Significant Fauna:** **Comments:**
Species: 12 (natives); 2 (weeds)

Species	Cover (%)						
	E	T1	T2	T3	S1	G	Epi
Macaranga tanarius	0	70	0	0	0	0	0
Dysoxylum gaudichaudianum	0	5	2	0	5	0	0
Ficus microcarpa	0	25	0	0	0	0	0
Claoxylon indicum	0	0	15	0	0	0	0
Planchonella nitida	0	0	1	0	0	0	0
Guettarda speciosa	0	0	1	0	0	0	0
Maclura cochinchinensis var. *cochinchinensis*	0	0	5	0	20	0	0
Nephrolepis biserrata	0	0	0	0	60	0	1
**Leucaena leucocephala*	0	0	0	0	2	0	0
**Psidium guajava*	0	0	0	0	1	0	0
Tristiropsis acutangula	0	0	0	0	1	0	0
Arenga listeri	0	0	0	0	2	0	0
Asplenium nidus	0	0	0	0	0	0	1
Pyrrosia lanceolata	0	0	0	0	0	0	1

Date: 6/23/2017 **Recorders:** RP & SA **Location:** Area 110-MB1 **Site Number:** CI24
Coordinates: 568206 mE, 8839346 mN (WGS84, Zone 48) **Landform:** Plateau **Aspect:** Flat **Slope:** 0 **Altitude:** 156 (m) **Comments**:

N/A = Not Applicable; n/a = Not Assessed.

Field Data

No Photo.

Geoscience Australia (2014) Vegetation Classification: Regrowth **Height (m):** 10-15m
Vegetation Structural and Floristic Description: *Macaranga tanarius* with occasional *Dysoxylum, Aleurites moluccana* and *Ehretia javanica* over *Claoxylon indicum* with **Spathodea campanulata* and **Leucaena*. Sparse understory of *Nephrolepis biserrata* with weeds and seedlings. **Canopy Height (m):** 15-20

Strata	E (m)	T1 (m)	T2 (m)	T3 (m)	S1 (m)	G (m)
Heights/Ranges		12-16	4-10		1-3	0-1

Vegetation Condition: Excellent - Very Good **Last Cleared:** pre 1976 **Source of degradation:** Nearby expl. track cleared 2009
Threatened Flora: 0 **Conservation Significant Fauna:** **Comments:**
Species: 11 (natives); 6 (weeds)

Species	**Cover (%)**						
	E	**T1**	**T2**	**T3**	**S1**	**G**	**Epi**
Macaranga tanarius	0	60	0	0	0	0	0
Dysoxylum gaudichaudianum	0	2	40	0	1	<1	0
**Aleurites moluccana*	0	2	0	0	0	0	0
Ehretia javanica	0	2	0	0	0	0	0
**Spathodea campanulata*	0	0	2	0	0	0	0
**Leucaena leucocephala*	0	0	2	0	<1	0	0
Claoxylon indicum	0	0	5	0	2	0	0
Planchonella nitida	0	0	<1	0	0	0	0
Arenga listeri	0	0	0	0	5	0	0
Tristiropsis acutangula	0	0	0	0	<1	<1	0
**Psidium guajava*	0	0	0	0	<1	0	0
**Capsicum frutescens*	0	0	0	0	0	<1	0
**Stachytarpheta cayennensis*	0	0	0	0	0	<1	0
Davallia solida	0	0	0	0	0	<1	0
Nephrolepis biserrata	0	0	0	0	0	15	0
Asplenium nidus	0	0	0	0	0	0	1
Pyrrosia lanceolata	0	0	0	0	0	0	1

N/A = Not Applicable; n/a = Not Assessed.

Appendix B – Species List

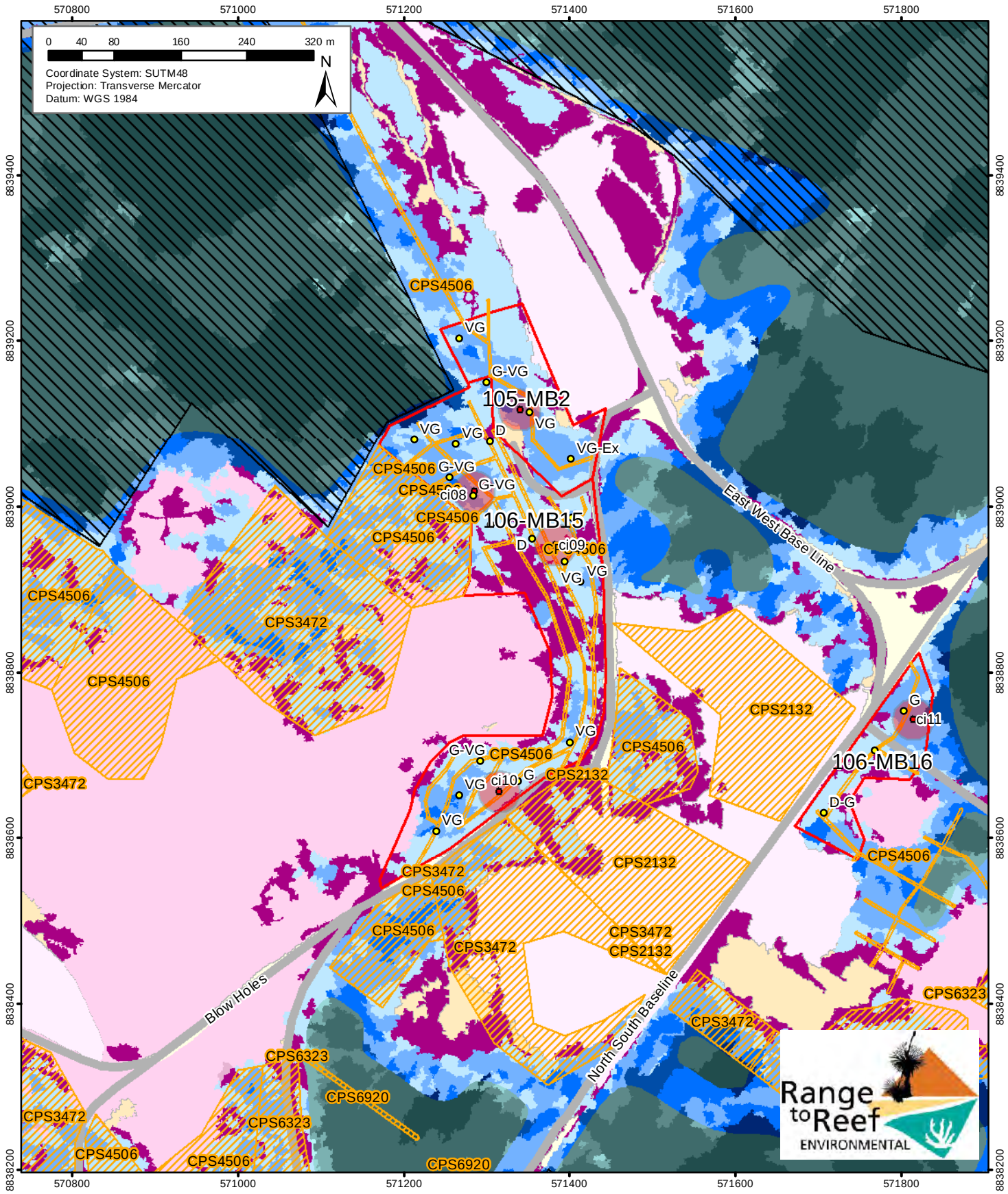
§: denotes endemic species
*: denotes foreign introduced species
?: denotes status unknown

FAMILY		TAXA	105-MB2	106-MB12	106-MB15	106-MB16	109-MB1	110-MB1	116-MB5	122-MB2	126-STP9F	127-STP9E
ACANTHACEAE	*	*Asystasia gangetica*		+	+				+			
APOCYNACEAE	§	*Hoya aldrichii*			+							
		Ochrosia ackeringae			+							
ARALIACEAE		*Schefflera elliptica*	+	+	+	+	+		+	+	+	+
ARECACEAE	§	*Arenga listeri*	+	+	+	+	+	+	+	+	+	+
		Cocos nucifera			+	+						
ASPLENIACEAE		*Asplenium nidus*	+	+	+	+	+	+	+	+	+	+
		Asplenium polyodon					+					
ASTERACEAE	*	*Mikania micrantha*	+	+	+	+		+	+			
	*	*Tithonia diversifolia*			+	+						
BIGNONIACEAE	*	*Spathodea campanulata*						+				
	*	*Tecoma stans* var. *stans*		+								
BORAGINACEAE	*	*Cordia curassavica*	+	+	+	+	+	+	+			+
		Ehretia javanica						+		+		
CAESALPINIACEAE	*	*Senna occidentalis*	+									
CANNABACEAE		*Celtis timorensis*						+				+
CARICACEAE	*	*Carica papaya*				+			+			
COMBRETACEAE		*Combretum acuminatum*		+				+	+	+		
CYPERACEAE	?	Cyperaceae sp.	+		+	+						
DAVALLIACEAE		*Davallia denticulata*					+			+		+
		Davallia solida						+			+	
		Nephrolepis biserrata	+	+	+	+	+	+	+	+	+	+
DENNSTAEDTIACEAE		*Microlepia speluncae*		+	+			+			+	
DIOSCOREACEAE		*Dioscorea alata*			+	+						
DRYOPTERIDACEAE		*Tectaria dissecta*										+
EUPHORBIACEAE		*Alchornea rugosa*					+					
	*	*Aleurites moluccana*					+	+				

