ELLA BAY INTEGRATED RESORT PROPOSAL

SUPPLEMENTARY EIS
ACCESS ROAD STRATEGY

ENVIRONMENT NORTH

PROJECT NUMBER 413B

19 NOVEMBER 2007

ENVIRONMENT NORTH

DOCUMENT CONTROL CERTIFICATE

PROJECT AND CLIENT DETAILS

Project name:	Ella Bay Integrated Resort Proposal	Job Number:	413b
Title:	Supplementary EIS – Access Road Strategy		
Client:	Satori Resorts Ella Bay Pty Ltd		
Contact:	Paul Sparshott		
Description of report:	This report has been prepared to document additional investigations into options for providing access to the proposed Ella Bay Integrated Resort in the Johnstone Shire. The original EIS described a number of options for access to the site and undertook a preliminary evaluation of these. On the basis of comments received during consultation on the draft EIS and further consideration by the proponent, further options have been developed for assessment. This report documents the process which involved: • a high level screening of options considered in the EIS or as raised in post-EIS consultation, • a detailed multi-criteria analysis (MCA) of the four most promising options from the high level screening, and • impact assessment of the preferred solution from the MCA and recommendations for mitigation. This report describes the development of suitable options and proposes an Access Road Strategy to guide the detailed design, construction, and operation of the road.		

PREPARATION AND DISTRIBUTION DETAILS

Version	Purpose	Prepared by	Checked by	Date
1d	Interim release (COG Review)	David Rivett	Paul Sparshott	10 September 2007
2c	Draft release (Agency Review)	David Rivett	Paul Sparshott	14 October 2007
3d	Final Draft	David Rivett		19 November 2007

© **Environment North**
P.O. Box 616N
NORTH CAIRNS Q 4870
Telephone: (07) 4031 6619
Facsimile: (07) 4051 5386

Form ENDQ/01 (D) 30 March 1998

CONTENTS

EXECUTIVE SUMMARY

1. INTRODUCTION

1.1 PURPOSE OF REPORT AND OUTLINE

This report documents the development of a preferred access solution for the proposed Ella Bay Integrated Resort in the Johnstone Shire and recommendations for impact mitigation and management.

The original EIS described a number of options for access to the site and undertook a preliminary evaluation of these. On the basis of comments received during consultation on the draft EIS and further consideration by the proponent, further options for the preferred access via Flying Fish Point have been developed for assessment and refinement. This has involved:

- a high level screening of Flying Fish Point options considered in the EIS or as raised in post-EIS consultation,
- a detailed multi-criteria analysis (MCA) of the four most promising options from the high level screening, and
- impact assessment of the preferred solution from the MCA.

Detailed management initiatives for the preferred Access Road solution have been identified, including:

- a Fence and Funnel Strategy (comprising fencing, fauna connectivity initiatives such as "fauna friendly" bridges and rope canopy bridges, and associated road ecology initiatives),
- a specific Cassowary Management Strategy (i.e. to reduce conflict with traffic and thereby promote the conservation of this species – note that the Cassowary Management Strategy also addresses other aspects of cassowary conservation at the resort site and elsewhere),
- a Road Runoff Strategy (to document the approach to road drainage and pollution control), and
- an overall Environmental Management Plan for the road (an overview of the recommended approach to minimise road impacts through the design, construction and operational phases).

In addition, an Offsets and Additionality Policy has been developed for the whole project (i.e. the Ella Bay Integrated Resort and the Access Road). This includes suitable on-site and off-site works or actions to mitigate or offset impacts on listed species, vegetation communities, and ecological processes. With respect to the Access Road, this Offsets and Additionality Policy provides remedies for mitigating residual road impacts not able to be further ameliorated.

1.2 ADDENDUM TO ACCESS ROAD STRATEGY

Review of the draft Access Road Strategy in December 2007 by the Environmental Protection Agency, the Wet Tropics Management Authority and the Department of the Environment, Water, Heritage and the Arts resulted in the evolution of two further options for alignments in the vicinity of the Flying Fish Point Reserve for assessment. An Addendum report has been prepared to document the consideration of these two additional route options which were suggested on the basis that they appear to offer some environmental benefits. Specifically, the Addendum:

- compares the performance of the new options with the original four options by re-running the multi-criteria analysis process for all six routes, and
- discusses the relative merits of the two new options and the preferred solution as derived by the Access Road Strategy.

Key findings are described at the end of this revised Executive Summary in **Chapter 8**. The Preferred Solution developed in the Access Road Strategy remains the proponent's first choice. The final decision on the route is expected to be the subject of further negotiations.

1.3 CONCLUSIONS & RECOMMENDATIONS

1.3.1 Recommended Solution: Bypass Flying Fish Point and Upgrade Road to Ella Bay

The preferred solution for providing access to the site is a composite of three segments (refer to **Figure 1**). More details are provided in **Section 7**. It should be noted that sections of the new road are proposed to be fenced to protect fauna (and in particular cassowaries) from impacts with traffic, with safe crossings to be provided in key locations (i.e. over the tunnel and opposite the Flying Fish Point Reserve).

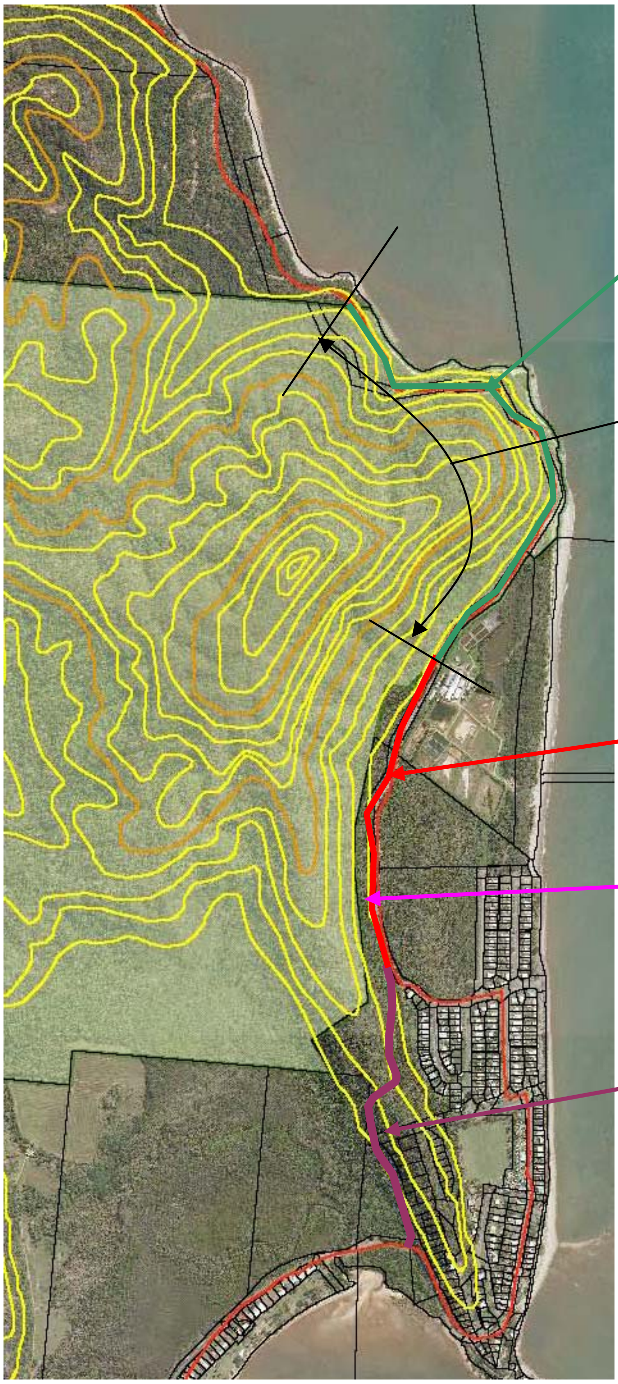


Figure 1. Proposed Access Road

Segment 3: Start of World Heritage Area to Little Cove (upgrade existing road)

Road within WHA

Segment 2: South of Fish Farm to Start of World Heritage Area (upgrade existing road)

"Fauna friendly" bridge (approximate location)

Segment 1: Flying Fish Point to South of Fish Farm (Bypass)

Some key statistics of the new Access Road are:

- length of new bypass section = 0.94 km,
- length overall = 3.78 km,
- area of existing clearing incorporated in new road – 3.13 ha (1.95 ha in World Heritage Area),
- area of new clearing = 2.47 ha overall (2.44 ha of remnant vegetation),
- area of new clearing in World Heritage Area = 0.44 ha, and
- area of rehabilitation (over cut-and-cover tunnel) = 0.49 ha.

a) Segment 1. Flying fish Point to South of the Fish Farm

Description: a new bypass road west of Flying Fish Point incorporating a cut and cover tunnel. This bypass meets the existing road alignment just north of Flying Fish Point. Key aspects are as follow:

- length is 0.94 km,
- this is a new road bypassing the Flying Fish Point township, thereby avoiding any significant adverse social impacts,
- loss of vegetation and habitat is minimal and is to be offset via the overall Offsets and Additionality Policy, and
- a tunnel will be built which provides over-road connectivity of habitat and significantly mitigates loss of vegetation and habitat.

The bypass has a superior horizontal and vertical alignment to the existing road and this results in reduced travel time to Ella Bay. The land over the tunnel is to be revegetated (0.94 ha).

b) Segment 2: South of the Fish Farm to Start of World Heritage Area

Description: upgrading of the existing Ella Bay Road from the end of the bypass to the beginning of the World Heritage Area opposite the Fish Farm. It is in this segment that the two new options are to be considered. Key aspects are as follow:

- length is 0.84 km,
- this is an existing flat road that only requires minimal widening (loss of vegetation and habitat is minimal and is to be offset via the overall Offsets and Additionality Policy), and
- a “fauna friendly” bridge is to be provided in this section to allow safe under-road passage for cassowaries and other fauna to move between the Ella Bay National Park and the Flying Fish Point Reserve.

c) Segment 3: Start of World Heritage Area to Little Cove, Ella Bay

Description: upgrading of the existing Ella Bay Road within the World Heritage Area (i.e. to the southern boundary of the Little Cove site). Key aspects are as follow:

- length is 2.00 km,
- the existing steep and winding road will be widened,
- loss of vegetation of habitat is minimal and is to be offset via the overall Offsets and Additionality Policy,
- significant mitigation measures will be put in place to reduce impact such as planted retaining structures,

- constrained sections of road are proposed to reduce road width, and
- water runoff measures will be put in place.

1.3.2 Impacts

Providing that the recommended mitigation measures are adopted (see **Section 4**), the adverse impacts of the upgrade are considered to be minor. Impacts on the residential community of Flying Fish Point will be negligible, and arguably beneficial as the proposed road will mean that existing Ella Bay Road traffic will bypass the town, along with the new traffic.

2. DEVELOPMENT OF PREFERRED ACCESS ROAD SOLUTION

2.1 INTRODUCTION

The development of a preferred solution for access to the Ella Bay Integrated Resort involved a comprehensive screening process that started in the EIS and was completed in the Access Road Strategy. Key steps were:

- **EIS Step #1 – Broad Access Options** (i.e. three broad alternative access routes to the resort),
- **EIS Step #2 – Flying Fish Point Options** (i.e. four variations on routes via Flying Fish Point),
- **Access Road Strategy Step #1 – High Level Screening** (i.e. consideration of the four EIS Flying Fish Point options plus three additional routes as proposed by the Environmental Protection Agency during consultation),
- **Access Road Strategy Step #2 – Refinement of High Level Screening Survivors** (i.e. consideration of improvements to the four options that survived the High Level Screening), and
- **Access Road Strategy Step #3 – Multi-criteria Analysis** (i.e. detailed assessment of the four refined options from the high level screening, informed by additional studies).

These steps which led to the selection of the preferred access road solution are outlined below.

2.2 EIS CONSIDERATION OF OPTIONS

2.2.1 EIS Step #1 – Broad Access Options

The initial consideration documented in the EIS involved three broad route options for site access, namely:

- Option 1 – Upgrading of Flying Fish Point Road (i.e. several options were developed that follow the general alignment from Innisfail via Flying Fish Point and the existing Ella Bay Road).
- Option 2 – Mountainous Road Option (via Garradunga).
- Option 3 – Tunnel Option (direct route via existing road reserve from the Bruce Highway).

After extensive analysis and discussions with the relevant stakeholders and government agencies during the preparation of the EIS, it was concluded that the Flying Fish Point Road Option (Option 1) was the best broad route option for Ella Bay Developments Pty Ltd to pursue.

Outcome: Flying Fish Point Road Option (Option 1) selected for further consideration.

