

Ella Bay Integrated Resort Proposal

SEIS Submission Response

Volume Five

Offset Package Proposal





Executive Summary

The Ella Bay property comprises of 470 hectares of freehold land that is isolated within the Ella Bay National Park and Wet Tropics World Heritage Area. The site is predominantly cleared, and has been cleared since early 1900's; the land is degraded to an extent that the property was not considered of sufficient value to be included in the World Heritage Area nomination.

It is proposed to construct the Ella Bay Integrated Resort and access road; an integrated resort and residential development focussing on sustainability, and environmental stewardship. The ecological goal of the development is to:

- Live sustainably with the minimum carbon footprint, rain harvesting and recycling of water and minimising pollution, through the general philosophy of ecological living and principles of sustainable development; and
- Protect and enhance the fauna and flora of the site and surrounds through responsible use and protection of the natural environment, through conservation and sustainable practices.

The Ella Bay Integrated Resort was referred as an action under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), and later determined to be a controlled action due to potential or likely significant impacts on Matters of National Environment Significance.

The controlling provisions for the action are:

- World Heritage properties;
- listed threatened species and ecological communities;

The Environmental Impact Statement process identified issues that may arise and potentially cause a negative impact through the Ella Bay Development. The matters addressed are:

- World Heritage and National Heritage values (both in relation to the Wet Tropics Queensland World Heritage Area and the Great Barrier Reef);
- Clearing of remnant vegetation;
- The endangered vegetation community Littoral Rainforest and Coastal Vine Thickets of Eastern Australia; and
- Loss of habitat for endangered and vulnerable fauna (including the Southern Cassowary *Casuarius casuarius johnsonii* and the Common Mistfrog *Litoria rheocola*)

Extensive mitigation has been included in the design and environmental management plans of Ella Bay Development and Ella Bay Road to minimise the environmental threats and impacts, however some residual impacts will remain and will require offsetting.

The Proponent has focussed on environmental stewardship of the area in mitigation design and in the provision of this offset package for the long term benefit of the local and regional habitat for the recovery of the cassowary. The objectives of the offset package will be in integrating elements of the Commonwealth EPBC and state based VMA principles to:

- Provide an offset that compensates the residual impacts of the project on biodiversity; in particular the cassowary;
- Deliver an offset that improves the environmental outcome of the cassowary;
- Develop an offset package that incorporates the key elements of the Southern Cassowary Recovery Plan; and
- Ensure in perpetuity security of the offset sites through incorporation with National Parks and provide a framework for their ongoing and long term maintenance.

The Offset Package will achieve an environmental benefit from the Ella Bay Integrated Resort for the Matters of National Environmental Significance and World Heritage Values. The proponent's goal is that there will be a long term positive outcome from the Offset Package and onsite mitigation such that the short term "do nothing" prediction of extinction of the Graham-Seymour subpopulation of cassowaries is reversed. (Moore, 2007)



Direct Impacts - Queensland Legislation

Legislation and offsetting requirements with regards to biodiversity and clearing of native vegetation are controlled under Queensland legislation, including the Vegetation Management Act (VMA) (Qld) and the Nature Conservation Act 1992 (NCA). The Draft Policy for Biodiversity Offsets has been used for determining offsets and multipliers.

The clearing required for the proposed upgrade of Ella Bay Road is the minimum necessary for safety of motorists and to improve the road-side drainage to meet current standards. The road design has also focussed on maintaining mature trees to maximise canopy connectivity.

The revocation of a small area 0.014ha (140m²) of Ella Bay National Park will enable an improved alignment at the intersection of Stage 1 and Stage 2 resulting in a reduction in clearing of 1400m².

The proposed clearing of 0.95ha for the Ella Bay Development will comprise;

- Clearings for a number of bridges within creek riparian areas for creek crossings. The clearings have been minimised and where possible existing cleared crossings have been used requiring only extension of the clearing width;
- Multiple small clearings to locate the discharge of constructed wetlands and bioretention filters. The locations have been located in areas that have been previously cleared and contain regrowth trees less than 150mm diameter;
- One area of built development – Southern Hill, which continues along from the existing house site.

Areas Subject to Queensland Regulatory Offsets					
	<i>Revocation of National Park¹</i>	<i>Clearing of National Park Of Concern²</i>	<i>Clearing of Essential Cassowary habitat³</i>	<i>Clearing of remnant Of concern RE⁴</i>	<i>Total Area</i>
Ella Bay Road	0.014 ha	0.33 ha	2.13 ha	0.34 ha	2.82 ha
Ella Bay Development			0.70 ha	0.25 ha	0.95 ha
TOTAL	0.014 ha	0.33 ha	2.83 ha	0.59 ha	3.77 ha
Impact : Offset Ratio	5	5	5	2.5	
TOTAL Offset	0.70 ha	1.65 ha	14.15 ha	1.48 ha	17.35 ha

^{1,2} Policy for Biodiversity Offsets - Appendix 2 Offset Rules section - Protected area estate

³ Policy for Biodiversity Offsets - Appendix 2 Offset Rules section - Endangered Species

⁴ Regional Vegetation Management Code for Coastal Bioregions – Of Concern RE

Table ES 1 Cleared Areas and Resulting Regulatory Offsets

The property based offset will comprise:

- 22.60ha of RE 7.11.1 and RE 7.11.1b (Essential cassowary habitat) located on the south-western corner of Ella Bay property. This area will be donated and titled to National Parks. The land will provide higher level of tenure for the North South cassowary corridor along the Seymour Range; and
- The timeframe to deliver the offset will be less than 12 months.

The total increase in National Park Estate area will be 22.60ha within the same bioregion and biodiversity values.



Direct Impacts - Commonwealth Legislation

Legislation and offsetting for Matters of NES, World Heritage and National Heritage are controlled under the EPBC Act. The Draft Policy Statement: Use of Environmental offsets under the Environment Protection and Biodiversity Conservation Act. 1999 and EPBC Act Consultation Draft Environmental Offsets Policy 2011 have been used to determine direct and indirect impacts and offsets.

Extensive mitigation has been applied to Ella Bay Road and Ella Bay Development to reduce impacts to Matters of NES. A number of residual direct impacts remain for the endangered fauna, the Southern Cassowary and the Common Mistfrog.

The clearing of essential cassowary and Common Mistfrog habitat and offsetting has been described in the State based offsets. The remaining residual direct impacts are isolation and edge effect of habitat of the Southern Cassowary and the Common Mistfrog.

Ella Bay Road

For Ella Bay Road the isolation of habitat includes the area between the cassowary fence and the road. The cassowary fence will be located between 5 to 10m within the rainforest and isolate some habitat between the roadside and the fence and have a small impact around the fence alignment. The cassowary fence isolation area has been calculated for the road alignment by habitat type. An offset ratio multiplier has been proposed based on habitat value.

Noise and disturbance will also create an edge effect along Ella Bay Road. The traffic noise has been modelled against a Kuranda Range Road study with the same noise level at 31m to 40m for Ella Bay Road. Noise is not considered as disruptive to cassowaries and studies at Mission Beach (Moore pers comm.) indicate that cassowaries appear to have habituated to the sound of cars and trucks on the roads.

An edge effect area has been calculated by taking a distance of 25m into the rainforest along both sides of the road except for the eastern side of the road around Heath Point Headland where the impact of noise would be nullified by the steep headland and elevation of the road above the coastal vegetation. The 25m has been taken as additive to the cleared area required for road realignment and improved road-side drainage and the area that will be isolated by the cassowary fence. The effective distance from the road lane will be between 30m to 40m from road edge.

Ella Bay Development

The edge effect from the agricultural activities within the existing vegetation of the Ella Bay development site is extensive with significant areas of exotic weed infestations and fenced paddocks of introduced pasture grasses. In the vegetation bordering the development edge effects are characterised by Pond Apple and other weed infestation, logging roads, clearing over boundaries, historical fence remnants and on the dunal swale area from camping.

The edge effect impact of urban encroachment by development has been based on research by McWilliam, et al., (2010) in that with education and fencing barriers the maximum encroachment distance was 25m. The Ella Bay design includes the elements described in the report: that the greatest reduction in encroachment could be achieved by installing fences around development housing (precinct fencing), pathways within the vegetation, design boundaries so staff and the community can monitor boundaries, and monitor infrequently.

The edge effect has been calculated based on 25m impact into the vegetation with the offset ratio modified to account for the habitat value. The 25m has been calculated from the edge of the current vegetation and with setbacks and revegetation will mean that this buffer distance will equate to 35 to 45m from the development.



Areas Subject to EPBC –Endangered Fauna					
	<i>Isolation Essential cassowary habitat</i>	<i>Isolation General cassowary habitat</i>	<i>Edge Effect Essential cassowary habitat</i>	<i>Edge Effect Essential cassowary habitat</i>	<i>Total Area</i>
Ella Bay Road	1.05 ha		8.38 ha		9.43 ha
Ella Bay Development		1.07 ha		8.05 ha	9.12 ha
TOTAL	1.05 ha	1.07 ha	8.38 ha	8.05 ha	18.55 ha
<i>Impact : Offset Ratio</i>	3	1	1.5	1	
<i>TOTAL Offset - Fauna</i>	3.15 ha	1.07 ha	12.57 ha	8.05 ha	24.84 ha

Table ES 2 Proposed Direct Residual offset - EPBC

The property based offset will comprise

- 40.18ha of RE 7.11.1, 7.3.3a, 7.3.10c, 7.2.9, 7.2.4, 7.2.1d and 7.2.7a (Essential cassowary habitat) located on the Northern boundary of the Ella Bay property. This area will be donated and titled to National Parks. The land will provide a higher level of tenure and include the southern extent of the nationally significant Ella Bay Swamp Wetland in the extension to Ella Bay National Park; and
- The timeframe to deliver the offset will be less than 12 months.

Indirect Impacts to World Heritage Area

The World Heritage Area values of the Wet Tropics World Heritage Area and the Great Barrier Reef World Heritage Area are unique in that both areas satisfy the same four World Heritage Area Criteria listings.

Additionally the Wet Tropics World Heritage Area and the Great Barrier Reef World Heritage Area also have the same criteria for National Heritage Listing. The listing includes important reference to cultural and historical aspects of Australia.

Description	WHA listing	Impact Summary
Aesthetics/natural beauty	(vii)	Impact on visual amenity will be mitigated and temporary until revegetation reaches greater 10m height. The proponent considers that the mitigation adequately covers visual amenity and no offset is proposed for the temporary impact.
Significant geomorphic or physiographic features	(viii)	The proposed mitigation measures will reduce the potential of impact to the nationally significant Ella Bay Swamp Wetland and the Great Barrier Reef Marine Park; and along Ella Bay Road these measures will reduce the current impact. A high risk of temporary impact has been recognised during construction of the road The proponent considers that the mitigation adequately covers the impact and no offset is proposed. However the inclusion of the southern extent of the nationally significant Ella Bay Swamp Wetland within the direct impacts offset will provide a net positive benefit
Significant ecological and	(ix)	The proposed mitigation measures will reduce the risk of



biological processes		<p>impact to evolutionary processes.</p> <p>The proponent considers that the mitigation adequately covers the impacts and no offset is proposed.</p>
Significant biological diversity/threatened species	(x)	<p>The PVA for the cassowary showed that the Graham-Seymour Range Subpopulation is in decline and with “do nothing” management, the cassowary subpopulation will be extinct within 60 years.</p> <p>Extensive mitigation measures will reduce the impact of the development however significant land and research offsets are proposed to reverse the current decline.</p>

Table ES 3 Wet Tropics World Heritage Area Criteria and Summary of Impacts

According to Moore’s PVA the Graham-Seymour Range cassowary sub-population is currently in a declining vortex whereby extinction of that sub-population appears to be inevitable within 60 years. Many of the present indirect impacts of the local environment are cumulative and are contributing to this decline. That is; a “do nothing” scenario will lead to extinction of the Graham-Seymour Range cassowary sub-population.

Offset for Indirect Impacts on WHA	
Action Summary	Description
Land Based	
EPBC Indirect Impact	Key regional cassowary corridor protection.
Research based	
Cassowary rehabilitation through tracking after release.	Using GPS telemetry to track rehabilitated juvenile Cassowaries
Cassowary carrying capacity	Determining Cassowary Diet and Energetics through Remote Sensing and DNA analysis
Cassowary road access prevention	Design, develop and trial Cassowary Fence & Escape Gate
Monitoring and assessment of Ella Bay Development on cassowaries, fauna and flora.	Evaluation of environmental impacts of Ella Bay Development and mitigation strategies of roads on adjacent habitats and internal corridors, and monitoring of road mitigation strategies

Table ES 4 Commonwealth Indirect offset package comprising land and research based initiatives

Ella Bay Offset Package

The Proponent has taken a wider view and prepared an indirect offset package that goes beyond maintaining the status quo and delaying the eventual population decline. For the population to survive the local population must also increase, and this will require a number of positive actions as well as threat minimisation.

The Proponent has adopted a cassowary management strategy and undertaken a number of actions based on the Southern Cassowary Recovery Plan (Latch), as presented The Ella Bay Southern Cassowary Recovery Plan Matrix (Table 6.1). This matrix contains a number of Specific Objectives from the Cassowary Recovery Plan that the proponent will be assisting and/or supporting. The actions, level of certainty and timeframe are included with the Cassowary Recovery Plan Matrix. The majority of the elements of the matrix are quantifiable as offset under the DSEWPac policy drafts.



The proposed offset for indirect impact comprises both a land based offset and research initiatives. The main element of the offset package is to increase the strength of the linkage and create a viable cassowary corridor linkage to the West through Eubenangee Swamp National Park. The research package is to further understanding in terms of reducing cassowary mortality and increasing the local population. Part of the research package will be to offset for indirect impacts to the cultural and historical values.

Land-based Offset				
<i>Action Summary</i>	<i>Offset Area</i>	<i>Contribution</i>	<i>Value (est.)</i>	<i>Timing</i>
Queensland VMA & NCA <i>For clearing of 3.764 ha and revocation of 0.014 ha National Park</i> EB REF CZ A.1	22.60 ha	In perpetuity regional corridor and essential cassowary habitat protection. Legally handed over to State for National Park	\$ 250,000	<1 year
EPBC Direct Impact <i>For edge effect and isolation of 29.42 ha</i> EB REF CZ A.2	40.18 ha	In perpetuity essential cassowary habitat protection and extension of protection to Ella Bay Swamp Wetland. Legally handed over to State for National Park.	\$ 450,000	<1 year
EPBC Indirect Impact Eubenangee Offset Property	63.62 ha	In perpetuity key regional cassowary corridor protection. Legally handed over to State for National Park.	\$ 400,000	<1 year
Implementation of Management Strategy for Eubenangee Offset Property		Establishment of vegetated connectivity corridor between key habitats	estimated \$ 500,000+	1-3 years
TOTAL	126.42 ha		\$ 1,600,000	

Table ES 5 Land based direct offsets



Indirect Offsets			
<i>Action Summary</i>	<i>Contribution</i>	<i>Value (est.)</i>	<i>Timing</i>
Cassowary tracking	UQ/QPWS/Ella Bay project Using GPS telemetry to track rehabilitated juvenile Cassowaries	\$30,000	In progress <1 year
Cassowary Diet and DNA analysis	University of Queensland/QPWS project Determining Cassowary Diet and Energetics through Remote Sensing,	\$30,000	In progress <1 year
Cassowary Fencing & Escape Gate Research Project	Ella Bay Developments. Design, develop and trial Cassowary Fence & Escape Gate	\$100,000	complete
Impact of Ella Bay Development on cassowaries, fauna and flora.	James Cook University Environmental impacts of Ella Bay Development access and internal roads, design of strategies to mitigate road impacts on adjacent habitats and internal corridors, and monitoring of road mitigation strategies	\$130,000	Before and after construction +3 year
TOTAL		\$290,000	

Table ES 6 Research based indirect offset package

Direct Impact Offset for Queensland VMA & NCA and EPBC

The proposed Direct Impact offset comprises two areas of high integrity land totalling 62.78 ha. This land will be transferred and incorporated into Ella Bay National Park. The two areas are shown as CZ A.1 & CZ A.2 on Figure ES 1. The time period for transfer to National Parks will be less than 12 months.

The primary purpose of the offset CZA.1 (Conservation Zone A.1) located on the Northern boundary of the Ella Bay property is protection of essential cassowary habitat, and the nationally significant Ella Bay Swamp Wetland.

CZA.1 comprises 40.18 ha of vegetation RE 7.11.1, 7.3.3a, 7.3.10c, 7.2.9, 7.2.4, 7.2.1, 7.2.1d and 7.2.7a (Essential cassowary habitat). The land will provide a higher level of tenure and include the southern extent of Ella Bay Swamp Wetland in the extension to Ella Bay National Park.

The primary purpose of the offset CZA.2 located on the south-western corner of Ella Bay property is to increase protection of the Seymour range north-south corridor and essential cassowary habitat.

CZA.2 comprises 22.60 ha of RE 7.11.1 and RE 7.11.1b (Essential cassowary habitat). To the west it will widen the existing narrow World Heritage Area linkage by adding a section of land to the Ella Bay National Park to provide a near contiguous linkage to the geographically isolated southern section of Ella Bay National Park. This area forms the eastern slope of the Seymour Range and is part of a regional cassowary habitat corridor. The land will provide a higher level of tenure and secure a wider North South cassowary corridor along the Seymour Range. The triangular section of WTWHA is over freehold land which joins the WHA areas. This cassowary corridor has been identified by Terrain NRM. (Terrain 2008) *“Whilst a small section of the Ella Bay site to the SW is close to the World Heritage area, it would be of benefit to seek a widening of the corridor in this area.”*



Figure ES 1 Land based direct impacts offset 62.78 ha including Ella Bay Swamp Wetland

Indirect Impacts Offset for EPBC - Eubenangee Offset Property

As part of the offset proposal the proponent has purchased property located within a strategic regional habitat connectivity corridor; identified within the Recovery Plan for the Southern Cassowary as an area of key ecological function, broad movement corridors and appropriate rehabilitating habitat. This corridor ‘link’ was identified as important for conservation by Terrain NRM and key regulatory stakeholders including Queensland Environmental Protection Agency, Wet Tropics Management Authority, Queensland Parks and Wildlife Service and Cairns City Council.

The proposed offset comprises land on 3 titles totalling 63.62 ha. The land is contiguous with Eubenangee Swamp National Park on the south and western boundary and WTWHA on the northern boundary. The area is shown on Figure ES 2. The land has been procured and the time period for transfer to National Parks will be less than 12 months.

The land is currently laying fallow following purchase of the operating sugar cane farm. The land will require revegetation before providing an important corridor between the WTWHA and Eubenangee Swamp National Park

The offset property will undergo extensive revegetation/rehabilitation to create a habitat corridor linking a World Heritage area and Eubenangee Swamp National Park. This on-ground property-based offset will:

- deliver real conservation outcomes;
- will be commensurate with the magnitude of the impacts of the development;
- will be within the same area as the development;
- will be delivered in a timely manner and be long lasting; and
- will be enforceable, monitored and auditable as required

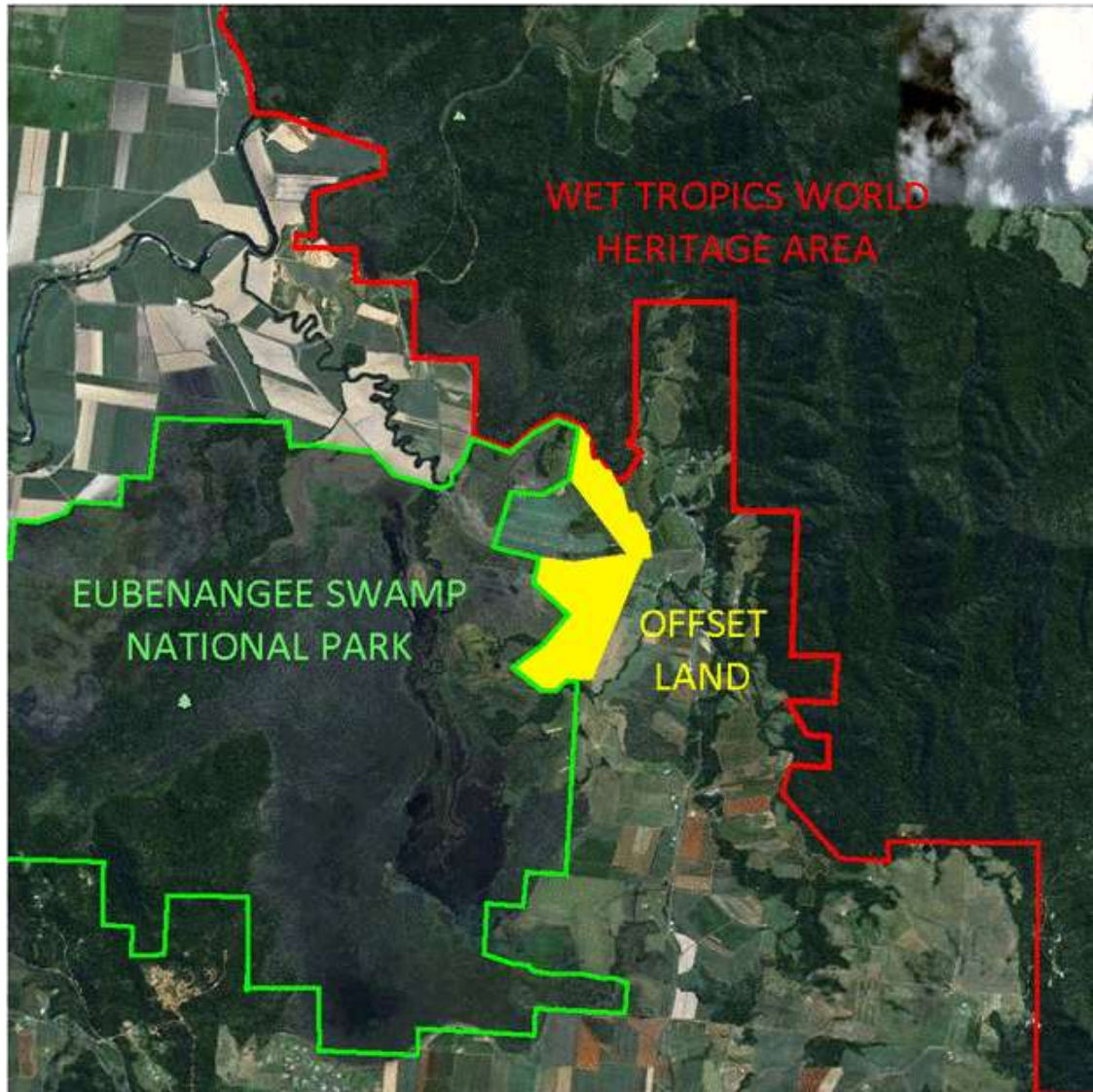


Figure ES 2 Offset land showing the relationship between Eubenangee Swamp National Park and WTWHA

Management Strategy for Eubenangee Offset Property

The revegetation strategy (refer to Appendix 2) focuses on establishing a continuous vegetated corridor connecting the National Park and World Heritage Area. The site requires rehabilitation due to the nonexistence of remnant vegetation communities; ground covering with sugarcane and weed infested grass pasture, and inundation for periods during a high rainfall Wet Season. The revegetation must be attractive for the cassowary in order for the corridor to be a success.

The management strategy focuses on revegetation, weed management, and fauna monitoring.



EPBC Indirect Impacts Offset -Research Package

The research package is designed to further understanding in terms of reducing cassowary mortality, increasing the local population and monitoring the impact of development on the cassowary and the environment.

The research package will be made by direct donation or payment of costs to the project institution. In the SEIS it was proposed to use the Ella Bay Environmental Trust as a conduit to fund the research grants. The environmental trust will still be used for ongoing research funding but not the offsets.

The research projects are complementary to the Recovery Plan for the Southern Cassowary (Latch 2007). The offset research projects target the major threats and improving the knowledge base.

Cassowary Population – growth and carrying capacity

- Cassowary tracking UQ/QPWS/Ella Bay project Using GPS telemetry to track rehabilitated juvenile Cassowaries Survival of Juveniles and rehabilitation
- Cassowary Diet and DNA analysis University of Queensland/QPWS project Determining Cassowary Diet and Energetics through Remote Sensing,

Road Mortality – mitigation strategies

- Cassowary Fencing & Escape Gate Research Project Ella Bay Developments, EcoLogical and Chenoweth . Design, develop and trial Cassowary Fence & Escape Gate

Measurement of impacts

- Impact of Ella Bay Development on cassowaries, fauna and flora James Cook University Environmental impacts of Ella Bay Development access and internal roads, design of strategies to mitigate road impacts on adjacent habitats and internal corridors, and monitoring of road mitigation strategies

Offset Package Matrix

The offset package has been designed for maximum immediate outcome as per the Offsets Matrix tool (DEWR 2007). Table ES 7 provides a review of the key characteristics of the Proponent's offset package proposal and an indication of the probable conservation outcome, and whether there is a balance of high and low risk actions.

Long Term Conservation Result

The proponent's goal is that there will be a long term positive outcome from the Offset Package and onsite mitigation. The package has been integrated into; and supports the aims of the Recovery Plan for the Southern Cassowary (Latch 2007). The proponent's actions are designed to enhance the movement and ultimately the long term survival of cassowaries within the local Ella Bay Development and in the regional context.

The research initiatives are designed to minimise impacts, monitor and study the survival of the cassowary and other fauna.

The Offset package and mitigation have been measured against the Recovery Plan for the Southern Cassowary in Table 6.1. Ella Bay Cassowary Recovery Matrix



	IMMEDIATE OUTCOME (less than 12 months)	MEDIUM TERM OUTCOME (within 1 to two years)	LONG TERM OUTCOMES (greater than 2 years)
<p>HIGH LEVEL OF CERTAINTY</p> <p>technique used regularly with effective results</p> <p>good quality scientific data is available on key conservation needs of the matter of NES</p>	<ul style="list-style-type: none"> • 22.60 ha of essential cassowary habitat for ecological cassowary corridor on private land to be gifted to National Parks; • 40.18 ha of essential cassowary habitat including the southern extent of the nationally significant Ella Bay Swamp Wetland on private land to be gifted to National Parks; • 63.62 ha Eubenangee offset property to be gifted to National Parks; • 67.8 ha of buffer from World Heritage/ National Park will be placed in Conservation Covenants; and • 87.3 ha of fauna corridors will be placed in Conservation Covenants. • Research - Cassowary Tracking. Juvenile Tagging and Tracking – research has been 50% completed 		<ul style="list-style-type: none"> • Research impact of Ella Bay Development on cassowaries, fauna and flora
<p>MEDIUM LEVEL OF CERTAINTY</p> <p>-approach has successfully been used previously in relation to this or highly similar matter of NES</p>	<ul style="list-style-type: none"> • Eubenangee offset property: Creation of essential cassowary habitat under a Revegetation Management Strategy (with precedence). • Research – Cassowary fencing and escape gate project - complete 	<ul style="list-style-type: none"> • Targeted Survey: Specific monitoring of cassowary usage of Eubenangee offset habitat corridor 	
<p>LOW LEVEL OF CERTAINTY</p> <p>New or untested on-ground conservation activity limited scientific data on the matter of NES</p>	<ul style="list-style-type: none"> • Research – Cassowary diet and DNA analysis. 		<ul style="list-style-type: none"> • Education Programs • Frog fencing erected at creek crossings on Ella Bay Road

Table ES 7 Offset Package Matrix based on Offsets Matrix tool (DEWR 2007)



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1. Introduction

The following proposal outlines the Offset Package to achieve a long term environmental benefit from the Ella Bay Integrated Resort for the Matters of National Environmental Significance including the Southern Cassowary, and World Heritage Values.

The proponent's goal is that there will be a long term positive outcome from the Offset Package and onsite mitigation such that the short term prediction of extinction of the Graham-Seymour subpopulation of cassowaries is reversed. The package has focussed on movement corridors and research such that ultimately the long term survival of cassowaries within the local Ella Bay Development and in the regional context is enhanced.

1.1 Project Background

The Ella Bay property comprises of 470 hectares of freehold land that is isolated within the Ella Bay National Park and Wet Tropics World Heritage Area. The site is predominantly cleared, and the land is degraded to an extent that the property was not considered of sufficient value to be included in the World Heritage Area nomination. The land was initially cleared in the early 1900's for banana growing and has degraded through significant weed infestation since. The narrow riparian corridors which are evident today, are regrowth from near total clearing as shown on Army maps (Army 1943) (Refer to Volume One: *Report on Matters of National Environmental Significance* for history since 1900). The extensive pond apple infestations along these riparian areas; although providing a short duration fruit source for the cassowaries, are in danger of spreading throughout Ella Bay Swamp Wetland from pig and cassowary dispersal of seeds.

The proposed development will consist of: (refer Volume One: *Report on Matters of National Environmental Significance*)

- Four (4) resort precincts comprising 860 units and villas along the Coastal side of the site. The resorts will consist of single and two storey villas in the northern precinct, single, two and three storey apartments in the central foreshore precinct and three to four storey and terraces around the village and golf clubhouse (refer to Volume 6.5a Local Area Plan);
- Sited on the Western boundary within existing cleared areas of the property will be three precincts containing 540 residences situated adjacent to restored rainforest vegetation;
- A Recreation/Open Space area comprising recreational amenities, community services and an 18 hole golf course;
- A mixed-use community village precinct forming a centre for visitors, with retail spaces, professional services, offices and restaurants;
- A research and educational area incorporating the welcome centre, a collaborative research institute, an international school and a sports centre;
- The development is expected to accommodate a maximum of 1200 permanent residents and 2000 tourists when the development is at full capacity and during the peak period of the dry season.

The Ella Bay Development has been declared a significant project under the *State Development and Public Works Organisation Act 1971*, section 26; and a referred action under the *Environment Protection and Biodiversity Conservation Act 1999*.

1.2 Matters of National Environmental

Ella Bay Development was referred as an action under the EPBC Act, and later determined to be a controlled action due to potential or likely significant impacts on matters of National Environment Significance. The controlling provisions for the action are:

- World Heritage properties;
- listed threatened species and ecological communities;



This report addresses impacts upon;

- Biodiversity and clearing of native vegetation: and
- Issues of MNES (DSEWPaC 2009) which were identified in the EIS, SEIS and MNES reports:
 - World Heritage and National Heritage values (both in relation to the Wet Tropics Queensland World Heritage Area and the Great Barrier Reef)
 - the endangered vegetation community Littoral Rainforest and Coastal Vine Thickets of Eastern Australia;
 - and loss of habitat and impact on endangered and vulnerable fauna (including the Southern Cassowary *Casuarius casuarius johnsonii* and the Common Mistfrog *Litoria rheocola*)

The proponent has developed an offset package for Ella Bay Development that satisfies its regulatory requirements focusing on clearing of vegetation, residual impacts on World Heritage values of sustainability, biodiversity and protection of habitat for endangered species; and once implemented, will have the effect of achieving net overall environmental improvements both at Ella Bay and surrounding area.

The impact of the development will be mitigated through a range of actions that will be undertaken both at Ella Bay and along Ella Bay Road. This extensive mitigation has addressed the many environmental concerns and minimised the residual impacts.

1.3 Purpose of Report

The purpose of this report is to:

- Outline relevant legislative requirements;
- Define direct impacts and residual impacts to vegetation and Biodiversity;
- Define direct impacts and revocation of protected area estate (National Park);
- Define direct and residual impacts to MNES, and World Heritage Areas that cannot be adequately mitigated;
- Define indirect impacts to MNES, WHA and National Heritage values that cannot be adequately mitigated;
- Detail the Proponent's offset measures;
- Direct Offsets;
 - including the timing and title arrangement, site description, biodiversity and environmental values relevant to MNES;
 - Revegetation and rehabilitation plans.
- Indirect Offsets;
 - Detail research and actions to compensate for indirect adverse impacts on MNES

The report is for the following stakeholders:

- Australian Government Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC);
- Wet Tropics Management Authority (WTMA);
- Department of Infrastructure and Planning (DIP); and
- Department of Environment and Resource Management (DERM).

The proponent in this report is Satori Resorts Ella Bay Pty Ltd for *Ella Bay Integrated Resort Development Proposal (EPBC 2005/2159)* (Ella Bay Development).

1.4 Formal Offset Requirements

State and Commonwealth offset requirements are addressed separately in this report reflecting the separation of the regulatory and policy requirements at each level of Government.

- Impacts upon biodiversity and clearing of native vegetation are the key issues for determining offsetting obligations under Queensland regulations, including the Vegetation Management Act (VMA) (Qld), Nature Conservation Act (NCA) (Qld), and the Draft Queensland Government Policy for Biodiversity Offsets.
- The MNES impacts are covered under the EPBC Act which contains no formal offset requirements (DSEWPaC 2009, 2011), however a range of Direct and Indirect opportunities are available while still meeting the conservation goals of the Act.

1.4.1 Offsets required under the Vegetation Management Act (VMA) and Nature Conservation Act (NCA)

State based offset assessment and analysis requires the co-ordination of offset policies and guidelines under the following:

- Nature Conservation Act 1992 (NCA) (Queensland) – the Proponent must provide offsets for the loss of Essential Habitat;
- Draft Policy for Biodiversity Offsets - Consultation Draft 2008 (Queensland).Vegetation Management Act (VMA), 1999 (Queensland) and
- Vegetation Management and Other Legislation Amendment Bill (2009),
- Regional Vegetation Management Code for Coastal Bioregions – version 2 2009
- Queensland Government Environmental Offset Policy 2008 (QGEOP);
 - Policy for Vegetation Management Offsets – 2007 (superseded)
 - Policy for Vegetation Management Offsets — Version 2 - 2009 (Offsets Policy)

The Nature Conservation Act requires that offsets be provided for loss or disturbance to *essential habitat*. The Draft Policy for Biodiversity Offsets provides offset ratios on a variable scale. The Draft Policy for Biodiversity Offsets also addresses offsets for revocations and clearing of protected area estate (National Parks).

The Vegetation Management Act (and Vegetation Management and Other Legislation Amendment Bill 2009) requires that offsets be provided for loss or disturbance to remnant vegetation. The Regional Vegetation Management Code for Coastal Bioregions – version 2 2009 provides offset ratio multipliers for clearing of non-essential habitat.

An offset may be proposed by an applicant for particular development activities as a solution to meet specific performance requirements (PRs) that require a development to maintain the current extent of a particular regional ecosystem.

However, this may only occur where the applicant has first demonstrated to the chief executive that the development has first avoided and mitigated the impacts of the development on vegetation prior to proposing an offset.

Details of mitigation are provided within the Volume One: *Report on Matters of National Environmental Significance* which provides the full scope of the action.

1.4.2 Offsets required under the Environmental Protection and Biodiversity Conservation Act

Commonwealth based offset assessment and analysis requires the co-ordination of offset policies and guidelines under the following:

- Draft Policy Statement: Use of Environmental offsets under the Environment Protection and Biodiversity Conservation Act. 1999 (EPBC) 2007 (Commonwealth).
- EPBC Act Policy Statement 1.1: Significant Impact Guidelines - Matters of National Environmental Significance 2009
- EPBC Act Policy Statement 3.15: Significant Impact Guidelines for the Endangered Southern Cassowary (*Casuarius casuarius johnsonii*) Wet Tropics Population 2010
- EPBC Act Consultation Draft Environmental Offsets Policy 2011



The Commonwealth Government has provided advice on offsets in the *Draft Policy Statement: Use of environmental offsets under the Environment Protection and Biodiversity Conservation Act 1999* (Department of Environment and Water Resources (DEWR), August 2007). The policy defines environmental offsets as ‘actions taken outside a development site that compensate for the impacts of that development - including direct, indirect or consequential impacts’. This includes environmental impacts that may arise through the Ella Bay Integrated Resort development and include impacts that cannot be fully mitigated through the use of on-site measures and Environmental Management Plans, and impact on those matters of national environmental significance protected by the EPBC Act.

It is important to note that offsets do not reduce the actual impacts of a development but may change the net effect of a proposal on the environment because of the reparation or ‘environmental gain’ achieved through those actions.

1.5 Offset Objectives

Ella Bay Developments has focussed on environmental stewardship of the area in mitigation design and in the provision of this offset package for the long term benefit of the local and regional habitat for the recovery of the cassowary. The objectives of the offset package will be in integrating elements of the Commonwealth EPBC and state based VMA principles to:

- Provide an offset that compensates the residual impacts of the project on biodiversity; in particular the cassowary;
- Deliver an offset that improves the environmental outcome of the cassowary;
- Develop an offset package that incorporates the key elements of the Southern Cassowary Recovery Plan; and
- Ensure in perpetuity security of the offset sites through incorporation with National Parks and provide a framework for their ongoing and long term maintenance.



2. Quantifiable Impacts under the Queensland Vegetation Management Act (VMA) and Nature Conservation Act (NCA)

This section relates to the requirements for an offset as a condition of a development approval under the *Vegetation Management Act 1999* (VMA) (and *Vegetation Management and Other Legislation Amendment Bill 2009*), as outlined in the *Policy for Vegetation Management Offsets* 2009 DERM and *Policy for Biodiversity Offsets (Consultation Draft)* EPA 2008 consistent with the Queensland Government Environmental Offsets Policy (QGEOP) which commenced on 1st July 2008 and the Nature Conservation Act 1992 (NCA) (Queensland).

The state based policies address the clearing of vegetation and endangered species habitat.

2.1.1 Ella Bay Road

The clearing required for the proposed upgrade of Ella Bay Road is the minimum necessary for safety of motorists and to improve the road-side drainage to meet current standards. The road design has also focussed on maintaining mature trees to maximise canopy connectivity (refer to Volume Four: *Road Design and Environmental Management Report*).

The revocation of a small area (140m²) of Ella Bay National Park will enable an improved alignment at the intersection of Stage 1 and Stage 2 resulting in a reduction in clearing of 1400m². This is a change in the road reserve envelope and will contribute to 30m² of clearing within the revoked area. This section of Ella Bay National Park is not part of the Wet Tropics World Heritage Area.