FAMILY		TAXA	105-MB2	106-MB12	106-MB15	106-MB16	109-MB1	110-MB1	116-MB5	122-MB2	126-STP9F	127-STP9E
		Claoxylon indicum	+	+	+	+	+	+	+	+	+	+
	*	*Euphorbia* sp.				+						
		Macaranga tanarius	+	+	+	+	+	+	+	+	+	+
	*	*Manihot glaziovii*	+		+							
		Sauropus androgynous			+							
FABACEAE	*	*Centrosema molle*					+					
		Inocarpus fagifer		+			+		+	+	+	+
		Pongamia pinnata					+					
FLACOURTIACEAE	*	*Muntingia calabura*	+	+	+	+		+		+		+
LAMIACEAE	*	*Hyptis capitata*	+	+					+			
LECTHYTHIDACEAE		*Barringtonia racemosa*		+	+		+	+	+	+	+	+
LOMARIOPSIDACEAE		*Bolbitis heteroclita*									+	
MALVACEAE		*Kleinhovia hospita*		+								
		Melochia umbellata		+	+							
	*	*Sida acuta*								+		+
		Sida rhombifolia		+								
		Sida sp.	+									
		Urena lobata										+
MELIACEAE		*Dysoxylum gaudichaudianum*	+	+	+	+	+	+	+	+	+	+
	*	*Melia azedarach*		+					+			+
MENISPERMACEAE		*Pachygone ovata*						+				
MIMOSACEAE	*	*Leucaena leucocephala*		+	+	+	+	+	+	+	+	+
	*	*Mimosa invisa*							+			
	*	*Mimosa pudica*	+	+	+			+		+		+
MORACEAE		*Ficus microcarpa*	+	+				+		+		
		Maclura cochinchinensis var. *cochinchinensis*		+	+	+	+	+	+	+	+	+
MYRTACEAE	*	*Psidium guajava*		+		+	+	+				
		Syzygium nervosum		+	+					+		+
NYCTAGINACEAE		*Pisonia umbellifera*		+		+	+		+	+	+	
ORCHIDACEAE		*Corymborkis veratrifolia*		+					+	+		

FAMILY		TAXA	105-MB2	106-MB12	106-MB15	106-MB16	109-MB1	110-MB1	116-MB5	122-MB2	126-STP9F	127-STP9E
PANDANACEAE	§	*Pandanus elatus*		+	+	+	+	+	+	+	+	+
PITTOSPORACEAE		*Pittosporum ferrugineum*						+	+			
POACEAE	?	Poaceae sp. 1	+									
	?	Poaceae sp. 2	+									
POLYPODIACEAE		*Pyrrosia lanceolata*	+	+	+	+	+	+	+	+	+	+
		Microsorum scolopendria		+	+		+					+
RUBIACEAE		*Aidia* aff. *racemosa*	+	+								+
		Guettarda speciosa	+		+			+		+		
RUTACEAE	*	*Clausena excavata*		+								+
SAPINDACEAE		*Allophyllus cobbe*		+							+	+
		Tristiropsis acutangula	+	+	+	+	+	+	+	+	+	+
SAPOTACEAE		*Planchonella nitida*	+	+	+	+	+	+	+	+	+	+
SOLANACEAE	*	*Capsicum frutescens*						+	+		+	
TURNERACEAE	*	*Turnera ulmifolia*		+	+	+				+		
URTICACEAE		*Dendrocnide peltata* var. *peltata*								+	+	+
VERBENACEAE	*	*Stachytarpheta cayennensis*	+	+	+			+	+		+	+
VITACEAE		*Cayratia japonica*		+				+				+
		Cissus repens								+		
		Leea angulata		+			+			+	+	+
#N/A	?	*Indeterminate tree*									+	

Appendix C – Vegetation Maps



Vegetation Map 105-MB2 and 106-MB15

Legend

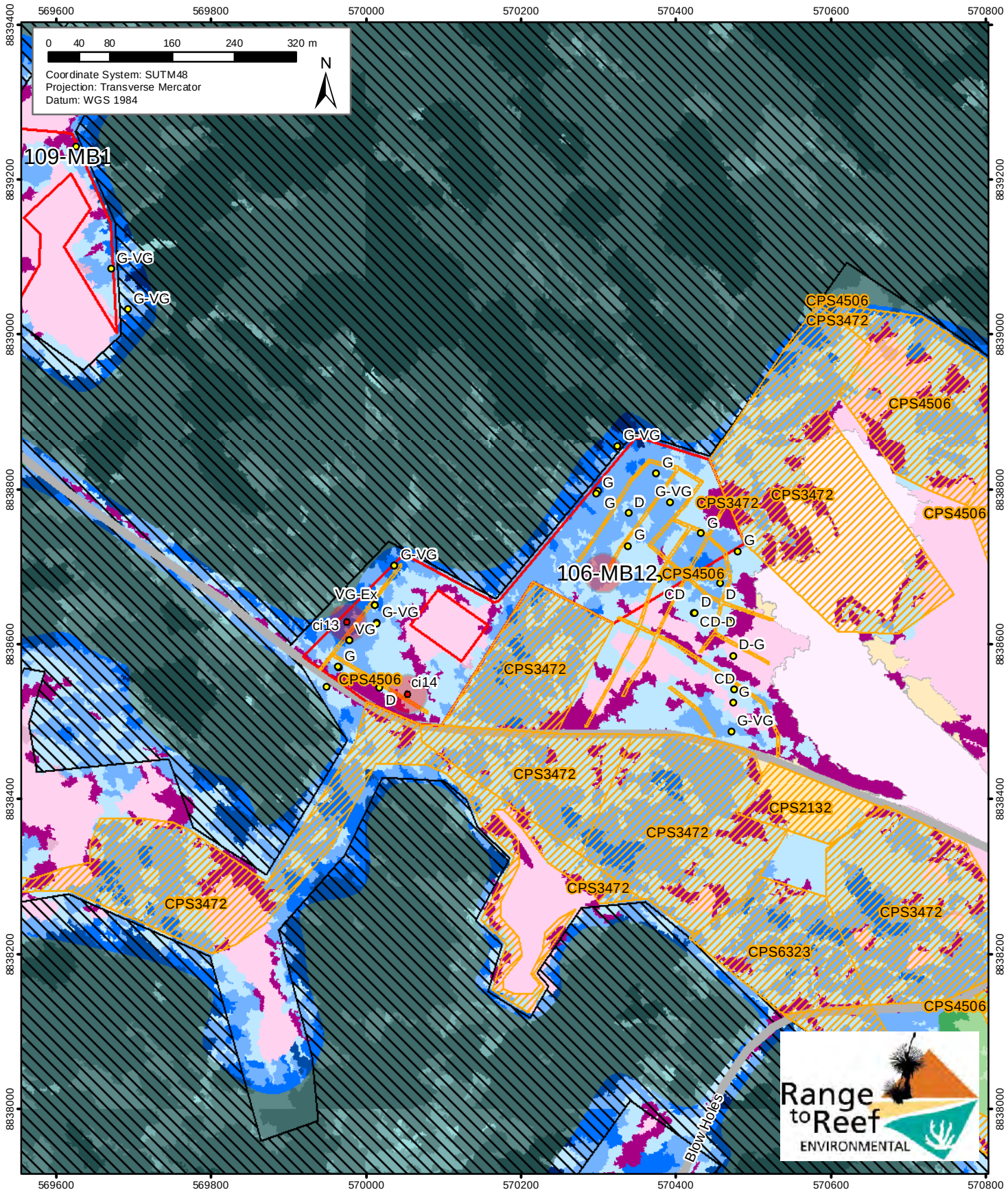
- 2010-2011 Survey Site (Condition Labelled)
- R2R Vegetation Survey Point
- 25 m Survey Site Radius
- Approved CIP Clearing
- Potential Clearing Area
- Roads
- National Park

Fern field
- 5-10 m
- <5 m

Regrowth
- 25-30 m
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- Mixed weed and pioneer species, <5m

Closed Canopy Evergreen Forest
- 25-30 m (tall)
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- <5m

Other
- Bare ground
- Mining
- Infrastructure



Vegetation Map 106-MB12

Legend

- 2010-2011 Survey Site (Condition Labelled)
- R2R Vegetation Survey Point
- 25 m Survey Site Radius
- Approved CIP Clearing
- Potential Clearing Area
- Roads
- National Park

Fern field
- 5-10 m
- <5 m

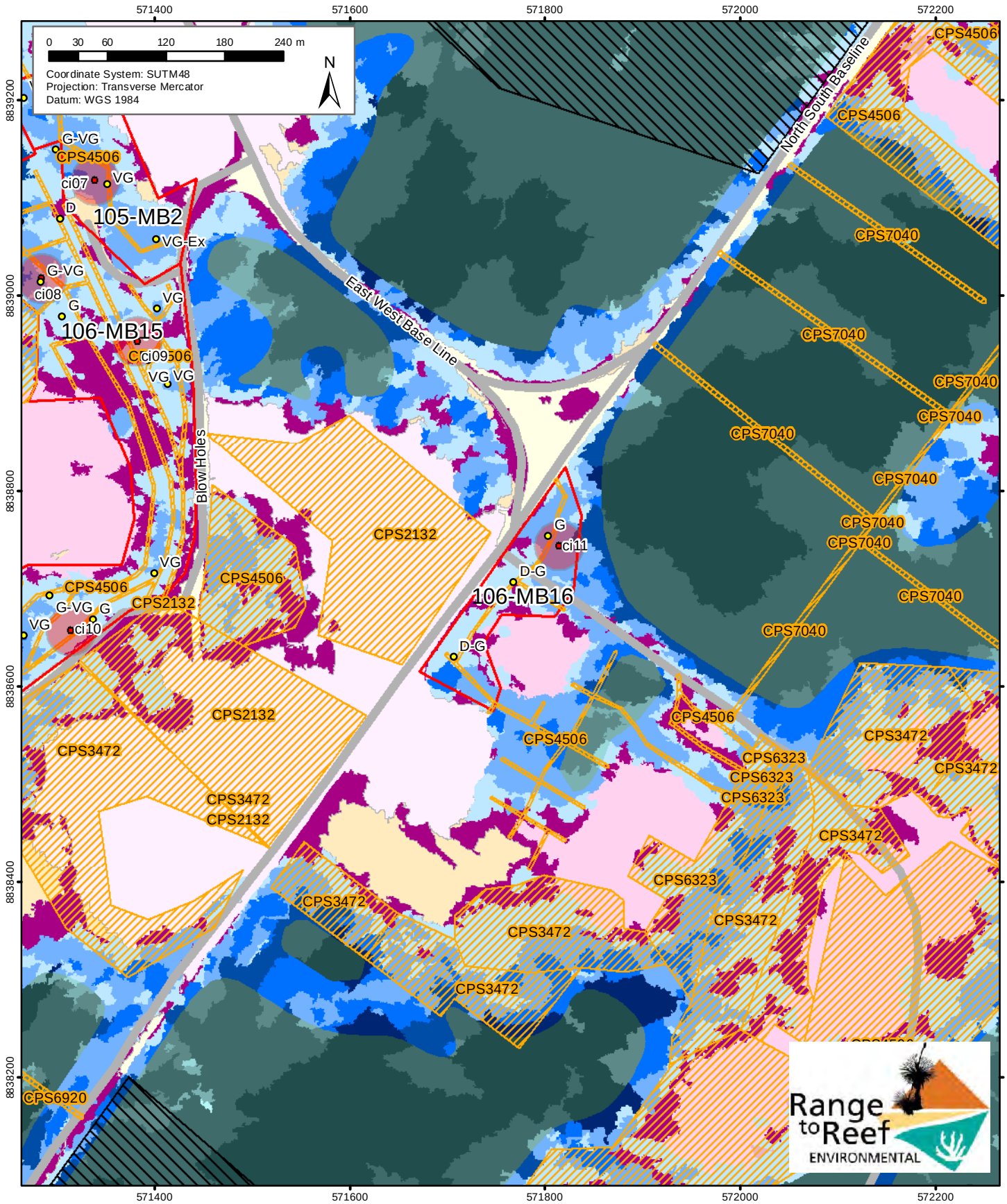
Rehabilitation
- 10-15 m
- 5-10 m
- <5 m