2.2.2 EIS Step #2 – Flying Fish Point Options

The EIS then considered variations on Option 1 above, with all options including a common route from Innisfail to Flying Fish Point and then following the existing route to the resort site north of Heath Point via the (upgraded) existing Ella Bay Road:

- Flying Fish Point Option 1 (via Elizabeth, George, Judy and Ruby Streets).
- Flying Fish Point Option 2 (via a new road on the western side of the existing urban area).
- Flying Fish Point Option 3 (via a new road along the esplanade and then west of the Seafarm site).
- Flying Fish Point Option 4 (via a new road along the esplanade (Option 3) then continuing east of the Seafarm site).

The EIS and supporting documents assessed these options based on a number of environmental and social criteria. However, no firm recommendation was made at the time and it was noted that further refinement of the four EIS options for access via Flying Fish Point was required to resolve these issues and consider approvals, construction, operation, environmental, social and economic view points and, on the basis of this work, develop a preferred solution.

In particular, consultation on the EIS (both community and agency) revealed divergent views on the need to protect biodiversity on the one hand and social values on the other, and the need to carefully weigh these in a more formal assessment of options.

Outcome: No conclusion. All four Flying Fish Point Road Options (Flying Fish Point Options 1 to 4) selected for further consideration (post-EIS).

2.3 ACCESS ROAD STRATEGY CONSIDERATION OF OPTIONS

2.3.1 Access Road Strategy Step #1 – High Level Screening

Following the analysis of agency and community comments on the EIS analysis, further refinement was undertaken in developing this Access Road Strategy, comprising:

- a workshop between project experts and officers from the Environmental Protection Agency and the Wet Tropics Management Authority (this confirmed that, of the three broad route options, the Flying Fish Point option was preferred and that further analysis be undertaken of suitable sub-options), and
- a high level screening of all Flying Fish Point options (i.e. EIS options and those arising subsequently from consultation on the EIS). The following high level criteria were used as they encapsulate the relevant issues:
  - **Biodiversity:** in particular the effect on cassowary habitat and movement (i.e. potential for roadkill), and likely loss of high value regional ecosystems (vegetation communities).
  - **Residences:** number of residences directly affected by resort traffic. This has both amenity and safety aspects.
  - **Scenic Amenity:** likely impacts of roadworks when viewed by ships at sea or from the township.
  - **Constructability:** general assessment of engineering issues (extent of earthworks, difficult construction (e.g. along foreshore)).
  - **Coastal Management:** specific coastal management issues likely to be involved with foreshore option. In particular, whether or not the works are consistent with the *Wet Tropical Coast Regional Coastal Management Plan 2003*.

In all, seven Flying Fish Point options were assessed. These included the existing route and variations via the Flying Fish Point road network ("town" Options 1 and 3-7), and a western bypass of the town (the "bypass" option, Option 2).

Outcome: Three options using the Flying Fish Point road network ("town" Options 1 and 3-7), and a western bypass of the town (the "bypass" option, Option 2) selected for further improvement and development.

2.3.2 Access Road Strategy Step #2 – Refinement of High Level Screening Survivors

This assessment showed that while Option 2 (the bypass option) scored poorly in terms of biodiversity and scenic amenity, it was considered to be the best outcome for Flying Fish Point residents by a wide margin. The assessment also revealed that, if the alignment could be modified to bring the road clear of the coastal wetlands (i.e. further to the east), and attention given to cassowary conservation and scenic amenity, it could become a good overall solution, despite its likely cost.

Based on the above analysis and consideration of likely issues, the following overall options were selected for detailed evaluation. These were re-labelled to avoid confusion:

- **Option A:** High Level Option 1 (existing route) – a well-scoring "town" option,
- **Option B:** High Level Option 7 (the most promising biodiversity option, also a "town option"),
- **Option C:** High Level Option 2 (bypass of Flying Fish Point, but modified to be on a more easterly alignment – the most promising in terms of residential issues), and
- **Option D:** as for Option C (Flying Fish Point bypass) but with a cut-and-cover tunnel to address biodiversity and scenic amenity issues.

All options eventually meet at a point just south of the Fish Farm after which the Access Road follows the route of the existing Ella Bay Road which is to be upgraded. Refer to **Figure 2**.

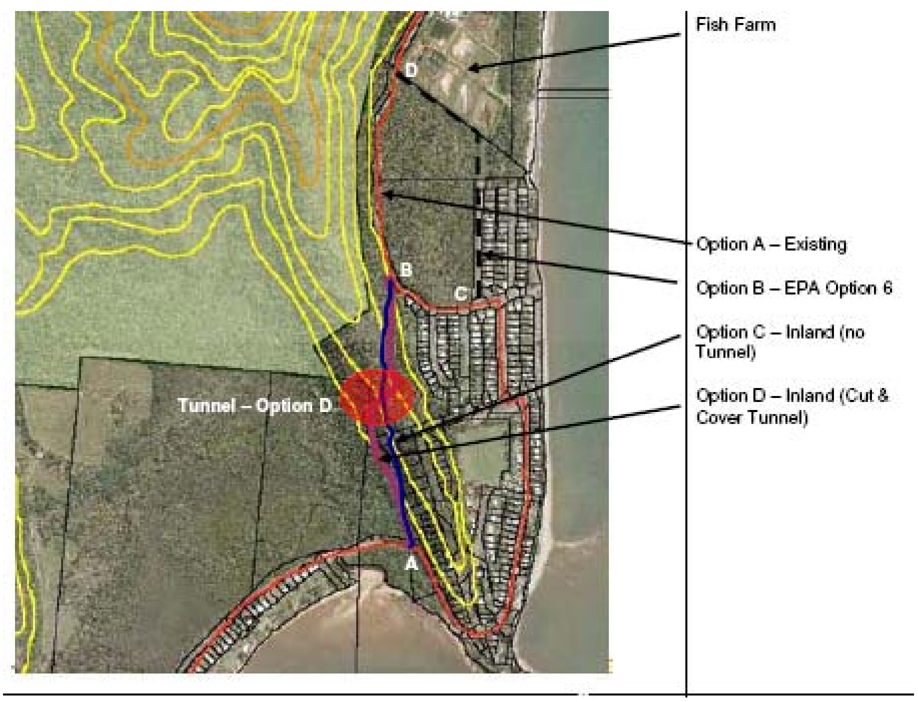


Figure 2: Route options developed from the high level screening and as assessed in detail in the multi-criteria analysis.

Outcome: Two options using the Flying Fish Point road network (Option A = "town" Option 1; Option B = "town" Option 7), and a western bypass of the town (a refinement of the "bypass" option, Option 2) selected. Two variations of Option 2 selected: one without a cut-and-cover tunnel (Option C) and one with (Option D).

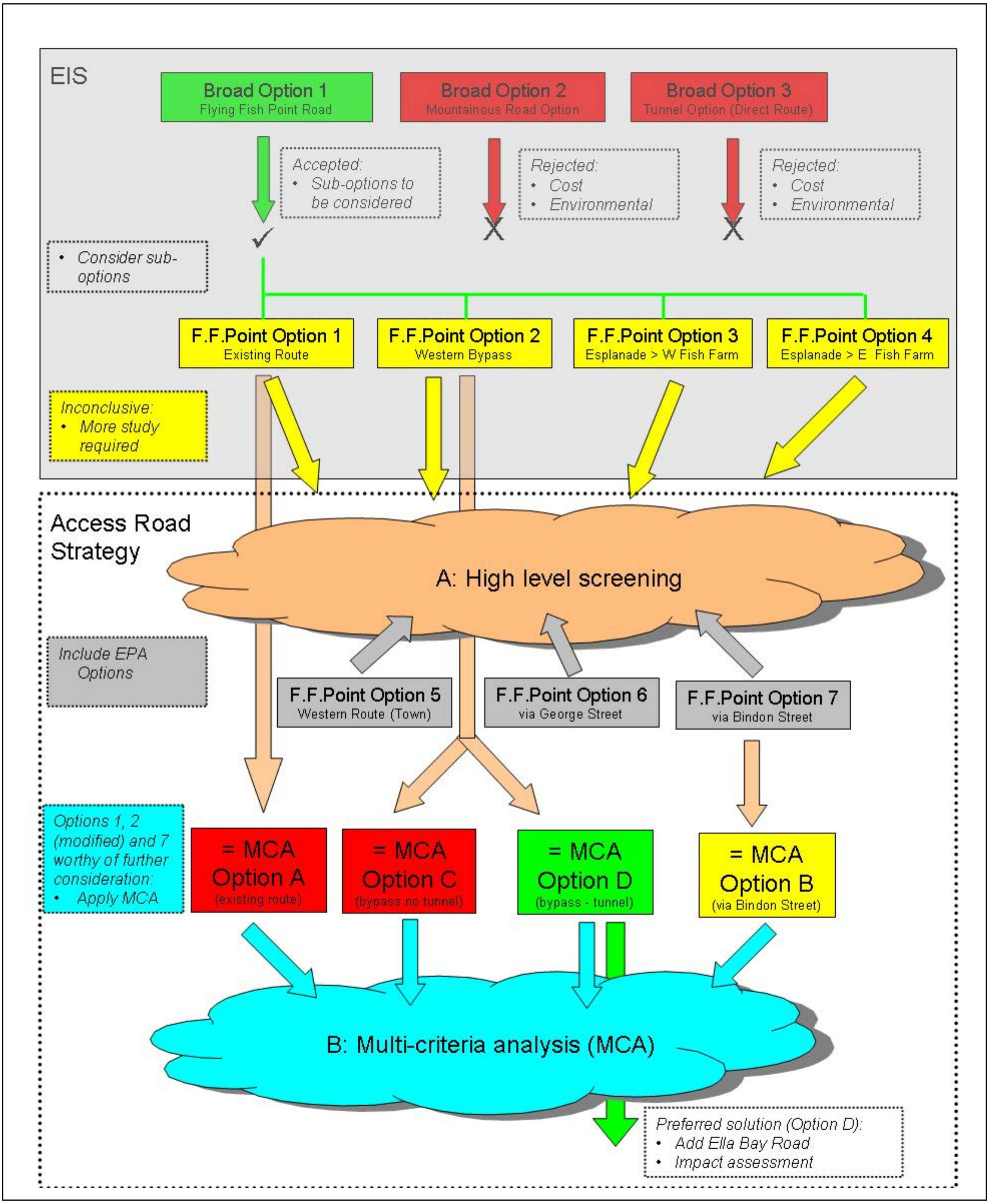
2.3.3 Access Road Strategy Step #3 – Multi-criteria Analysis

This step involved the application of multi-criteria analysis (MCA) techniques to undertake a detailed assessment of the four refined options from the high level screening. This assessment was informed by a round of additional studies required to improve the understanding of key technical issues affecting the access road route.

Outcome: As described in the following section, the MCA resulted in the selection of Option D (the Flying Fish Point bypass with a cut-and-cover tunnel) as the preferred solution for a route through/past Flying Fish Point. This meets the existing Ella Bay Road just north of Flying Fish Point. Option D plus the upgrade of the Ella Bay Road through to the Little Cove site was then subjected to impact assessment.

2.4 SUMMARY OF CONSIDERATION OF ALTERNATIVES

The following schematic demonstrates the above process graphically.


EIS
Broad Option 1
Flying Fish Point Road
Broad Option 2
Mountainous Road Option
Broad Option 3
Tunnel Option (Direct Route)
Accepted:
• Sub-options to be considered
Rejected:
• Cost
• Environmental
Rejected:
• Cost
• Environmental
• Consider sub-options
F.F.Point Option 1
Existing Route
F.F.Point Option 2
Western Bypass
F.F.Point Option 3
Esplanade > W Fish Farm
F.F.Point Option 4
Esplanade > E Fish Farm
Inconclusive:
• More study required
Access Road Strategy
A: High level screening
Include EPA Options
F.F.Point Option 5
Western Route (Town)
F.F.Point Option 6
via George Street
F.F.Point Option 7
via Bindon Street
Options 1, 2 (modified) and 7 worthy of further consideration:
• Apply MCA
= MCA
Option A
(existing route)
= MCA
Option C
(bypass no tunnel)
= MCA
Option D
(bypass - tunnel)
= MCA
Option B
(via Bindon Street)
B: Multi-criteria analysis (MCA)
Preferred solution (Option D):
• Add Ella Bay Road
• Impact assessment

3. DETAILED ASSESSMENT – ADDITIONAL STUDIES AND MCA

3.1 ADDITIONAL STUDIES

As recommended in the EIS and as subsequently identified, the following additional studies were undertaken to inform the refined assessment of options via the multi-criteria analysis and to provide information needed for the impact assessment:

- engineering,
- biodiversity (flora, fauna other than cassowaries),
- biodiversity (cassowaries),
- topographic survey,
- geotechnical assessment,
- social and amenity assessment,
- scenic amenity assessment, and
- offsets (road and resort).

3.2 MULTI-CRITERIA ANALYSIS – OVERVIEW

The four options developed during the high level screening were then further refined on the basis of these additional studies and subjected to a multi-criteria analysis (MCA). MCA is a formal assessment process wherein a number of criteria are selected (each broken down into attributes) against which the performance of each of a number of options are then quantitatively measured. The selected criteria and attributes are as tabulated below.