Additional clearing over that listed in Table 2.1 not requiring offsets will occur within:

- The Little Cove development; 0.7 ha which will be covered under Development Application 372/2 along the existing partially cleared road easement by a clearing permit; and
- Non-remnant vegetation of which 0.04 ha is on Ella Bay Road Reserve in Stage 1 and 0.03 ha is on State land in Stage 2.

The clearing areas are identified in Volume 7 Dwg EBR1CE-PD09 and in Table 2.1

2.1.2 Ella Bay Development

The proposed clearing for the Ella Bay Development will comprise;

- Clearings for a number of bridges within creek riparian areas for creek crossings. The clearings have been minimised and where possible existing cleared crossings have been used requiring only extension of the clearing width;
- Multiple small clearings to locate the discharge of constructed wetlands and bioretention filters. The locations have been located in areas that have been previously cleared and contain regrowth trees less than 150mm diameter;
- One area of built development – Southern Hill, which continues along from the existing house site.

The clearing areas are identified on Volume 7 Drawing 15 and in Table 2.1.

2.1.3 State based Offset Proposal

The Ella Bay Development is recognised as a significant project under the State Development and Public Works Organisation Act (1971) (SDPWO Act) provides for a Coordinator-General assessment decision to impose conditions, including environmental offset conditions that the Coordinator-General considers necessary or desirable. The total offset requirements are to be based on a multiplier of up to 5 ha for every 1 ha impacted.

Under the Queensland Government Environmental Offsets Policy principle 6 ('additionality'): Offsets must provide additional protection to environmental values at risk, or additional management actions to improve environmental values.



The applicable policy for Offset determination is the Regional Vegetation Management Code for Coastal Bioregions – version 2 2009 and the *Policy for Biodiversity Offsets (Consultation Draft)* EPA 2008. The clearing areas have been analysed as to compliance with the code based on Regional Ecosystem mapping and correlation to Essential cassowary habitat mapping from the Southern Cassowary Recovery Plan (Latch 2007). Under the criteria any clearing of essential habitat reduces the extent of an ecological community and all the clearing described under the essential habitat criteria of the Queensland VMA is a significant impact.

Critical habitat for the Common Mistfrog is not listed in the Species Profile and Threats Database (SPRAT, DSEWPAC) and for this purpose riparian habitat along creek lines has been evaluated. In all cases riparian habitat is also listed as essential cassowary habitat.

Areas Subject to Queensland Regulatory Offsets					
	Revocation of National Park ¹	Clearing of National Park Of Concern ²	Clearing of Essential Cassowary habitat ³	Clearing of remnant Of concern RE ⁴	Total Area
Ella Bay Road	0.014 ha	0.33 ha	2.13 ha	0.34 ha	2.814 ha
Ella Bay Development			0.70 ha	0.25 ha	0.95 ha
TOTAL	0.014 ha	0.33 ha	2.83 ha	0.59 ha	3.764 ha
Impact : Offset Ratio	5	5	5	2.5	
TOTAL Offset	0.70 ha	1.65 ha	14.15 ha	1.475 ha	17.35 ha

^{1,2} *Policy for Biodiversity Offsets - Appendix 2 Offset Rules section - Protected area estate*

³ *Policy for Biodiversity Offsets - Appendix 2 Offset Rules section - Endangered Species*

⁴ *Regional Vegetation Management Code for Coastal Bioregions – Of Concern RE*

Table 2.1 Cleared Areas and Resulting Regulatory Offsets

The offset strategy will provide land of greater than 17.35 ha which will provide an ecological corridor for cassowary movement and preservation of Of Concern regional ecosystem.

The property based offset will comprise:

- 22.60 ha of RE 7.11.1 and RE 7.11.1b (Essential cassowary habitat) located on the south-western corner of Ella Bay property. This area will be donated and titled to National Parks. The land will provide higher level of tenure for the North South cassowary corridor along the Seymour Range. The strategic ecological (cassowary) corridor has been identified in research on identification of preferred offset properties prepared by Terrain NRM (Appendix 1: *Terrain NRM Offset Corridors Report*) and DSEWPAC; and
- The timeframe to deliver the offset will be less than 12 months.

The total increase in National Park Estate area will be 22.60 ha within the same bioregion and biodiversity values.

<p>Queensland Vegetation Management Act and Nature Conservation Act</p> <p>The offset will be 22.60 ha Offset for 17.35 ha regulatory requirement for the clearing of 3.764ha of equivalent habitat within the same bioregion and biodiversity values.</p> <p>Overall Offset Ratio of 6:1</p>

3. Residual Significant Direct Impacts under EPBC

This section relates to the requirements for an offset for quantifiable impacts to MNES under the EPBC Act. The following policies provide guidance to impacts and offset assessment.

- Draft Policy Statement: Use of Environmental offsets under the Environment Protection and Biodiversity Conservation Act. 1999 (EPBC) 2007 (Commonwealth);
- EPBC Act Policy Statement 1.1: Significant Impact Guidelines - Matters of National Environmental Significance 2009;
- EPBC Act Policy Statement 3.15: Significant Impact Guidelines for the Endangered Southern Cassowary (*Casuarius casuarius johnsonii*) Wet Tropics Population 2010; and
- EPBC Act Consultation Draft Environmental Offsets Policy 2011.

The significant impact criteria as defined in *Significant Impact Guidelines - Matters of National Environmental Significance 2009* are listed below for an endangered species. This also has to be measured against more specific guidelines presented in *Significant Impact Guidelines for the Endangered Southern Cassowary*.

Significant impact criteria

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- reduce the extent of an ecological community;
- fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;
- adversely affect habitat critical to the survival of an ecological community;
- modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;
- cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;
- cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:
 - assisting invasive species, that are harmful to the listed ecological community, to become established, or
 - causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or
- Interfere with the recovery of an ecological community.

3.1 Residual Direct Impacts

Extensive mitigation has been applied to Ella Bay Road and Ella Bay Development to reduce impacts to Matters of NES. A number of residual direct impacts remain for the endangered fauna, the Southern Cassowary and the Common Mistfrog.

The clearing of essential cassowary and Common Mistfrog habitat and offsetting has been described in the State based offsets in Chapter 2 of this report. The proposed offset at an effective offset ratio of 6:1 will contribute to the Commonwealth requirements.

The following describes isolation and edge effect of habitat of the Southern Cassowary and the Common Mistfrog, and the endangered community littoral rainforest habitat.

Potential impacts on the endangered flora and fauna, and description of the habitat quality have been addressed in Volume One: *Report on Matters of National Environmental Significance*. Recommendations as a result of this and of the Recovery Plan for the Southern Cassowary, Stream-dwelling Rainforest Frogs and EPBC Policy Statement 3.9 have been incorporated into



the management EMP and monitoring processes for the development. (Refer to Volume Three *Environmental Management Plans*).

3.1.1 Ella Bay Road

The proposed upgrade to Ella Bay Road will follow along the existing gazetted unsealed Ella Bay Road as it passes through or adjacent to Ella Bay National Park between Flying Fish Point and Ella Bay. The Flying Fish Point Bypass Road will be a new road alignment from Bay Road to join Ella Bay Road.

The vegetation along the proposed road alignment has been surveyed for flora and for its importance to the cassowary, from the Ella Bay Property gate in the north, to the Flying Fish Point-Innisfail (Bay) Road in the south, and including the eastern slopes and adjacent ridges of the Seymour Range.

3.1.1.1 Isolation and Edge Effect on Cassowary Habitat

The Ella Bay Development will increase the traffic volumes along Ella Bay Road and increase potential impacts to the MNES flora and fauna. The major potential impact is an increased road mortality threat to the cassowary and extensive mitigation has been incorporated to minimise the impact. The cassowary population along Ella Bay Road to Little Cove property has been surveyed over different seasonal conditions and has remained stable at 2 or 3 adult cassowaries with one sub-adult or chick (Buosi 2010b).

The mitigation will comprise three cassowary underpasses and one overpass. The roadside will be fenced to funnel the cassowaries to the underpass/overpass. (Refer to Volume Four: *Road Design and Environmental Management Report*). The fencing along the road and funnelling of the cassowaries to the underpass/overpass will isolate some essential and general cassowary habitat along the roadside and other non-cassowary habitat within the World Heritage Area. Additionally any revegetation works within the fenced road alignment will exclude cassowary fruiting species to reduce the possibility of enticement on to the roadway.

The cassowary fence will be located between 5 to 10m within the rainforest and isolate some habitat between the roadside and the fence and have a small impact around the fence alignment. The impact of the fence installation and maintenance will be from localised hand clearing and the potential for weed incursion. The fence trials at Ella Bay were able to demonstrate that the impact was minimal and despite a number of cyclone events there was no increase in weeds or clearing requirement. (Refer to Volume 6.1j *Report on Cassowary Exclusion Fence Trials*).

The cassowary fence isolation area has been calculated for the road alignment by habitat type. (Refer to Volume Four: *Road Design and Environmental Management Report*). An offset ratio multiplier has been proposed based on habitat value.

During construction of Ella Bay Road upgrade, areas of habitat will be temporarily isolated. A temporary construction fence will be used along the road and in particular during the construction of the three underpasses and the overpass to prevent possible cassowary vehicle/construction workforce interaction. Temporary fencing of the underpass near Flying Fish Point will isolate access of up to three cassowaries from approximately 10% of their habitat during one dry season. The two underpasses at Little Cove will isolate one cassowary from approximately 3% of its habitat during one dry season. It is neither feasible nor desirable to allow the cassowaries to pass and possibly be trapped on the coastal side of the road during the construction.

The noise from the increased traffic volumes will create an edge effect impact to the rainforest. The projected noise levels have been calculated (Refer to Volume Four: *Road Design and Environmental Management Report*) and compared to studies at Kuranda Range. The noise levels will be significantly lower -7db(A) than the current Kuranda Range traffic. This is equivalent to the same noise level along Ella Bay Road at a distance of 31m to 40m as that of



Kuranda Range Road at 100m. The topography of Kuranda Range Road is also markedly different to that of the coastal headland of the Ella Bay Road alignment.

Recent Kuranda Range studies (Dawe, G. and Goosem, M, 2008) have investigated the impact of compensatory pitch adjustments to the dominant frequency of song in avian rainforest fauna and the reduced densities of avifauna in habitat adjacent to roads.

Studies at Mission Beach (Moore pers comm.) however indicate that cassowaries appear to have habituated to the sound of cars and trucks on the roads. This is illustrated by many observations of cassowaries standing by the roadside waiting for an adequate break in the traffic flow to allow them to cross. They take little notice of cars even when birds are foraging close to the road corridor, but loud trucks, noisy trailers, or sudden noise do startle them. In these situations they move away from the road initially but generally come back if the source of the unexpected noise ceases.

The proponent has calculated an edge effect area due to noise and disturbance along Ella Bay Road taking a distance of 25m into the rainforest along both sides of the road except for the eastern side of the road around Heath Point Headland where the impact of noise would be nullified by the steep headland and elevation of the road above the coastal vegetation. The 25m is additive to the cleared area required for road realignment and improved road-side drainage and the area that will be isolated by the cassowary fence. The effective distance from the road lane will be between 30m to 40m from road edge.

On the positive side the edge effect impact of increased visitation, entry and litter scatter distance into the road edges will be reduced due to the barrier effect of the cassowary fence. The cassowary fence will improve over the current invasive practices of green and household rubbish dumping and manmade entry paths.

3.1.1.2 Isolation and Edge Effect on Stream Dwelling Rainforest Frog Habitat

The Species Profile and Threats Database (SPRAT, DSEWPAC) does not specify any habitat critical to the species, however habitat suitable for *Litoria rheocola* (Common Mistfrog) and *Nyctimystes dayi* (Australian Lacelid) is present along the road alignment. Creeklines supporting habitat suitable for the frogs are crossed by the existing Ella Bay Road north of Heath Point and the presence of the Common Mistfrog was identified upstream from the road. Currently the creeks pass beneath the existing road within pipe culverts, then immediately discharge to the ocean. The proposed mitigation is to replace the pipe culvert with a specific small fauna culvert suitable for frogs. Frog fences will also be installed for 25m either side of the road.

No habitat will be isolated and the edge effect has been included in the cassowary edge effect calculation in the previous section as the riparian habitat is recognised as essential cassowary habitat. (refer to Volume 7 Drawings EBR1- DD31 & DD32)

3.1.1.3 Potential Degradation of an Critically Endangered Vegetation Community

Along Ella Bay Road there is one location that the critically endangered ecological community (Littoral rainforests) will be impacted by the road upgrade. This ecological community is located at the northern-most extent of the Prawn Farm, adjacent to and part inclusive of Heath Point Park. The quality of habitat is very poor and degraded from the proximity to the road and the park. This habitat will be rehabilitated as part of the Ella Bay Road upgrade roadworks.

No critically endangered habitat will be cleared but a small section of the habitat will be isolated by the cassowary fence. No offset is proposed for this poor quality habitat, which will be revegetated.

3.1.1.4 Ella Bay Road Isolation and Edge Effect Offset Multipliers

The following offset multipliers have been proposed based on the habitat value to the endangered fauna and habitat condition.

Offset Ratio – Ella Bay Road		
<i>Habitat type</i>	<i>Essential cassowary habitat</i>	<i>WHA/NP Of Concern</i>
Clearing (VMA/NCA)	5	5
Cassowary Fence Isolation	3	2
Edge Effect	1.5	1

Table 3.1 Ella Bay Road – Residual direct impact offset multipliers

3.1.2 Ella Bay Development

The Ella Bay site has been extensively cleared and degraded from over a century of intensive banana farming and cattle grazing.

Vegetation within the area of the development site was cleared early last century. The current cleared area is 241 ha with thin corridors of riparian vegetation along the creeks. This riparian and littoral vegetation is predominately regrowth with some of the vegetation mapped as non-remnant and in other areas the regrowth has obtained 70% of mature height and remnant status. (Refer to Volume One: *Report on Matters of National Environmental Significance* section 4.1.1.1)

Edge effect from the agricultural activities within the existing vegetation of the development site is extensive with significant areas of exotic weed infestations and fenced paddocks of introduced pasture grasses. In the vegetation bordering the development edge effects are characterised by Pond Apple and other weed infestation, logging roads, clearing over boundaries, historical fence remnants and on the dunal swale area from camping. Cattle also have degraded vegetation at the edge of the property and site creeks through grazing and trampling and aided in the spread of weeds. The thin riparian corridors have also been susceptible to cyclone damage. (Refer to Volume One: *Report on Matters of National Environmental Significance*).

3.1.2.1 Isolation and Edge Effect on Cassowary Habitat

While the development will subject the area to a significant increase in population and potential anthropogenic impacts, extensive mitigation in terms of revegetation, and rehabilitation of degraded and weed infested vegetation will be undertaken. Cassowary and wildlife corridors will be established and provide connectivity between areas of vegetation and improve riparian corridors. Constructed wetlands for storm water mitigation will also provide cassowaries with more abundant permanent water.

In response to the Ella Bay EIS and SEIS; DSEWPac, WTMA and DERM have made recommendations of cassowary corridors of 100m width, 100m setbacks from Ella Bay National Park and 50m setbacks from the northern vegetation. All of the recommendations have been adopted and are reflected in the site plan.

The quantifiable impacts addressed here have been identified as the isolation of cassowary habitat and possible edge effects on Common Mistfrog habitat. Clearing of essential cassowary habitat and offsetting was addressed with state based regulations.

All areas of essential habitat will remain accessible within Ella Bay development site through the cassowary corridors and cassowary underpasses for creek crossings. (refer to drawing *Cassowary Accessibility Through Ella Bay* Dwg 14). The only area that will have restricted access will be 1.07ha Of Concern vegetation which is classified as “general” cassowary habitat. This section is of very poor quality and invaded by pond apple which will be rehabilitated. The



location of this vegetation is adjacent to the central resort area. (Refer to Volume One: *Report on Matters of National Environmental Significance*)

The edge effect from the impact of the population increase is arguably less than the edge effect from agriculture and the past clearing. The impact of urban encroachment into forests from development has been studied by McWilliam, et al., (2010). The relationship of impact to distance was shown to be asymptotic between the impacts and the intensity of ecological impacts. That with education and fencing barriers, the mean encroachment was only 14m and the maximum encroachment distance was 25m. McWilliam concluded that the greatest reduction in encroachment could be achieved by installing fences around development housing, pathways within the vegetation, design boundaries so staff and the community can monitor boundaries, and monitor infrequently. These recommendations have been adopted. Precincts will be fenced and nominated walkways will be constructed to reduce vegetation damage from visitors creating temporary paths.

It is proposed to offset for an edge effect impact at 25m from the edge of riparian vegetation.

The Ella Bay Development has 20m, 15m and 10m setbacks depending on stream order from the riparian vegetation which will be revegetated to increase width and the riparian strips will be rehabilitated. Degradation of essential fauna habitat under the guidelines in this case will be reversed and improved and area of habitat increased.

3.1.2.2 Isolation and Edge Effect on Stream Dwelling Rainforest Frog Habitat

Habitat suitable for two EPBC Act listed stream-dwelling frogs, *Litoria rheocola* (Common Mistfrog) and *Nyctimystes dayi* (Australian Lacelid) is present within the Ella Bay Development site; however only the presence of the Common Mistfrog has been confirmed.

Suitable habitat is confined to the southern section of the major north-south creekline on the southern boundary and the south-western corner of the property where riffle zones are present. It is primarily located upstream and away from the proposed development area, and with appropriate controls, as set out in the *Stream Dwelling Rainforest Frog Species Management Sub-plan*, will not be affected by construction or operation activities.

Frog fences will be installed for 25m either side along the internal roads within the development and fauna sensitive culverts specifically designed with riffle zones for amphibian mobility and frog fencing.

No habitat will be isolated and the riparian habitat has already been included in the edge effect calculation for essential cassowary habitat in the previous section.

3.1.2.3 Potential Degradation of Critically Endangered Vegetation Community

The Critically Endangered Vegetation Community: littoral rainforest occurs on the north and along the south-eastern boundary of the Ella Bay Development site.

The northern community of littoral rainforest is in good condition with only minor infestations of Pond apple in the eastern section and agricultural disturbance edge effect within the first 10 to 20m along the northern interface to the cleared areas.

No critically endangered habitat will be cleared. Access for walking tracks have been conceptually designed to avoid clearing of vegetation. (Refer to Volume Six 6.5e *Ella Bay Walking Track Design Report*)

The south-eastern littoral rainforest is in poor condition and suffers from extensive levels of weed invasion, wind damage as well as wallaby damage (through understorey browsing and trampling). The declared weed *Annona glabra* (pond apple) forms dense stands throughout the northern section of the littoral rainforest area. In these areas, habitat loss is occurring through the replacement and suppression of native plant species. Pond apple could also be a key threatening process to Endangered, Vulnerable and Rare (EVR) plants found on site (WONS

2000). The northern part of the ecological community was specifically surveyed as to the impact of the pond apple and if this community should be rezoned as non-remnant due to the extent of the weed infestation. (Refer to Volume Six 6.2 g *Pond Apple Assessment on Littoral Rainforest*). The southern portion is regrowth and this section of the vegetation was shown as being cleared in the 1898 survey (Surveyor Generals Office Brisbane, 1898) and in the 1943 Army mapping (1943 Army Topographical map).

No critically endangered habitat will be cleared. Beach access walkways have surveyed and designed to avoid clearing of vegetation (refer to Volume Six 6.5d *Beach Access Report*). No offset is proposed for this poor quality habitat, which will be revegetated/rehabilitated.

3.1.2.4 Ella Bay Development Isolation and Edge Effect Offset Multipliers

The following offset multipliers have been proposed based on the habitat value to the endangered fauna and habitat condition.

Offset Ratio – Ella Bay Development		
<i>Habitat type</i>	<i>Essential cassowary habitat</i>	<i>Of Concern/ General Cassowary habitat</i>
Clearing (VMA/NCA)	5	2.5
Precinct Fence Isolation	n/a	1*
Edge Effect	1.5	1

Table 3.2 Ella Bay Development – Residual direct impact offset multipliers

The edge effect has been calculated based on 25m impact into the vegetation with the offset ratio modified to account for the habitat value. The 25m has been calculated from the edge of the current vegetation and with setbacks and revegetation will mean that this buffer distance will equate to 35 to 45m from the development.

3.1.3 Commonwealth Direct Offset Proposal

The applicable policy for Commonwealth Offset determination comprises the following draft documents

- Draft Policy Statement: Use of Environmental offsets under the Environment Protection and Biodiversity Conservation Act. 1999 (EPBC) 2007 (Commonwealth); and
- EPBC Act Consultation Draft Environmental Offsets Policy 2011

The draft policies provide general guidelines but no specific offset ratios nor recommendations on the management of edge effect of isolation of habitat. The proposed offset ratios have been applied to the Regional Ecosystem mapping and correlation to Essential cassowary habitat mapping from the National recovery plan for the southern cassowary (Latch 2007) and potential cassowary habitat as provided in Map 2 of EPBC Act Policy Statement 3.15: *Significant Impact Guidelines for the Endangered Southern Cassowary (Casuarus casuarus johnsonii) Wet Tropics Population 2010*



Areas Subject to EPBC –Endangered Fauna					
	<i>Isolation Essential cassowary habitat</i>	<i>Isolation General cassowary habitat</i>	<i>Edge Effect Essential cassowary habitat</i>	<i>Edge Effect Essential cassowary habitat</i>	<i>Total Area</i>
Ella Bay Road	1.05 ha		8.38 ha		9.43 ha
Ella Bay Development		1.07 ha		8.05 ha	9.12 ha
TOTAL	1.05 ha	1.07 ha	8.38 ha	8.05 ha	18.55 ha
<i>Impact : Offset Ratio</i>	3	1	1.5	1	
<i>TOTAL Offset - Fauna</i>	3.15 ha	1.07 ha	12.57 ha	8.05 ha	24.84 ha

Table 3.3 Proposed Direct Residual offset - EPBC

The property based offset will comprise

- 40.18 ha of RE 7.11.1, 7.3.3a, 7.3.10c, 7.2.9, 7.2.4, 7.2.1d and 7.2.7a (Essential cassowary habitat) located on the Northern boundary of the Ella Bay property. This area will be donated and titled to National Parks. The land will provide a higher level of tenure and include the southern extent of the nationally significant Ella Bay Swamp Wetland in the extension to Ella Bay National Park; and
- The timeframe to deliver the offset will be less than 12 months.

Environment Protection and Biodiversity Conservation Act. 1999

The offset will comprise 40.18 ha Offset for 24.84 ha regulatory requirement, for the edge effect and habitat isolation of 18.55 ha. Which will be equivalent habitat within the same bioregion and biodiversity values, and including the unprotected portion of the Nationally significant Ella Bay Swamp Wetland

Overall Offset Ratio of 2.2:1



4. Indirect Impacts to World Heritage Area

The World Heritage Area values of the Wet Tropics World Heritage Area and the Great Barrier Reef World Heritage Area are unique in that both areas satisfy the same four World Heritage Area Criteria listings.

Description	WHA listing	WHA Criterion
Aesthetics/natural beauty	(vii)	Contain unique, rare or superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance.
Significant geomorphic or physiographic features	(viii)	Be an outstanding example representing the major stages of Earth's history, including the record of life, and significant ongoing geological processes in the development of landforms, or significant geomorphic or physiographic features.
Significant ecological and biological processes	(ix)	Be an outstanding example representing significant ongoing ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals
Significant biological diversity/threatened species	(x)	Contain the most important significant habitats for in situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

Table 4.1 Wet Tropics World Heritage Area Criteria

Additionally the Wet Tropics World Heritage Area and the Great Barrier Reef World Heritage Area also have the same criteria for National Heritage Listing. The listing includes important reference to cultural and historical aspects of Australia.

4.1 WHA Listing Criteria (vii) - Visual Amenity

The Wet Tropics World Heritage Area WTWHA was declared as a World Heritage Area partly on the basis of its scenic values - Exceptional natural beauty and aesthetic importance. The coastal scenic value of the Ella Bay area was described as being “High Scenic Significance” (High Priority 2) in Scenic Management Area 20 (WTMA 1992).

4.1.1 Great Barrier Reef World Heritage Area and Wet Tropics World Heritage Area

The Great Barrier Reef provides some of the most spectacular scenery on earth and is of exceptional natural beauty. The coastal vista values comprise the rich variety of landscapes and seascapes including rugged mountains with dense and diverse vegetation. At the local level, the Ella Bay National Park and Heath Point are key areas, especially when viewed from ships at sea.

The scenic values for the Wet Tropics World Heritage Area for Ella bay are described as High Scenic Significance however there are no individual natural features of note in the area and the identified values are at the landscape level.

The quality objective to preserve this scenic beauty is that future developments should not be visually apparent.

4.1.1.1 Ella Bay Road Scenic Values

A Visual Landscape Assessment (VLA) has been undertaken for Ella Bay Road, refer to (Volume 4 *Ella Bay Road Design and Environmental Management Report* Appendix 1 *Visual Landscape Assessment Ella Bay Road*). The proposed upgrade of the existing Ella Bay Road and bypass of Flying Fish Point will provide safe access to visitors and residents of the Ella Bay Development whilst maintaining natural visual integrity. The alignment of Ella Bay road is located adjacent to and passes through the WTWHA within a sensitive visual catchment which exhibits moderate to high levels of visual sensitivity. (Refer to Figure 4.1)

The landscape assessment has identified key values forming the basis of the scenic amenity;

- The rainforest canopy formed by the proximity of mature trees to the roadside;
- The corridor effect of dense roadside vegetation;
- The extensive vistas of the Great Barrier Reef Marine Park and World Heritage Area from Heath Point Park and headland.

Additionally, there are pre-existing negative impacts of both the visual and environmental aspect of the dirt road. Substantial weed encroachment is evident on the margins; and dust is contributing to both smothering of vegetation and silting of streams.

The proposed road design takes into account the competing requirements of road safety requiring extensive clearing, versus visual sensitivity with limited clearing, by restricting speed limits and where required to save mature trees utilising alternative management of road safety requirements for sight and evasive action distances. The proposed road upgrade alignment utilises all of the existing clearing

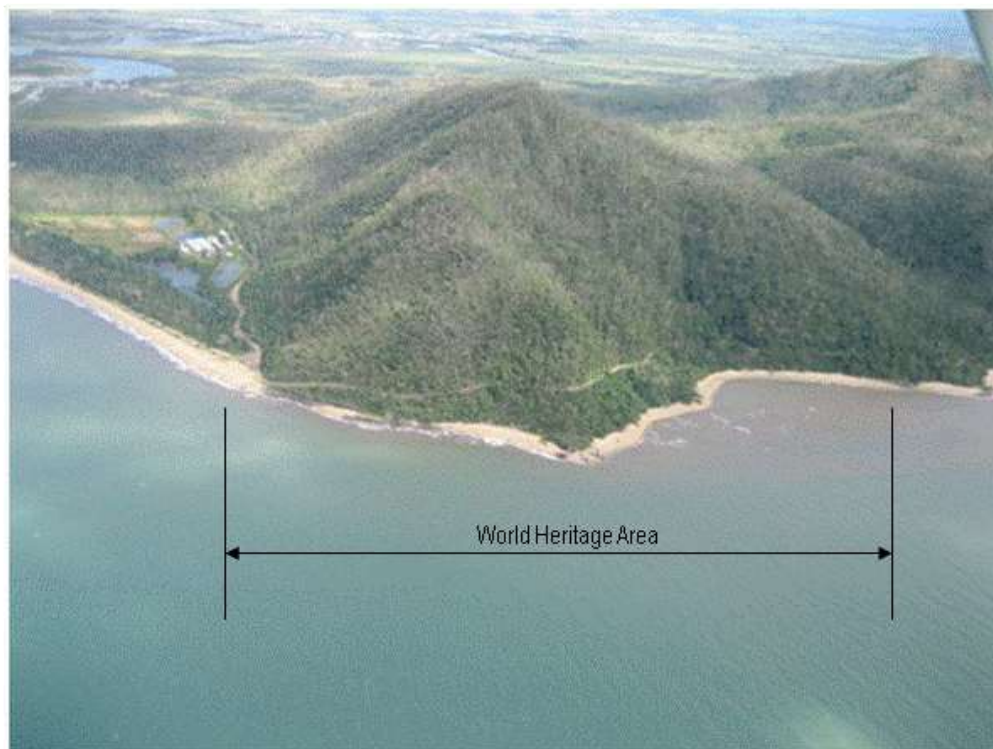


Figure 4.1 Ella Bay Road Heath Point Headland showing vista of WTWHA

The landscape integration strategy (Volume 4 *Ella Bay Road Design and Environmental Management Report* and Volume four Appendix 1 *Visual Landscape Assessment Ella Bay Road*) identified the following outcomes:

- Retain the corridor effect created by dense vegetation;
- Retain existing mature trees, in particular trees with canopy connectivity;
- Relocate where possible EVR (endangered, vulnerable or rare) flora within clearing envelope;



- Remove existing weed infestations of batters, drains and shoulders and revegetate with frangible edge closure vegetation;
- Influence the natural surrounds with a comprehensive revegetation strategy;
- Include water sensitive design coupled with revegetation to improve roadside aesthetics and assist in weed control;
- Discrete shade cloth fencing to reduce the potential mortality of the Southern Cassowary;
- Stabilisation of embankments using vegetated gabions;
- Protect the existing rainforest and woodland from edge effects; and
- Promote this 4km stretch of road as a tourist drive in conjunction with local council and WTMA.

The visual catchment values of Ella Bay Road can be maintained, and improved through sensitive design without compromising safety or ecological design.

4.1.1.2 Ella Bay Scenic Values

The Ella Bay property is predominately cleared with 241ha of the 470ha cleared. The property can only be viewed by the public from the water or by air. There are no roads, or walking tracks that allow for public view.

From the Heath Point road lookout looking north, Ella Bay property is not visible as it is shielded by the smaller headlands (refer Volume Seven *World Heritage Area Visual Amenity From Heath Point*. Dwg 19). When viewed from the sea a foreshore fringe of trees of 10 to 25m high shields the cleared areas from view. The farm homestead is currently visible from the sea. (Refer to Volume Six 6.5b *Visual Assessment and Mitigation*). EIS Vol.2 Section 4.1.1.8 Visual Amenity, SEIS Vol. 1 Section 1.7.5)

While the cleared site is only visible from the air, some of the proposed development will be visible from the sea temporarily until screening vegetation and the revegetation is high enough to shield the view.

Planned conservation zone revegetation and rehabilitation will screen the majority of development views leaving only temporary visibility of the upper parts of buildings and roofs while the vegetation grows. In time, the revegetation will weaken colour and textural contrasts, further reducing the visual impact.

To assist the management of visual interaction between the built form and natural environment an indicative colour palette has been developed by extracting natural colours and hues from Ella Bay. This palette, combined with additional treatment methodologies applied to any built forms proposed for the site will negate any potential negative visual outcomes. (Refer to Volume Six 6.5b *Visual Assessment and Mitigation*). EIS Vol.2 Section 4.1.1.8 Visual Amenity, SEIS Vol. 1 Section 1.7.5)

4.1.2 Visual Amenity Impact

The net visual impact of Ella Bay Road Upgrade and of Ella Bay Integrated Resort on World Heritage Values will be temporary; during and immediately after construction and in places until revegetation reaches greater than 10m in height.

The proponent considers that the mitigation adequately covers visual amenity and no offset is proposed for the temporary impact.

4.2 WHA Listing Criteria (viii) - Significant geomorphic or physiographic features

The WTWHA includes many significant geomorphic features including tropical rainforest ecosystems and wetlands. Downstream and consequential impacts may affect:

- The Ella Bay Swamp Wetland which lies to the north of the Ella Bay Development through urbanisation; and

- The Great Barrier Reef World Heritage Area, including coastal wetlands,

4.2.1 Nationally Important Wetland

The southern-most tip of the Ella Bay Swamp Wetland enters the property in its north-eastern reaches, as depicted in Figure 4.2. This wetland is classified by DSEWPaC as a Nationally Important Wetland.

Ella Bay Swamp Wetland lies 500m to the north of the development site. Downstream impacts; from sediment, fertilisers or chemicals, changes in surface and groundwater hydrology and the introduction of weeds may impact on the wetlands.

The wetland mapping is from DSEWPaC's Protected Matters Search Tool (<http://www.environment.gov.au/arcgis-framework/apps/pmst/pmst.jsf>)



Figure 4.2 Ella Bay Swamp Wetland - DSEWPaC's Protected Matters Search Tool





Figure 4.3 Ella Bay Development showing constructed wetlands and proximity to Ella Bay Swamp Wetland and direct impact offsets.

Extensive mitigation is proposed through the use of constructed wetlands to minimise any nutrient and sediment inflow, and “organic” management of the golf course areas that drain northerly (Refer to Figure 4.3). The constructed wetlands will also maintain the current surface water hydrological flow regime to the north. (Refer to Volume Six 6.4G *Stormwater Management Plan*)

Groundwater occurs in two aquifers; a shallow aquifer that flows towards the coast and is (semi)confined showing evidence of tidal forcing, and a lower aquifer that is proposed to be used as drinking water in times of low rainfall. Test bores have established that there is no direct connection between the aquifers. When abstracting groundwater the upper aquifer will be monitored to determine if there is greater than net 100mm drawdown at the northern vegetation boundary or at the dunal swale and if the drawdown is sustainable. (Refer to Volume Six 6.4f *Groundwater Evaluation*)

It is not proposed to use or impact on the upper aquifer, and while the underground aquifer flow follows the topography and flows slightly northerly it is not considered that this flow will be changed or that it will impact on Ella Bay Swamp.

4.2.2 Great Barrier Reef World Heritage Area

The Great Barrier Reef Marine Park and World Heritage Area are adjacent to the coast of Ella Bay. Ella Bay Development is not directly contiguous with the GBRMP being separated by an Esplanade of approximately 100m width. The GBRMP in this area has the following properties:

- The GBRMP from Flying Fish Point to Ella Bay is zoned for general use which is the lowest level of protection;
- The coastal area from Mission Beach to Cairns is shown as a significant coastal wetland; and
- Ella Bay Road and Ella Bay Development are not located within proximity to:
 - coral reefs;
 - significant sites for birds;
 - seagrass beds;
 - estuarine wetlands; or
 - freshwater wetlands.

The objective to preserve this environment is that future development should not impact on the coastal wetlands.

4.2.2.1 Ella Bay Road

The existing Ella Bay Road is unsealed with un-retained cuttings and embankments and there are currently no measures in place to reduce or control erosion and subsequent sedimentation.

The potential impacts on the GBRWHA from the Ella Bay Road upgrade and increased traffic along Ella Bay Road are:

- The potential for altered water flows and drainage of waterways and wetlands;
- Sedimentation of streams, seasonal wetland habitats, and adjacent marine habitats;
- Direct changes to stream hydrology and flow regime which results in loss of habitat or biodiversity through either erosion of riparian and peripheral areas and/or destruction or modification of aquatic habitat; and
- Pollutants from litter and road runoff.

There are no major watercourses entering the Great Barrier Reef lagoon along the road alignment, and the existing small creeks are intended to remain unaltered by the roadworks. Existing creek culverts are proposed to be removed and replaced with bridges (fauna underpasses) which better protect aquatic habitat and water quality. All other pipe culverts will be replaced and use the existing drainage alignments. The potential for sedimentation will be



reduced with road sealing and stabilisation of embankments. The potential increase in road runoff nutrients, road pollutants and litter will be mitigated by incorporating bio-filtration and gross pollutant traps along the road where possible.

Potential temporary impacting process to the Great Barrier Reef World Heritage Area may occur from the following:

- An extremely low risk emergency release of pollutants from vehicle accidents could temporarily impact on water quality; and
- Erosion and sedimentation could occur during construction impacting on water quality. This will be the highest risk period during earthworks and will require above normal standards of construction management and planning. (Refer to Volume four *Ella Bay Road Design and Environmental Management Report* and Volume three Environmental Management Plan)

4.2.2.2 Ella Bay Development

The potential downstream impacts will be from sediment, fertilisers or chemicals, from a lesser extent changes in surface and groundwater hydrology and from beach access and use.

Storm and surface waters from all development areas including the golf course open areas will be treated through constructed wetlands and bioretention filters to remove nutrients and sediment and to maintain the hydrological flow regime of the creeks. Chemical use (herbicides etc) will be restricted to chemicals recommended in the *Water Quality Guideline for the Great Barrier Reef Marine Park* (2008).

4.2.3 Groundwater and Surface Water Impact on World Heritage Values

The proposed mitigation measures will reduce the potential of impact to the nationally significant Ella Bay Swamp Wetland and the Great Barrier Reef Marine Park.

The downstream impacts of surface water along Ella Bay Road will be improved with regards to quality, sediment and there will be no change to stream hydrology. A high risk of temporary impact has been recognised during construction of the road.

The residual impact for surface water from Ella Bay Development will be negligible providing that constructed wetlands are maintained and perform to specification.

The residual impact for ground water will be negligible providing that the groundwater abstraction is monitored to confirm that any net drawdown on the upper aquifer is less than a mean 100mm at the northern vegetation boundary or at the dunal swale.

The proponent considers that the mitigation adequately covers the impact and no offset is proposed however the inclusion of the southern extent of the nationally significant Ella Bay Swamp Wetland within the direct impacts offset will provide a net positive benefit under WHA listing criteria (viii) - Significant geomorphic or physiographic features.

4.3 WHA Listing Criteria (ix) - Significant Ecological and Biological Processes

This world heritage value is related to the elements of evolutionary processes and in the context of Ella Bay Road and Ella Bay Development the potential impacts are those that could cause greater loss through consequential impact, such as:

- Vegetation clearing and fragmentation of habitat;
- Inhibition or prevention of wildlife movement in important arboreal, terrestrial and aquatic ecosystems;
- Loss of biodiversity through facilitation of weed, pest and disease invasion into adjacent and peripheral vegetation communities.

While the WTWHA is recognised as one of the most significant ecosystems the area of Ella Bay Road and Ella Bay Development has been degraded.