Regrowth
- 25-30 m
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m

- Mixed weed and pioneer species, <5m

Closed Canopy Evergreen Forest
- 25-30 m (tall)
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m

Other
- Bare ground
- Mining
- Infrastructure



Vegetation Map 106-MB16

Legend

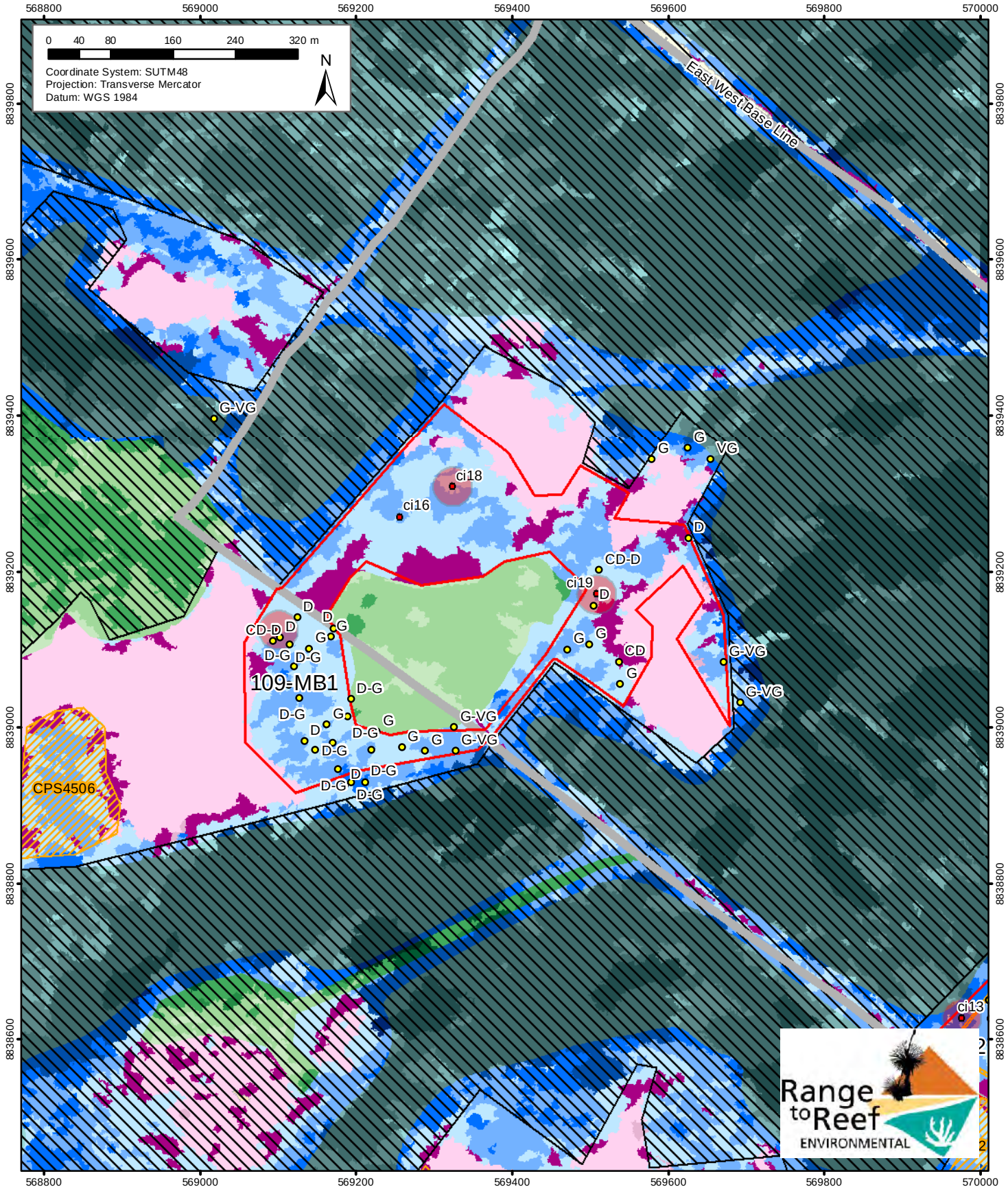
- 2010-2011 Survey Site (Condition Labelled)
- R2R Vegetation Survey Point
- 25 m Survey Site Radius
- Approved CIP Clearing
- Potential Clearing Area
- Roads
- National Park

Fern field
- 5-10 m
- <5 m

Regrowth
- 25-30 m
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- Mixed weed and pioneer species, <5m

Closed Canopy Evergreen Forest
- 25-30 m (tall)
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- <5m

Other
- Bare ground
- Mining
- Infrastructure



Vegetation Map 109-MB1

Legend

- 2010-2011 Survey Site (Condition Labelled)
- R2R Vegetation Survey Point
- 25 m Survey Site Radius
- Approved CIP Clearing
- Potential Clearing Area
- Roads
- National Park

Fern field
- 5-10 m
- <5 m

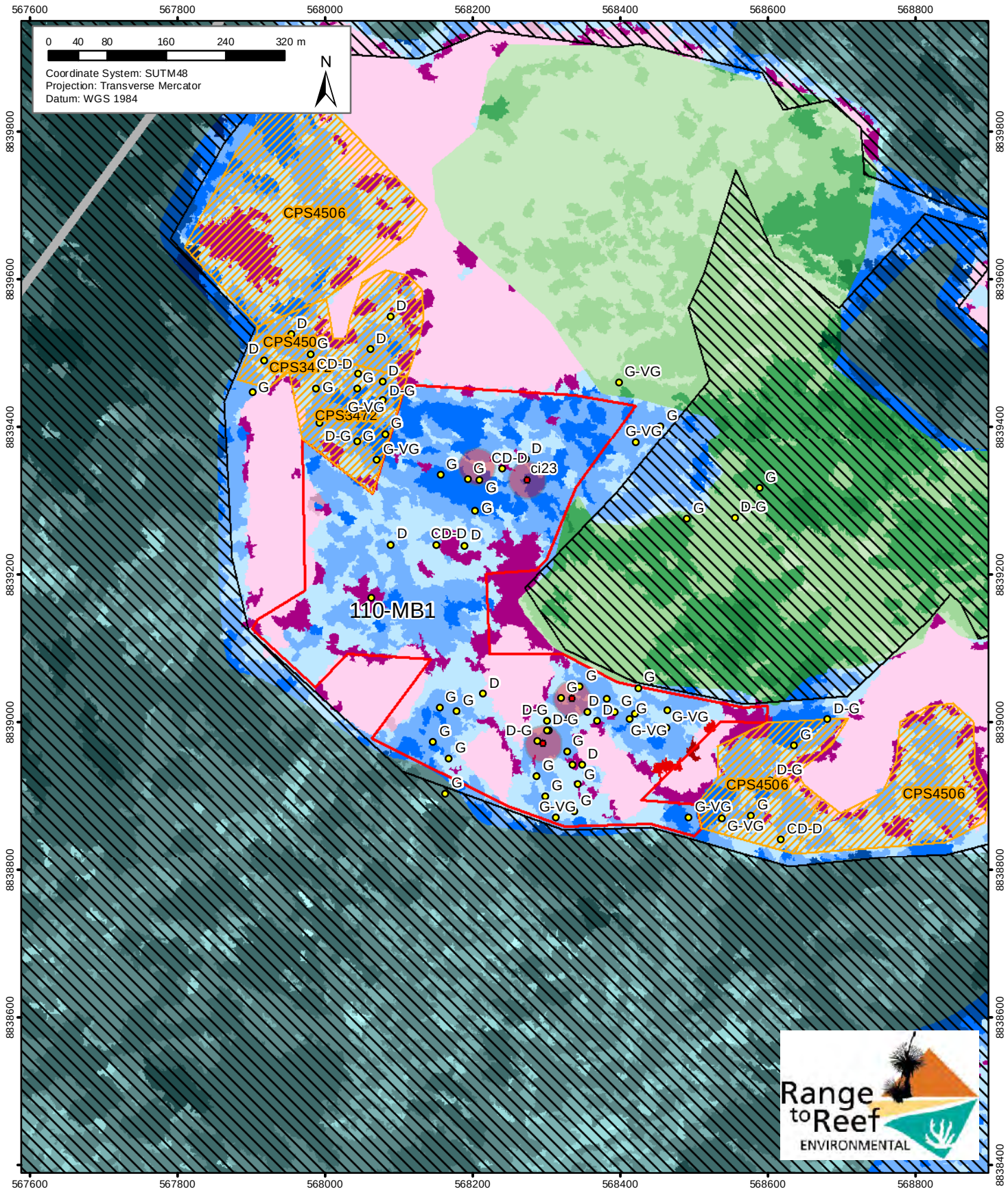
Rehabilitation
- 25-30 m
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- <5 m

Regrowth
- 25-30 m
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m

Mixed weed and pioneer species, <5m

Closed Canopy Evergreen Forest
- 30-35 m (tall)
- 25-30 m (tall)
- 20-25 m
- 15-20 m
- 10-15 m

Other
- 5-10 m
- <5m
- Bare ground
- Infrastructure



Vegetation Map 110-MB1

Legend

- 2010-2011 Survey Site (Condition Labelled)
- R2R Vegetation Survey Point
- 25 m Survey Site Radius
- Approved CIP Clearing
- Potential Clearing Area
- Roads
- National Park