TABLE 3.2: CRITERIA AND ATTRIBUTES

CRITERION	CODE	ATTRIBUTE
Environmental Sustainability	E1	Important Areas for Plants (Communities)
	E2	Important Areas for Plants (Species)
	E3	Important Areas for Animals (Other than Cassowaries)
	E4	Important Areas for Animals (Cassowaries)
	E5	Ecological Processes
Transport Efficiency	T1	Travel Time at Level of Service (LOS) E
	T2	Capacity at LOS E
	T3	Accommodate Service Vehicle
	T4	Accommodate Bicycles
	T5	Stability
	T6	Safety
	T7	Constructability
		(continued over)

CRITERION	CODE	ATTRIBUTE
Social Amenity	S1	Important areas for scenic amenity
	S2	Opportunities for viewing and presentation
	S3	Noise
	S4	Construction Issues
	S5	Severance of Communities
Cost	C1	Cost

The performance of each option against each attribute was measured, weighted as appropriate, standardised (i.e. adjusted to a score of -5 to +5 when compared with the existing situation) and then subjected to a sensitivity analysis to determine the effect of various weighting profiles.

3.3 OBVIOUS MITIGATION ACTIONS

The measurement of comparative impacts revealed that there were some obvious opportunities to modify the bypass options by replacing large cuttings and embankments with retaining walls and thereby reduce clearing and earthworks. Fauna connectivity was also improved for Options A, C and D by the inclusion of the “fauna friendly bridge” between the Flying Fish Point Reserve and the Ella Bay National Park.

These modifications were made to the options and the MCA re-run with revised quantities of clearing and other attributes.

3.4 WEIGHTING PROFILES

A number of weighting profiles were examined to investigate the effect on the overall outcome of giving priority to each of the four criteria in turn. A weighting profile giving no or very little priority to cost was also examined.

3.5 KEY FINDINGS

After a consideration of the significance of all attributes (some were found to be inappropriate or to not influence the selection process) and variations in weighting between criteria to test sensitivity, the following conclusions were drawn:

- **Cost is not considered to be a significant criterion**. In the context of the overall cost of the Ella Bay Integrated Resort, the effect of the comparative cost differences between the Access Road alternatives between Points A and D is minor and is unlikely to be an important consideration to key stakeholders such as the Flying Fish Point community and the environmental agencies. The proponent has indicated a similar position.
- **Option D (the bypass option with the cut-and-cover tunnel) is preferred overall.** It scores best for:
  - Priority given to *Transport Efficiency* (even when *Cost* is included)
  - Priority given to *Social Amenity* (even when *Cost* is included)
  - Flying Fish Point Community’s weighting scheme (*Cost* is not included)
  - Ella Bay Integrated Resort Community’s weighting scheme (even when *Cost* is included)
  - Proponent’s weighting scheme (*Cost* is not included).

Three overall findings are relevant:

- Although the MCA shows that Option B scores better than Option D based on *Environmental Sustainability*, the environmental performance of Option B is not actually significantly better than that of Option D, especially with the inclusion of the fauna bridge over the tunnel and the "fauna friendly" bridges opposite the Flying Fish Point Reserve and at Heath Point. In the MCA, Option B scores well for *Environmental Sustainability* because it contributes to the rehabilitation of a section of the Ella Bay Road. This comparative advantage diminishes to become insignificant when considered in the context of the proposed Offsets & Additionality Policy.
- While any minor difference in environmental performance can be remedied by environmental offsets, no such remedy is available for social amenity impacts which are all "town" options involve. Thus few of the adverse impacts of Options A and B can be mitigated or offset.
- While in a comparative sense the difference in cost between the options is significant (approximately $8 million between Options B and D), the proponent has decided that, in the context of the overall project, this differential cost should not be an impediment to selecting the option that bests meets the remaining criteria.

On the basis of the above, the proponent has a preference for Option D, especially with mitigation and management options as later described. The Access Road Strategy (i.e. impact assessment and recommendations for mitigation) is based on Option D plus the balance of the Ella Bay Road.

4. IMPACT ASSESSMENT AND OPPORTUNITIES FOR MITIGATION

4.1 IMPACT ASSESSMENT

The impact assessment revealed that there will be very little clearing. Key statistics are:

- There will be 2.44 ha of new clearing of remnant vegetation.
- Of this, 0.44 ha is in the World Heritage Area and 2.00 ha is outside the World Heritage Area.
- No "endangered" regional ecosystems will be affected.
- There is an opportunity to revegetate 0.49 ha over the cut-and-cover tunnel.

It is likely that some listed plants and animals will be affected, and specific mitigation measures are proposed for key species. The Southern Cassowary and the stream-dwelling frogs are of most concern.

Ecological processes are expected to continue largely unaffected, providing that the recommended mitigation measures regarding fauna connectivity, management of fauna/vehicle interactions, and attention to maintaining aquatic habitat are adopted.

Visual amenity (especially when viewed from ships at sea) will initially be reduced but this impact will lessen over time as the proposed revegetation of the retaining walls becomes established. The new road will provide new opportunities for presentation and is expected to become a high quality scenic drive.

Impacts on the residential community of Flying Fish Point will be negligible, and arguably beneficial as the proposed road will mean that existing Ella Bay Road traffic will bypass the town, along with the new traffic.

4.2 MITIGATION

4.2.1 Mitigation

The analysis revealed that there are many opportunities to mitigate impacts by further refinements to the design and by associated management. Issues investigated included:

- retaining wall options to reduce clearing and enhance stability,
- revegetation, including plantings within the structure of the retaining walls,
- use of constrained (narrower) sections of road to reduce clearing and slow traffic down,
- stormwater drainage and measures to improve water quality,
- fauna-sensitive design, and
- improvements to scenic amenity and presentation opportunities.

All of these techniques provide opportunities to improve the preferred solution and thereby reduce impacts. It is recommended that these issues be further investigated in the detailed design stage.

In addition, the proponent is committed to an overall Offsets and Additionality Policy to compensate for any residual impacts following mitigation.

5. ISSUES FOR ENVIRONMENTAL APPROVALS

5.1 INTRODUCTION

The Access Road Strategy report provides information relevant to the approval to construct the Access Road under:

- the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth),
- the *Wet Tropics Management Plan 1998* (Qld),
- the *Vegetation Management Act 1999* (Qld),
- the *Nature Conservation Act 1992* (Qld), and
- the *Coastal Protection and Management Act 1995* (Qld).

The following is a brief summary of the key issues.

5.2 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT

5.2.1 Overview

The *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) protects what are termed matters of national environmental significance by requiring that actions that pose significant impacts be subject to assessment by the Minister for the Environment and Water Resources.

Key EPBC Act issues are the impacts of the proposed works on:

- World Heritage values (both the Wet Tropics and Great Barrier Reef World Heritage areas), and
- listed species.

5.2.2 Compliance

The key issues identified are:

- impact on scenic values of the Wet Tropics World Heritage Area when viewed from the Great Barrier Reef World Heritage Area, and
- impacts on the Southern Cassowary.

Visual impacts are proposed to be managed by the revegetation of cuttings, embankments, and retaining walls in accordance with the Revegetation Strategy. In terms of presenting World Heritage values, the new road is expected to have a beneficial impact and will become a quality scenic drive.

The conservation of the Southern Cassowary is to be addressed via:

- the development of a Cassowary Management Strategy for the Access Road that includes a Fence & Funnel Strategy and specific initiatives to reduce vehicle/cassowary collisions (one such is the proposed “fauna friendly” bridges that provide connectivity between the Flying Fish Point Reserve and the Ella Bay National Park at the southern end and at Heath Point at the northern end of the road), and
- a comprehensive Offsets and Additionality Policy to investigate suitable on-site and off-site works or actions that could mitigate or offset project impacts on all matters of national environmental significance.

5.3 THE WET TROPICS MANAGEMENT PLAN

5.3.1 Overview

Part of the Ella Bay Road traverses the Wet Tropics World Heritage Area. Any roadworks requires a permit under the *Wet Tropics Management Plan 1998* (Qld) (WTMP).

The key consideration under the WTMP is that the Authority may issue a permit to build a road only if building the road under the permit would not have a net adverse impact on the integrity of the World Heritage Area <u>or</u> there is no prudent and feasible alternative. <u>These requirements are alternatives (not additive) such that only one needs to be met.</u>

As the following table establishes, there are no prudent and feasible alternatives to the preferred solution as developed in this Access Road Strategy. See also schematic in **Section 2.4** above.

TABLE 5.3.1: SUMMARY OF ALTERNATIVES

ALTERNATIVE	PRUDENT?	FEASIBLE?
s58(2)(a) Alternative Sites for the Proposed Activity		
Broad Route Option – Mountainous Road Option (via Garradunga).	✕	✕
Broad Route Option 3 – Tunnel Option (direct route via existing road reserve from the Bruce Highway)	✕	✕
s58(2)(b) Alternative Use for the Proposed Site of the Activity		
Existing road (does not meet transport efficiency criteria).	✕	✕
Conservation (does not meet transport efficiency criteria).	✓	✕
s58(2)(c) Alternative Way of Carrying Out the Activity		
Broad route options ruled out.	✕	✕
Further refinement of preferred route / road option. Concept design as proposed.	✓	✓
S58(2)(d) Alternative of Not Carrying Out / Postponing Activity		
No upgrade or deferred upgrade. Ruled out.	✕	✕

5.3.2 Compliance

The following table summarises the compliance of the proposal with the detailed requirements of the WTMP.

TABLE 5.3.2: COMPLIANCE WITH PERMIT ASSESSMENT CRITERIA

CONDITION	EXTENT OF COMPLIANCE
s56: Most important consideration (likely impact on the area's integrity)	Complies. Providing that the recommended mitigation works are implemented effectively, there will be little adverse impact in integrity.
s57: Precautionary principle	Complies. It is concluded that due cognisance has been given to the precautionary principle. Specifically, attention has been given to the reversibility of impacts through the environmental management and mitigation strategies to ensure that reversibility of adverse impacts has been maximised.
s58: No prudent and feasible alternatives	Complies. There are no prudent and feasible alternatives to the preferred solution.
s59: Minimal impact on World Heritage values	Complies. It is concluded that there will be minimal impacts on World Heritage values providing that the recommended mitigation works are implemented effectively. (continued over)

CONDITION	EXTENT OF COMPLIANCE
s60: Community considerations	Complies.
s61: Carrying capacity	N/A.
s62: Consultation guidelines	Complies. These guidelines will be met during the permit process (the Access Road Strategy is to be advertised as part of the Supplementary EIS process).
s65(1): No net adverse impact on the integrity of the area or no prudent and feasible alternatives.	Complies. While there will be a net adverse impact on the integrity of the area, no prudent and feasible alternative exists.
s65(2): Confine roadworks (to the greatest extent possible) to existing cleared or otherwise degraded areas	Complies. The design confines roadworks to land already cleared or otherwise degraded, to the greatest possible extent.
s65(3)(a): Permit canopy clearing if the roadworks are needed for the provision of a community service	Complies. While canopy clearing is required, the road is a service to a future community. Canopy connectivity will be addressed as part of the detailed Fence & Funnel Strategy which includes rope bridge s.
s65(3)(b): Have regard to the potential cumulative impact on the area's integrity of the proposed activity and another activity carried out or likely to be carried out.	Complies. Cumulative impacts are offset by the initiatives of the Offsets & Additionality Policy.

5.4 THE VEGETATION MANAGEMENT ACT

5.4.1 Overview

The key consideration of the *Vegetation Management Act 1999* (Qld) (VMA) is the conservation of significant regional ecosystems and the provision of offsets where impact cannot be avoided. The following table shows the areas of new clearing by regional ecosystem category.

TABLE 5.4.1: SUMMARY OF CLEARING QUANTITIES BY REGIONAL ECOSYSTEM

REGIONAL ECOSYSTEM TYPE	AREA OF CLEARING (ha)
Endangered	0.00
Of concern	0.58
Not of concern	1.86
Non-remnant	0.02
Total	2.47
Revegetation (Tunnel)	-0.49
Net	**1.98**

5.4.2 Compliance

With respect to the VMA:

- the (currently) preferred solution has been selected to minimise the need to clear regional ecosystems with a high conservation value,
- implementation of the proposed mitigation strategy (retaining walls, constrained sections etc.) will further reduce the need to clear vegetation communities of conservation significance, and
- the comprehensive Offsets and Additionality Policy includes suitable on-site and off-site works or actions to mitigate or offset impacts on regional ecosystems of significance.

5.5 THE NATURE CONSERVATION ACT 1992

5.5.1 Overview

The key consideration is the conservation of significant plant and animal species and the provision of offsets where impacts cannot be avoided.

The modelling of habitat for plants and animals of conservation significance shows that only small areas will be lost (i.e. only 2.44 ha of remnant vegetation is to be cleared) and attention is being given to connectivity, both in terms of the Fence & Funnel Strategy (two dedicated crossings) and the construction of bridges at the key creek crossings where important frogs have been located.