No important wildlife movement corridors have been identified for arboreal, terrestrial and aquatic ecosystems. The only significant impact is with regards to potential movement corridors for the endangered cassowary which is covered under the WHA listing criteria (x).

Vegetation clearing and fragmentation of habitat have been identified under the Queensland VMA and NCA policies in Chapter 2.

The current weed, pest and disease issues have been reported in the MNES Report and will be managed through the Environmental Management Plan and Sub-plans (Refer to Volume One: *Report on Matters of National Environmental Significance*, Volume 3, Environmental Management Plan).

The major identified WTWHA threat diseases such as forest dieback (*Phytophthora cinnamomi*) and chytrid fungus (*Batrachochytrium Dendrobatidis*) are reported to be active only in the high-altitude rainforest areas, generally above 400m (Gadek,1998), (Alford,2009).

Chytrid fungus has been identified as occurring on the site and at multiple sites within 20 km of the Ella Bay however on the coastal area the fungus appears to be active only in the cooler months and is quickly killed by increase in temperature without appearing to impact on the frog population (Alford 2009).

There are no recognised disease threats on the Southern Cassowary and the Recovery Plan for the Southern Cassowary (2007) has no guidelines on preventative measures.

The Proponent has committed to a no dog or cat policy, instigated control of feral pigs and dogs, and started control of WONS listed weeds. (Refer to Volume One: *Report on Matters of National Environmental Significance*). .

4.3.1 Impact to Ecological and Biological Processes

The proposed mitigation measures will reduce the risk of impact to evolutionary processes. The proponent considers that the mitigation adequately covers the impacts and no offset is proposed.

4.4 WHA Listing Criteria (x) Significant Biological Diversity/Threatened Species

Impacts on threatened species have been extensively covered in the Volume One: *Report on Matters of National Environmental Significance*) and within the Volume Three *Southern Cassowary Management Sub-Plan*, and *Stream Dwelling Rainforest Frog Species Management Sub-plan* and in the EIS, and SEIS.

The proposed mitigation will reduce the impact of increased human population from Ella Bay Development on the World Heritage values, endangered Common Mistfrog and critically endangered littoral rainforest making these threats relatively small. The greater potential is to the Southern Cassowary population from indirect impacts of an increase in human population.

Direct impacts to habitat through clearing, isolation and edge effects have been addressed under chapters 2 and 3.

The remaining residual impacts are related to potential indirect impacts from the development and the cumulative impacts of the existing indirect anthropogenic threats.

4.4.1 Cassowary Population Viability Analysis and Present Indirect Impacts

Moore's Population Viability Analysis of the Southern Cassowary subpopulation of the Graham-Seymour Range was presented in the SEIS and the report is also collated in this response in Volume Six 6.1k *Moore's Cassowary Reports Volume I, II, & III*.

Moore reported that the Graham-Seymour Range cassowary population “is a linear subpopulation which has lost all connectivity with the larger cassowary populations to the west, the Graham Seymour Range population is currently experiencing high levels of anthropogenic impact, and declining rapidly as a result.”



The time frame predicted by Moore's modelling for extinction is 60 years for isolated populations with the current levels of threat: (SEIS & Volume Six 6.1L - PVA page 28 Summary of all Models)

"In the absence of future dispersal between the two currently connected coastal populations of Graham Range and Seymour Range, all PVA models indicate there is a high probability that both populations will die out within 60 years."

Moore also concluded that *"Natural catastrophes in the form of severe cyclones and the environmental uncertainties of climate change, are hastening this decline."*

According to Moore's PVA the Graham-Seymour Range cassowary sub-population is currently in a declining vortex whereby extinction of that sub-population appears to be inevitable. Many of the present indirect impacts of the local environment are cumulative and are contributing to this decline. That is; a "do nothing" scenario will lead to extinction of the Graham-Seymour Range cassowary sub-population.

4.4.2 Residual Indirect Impacts

The residual indirect impacts for the local cassowary population comprise the cumulative impacts of the existing indirect anthropogenic threats and potential indirect impacts from the development.

The existing treats are:

- Isolation of the sub-population within the Seymour Range from failure of existing movement corridors;
- Road mortality where roads cross the major movement corridors; and
- Dog related mortality primarily from pig hunting dogs.

The potential indirect impacts of the development are;

- Isolation of critical species habitat within the development;
- Sub regional traffic increase;; and
- Human fauna interaction

4.4.2.1 Existing Indirect Anthropogenic Threats

Analysis of causes of mortality to the endangered Southern Cassowary (Kofron, 2006) reported that of 110 cassowary mortalities from 1986-2004 motor vehicles and dogs caused 74% of cassowary mortalities for which causes of death could be determined. For the specific Graham-Seymour subpopulation Moore reported the problem areas being that of:

- The maintenance and protection of the existing movement corridors linking the two range populations;
- the development and implementation of a cassowary road management strategy for the Bramston Beach Road;
- the implementation of an effective dog control program for the communities adjoining the Graham-Seymour Range;

Moore's analysis relies on maintenance of the Graham-Seymour Range subpopulation by threat minimisation without looking at reestablishment of the East West corridors as proposed under the Southern Cassowary Recovery Plan.

The Bramston Beach Road management strategy and effective dog control can only be driven by community involvement and action. Ella Bay Development can help by being a conduit to that action by communication of the PVA and population monitoring information and the results of research and monitoring of mitigation methods.

This action is not seen as an offset by the proponent but as part of the Ella Bay Cassowary Recovery Plan (Refer to chapter 6 Table 6.1 *Cassowary Recovery Plan Matrix*).

4.4.2.2 Potential Indirect Impacts from Development

The potential Isolation of Critical Species Habitat has been evaluated in the design review of the Ella Bay Development, Conservation Zoning has been undertaken to ensure protection and habitat connectivity across the site. (Refer to Volume Six 6.5f *Conservation Covenant Zones*). The conservation zones and proposed offset areas are extensive and comprise the majority of existing remnant vegetation which will be under protection and management. (Refer to Figure 4.4)

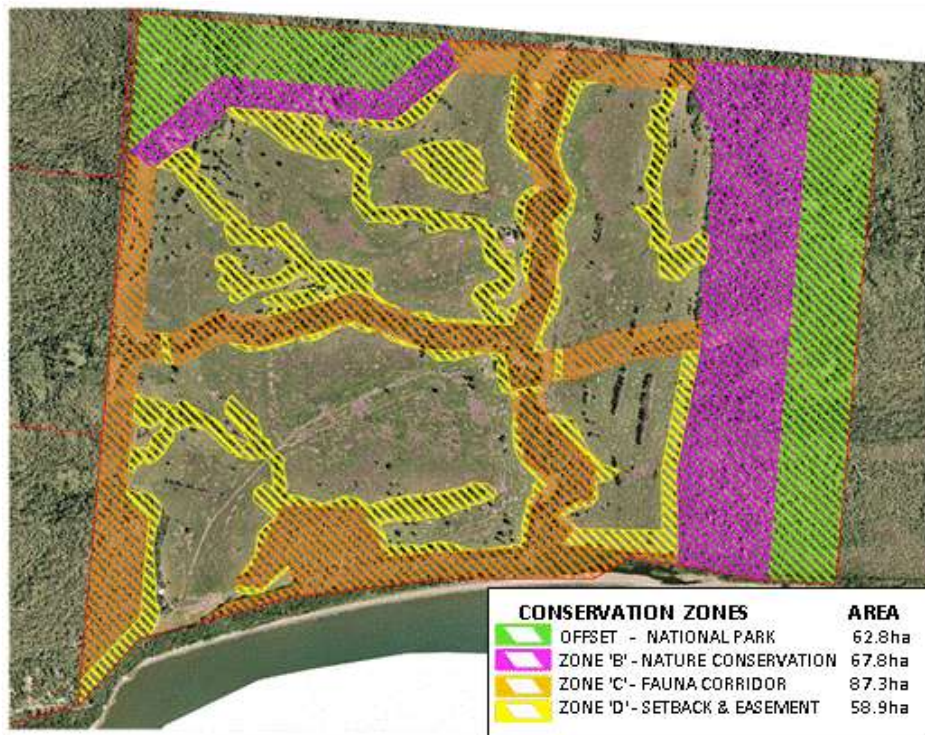


Figure 4.4 Ella Bay Conservation Zones

The result of the conservation zoning and open space is that there are extensive cassowary movement corridors along all the riparian areas and no areas of essential cassowary habitat are isolated.

The proponent considers that the potential impact is low and no offset is proposed.



Figure 4.5 Cassowary accessible areas (green shading) totalling 336ha out of a 470ha with movement corridors. The white outline is the edge of the conservation zoned areas. The markers are from all surveys.

The sub-regional traffic will increase along Flying Fish Point Road (known as the Esplanade near Coconuts) from Innisfail and along Ella Bay Road.

There have been two cassowary deaths along these roads in the past 18 years:

- Ella Bay Road 28/10/2002 Chick - 100mtrs South of Ella Bay NP sign – hit by car.
- Flying Fish Point Road 23/03/2006 Adult – likely hit by car

And one cassowary death along Bramston Beach Road:

- Bramston Beach Road 5/09/2010 Female – vehicle strike

Ella Bay Road is recognised as a known cassowary crossing point and will be mitigated with fence and funnel to underpasses. Flying Fish Point Road and the Esplanade do not have known cassowary crossing points and are not within close proximity to cassowary habitat. Flying Fish Point Road is a regional arterial road with a current usage of 1,500v/d.

The road side to Flying Fish Point comprise sugar cane farms and open paddocks for the first 2km and then for the next 2km cleared paddocks on at least one side. On the coastal side is tidal mangrove swamp and palm swamp. Cassowaries have been reported to cross the road to the Carello Palm Swamp Conservation Park (2009) and to the Coconuts (2011). These crossings are infrequent.

A juvenile cassowary that visited Coconuts in 2011 was relocated by QPWS as a nuisance bird which accosted people for food. It is suspected that this may have been a result of handfeeding. There will be occasions when cassowaries cross Flying Fish Point Road (Esplanade) however these occurrences are rare.

The Proponent considers the threat to cassowaries of increased sub-regional road traffic to be low and the relevant mitigation at this time is for increased cassowary awareness signage near the Carello Palm Swamp Conservation Park and Johnstone River Crocodile Farm. If cassowary numbers and sightings increase then speed humps and chevron markings would be appropriate.



The proponent considers this threat is low and that increasing the road traffic level will not increase the risk significantly for a low risk event at the very edge of a home range.

Ella Bay Development

The risks associated with fauna-human interaction at Ella Bay Development will be managed by education, fencing to limit interaction and the banning of cats and dogs.

A compulsory induction course on appropriate behaviour around cassowaries and other important fauna will include:

- appropriate behaviour in cassowary habitat;
- specific responses and behaviour for golfers;
- strictly enforced 'no feeding' policy;
- During operation the Welcome Centre will provide education to all visitors;
- All construction personnel, staff and (sub) contractors will be inducted on this appropriate behaviour around cassowaries Cassowary Environmental Sub-plan; and
- Cassowary sighting and incident reporting will be undertaken within EBD and along Ella Bay Road.

Precinct and construction fencing will be used to isolate people from cassowaries

- All precinct areas will be fenced, limiting access of cassowaries to the built environs of Ella Bay Development;
- The majority of internal roads will be fenced, with the remaining area available to cassowary movement, including conservation zones, golf course and revegetated areas;
- Temporary cassowary exclusion fencing will be erected prior to start of each construction phase to exclude cassowaries from accessing construction sites;
- Less than 150m of internal, secondary road is unfenced and speed limited to 20km/h with permanent traffic control measures to ensure a low speed environment;

Additional measures:

- A protocol on appropriate methods for removing a cassowary from construction, residential or resort areas will be developed. .
- Revegetation planning strategy will draw birds away from Fore Dune areas during 'peak' tourist season (dry season/winter)
- No dog or cat policy

The Proponent considers that given the mitigation measures the impact from human-fauna interaction to be low.

The Proponent considers the impact of development specific indirect impacts to be low however a Research project is proposed to monitor any impacts and advise on corrective action;

- Evaluation of environmental impacts of Ella Bay Development and mitigation strategies of roads on adjacent habitats and internal corridors, and monitoring of road mitigation strategies.

4.4.3 Great Barrier Reef World Heritage Area.

The inshore marine area of Ella Bay is possibly frequented by rare and threatened fauna such as the Irrawaddy and Indo-Pacific humpback dolphins, dugong and turtles.

Possible impacts and mitigation measures due to Stormwater and Groundwater have been detailed in section 4.2 of this report.

Other potential impacts have been detailed in the *Marine Turtle Species Management Sub-plan*. (Refer to Volume 3). The measures undertaken within this Sub-plan are appropriate for all marine species.

The Proponent considers that there is no residual impact on EVT marine species.



4.5 National Heritage Values - Cultural and Historical Impacts

Although the controlling provisions of the project do not include National Heritage values the Proponent has prepared a Heads of Agreement to establish the Ella Bay Bagirbarra Development Trust to establish a cultural economy and assist with sustainability of the Bagirbarra cultural heritage.

The Bagirbarra are recognised as the Traditional Owners of the Ella Bay area and have received recognition as the Traditional Owner from the Northern Queensland Land Council during 2011. The Bagirbarra clan have lost much of their history having been translocated from the area since the early 1900's. The first recorded history of the Traditional Owners is from survivors of the wreck of the brig Maria who landed at the Ella Bay site on a raft in 1873.

The Ella Bay site was cleared in the early 1900's and most of the cultural and ethno-history have been removed or lost. The only known significant cultural artefacts are at the entrance to the Ella Bay property; a significant rock (women's business) and grinding grooves on beach rocks.

The Welcome centre will feature Traditional Owner Cultural Heritage values and history and application of indigenous natural heritage management principles.

4.6 Commonwealth Indirect Offset Proposal

The applicable policy for Commonwealth Offset determination comprises the following draft documents

- Draft Policy Statement: Use of Environmental offsets under the Environment Protection and Biodiversity Conservation Act. 1999 (EPBC) 2007 (Commonwealth); and
- EPBC Act Consultation Draft Environmental Offsets Policy 2011

The Proponent has taken a wider view and prepared an indirect offset package that goes beyond maintaining the status quo and delaying the eventual population decline. For the population to survive the local population must also increase, and this will require a number of positive actions as well as threat minimisation.

The Proponent has adopted a cassowary management strategy and undertaken a number of actions based around the Southern Cassowary Recovery Plan (Latch, 2007). The Ella Bay Cassowary Recovery Plan Matrix is presented in (Table 6.1). This matrix contains a number of Specific Objectives from the Cassowary Recovery Plan that the proponent will be assisting and/or supporting. The actions, level of certainty and timeframe are included with the Cassowary Recovery Plan Matrix. The majority of elements of the matrix are quantifiable as offset under the DSEWPac policy drafts.

The proposed offset for indirect impact comprises both a land based offset and research initiatives. The main element of the offset package is to increase the strength of the linkage and create a viable cassowary corridor linkage to the West through Eubenangee Swamp National Park. The research package is to further understanding in terms of reducing cassowary mortality and increasing the local population. Part of the research package will be to offset for indirect impacts to the cultural and historical values.

Indirect Offset	
Action Summary	Description
Land Based	
EPBC Indirect Impact	Key regional cassowary corridor protection.



Research based	
Cassowary rehabilitation through tracking after release.	Using GPS telemetry to track rehabilitated juvenile Cassowaries
Cassowary carrying capacity	Determining Cassowary Diet and Energetics through Remote Sensing and DNA analysis
Cassowary road access prevention	Design, develop and trial Cassowary Fence & Escape Gate
Monitoring and assessment of Ella Bay Development on cassowaries, fauna and flora.	Evaluation of environmental impacts of Ella Bay Development and mitigation strategies of roads on adjacent habitats and internal corridors, and monitoring of road mitigation strategies

Table 4.2 Commonwealth Indirect offset package comprising land and research based initiatives

Environment Protection and Biodiversity Conservation Act. 1999 Provide a Key regional cassowary corridor and research as an offset for Indirect impacts to MNES including World Heritage Area Values



5. Ella Bay Offset Package

The offset package has been developed for residual impacts from the proposed development and road upgrade after all available impact mitigation strategies have been exhausted. The offsets have been developed in the context of the current approvals process under the *Environmental Protection and Biodiversity Conservation Act 1999* and protection requirements under the *Vegetation Management Act 1999* and *Nature Conservation Act*.

The proponent's goal has been that the sum outcome will be positive, and beneficial to the survival of the cassowary and the environment. The primary purpose of the offset package is to improve habitat connectivity for the endangered Southern Cassowary through ecological equivalence in increasing the extent and protection of their habitat. The offset package will support and assist the Southern Cassowary Recovery Plan (Latch 2007) by conserving essential cassowary habitat, protecting an important north-south regional cassowary habitat corridor and establishing an additional east-west cassowary habitat corridor.

The impact area and offset ratio justification for the land based offsets have been derived in chapters 2, 3 and 4.

Land-based Offset				
Action Summary	Offset Area	Contribution	Value (est.)	Timing
Queensland VMA & NCA For clearing of 3.764 ha and revocation of 0.014 ha National Park EB REF CZ A.1	22.60 ha	In perpetuity regional corridor and essential cassowary habitat protection. Legally handed over to State for National Park	\$ 250,000	<1 year
EPBC Direct Impact For edge effect and isolation of 29.42 ha EB REF CZ A.2	40.18 ha	In perpetuity essential cassowary habitat protection and extension of protection to Ella Bay Swamp Wetland. Legally handed over to State for National Park.	\$ 450,000	<1 year
EPBC Indirect Impact Eubenangee Offset Property	63.62 ha	In perpetuity key regional cassowary corridor protection. Legally handed over to State for National Park.	\$ 400,000	<1 year
Implementation of Management Strategy for Eubenangee Offset Property		Establishment of vegetated connectivity corridor between key habitats	estimated \$ 500,000+	1-3 years
TOTAL	126.42 ha		\$ 1,600,000	

Table 5.1 Land based direct offsets

A number of additional indirect offsets measures have been undertaken and are proposed to support the conservation efforts of the Ella Bay Development. The indirect offsets are research based and are detailed in section 5.4 Indirect Offsets Research. The primary purpose of the indirect offsets package is to further the understanding of cassowary research in terms of reducing cassowary mortality.



EPBC Indirect Offsets			
Action Summary	Contribution	Value (est.)	Timing
Cassowary tracking	UQ/QPWS/Ella Bay/San Diego Zoo/CSIRO project Using GPS telemetry to track rehabilitated juvenile Cassowaries	\$40,000	In progress <1 year
Cassowary Diet and DNA analysis	University of Queensland/QPWS/CSIRO project Determining Cassowary Diet and Energetics through Remote Sensing,	\$40,000	In progress <1 year
Cassowary Fencing & Escape Gate Research Project	Ella Bay Developments. Design, develop and trial Cassowary Fence & Escape Gate	\$100,000	complete
Impact of Ella Bay Development on cassowaries, fauna and flora.	James Cook University Environmental impacts of Ella Bay Development access and internal roads, design of strategies to mitigate road impacts on adjacent habitats and internal corridors, and monitoring of road mitigation strategies	\$130,000	Before and after construction +3 year
TOTAL		\$290,000	

Table 5.2 Research based indirect offset package

Detailed description of the offset packages is contained in the subsequent sections of this chapter.

5.1 Queensland VMA & NCA and EPBC Direct Impact Offset

The proposed Direct Impact offset comprises two areas of high integrity land totalling 62.78 ha. This land will be transferred and incorporated into Ella Bay National Park. The two areas are shown as CZ A.1 & CZ A.2 on Figure 5.1. The time period for transfer to National Parks will be less than 12 months.

The primary purpose of the offset CZA.1 (Conservation Zone A.1) located on the Northern boundary of the Ella Bay property is protection of essential cassowary habitat, and the nationally significant Ella Bay Swamp Wetland.

CZA.1 comprises 40.18 ha of vegetation RE 7.11.1, 7.3.3a, 7.3.10c, 7.2.9, 7.2.4, 7.2.1, 7.2.1d and 7.2.7a (Essential cassowary habitat). The land will provide a higher level of tenure and include the southern extent of Ella Bay Swamp Wetland in the extension to Ella Bay National Park.

The primary purpose of the offset CZA.2 located on the south-western corner of Ella Bay property is to increase protection of the Seymour range north-south corridor and essential cassowary habitat.

CZA.2 comprises 22.60 ha of RE 7.11.1 and RE 7.11.1b (Essential cassowary habitat). To the west it will widen the existing narrow World Heritage Area linkage by add a section of land to the Ella Bay National Park to provide a near contiguous linkage to the geographically isolated southern section of Ella Bay National Park. This area forms the eastern slope of the Seymour Range and is part of a regional cassowary habitat corridor. The land will provide a higher level of tenure and secure a wider North South cassowary corridor along the Seymour Range. The triangular section of WTWHA is over freehold land which joins the WHA areas. This cassowary corridor has been identified by Terrain NRM. (Terrain Appendix 1) *“Whilst a small section of the Ella Bay site to the SW is close to the World Heritage area, it would be of benefit to seek a widening of the corridor in this area.”*



Figure 5.1 Land based direct impacts offset 62.78 ha including Ella Bay Swamp Wetland

5.2 EPBC Indirect Impacts Offset - Eubenangee Offset Property

The proposed offset for Indirect Impacts comprises land on 3 titles totalling 63.62 ha. The land is contiguous with Eubenangee Swamp National Park on the south and western boundary and WTWHA on the northern boundary. The area is shown on Figure 5.2. The land has been procured and the time period for transfer to National Parks will be less than 12 months.

The land is currently laying fallow following purchase of the operating sugar cane farm. The land will require revegetation before providing an important corridor between the WTWHA and Eubenangee Swamp National Park. A revegetation management plan has been prepared (refer to Appendix 2)

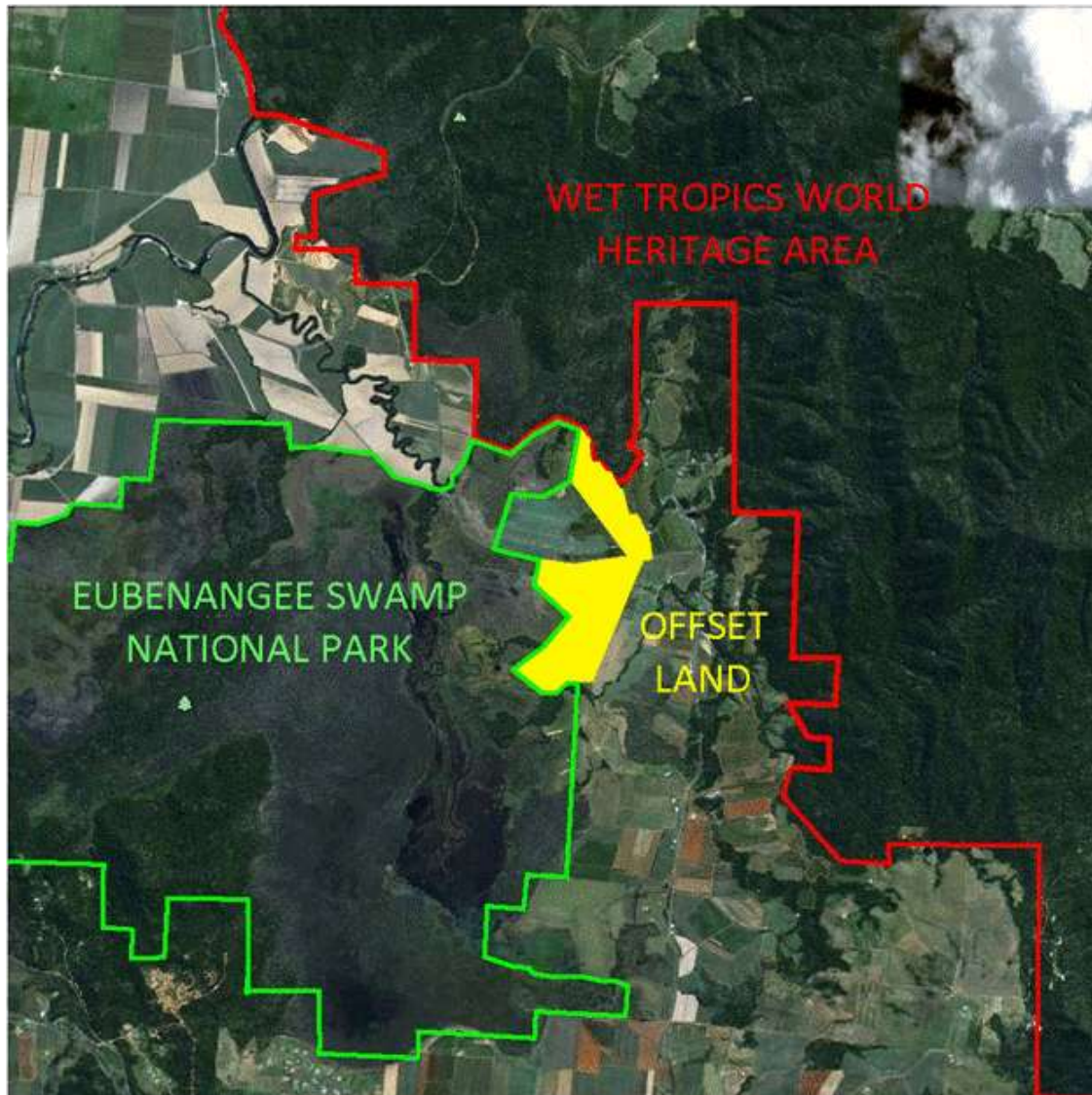


Figure 5.2 Offset land showing the relationship between Eubenangee Swamp National Park and WTWHA

5.2.1 Background: Cassowary habitat connectivity in the sub-region

The area surrounding the Ella Bay development locality is substantially protected by a number of state, federal and international legislative measures. However, there are a number of breaks in the protected area network that restrict connectivity to the Graham-Seymour range to the north and west. The disturbed landscapes (predominantly as a result of intensive agriculture) in these narrow corridors pose a threat to the functionality of the entire cassowary corridor network. For the survival of the Graham-Seymour Range cassowary sub-population it is essential that these critical corridors are strengthened through enhanced protection mechanisms.



The selection process for purchase of this strategic land was based on:

- Terrain Natural Resource Management (Terrain NRM) research;
- Corridors identified in Potential Cassowary Habitat mapping (DEWHA 2009); and
- WTMA Wet Tropics Conservation Strategy 2004 rehabilitation priorities.

Terrain NRM was consulted to research strategic information related to the establishment of conservation corridors that could inform the proponent of an offset package for Ella Bay Development. Terrain NRM was specifically requested by the proponent to provide strategic corridor planning information that would be relevant to the enhancement of cassowary corridors to the Ella Bay/Graham-Seymour Range cassowary sub-population. (Refer to report in Appendix1)

Terrain NRM brought key regulatory stakeholders together to collectively identify the process criteria for a multi criteria analysis to produce key sites in the regional corridors that should be targeted for protection. Participants included representatives from the DSEWPaC, DERM (EPA), Wet Tropics Management Authority, Queensland Parks and Wildlife Service and Cairns City Council.

Discussion focused around the key corridors and the criteria that should be used to determine which sites are critical for this project. The need to focus on connectivity and ecological function was determined as key in this process. Likewise existing levels of protection and level of threat were considered to be equally important.

The corridor identified by Terrain NRM as EW1 was considered to be the most efficient in providing a potential to increase the connectivity between populations.

Eubenangee Swamp was described as an area of high activity or 'hot spot' for cassowaries (Crome and Moore 1990) and numerous sightings have been reported by QPWS rangers (Biotropica 2005). An east-west corridor between the Wet Tropics World Heritage Area; Graham-Seymour Ranges (east) and the Eubenangee Swamp National Park (west) is recognised as a critical element in cassowary conservation in order to improve the mobility of cassowaries between the isolated Graham-Seymour sub populations.

The Significant Impact Guidelines for the Endangered Southern Cassowary (DSEWPAC) identify important areas of key ecological function, broad movement corridors and appropriate rehabilitating habitat. An extract of Map 2 is shown Figure 5.4 with the relationship between the Eubenangee Swamp National Park, WTWHA and the offset land.

Biotropica (2005) comments on the importance of this linkage:

Restoration along the Dinner Creek Falls Road properties, and within Crown tenures adjacent to Cartwright Road, would significantly improve the mobility of cassowaries between Eubenangee Swamp and the Graham Ranges. Both Areas maintain permanent population and the continued interaction between these populations is necessary for broad north south population connectivity to occur.

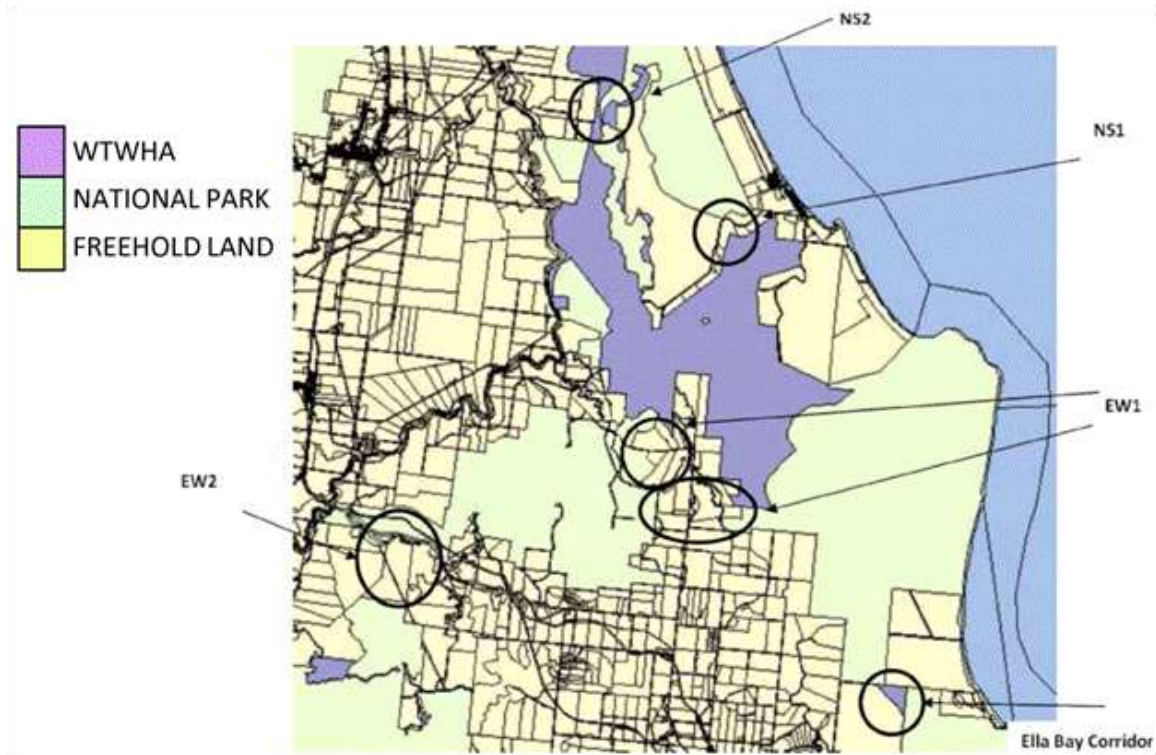


Figure 5.3 Priority NS and EW corridors in the Bramston/Eubenangee area

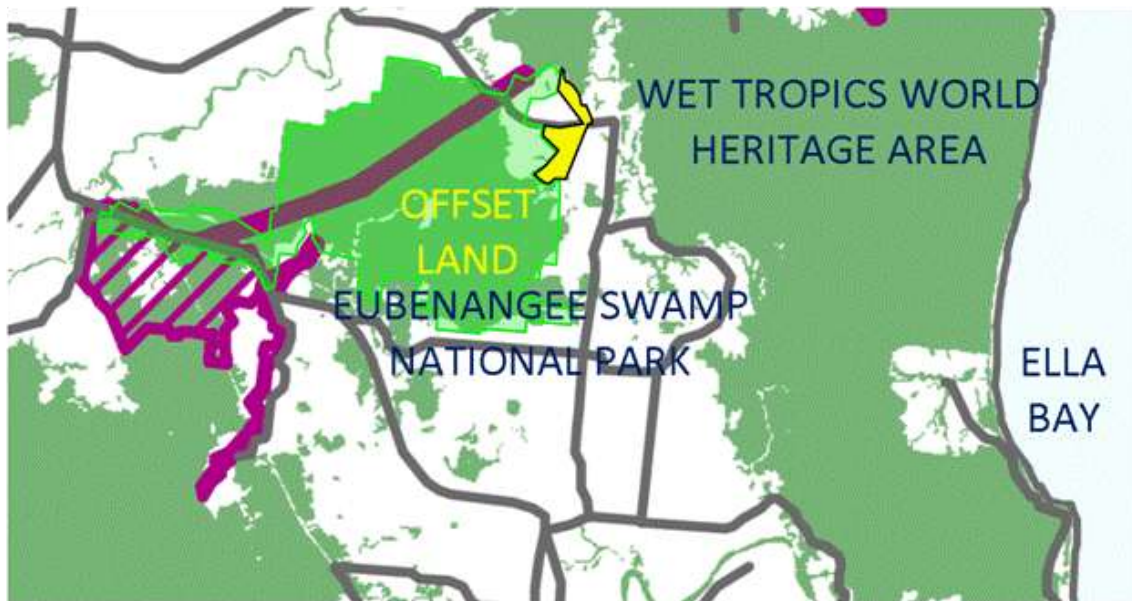


Figure 5.4 Location of offset in relation to cassowary corridors and Eubenangee Swamp NP from Potential Cassowary Habitat Map 2 (DEWHA 2009).

The main barrier to cassowary movement is that significant clearing for agriculture has occurred between the two protected areas. This is clearly indicated in Figure 5.4 by the white band which the offset property traverses.

This corridor was identified by WTMA (2004) as a priority for land management actions, including to protect and rehabilitate critical landscape linkages to connect separate sections of the WHA and connect remnants to the WHA where possible, particularly habitat of rare and threatened species (refer to Figure 5.5).



Figure 5.5 WTMA Rehabilitation priorities for landscape linkages, riparian zones and wetland areas Map 9- From Wet Tropics Conservation Strategy 2004

Terrain NRM recognised that

“The opportunity for revegetation on private land in the eastern section of EW1 could be investigated to strengthen links between the 2 protected areas. This recommendation is backed up by investigations conducted as part of the Biotropica report prepared in 2005 which states that restoration in this area, ‘would significantly improve the mobility of cassowaries between Eubenangee Swamp and the Graham Ranges’ (pp.23, 2005).

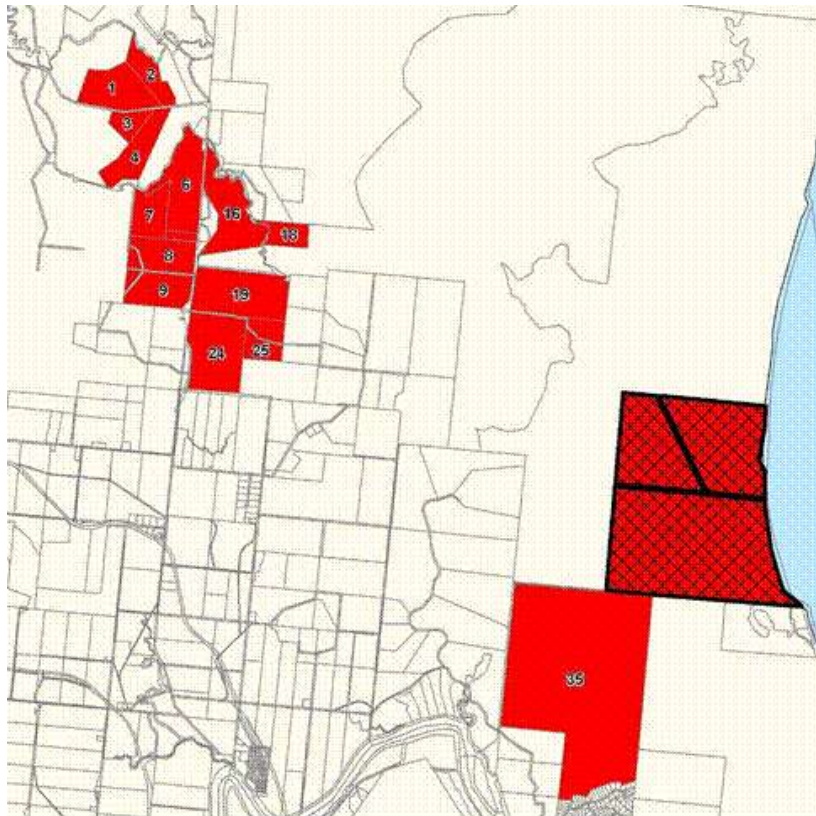


Figure 5.6 Recommended priority sites southern section (Ella Bay-Eubenangee Swamp) from Terrain NRM

There is currently a narrow link of protection between the northern section of Eubenangee Swamp National Park and the Graham-Seymour Range National Park; however the area would benefit from widening through either acquisition or revegetation on adjacent private land. “

The proponent focussed on lots that were contiguous with Eubenangee Swamp NP; that were existing farm land and could lead to improvement in total habitat. The proponent investigated purchase or covenant on a number of properties before selecting lots 2, 3 & 4 for purchase as the most strategic and availability. (Refer to Figure 5.6)

5.2.2 Site Location and Description

The proponent legally secured three lots Site No. 2, 3 & 4 within the East-West (EW1) corridor based on the Terrain assessment (Figure 5.6). Table 5.2 is an extract from Terrain NRM’s analytical summary of ‘Key sites within the priority regional corridor’, for the purchased properties. The offset property is located less than 7 km north-west of Ella Bay, on the outskirts of Eubenangee Swamp.