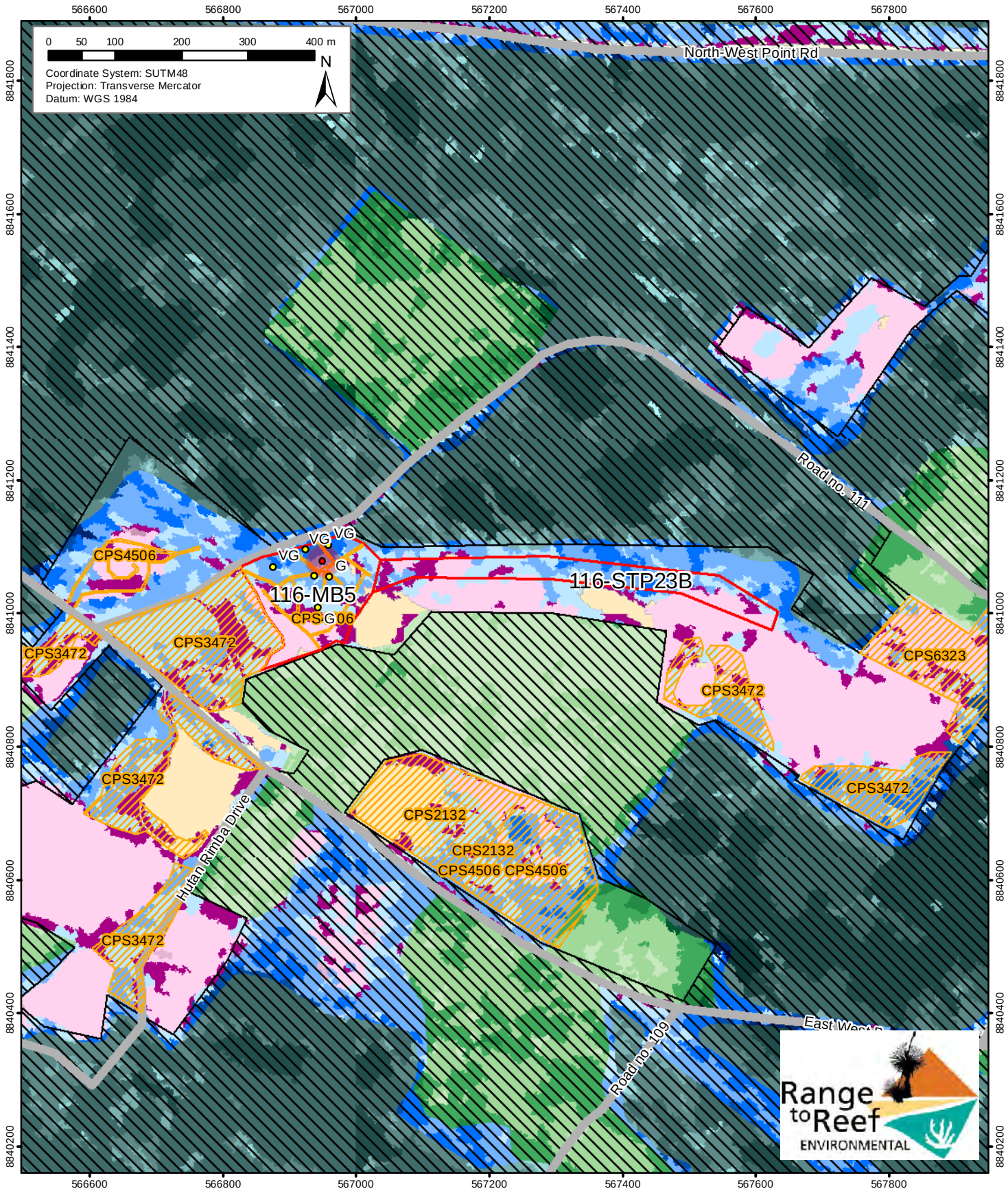
***Leucaena leucocephala dominant**
- 5-10 m
- <5 m

Fern field
- 10-15 m
- 5-10 m
- <5 m

Rehabilitation
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- <5 m

Regrowth
- 25-30 m
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- Mixed weed and pioneer species, <5m

Closed Canopy Evergreen Forest
- 30-35 m (tall)
- 25-30 m (tall)
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- <5m



Vegetation Map 116-MB5 and 116-STB23B

Legend

- 2010-2011 Survey Site (Condition Labelled)
- R2R Vegetation Survey Point
- 25 m Survey Site Radius
- Approved CIP Clearing
- Potential Clearing Area
- Roads
- National Park

Fern field
- 10-15 m
- 5-10 m
- <5 m

Rehabilitation
- 25-30 m
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m

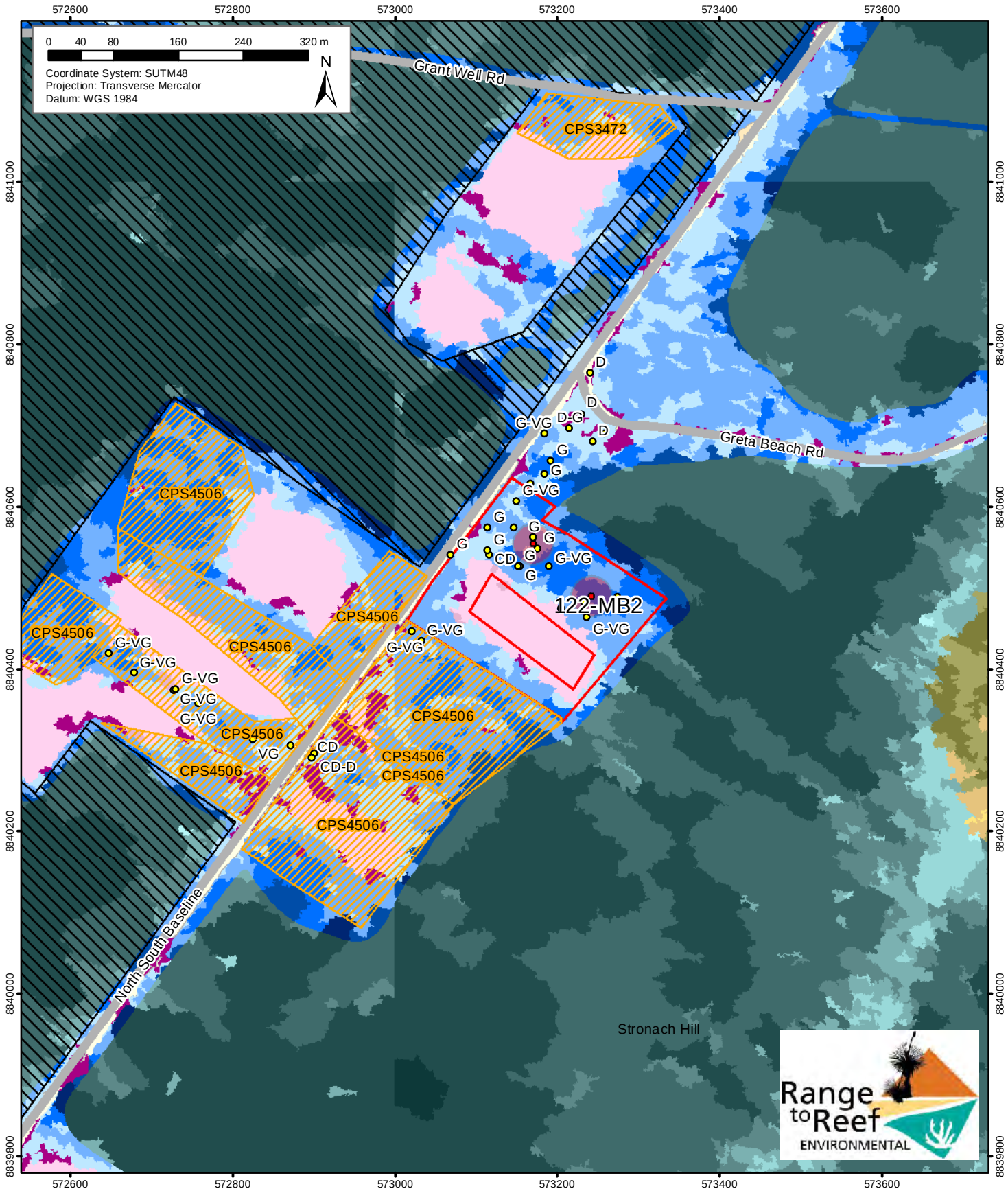
Regrowth
- 30-35 m
- 25-30 m
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m

- Mixed weed and pioneer species, <5m

Closed Canopy Evergreen Forest
- 30-35 m (tall)
- 25-30 m (tall)
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m

- <5m

Other
- Bare ground
- Infrastructure



Vegetation Map 122-MB1

Legend

- 2010-2011 Survey Site (Condition Labelled)
- R2R Vegetation Survey Point
- 25 m Survey Site Radius
- Approved CIP Clearing
- Potential Clearing Area
- Roads
- National Park