5.5.2 Compliance

On the basis of observations and modelling of likely occurrence of listed plants and animals, it is likely that there will be some impacts on certain species listed under the *Nature Conservation Act 1992* (Qld). Specific permits will be required to take native wildlife.

Proposed mitigation works include:

- revegetation above the cut-and-cover tunnel (0.49 ha),
- cassowary conservation and Fence & Funnel Strategy initiatives as described above,
- attention to maintaining important ecological processes via:
  - the Fence & Funnel Strategy
  - attention to aquatic and riparian connectivity
  - the Road Runoff Strategy
  - the Revegetation Strategy, and
- the Offsets & Additionality Policy of suitable on-site and off-site works or actions to mitigate or offset impacts on listed species.

5.6 COASTAL PROTECTION AND MANAGEMENT ACT 1995 (QLD)

5.6.1 Overview

The *Wet Tropical Coast Regional Coastal Management Plan 2003* (Regional Coastal Plan) provides a regional direction for the implementation of the State Coastal Management Plan – Queensland's Coastal Policy (State Coastal Plan) in the Wet Tropical Coast Region, including Ella Bay. The Plan has been developed by the Queensland Government under the *Coastal Protection and Management Act 1995* (Qld), and describes how the costal zone of the Wet Tropical Coast Region is to be managed.

Key coastal issues for the Access Road Strategy are:

- protection of biological resources (especially wetlands and coastal vegetation communities),
- avoidance of erosion prone areas, and
- protection of visual amenity.

5.6.2 Compliance

This analysis reveals that the proposed Access Road complies with the Regional Coastal Plan with respect to all biological criteria. As previously noted, visual amenity (especially when viewed from ships at sea) will initially be reduced but this impact will lessen over time as the proposed revegetation of the retaining walls becomes established.

Visual impacts are proposed to be managed and mitigated as described above.

6. DETAILED MANAGEMENT CONSIDERATIONS

The analysis reveals that the impacts of the proposed Access Road can be mitigated by:

- a Fence and Funnel Strategy (comprising fauna corridors, fencing, and associated road ecology initiatives),
- a Cassowary Management Strategy (i.e. to reduce conflict with traffic and thereby promote the conservation of this species),
- a Road Runoff Strategy (to document the approach to road drainage and pollution control),
- a Revegetation Strategy, and
- an overall Environmental Management Plan for the road (an overview of the recommended approach to minimise road impacts through the design, construction and operational phases).

Finally, the Offsets and Additionality Policy includes suitable on-site and off-site works or actions to mitigate or offset residual impacts on listed species, vegetation communities, and ecological processes.

7. RECOMMENDED ACCESS SOLUTION BY PASSING FLYING FISH POINT AND UPGRADING ROAD TO ELLA BAY

7.1 INTRODUCTION

As noted earlier, the multi-criteria analysis has informed a decision on route options between Flying Fish Point and the Fish Farm, with the preferred solution being Option D (refer to **Section 2.3.2**). This is a composite of three segments (refer to **Figure 1**).

- **Segment 1**: a new bypass road west of Flying Fish Point incorporating a cut and cover tunnel. This bypass meets the existing road alignment just north of Flying Fish Point.
- **Segment 2:** upgrading of the existing road from the end of the bypass to the beginning of the World Heritage Area opposite the Fish Farm.
- **Segment 3:** upgrading of the existing road within the World Heritage Area (i.e. to the southern boundary of the Little Cove site).

Sections of the new road are proposed to be fenced to protect fauna (and in particular cassowaries) for impacts with traffic, with safe crossings to be provided in key locations (i.e. over the tunnel, opposite the Flying Fish Point Reserve, south of Heath Point, and at two key creek crossings.

This route has been refined after further consultation with the community and government agencies in the light of additional information and analysis.

7.2 SEGMENT 1: FLYING FISH POINT TO SOUTH OF THE FISH FARM

Description: a new bypass road west of Flying Fish Point incorporating a cut and cover tunnel. The Flying Fish Point Option D is the preferred route from the existing Flying Fish Point Road as it bypasses the residential area and avoids any significant adverse impact on amenity and social values. Under this option it is proposed that the existing access to the Ella Bay Road, just north of Flying Fish Point, will be closed to vehicles. This will effectively make Flying Fish Point a cul de sac with no through access to Ella Bay from Flying Fish Point except for bicycles, pedestrians and during emergencies.

A tunnel has been incorporated into this route at a saddle in the ridge behind the Flying Fish Point township. The incorporation of a tunnel in this option has resulted in:

- A gentle road gradient, with the road only rising approximately 20 metres at the highest point.
- Greatly reduced earthworks because the road is predominately traversing low slope areas. This has resulted in minimal vegetation clearing, reduced habitat loss and improved visual amenity.
- The tunnel provides connectivity of habitat and also reduces the amount of ultimate vegetation loss (after re vegetation).
- Few if any impacts on the existing residential Flying Fish Point community.
- A reduced travel time due to the shorter route and gentle grades, and no major intersections that slow traffic in the bypass section.

This section of road is on a new alignment and passes through a section of an “of concern” regional ecosystem with important biodiversity values for plants and animals. The extent of vegetation and habitat loss (after revegetation above the tunnel (0.49 ha) and after reduction in clearing areas by the use of retaining structures) is 1.44 ha, of which only 0.2 ha is within the “of concern” regional ecosystem. This loss is to be off-set and compensated for by an extensive revegetation and rehabilitation program at the Ella Bay property as described in **Working Paper 5** to the Access Road Strategy.

This section of the road will be covered by the Cassowary Management Strategy and Fence and Funnel Strategy to provide cross-road connectivity for fauna and for excluding fauna from the road. A 50 metre rehabilitated corridor above the tunnel maintains connectivity of habitat.

7.3 SEGMENT 2: SOUTH OF THE FISH FARM TO THE START OF THE WORLD HERITAGE AREA

Description: upgrading of the existing Ella Bay Road from the end of the bypass to the beginning of the World Heritage Area opposite the Fish Farm. The road at this point flattens out significantly and follows the existing road alignment to the point at which it enters the Wet Tropics World Heritage Area (Ch 1780).

Minor vegetation clearing (0.21 ha) will be required to widen the existing road to the World Heritage Area boundary. Just prior to the Fish Farm is a known cassowary crossing point. Proposed cassowary management at this point under the Cassowary Management Strategy involves a “fauna friendly” bridge to allow safe under-road passage for cassowaries and other fauna to move between the Ella Bay National Park and the Flying Fish Point Reserve as well as measures such as speed reduction (to a maximum speed of 40 km/h). Speed enforcement strategies are currently being considered.

A second “fauna friendly” bridge to the north of the Fish Farm was proposed in this segment (refer **Figure 3**) but has been reconsidered as its benefits were considered negligible.

Figure 3. Proposed fence and funnel strategy. Note that the northern “fauna friendly bridge is currently being reconsidered.

7.4 SEGMENT 3: START OF WORLD HERITAGE AREA TO LITTLE COVE, ELLA BAY

Description: upgrading of the existing Ella Bay Road within the World Heritage Area (i.e. to the southern boundary of the Little Cove site). Within the World Heritage Area, the existing winding road is to be upgraded to the new standards. Extensive use is to be made of retaining structures and the “constrained sections” approach to limit the need for extensive clearing and earthworks and thus protect both biodiversity and scenic values. These structures will incorporate vegetation to reduce visual impact and improve habitat values. Services will be located under the road to further reduce the need for clearing.

Only 0.44 ha of clearing is proposed within the World Heritage Area and this may be able to be reduced by the use of constrained sections. In Segment 3 the total area of clearing is 0.46 ha (i.e. from Heath Point to Little Cove).

The Road Runoff Strategy will be particularly important in this location to protect water quality and the concept design includes small bridges at crossing points in preference to culverts as a measure to protect aquatic and riparian habitat and habitat connectivity.

7.5 CONCLUSIONS

Providing that the recommendations of the overall Access Road Strategy and associated strategies are implemented, the proposed Access Road is expected to be sustainable from an environmental and social perspective.

8. CONSIDERATION OF FURTHER ALTERNATIVES

8.1.1 New Options

Review of the draft Access Road Strategy in December 2007 by the Environmental Protection Agency, the Wet Tropics Management Authority and the Department of the Environment, Water, Heritage and the Arts resulted in the evolution of two further options for alignments in the vicinity of the Flying Fish Point Reserve for assessment as described below.

a) Option RB1

This option varies from the preferred solution in the vicinity of the Flying Fish Point Reserve where it passes to the east of the Flying Fish Point Road (see **Figure 1**). Features include:

- western bypass with cut and cover tunnel (as per Segment 1 of the preferred solution (Option D of the multi-criteria analysis),
- use of a short section of Ruby Street running east to the Bindon Street intersection,
- use of the existing Bindon Street road reserve east of the Flying Fish Point Reserve and construction on a new reserve along the southern side of the Fish Farm (as per Option B of the multi-criteria analysis), and
- use of the balance of the Ella Bay Road north from the Fish Farm (as per Segment 2 (part) and Segment 3 of the preferred solution).

b) Option RB2

This option varies from Access Road Strategy Option D (the preferred solution) in the vicinity of the Flying Fish Point Reserve where it passes to the east of the Ella Bay Road but not as close to the existing houses along Bindon Street as Option RB1. It does not directly use the Ruby Street corridor. Features include:

- western bypass with cut and cover tunnel (as per Segment 1 of the preferred solution),
- construction on a new alignment within the Flying Fish Point Reserve on a more westerly alignment than RB1 buffered from the adjacent community by a 50 m separation, and construction on a new reserve along the southern side of the Fish Farm,
- inclusion of a fauna underpass to provide habitat connectivity under the road within the Flying Fish Point Reserve, and
- use of the balance of the Ella Bay Road north from the Fish Farm (as per Segment 2 (part) and Segment 3 of the preferred solution).

8.2 SUMMARY OF ANALYSIS AND CONCLUSIONS

8.2.1 Multi-criteria Analysis

The MCA described above was re-run for the two new options, using the “significant” attributes derived in the Access Road Strategy. This showed that

- Option D scores best overall and for four of the six unique weighting schemes,
- Option B remains the superior environmental option, and
- Option D remains the preferred option for social amenity and transport efficiency.

However, in few cases are the differences shown by the MCA to be significant and furthermore, the analysis has revealed a number of issues that are not shown up by the MCA. These are discussed below.

8.2.2 Overall Findings

It is apparent that the final decision will be one that decides between:

- environmental sustainability (E) where **Option B** is superior, and
- transport efficiency (T) and social amenity (S) where the **Preferred Solution** prevails.

Of the two new options, RB1 scores better than RB2 in terms of environmental sustainability but worse in terms of transport efficiency and social amenity.

One of the drivers for considering Options RB1 and RB2 was to reduce fragmentation of the Reserve from the national park where the existing and upgraded Ella Bay Road passes between the two. The solution to this issue in the Access Road Strategy was the installation of a purpose-designed fauna friendly bridge and associated fencing. This is still a viable option.

The whole idea of considering Options C and D in the Access Road Strategy was to bypass the Flying Fish Point township and hence reduce impacts on residents. To construct the bypass and cut and cover tunnel and then return to the residential area is an inefficient solution, although the points of conflict are still better than a pure “town” option.

Should it be decided that Option RB1 or RB2 have merit (and this would only be if the approving agencies believe that the differential environmental performance is significantly better than for the Preferred Option), then it would be more logical to further consider Option B and dispense with the expensive bypass west of the town.

8.2.3 Conclusions

The proponent considers that the potential impacts of the two new options outweigh and possible benefits and that the Preferred Solution (i.e. Option D of the Access Road Strategy) remains the best option.

8.3 FURTHER IMPROVEMENT OF PREFERRED OPTION

Additional investigations have been undertaken into the critical environmental issue of maintaining fauna (and especially cassowary) access between the Ella Bay National Park and the Ella Bay Reserve. The solution to this issue in the Access Road Strategy was the installation of a purpose-designed “fauna friendly” bridge and associated fencing.

Further investigations have been undertaken and plans are being considered to provide four separate fauna underpasses to replace this single bridge structure where there the terrain offers opportunities to slightly elevate the road. Four separate structures are proposed with lengths of 3.6, 18, 32.4 and 3.6 m.

Research by the Department of Main Roads in association with the former Rainforest CRC at the James Cook University has confirmed the use of appropriately designed structures by cassowaries (and other fauna) at the following locations:

- Streets Creek on the Kuranda Range Road,
- Laceys Creek and the Hull River Bridge on the Tully – Mission Beach Road, and
- Fauna Underpass on the East Evelyn Road.

Details of the enhanced fauna underpasses are shown below.