Site No.	Lot/Plan	Ha	Tenure	Rank	Presence of RE	Essent. Habitat	Bio - tropica Report	Comment	Recommendation
2	5RP747500	19.72	FH	1	non remnant	Yes	No	Majority of site used for agricultural purposes.	NS link between Eubenangee and state land to north
3	6RP713994	12.26	FH	1	non remnant	No	No	Cane/cattle property. Owners currently undertaking reveg. works in riparian zone of Dinner Ck	Reveg parts of these lots focusing on creek links to contribute to EW connectivity
4	7RP713994	30.99	FH	1	non remnant	No	No	Cane/cattle property. Owners currently undertaking reveg. works in riparian zone of Dinner Ck	Reveg parts of these lots focusing on creek links to contribute to EW connectivity

Table 5.3 Key sites within the priority regional corridor From Table 1 Terrain NRM

Eubenangee Swamp National Park is protected as a National Park; is listed as a significant wetland in the Wet Tropical Coast Regional Coastal Management Plan and is also listed under the Directory of Important Wetlands Australia.

Figure 5.7 shows the lots (in yellow) which share common boundaries with land parcels purchased by EPA QPWS and incorporated into the Eubenangee Swamp National Park in 2003.

Revegetation by QPWS along Alice River has resulted in robust riparian vegetation on the western side of Cartwright Road but a narrow linkage on the eastern side of Cartwright Road along Nigger Creek of less than 20m width for 300m still remains. (Refer to Figure 5.8 & 5.9 Pink outline)

Cassowaries have been reported as active in the Alice River revegetation site (Biotropica 2005 from QPWS reporting) and this further linkage focussing on cassowary fruiting habitat will strengthen the potential population viability.

In an east-west direction along Dinner creek, patches of regrowth vegetation form a second but discontinuous part linkage, with cane farms interrupting its connectivity (Refer to Figure 5.8 & 5.9 Mauve outline).

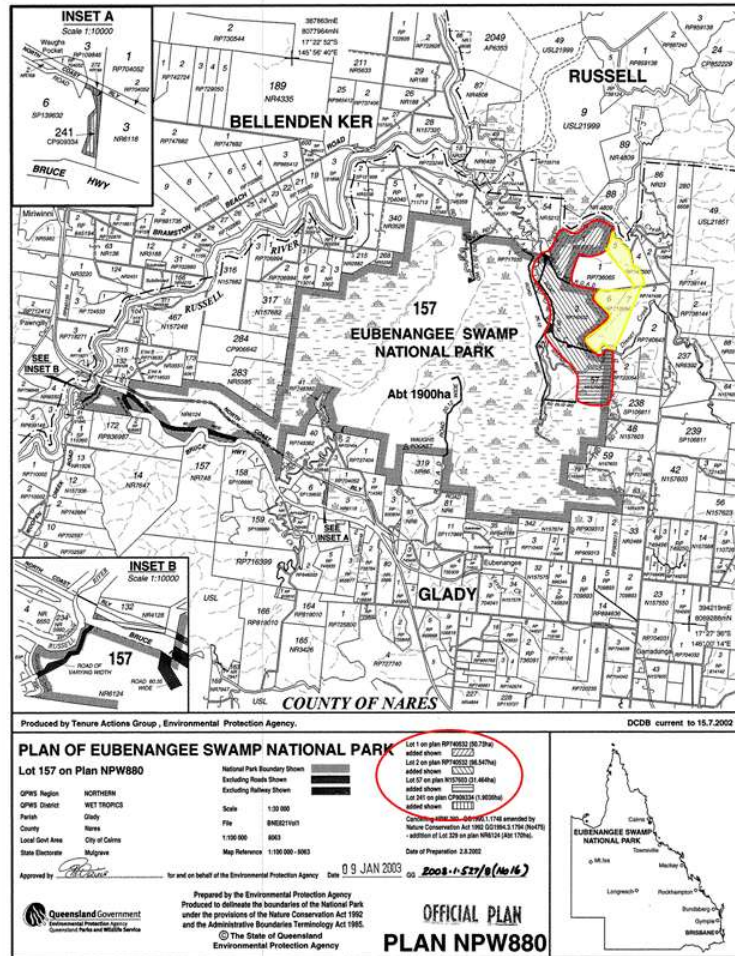


Figure 5.7 Plan of Eubenangee Swamp NP with lot purchase highlighted in red with offset lots in yellow

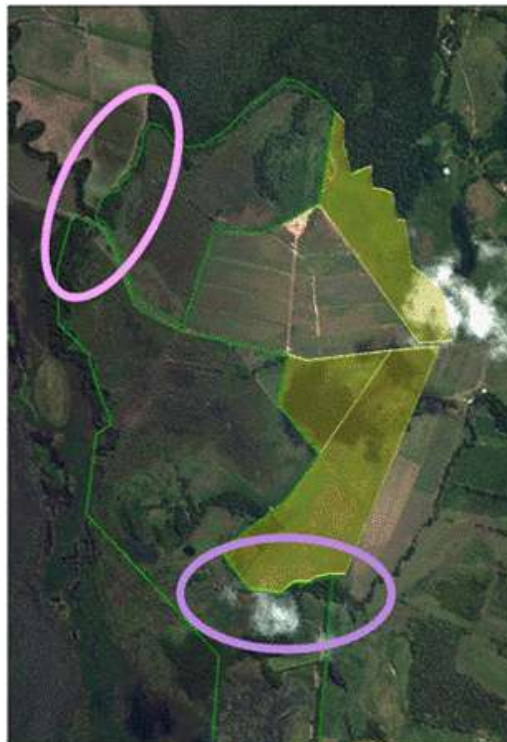


Figure 5.8 Aerial of offset lot (yellow) and Nigger Creek riparian (pink) and Dinner Creek riparian (mauve)

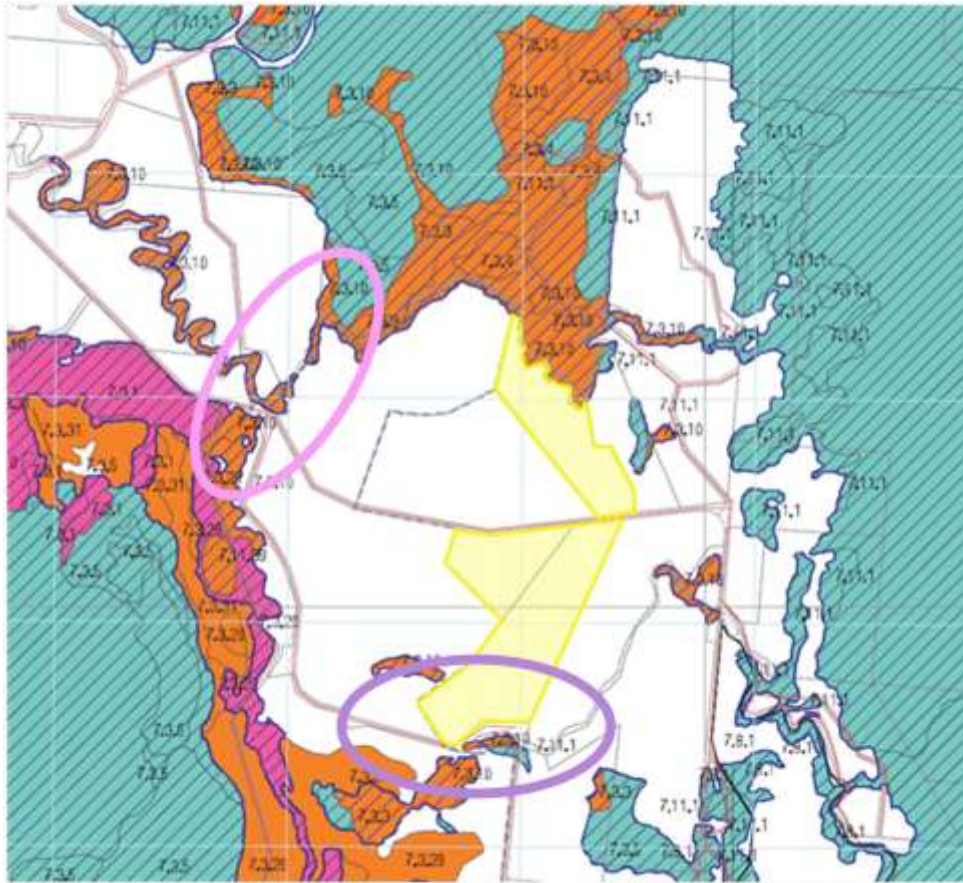


Figure 5.9 Regional Ecosystem Mapping, and highlighted thin riparian vegetation

The offset property abuts both of the only existing vegetated areas, joining the WHA in the north (above) and the partial east-west linkage (below) to the south. (refer to Figure 5.10)



Figure 5.10 Offset property in yellow showing shared boundaries with Eubenangee Swamp National Park (red) to the Southwest and Wet Tropics World Heritage Area (purple) to the north

The 63.62ha offset land is not currently captured by any land management programs, and was purchased as an operating sugar cane farm with standing sugar cane, and ploughed fallow



pasture comprising grasses and weeds. This land on the outer extremities of Eubenangee Swamp is often very wet and prone to frequent inundation in the Wet Season. Typical of these swampy lands the property has been drained by deep channels to reduce the unsuitable conditions.

Eubenangee Swamp is cited as a local, state and Australian priority wetland conservation area with regional endangered/of concern ecosystem types (RE 7.3.1 and RE 7.3.5). There are no remnant vegetation communities remaining on the offset property, however in surrounding areas the identified Regional Ecosystems (RE) are: (refer to Figure 5.9)

- 7.3.10: Of Concern (VMA) and Endangered (Biodiversity status) Simple to complex mesophyll to notophyll vine forest on moderate to poorly drained alluvial plains of moderate fertility; and
- 7.11.1: Least Concern (VMA) Simple to complex mesophyll to notophyll vine forest on moderately to poorly drained metamorphics (excluding amphibolites) of moderate fertility of the moist and wet lowlands, foothills and uplands

This region represents the optimum for the development of rainforest in Australia due to the favourable conditions of fertility, rainfall, topography and temperature.

After clearing for agricultural purposes the offset property has very few remaining trees, and those existing along the riparian areas are post logging regrowth. At present the land has no value as cassowary habitat, however its landscape habitat value (as defined by Latch (2007)) for regional scale connectivity is potentially very high.

Detailed Regional Ecosystem Mapping and VMA Essential Habitat Mapping is included in Appendix. 4.

With the isolated sub-population of the endangered Southern Cassowary in the Graham-Seymour Ranges under serious threat of extinction, important headway will be achieved in the field of cassowary conservation through the transformation of the offset property from active agriculture use into a cassowary habitat corridor. This corridor will serve to connect the protected Eubenangee Swamp National Park and Wet Tropics World Heritage Area; an effort that both encourages and will support the movement of cassowaries between the East and West sub-populations.



5.3 Management Strategy for Eubenangee Offset Property

The management strategy focuses on revegetation, weed management, and fauna monitoring.

The revegetation strategy focuses on establishing a continuous vegetated corridor connecting the National Park and World Heritage Area. The site requires rehabilitation due to the nonexistence of remnant vegetation communities; ground covering with sugarcane and weed infested grass pasture, and inundation for periods during a high rainfall Wet Season. The revegetation must be attractive for the cassowary in order for the corridor to be a success. A Revegetation Strategy has been developed. Refer to Appendix 2

The site inundation limits the suitable cassowary attractant species selection for revegetation. Additionally after generations of farming the natural surface has been flattened for ease of farming and drainage.

The goal is to establish a primary 50m wide high quality cassowary attractant corridor. One of the limiting factors to this is the restriction on suitable cassowary specific species that tolerate inundation. The proposed method to improve the growing environment is to form an elevated mounded berm up to 0.3m in height (dependant on the topography). This will also scrape off the weed prolific topsoil of the adjacent areas and burying it under the mounding.

By planting 'bait' species and attracting frugivores, natural dispersion will result from native species in proximity to the area. Given the success of natural recruitment at the QPWS Alice River site; it is anticipated that future expansion of the rehabilitated area will occur naturally.

The strategy will include the rehabilitation of two riparian areas, including sections of Nigger Creek running along the Northern boundary, Dinner Creek along the Southern boundary (refer to Figure 5.11), and two smaller watercourses (drains) that traverse the area.

Management of the revegetation will require weed control until the trees have established a shade canopy to suppress weeds. It is expected that weed management and tree replacement will be ongoing for 3 years. The weed management practices have been established in the Ella Bay revegetation trials. Refer to Volume 6.2f *Cassowary Specific Revegetation - A Cyclone Tolerant Orchard* and Volume 2.7 *Weed Management Sub-Plan*.

The corridor may not be used until the trees have matured sufficiently to be suitably attractive and a food source for the cassowary. Monitoring of cassowary movement will therefore be initially through scat, footprint and anecdotal sightings. Longer term monitoring with remote cameras, will be required once the initial corridor movement has been initiated to determine the usage pattern.

The road which divides the property will require cassowary awareness mitigation in the form of reduced speed limits, chevron markings, signs and raised speed platforms once it has been established that cassowaries have returned to the area.

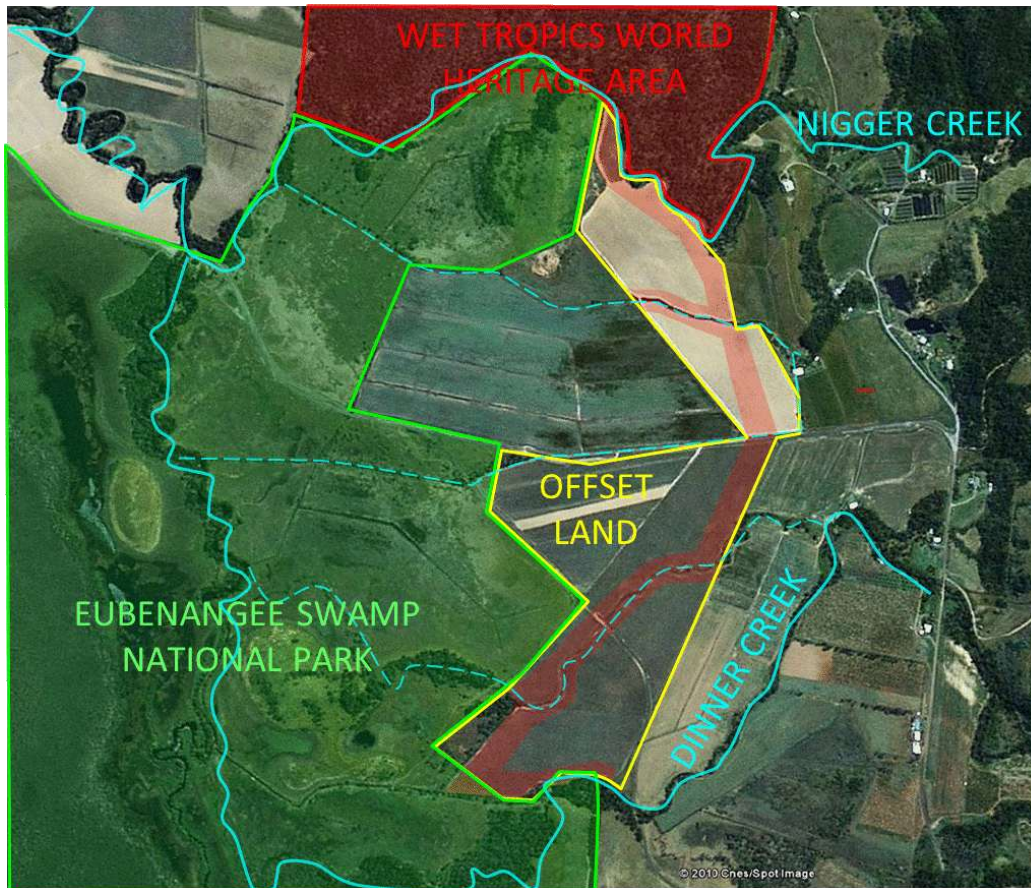


Figure 5.11 Offset property showing revegetation corridor (light red shading) along riparian zones



Figure 5.12 Offset property Looking north to the riparian vegetation along Nigger Creek in WTWHA



Figure 5.13 Cleared southern bank of Nigger Creek with riparian vegetation on the northern bank in the World Heritage Area



Figure 5.14 Looking west towards Eubenangee Swamp National Park



5.4 EPBC Indirect Impacts Offset -Research Package

The research package is designed to further understanding in terms of reducing cassowary mortality, increasing the local population and monitoring the impact of development on the cassowary and the environment.

The research package will be made by direct donation or payment of costs to the project institution. In the SEIS it was proposed to use the Ella Bay Environmental Trust as a conduit to fund the research grants. The environmental trust will still be used for ongoing research funding but not the offsets.

The research projects are complementary to the Recovery Plan for the Southern Cassowary (Latch 2007). The offset research projects target the major threats and improving the knowledge base.

Cassowary Population – growth and carrying capacity

- Cassowary tracking UQ/QPWS/Ella Bay project Using GPS telemetry to track rehabilitated juvenile Cassowaries Survival of Juveniles and rehabilitation
- Cassowary Diet and DNA analysis University of Queensland/QPWS project Determining Cassowary Diet and Energetics through Remote Sensing,

Road Mortality – mitigation strategies

- Cassowary Fencing & Escape Gate Research Project Ella Bay Developments, EcoLogical and Chenoweth . Design, develop and trial Cassowary Fence & Escape Gate

Measurement of impacts

- Impact of Ella Bay Development on cassowaries, fauna and flora James Cook University Environmental impacts of Ella Bay Development access and internal roads, design of strategies to mitigate road impacts on adjacent habitats and internal corridors, and monitoring of road mitigation strategies

5.5 Offset Package Matrix

The offset package has been designed for maximum immediate outcome as per the Offsets Matrix tool (DEWR 2007). Table 5.3 provides a review of the key characteristics of the Proponent's offset package proposal and an indication of the probable conservation outcome, and whether there is a balance of high and low risk actions.

	IMMEDIATE OUTCOME (less than 12 months)	MEDIUM TERM OUTCOME (within 1 to two years)	LONG TERM OUTCOMES (greater than 2 years)
HIGH LEVEL OF CERTAINTY technique used regularly with effective results good quality scientific data is available on key conservation needs of the matter of NES	<ul style="list-style-type: none"> • 22.60 ha of essential cassowary habitat for ecological cassowary corridor on private land to be gifted to National Parks; • 40.18 ha of essential cassowary habitat including the southern extent of the nationally significant Ella Bay Swamp Wetland on private land to be gifted to National Parks; • 63.62 ha Eubenangee offset property to be gifted to National Parks; • 67.8 ha of buffer from World Heritage/ National Park will be placed in Conservation Covenants; and • 87.3 ha of fauna corridors will be placed in Conservation Covenants. • Research - Cassowary Tracking. Juvenile Tagging and Tracking – research has been 50% completed 		<ul style="list-style-type: none"> • Research impact of Ella Bay Development on cassowaries, fauna and flora
MEDIUM LEVEL OF CERTAINTY -approach has successfully been used previously in relation to this or highly similar matter of NES	<ul style="list-style-type: none"> • Eubenangee offset property: Creation of essential cassowary habitat under a Revegetation Management Strategy (with precedence). • Research – Cassowary fencing and escape gate project - complete 	<ul style="list-style-type: none"> • Targeted Survey: Specific monitoring of cassowary usage of Eubenangee offset habitat corridor 	
LOW LEVEL OF CERTAINTY New or untested on-ground conservation activity limited scientific data on the matter of NES	<ul style="list-style-type: none"> • Research – Cassowary diet and DNA analysis. 		<ul style="list-style-type: none"> • Education Programs • Frog fencing erected at creek crossings on Ella Bay Road

Table 5.4 Offset Package Matrix based on Offsets Matrix tool (DEWR 2007)

6. Long Term Conservation Result

The proponent's goal is that there will be a long term positive outcome from the Offset Package and onsite mitigation. The package has been integrated into; and supports the aims of the Recovery Plan for the Southern Cassowary (Latch 2007). The proponent's actions are designed to enhance the movement and ultimately the long term survival of cassowaries within the local Ella Bay Development and in the regional context. (Refer to Figure 6.1)

The research initiatives are designed to minimise impacts, monitor and study the survival of the cassowary and other fauna.

The Offset package and mitigation have been measured against the Recovery Plan for the Southern Cassowary in Table 6.1. Ella Bay Cassowary Recovery Matrix

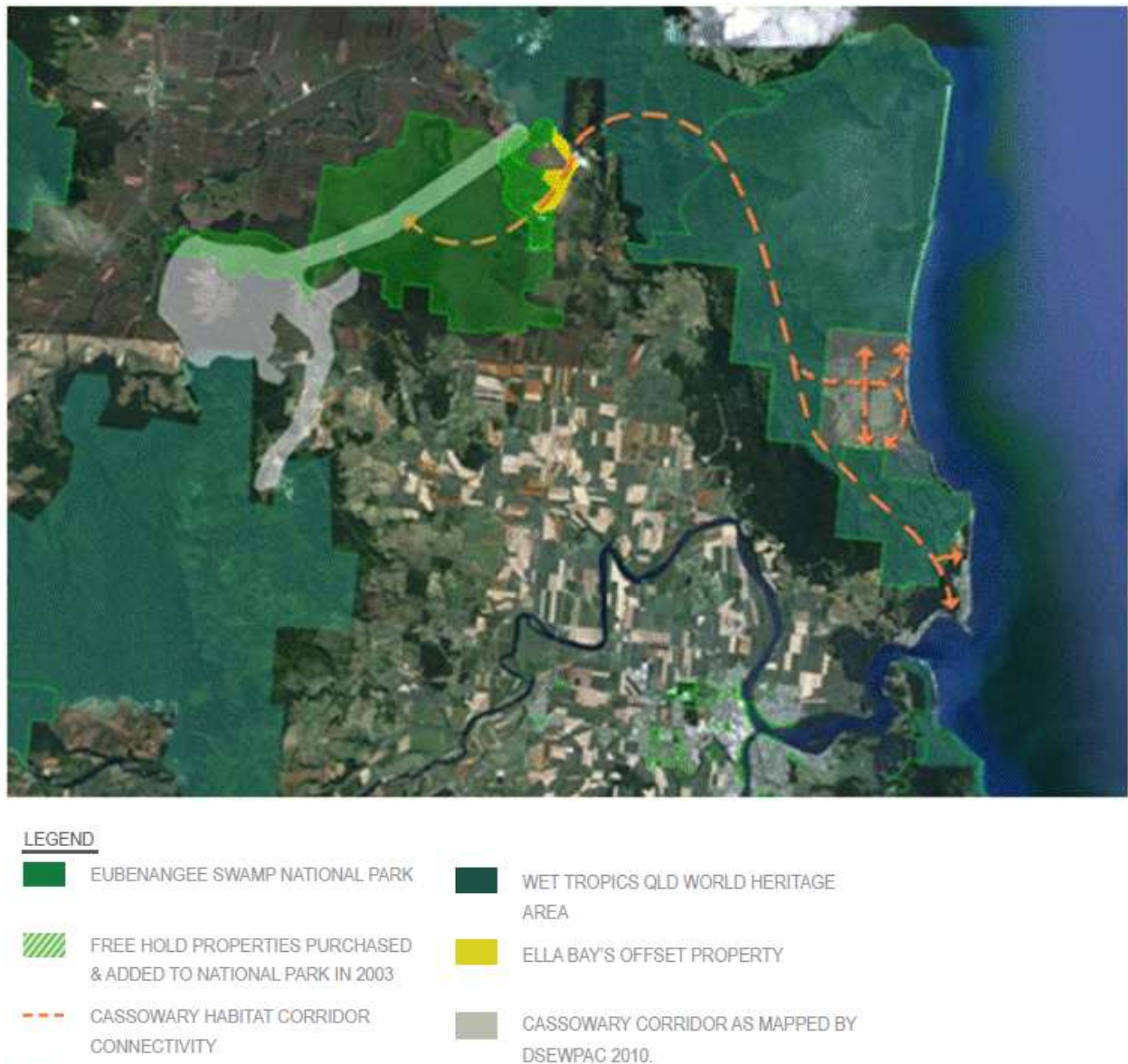


Figure 6.1 Local and regional context of the Ella Bay Development Offset package and mitigation.

Table 6.1 Cassowary Recovery Plan Matrix in the format of DSEWPaC Offset

Ella Bay Cassowary Recovery Plan Matrix			
	IMMEDIATE OUTCOME (less than 12 months)	MEDIUM TERM OUTCOME (within 12 months to two years)	LONG TERM OUTCOMES (> 2 years)
<p>HIGH LEVEL OF CERTAINTY</p> <p>-technique used regularly with effective results</p> <p>- good quality scientific data is available on key conservation needs of the matter of NES</p>	Specific Objective 1: Protect essential cassowary habitat and landscape corridors		
	<p>Action 1.1 Complete mapping of essential cassowary habitat</p> <p>Regional Ecosystems classified as Essential Cassowary Habitat has been identified and detailed mapped both on site and along the road. On Ella Bay greater than 95% of Essential Cassowary Habitat will be protected under Conservation Covenant or gifted to National Parks.</p> <p>Action 1.2 Identify and prioritise areas of essential habitat for protection and management</p> <p>The Ella Bay Road Design and Environmental Report specifically avoids unnecessary clearing of Essential Habitat and Conservation covenants will secure.</p> <p>Action 1.3 Identify and prioritise habitat corridors for protection, restoration and management</p> <p>The 63.6ha offset property is positioned within a strategically important East-West regional corridor identified as an area of key ecological function, broad movement corridors and appropriate rehabilitating habitat. This property will be gifted to National Parks</p> <p>Onsite 62.7ha of the property will be gifted to National Parks, and possible inclusion in World Heritage Area.</p> <p>Revegetation of 50.3 ha and rehabilitation of 64.3 ha will increase the carrying capacity.</p> <p>Action 1.4 Investigate strategies to conserve cassowary habitat on private lands</p> <p>A Conservation Covenant will cover 154ha of revegetated riparian fauna corridor that traverse Ella Bay</p>		
	Specific Objective 2: Institute a more coordinated and stronger planning response to development issues in cassowary habitat		
	<p>Action 2.1 Strengthen linkages with other planning mechanisms to ensure an integrated and more consistent approach to cassowary conservation</p> <p>Sharing of site specific cassowary population research and survey data.</p> <p>Action 2.2 Develop and implement Cassowary Conservation Local Area Plans</p>		

	<p>Ella Bay is committed to conserving and increasing the cassowary sub-population. A number of protection measures will be implemented addressing issues arising from the development; such as:</p> <ul style="list-style-type: none"> o Education through the Welcome Centre; o planning and design for habitat connectivity; o no dogs allowed; o fencing the road to reduce vehicle strike o gifting 62.6ha of the property to National Parks; o providing a 63.6ha offset property positioned within a strategically important East-West regional corridor; o Revegetation of 50.3 ha, rehabilitation of 64.3 ha; and o Conservation covenanting 154ha of riparian fauna corridors traversing the site. 		
	Specific Objective 3: Implement strategies to protect cassowary populations by minimising the adverse impacts of roads, dogs, pigs and cyclone events		
	<p>Action 3.2 Implement appropriate dog control to minimise dog attacks on cassowaries</p> <p>Dogs and cats are not permitted on Ella Bay. Hunting dogs have been banned from accessing the site,</p> <p>Action 3.3 Assess potential impacts of pigs on cassowaries</p> <p>Feral pigs were identified as a threat to the cassowary sub-population at Ella Bay, and have been actively culled</p> <p>Action 3.4 Support existing planning and management strategies that target pests and weeds in cassowary habitat</p> <p>Successfully implemented feral pig trapping programme across Ella Bay and Little Cove. Operational since 2008 - over 100 pigs culled.</p> <p>Operational Weed Management Plan across Ella Bay targeting Weeds of National Significance: Pond Apple and Hymenachne and other weeds.</p> <p>Action 3.5 Manage threats arising from human–cassowary interaction</p> <p>Cassowary specific Cass-O-wary education of all residents, visitors,</p>	<p>Action 3.1 Minimise cassowary road mortality and injury</p> <p>Three cassowary specific underpasses (bridges) and an overpass will be included in the upgrade of the Ella Bay Road.</p> <p>Research has been undertaken to determine a suitable fencing strategy including a purpose designed escape gate to be installed along Ella Bay Road.</p> <p>Provide and support community action for Cassowary Road Management Strategy for Bramston Beach Road.</p> <p>Action 3.2 Implement appropriate dog control to minimise dog attacks on cassowaries</p> <p>Support local information and PVA to change mindset on the local sport of using dogs to hunt for pigs. Promote alternative methods of pig culling and</p>	<p>Action 3.1 Minimise cassowary road mortality and injury</p> <p>Monitoring success of fence and funnel strategy – Three cassowary specific underpasses, overpass fencing and escape gate along Ella Bay Road.</p> <p>Provide research results and survey information to Department of Transport and Main Roads and support inclusion of mitigation on Bramston Beach Road.</p>

	<p>employees.</p> <p>Precinct areas will be fenced to reduce the potential for cassowary-human interaction.</p> <p>Action 3.6 Develop and implement if required a post-cyclone cassowary response strategy</p> <p>Implementation of a cyclone tolerant and protected cassowary fruiting orchard in North west corner.</p> <p>Liaison (Cyclone Yasi) with QPWS staff and monitoring of local fruit availability.</p>	<p>Action 3.6 Develop and implement if required a post-cyclone cassowary response strategy</p> <p>A cassowary research station is to be located in the North West corner, with a number of ongoing projects being monitored. In particular fruit survival post cyclone.</p>	
Specific Objective 4: Progress an effective cassowary rescue, rehabilitation and release programme			
	<p>Action 4.1 Continue to implement the cassowary rescue programme</p> <p>Performance criterion 4.1 Cassowary rescue programme implemented and all rehabilitated animals released back to the wild</p> <p>Ella Bay is collaborating with the University of Queensland to reintroduce rehabilitated orphaned cassowaries back into the wild.</p> <p>To monitor the results of the sub adult's release; Ella Bay purchased five (5) purpose designed GPS units to tag the birds, also financing the unit's recovery for analysis. Results have shown that the juveniles survive after release.</p> <p>Action 4.2 Implement EPA translocation strategy</p> <p>Recognised by QPWS as a "friendly" translocation area for juvenile cassowaries. Two juvenile releases in 2011.</p>		
Specific Objective 5: Cassowary populations are monitored to assess population size, trends and status			
	<p>Action 5.2 Establish and implement a monitoring protocol in key habitat areas</p> <p>Performance criterion 5.2 Monitoring protocol established for all cassowary populations</p> <p>Substantial survey information of the Cassowary population in the surrounds of Ella Bay has (and continually) been collected, collated and assessed by staff and Cassowary advisors over the past 4 years.</p> <p>Action 5.3 Assess size of Wet Tropics and Cape York populations and develop population viability models</p> <p>Performance criterion 5.3 Estimates of cassowary population sizes determined and PVA models completed</p> <p>Ella Bay has undertaken a PVA for the local cassowary Graham-</p>	<p>Action 5.1 Develop and implement a population survey methodology based on faecal DNA</p> <p>Cassowary Diet and DNA analysis research to include DNA testing and camera identification.</p> <p>Action 5.2 Establish and implement a monitoring protocol in key habitat areas</p> <p>Future targeted Surveys: Specific monitoring of cassowary trends in the Ella Bay area: population size, usage and movement.</p>	<p>Action 5.2 Establish and implement a monitoring protocol in key habitat areas</p> <p>Future targeted Surveys: including Eubenangee Swamp corridor</p>

	<p>Seymour Range sub-population, however this was based on factoring Mission Beach Data. New survey results indicate a potential higher local population.</p> <p>The proponent will share this data to support a regional monitoring programme, subsequent monitoring will allow fine tuning of the model.</p> <p>Action 5.4 Monitor and assess the effectiveness of corridors in facilitating cassowary movement</p> <p>The revegetation strategy for the offset property is aimed at restoring and widening a priority East-West regional movement corridor.</p> <p>The UQ tagging of sub adults will provide dispersal patterns and other population information</p> <p>Action 5.5 Maintain a cassowary database</p> <p>From monitoring information Ella Bay has established a Cassowary database of which the proponent is willing to share to support a regional monitoring programme</p>	<p>Action 5.5 Maintain a cassowary database</p> <p>Performance criterion 5.5 The cassowary sightings database maintained</p> <p>Ongoing monitoring information will enable refinement of Cassowary database</p>	
Specific Objective 6: Improve understanding of cassowary ecology and threats to its survival to better inform cassowary recovery			
		<p>Action 6.2 Determine the population genetic structure of cassowaries</p> <p>Performance criterion 6.2 Population genetic structure for cassowaries determined</p> <p>Ella Bay will provide DNA results from Diet research program and identification photos to research institutions.</p> <p>Action 6.3 Determine the survival rate and cause of mortality of subadults in different habitats</p> <p>Performance criterion 6.3 Assessment of factors affecting survival rate of sub-adults completed</p> <p>Through the UQ tagging of sub adults prior to release, information may be gained to support this action. Tagging of juveniles will continue for longer than 6 month duration.</p>	
Specific Objective 7: Engage the community in cassowary conservation and education			
	<p>Action 7.1 Involve community in cassowary conservation</p> <p>Staff and contractors are inducted before entering site, raising awareness and importance of the cassowary to the area. Cassowary recovery is Ella Bay prime environmental cause.</p>	<p>Action 7.1 Involve community in cassowary conservation</p> <p>The cassowary is significant within a marketing perspective of the area, and its conservation profile will be raised to increase local awareness. In particular existing threats of hunting dogs and potential traffic mortality.</p>	<p>Action 7.1 Involve community in cassowary conservation</p> <p>Performance criterion 7.1 Level of community involvement in cassowary recovery implementation has measurably improved over the life of plan and public support for the conservation of cassowaries</p>

		<p>Action 7.2 Promote and publicise recovery plan</p> <p>The Welcome Centre will both inform and educate residents and visitors alike.</p> <p>Action 7.3 Ensure Aboriginal communities participate in all aspects of the recovery process</p> <p>The Bagirbarra have agreed to an MOU in which they will be employed to be part of the revegetation and cultural and environmental rangers</p>	<p>is increased</p> <p>The cassowary is significant within a marketing perspective of the area, and its conservation profile will be raised to increase local awareness. Ella Bay will focus on cassowary recovery as its prime environmental cause.</p> <p>Action 7.2 Promote and publicise recovery plan</p> <p>Performance criterion 7.2 A range of public information and educational materials produced and disseminated to community</p> <p>The Welcome Centre will both inform and educate residents and visitors. With the cassowary as Ella Bays focus local Innisfail and Flying Fish Point residents will be encouraged to be part of the recovery.</p> <p>Action 7.4 Document traditional cultural knowledge of cassowaries</p> <p>Performance criterion 7.4 Traditional cultural knowledge of cassowaries documented and where negotiated incorporated into recovery plan projects</p> <p>A section of the Welcome Centre will be dedicated to the cultural significance of the area, and the fauna and flora within it.</p>
	<p>Specific Objective 8: Manage the recovery programme</p>		
	<p>Action 8.1 Ensure recovery plan implementation is coordinated effectively</p> <p>A site specific (including Ella Bay Road) Cassowary Environmental Management Plan has been developed, which involves regular, ongoing monitoring, reporting and evaluation of activities. An external cassowary professional will review the EMP annually?</p> <p>Other sub-plans contained within the Environmental Management Plan will ensure mitigation measures (such as Revegetation) are also regulated.</p>	<p>Action 8.2 Review the recovery plan</p> <p>The recovery plan is entwined in the Ella Bay Southern Cassowary Environmental Management Sub-plan. the subplan will be reviewed annually.</p>	

<p>MEDIUM LEVEL OF CERTAINTY</p> <p>-approach has successfully been used previously in relation to this or highly similar matter of NES</p>		<p>Action 3.1 Minimise cassowary road mortality and injury</p> <p>The Cassowary fence and escape gate have been trialled with captive cassowaries, further trials are required on existing roads.</p> <p>Action 5.2 Establish and implement a monitoring protocol in key habitat areas</p> <p>Performance criterion 5.2 Monitoring protocol established for all cassowary populations</p> <p>Targeted Survey have been undertaken: Specific monitoring of cassowary trends in the Ella Bay area: population size, usage and movement</p>	<p>Action 3.1 Minimise cassowary road mortality and injury</p> <p>Research has been undertaken to determine a suitable escape gate to be installed along Ella Bay Road. Long term monitoring will be required.</p> <p>Action 5.4 Monitor and assess the effectiveness of corridors in facilitating cassowary movement</p> <p>Performance criterion 5.4 Monitoring programme established to assess role of restored corridors in facilitating cassowary movement</p> <p>Future targeted Surveys will include Eubenangee Swamp corridor, which will determine whether a corridor can be re-established.</p>
<p>LOW LEVEL OF CERTAINTY</p> <p>New or untested on-ground conservation activity limited scientific data on the matter of NES is available</p>			

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APPENDICES

Appendix 1. Terrain NRM Offset Corridors Report

Property-Scale Options for Regional Corridor Protection in the Bramston /Eubenangee Area

Prepared by



May 2008

1. Introduction

This report has been prepared to provide strategic information related to the establishment of conservation corridors that could inform the development of an offsets package for the **Ella Bay** development. Satori has been requested to consider the development of offsets for residual impacts from their proposed development after all available impact mitigation strategies have been exhausted. These offsets are being developed by Satori in the context of the current approvals process under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC). In this regard, Terrain has been specifically requested by Satori to provide strategic corridor planning information that may be relevant to the enhancement of cassowary corridors of relevance to the Ella Bay/Graham Seymour Range cassowary sub-population.

2. Background

The Ella Bay site sits within the Graham-Seymour range which extends in the north to Bramston Beach, south to the Johnstone River and west to Eubenangee swamp. The range is internationally recognised for its ecological significance. Habitat in this area is complex and extends from high order protected species (cassowary and common mist frog) to others of equal significance but less recognised (including freshwater fish species and flora of significance to many other terrestrial species). In sum, the intricate ecological systems in this area require protection and minimal disturbance to permit their effective functioning.