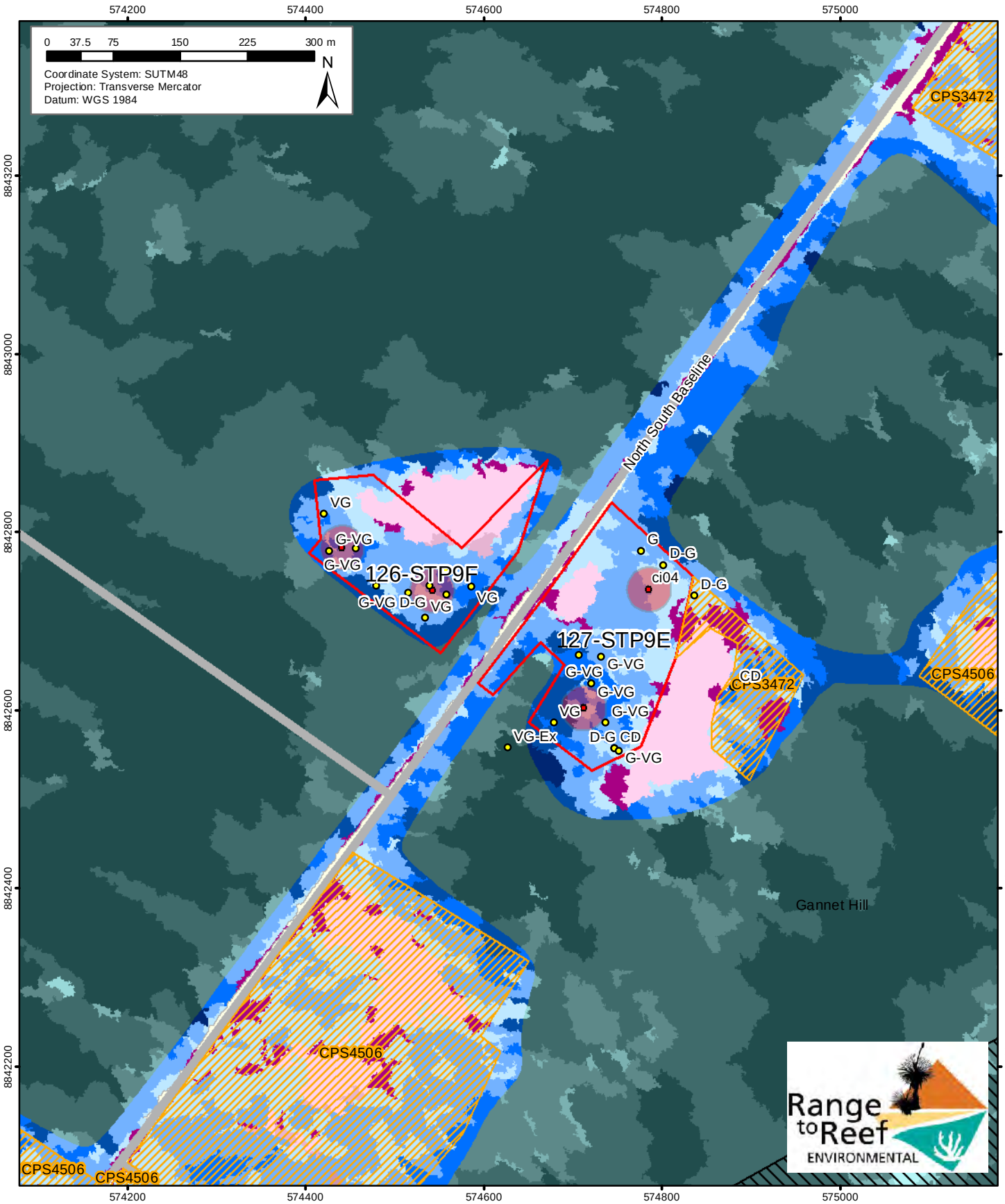
Fern field
- 10-15 m
- 5-10 m
- <5 m

Regrowth
- 25-30 m
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- Mixed weed and pioneer species, <5m

Semi-deciduous
- 15-20 m (forest)
- 10-15 m (forest)
- 5-10 m (scrub)
- <5 m (scrub)

Closed Canopy Evergreen Forest
- 30-35 m (tall)
- 25-30 m (tall)
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- <5m

Other
- Bare ground
- Infrastructure



Vegetation Map 126-STP9F and 127-STP9E

Legend

- 2010-2011 Survey Site (Condition Labelled)
- R2R Vegetation Survey Point
- 25 m Survey Site Radius
- Approved CIP Clearing
- Potential Clearing Area
- Roads
- National Park

Fern field

- 10-15 m
- 5-10 m
- <5 m

Regrowth

- 25-30 m
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- Mixed weed and pioneer species, <5m

Closed Canopy Evergreen Forest

- 30-35 m (tall)
- 25-30 m (tall)
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- <5m

Other

- Bare ground
- Infrastructure

Appendix D – Conservation Codes

Environment Protection and Biodiversity Conservation Act 1999 Categories of Threatened Species

Threatened fauna and flora may be listed under Section 178 of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) in any one of the following categories:

Extinct (Ex)
A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.

Extinct in the Wild (EW)
A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time:

(a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or
(b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.

Critically Endangered (Cr)
A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.

Endangered (En)
A native species is eligible to be included in the endangered category at a particular time if, at that time:

(a) it is not critically endangered; and
(b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.

Vulnerable (Vu)
A native species is eligible to be included in the vulnerable category at a particular time if, at that time:

(a) it is not critically endangered or endangered; and
(b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

Conservation Dependent (CD)
A native species is eligible to be included in the conservation dependent category at a particular time if, at that time:

(a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or
(b) the following subparagraphs are satisfied:
    i. the species is a species of fish;
    ii. the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised;
    iii. the plan of management is in force under a law of the Commonwealth or of a State or Territory;
    iv. cessation of the plan of management would adversely affect the conservation status of the species.

IUCN Red List Categories (2001) Version 3.1

Extinct (EX)
A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

Extinct in the Wild (EW)
A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

Critically Endangered (CR)
A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.

Endangered (EN)
A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.

Vulnerable (VU)
A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.

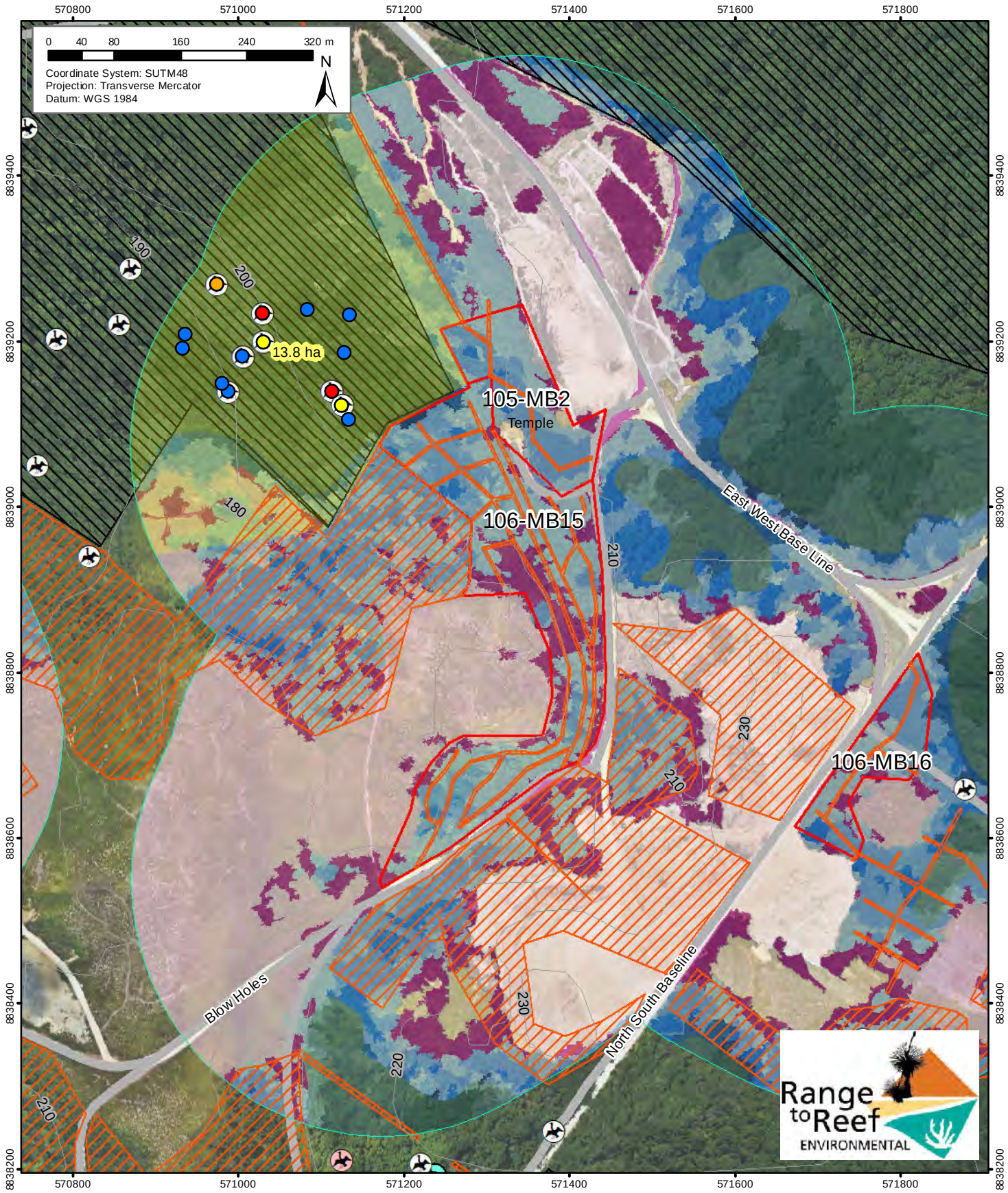
Near Threatened (NT)
A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

Least Concern (LC)
A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

Data Deficient (DD)
A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

Not Evaluated (NE)
A taxon is Not Evaluated when it is has not yet been evaluated against the criteria.

Appendix E – Abbott's Booby Survey Maps



Fauna Records 105-MB2 and 106-MB15

Legend

R2R June 2017 Abbotts Survey

- CONFIRMED FALSE
- FALSE ON THIS DAY
- MAYBE
- TRUE
- Contours 10 m
- 300m buffer

- Confirmed *Papasula abbotti* (Abbott's booby) (R2R, 2016)
- Abbotts Booby Detections 2009-2015 (DNP, 2016)
- *Cyrtodactylus sadleiri* (giant gecko) Observations by Range to Reef Fauna Surveys 2016
- Approved CIP Clearing