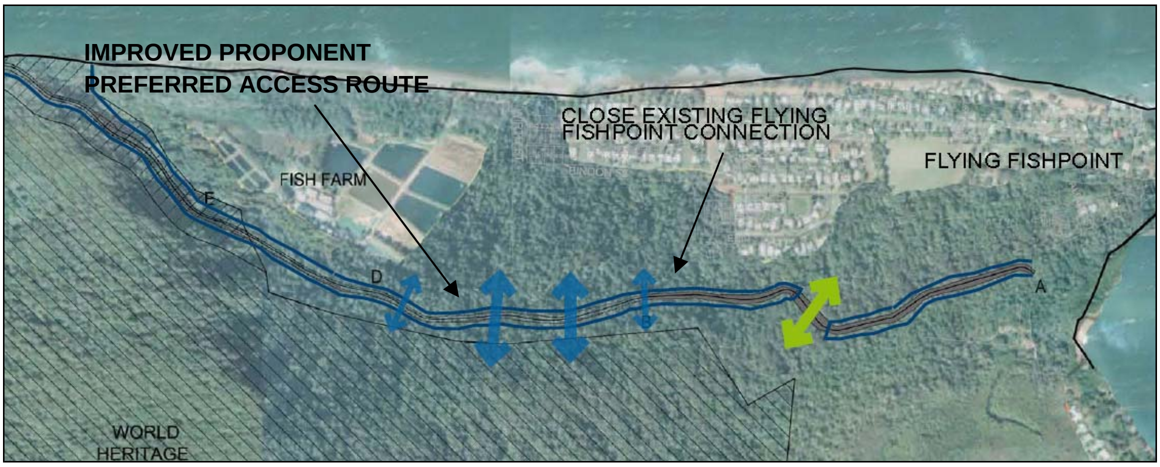


Figure 4: Aerial photo of improved access route D plus balance of road.

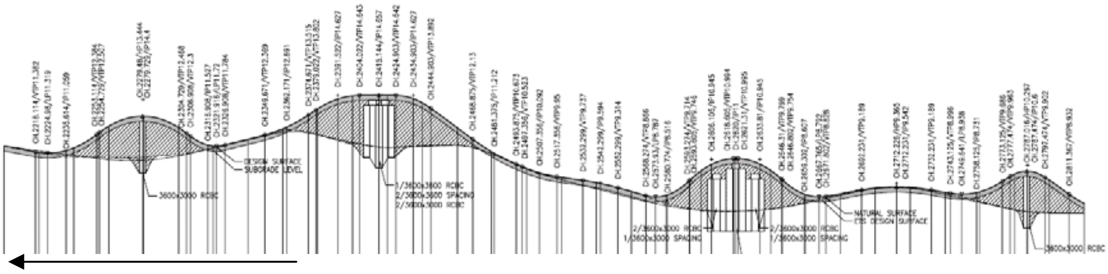


Figure 5: Longitudinal section of the improved preferred access route option D. Note that a vertical exaggeration of 10 has been applied.

MAIN REPORT

1 INTRODUCTION

1.1 PURPOSE AND NATURE OF REPORT

This report has been prepared to document additional investigations into options for providing access to the proposed Ella Bay Integrated Resort in the Johnstone Shire and the subsequent impact assessment of the preferred solution.

The original EIS (Ella Bay Developments Pty Ltd 2007) described a number of initial options for access to the site and undertook a preliminary evaluation of these. On the basis of comments received during consultation on the draft EIS and further consideration by the proponent, further options have been developed for assessment.

This report describes the development and evaluation of suitable options and management needs of the preferred solution via what is termed the Access Road Strategy. This material is intended to be incorporated into the Supplementary EIS being prepared in response to comments on the original EIS.

The Access Road Strategy addresses the following issues:

- overview of previous broad options and the suite of options via Flying Fish Point Road,
- need for refinement of the EIS preferred Flying Fish Point Road option,
- high level screening of possible alternatives between Flying Fish Point and the Ella Bay Road and subsequent refinement of those showing promise,
- development and evaluation of refined options using a sophisticated multi-criteria analysis,
- impact assessment and identification of mitigation opportunities for the preferred solution, and
- development of detailed management needs for the preferred solution, including:
  - a **Fence and Funnel Strategy** (comprising fauna corridors, fencing, and associated road ecology initiatives),
  - a specific **Cassowary Management Strategy**[1] (i.e. to reduce conflict with traffic and thereby promote the conservation of this species),
  - a **Road Runoff Strategy** (to document the approach to road drainage and pollution control),
  - an overall **Environmental Management Plan** for the road (an overview of the recommended approach to minimise road impacts through the design, construction and operational phases), and
  - an **Offsets & Additional Environmental Investments Policy** of suitable on-site and off-site works or actions to mitigate or offset impacts on listed species, vegetation communities, and ecological processes.

[1] The Cassowary Management Strategy includes actions to protect cassowaries in terms of traffic issues (discussed in this Access Road Strategy) and in other areas (e.g. the Flying Fish Point township and the Ella Bay Integrated Resort).

1.2 FINDINGS

The preferred solution for providing access to the site developed through the high level screening and then the detailed MCA documented in this report is a composite of three road segments (see **Figure 1**):

- **Segment 1**: a new road (940 m long) that bypasses Flying Fish Point to the west and includes a cut-and-cover tunnel,
- **Segment 2:** an upgrade of the existing flat section of the Ella Bay Road (840 m long) to where the road enters the World Heritage Area just south of Heath Point, and
- **Segment 3:** an upgrade of the existing winding section of the Ella Bay Road (2000 m long) through the World Heritage Area to the Little Cove resort.

Parts of the road are proposed to be fenced to exclude fauna (especially cassowaries) and lead animals to safe crossing points above the tunnel and at two “fauna friendly” bridges at locations determined by specialist studies.

Some key statistics of the Access Road:

- length – 3.78 km,
- area of existing clearing incorporated in new road – 3.13 ha (1.95 ha in World Heritage Area),
- area of new clearing (in addition to existing cleared road) = 2.47 ha overall (2.44 ha of remnant vegetation),
- area of new clearing in World Heritage Area = 0.44 ha, and
- area of rehabilitation (over cut-and-cover tunnel) = 0.49 ha.

Regarding the existing access to Heath Point and Little Cove:

- resort traffic will bypass the Flying Fish Point township (the existing connection to the Ella Bay Road is proposed to be closed except for emergency vehicles),
- all of the existing Ella Bay Road is to be incorporated into the upgrade, and
- the upgrade through the World Heritage Area is proposed to be of a reduced engineering standard in order to limit speeds and a reduce the area of clearing required.

1.3 DETAILED DRAWINGS

A full set of A3 drawings of the Access Road is included in Volume 3 of the Supplementary EIS. These include details of:

- general arrangement,
- detailed plans,
- detailed longitudinal sections,
- detailed cross sections,
- detailed clearing plans for each of the four key biodiversity coverages (plant communities, plant species, animal species, and cassowary habitat), and
- other details including provision for cyclists and pedestrian and miscellaneous road details.

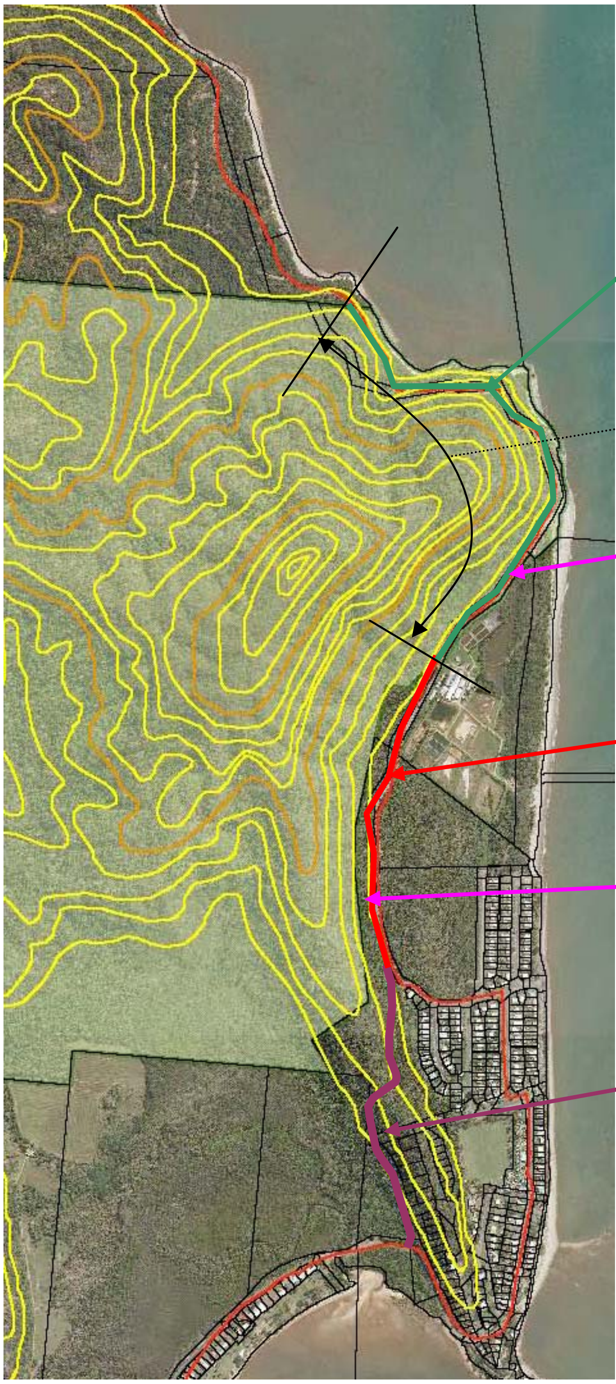


Figure 1. Proposed Access Road.

1.4 STUDY TEAM

The core team for this Access Road Strategy and the roles of team members is as follows.

COMPANY	INDIVIDUAL	ROLE
Environment North	David Rivett	• Study management • High level screening and multi-criteria analysis • Impact assessment (drawing on detailed inputs by others as required) • Recommendations for mitigation and environmental management • Reporting
Satori Resorts Ella Bay	Lindsay Byrne	• Town planning • Coastal Management • Social issues
ETS Group	Keith Howells Adam Allen	• Digital modelling • Engineering • Multi-criteria analysis (GIS work)
Biodiversity Assessment and Management	Paulette Jones Paula Boo	• Flora • Fauna (other than cassowaries) • World Heritage issues
Les Moore	Les Moore	• Cassowary issues
Golder Associates	James Beg	• Geotechnical issues
Terrain NRM	Allan Dale	• Offsets & Additional Environmental Investments Policy

Source: Study team compilation.

1.5 WORKING PAPERS

The following working papers have been prepared for this Access Road Strategy and are included in **Volume 2**. Material from these studies has been used by the authors (Environment North) in the preparation of this Access Road Strategy. While the original work has been used largely unaltered, the authors have used the material in accordance with their own judgement and take responsibility for this.

TABLE 1.5: WORKING PAPERS

WORKING PAPERS	AUTHOR	SUBJECT
Working Paper #1	ETS Group	Engineering Issues
Working Paper #2	Biodiversity Assessment and Management	Flora and Fauna (other than cassowaries)
Working Paper #3	Les Moore	Cassowary Issues
Working Paper #4	Golder Associates	Geotechnical Issues
Working Paper #5	Terrain NRM	Offsets & Additional Environmental Investments Policy (Executive Summary)

Source: Study team compilation.

2 OVERVIEW OF PREVIOUS ASSESSMENT OF OPTIONS

2.1 EIS EVALUATION

The EIS considered site access in two phases of assessment:

- Phase 1 – Broad Access Options (three broad options including upgrading the existing route and two new alignments), and
- Phase 2 – Flying Fish Point Options (variations on the preferred option from the Phase 1 evaluation).

These options and the EIS evaluation are briefly summarised below.

2.2 EIS PHASE 1 – BROAD ROUTE OPTIONS

The initial consideration involved three broad route options for site access (**Figure 2**), namely:

- Option 1 – Upgrading of Flying Fish Point Road (i.e. several options were developed that follow the general alignment from Innisfail via Flying Fish Point and the existing Ella Bay road).
- Option 2 – Mountainous Road Option (via Garradunga).
- Option 3 – Tunnel Option (direct route via existing road reserve from the Bruce Highway).