The locality is predominantly protected by a number of state, federal and international legislative measures. However, there are a number of breaks in the protected area network that restrict connectivity to the Graham Seymour range to the north and west. The disturbed landscapes (predominantly as a result of intensive agriculture) in these narrow corridors pose a threat to the functionality of the entire system. It is therefore essential that these critical corridors are strengthened through enhanced protection mechanisms.

Pressure for development in the coastal zone around the Bramston/Eubenangee locality should therefore encourage enhanced connectivity within the Graham-Seymour Range. A combination of on ground works and strategic planning (through Local Area Planning) is recommended as part of any offsets package for development in this area.

3. Objective

The objective of the process undertaken to develop this report was to identify key sites in the Bramston Beach/Eubenangee area that could contribute to improved connectivity between the Graham-Seymour Range and other parts of the protected area system to the north and west.

These sites have been targeted, through engagement with key Government agencies with an interest in the area, in an attempt to develop strategic land offset options to mitigate the residual impacts of the proposed residential/tourism development at Ella Bay. Their involvement included assisting the development of key criteria for identifying priority properties through multi-criteria analysis.

To identify the properties, this set of criteria have been developed and weighted depending on their importance in terms of re-establishing the corridors. The criteria were then applied to the locality using a collection of data sets from relevant sources.

This process aimed to identify the priority sites within the corridors to be targeted for conservation.

Additionally, the objective of the report has also been to provide a catalyst to further develop the Local Area Planning process with the aim further strategic land protection and enhancement to help secure the future of the Graham Seymour cassowary sub-population.

4. Identifying Property-Based Offset Options

Satori is considering an offsets package for the Ella Bay development that is a mixture of on and offsite measures. It is important that Satori propose on-ground property-based offsets that constitute the vast proportion of their overall offsets package. This commitment needs to be complemented by a local area based strategic planning framework that will facilitate overall landscape management by all key stakeholders. This combined approach is also in line with broader national conservation initiatives for the protection of cassowary habitat.

It should be noted at this point that the information provided in this report relates only to property-based offsets for the development of the Ella Bay site itself.

In the instance of the Ella Bay development proposal, offsets could assist the protection and enhancement of regional corridors that link the Graham -Seymour range with the remainder of the protected area system to the north and west. This report identifies priority localities needed to strengthen corridor networks between this location and nearby areas of core habitat. Securing specific conservation outcomes in this area will ensure the longevity of the cassowary sub population in the Graham-Seymour range by enhancing access to food sources, breeding partners and facilitating movement of species throughout the landscape.

4.1 The Process

4.1.1 Initial regulatory stakeholder discussions

Key regulatory stakeholders were brought together to collectively identify the key sites in the regional corridors that should be targeted for protection. Participants included representatives from the Queensland Environmental Protection Agency, Wet Tropics Management Authority, Queensland Parks and Wildlife Service and Cairns City Council. Representatives from Johnstone Shire Council were also invited but were unavailable to attend.

EPA's most comprehensive and up to date data sources were used to identify the key corridors and specific sites that require protection. The data set was based on the information provided for the FNQ2025 regional planning process and included the following layers:

- 1:25 000 aerial photos
- Corridors and landscape layers
- Wet Tropics habitat corridors
- Priority riparian vegetation (stream order 5 and higher in developed sub regions)

- State wetlands maps – areas of high ecological significance
- Endangered and of concern Regional Ecosystems
- Cassowary essential habitat
- Protected area estate including Nature refuges, World Heritage area, National parks, conservation parks and timber/forest/state reserves
- Wet topics habitat corridors special management areas
- DCDB
- Existing urban and rural residential footprint
- Regional Ecosystems for Queensland

Discussion focused around the key corridors and the criteria that should be used to determine which sites are critical for this project. The need to focus on connectivity and ecological function was determined to be key in this process. Likewise existing levels of protection and level of threat were considered to be equally important.

It was recognised that the north-south link is particularly crucial, specifically around the Bramston Beach area where there is a significant population of cassowaries. The east-west corridor is equally significant, particularly in the Eubenangee Swamp area. However, further to the west, the Bruce Highway is currently a barrier to guaranteed connectivity. Through further liaison with state government, traffic management solutions could resolve this issue. This is a matter that could be more adequately dealt with through a local area planning process.

Using these criteria along with significant locally specific knowledge and a complex array of data sets, key sites were identified within the habitat corridors.

The results of this initial workshop were mapped and can be found in Appendix A. Note that the original selection was narrowed down through further analysis and only the priority sites that were considered critical to the reestablishment of corridors were included in the final map. These sites were also ranked in terms of priority and options relevant to their protection.

4.1.2 Identification of key criteria and weightings to be applied

Further to this initial workshop, it was noted that a demonstrated process was needed to identify the key sites based on more refined criteria. The criteria considered important by DEW are:

1. Contribution that the site makes to connectivity in the landscape;
2. Level of protection afforded to individual sites; and,
3. Presence of suitable cassowary habitat.

Key members of the stakeholder committee reconvened to further refine the criteria and weightings that could be used to identify the key sites.

A series of more detailed criteria were established based on values that were considered to be important in determining the priority areas. The criteria were classified to assist in determining weightings which were then applied in relation to

level of importance in re-establishing the corridors (where 1 = low importance, 2 = medium importance, and 3 = high importance). The criteria identified include:

- a) Proximity to protected area estate
- b) Contribution to corridors identified in FNQ2025
- c) Covenants
- d) Tenure
- e) Zoning
- f) Regional Ecosystem Status
- g) Essential Habitat
- h) FNQ2025
- i) Wet Tropics (WH status)
- j) Land Zone (Geology)
- k) Topography (slope)
- l) Watercourse
- m) Cassowary habitat (EPA mapped)

At this stage it was recognised that the final criteria list and applied weightings were not necessarily comprehensive and further refinement of criteria would be required once the different scenarios were developed.

The complete list of criteria and applied weightings can be found in Appendix B. Maps of the individual criteria can be found in Appendix C.

4.1.3 Development of scenarios

Having mapped each of the criteria individually, the next step was to combine the criteria in an attempt to identify the key sites to be targeted.

In the first instance, it was determined that all lands identified as being National Park, World Heritage, State land or reserves should be removed from the initial data set. These lands already enjoy a high level of protection and are not relevant when applying the other criteria. In essence, it is only freehold and leasehold land that is of most interest in this exercise.

Four scenarios were developed using a variety of criteria and overall weightings to determine the key sites of importance in the regional conservation planning context. The development of different scenarios facilitated the identification of criteria faults that were in some instances distorting the results. By applying a number of different scenarios, it was then possible to determine the most useful criteria and their relevant weighting in the overall process. It is considered that this stage was key to determine the most suitable scenario for identifying the key corridors and sites.

A table outlining the different scenarios that were run, weightings applied, commentary on the results and the maps can be found in Appendix D. A more detailed explanation of each of the criteria and their use in the development of scenarios can be found in the table in Appendix B.

4.1.4 Identification of preferred corridors

Through the mapping process a number of key corridors were identified for protection that would contribute to the enhancement of strategic regional corridors. The key corridors identified through this process can be seen in Figure 1. The key corridors for consideration in this proposal are outlined as follows:

East West links

The main bottlenecks in the EW link occur in 2 locations. The first (EW1) is between the Ella Bay National Park and the Eubenangee Swamp National Parks. The opportunity for revegetation on private land in the eastern section of EW1 could be investigated to strengthen links between the 2 national parks. This recommendation is backed up by investigations conducted as part of the Biotropica report prepared in 2005 which states that restoration in this area, 'would significantly improve the mobility of cassowaries between Eubenangee Swamp and the Graham Ranges' (pp.23, 2005). There is currently a narrow link between the northern section of Eubenangee Swamp National Park and the Graham Seymour Range National Park, however these areas could benefit from widening through either acquisition or revegetation on adjacent private land.

The other EW link (EW2) is further to the west of the Bruce Highway in the Russell River/Woopen Creek area. There are two sites in this vicinity that are critical to connecting Eubenangee National Park and the Wet Tropics WHA to the west. One of these in particular is completely vegetated and is considered by the Biotropica report to be one of the most critical linkage blocks in the Wet Tropics region. Road and rail bridges over waterways in this vicinity provide safe crossing points for cassowaries to cross the highway corridors.

North South links

The key NS linkages occur in the Bramston Beach area. The first (NS1) is a small section along the Bramston Beach Road which links the northern and southern sections of the Graham Seymour Range National Park. Currently there is no through connectivity at all in this section, although some sections of these lots are covered by the World Heritage listing. However, enhanced protection for the remainder of these freehold lots needs to be investigated to ensure the NS link can be protected into the future.

The second is to the north of Bramston Beach where there is a narrow section linking the north and south parts of the World Heritage Area. This corridor requires widening to guarantee greater connectivity between these two parts of the reserve system.

Ella Bay Corridor

Whilst a small section of the Ella Bay site to the SW is close to the World Heritage area, it would be of benefit to seek a widening of the corridor in this area. We understand Satori is proposing to dedicate this land to NP in 5 years. Satori is also proposing other on site corridors which involve revegetation and rehabilitation.

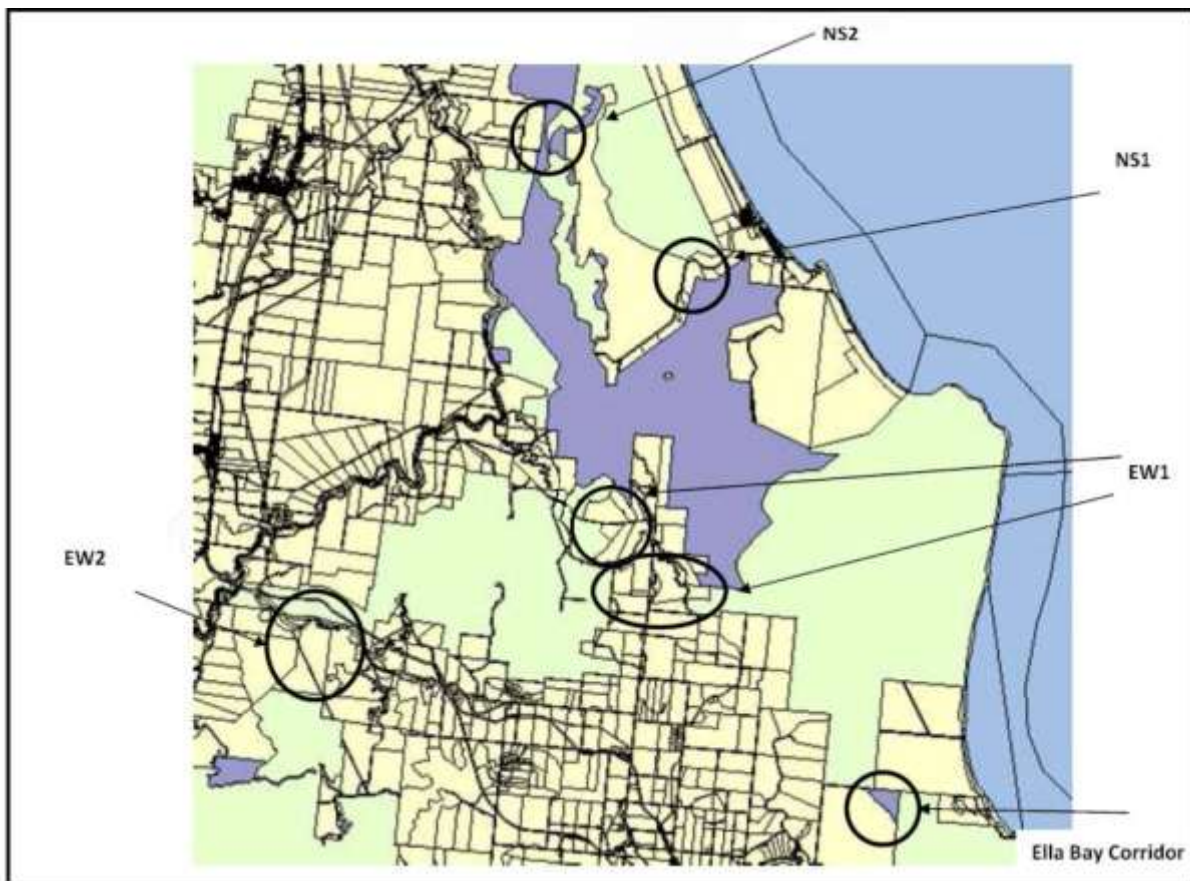


Figure 1 – Priority NS and EW corridors in the Bramston/Eubenangee area

Prioritisation of key sites

Within the preferred corridors identified in the previous section, a number of key sites were identified as being high priority in terms of reestablishing regional corridors. A thorough analysis of each of the priority sites was undertaken with consideration given to Regional Ecosystem Status, presence of Essential Habitat on site and consistency with other regional planning documents. The full list of priority sites can be found in Appendix E which includes details relating to the preferred options in terms of enhancing connectivity.

Within this list of priority sites, a smaller group was selected as being highly critical in terms of reestablishing the regional corridors. The sites chosen have the ability to enhance the Graham-Seymour Rang cassowary sub-population by strengthening existing narrow corridors or establishing connectivity where none exists to date. This would facilitate movement by cassowaries across the landscape and enhance feeding and breeding opportunities within the subpopulation.

Figures 2, 3 and 4 below highlight the recommended priority sites in the northern, southern and western sections of the study area. Table 1 complements these figures.

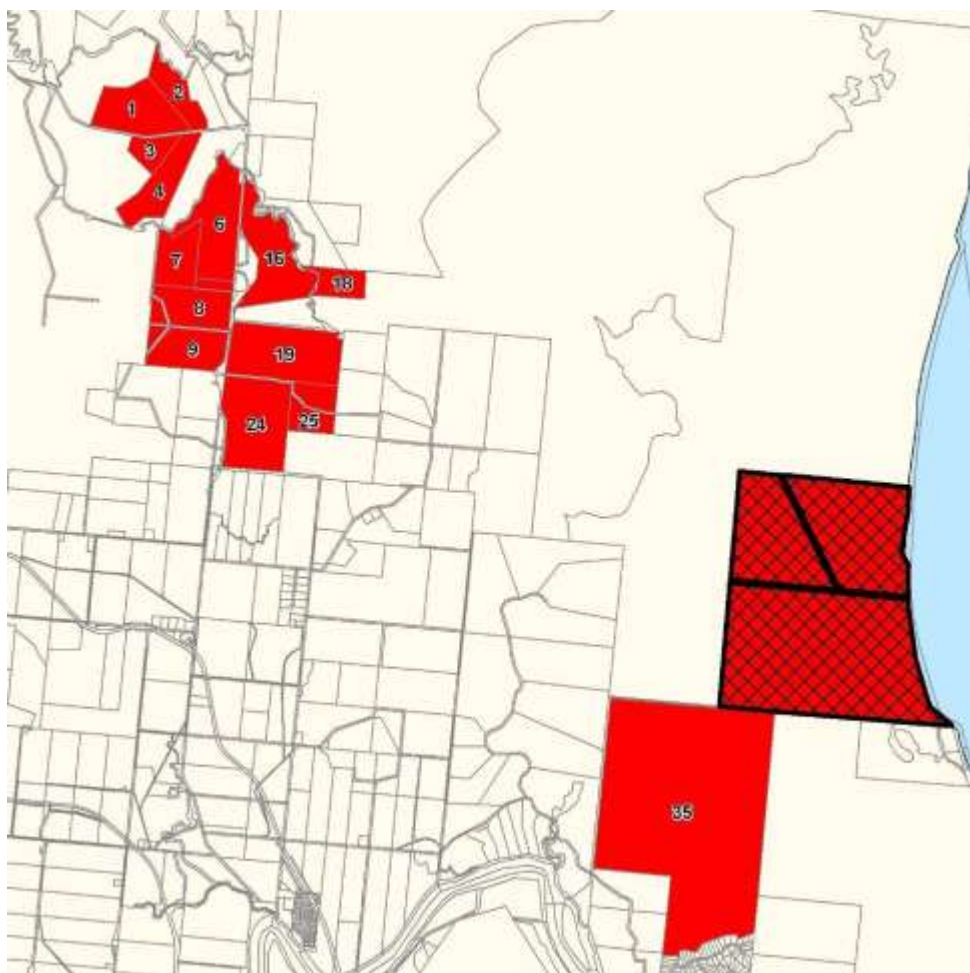


Figure 2 – Recommended priority sites southern section (Ella Bay-Eubenangee Swamp)

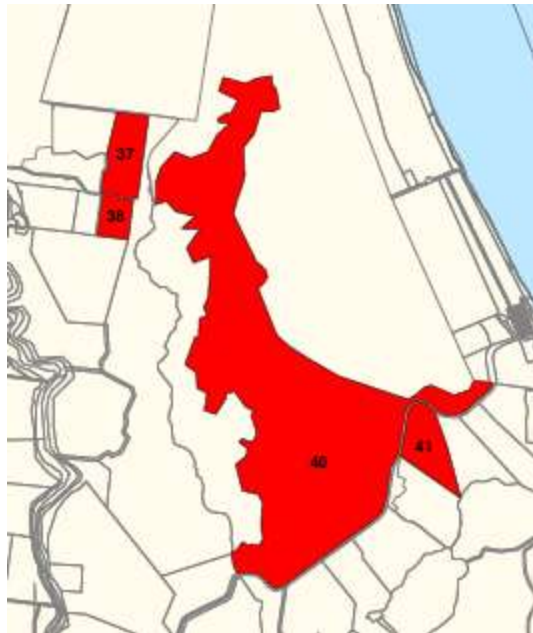


Figure 3 – Recommended priority sites Northern section (Bramston Beach)



Figure 4 – Recommended priority sites western section (Woopen Creek/Russel River)

Table 1 – Key sites within the priority regional corridor

Site No.	Lot/Plan	Hectares	Tenure	Rank	Presence of RE	Essential Habitat	Biotropica Report	Comment	Recommendation
1	1RP736065	39.556	FH	1	Non remnant	No	No	Cleared land - cattle. Now has a residential house under construction	NS link between Eubenangee and state land to north
2	5RP747500	19.721	FH	1	non remnant	yes	no	Majority of site used for agricultural purposes.	NS link between Eubenangee and state land to north
3	6RP713994	12.265	FH	1	non remnant	No	NO	Cane/cattle property. Owners currently undertaking reveg. works in riparian zone of Dinner Ck	Reveg parts of these lots focusing on creek links to contribute to EW connectivity
4	7RP713994	30.988	FH	1	non remnant	No	NO	Cane/cattle property. Owners currently undertaking reveg. works in riparian zone of Dinner Ck	Reveg parts of these lots focusing on creek links to contribute to EW connectivity

Site No.	Lot/Plan	Hectares	Tenure	Rank	Presence of RE	Essential Habitat	Biotropica Report	Comment	Recommendation
6	3RP722054, 2RP740643	4.064 and 49.267 respectively (total=53.331)	FH	2	Of concern dominant in sthn section. Not of concern around creek line in nth	Yes	YES	Biotropica report notes site having significance in NS corridor - increase ranking to 1. Some pond apple eradication works complete on site.	Reveg part of this lot to create second major EW corridor
7	2RP722054	24.943	FH	1	Of concern dominant on eastern boundary. Small area of endangered dominant also	Yes	YES	some pond apple works proposed	Reveg part of this lot to create second major EW corridor
8	238SP106811	32.287	FH	1	non remnant - small section of concern dominant along western boundary	Yes	NO	Majority of site used for agricultural purposes.	covenant western section of concern dominant Completion of corridor with 19
9	48N157603	32.486	FH	1	non remnant - small section of concern dominant along western boundary	Yes	NO	Majority of site used for agricultural purposes.	covenant western section of concern dominant Completion of corridor with 19

Site No.	Lot/Plan	Hectares	Tenure	Rank	Presence of RE	Essential Habitat	Biotropica Report	Comment	Recommendation
16	237NR6392	50.871	FH	1	Of concern dominant along western bound fronting Dinner Ck Rd. Endangered dominant and not of concern along eastern boundary creek line.	Yes	YES	contributes to major EW corridor	Reveg to link with essential habitat
18	64N157620	15.33	FH	1	100% site cover not of concern	Yes	Yes	Significant remnant habitat associated with high densities of cassowary.	Covenant all or part of essential habitat
19	239SP106811	63.394	FH	1	Not of concern along eastern boundary, of concern dominant in southern section.	Yes	Yes	Mostly cultivated. Isolated vegetation patches. Adjacent to WHA	Possible Acquisition
24	42N157603	61.877	FH	2	Small cover of concern dominant in SE corner . Some plantation	Yes	YES	Isolated remnant/regrowth - major linkage between GS range and Eubenangee	Revegetation to link with essential habitat in 11 and 12

Site No.	Lot/Plan	Hectares	Tenure	Rank	Presence of RE	Essential Habitat	Biotropica Report	Comment	Recommendation
25	3RP721435	22.53	FH	2	50% cover of concern dominant. All classified as essential habitat		YES	Isolated remnant regrowth and cultivation.	Covenant all or part of essential habitat to create link to 24 and 19
35	998RP894596	362.111	FH	1	100% cover not of concern (NE corner listed WHA)	Yes	Yes	major area of significant remnant habitat associated with high densities of cassowary adjoining Ella Bay development site	covenant all or part of essential habitat or purchase
37	1RP743481	40.951	FH	1	Close to 100% cover not of concern	Yes	no	significant remnant vegetation to strengthen habitat continuity in a vulnerable area and to consolidate area of significant habitat	Covenant all or part of site. Would strengthen narrow linkage in NS corridor
38	1NR5032	17.917	FH	1	Small percentage cover - not of concern and of concern dominant	yes	no	remnant vegetation to consolidate area of significant habitat	Reveg plus covenant all or part of site to strengthen narrow linkage in NS corridor
40	7SP143729	679.638	FH	1	Mostly cleared. Critical of concern	Yes	No	remnant in SE area is a critical link in the	Covenant remnant in SE area of site.

Site No.	Lot/Plan	Hectares	Tenure	Rank	Presence of RE	Essential Habitat	Biotropica Report	Comment	Recommendation
					dominant in SE corner of site			weakest area of the eastern NS corridor	
41	4RP895749	41.128	FH	1	Sections of concern dominant and not of concern in southern 2/3 of site	Yes	no	critical link in weakest area of eastern NS corridor	Apply covenant over remnant veg and some reveg. needed
44	158SP108880	68.8	FH	1	NW section of site covered in not of concern vegetation. Small patches of concern dominant	Yes	Yes	Large remnant patches with grazing areas, adjacent WHA. Critical linkage.	covenant all or part of essential habitat or purchase
45	157NR748	116.82	FH	1	site entirely covered in not of concern. Power line easement transects the site	Yes	Yes	Large remnant patches with grazing areas, adjacent WHA. Critical linkage.	covenant all or part of essential habitat or purchase

4.1.5 Cross check with original sites identified and other regional planning documents

The results of the process run for this project have proven to be consistent with Terrain's own NRM Plan (Sustaining the Wet Tropics), the Wet Tropics Conservation Strategy and the Biotropica report titled "A framework to establish lowland habitat linkages for the Southern Cassowary (*Casuarius casuarius johnsonii*) between Cairns and Cardwell" (2005). The end results are also consistent with the original mapping exercise that was undertaken with the broader stakeholder group (see Figure 5 below and Appendix F). The consistency of this information validates the results of this report and provides a sound foundation for further conservation management planning.

It is recognised that a multi criteria analysis has flaws with its application (usually due to base data set anomalies) and particularly in this case given that not all data sets were available. However, it is considered that the variety of data used, including local knowledge and expertise, has resulted in a process that has proved adequate and consistent with other planning reports for the region. Through a final assessment of these results with key stakeholders, a map could be produced that would clear up any inconsistencies or anomalies that exist at this point. However, it is thought that the end result would not be substantially different to the one already been presented in this report.

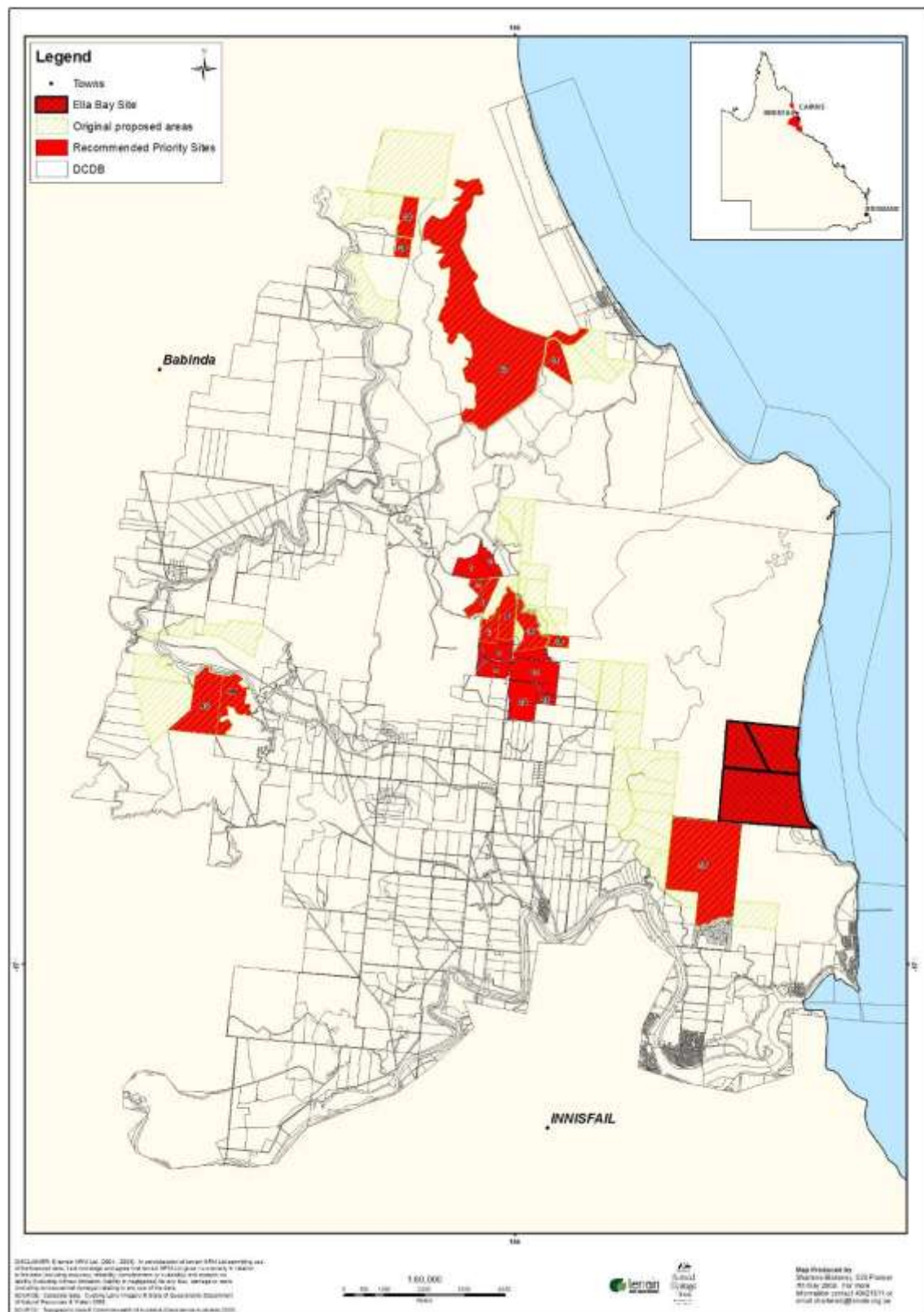
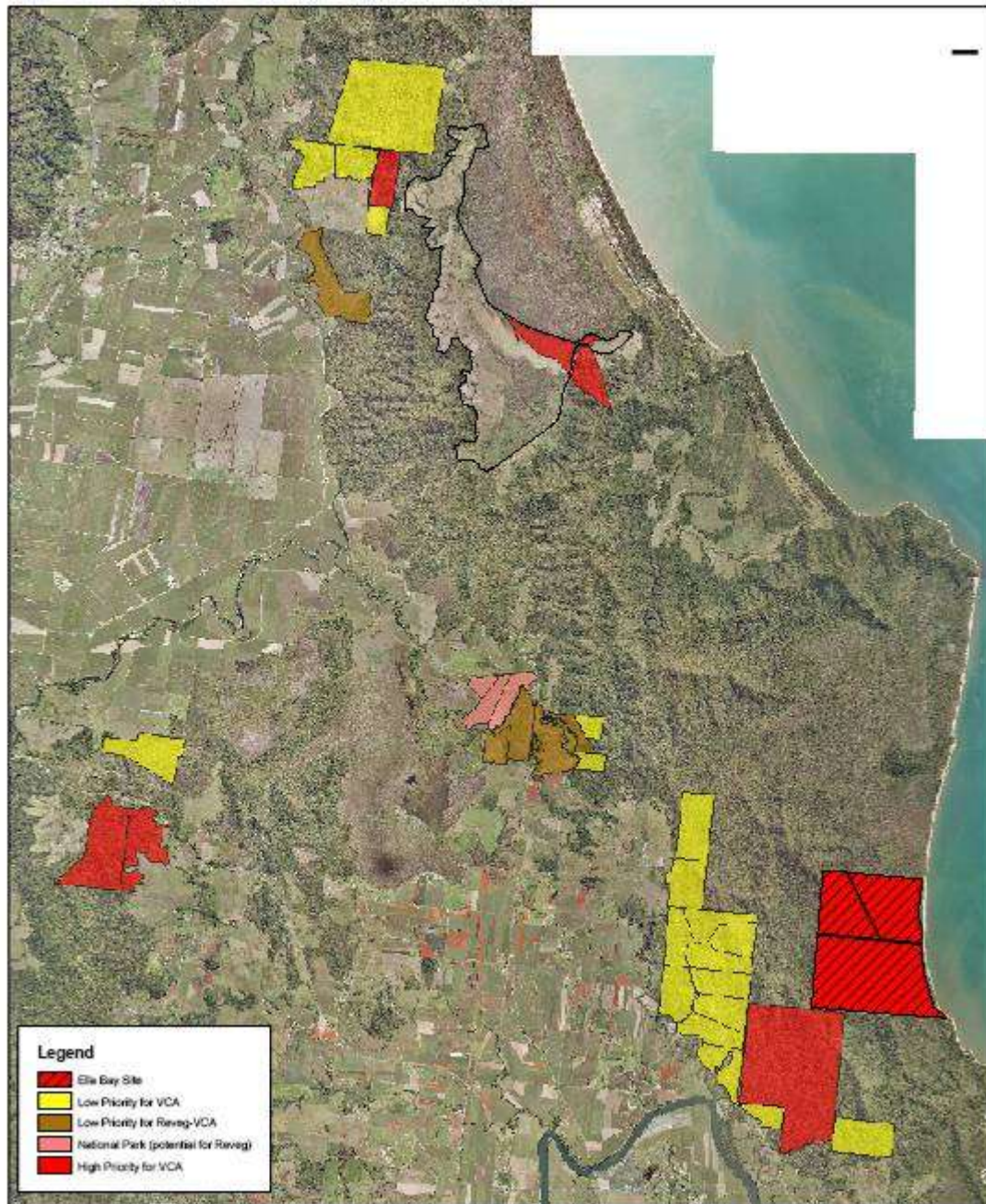


Figure 5 – Recommended priority sites with original overlaid

4.1.6 Conclusion

The above results highlight a number of sites within the key regional corridors that require greater protection for enhanced functionality in the Graham-Seymour Range and surrounding reserve systems. The outcomes indicate a variety of options for potential inclusion in the Satori offsets package that will meet the criteria defined by DEW. It is recommended that this information be utilised by Satori in the development of their offsets package that seeks to mitigate any residual impacts of the proposed Ella Bay development. Terrain understands that Satori has previously undertaken wider community engagement in the strategic planning for its offset package, and encourages the company to continue to do so through to the implementation phase of the offset project.

APPENDIX A– IDENTIFICATION OF KEY SITES



APPENDIX B – CRITERIA AND APPLIED WEIGHTINGS

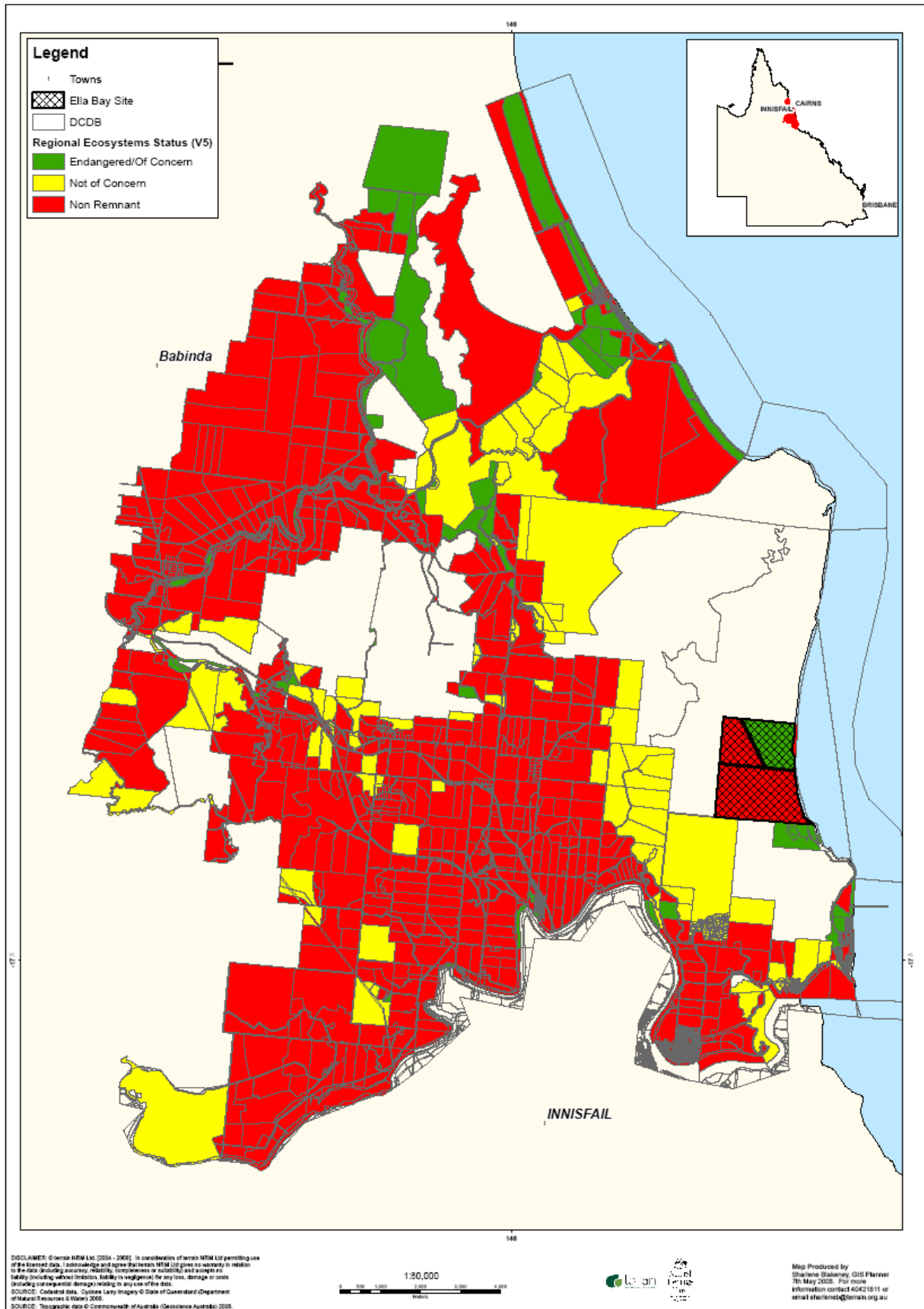
Category	Criteria	Classification	Weighting	Data Source	Comment
Connectivity	Proximity to protected area estate	Adjacent	3	DNRW/ QPWS	Sites immediately adjacent to protected area system were considered critical due to the contribution they could make to expand the reserve system. Would also assist in providing greater buffers between existing land uses and the protected area reserve. (ranked 0-3)
		Not adjacent	0		
	Contribution to corridors identified in FNQ2025	Site identified within state and regional conservation corridors in FNQ2025 mapping (EPA)	3	EPA	The most recent mapping prepared in relation to regional corridors was for the regional statutory plan, FNQ2025. This comprehensive data set has been endorsed by key stakeholders, including DEW for inclusion in the plan. This criteria was critical in determining each sites priority in terms of its contribution to connectivity. (ranked 0-3)
		Site not identified within state and regional conservation corridors in FNQ2025 mapping (EPA)	0		
Level of Protection	Covenants	Covenant Binding on title	1	Johnsto ne Shire Council, DNRW, Cairns City Council and EPA	Initially this criteria was considered essential for inclusion as it identifies sites that are already afforded maximum protection under legally binding titles. However, ultimately, it was abandoned as further research indicated that there were no significant covenants that applied in the study area, and the inclusion of this criteria skewed results.
		Limited Covenant	2		
		No covenant	3		
	Tenure	freehold (FH)	3	DNRW	This criteria was considered critical as it

Category	Criteria	Classification	Weighting	Data Source	Comment
		lands lease (LL)	2		determines the level of protection that applies to a site. Freehold and leasehold were obviously considered to be of greatest concern as the threats that apply on these lands are far greater than those of other tenures (such as state lands and national parks)
		national park (NP)	0		
		state forest (SF)	0		
		state lands / reserves (SL/RE)	0		
		timber reserve (TR)	0		
		water reserve (WR)	0		
		Covenant (CV)	1		
	Zoning	Urban	3	Johnston Shire Council, Cairns City Council	Initially this criteria was used to identify the potential threat in terms of development of a site. However, as the data set was incomplete and the application of zoning is considered an arbitrary mechanism, it was resolved to abandon this criteria
		Rural	2		
		Rural Residential	3		
		Conservation	1		
	Regional Ecosystem Status	Endangered	1	DNRW	The RE status on each site is considered critical in determining the level of protection that applies under the Vegetation Management Act. However, it was difficult to get accurate representation through data set as RE's cross many boundaries and therefore skew the results. It was therefore determined that the RE data would be applied at a final stage of assessment on a site by site basis (See details outlined in Appendix F).
		Of Concern	1		
		Not of concern	2		
		Non Remnant	3		
	Essential Habitat	Essential Habitat	1	DNRW	This data was unobtainable and therefore not