- Abbott's booby survey area
- Potential Clearing Area
- Roads
- National Park

Fern field

- 5-10 m
- <5 m

Regrowth

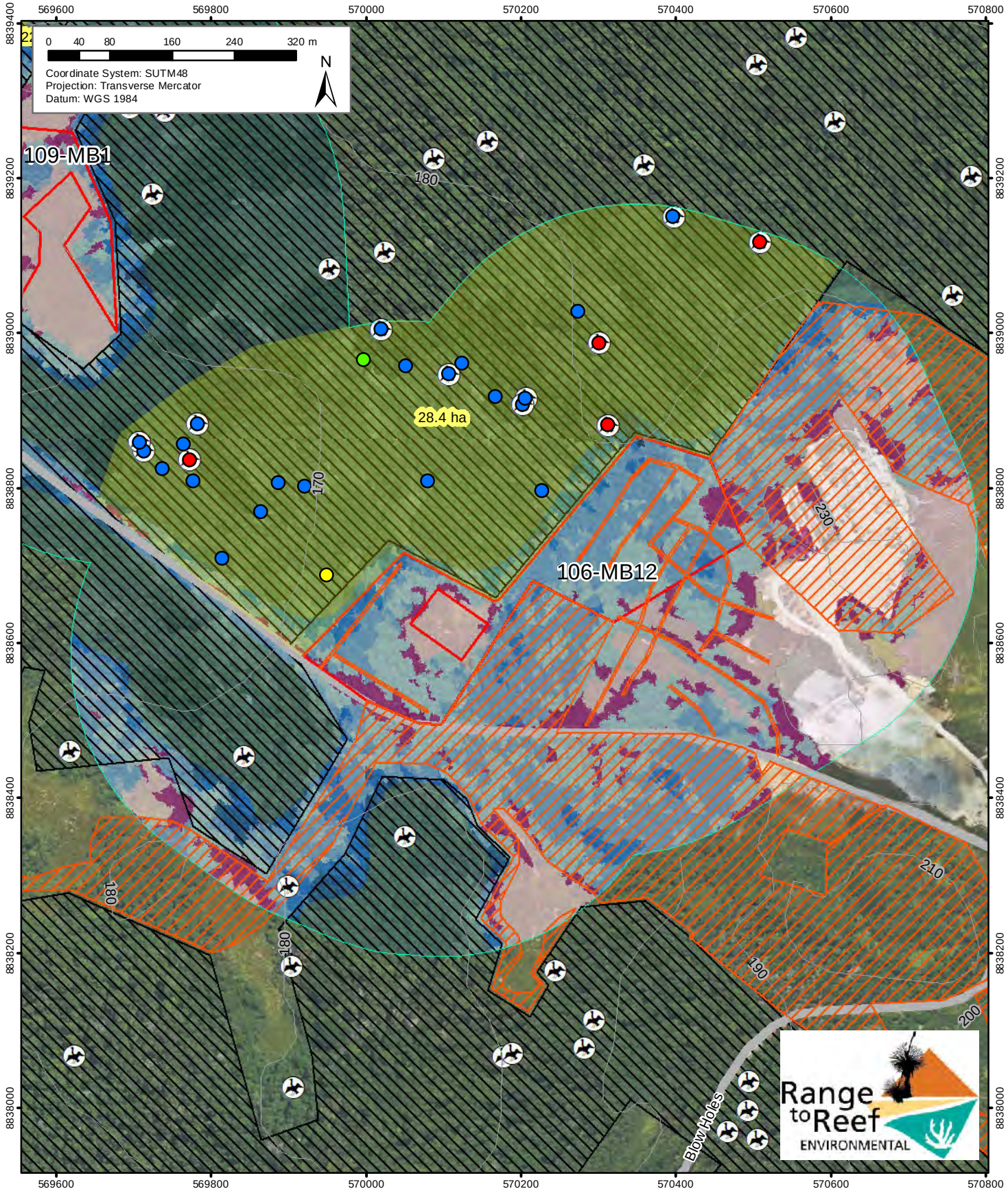
- 25-30 m
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- Mixed weed and pioneer species, <5m

Closed Canopy Evergreen Forest

- 25-30 m (tall)
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m

Other

- Bare ground
- Mining
- Infrastructure



Fauna Records 106-MB12

Legend

R2R June 2017 Abbotts Survey

- CONFIRMED FALSE
- MAYBE
- LIKELY
- TRUE
- Contours 10 m
- 300m buffer

- Abbotts Booby Detections 2009-2015 (DNP, 2016)
- Approved CIP Clearing
- Abbott's booby survey area
- Potential Clearing Area
- Roads
- National Park

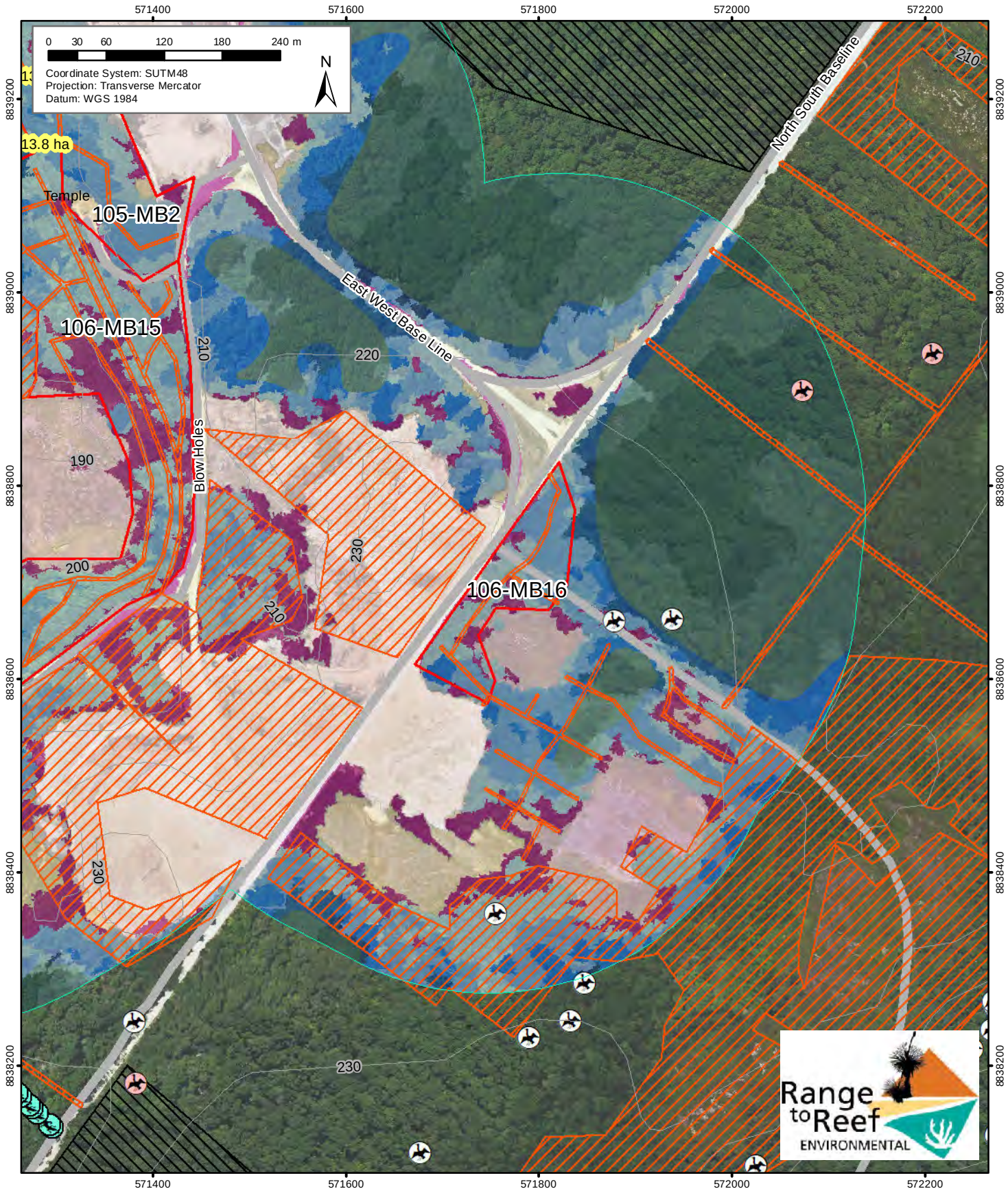
Fern field
- 5-10 m
- <5 m

Rehabilitation
- 10-15 m

Regrowth
- 25-30 m
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- Mixed weed and pioneer species, <5m

Closed Canopy Evergreen Forest
- 25-30 m (tall)
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m

Other
- Bare ground
- Mining



Fauna Records 106-MB16

Legend

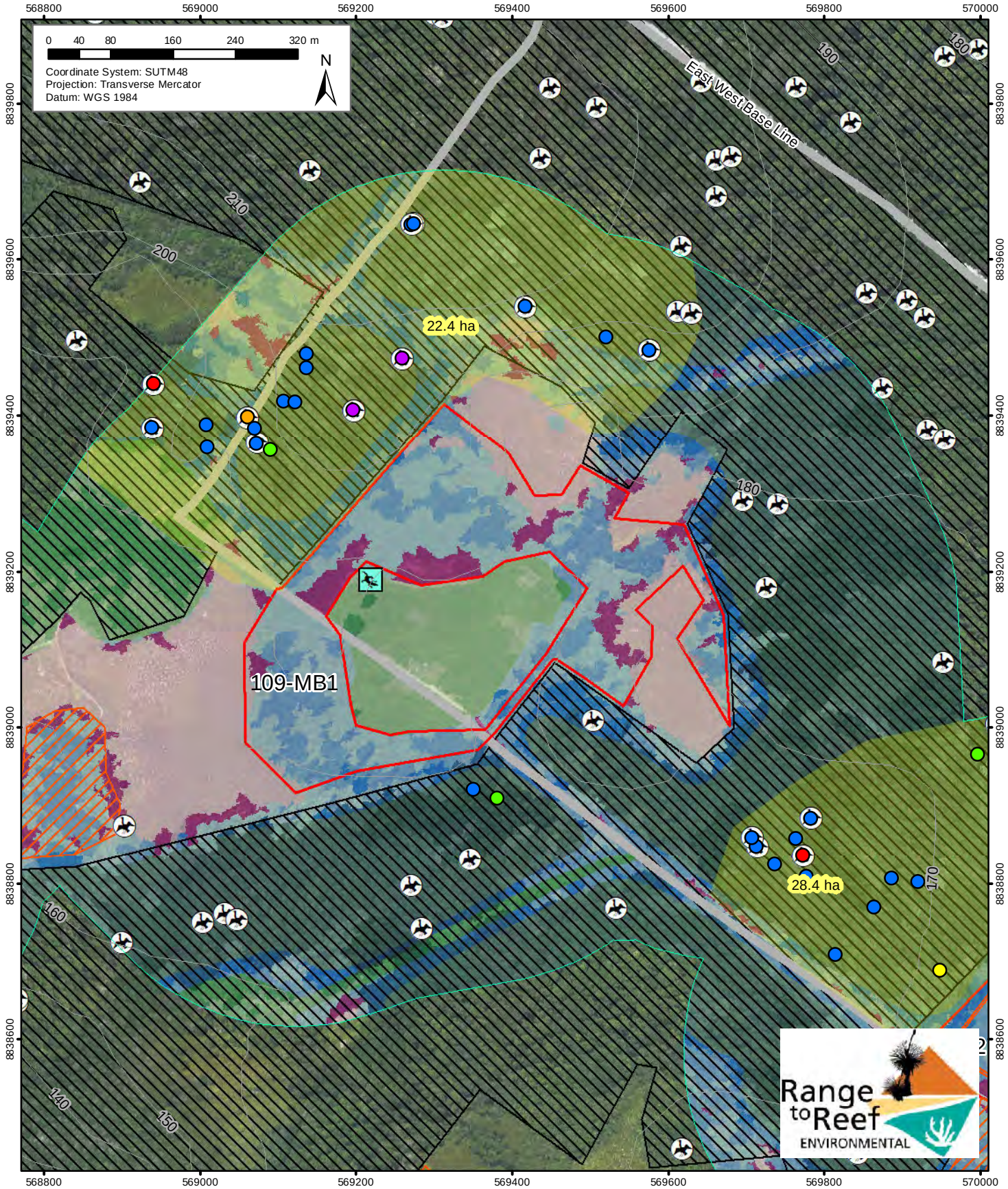
- Contours 10 m
- 300m buffer
- Confirmed *Papasula abbotti* (Abbott's booby) (R2R, 2016)
- Abbotts Booby Detections 2009-2015 (DNP, 2016)
- *Cyrtodactylus sadleiri* (giant gecko) Observations by Range to Reef Fauna Surveys 2016
- Approved CIP Clearing
- Abbott's booby survey area
- Potential Clearing Area
- Roads
- National Park