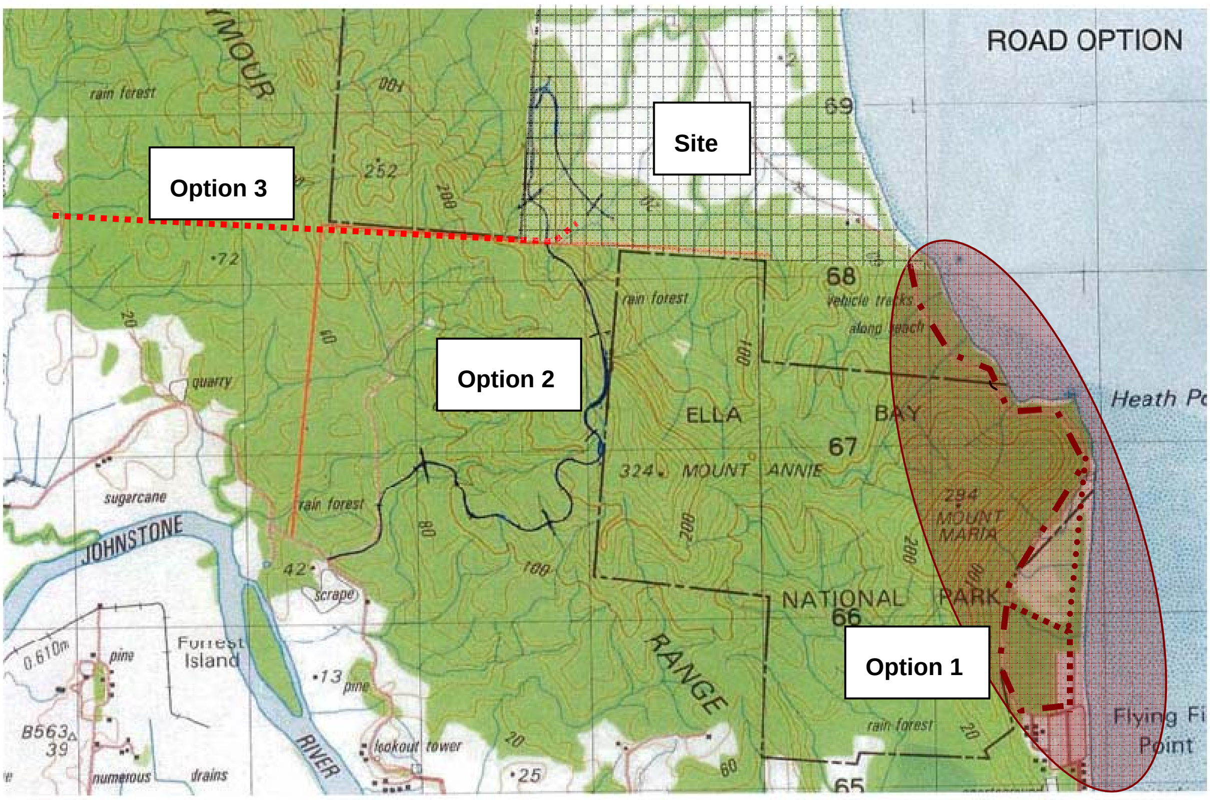


Figure 2. EIS Broad Route Options.

These options were assessed both within the EIS and in the agency review of the EIS as summarised below.

TABLE 2.2: EVALUATION OF BROAD EIS ROUTE OPTIONS

OPTION	DESCRIPTION	EVALUATION	FURTHER CONSIDERATION?
Broad Route Option 1	Flying Fish Point Road	Recommended in EIS after extensive analysis and discussions with stakeholders and government agencies. Sub-options proposed in EIS and discussed by agencies – see below.	✓
Broad Route Option 2	Mountainous Road Option	Rejected due to impacts on the Wet Tropics World Heritage Area and environmentally sensitive vegetation and cassowary habitat. EIS rejection supported by EPA and DEW.	✕
Broad Route Option 3	Tunnel Option (direct route)	Rejected due to environmental issues and cost. EIS rejection supported by EPA and DEW.	✕

Source: Based on Ella Bay Developments (2007a).

After extensive analysis and discussions with the relevant stakeholders and government agencies, it was concluded that the Flying Fish Point Road Option (Option 1) was the best broad route option for Ella Bay Developments Pty Ltd to pursue.

2.3 EIS PHASE 2 – FLYING FISH POINT OPTIONS

The EIS then considered variations on Option 1 above, with all options including a common route from Innisfail to Flying Fish Point and then variations to the resort site at Heath Point via parts of the existing Ella Bay Road (see **Figure 3** below):

- Flying Fish Point Option 1 (via Elizabeth, George, Judy and Ruby Streets),
- Flying Fish Point Option 2 (via a new road on the western side of the existing urban area),
- Flying Fish Point Option 3 (via a new road along the esplanade and then west of the Seafarm site).
- Flying Fish Point Option 4 (via a new road along the esplanade (Option 3) then continuing east of the Seafarm site).

The EIS and supporting documents assessed these options based on a number of environmental and social criteria. While the EIS expressed a preference for Flying Fish Point Road Option 1 overall, the Cassowary study (Moore 2007) favoured Flying Fish Point Road Option 4 (i.e. the coastal route). No firm recommendation was made at the time and it was noted that further refinement of the EIS options was required to resolve these issues and consider approval, construction, operation, environmental, social and economic view points and, on the basis of this work, develop a preferred solution. In particular, consultation on the EIS (both community and agency) revealed divergent views on the need to protect biodiversity and social values and the need to carefully weigh these in a more formal assessment of options.

This refinement is documented in this Access Road Strategy via the high level screening (**Chapter 3**) and the multi-criteria analysis (**Chapter 4**).

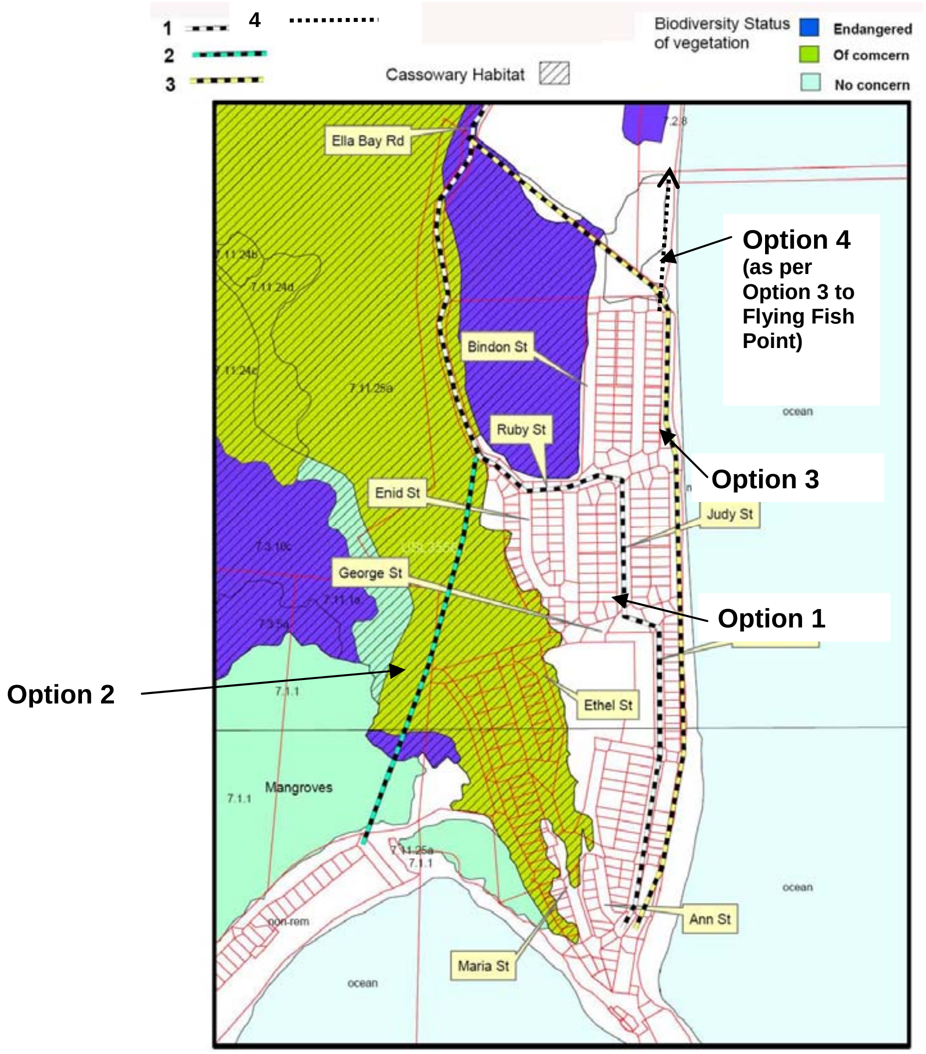


Figure 3. Flying Fish Point Road Options (Options 1 to 4).

2.4 ENVIRONMENTAL AGENCY COMMENTS ON EIS

2.4.1 Introduction

Comments from environmental agencies were received during the public notification period and some of these concerned the proposed Access Road. Key points from environmental agencies are summarised below. Further discussion on these and other issues also took place at a post-EIS workshop with environmental agencies to develop this Access Road Strategy (**Section 2.6**).

2.4.2 Broad Route Options

Comments were received on the broad route options from the following environmental agencies:

- Environmental Protection Agency,
- Wet Tropics Management Authority, and
- Department of the Environment and Water Resources.

All environmental agencies rejected the two broad route options that involved a totally new access road (i.e. Broad Options 2 and 3 in **Section 2.2** above) and preferred that access be via the existing Flying Fish Point Road (i.e. Broad Option 1 in **Section 2.2** above). This is consistent with the position taken by the proponent as described in the EIS.

2.4.3 Flying Fish Point Road Options

Although the environmental agencies preferred that access be via the existing Flying Fish Point Road, it is clear that none of the four Flying Fish Point Road options presented in the EIS met both biodiversity and social needs. It was recognised in the agency comments that there were competing biodiversity and social constraints and that more work was required to evaluate these in more detail. The key issues raised by the agencies were:

- impacts on vegetation communities (i.e. "of concern" regional ecosystems),
- impacts on cassowaries (their habitats and movement paths as well as "population sinks" and broader population dynamics),
- impacts on other fauna of conservation significance,
- visual impact of new cuttings etc., particularly as viewed from the Great Barrier Reef World Heritage Area, and
- residential amenity issues (e.g. noise, congestion and other traffic impacts for routes through or near the existing town area).

In its submission, the EPA (2007) provided detailed comments on three of the Flying Fish Point Road options described in the EIS and suggested three additional routes that could be worthy of consideration. These are described in the high level screening documented in **Section 3.5**.

2.5 COMMUNITY COMMENTS ON THE EIS

The public notification process identified a number of comments relevant to the Access Road Strategy. These include a number of biodiversity and social amenity issues that have been used as inputs to the development of this strategy. Key points raised were:

- effects of erosion on biodiversity values,
- impact of traffic on cassowaries and turtles, and
- impact of traffic on residents (pollution, fear of accidents, noise).

It was clear that community values included both biodiversity and social values and that none of the EIS options was considered to protect both meet both sets of values simultaneously. In particular, it was clear from the community comments that there was a need to refine the EIS bypass option (Flying Fish Point Option 2) to improve its biodiversity performance.

2.6 POST-EIS AGENCY CONSULTATION

2.6.1 Agency Workshop

An Access Road Strategy workshop was held in Cairns on 10 July 2007 and attended by the proponent and advisers and officers from WTMA and EPA. At this meeting:

- EPA and WTMA confirmed that they do not support Broad Options 2 and 3 described in **Section 2.2** above (i.e. access should be via Flying Fish Point Road),
- EPA and WTMA confirmed that this is also the view of DEW (this is also stated in DEW's review if the EIS as described above), and

- it was decided that the proponent should refine the Flying Fish Point Road options on the basis of a multi-criteria analysis (MCA) informed by additional fieldwork and analysis.

2.6.2 Additional Agency Consultation

During the development of this Access Road Strategy additional consultation has been undertaken by either or both the proponent and Environment North with the following environmental agencies:

- Wet Tropics Management Authority: officer level discussions; site inspection and subsequent meeting with the Board of the Authority.
- Great Barrier Reef Marine Park Authority: officer level discussions; site inspection and subsequent meeting (simultaneous to WTMA Board meeting).
- Environmental Protection Agency: officer level discussions.
- Department of the Environment and Water Resources: officer level discussions.

Inputs from these discussions have been incorporated into this report.

3 DEVELOPMENT AND EVALUATION OF ROAD OPTIONS

3.1 INTRODUCTION

This chapter describes the post-EIS work undertaken to refine broad access Option 1 (i.e. access via Flying Fish Point Road). This involved:

- delineation of a study corridor between Flying Fish Point and the resort site,
- development of an assessment methodology to guide further analysis,
- completion of additional studies to inform the detailed analysis:
  - biodiversity values
  - survey
  - traffic and transport issues
  - geotechnical issues
  - social and amenity issues,
- high level screening of all possible route options for the study corridor, and
- specification of a suite of short-listed options for detailed evaluation via the selected assessment methodology.

The actual evaluation is described in **Chapter 3.7** while assessment of impacts of the preferred solution is described in **Chapter 5**.

3.2 DELINEATION OF A STUDY CORRIDOR

The study corridor is bounded by the dashed line on the figure below. This area was selected to encompass all possible route options between Flying Fish Point and the Ella Bay Integrated Resort site.