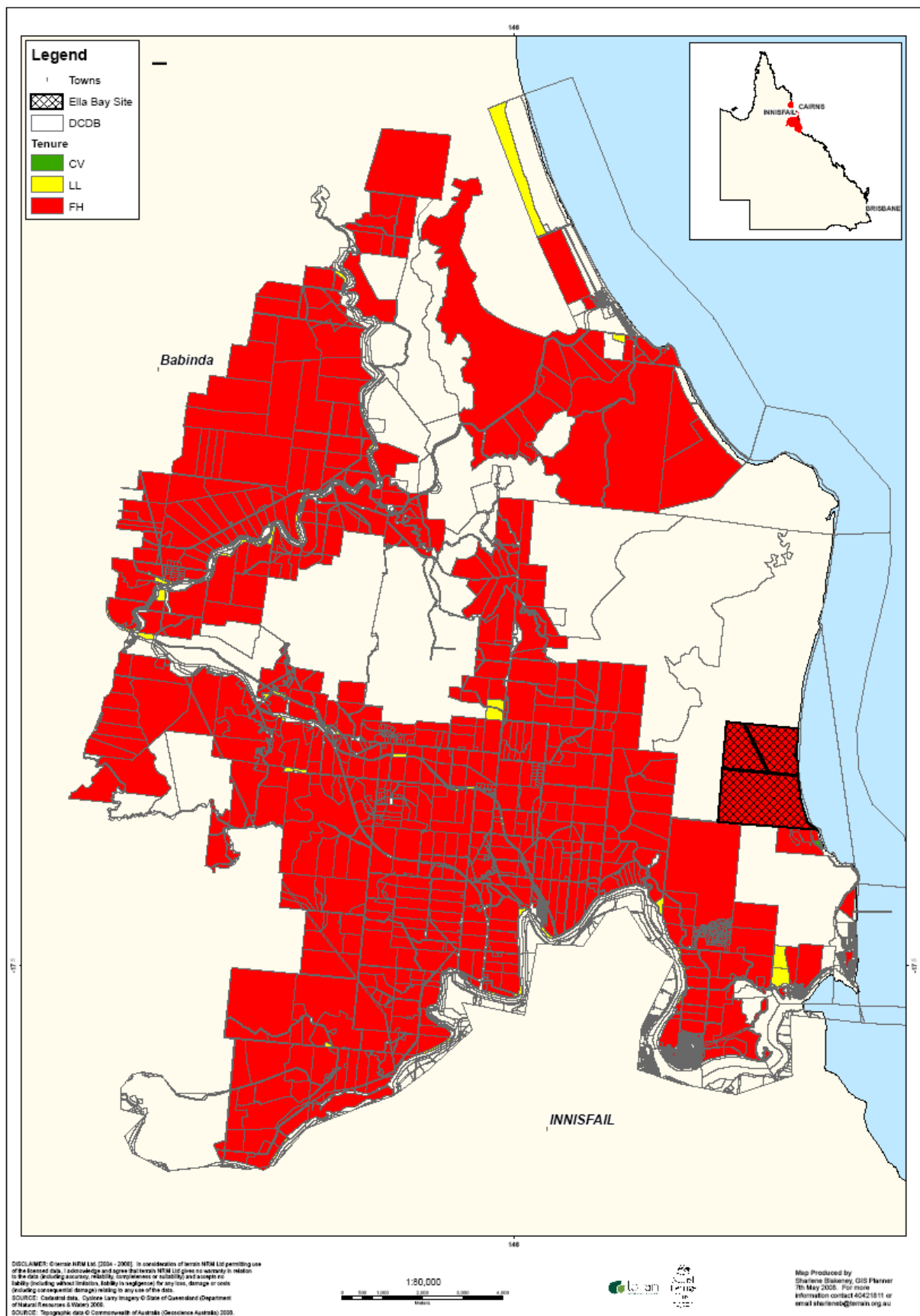
Category	Criteria	Classification	Weighting	Data Source	Comment
		Not Essential Habitat	3		included in the first cut of mapping. It was however applied at a later stage on a site by site basis as per RE status (above).
	FNQ2025	Inside urban footprint	3	DIP	Data unavailable – criteria abandoned.
		Outside urban footprint	1		
	Wet Tropics (WH status)	inside WHA boundary	0	WTMA	This was originally to be used as a separate criteria. However in the end it was decided to remove all WHA land in the first instance as they are already afforded maximum protection under the Wet Tropics Management Plan 1998.
		outside WHA boundary	3		
Cassowary Habitat Suitability	Land Zone (Geology)	Gabroid	1	DNRW	Soil type assists in determining vegetation types and is useful in determining the likelihood of success through revegetation/rehabilitation efforts. It also assists in determining diversity and nutritional value of food source and is a good indicator of slope. However, as geology data is mapped at a very broad scale (1:100 000), with not enough detail for the level required, it was therefore excluded from final mapping exercise.
		Granitoid	1		
		Estuarine/marine	n/a		
		Sand	3		
		Metamorphic	2		
		Mud rock	2		
		Basalt	3		
		Alluvials	3		
Topography (slope)	Slope > 30%	1	No data available	Contour data available but formula to apply slope to mapping not yet complete	
	Slope>10% but <30%	2			
	Slope >1% but <10%	3			
Watercourse	Present	3	DNRW	Presence of a water course is a good	

Category	Criteria	Classification	Weighting	Data Source	Comment
		Absent	1		indication of cassowary habitat suitability. However, almost every site within the study area has some form of water course present, it was considered to provide inaccurate results. Further, data reflecting stream order and flow unavailable. Criteria removed.
	Cassowary habitat (EPA mapped)	cassowary habitat	3	EPA	Similar to mapping of essential habitat and a critical factor in determining suitability for cassowary habitat.
		not cassowary habitat	1		
Scale	3	Highest			
	2	Medium			
	1	Low			
	0	criteria does not apply			

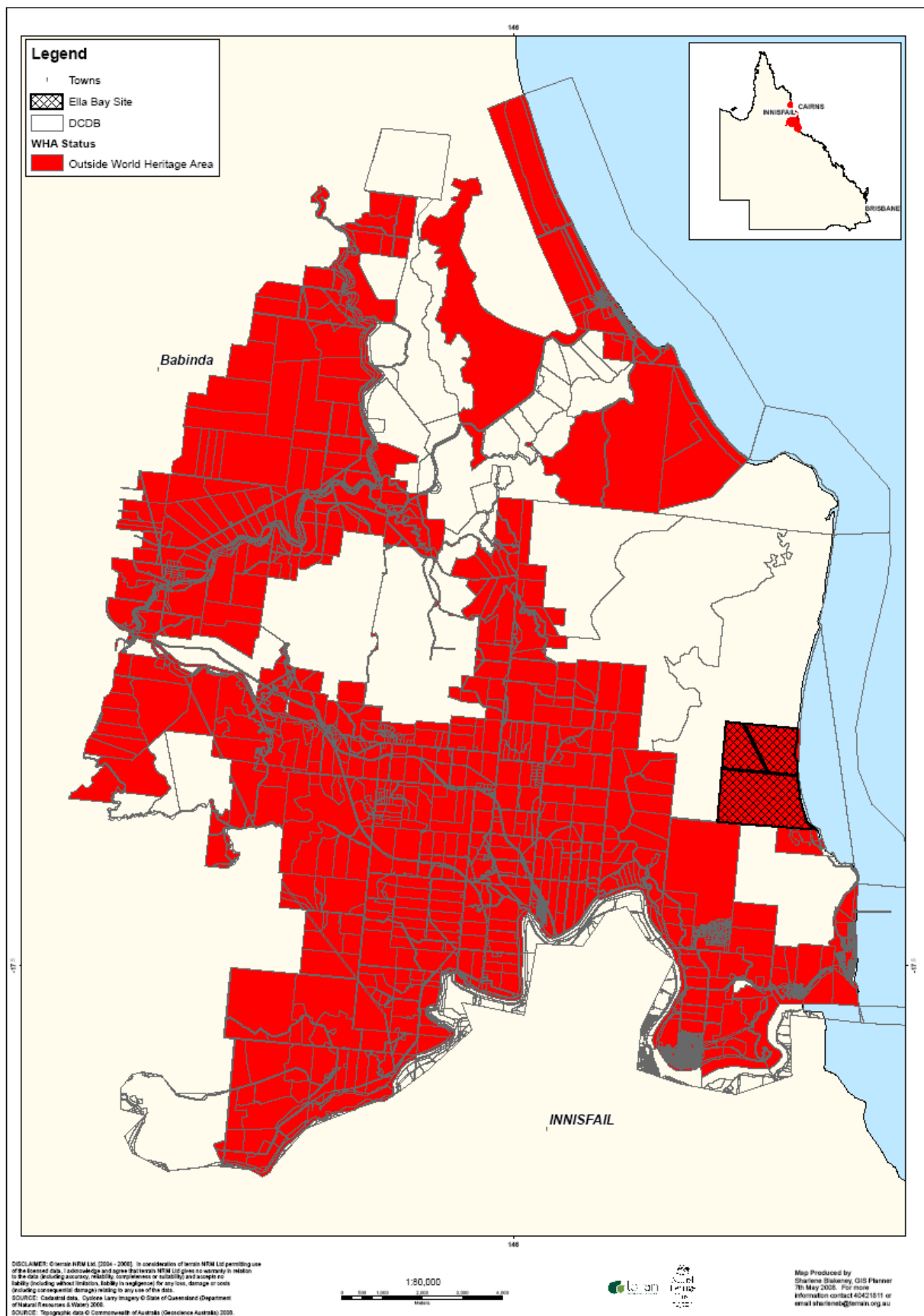
APPENDIX C – INDIVIDUAL CRITERIA MAPPED



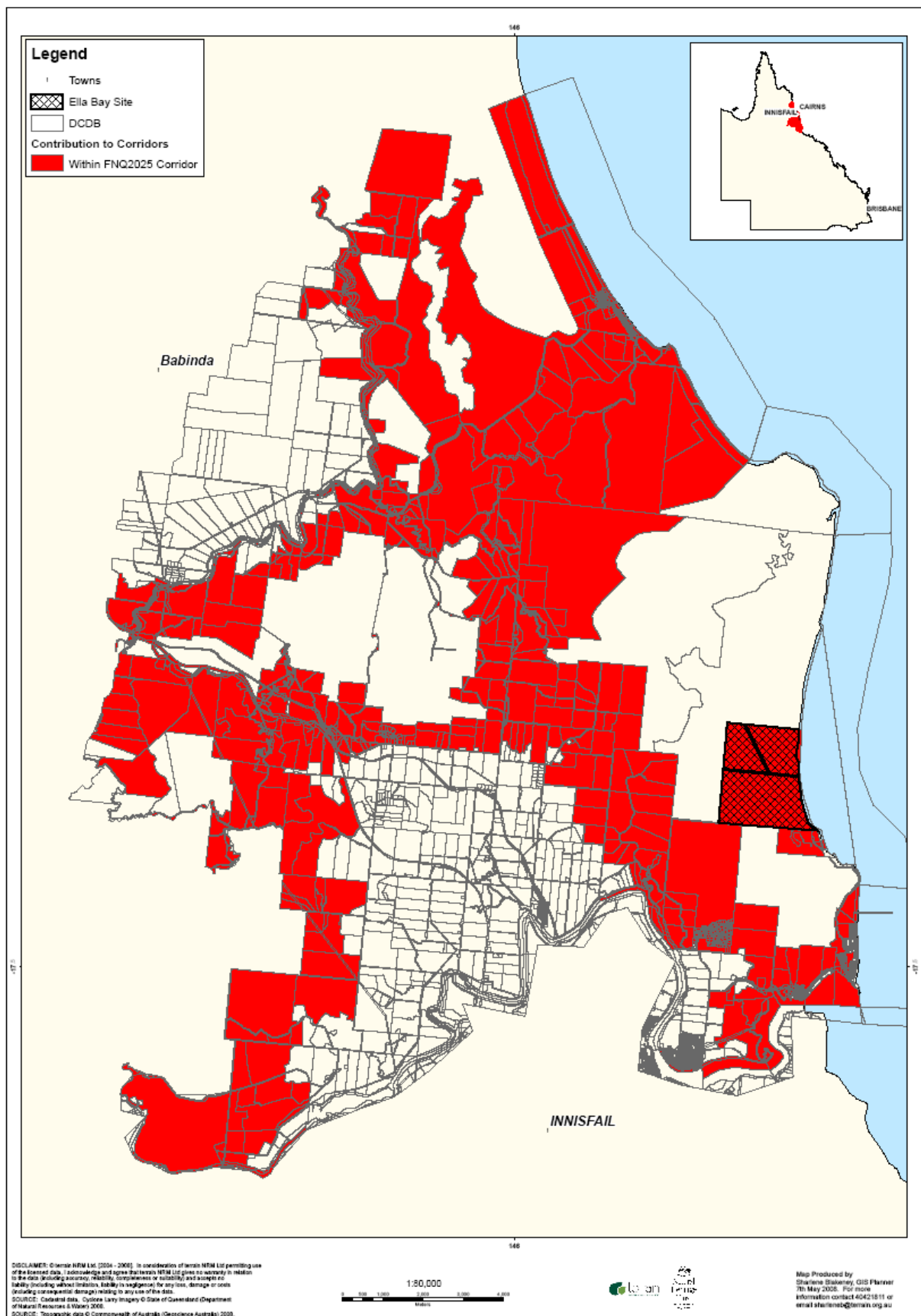
Regional Ecosystem Status (v5)



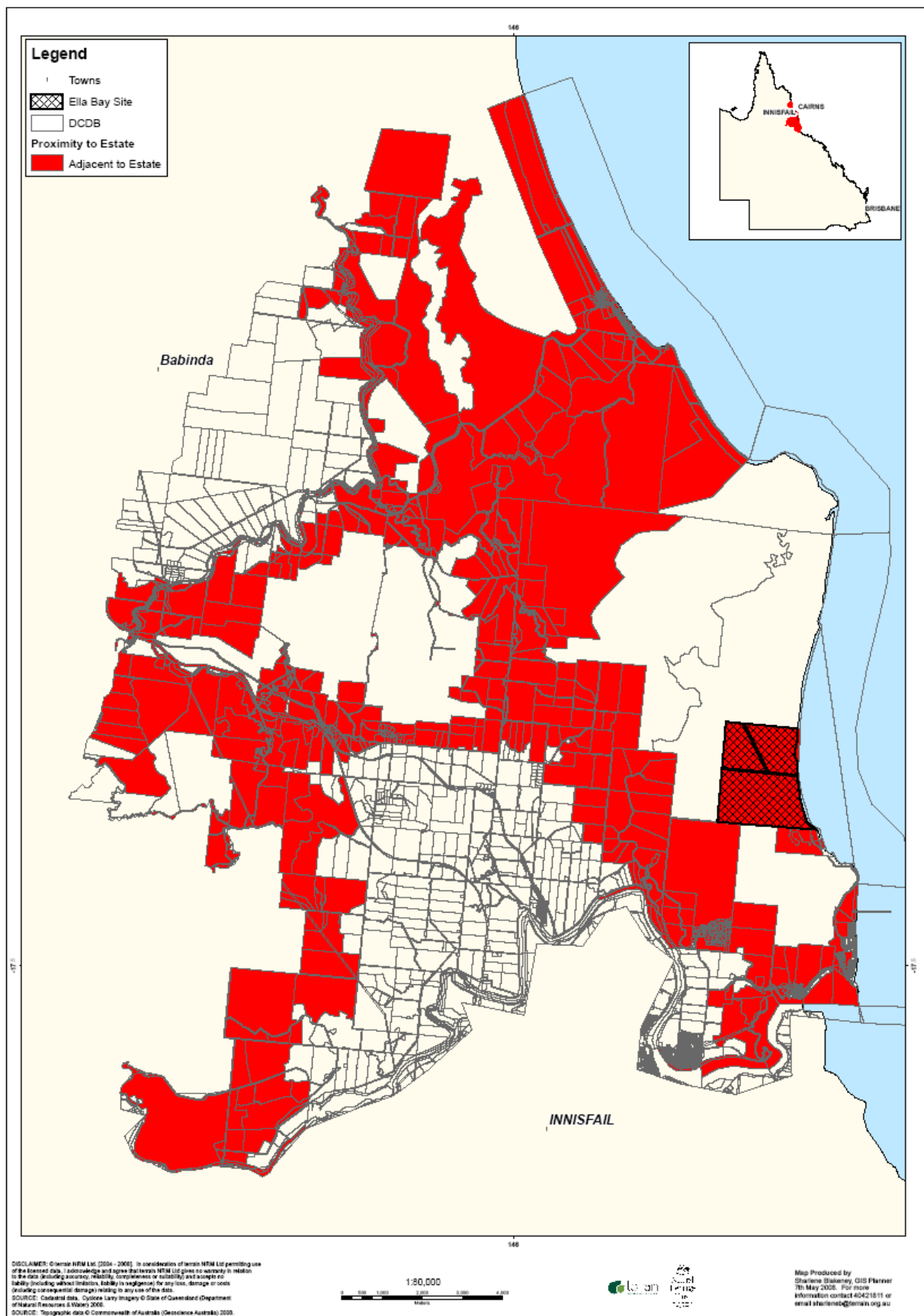
Tenure



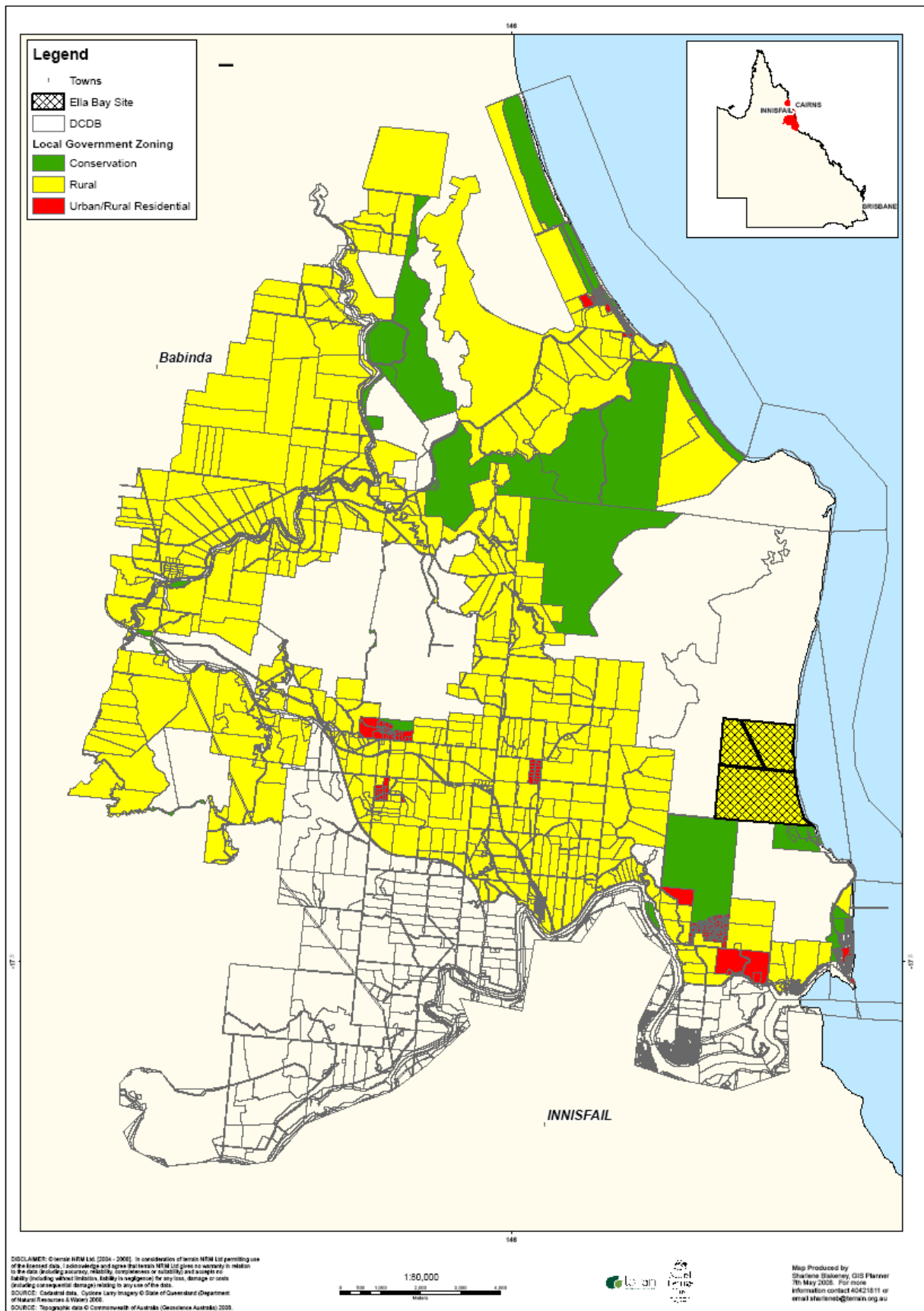
Sites outside of World Heritage Area



FNQ2025 corridors

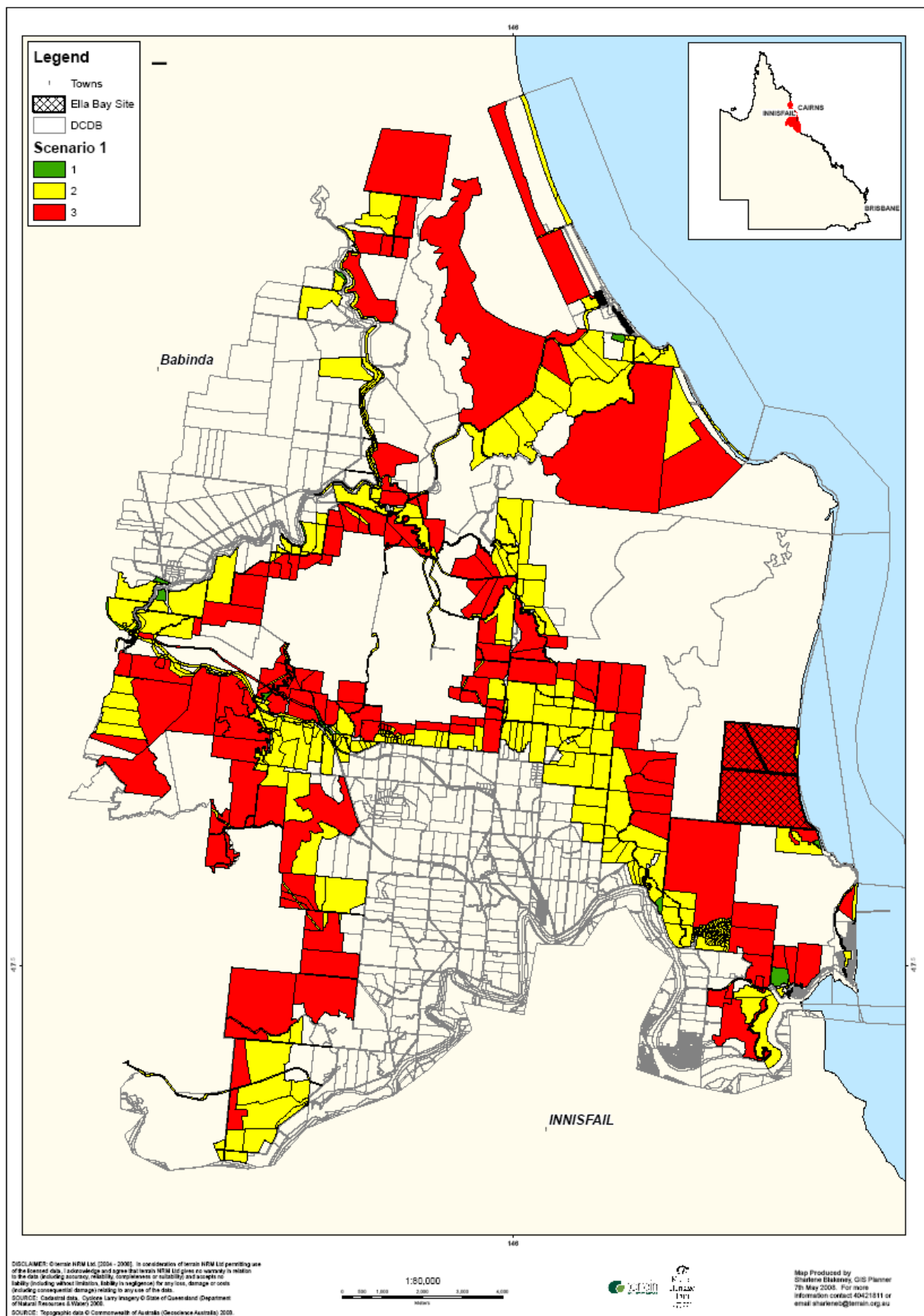


Proximity to the Protected Area Estate (sites within 100m)

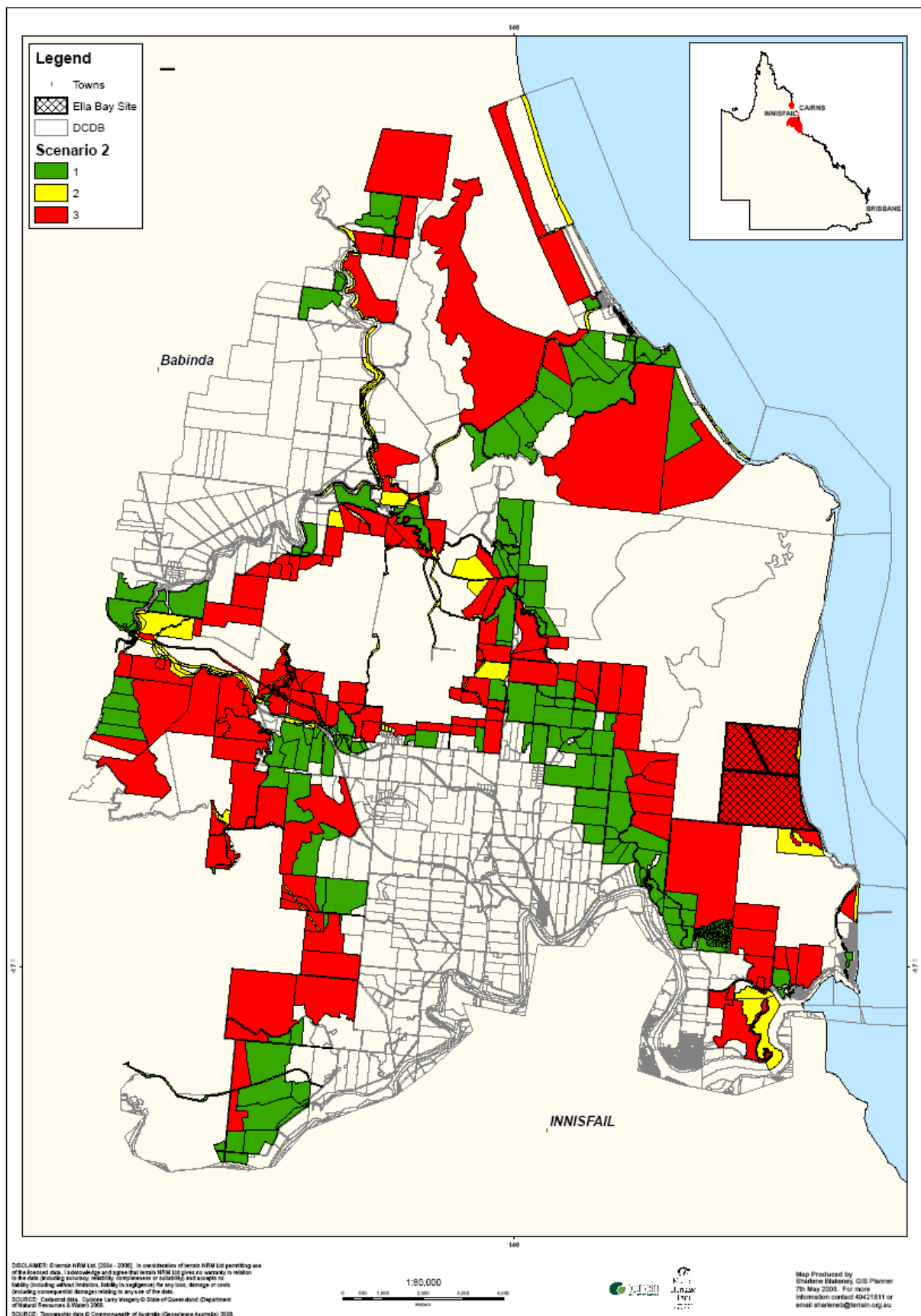


Local Government Zoning

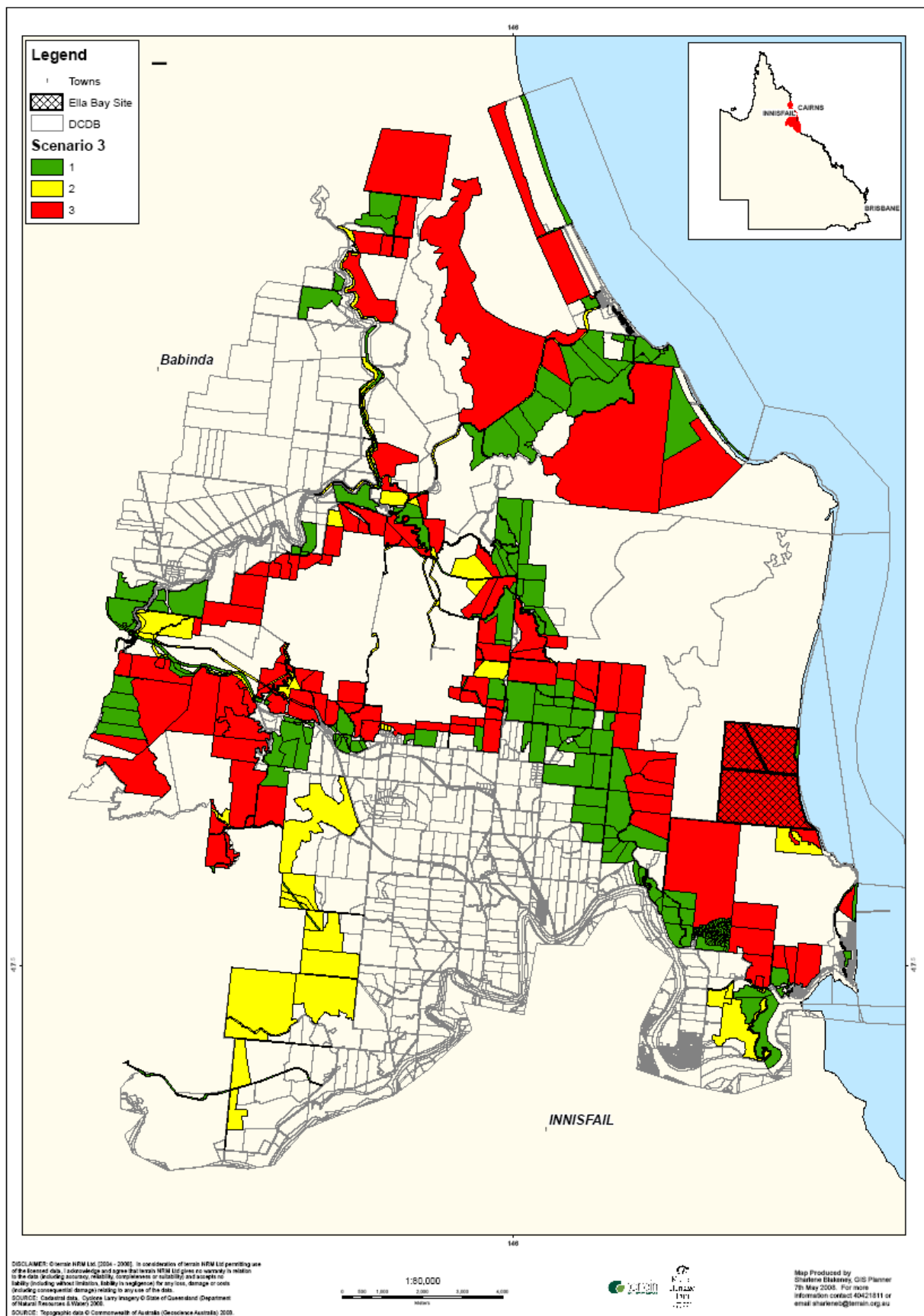
APPENDIX D – APPLIED SCENARIOS



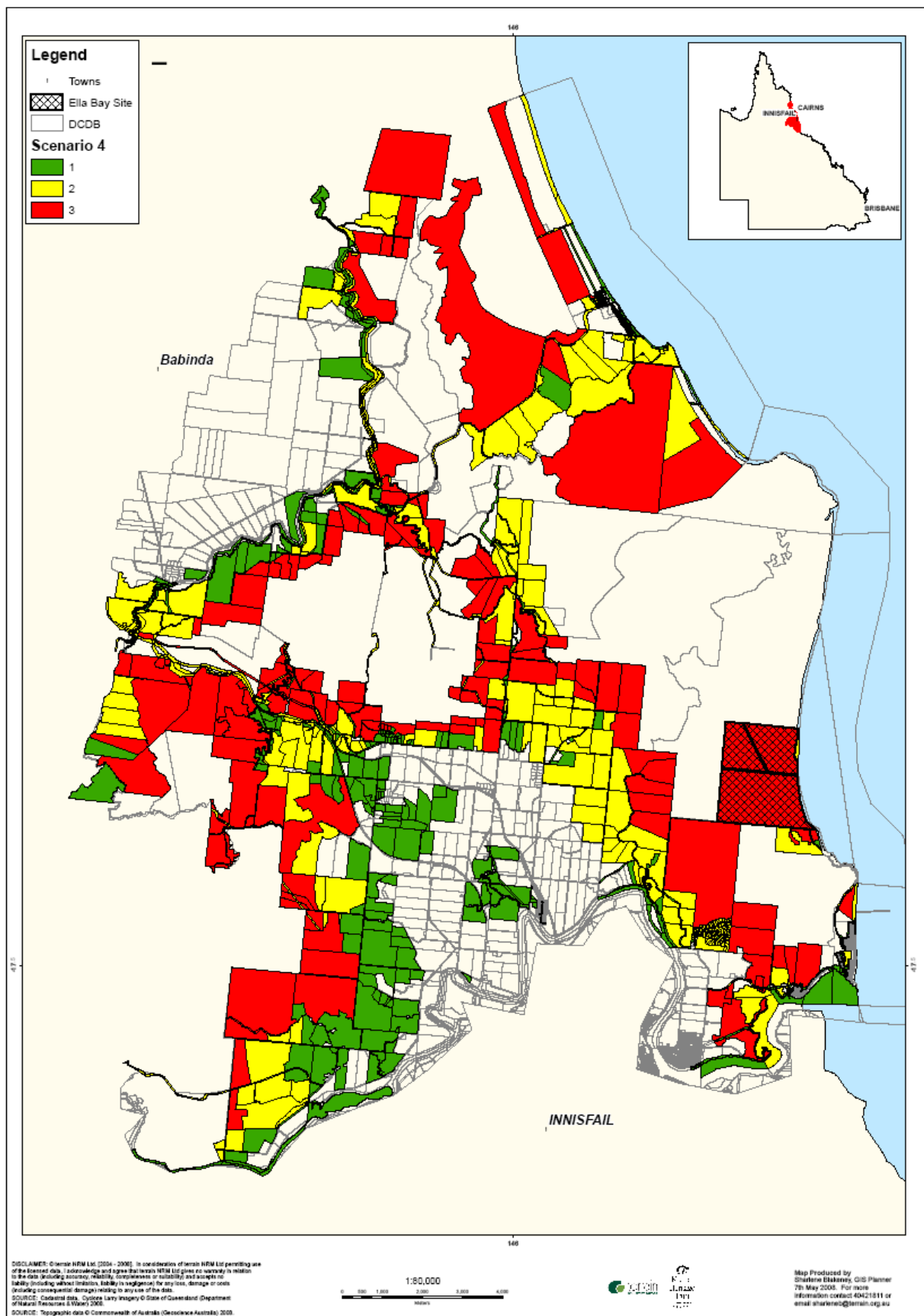
Scenario 1 – Proximity to Estate (x2), corridor (x2), Tenure



Scenario 2 – Proximity to estate (x2), corridor (x2), tenure, cassowary habitat, geology