Fern field
- <5 m

Regrowth
- 25-30 m
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- Mixed weed and pioneer species, <5m

Closed Canopy Evergreen Forest
- 25-30 m (tall)
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m

Other
- Bare ground
- Mining
- Infrastructure



Fauna Records 109-MB1

Legend

R2R June 2017 Abbotts Survey

- CONFIRMED FALSE
- FALSE ON THIS DAY
- MAYBE
- LIKELY
- TRUE
- Unknown
- Contours 10 m
- 300m buffer

- Abbotts Booby Detections 2009-2015 (DNP, 2016)
- *Cyrtodactylus sadleiri* (giant gecko) records (DNP, 2016)
- Approved CIP Clearing
- Abbott's booby survey area
- Potential Clearing Area
- Roads
- National Park

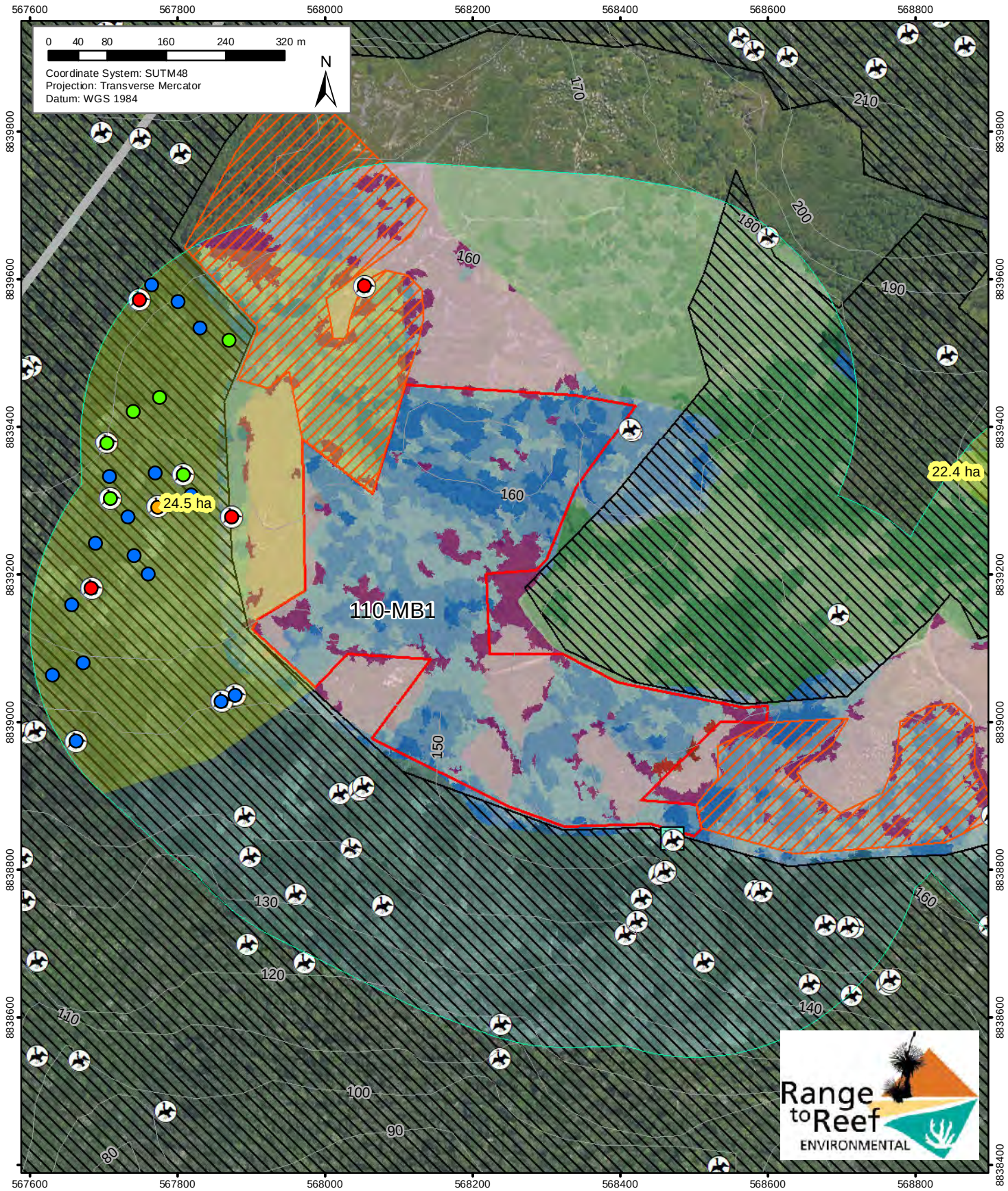
Fern field
- 5-10 m
- <5 m

Rehabilitation
- 25-30 m
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- <5 m

Regrowth
- 25-30 m
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- Mixed weed and pioneer species, <5m

Closed Canopy Evergreen Forest
- 25-30 m (tall)
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- <5m

Other
- Bare ground



Fauna Records 110-MB1

Legend

R2R June 2017 Abbotts Survey

- CONFIRMED FALSE
- FALSE ON THIS DAY
- LIKELY
- TRUE
- Contours 10 m
- 300m buffer
- Abbotts Booby Detections 2009-2015 (DNP, 2016)
- *Cyrtodactylus sadleiri* (giant gecko) records (DNP, 2016)
- Approved CIP Clearing
- Abbott's booby survey area
- Potential Clearing Area
- Roads
- National Park

***Leucaena leucocephala dominant**

- 5-10 m
- <5 m

Fern field

- 10-15 m
- 5-10 m
- <5 m

Rehabilitation

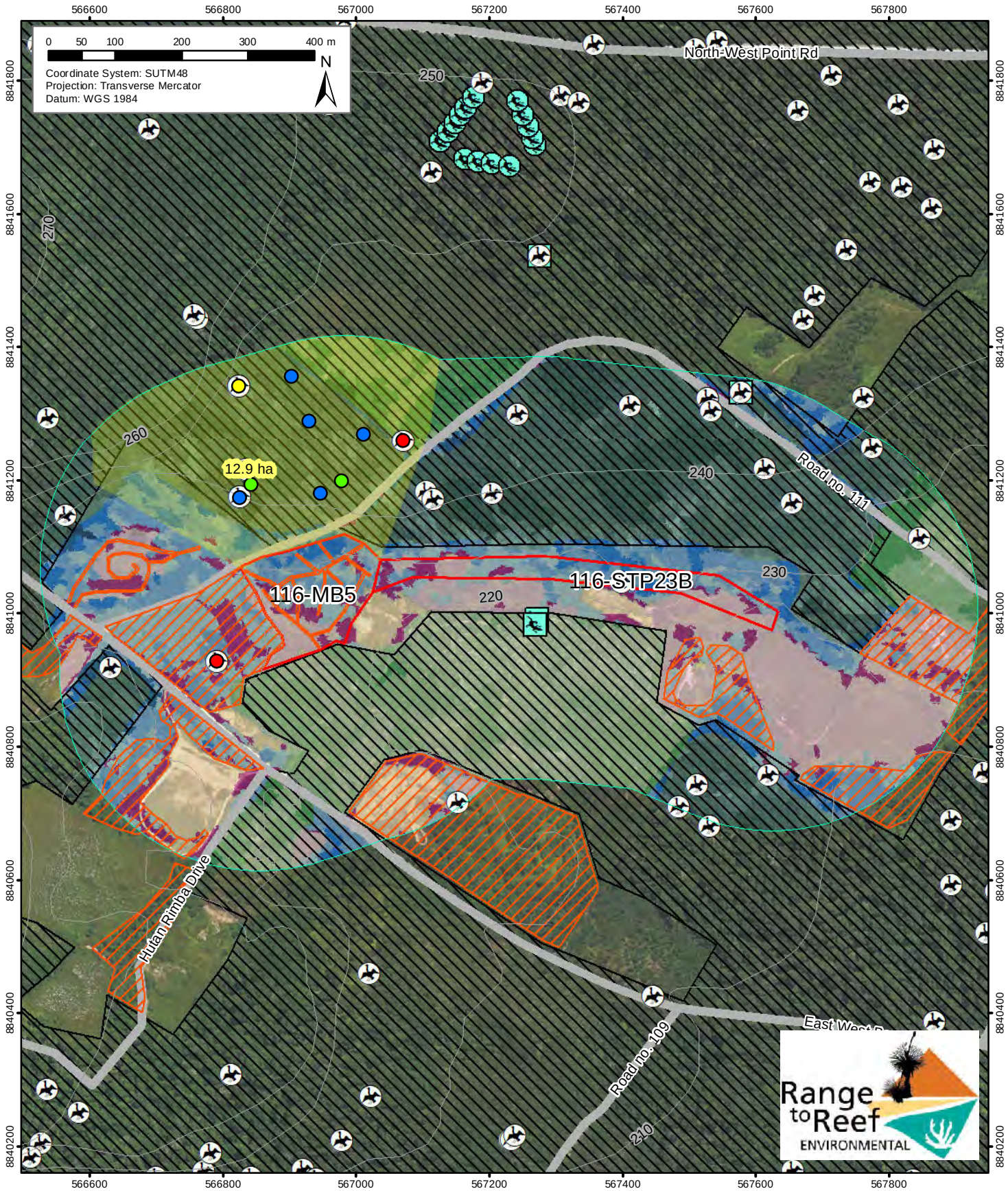
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- <5 m

Regrowth

- 25-30 m
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- Mixed weed and pioneer species, <5m