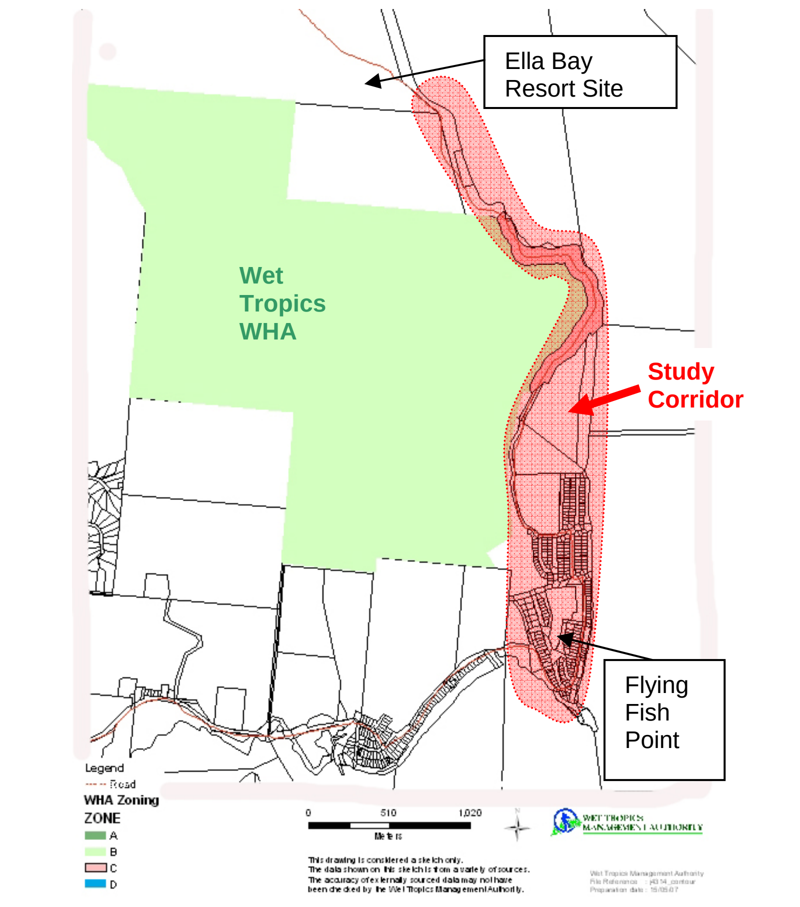


Figure 4. Study Corridor for Flying Fish Point Road options.

3.3 DEVELOPMENT OF AN ASSESSMENT METHODOLOGY

3.3.1 Introduction

It is clear that there are environmental, social, engineering and cost constraints to the Access Road and that, of the various options discussed in the EIS, none performed especially well with respect to all criteria. This is a common situation in infrastructure development and tools have been developed to consider disparate constraints in a robust and methodical way.

Multi-criteria analysis (MCA) is one of these tools and is a useful process for comparing initial options so that the "best" option can be determined. It is a comparative tool that requires:

- project objectives (i.e. the criteria against which to compare options),
- spatial coverages that map the criteria (including any variations in quality within each criterion),
- project alternatives whose performance can be quantitative measured for their effect on the criteria, and
- a sensitivity analysis to test the relative importance of various criteria and investigate weighting profiles.

A useful feature of MCA is that lessons learned during the measurement phase can be used to improve the "best" option (i.e. by optimising its performance) and thereby develop an even better solution. It is stressed that MCA cannot be used directly for impact assessment as it involves relative and not absolute measurements.

However, much of the quantitative assessment needed to inform the MCA is also useful for impact assessment and in the case of this Access Road Strategy this is certainly the case.

The balance of this section describes the principles of MCA as applicable to the Access Road Strategy.

3.3.2 Overview

The general approach adopted in applying MCA is explained below.

TABLE 3.3.2: GENERAL APPROACH

STEP	GENERAL APPROACH
1. Identify overall project desired outcomes	Determine the list of desired outcomes for the project in terms of things that it must or should achieve (beneficial impacts) such as return on investment and those things that it must not or should not result in (adverse impacts) such as destruction of cassowary habitat. Guidance on these issues can be found from a range of sources such as the client's stated business objectives, the local Planning Scheme, the *Vegetation Management Act 1999* (Qld), and other policy level documents such as the FNQ Natural Resource Management Plan, the Wet Tropics Management Plan, the EPBC Act, and a host of other documents.
2. Identify alternative development solutions	These are the range of route options considered to be worthy of further analysis – i.e. those that will meet the above project desired outcomes. Learnings from the EIS are relevant to this initial assessment. For this Access Road Strategy, an initial high level screening has been undertaken as part of the process of developing realistic options for evaluation. This was undertaken prior to the MCA.
3. Identify and measure values that may be impacted upon by the options and convert these to evaluation criteria	Determine the values of the study corridor that could be impacted upon by the various options, taking care to avoid confusion between values and impacts. Organise these into a hierarchy of criteria, attributes, and elements to produce "packages" of values such as *Environmental Sustainability*, *Transport Efficiency*, *Social Amenity*, and *Cost* likely to be affected by the works, either adversely or beneficially. Measure and otherwise assess the impacts of different options on these values through supporting technical studies and calculations.
4. Score the impacts (see **Special Note 1**)	Convert impacts into a form that is based on some unique characteristic of the option under consideration. This needs to be based on a combination of measured impacts, expert opinion, and through the consultation processes where possible.
5. Standardise the scores (see **Special Note 2**)	Convert the above scores to a standardised scale of -5 to +5. This provides both the relative ranking of options as well as some idea of the magnitude of the comparative performance of options. In this system, the performance of the existing road is deemed to be the benchmark and standardised scores are compared with this.
6. Determine overall scores (see **Special Note 3**)	Aggregate the individual standardised attribute scores into scores for each option as a whole. Attributes can be aggregated to the criterion level or to the overall score for the option. (continued over)

STEP	GENERAL APPROACH
7. Undertake a sensitivity analysis (see **Special Note 4**)	As required. Consider weightings to test robustness.
8. Iteration (see **Special Note 5**)	Repeat the process as often as necessary to refine options to arrive at the preferred solution.
9. Making a decision	The decision-maker (i.e. the owner or the approving agencies) makes a decision, using the results of the analysis as a guide.

3.3.3 Special Note 1: Step 4 – Score the Impacts

A key step in the process requires that measured or otherwise quantified impacts are converted into a form that is based on some unique characteristic of the option under consideration such as travel time, relative value of clearing between different areas, or relative cost of different engineering solutions.

If there is to be a difference between the performance of options with respect to a particular attribute (and if there is not, then the attribute is not useful for the evaluation process), some relationship needs to be found between the distinctives of the option for that attribute and the comparative importance of impacts. **In other words, some property of the option needs to be correlated with a comparative impact.**

It is evident that some relationships are very simple (i.e. cost) while others such as scenic amenity are quite complex, requiring the development of indices that encapsulate a range of quantitative and qualitative criteria.

3.3.4 Special Note 2: Step 5 – Standardise the Scores

In MCA, it is then necessary to convert the scores for each attribute (which could be in a range of units including hectares of habitat, dollars, minutes of travel time etc.) to a standardised scale that provides both the relative ranking of options and some idea of the magnitude of the comparative performance of options for each criterion.

The preferred method (based on detailed advice by Dr Geoff McDonald, then Head of Department of Geographical Sciences and Planning at the University of Queensland and as adopted in the Kuranda Range Impact Assessment Study (Maunsell McIntyre Proprietary Limited & Environment North (2000)) is to fit attribute measurements to a range of ***+5*** (most desirable) through ***0*** (neutral) to ***-5*** (least desirable) and interpolate intermediate values based on the scores. In this system, the sign indicates the direction of the impact (beneficial through neutral to adverse respectively) and the magnitude of the assigned (relative) significance levels.

3.3.5 Special Note 3: Step 6 – Determine Overall Scores

The final step in the primary evaluation is to aggregate the individual standardised attribute scores into scores for each option as a whole. Attributes can be aggregated to the criterion level or to the overall score for the option. Experience indicates that it is best not to be too reductionist in the application of MCA – a single answer (such as the famous "42") may not be helpful and may mask the various adverse and beneficial attributes of an option.

a) Algorithms to Rank or Score

Some sort of algorithm is required to rank and/or score the options, with the most simple being averaging, with or without weights. This is a very important component of the evaluation process, as it is easy to introduce unintended bias. For example, if the standardised scores for each of the attributes are simply added together (or averaged), the result will be influenced by both the number of attributes for each criterion and the relative importance of attributes. Secondly, a decision needs to be made about the relative importance of criteria.

b) Number of Attributes

If there are "n" *Transport Efficiency* attributes and one *Cost* attribute (this may be simply a reflection of the relative complexity of each criterion), then a simple sum or average of all attribute scores will weight *Transport Efficiency* relative to *Cost* by a factor of n:1. This is unlikely to be the intent.

A solution to this is to first determine scores at the criterion level by averaging the standardised attribute scores and then to compare overall criterion scores. A single score for each criterion is far easier to deal with.

c) Relative Importance of Attributes

While it may be possible to measure the performance of options by a large number of attributes, these are not always of equal importance and in some cases the things that they measure may not be independent. In other cases the attribute may reveal very little difference between options and to include this attribute may mask more significant differences and make the process unnecessarily complex.

Taking *Transport Efficiency* as an example, all options considered may have very similar (but not identical) capacities, whereas they could be clearly quite different in terms of constructability. While it is important to carefully measure the performance against all reasonable attributes, care must be taken in the conclusions drawn from this measurement.

It is possible to either weight individual attributes and then consider them all, or to include only those attributes that show significant differences between options or are in some way deemed to be "important". This is a form of weighting in itself.

d) Relative Importance of Criterion

Weighting at the criteria level involves taking more notice of some criteria than others. Qualitative or quantitative information is obtained from the decision-maker to assess the relative importance of the objectives and criteria. Weights obtained for higher order objectives in the objectives hierarchy (i.e. those performance measures for the upgrade that are more important than others) are used to constrain the importance assigned to lower order criteria. **This is the major judgmental phase of the MCA process and one for which a combination of professional judgement and community input is needed.**

Criteria weights are dependent on the preferences of the decision-maker and ideally should be derived through close interaction between the decision-maker (the proponent and/or government) and the decision analyst (the IAS consultant aided by stakeholders).

3.3.6 Special Note 4: Step 7 – Undertake a Sensitivity Analysis

Once the above steps are complete and an overall or by-criteria score is obtained for each option, attention needs to be given to the sensitivity of the results to minor changes in criteria scores (performance measures) and weightings. Sensitivity analysis is the systematic variation of data and decision rules used to rank alternatives to determine the reliability or "robustness" of the final ranking. It permits an assessment of the credibility of the results of MCA analysis. A ranking of alternatives which either does not change or changes minimally can be considered robust and reliable.

3.3.7 Special Note 5: Step 8 – Iteration

For this project, the first iteration involves the investigation of the effect of some "obvious" mitigation actions. These are changes to the design of some of the options that the team believed necessary to be made in order that the option remained prudent in terms of environmental sustainability and other criteria.

3.4 ADDITIONAL STUDIES

3.4.1 Traffic and Transport Issues

This report, prepared by the ETS Group (**Working Paper 1**), describes key aspects of the preliminary engineering design of the access road alternatives. It describes:

- design traffic (volumes, composition, design vehicle),
- design standards and their derivation, including justification for reduced standards,
- development of type cross section (including consideration of slope stability issues as described in **Working Paper 4** – see **Section 3.4.4**),
- preliminary drainage design/strategy,
- measurement of clearing areas for the environmental sustainability coverages (including allowance for existing road clearing),
- major quantities and costs, and
- concept level solutions to minimising environmental impacts).

Working Paper 1 also includes detailed engineering drawings of some of the route options and includes material used for the following transport efficiency coverages for the multi-criteria analysis (see **Sections 4.7.1** to **4.7.7**):

- Travel time at Level of Service (LOS) E,
- Capacity at LOS E,
- Accommodate service vehicle,
- Accommodate bicycles,
- Stability,
- Safety, and
- Constructability.

As noted previously, a full set of A3 drawings of the Access Road produced as part of the preparation of **Working Paper 1** is included in Volume 3 of the Supplementary EIS.

3.4.2 Biodiversity Values

a) Flora and Fauna (Other than Cassowaries)

This report, prepared by Biodiversity Assessments and Management (**Working Paper 2**), describes the findings of an assessment of flora and fauna (other than cassowaries) values, constraints and opportunities and was used to identify and map the following biodiversity coverages for the MCA:

- Important areas for plants (communities) (see **Section 4.6.1**),
- Important areas for plants (species) (see **Section 4.6.2**),
- Important areas for animals (other than cassowaries) (see **Section 4.6.3**), and
- Ecological processes (see **Section 4.6.5**).

Working Paper 2 also includes assessment of impacts and recommendations for impact mitigation of the preferred solution arising from the MCA and this is used in this Access Road Strategy in subsequent chapters.

b) Cassowary Issues

This report, prepared by Les Moore (**Working Paper 3**), describes findings of an assessment of cassowary values, constraints and opportunities and was used to identify and map the following biodiversity coverages for the MCA:

- Important areas for animals (cassowaries) (see **Section 4.6.4**).