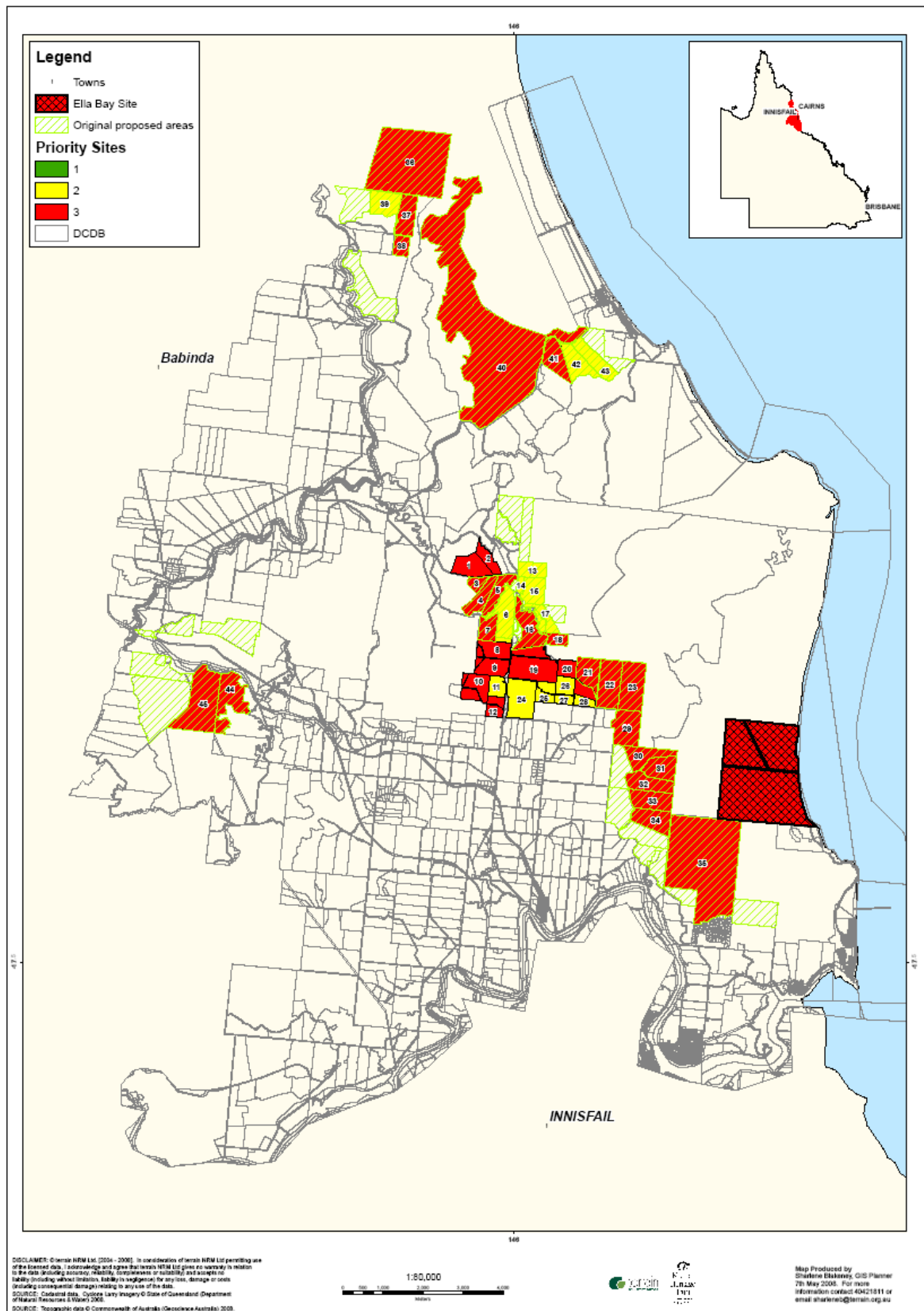
Scenario 3 – estate (x2), corridor (x2), tenure, cassowary habitat, zoning



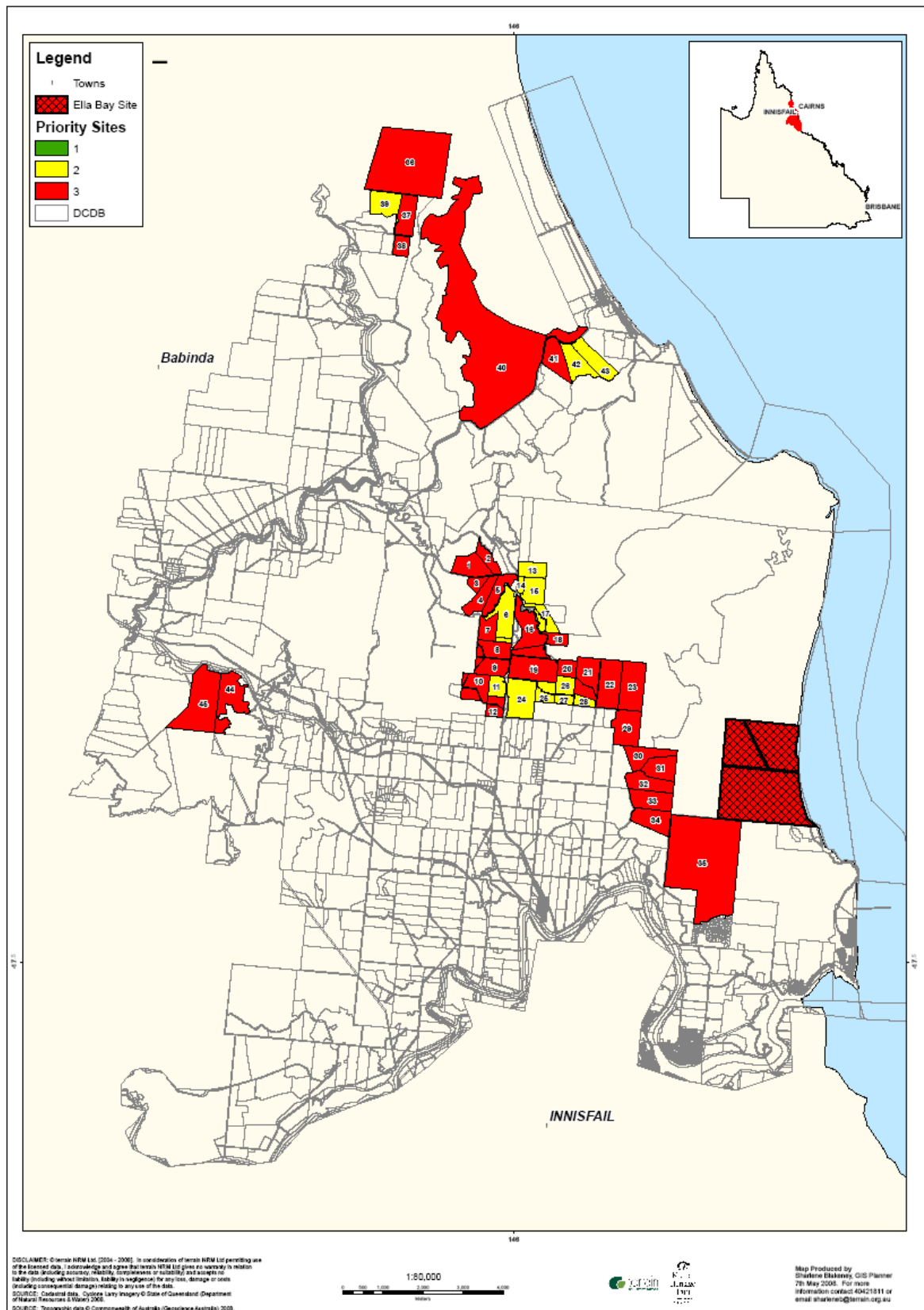
Scenario 4 – corridor (x5), estate (x4), tenure (x3) cassowary habitat (x2)

Scenario	Criteria	Weighting	Comment
1	proximity to protected area estate	2	Considered too simplistic and did not adequately address the overarching criteria of contribution to connectivity, level of protection and cassowary habitat suitability.
	contribution to corridors identified in FNQ2025	2	
	Tenure	1	
2	proximity to protected area estate	2	Same as scenario 1 with inclusion of cassowary habitat and geology. Scale of geology mapping too high to provide the detail required for this exercise. End results distorted because of this.
	contribution to corridors identified in FNQ2025	2	
	Tenure	1	
	Cassowary habitat	1	
	Geology	1	
3	proximity to protected area estate	2	Same as scenario 2 less geology and inclusion of zoning. Zoning data was incomplete and through discussions with other stakeholders, considered arbitrary under the Integrated Planning Act.
	contribution to corridors identified in FNQ2025	2	
	Tenure	1	
	Cassowary habitat	1	
	Zoning	1	
4	proximity to protected area estate	4	Final scenario considered to address all essential criteria and identified key sites in the key corridors for consideration in regional conservation planning process.
	contribution to corridors identified in FNQ2025	5	
	Tenure	3	
	Cassowary habitat	2	

APPENDIX E – PRIORITY SITES WITH ORIGINAL OVERLAID



APPENDIX F –PRIORITY SITES IN KEY CORRIDORS AND DATA TABLES



NO.	LOT PLAN	Ha	TENURE	RANK	PRESENCE OF RE	ESS. HAB.	BIOTROPICA	COMMENT	RECOMMENDATIONS
1	1RP736065	39.556	FH	1	non remnant	No	No	Cleared land - cattle.	Strengthen NS link between Eubenangee and state land to north
2	5RP747500	19.721	FH	1	non remnant	yes	no	Majority of site used for agricultural purposes.	NS link between Eubenangee and state land to north
3	6RP713994	12.265	FH	1	non remnant	No	NO	Cane/cattle property. Owners currently undertaking reveg. works in riparian zone of Dinner Ck	Reveg parts of these lots focusing on creek links to contribute to EW connectivity
4	7RP713994	30.988	FH	1	non remnant	No	NO	Cane/cattle property. Owners currently undertaking reveg. works in riparian zone of Dinner Ck	Reveg parts of these lots focusing on creek links to contribute to EW connectivity
5	2RP747498	30.682	FH	1	Non remnant. Some not of concern on creek line	No	NO	Cane/cattle property. Owners currently undertaking reveg. works in riparian zone of Dinner Ck	Reveg parts of these lots focusing on creek links to contribute to EW connectivity

NO.	LOT PLAN	Ha	TENURE	RANK	PRESENCE OF RE	ESS. HAB.	BIOTROPICA	COMMENT	RECOMMENDATIONS
6	3RP722054, 2RP740643	4.064 and 49.267 respectively (total=53.331)	FH	2	Of concern dominant in sthn section. Not of concern around creek line in nth	Yes	YES	Biotropica report notes site having significance in NS corridor - increase ranking to 1. Some pond apple eradication works complete on site.	Reveg part of this lot to create second major EW corridor
7	2RP722054	24.943	FH	1	Of concern dominant on eastern boundary . Small area of endangered dominant also	Yes	YES	some pond apple works proposed	Reveg part of this lot to create second major EW corridor
8	238SP106811	32.287	FH	1	non remnant - small section of concern dominant along western boundary	Yes	NO	Majority of site used for agricultural purposes.	covenant western section of concern dominant
9	48N157603	32.486	FH	1	non remnant - small section of concern dominant along western boundary	Yes	NO	Majority of site used for agricultural purposes.	covenant western section of concern dominant
10	59N157603	40.043	FH	1	southern 2 lots of land covered in endangered dominant	Yes	NO	Majority of site used for agricultural purposes.	put essential habitat under covenant or put in estate

NO.	LOT PLAN	Ha	TENURE	RANK	PRESENCE OF RE	ESS. HAB.	BIOTROPICA	COMMENT	RECOMMENDATIONS
11	2RP717465	19.895	FH	2	southern half contains of concern dominant and endangered dominant	Yes	Yes	Isolated remnant/regrowth and cultivation. Contributes to EW corridor	covenant essential habitat
12	83NR4378	19.793	LL	1	Northern section covered in of concern dominant/endangered dominant. Southern section under rehabilitation.	Yes	NO	Crown land	disregard
13	1RP738144	25.434	FH	2	Mixture of concern dominant and not of concern around northern and eastern boundaries.	Yes	NO	remnant vegetation to consolidate area of significant habitat	Covenant all or part of essential habitat. Some reveg. needed also
14	1RP724907	6.081	FH	2	mixed not of concern and rehabilitating habitat	Yes	NO	includes remnant vegetation that contributes to viability of proposed EW corridor	covenant all or part of essential habitat

NO.	LOT PLAN	Ha	TENURE	RANK	PRESENCE OF RE	ESS. HAB.	BIOTROPICA	COMMENT	RECOMMENDATIONS
15	2RP738144	33.426	FH	2	Of concern dominant through central section. Not of concern and of concern dominant along eastern boundary. Some rehabilitating habitat also.	Yes	NO	Significant remnant habitat associated with high densities of cassowary. Significant part of proposed EW corridor	Covenant all or part of essential habitat. Some reveg. needed also
16	237NR6392	50.871	FH	1	Of concern dominant along western bound fronting Dinner Ck Rd. Endangered dominant and not of concern along eastern boundary creek line.	Yes	YES	contributes to major EW corridor	Reveg. to link with essential habitat
17	282NR8035	24.579	FH	2	Not of concern on eastern bounds. Small section of endangered dominant in south. Some rehabilitating habitat on site.	Yes	YES	Significant remnant habitat associated with high densities of cassowary. Significant part of proposed EW corridor	Covenant all or part of essential habitat. Some reveg. needed also
18	64N157620	15.33	FH	1	100% site cover not of concern	Yes	Yes	Significant remnant habitat associated with high densities of cassowary.	covenant all or part of essential habitat

NO.	LOT PLAN	Ha	TENURE	RANK	PRESENCE OF RE	ESS. HAB.	BIOTROPICA	COMMENT	RECOMMENDATIONS
19	239SP106811	63.394	FH	1	Not of concern along eastern boundary, of concern dominant in southern section.	Yes	Yes	Mostly cultivated. Isolated vegetation patches. Adjacent to WHA	Possible acquisition
20	3RP720706	18.572	FH	1	Northern section all not of concern. Small section of rehabilitating habitat in central neck	Yes	Yes	Largely vegetated. Adjacent WHA.	covenant all or part of essential habitat
21	4RP720706, 3RP720706	38.455 and 15.145 respectively (total=53.6)	FH	1	not of concern on northern boundary, some rehabilitating habitat	Yes	NO	remnant vegetation to consolidate area of significant habitat	Covenant all or part of essential habitat. Some reveg. needed also
22	90NR16	62.315	FH	1	Not of concern in northern section. Some rehabilitating habitat	Yes	NO	remnant vegetation to consolidate area of significant habitat	Covenant all or part of essential habitat. Some reveg. needed also
23	91NR16	68.242	FH	1	Majority of site covered in not of concern. some rehabilitating habitat	Yes	NO	significant remnant habitat associated with high density of cassowaries	covenant all or part of essential habitat
24	42N157603	61.877	FH	2	Small cover of concern dominant in SE corner . Some plantation	Yes	YES	Isolated remnant/regrowth - major linkage between GS	Reveg. to link with essential habitat in 11 and 12

NO.	LOT PLAN	Ha	TENURE	RANK	PRESENCE OF RE	ESS. HAB.	BIOTROPICA	COMMENT	RECOMMENDATIONS
								range and Eubenangee	
25	3RP721435	22.53	FH	2	50% cover of concern dominant. All classified as essential habitat		YES	Isolated remnant regrowth and cultivation.	covenant all or part of essential habitat to create link to 24 and 19
26	1RP721435	19.684	FH	2	Of concern dominant in northern section (rehabilitating habitat)	Yes	Yes	Isolated remnant regrowth and cultivation.	covenant all or part of essential habitat
27	2RP721435	10.201	FH	2	of concern dominant on western boundary	Yes	Yes	Isolated remnant regrowth and cultivation.	covenant all or part of essential habitat
28	2RP720706	11.786	FH	2	some rehabilitating habitat	No	NO	Isolated remnant regrowth and cultivation.	
29	2RP736490	55.205	FH	1	majority covered in not of concern	Yes	NO	significant remnant habitat associated with high density of cassowaries	covenant all or part of essential habitat
30	3RP894611	40.056	FH	1	100% cover not of concern	Yes	NO	significant remnant habitat associated with high density of cassowaries	covenant all or part of essential habitat
31	2RP894611	40.034	FH	1	100% cover not of concern	Yes	NO	significant remnant habitat associated with	covenant all or part of essential habitat

NO.	LOT PLAN	Ha	TENURE	RANK	PRESENCE OF RE	ESS. HAB.	BIOTROPICA	COMMENT	RECOMMENDATIONS
								high density of cassowaries	
32	1RP894611	41.731	FH	1	100% cover not of concern	Yes	NO	significant remnant habitat associated with high density of cassowaries	covenant all or part of essential habitat
33	18SP110724	44.693	FH	1	100% cover not of concern	Yes	NO	significant remnant habitat associated with high density of cassowaries	covenant all or part of essential habitat
34	17SP110724	44.146	FH	1	100% cover not of concern	Yes	NO	significant remnant habitat associated with high density of cassowaries	covenant all or part of essential habitat
35	998RP894596	362.111	FH	1	100% cover not of concern (NE corner listed WHA)	Yes	Yes	major area of significant remnant habitat associated with high densities of cassowary adjoining Ella Bay development site	covenant all or part of essential habitat or purchase
36	8RP707559	278.38	FH	1	close to 100% cover not of concern	Yes	NO	Majority of site inside WHA boundary.	small section outside of WHA boundary should be covenanted

NO.	LOT PLAN	Ha	TENURE	RANK	PRESENCE OF RE	ESS. HAB.	BIOTROPICA	COMMENT	RECOMMENDATIONS
37	1RP743481	40.951	FH	1	close to 100% cover not of concern	Yes	no	significant remnant vegetation to strengthen habitat continuity in a vulnerable area and to consolidate area of significant habitat	Covenant all or part of site. Would strengthen narrow linkage in NS corridor
38	1NR5032	17.917	FH	1	small percentage cover - not of concern and of concern dominant	yes	no	remnant vegetation to consolidate area of significant habitat	Reveg. plus covenant all or part of site to strengthen narrow linkage in NS corridor
39	2RP743481	40.837	FH	2	close to 100% cover not of concern	Yes	no	remnant vegetation to consolidate area of significant habitat	Covenant all or part of site. Would strengthen narrow linkage in NS corridor
40	7SP143729	679.638	FH	1	Mostly cleared. Critical of concern dominant in SE corner of site	Yes	No	remnant in SE area is a critical link in the weakest area of the eastern NS corridor	Covenant remnant in SE area of site.
41	4RP895749	41.128	FH	1	sections of concern dominant and not of concern in southern 2/3 of site	Yes	no	critical link in weakest area of eastern NS corridor	Apply covenant over remnant veg and some reveg. needed

NO.	LOT PLAN	Ha	TENURE	RANK	PRESENCE OF RE	ESS. HAB.	BIOTROPICA	COMMENT	RECOMMENDATIONS
42	3RP895749	40.692	FH	2	sections of concern dominant and not of concern in southern 2/3 of site	yes	no	critical link in weakest area of eastern NS corridor	Apply covenant over remnant veg and some reveg. needed
43	2RP895749	40.279	FH	2	sections of concern dominant and not of concern in southern 2/3 of site	yes	no	critical link in weakest area of eastern NS corridor	Apply covenant over remnant veg and some reveg. needed
44	158SP108880	68.8	FH	1	NW section of site covered in not of concern vegetation. Small patches of concern dominant	Yes	Yes	Large remnant patches with grazing areas, adjacent WHA. Critical linkage.	covenant all or part of essential habitat or purchase
45	157NR748	116.82	FH	1	site entirely covered in not of concern. Power line easement transects the site	Yes	Yes	Large remnant patches with grazing areas, adjacent WHA. Critical linkage.	covenant all or part of essential habitat or purchase

Appendix 2. Revegetation Strategy for Ella Bay Offset Property – Ella Bay

Revegetation Strategy

for

Cassowary Corridor Offset Property

August 2010 Revision A



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Executive Summary

With the isolated sub-population of the endangered Southern Cassowary in the Graham-Seymour Ranges under serious threat of extinction, important headway will be achieved in the field of cassowary conservation through the transformation of the offset property from active agriculture use into a Cassowary Habitat Corridor. This Corridor will serve to connect the protected Eubenangee Swamp National Park and Wet Tropics World Heritage Area; an effort that both encourages and supports the movement of cassowaries between the East and West sub-populations.

Revegetation is required as the property has no remaining remnant vegetation communities, is covered by sugarcane and fallow, weeds infest grass pasture, and is inundated at times during the Wet Season. The revegetation must be attractive for the cassowary in order for the corridor to be a success.

The corridor will be specifically planted with local cassowary 'attractant' fruiting species, while focusing on maximum diversity. Soft engineering will assist in creating a more conducive growing environment for high quality, attractant habitat species through local elevation by a mounded berm. In the resulting depressions water will be available to the cassowaries.

Many other rain forest vertebrate and invertebrate species will also use this linkage due to the cassowary attractant species. Through planting the 'bait' species and attracting frugivores, natural dispersion will recruit further native tropical rainforest species seeds to the areas; it is anticipated that future expansion of the rehabilitated area will be by natural recruitment.

The on-ground property-based offset will:

- deliver real conservation outcomes;
- will be commensurate with the magnitude of the impacts of the development;
- will be within the same general area as the development;
- will be delivered in a timely manner and be long lasting;
- and will be enforceable, monitored and audited as required



1. Introduction

While the cassowary can utilise open eucalypt woodlands or cleared pasture to move between rainforest patches, it prefers the protection afforded by dense forest. Hence land clearing is recognised as a major threat to the species survival.

The primary purpose of this offset is to provide a key east west corridor for the cassowary between the Graham Seymour Range and Eubenangee Swamp. This management plan looks at establishing dense cassowary species specific habitat to provide that connectivity.

Habitat linkages can be defined as linear networks of habitat which join isolated patches of structurally similar habitats (commonly known as wildlife corridors in the sense that they provide an avenue for movement). Connectivity gaps are generally the narrowest section of a linkage, so the impact of edge effects such as weed invasion, mortality from predation or road-kill, and the risk of competitive exclusion and antagonistic encounters are more pronounced. Generally, the management of these two areas require different approaches. Habitat linkages can be generally managed using either passive or active restoration, whilst connectivity gaps generally require possible land acquisition or protection incentives, ecological restoration, hard and soft engineering, in addition to road user and community education programs.

Biotropica 2008 Wongaling Creek Habitat Linkages

When identifying the significant impacts on the cassowary, DEWHA released a map identifying Potential Cassowary Habitat in the Wet Tropics. Cassowary corridors were also identified; the call out box has zoomed in on the area of Ella Bay to Eubenangee Swamp National Park.

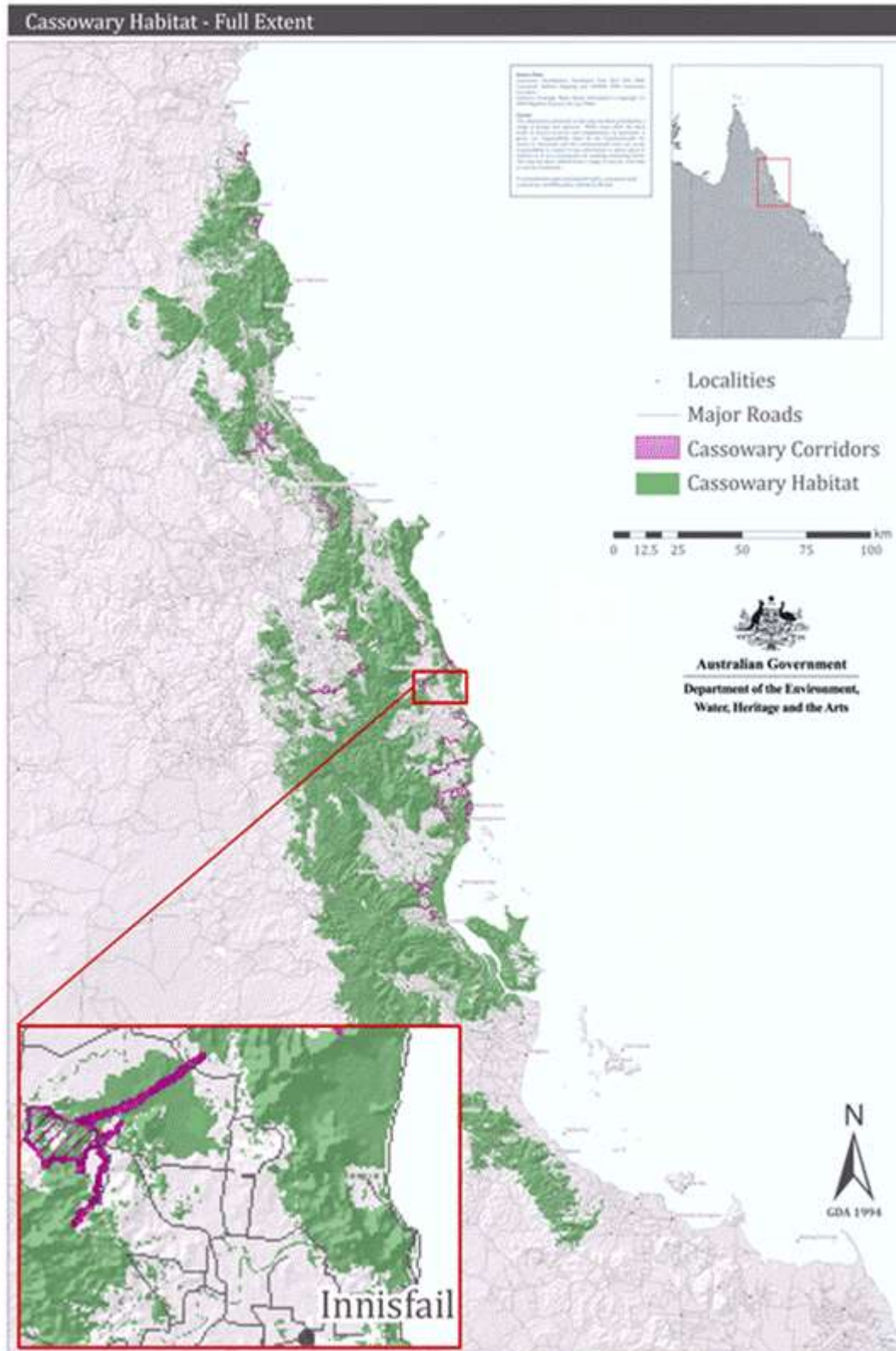
The cassowaries of the Graham Seymour Range are an isolated sub group of approximately 70 birds which based on the Population Viability Analysis (Moore 2007) will be potentially extinct from existing anthropogenic causes in 60 years. This limited time frame to potential extinction of the cassowaries in the area requires extreme measures to establish a cassowary friendly linkage suitable for genetic and species migration.

This area was previously described as of high activity or 'hot spot' for cassowaries (Chrome & Moore 1990) and the east-west corridor between the Wet Tropics World Heritage Area's Graham Seymour Ranges (east) and the Eubenangee Swamp National Park (west) is recognised as a critical element in cassowary conservation in order to improve the mobility of cassowaries between the sub-populations.

Significant clearing for agriculture has occurred between the two protected areas, resulting in the necessity to identify suitable 'links' within the corridor area which can be established. The proponent commissioned Terrain NRM to review the links and workshop the solutions with key regulatory stakeholders including DEWHA (DSEWPaC), Queensland EPA (DERM), Wet Tropics Management Authority, Queensland Parks and Wildlife Service and Cairns City Council to be the most suitable for cassowary conservation. (Terrain 2008). (Refer to Figure 1)

The links have been reported in Appendix 1 and the East West Corridor of Sites 2, 3 & 4 have been purchased. These sites are contiguous on a number of sides with either Eubenangee Swamp National Park or WTWHA.

QPWS has had success with revegetating part of a corridor along the Alice River which is close to the purchased land. However the remaining linkage of about 300m is a narrow riparian remnant between 5 to 30m wide (refer to Figure 2). Cassowaries have been reported as active in the Alice River revegetation site (Biotropica 2005 from QPWS reporting) and this further linkage focussing on cassowary fruiting habitat will strengthen the potential population viability.



In an east-west direction, on the southern boundary of the property along Dinner Creek; patches of regrowth vegetation form a second but discontinuous linkage with cane farms interrupting its connectivity. (Refer to Figure 2)

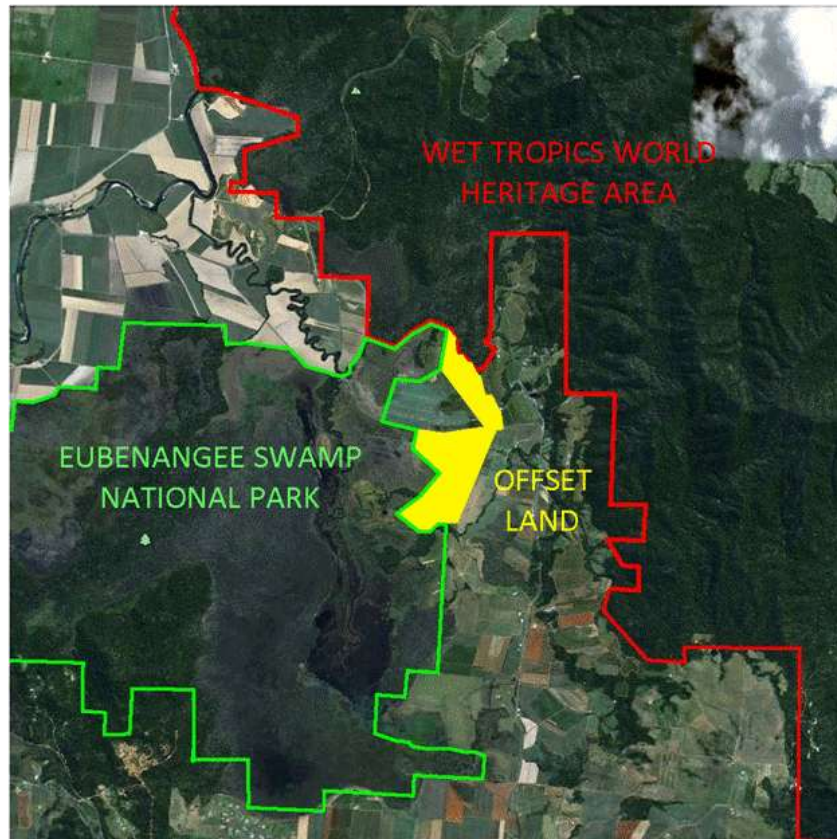


Figure 7 Offset land showing the relationship between Eubenangee Swamp National Park and WTWHA



Figure 2 Areas of narrow riparian vegetation; pink - Alice River, purple - Dinner Creek.

2. Site Description

The offset property is located less than 7 km north-west of Ella Bay, on the outskirts of Eubenangee Swamp, with a total land area of 63.6ha (see *Figure 3*). The property contributes towards strengthening the existing minimally vegetated, narrow link between the Graham-Seymour Ranges to the North and the Eubenangee Swamp National Park to the South-West (see *Figure 4*).

The offset property abuts both of the existing linkages, joining the WHA in the north and the partial east-west linkage to the south. The corridor it will support the linkages by increasing the vegetation to a wider, higher quality coverage of a continuous 'habitat corridor'.

The property is ideally suited to habitat connectivity in that the combined properties will be able to provide a linear shaped linkage.

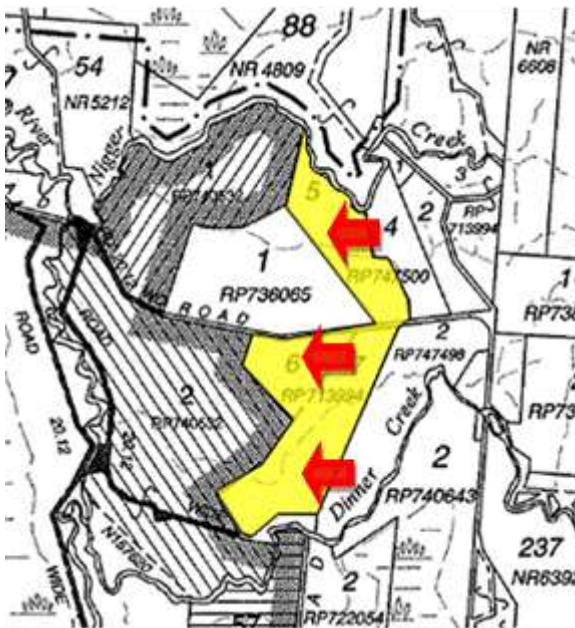


Figure 3 Offset Property locality shown in yellow



Figure 4 Offset Property (in yellow) showing shared boundaries with Eubenangee Swamp National Park (red) in the Southwest, and Wet Tropics World Heritage Area (purple) to the North.

The offset property was purchased as an operating sugar cane farm with standing sugar cane, and ploughed fallow pasture comprising grasses and weeds. The land is often very wet and prone to Wet Season flooding of up to 500mm depth. Typical of these swampy lands the property has been drained by deep channels to reduce the unsuitable conditions.

There are no remnant vegetation communities remaining on the property, however in surrounding areas there are three identified Regional Ecosystems (RE); Eubenangee Swamp is cited as a local, state and Australian priority wetland conservation area with regional endangered/of concern ecosystem types (RE 7.3.1 and RE 7.3.5).

- 7.3.1 - *Hemarthria uncinata* and/or *Ischaemum australe* +/- *Sorghum* spp. grassland, and/or ephemeral sedgeland, on seasonally inundated alluvial plains
- 7.3.5 - *Melaleuca quinquenervia* and/or *Melaleuca cajuputi* closed-forest to shrubland on poorly drained alluvial plains
- 7.3.3 – Mesophyll vine forest with *Archontophoenix alexandrae* (feather palm)
- 7.3.10 - 'Simple-complex mesophyll to notophyll vine forest, on moderately to poorly-drained alluvial plains, of moderate fertility

After clearing for agricultural purposes there are very few remaining trees, and those existing along the riparian areas are regrowth after logging. At present the land has no value as Cassowary habitat.

This region represents the optimum for the development of rainforest in Australia due to the favourable conditions of fertility, rainfall, topography and temperature. However this site on the outer extremities of Eubenangee Swamp is prone to seasonal inundation.

3. Planning Phase

The revegetation strategy focuses on establishing a continuous vegetated corridor connecting the National Park and World Heritage Area (refer to Figure 4). Additionally it will rehabilitate two riparian areas, including sections of Nigger Creek running along the Northern boundary, Dinner Creek along the Southern boundary (refer to Figure 5), and two smaller watercourses (drains) that traverse the area.

A linear shaped linkage without connectivity gaps, whilst having a greater edge to area ratio, provides a direct path and line-of-sight for most terrestrial fauna.

(Biotropica 2008)



Figure 5 Indicative corridor area to be revegetated (within red outline)

The minimum desirable width for establishing cassowary specific habitat linkage based on the successful QPWS revegetation at the nearby Alice River is 50m and also Biotropica

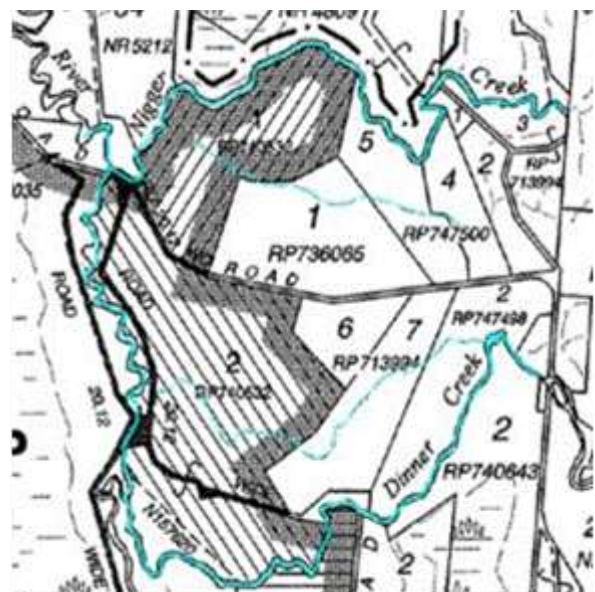


Figure 6 Waterways - Creeks and Drains



(2008). While desirably the linkage should be as linear as possible the changes of direction in Figure 5 are due to intersection with water courses.

Improving Habitat Value

To achieve cassowary movement linking the NP and WHA will require dense forested corridors creating a vegetation protected path and food source. Re-establishment of the corridor will potentially increase the population and diversify the gene pool of the isolated Graham Seymour sub-population.

Fauna species diversity in rainforest patches connected by corridors tends to be greater than in disconnected patches. Corridors may also act as conduits for genetic exchange among small populations, helping to maintain their viability and adaptability. Corridors increase the movement of adults among patches and dispersal of young (Goosem S, Tucker N 1995).

To increase the value of the site for cassowaries, the plant species selection will focus on establishing high quality cassowary attractant habitat of rainforest species; however a limiting factor is that the site is regularly inundated in the Wet Season especially on the southern section, reducing suitable species selection for revegetation. Additionally after generations of farming the natural surface has been flattened for ease of farming and drainage.

To create a more conducive growing environment for high quality, attractant habitat species, the habitat corridor where it is low lying will be raised to form an elevated mounded berm, approximately 30 to 50m in width and up to 0.5m high, by pushing up earth up from either side, as illustrated below (*Diagram 1*).

The existing drainage channels will cause a barrier to cassowary movement. The channels are deep with near vertical banks. Both battering the banks and the placement of large diameter pipe culverts with emplaced fill for revegetation with grasses will aid cassowary movement.

Species Selection

The sole purpose of this linkage is to entice cassowaries to re-establish an east west corridor; the focus must be on attracting the cassowaries by using high quality cassowary habitat. This revegetation will focus on maximum diversity planting which attempts to recreate as much as possible the adjoining Mesophyll vine forest which would have been the dominant pre-clearing habitat on the non waterlogged raised areas. The species selection will focus on mature phase species to form the bulk of these plantings with reduced numbers of non cassowary attractant pioneer species, ie pioneer phase species are not generally cassowary attractant species.

The majority of the revegetation selection will contain endemic rainforest species providing fruit that is consumed by cassowaries and other frugivores, generating an attractant 'bait' crop. An additional consideration is to include a high percentage of species that have proven to be more resilient in high wind events. This is intended to protect the smaller, more vulnerable species to a degree that will reduce fruit drop and enable them to continue fruiting after a natural hazard.

Typically maximum diversity planting is characterised by a poor success rate, with high cost weed control however the limited timeframe to potential extinction of the cassowaries of the Graham Seymour range requires that a mature habitat be developed with urgency.

Along the edges of the replanting area, a strip of denser species will be planted to ameliorate the 'edge effect'. It has been suggested that the disadvantages of narrow corridors with large edge to area ratios can sometimes be reduced if species with dense canopies that persist to ground level are used to 'seal' the boundary (Tucker and Murphy 1997 in Pullar & Lamb 2008). Species suitable for this edge include sun tolerant small trees, shrubs and herbaceous plants. The spacing density for these edge plantings will be similar to natural rainforest in order to rapidly seal edges to reduce weed invasion and wind as well as light penetration.



Approximately 30 species of cassowary attractant trees will be used in the planting mix to maximise an all year fruiting cycle and provide diversity and promote resilience to environmental threats. The goal of maximum diversity planting is to establish a successful revegetated rainforest area that endures and will be able to cope with the varied Wet Tropic environmental factors.