Closed Canopy Evergreen Forest

- 25-30 m (tall)
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- <5m



Fauna Records 116-MB5 and 116-STB23B

Legend

R2R June 2017 Abbotts Survey

- CONFIRMED FALSE
- MAYBE
- LIKELY
- TRUE
- Contours 10 m
- 300m buffer
- Abbotts Booby Detections 2009-2015 (DNP, 2016)

- *Cyrtodactylus sadleiri* (giant gecko) Observations by Range to Reef Fauna Surveys 2016
- *Cyrtodactylus sadleiri* (giant gecko) records (DNP, 2016)
- Approved CIP Clearing
- Abbott's booby survey area
- Potential Clearing Area
- Roads
- National Park

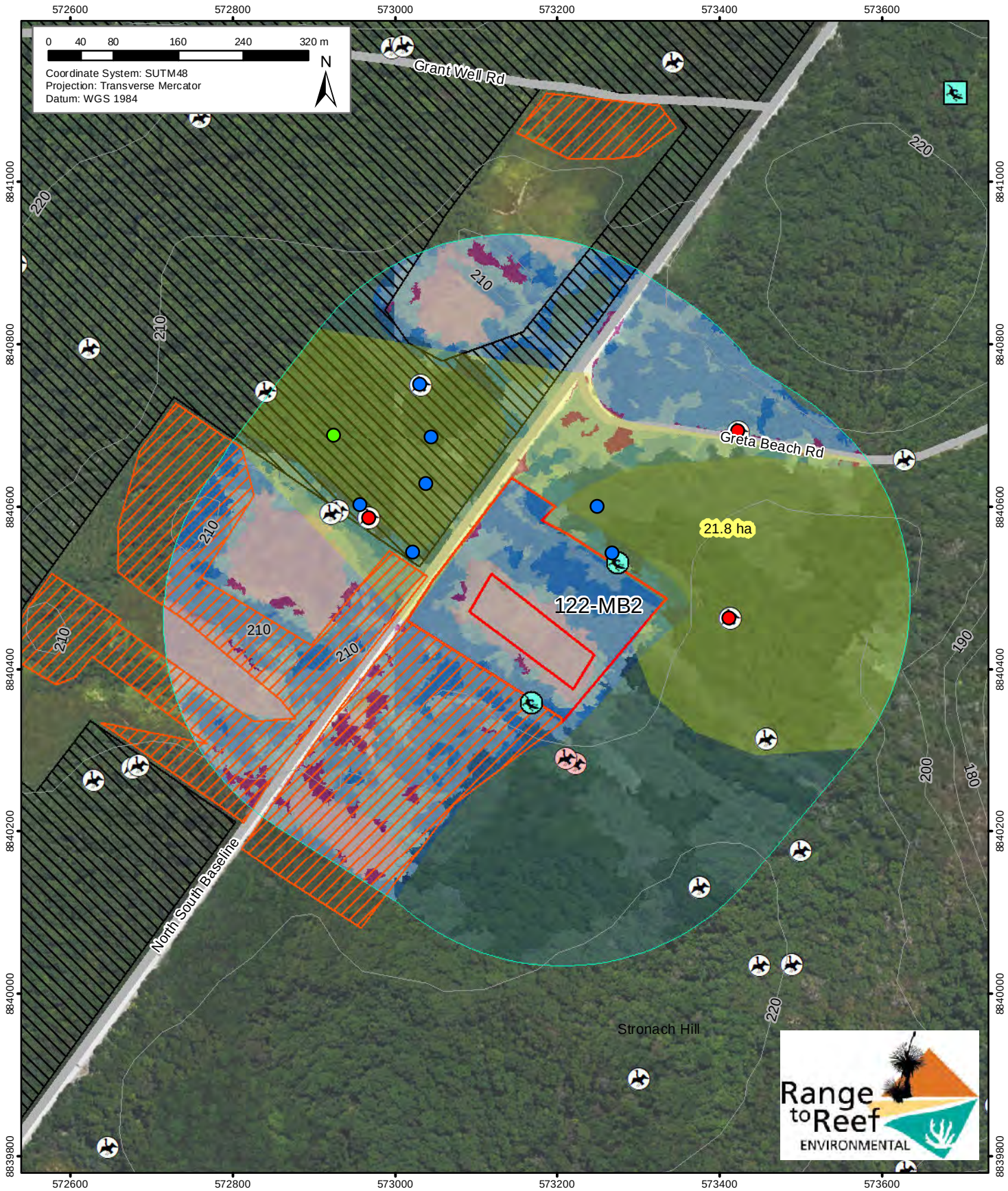
Fern field
- 10-15 m
- 5-10 m
- <5 m

Rehabilitation
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- <5 m

Regrowth
- 25-30 m
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- Mixed weed and pioneer species, <5m

Closed Canopy Evergreen Forest
- 25-30 m (tall)
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- <5m

Other
- Bare ground
- Infrastructure



Fauna Records 122-MB1

Legend

R2R June 2017 Abbotts Survey

- CONFIRMED FALSE
- LIKELY
- TRUE
- Contours 10 m
- 300m buffer
- Confirmed *Papasula abbotti* (Abbott's booby) (R2R, 2016)
- Abbotts Booby Detections 2009-2015 (DNP, 2016)
- *Cyrtodactylus sadleiri* (giant gecko) Observations by Range to Reef Fauna Surveys 2016
- *Cyrtodactylus sadleiri* (giant gecko) records (DNP, 2016)
- Approved CIP Clearing
- Abbott's booby survey area
- Potential Clearing Area
- Roads
- National Park

Fern field

- 10-15 m
- 5-10 m
- <5 m

Regrowth

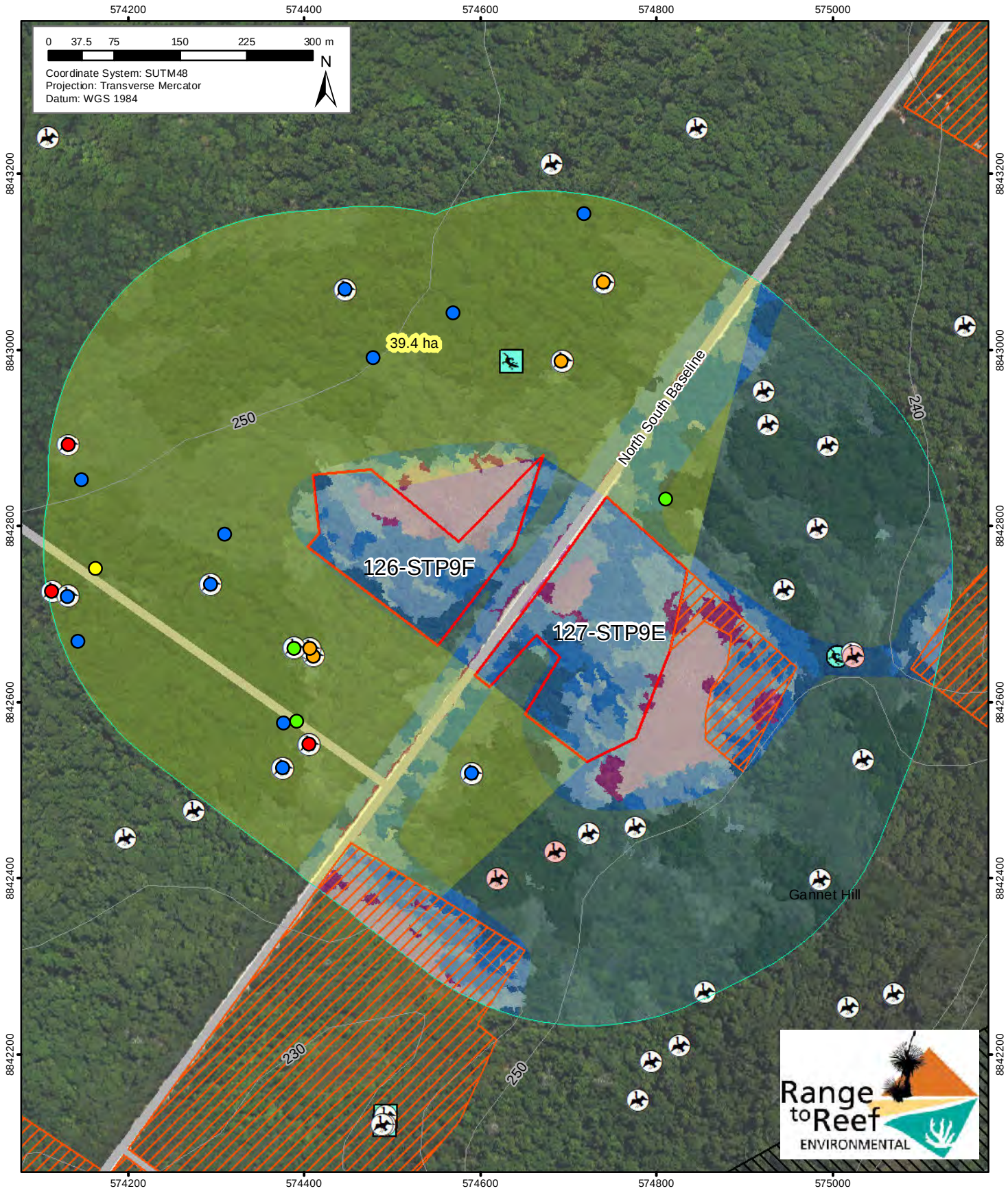
- 25-30 m
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- Mixed weed and pioneer species, <5m

Closed Canopy Evergreen Forest

- 25-30 m (tall)
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m

Other

- Bare ground
- Infrastructure



Fauna Records 126-STP9F and 127-STP9E

Legend

R2R June 2017 Abbotts Survey

- CONFIRMED FALSE
- FALSE ON THIS DAY
- MAYBE
- LIKELY
- TRUE
- Contours 10 m
- 300m buffer

- Confirmed *Papasula abbotti* (Abbott's booby) (R2R, 2016)
- Abbotts Booby Detections 2009-2015 (DNP, 2016)
- *Cyrtodactylus sadleiri* (giant gecko) Observations by Range to Reef Fauna Surveys 2016
- *Cyrtodactylus sadleiri* (giant gecko) records (DNP, 2016)

- Approved CIP Clearing
- Abbott's booby survey area
- Potential Clearing Area
- Roads
- National Park

Fern field

- 5-10 m
- <5 m

Regrowth

- 25-30 m
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m
- Mixed weed and pioneer species, <5m

Closed Canopy Evergreen Forest

- 25-30 m (tall)
- 20-25 m
- 15-20 m
- 10-15 m
- 5-10 m

Other

- Infrastructure