Revegetation Layout

The fauna corridor will be designed to have vegetation on either side of a cassowary movement pathway running its full length. The species will be planted in zones of differing height trees with an edge zone to seal vegetation.

To simplify planting, the species selection has been divided into three (3) zones based on height and suitability. The preliminary species list is in Appendix A.

1. the edge species <15m tall,
2. the <25m trees of cassowary fruiting species; and
3. the >25m mix of wind tolerant species

The Zone 1 edge species will be placed on the outer edge of both sides of the revegetation, except along existing riparian areas where it will only be placed on the outside. Relatively small sized shrubby vegetation (<15m tall) will be used with a planting density of 3000 plants per ha. These plants will have a spacing of 1.8m and due to the high density of planting as well as differences in height, width and growth rate the rows will form a sealing wind barrier.

The Zone 2 species (<25m tall) lowland rainforest species will be used in the adjoining internal vegetation zone. The purpose of this height differential is to form an increase in vegetation height that will also help reduce the impact of cyclonic winds. These trees are not necessarily cyclone tolerant but will form the major source of cassowary fruit. A planting density of 2000 plants per hectare (2.0m spacing) will be used.

The Zone 3 species (>25m tall) lowland rainforest species will be the inner most trees of the revegetation. The selection has also been based on selecting tree species that performed well during the devastation of Cyclone Larry. The planting density used will be 1500 plants per hectare (2.2m spacing between rows).

The areas surrounding the habitat corridor will undergo weed control and follow up planting of endemic grass and sedge species suited to the wet conditions typically species such as *Sacciolepis indica*, *Isolepis inundata* and *Fimbristylis depauperata*. In the transitional zone species such as *Melaleuca quinquenervia* and *Barringtonia racemosa* will be suitable, whereas more tolerant species such as *Nauclea orientalis* may be planted in both environs. This area will be planted with open spacing of 100 to 300 species per hectare, similar to the existing Eubenangee habitat.

4. Project Implementation

The plant stock for revegetation will be sourced from seeds from the local area. Ideally seed stock would be sourced from the property however in this case there is no remnant vegetation.

Teams will be required to carry out both planting and maintenance of the revegetation areas. Duties will include, site preparation eg. weed control; separating species; randomising (mixing) species within each Zone; marking out; planting the tube stock; irrigation if required; and follow up weed maintenance.

Site Preparation

The major aspects of site preparation will be scraping of the top soil for weed control and mounding for the raised berm. Weed control will be important prior to any planting as the property has fallow ground vegetated by grasses, weeds, and an abandoned cane crop. All



areas that will either be mounded or scraped will be sprayed for weed control, using an approved herbicide such as aquatic friendly Glyphosate. Care will be required around waterways; and to retain any native regeneration occurring in the paddock. After spraying the paddock, dead vegetation will be left to mulch and will form part of the organic nutrients of the berm. A follow up spraying will be required.

Where required the site will then be mounded by dozer push to build up the revegetation berm. Borrow pit areas will be left fallow until stabilisation of moisture allow selection of grasses and sedges.

The process will be:

- Fallow paddocks are to be sprayed using glyphosate taking care to retain any native regeneration occurring in the paddock.
- After successive sprayings the paddock is scraped/disc'd by dozer/tractor to remove weeds, cultivate the soil and

Planting and Maintenance

Plants will be collected as tube stock from the nursery and will be based on species characteristics and planted in pre-marked locations. Reference to the layout plan will provide the necessary row spacing, density, etc.

Regular weed control maintenance will be required for the initial years and until canopy closure regulates weed growth. The weed control will be performed by spraying with aquatic friendly glyphosate.

The process will be:

- Tube stock will be mixed by height zone and planted by hand using contract planters at 2.5m spacing's between the rows and 1.8m, 2.0m or 2.2m spacing's between the plants
- The plantings have been designed with a wider spacing between the rows to allow access with a quad bike for spraying.
- The planted areas will have to be sprayed periodically for weeds till full canopy closure has been achieved. It is anticipated that it will take two years for this to be achieved.
- A typical maintenance regime would typically include 6 maintenance tends in the 1st year post planting, and 3 tends in the 2nd year.

Proposed Work Plan

It is proposed to complete the work over 4 years to allow for greater flexibility and so that tree and seed supply requirements are manageable. This also means that there will be regular maintenance workforce available in case of follow up spraying requirement or tree replacement. It is envisaged that only 20 hectares of cassowary linkage habitat will be planted with the remaining area 20 hectares of native grasses and open swampland trees at low density and the remaining 20 ha of native grasses only.

	Time	Activity
Year 1	January –November	<ul style="list-style-type: none"> • Negotiation of forward orders with Nurseries to supply seedlings and/or • Establishment of Ella Bay nursery • Collection of seed and plant material for Nursery
	August – October	<ul style="list-style-type: none"> • Control of weeds and preparation of new planting areas
Year 2	November to March	<ul style="list-style-type: none"> • Planting 15ha of cassowary linkage



	March to March Yr 3 August-October	habitat. <ul style="list-style-type: none"> • Maintenance of planted areas (6 tends) • Preparation of new planting areas for next year's plantings
Year 3	November to March March to March Yr 4 August-October	<ul style="list-style-type: none"> • Planting 5 ha of edge sealing plants and palms along edge of cassowary linkage habitat. (delayed to enable increased canopy cover from established plantings) • Planting 20ha of low density planting of non linkage habitat – swamp grasses, sedges • Maintenance of new planting areas (6 tends) • Maintenance of previous years plantings (3 tends) • Preparation of new planting areas for next year's plantings
Year 4	November to March March to March Yr 5	<ul style="list-style-type: none"> • Planting 20ha of of non linkage habitat – native grasses • Maintenance of new planting areas (6 tends) • Maintenance of previous years plantings (3 tends)
Year 5	November to March	<ul style="list-style-type: none"> • Maintenance of previous years plantings (3 tends)

Future Vegetation

Once the revegetation is complete and maturing it is expected that nature will assist in widening and extending the corridors. The interdependence of fruit eating animals and dispersal of seeds is of profound importance in many habitats. This interdependence is particularly well developed in the tropics, where a majority of trees and shrubs depend on animals for their seed dispersal (Janzen 1975).

By planting a 'bait' crop and attracting frugivores, enhancement through natural dispersal of native tropical rainforest species seeds will provide fill-in vegetation. This should follow along similar lines as the rehabilitated plot on neighbouring Eubenangee Swamp National Park which saw significant natural recruitment occurring after ten (10) years (see Appendix B).

Cassowary Monitoring

The goal of attracting cassowaries to a corridor linking the NP and WHA is a long term experiment in the recovery of the endangered Southern Cassowary. Results from revegetation at Ella Bay has shown that many species are fruiting within the first 6 to 12 months of planting. Species that fruited within 12 months and were recorded attracting cassowaries were; (refer to Figure 4 & 5).

Red leafed fig (*Ficus congesta*)
 Fart bush (*Breynia cernua*)
 Cheesefruit (*Morinda citrifolia*)
 Bandicoot berry (*Leea indica*)

Other Species known to fruit early are:

Native ginger (*Alpinia caerulea*)
 Native banana (*Musa banksii*)

Palm lilly (*Cordyline cannifolia*)
 Giant palm lilly (*Cordyline manners-suttoniae*)
 Bandicoot berry (*Leea indica*)
 Red leafed fig (*Ficus congesta*)
 Cheese fruit (*Morinda citrifolia*)
 Scrub breadfruit (*Pandanus monticola*)
 Blue flax lilly (*Dianella sp.*)
 Pothos (*Pothos longipes*)
 Glory Vine (*Faradaya splendida*)

The corridor may not be used until the trees have matured sufficiently to be suitably attractive and a food source for the cassowary. Monitoring of cassowary movement will be therefore initially be through camera monitoring, scat, footprint and anecdotal sightings. Longer term monitoring utilising radio GPS tracking will be required once the initial corridor movement has been initiated to determine the usage pattern and ultimately the genetic translocation.



Figure 4 Early fruiting revegetation at Ella Bay after 6 months Fart bush (*Breynia cernua*)



Figure 5 Male Cassowary and chick feeding on early fruiting revegetation Ella Bay after 6months.



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Appendix A – Potential Selection of Cassowary ‘Attractant’ Species

Edge Zone	
Species Name	Common Name/s
<i>Aglaia sapindina</i>	Boodyarra
<i>Alpinia caerulea</i>	Native ginger
<i>Alyxia spicata</i>	Chain Fruit
<i>Ardisia brevipedata</i>	Rambling spearflower
<i>Calamus australis</i>	Hairy Mary Lawyer Cane
<i>Calamus caryotoides</i>	Fishtail Lawyer Cane
<i>Calamus moti</i>	Yellow Lawyer Cane
<i>Calamus radicalis</i>	Vicious Hairy Mary
<i>Cordyline cannifolia</i>	Palm Lily
<i>Cordyline manners-suttoniae</i>	Giant Palm Lily
<i>Cycas media</i>	QLD Cycad
<i>Davidsonia pruriens</i>	Davidson's Plum
<i>Diplocyclos palmatus</i>	Striped cucumber
<i>Diploglottis smithii</i>	Smith's Tamarind
<i>Fagraea cabbagei</i>	Porcelain fruit
<i>Faradraya splendida</i>	Potato Vine
<i>Ficus congesta</i>	Fig, Red Leaved Fig
<i>Ficus copiosa</i>	plentiful fig
<i>Ficus hispida</i>	Hairy Fig
<i>Ficus leptoclada</i>	Atherton Fig
<i>Gmelina fasciculiflora</i>	Northern White Beech
<i>Lepidozamia hopeii</i>	Zamia Palm
<i>Linospadix minor</i>	Walking Stick Palm
<i>Melodinus australis</i>	Bell bird vine
<i>Melodorum leichardtii</i>	Acid Drop Vine
<i>Morinda citrifolia</i>	Great Morinda, Rotten cheese fruit Tree
<i>Mischocarpus exangulatus</i>	Red Tokoonja
<i>Musa banksii</i>	Native Banana
<i>Neimeyera prunifera</i>	Plum Boxwood
<i>Neolitsea dealbata</i>	White Bollywood
<i>Pandanus monticola</i>	Rainforest Pandan
<i>Passiflora aurantia</i>	Passionflower
<i>Phaleria clerodendron</i>	Scented Daphne
<i>Phaleria octandra</i>	Dwarf Phaleria
<i>Polyscias australiana</i>	Ivory Basswood
<i>Pouteria chartacea</i>	Dugulla
<i>Rhodamnia sessiliflora</i>	Iron malletwood
<i>Rhysotoechia robertsonii</i>	Roberts tuckeroo
<i>Scaevola taccada</i>	Beach Cabbage
<i>Smilax australis</i>	Austral Sarsparilla
<i>Ximenia americana</i>	Yellow Plum

<25m Zone	
Species Name	Common Name/s
<i>Acronychia acidula</i>	Lemon Aspen

<i>Acronychia acronychioides</i>	White Aspen
<i>Acronychia vestita</i>	Fuzzy Lemon Aspen
<i>Alstonia meulleriana</i>	Hard Milkwood
<i>Antidesma erostre</i>	Currantwood
<i>Atractocarpus fitzalanii</i>	Native Gardenia
<i>Barringtonia racemosa</i>	Cassowary Pine
<i>Chionanthus ramiflorus</i>	Native Olive
<i>Citronella smythii</i>	Northern Silky Beech
<i>Cryptocarya cunninghamii</i>	Cunningham Laurel
<i>Cryptocarya mackinnoniana</i>	Rusty Laurel, Mackinnons laurel
<i>Diploglottis bracteata</i>	Boonjee Tamarind
<i>Eleaocarpus michaelii (culminicola)</i>	Michael's Quandong
<i>Endiandra compressa</i>	Queensland Greenheart
<i>Endiandra impressicosta</i>	Steelbutt
<i>Gomphandra australiana</i>	Buff Beech
<i>Helicia nortoniana</i>	Norton's Oak
<i>Hydriastele wendlandiana</i>	Cat-o-nine-tails
<i>Irvingbaileya australis</i>	Cloud Fruit
<i>Licuala ramsayi</i>	Licuala
<i>Myristica insipida</i>	Native Nutmeg
<i>Siphonodon membranaceum</i>	Ivorywood
<i>Syzygium cormiflorum</i>	Bumpy Satinash
<i>Xanthophyllum octandrum</i>	Yellow Boxwood

>25m Zone	
<i>Acmena divaricata</i>	Cassowary Satinash
<i>Acmena hemilampra</i> subsp. <i>hemilampra</i>	Broad leaf Lilly Pilly
<i>Archontophoenix alexandrae</i>	Alexander Palm
<i>Calophyllum sil</i>	Blush Touriga
<i>Cananga odorata</i>	Ylang Ylang Perfume Tree
<i>Canarium vitiense</i>	Canarium
<i>Castanopora alphanthii</i>	Brown Tamarind
<i>Castanospermum australe</i>	Black Bean
<i>Castanopora alphanthii</i>	Brown Tamarind
<i>Cryptocarya grandis</i>	White Laurel
<i>Cryptocarya murrayi</i>	Murrays Laurel
<i>Cryptocarya oblata</i>	Tarzali silkwood
<i>Cryptocarya pleurosperma</i>	Poison Walnut
<i>Cryptocarya vulgaris</i>	Northern laurel
<i>Darlingia darlingiana</i>	Brown Silky Oak
<i>Dysoxylum alliaceum</i>	Buff Mahogany
<i>Dysoxylum pettigrewianum</i>	Spur Mahogany
<i>Elaeocarpus bancroftii</i>	Kuranda Quandong
<i>Elaeocarpus grandis</i>	Blue quandong
<i>Endiandra cowleyana</i>	Rose Walnut
<i>Endiandra hypotephra</i>	Blue Walnut
<i>Endiandra longipedicellata</i>	Buff Walnut
<i>Endiandra monothyra</i>	Rose Walnut
<i>Endiandra montana</i>	Brown Walnut
<i>Ficus destruens</i>	Rusty Leaved Fig
<i>Ficus variegata</i>	Variegated fig
<i>Ficus virens</i> var. <i>virens</i>	White fig



<i>Flindersia bourjottiana</i>	Queensland Silver Ash
<i>Ganophyllum falcatum</i>	Daintree Hickory
<i>Gmelina dalrympleana</i>	White Beech
<i>Litsea leefeana</i>	Bollywood
<i>Nauclea orientalis</i>	Leichardt Pine
<i>Palaquium galactoxylon</i>	Red Silkwood
<i>Syzygium alliligneum</i>	Onion Wood
<i>Syzygium kuranda</i>	Kuranda Satinash
<i>Syzygium luehmannii</i>	Cherry Satinash
<i>Syzygium sayeri</i>	Pink Satinash
<i>Terminalia sericocarpa</i>	Damson Plum
<i>Trema orientalis</i>	Poison Peach



Appendix B - Eubenangee Swamp National Park's Natural Recruitment Species in 10 years

Naturally recruited species in 10-year-old 200sq.m rehabilitation plot established in June 1985 at Eubenangee Swamp National Park, Far North Queensland.		
Family	Genus/Species	Common Name
Annonaceae	<i>Melodorum uhrii</i>	Zig-zag Vine
Apocynaceae	<i>Melodinus australis</i>	Vanilla Vine
Araceae	<i>Gymnostlachys anceps</i>	Settlers Vine
Araliaceae	<i>Polyscias australiana</i>	Ivory Basswood
Arecaceae	<i>Archontophoenix alexandrae</i>	Alexander Palm
	<i>calamus mati</i> ;	Yellow lawyer
Asclepiadaceae	<i>Ichnocarpus sp. (syn. Tylophora)</i>	vine
Clusiaceae	<i>Gareinla warreni</i>	Native Mangosteen
Combretaceae	<i>Terminalia sericocarpa</i>	Damson Plum
Dilleniaceae	<i>Dillenia alata</i>	Red Beech
	<i>Hibbertia scandens</i>	Snake Vine
Euphorbieceae	<i>Breynia stipulata</i>	Coffee Bush
	<i>Glochidion sumatranum</i>	Buttonwood
	<i>Omalanthus novo-guineensis</i>	Bleeding Heart Tree
	<i>Mallotus polyadenos</i>	Kamala
Fabaceae	<i>Pongamia sp</i>	Pongamia
Flagellatiaceae	<i>Flagellaria Indica</i>	Supplejack
Lauraceae	<i>Beilschmiedia obtusifolia</i>	Blush Walnut
	<i>Cryptocarya grandis</i>	Cinnamon laurel
	<i>Cryptocarys murrayi</i>	Murray's laurel
	<i>Cryplocarya triplinervis</i>	Brown laurel
Leeaceae	<i>Leea Indica</i>	Bandicoot Berry
Lygodiaceae	<i>Lygodium microphyllum</i>	vine
Menispermaceae	Unidentified	vine
Monimiaceae	<i>Teltasynandra laxiflora</i>	vine
Moraceae	<i>Ficus Congesta</i>	Fig
	<i>Malaisia scandens</i>	vine
Myrtisticaceae	<i>Myristica Insipida</i>	Nutmeg
Papilionaceae	<i>Derris trifoliata</i>	vine
Plperaceae	<i>Plper novo-hollandiae</i>	Pepper Vine
Proteaceae	<i>Cardwellia sublimis</i>	Northern Silky Oak
	<i>Helicia nortoniana</i>	Norton's Silky Oak
Rhizophotaceae	<i>Carallia brachita</i>	Caralila
Rubraceae	<i>Randia fitzalanii</i>	Brown Gardenia
Rutaceae	<i>Melicope elleryana</i>	Evodia
	<i>Zanthoxylum ovalifolium</i>	Thorny Yellowwood
Sapindaceae	<i>Guioa acutifolia</i>	Glossy Tamarind
	<i>Rysotoectlia flavescens</i>	Tuckeroo
	<i>Mischocarpus exangulatus</i>	Rex Tokoonja



	<i>Mischocarpus lachnocarpus</i>	Woolly Brush Apple
	<i>Synima macrophylla</i>	Synima
	<i>Toeckia erythrocarpum</i>	Pink Tamarind
<i>Sapotaceae</i>	<i>Planchonella brownlessiana</i>	Box Wood
	<i>Planchonella chartacea</i>	Plachonella
	<i>Planchonella obovoidea</i>	Yellow Boxwood
<i>Smilacaceae</i>	<i>Smilax australis</i>	Austral Sarsaparilla
<i>Symplocaceae</i>	<i>Symplocos cochinchinensis</i>	White Hazelwood
	<i>SSp. Thwaitesii</i>	
	<i>var. pilosiuscula</i>	
<i>Verbenaceae</i>	<i>Gmelina fasilculiflora</i>	White Beech
	<i>Premna serratifolia</i>	Creek Premna
<i>xanthophyllaceae</i>	<i>Xanthophyllum octandrum</i>	Macintyre's Boxwood

Source: Goosem S. & Tucker N. (1995)

Appendix C - Offset Property Photos

State of vegetation; no-value habitat for Cassowary



Southern section of the Offset Property



Drainage line



Drainage line



Dinner Creek's denuded riparian zone on the Offset's Southern boundary (Offset Property is the left bank)



Appendix 3. Research Proposals



Cassowary Tracking – UQ

GPS-based tracking of southern cassowary chicks to determine movements and survivorship

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Scott Sullivan and Dan Meade- Queensland Parks and Wildlife, DERM

Dr Graham Lauridsen, Tully Vet surgery, Tully

San Diego Zoo

Ella Bay Pty Ltd

CSIRO

Summary

This project will monitor the spatial movement, resource selection, and survivorship of juvenile southern cassowaries (*Casuarius casuarius johnsonii*). Every year in Queensland a number of cassowary chicks are brought into care after the premature death of the parent bird — usually through traffic strike or dog attack. The orphaned chicks are hand-reared until they are considered of an age for release back into the wild. The fate of hand-reared chicks as well as that of wild chicks once they leave the natal area is presently unknown. This study aims to address that information gap by attaching Global Positioning System-based telemetry devices to five chicks that are currently in care and due to be released in April 2011. The purpose designed miniature devices will record the location of each bird every 60 min, and after 6 months the units will detach and transmit a VHF radio signal to enable their collection. The study will provide information pertaining to the dispersal ecology of juvenile cassowaries, which is imperative for effective management and conservation of the species

Project Methodology and Aims

Our team has already undertaken the successful GPS-based tracking of wild **adult** southern cassowaries. The GPS device was attached to the bird by a neoprene cuff - tailored for each bird, and wrapped around the left tarsus. The birds displayed no irritation whilst wearing the cuff, and no sign of abrasion or damage was observed when removed after ten weeks. A similar attachment technique will be used for the **juvenile** cassowaries but with a smaller, lighter telemetry device than was used for tracking adult birds.

The attached device will consist of 5 elements.

1. A purpose designed canvas cuff with neoprene lining for device attachment.
2. A GPS-based location recorder constructed by Telonics Inc (Arizona, U.S.A), weighing 185 g and dimensions 5 x 3.5 x 2.5 cm, containing a SIRF-4 chip, programmed to take a positional fix of its location on the earth's surface every 1 h for 180 days.
3. An activity sensor which will record every step made by the bird during the 6 month deployment.



4. A programmable electronic timed release mechanism to detach the device from the bird (48 g Telonics), accurate to 13 mins within one year of programming.
5. A two stage VHF radio transmitter, activated upon bird release and will duty cycle for 10 h per day for 12 months form activation, detectable 5 km from source.

The health of the birds is our primary concern and to ensure that the tagging procedure does not cause any physical harm from the tagging procedure the following measures will be undertaken.

1. The projected growth of the juvenile birds during the 6 month tracking period has been calculated from archival data, and this level of stretch has been incorporated into the attachment cuff.
2. Each of the timed release mechanisms has been rigorously field tested and considered to have a success rate 99.99%.
3. The VHF radio incorporated into each unit will stay active for 6 months after the proposed release date, so that in the case of detachment failure the bird can be manually radio-tracked, captured, and the tag removed.
4. In the remote possibility that all the above mechanisms fail each of the attachment cuffs will be laced closed with 2mm latex tubing. This material degrades and becomes brittle in the outdoor environment between 8 and 12 months, and will result in the unit detaching from the bird.

The finite relocation data will be plotted in geographical information software, and overlaid with land-use maps.

The study will provide much needed information on:

- 1. The survivorship of hand-reared juvenile cassowaries,**
- 2. The extent of movement, and dispersal,**
- 3. The type of habitat and landscape utilised be juvenile birds,**
- 4. The identification of threatening process encountered by young birds, and**
- 5. The intricacies of gps telemetry as an effective tool for studying the ecology of juvenile cassowaries.**

Ella Bay Pty Ltd has provided the Telemetry hardware for this research, assistance with supply of cassowary fruits prior to release, and labour.



Determining Cassowary Diet and Energetics through Remote Sensing UQ

Dr Hamish Campbell

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Background

The Southern Cassowary (*Casuarius casuarius johnsonii*) is known to regularly feed on the fruits of over 100 species of rainforest plants. Less is known about the energy content of the diet and how this varies between the sexes and across the seasons. Such information is important because alterations in energy intake will affect foraging patterns, home-range size and habitat utilisation. Alterations in diet intake are likely to show sexual disparity as nutritional requirements vary between the males and female adult birds due to inter-sexual asynchrony, embryo gestation, and parental care. Understanding the relationship between energetic requirements of an individual cassowary and the environment will improve predictions for habitat carrying capacity, population abundance, temporal patterns in spatial movement, and management actions in general.

Specifically we will:

1. Determine the variety and quantity of fruits ingested by adult male and female cassowaries inhabiting closed canopy rainforest during different seasons.
2. Calculate the energetic content that the cassowary removes from its diet, and assess if this varies with diet, sex, and seasonal cycles.
3. Determine the area of rainforest a cassowary requires to meet dietary energetic requirements.
4. Improve estimates of cassowary seed dispersal
5. Provide multiple dung samples of known animals for ground-truthing of DNA faecal analysis study currently being undertaken by CSIRO.

Methodology

Field work

A remote sensing unit consisting of a thermal dataloggers, a pedometer logger and a VHF-radio transmitter will be constructed. The entire unit will weigh less than 5 g weight and < 3 cm diameter, contain an internal circular aerial and encased in a bioinert non-toxic PVC sheath. Each unit will then be inserted within a large fruit (passionfruit mango), and deposited in known



areas of cassowary habitation. The fruit will be positioned at cassowary head height to prevent ingestion by ground animals. A number of the feeding stations will be deposited each day in areas of known cassowary visitation. The cassowary lacks a crop and digestion is gentle, and the remote sensing units will be smaller than some of the rainforest seeds that are ingested and evacuated by the cassowary. Thus the experimental study is unlikely to impact on the birds digestion or biology in any form.. This technique has been previously trialed on the dwarf cassowary, but this will be its first trial on the larger Southern Cassowary. Remote infrared motion detection cameras will be used to photograph visitors to the feeding station. These will be of a suitable quality to identify sex and returning individuals. On consecutive days each feeding stations will be checked and if the fruit has been taken the location of the VHF radio transmitter determined by directional tracking. From previous studies on seed dispersal the evacuation time of the remote sensing unit through the cassowary should be less than 12 hours. Upon finding the VHF unit deposited the whole scat will be collected.

Scat analysis

Each scat will be weighed and three samples of organic matter collected in 5 ml vials. These samples will be frozen and returned to the University of Queensland to undergo calorific analysis by bomb calorimetry. The entire scat will be washed through a sieve to separate out seeds. All seeds will be identified to the parent plant and their numbers in each scat quantified. Each of the plant species whose seeds are identified within the dung will have the fruit collected from the parent tree within the local area. These fruits will be frozen and undergo bomb calorimetry. Subtraction of energy content of the scat from the total energy content of the ingested fruits will reveal the amount of energy extracted by the cassowary. A small sample of each scat will also be preserved in 70% alcohol and labelled with location, sex and ID of the bird, this will be given to CSIRO as part of the faecal DNA analysis study.

Remote sensing

Within the remote sensing unit ingested by the cassowary there will be a thermal datalogger, which will provide information on animal body temperature during the digestion period. A pedometer within the unit will record each step taken by the bird. An exact measure of stride length for each individual will be determined by depositing an area of raked sand around the feeding station. Calculation of stride length against the number of steps will enable a precise estimation of distance travelled between fruit ingestion and deposition. This improves on previous seed dispersal studies which only measured the straight line distance of seed dispersal.



BY camera tracking the birds over a number of weeks/months a good idea of the movement patterns of different birds will be created. This will be valubel in informing about overall ecology of the cassowary. Collection of scats of known birds, will also allow collection of a number of scats from known birds. These will be preserved in 70% alchol

Ella Bay Pty Ltd will provide the Telemetry hardware for this research and assistance with supply of cassowary fruits, survey data, cassowary identification information and monitoring cameras.

CSIRO wil provid the DNA analysis of the cassowary scat and and genetics of the population.



Cassowary Fencing & Escape Gate Research Project Ella Bay

Road deaths are the primary threat to the survival of the endangered Southern Cassowary (*Casuarius casuarius johnsonii*). Mitigation measures against road deaths include directional fencing and safe crossing points. Fencing of the road and exclusion of cassowaries from the road corridor has only been trialled in a few locations with partial fencing. The overriding concern with fencing has been the lack of an effective escape mechanism which would allow safe exit for cassowaries inadvertently trapped within a road corridor. Typically in the absence of an effective one-way gate, a gap in the fence or funnel trap has been used to try and allow the cassowary access back through the fence. This has generally meant that the fence is not full length or of full height.

This research investigated the design, construction and trial of a wildlife exclusion fence, to prevent cassowaries and other wildlife from road corridors and a one way escape gate to allow safe exit for cassowaries inadvertently trapped within a road corridor. The exclusion fence will enable funnelling of the cassowaries and wildlife over or under Ella Bay Road underpass or overpass structures. The fence must also function in a hostile environment of the rainforest with tree branch drop and intense weather including cyclones.

The research will:

1. Review fence and funnel design best practice literature internationally and specifically cassowary fence trials within the Wet Tropics and develop a best practices strategy for Ella Bay Road;
2. Develop, trial and monitor a cassowary specific fence and funnel design in controlled conditions and in the wider environment;

Aims and Objectives

1. To develop a fence and funnel strategy specifically designed for cassowaries, suitable for cyclone areas and has a life of > 20 years;
2. To construct, trial and monitor a fauna friendly fence that is safe, resistant to fauna damage and cassowary specific under a controlled environment with captive cassowaries;
3. To construct, trial and monitor an escape gate, specifically designed for cassowary anatomy under a controlled environment with captive cassowaries;
4. To trial and monitor the fence and escape gate under wet season and cyclonic conditions in the wider environment;
5. To trial the fence and escape gate in a known cassowary area, monitor for usage, entrapment or damage. Modify and develop.

Methodology

The project will use

1. Literature review, field investigation and interview of cassowary researchers to establish current best practice and cassowary specific anatomical requirements;
2. Modify escape gate concept and material of construction to be cassowary specific;
3. Desktop design of fence and escape gate integrating into Ella Bay Road Design to minimise environmental footprint;
4. Fabricate and trial cassowary escape gate at Johnstone River Crocodile Farm on captive cassowaries with low tension fence;
5. Monitor trials with wildlife remote cameras;
6. Construct and trial high tension suspension fence as a wallaby exclusion fence for revegetation trials on Ella Bay property;
7. Evaluate fence performance during wet season and high wind;



Progress

The cassowary and escape fence trials have been completed and reported in Volume Six as

- 6.1i Report on Cassowary Escape Gate Trials At Johnson River Crocodile Farm and
- 6.1j Report on Cassowary Exclusion Fence Trials At Ella Bay.

The trials were successful in evaluating an escape gate comprising a series of opposing hinged sprung HDPE 'fingers' which form a funnelling valve that permit easy passage from one side no passage from the other side and were specifically designed for the anatomy of a cassowary.

The fence trials were successful in developing a shadecloth suspension fence which was trialled during two cyclonic events.

Research Team	
Organisation	Project Team Members
Ella Bay Development	Rod Lamb, Steven Garrad, Adrian Hogg, Dan Figueiredo
Missing Link	Kim Ford, Kate Roper
EcoLogical	Heather Tolley
Chenoweth Environmental	Dave Francis
NRA Environmental Consultants	Peter Buosi
Projex North	John Martin, Peter Evans



Impact of Ella Bay Development on Cassowaries, Fauna and Flora - JCU

Research Topic:

Environmental impacts of Ella Bay Development access and internal roads, design of strategies to mitigate road impacts on adjacent habitats and internal corridors, and monitoring of road mitigation strategies.

Research Team

<u>Name</u>	<u>Positions</u>	<u>Qualifications</u>
Dr Miriam Goosem	Research Fellow School of Environmental and Earth Science, James Cook University, Cairns	PhD, Environmental Science, James Cook University
Prof Steve Turton	Executive Director, JCU/SCIRO Tropical Landscapes Joint Venture, James Cook University, Cairns	PhD, Geography, James Cook University
Dr Catherine Pohlman	Postdoctoral Research Fellow, School of Environmental and Earth Science, James Cook University, Cairns	PhD, Environmental Science, James Cook University
Dr Robyn Wilson	Research Officer, School of Environmental and Earth Science, James Cook University, Cairns	PhD, Environmental Science, James Cook University
Mr Les Searle	Research Officer School of Environmental and Earth Science, James Cook University, Cairns	BSc, GIS, Computer Science, James Cook University BAppSc, Surveying, Queensland Institute Technology
Mr Peter Byrnes	Research Officer School of Environmental and Earth Science, James Cook University, Cairns	PhD candidate, Environmental Science, James Cook University, BSc (Hons), Environmental Science

Background and research questions:

The Ella Bay Development will involve the upgrade of the existing access to Ella Bay or construction of alternative access. It will also require the construction of roads within the site of a variety of widths and expected traffic loads that will divide important wildlife movement corridors within the site. The Ella Bay Integrated Resort Proposal Environmental Impact Statement (2007) states that:



“A key aspect of the conservation/mitigation measures is the protection of fauna movement corridors and habitat”.

To achieve these conservation measures, one critical aspect will require the incorporation of best practice environmental road design with respect both to the final access road and the internal roads. Research into the design and operation of these best practice roads is necessary to achieve the best possible outcomes.

The James Cook University School of Earth and Environmental Science road ecology team has the greatest expertise in research into rainforest road impacts and mitigation of impacts in Australia (and globally) with respect to rainforests (see references), being a proven research provider in this field to the Queensland Department of Main Roads and the Wet Tropics Management Authority through the Rainforest CRC and the JCU/CSIRO Tropical Landscapes Joint Venture and the Marine and Tropical Sciences Research Facility. The team also has expertise in best practice with respect to powerline access. The team will work in close collaboration with the postdoctoral cassowary research at the site to be undertaken by Mr Les Moore. We have expertise in research into habitat quality and faunal connectivity issues with respect to restoration priorities; road impacts including: roadkill; faunal movements; road edge effects on microclimate, vegetation and fauna; disturbance from traffic noise, headlights and vehicle movements, barrier effects of roads; invasions of weeds and alien fauna along roads; and mitigation strategies to minimize these impacts. Team members with expertise in rainforest roadside rehabilitation and road pollution can be included if required.

The research will:

1. Examine habitat quality of the remnant and riparian vegetation on site and within and adjacent to the access road footprint with respect to microclimate, vegetation and habitat for selected wildlife groups.
2. Review road design in terms of best practice literature from around the world and within the Wet Tropics and provide advice with respect to best environmental practice with regards design, construction and operation to achieve the smallest environmental footprint possible and to allow wildlife movements, both of the cassowary and other fauna.
3. Monitor wildlife mortality, edge effects and aspects of faunal connectivity both prior to and after road upgrade and construction.

Aims and objectives

1. To examine the existing habitat quality of remnant and riparian vegetation within the site and adjacent to the access road proposals with respect to vegetation quality and habitat quality and habitat connectivity for selected faunal groups using remote sensing, GIS and field truthing techniques.
2. To provide recommendations and maps regarding restoration priorities for faunal habitat connectivity within the site from the habitat quality assessment.
3. To review best practice road design principles in terms of the roads required for access to the development and within the site itself, with particular emphasis on the faunal habitat connectivity elements identified above with the aim of recommending mitigation strategies that will reduce impacts including fencing and wildlife crossing structures.
4. To examine current and potential road mortality and edge, barrier and disturbance effects, such as traffic noise, along the current access road that will inform the incorporation of road upgrade designs that minimize these impacts.



5. To examine representative populations of faunal groups other than the cassowary (which is already the subject of detailed research) that might require the incorporation of mitigation strategies to minimize road mortality and barrier effects, such as endangered frogs and terrestrial and arboreal species of mammals and other herpetofauna.
6. To monitor mitigation strategies once installed.
7. To continue monitoring of impacts including edge and disturbance effects, wildlife movements, mortality, during operational phase of development.

Methodology

The project will use methods established over the past 10 years to examine road impacts and mitigation strategies, habitat quality and connectivity issues.

1. Road mortality will be monitored on selected transects.
2. Edge effects adjacent to road clearings will be examined using traverse measurements of microclimate parameters including light, temperature, humidity, soil moisture and soil temperature and possibly diurnal measurement of some of these parameters. Vegetation parameters can be examined on transects parallel to the clearing and, where necessary, movements of animals can be monitored using mark and recapture of animals captured in Elliot, cage and pit traps, or radio-tracking as required.
3. Habitat quality parameters are examined using a combination of satellite and/or aerial photograph interpretation, GIS mapping and modeling, and field truthing. GIS is then used to delineate priority rehabilitation areas.
4. Disturbance by traffic noise and head and streetlights can be monitored using specialized noise and light measuring equipment already available in our laboratory.
5. Mitigation structures are monitored using a combination of sand or marble dust tracking, radiotracking, remotely-triggered photography and mark recapture techniques.
6. Corridor use by selected wildlife groups are evaluated using observational techniques, including spotlighting, bird and herpetofaunal observations and mark recapture techniques.

Outcomes

Expected outcomes include:

1. Literature review detailing potential impacts and recommended mitigatory strategies.
2. Maps of vegetation and habitat quality and recommended restoration priorities and reports detailing the information gained.
3. Report detailing road mortality and edge effects and potential disturbance parameters along current road access prior to upgrade.
4. Reports detailing monitoring of mitigatory strategies.
5. Reports describing monitoring of impacts during operational phase of development.

Funding

<i>Activity</i>	<i>Funding Requirements</i>	<i>Source of Funding</i>
Review of potential impacts and	Research Officer, Academic A, 2 months	Ella Bay



mitigatory strategies (first months of project)	\$15,000	Research Fellow – JCU \$3,000
Road mortality monitoring (first year of project, then again one year after project construction and again when fully operational)	Research Officer, Academic A, 1 day/wk \$15,800/yr Travel to site \$6,000	Ella Bay Equipment – JCU Research Fellow – JCU \$3,000
Edge effect study – microclimate and vegetation, initial (first year of project, then again one year after construction and again when fully operational)	Postdoctoral Fellow, Academic A, 15% of full- time, \$12,000 Research assistant, 15% of full-time, \$8,000 Travel to site \$3,000	Ella Bay Equipment – JCU (\$35,000)
Edge effect study – fauna (first year of project, then again one year after construction and again when fully operational)	Research Officer, Academic A, 5 days/month, 6 months, \$14,000 Travel to site and accommodation \$6,000	Ella Bay Research Fellow – JCU \$18,000 Equipment – JCU - \$8,000
Mitigatory Strategy monitoring (once construction completed)	Research Officer, Academic A, 1 day/week \$15,800/yr Travel to site \$6,000	Ella Bay Equipment – JCU Equipment – Ella Bay \$8,000
Disturbance by noise and headlights (first year of project, then again when fully operational)	Research Officer, Academic A, 2 months, \$15,000 Research Officer, Academic A, 2 months, \$15,000	Ella Bay Equipment – JCU (\$15,000)

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Appendix 4. Regional Ecosystem Mapping for Offset Property