Working Paper 3 also includes assessment of impacts and recommendations for impact mitigation of the preferred solution arising from the MCA and this is used in this Access Road Strategy in subsequent chapters. In addition, a Cassowary Management Strategy is in preparation at the time of writing (19 November 2007) and is therefore not appended. It will cover all aspects of cassowary management (i.e. for the Ella Bay Integrated Resort and the Access Road Strategy). Although not completed, much information on the Cassowary Management Strategy is already available from the original EIS and other work by Moore and this is described in **Section 7.3**.

3.4.3 Survey

A digital terrain model (DTM) was compiled by ETS for the study corridor based on:

- new photogrammetry based on existing aerial photography taken immediately post-Cyclone Larry (April 2006),
- a traverse of the existing road (centreline location and level and width of pavement), and
- other available survey data.

These various data sources were integrated into the project DTM and subjected to manipulation as required to reconcile data differences. Overall, it is considered (see **Working Paper 1**) that the resultant model is accurate to about 0.5 m where vegetation cover at the time of the photography allowed the ground to be reliably sighted and 1.5 m elsewhere. This accuracy is considered to be sufficient for the current level of assessment.

3.4.4 Geotechnical Issues

This report, prepared by Golder Associates (**Working Paper 4**), provides preliminary geotechnical advice on key design parameters for the Access Road (especially cut and fill slopes). As the report deals with a number of other issues not relevant to this Access Road Strategy, only an extract is included as **Working Paper 4**.

3.4.5 Social and Amenity Issues

It is clear from the analysis of comments on the EIS and arising from pre-EIS consultation that the Flying Fish Point community has two main concerns (see **Section 2.5**):

- that the environmental values be protected (especially in terms of reducing erosion and protecting cassowaries), and
- that traffic impacts on residents be limited (in terms of pollution, accidents, noise).

The proponent has provided key data on social issues for use in the MCA and impact assessment as described in the relevant sections.

3.4.6 Offsets & Additional Environmental Investments Policy

In anticipation of an outcome resulting in a net adverse impact by the Ella Bay Integrated Resort and the Access Road on biodiversity values, the proponent commissioned an Offsets & Additional Environmental Investments Policy to investigate suitable on-site and off-site works or actions that could mitigate or offset project impacts.

This report, by Terrain NRM, includes issues relevant to both the Access Road and resort itself. The executive summary of the **Offsets & Additional Environmental Investments Policy** is included as **Working Paper 5**.

In general, offsets are to be considered once all design and on-site mitigation options are exhausted. They are to compensate for the residual and irreducible impacts of the works on key biodiversity indicators including regional ecosystems, habitat for plants and animals of conservation significance, and specific conservation initiatives for the Southern Cassowary.

The offsets have deliberately not been applied prior to the high level screening, MCA and impact assessment as their magnitude would “swamp” the subtle differences in the performance of the options. For example, the total clearing of the preferred access road solution is under 3 ha whereas the Offsets & Additional Environmental Investments Policy is dealing in figures over twenty times this.

3.5 HIGH LEVEL SCREENING OF POSSIBLE ROUTE OPTIONS

3.5.1 Introduction

Together, the EIS, post-EIS suggestions by the EPA, and subsequent deliberations by the study team in consultation with the environmental agencies produced a large number of possible route options within the study corridor. These were first subjected to a high level screening to reject those with obvious problems prior to the more detailed work described in **Chapter 3.7**.

The following high level criteria were used as they encapsulate the relevant issues:

- **Biodiversity:** in particular the effect on cassowary habitat and movement (i.e. potential for road-kill), and likely loss of high value regional ecosystems (vegetation communities).
- **Residences:** number of residences directly affected by resort traffic. This has both amenity and safety aspects.
- **Scenic Amenity:** likely impacts of roadworks when viewed by ships at sea or from the township.

- **Constructability:** general assessment of engineering issues (extent of earthworks, difficult construction (e.g. along foreshore)).
- **Coastal Management:** specific coastal management issues likely to be involved with foreshore option. In particular whether or not the works are consistent with the *Wet Tropical Coast Regional Coastal Management Plan 2003*.

This screening is summarised in **Table 3.5.3**.

3.5.2 Options Considered

The following is a high level screen of broad options derived in the EIS and through post-EIS agency consultation. Flying Fish Point Road Options 1 to 4 are as developed in the EIS while Flying Fish Point Road Options 5 to 7 are as suggested by the EPA (2007). It should be noted that there is some inconsistency in labelling between the EIS and EPA options and this has been reconciled below. All seven options are shown on **Figures 5** and **6** below.

- Flying Fish Point Road Option 1 (EIS): via Elizabeth, George, Judy and Ruby Streets.
- Flying Fish Point Road Option 2 (EIS): via a new road on the western side of the existing urban area.
- Flying Fish Point Road Option 3 (EIS): via a new road along the esplanade and then west of the Seafarm site.
- Flying Fish Point Road Option 4:(EIS): via a new road along the esplanade and then east of the Seafarm site.
- Flying Fish Point Road Option 5 (EPA Option 4): via a new western route within the town footprint.
- Flying Fish Point Road Option 6 (EPA Option 5): a variation of Option 1 via George St rather than Ruby Street.
- Flying Fish Point Road Option 7 (EPA Option 6): a variation of Option 1 but continuing to the east via Bindon Street.

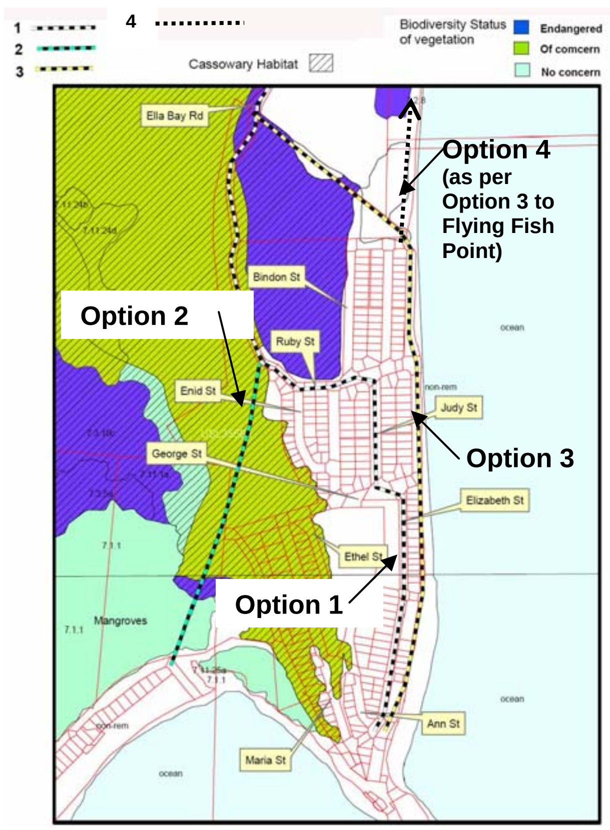
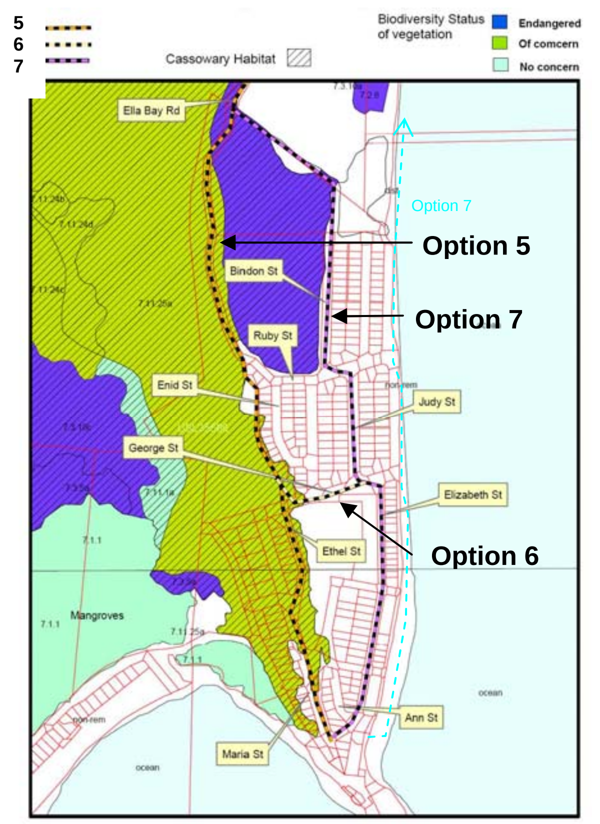
	

Figure 5. Flying Fish Point Road Options (Options 1 to 4).	**Figure 6.** Flying Fish Point Road Options(Options 5 to 7).

3.5.3 Analysis

See **Table 3.5.3**. For each criterion in this table:

- [Green] represents the best option(s),
- [Red] represents the worst option(s) or options that are unsuitable, and
- [Yellow] represents intermediate options.

In general, a single "worst" result (red) indicates that the option should be considered to be unsuitable unless some major modifications are considered. Explanatory text is included to briefly summarise the issue.

TABLE 3.5.3: ANALYSIS OF FLYING FISH POINT ROAD ROUTE OPTIONS

ITEM	FLYING FISH POINT ROAD OPTIONS						
	OPTION 1	**OPTION 2**	**OPTION 3**	**OPTION 4**	**OPTION 5**	**OPTION 6**	**OPTION 7**
Description	Existing Road	Western Route (Inland Option)	Esplanade then west of Fish Farm	Esplanade then east of Fish Farm	Western Route (Town Option)	George St Option	Bindon St Option
Biodiversity	Some conflict with cassowary movement.	Conflict with "of concern" and "endangered" regional ecosystems. Conflict with cassowary habitat and/or segregation of habitat.	Enables safe cassowary access to coastal habitat	Good outcome for cassowaries with some impact on regional ecosystems to the north.	Some loss of remnant vegetation ("not of concern").	Some small loss of remnant vegetation ("not of concern").	Best outcome for cassowaries and regional ecosystems.
Residences	Intermediate number of residences affected.	Best option for residences.	Intermediate number of residences affected.	Intermediate number of residences affected.	Best "town" option in terms of number of residences affected.	Intermediate number of residences affected. Little improvement on Option 1.	Largest number of residences affected (worse than Option 1).
Scenic Amenity	Little effect on scenic amenity.	Potential large impacts on scenic amenity (Large cuttings visible from ships at sea).	Likely to be highly visible for, ships at sea.	Likely to be highly visible for, ships at sea.	Likely to be highly visible for, ships at sea.	Little effect on scenic amenity.	Little effect on scenic amenity.
Constructability	Little work required.	Major construction required, large cuttings or tunnel required.	Major coastal construction required,	Major coastal construction required,	Major construction required at southern end.	Some minor construction works required in town area.	Some minor construction works required in town area.
Coastal Management	No coastal management issues.	Contrary to Coastal Management Plan.	Contrary to Coastal Management Plan.	Contrary to Coastal Management Plan.	No coastal management issues.	No coastal management issues.	No coastal management issues.

Source: Study team compilation.

3.5.4 Discussion

The above high level screening summarised above resulted in the following initial conclusions for each criterion as described in **Section 3.5.1**. It is stressed that these are initial conclusions and were used to not only rule out unsuitable options but also to identify possible improvements to shortcomings in the options as initially conceived. This is expanded upon in **Section 3.5.5**.

- **Biodiversity:** Option 7 is clearly the best option, followed by Option 3. Option 2 as currently conceived scores poorly for biodiversity as it impinges on the coastal wetlands. As noted below, there is scope to refine Option 2 to remove this shortcoming.
- **Residences:** Option 2 scores best by impacting on the fewest residences, while Option 5 is the best "town" option. Option 7 affects the most residences.
- **Scenic Amenity:** Options 1, 6 and 7 will have little or no impact on scenic amenity while all other options will be clearly visible from ships at sea. Option 2 may be improved if the large cutting is replaced by a tunnel section.
- **Constructability:** Option 1 requires little construction, while Options 6 and 7 will require new works within the town area. Options 3 and 4 will require significant coastal engineering work to stabilise the road. Option 5 would require major earthworks at the southern end while Option 2 involves a whole new alignment with substantial earthworks. However, this can be constructed off-line and therefore not result in traffic delays etc.
- **Coastal Management:** Options 2, 3 and 4 are all contrary to the *Wet Tropical Coast Regional Coastal Management Plan 2003* on the basis that they either conflict with wetlands (Option 2 as currently conceived) or erosion prone areas (Options 3 and 4).

It is clear that no one option as currently conceived performs well for all criteria. In terms of key biodiversity and amenity criteria, the most promising options are:

- **Biodiversity:** Options 3 and 7.
- **Residences:** Options 2 and 5.

In general terms, good biodiversity solutions involve impacts on residences and vice versa. As noted below there is scope for improvement in at least some of the options.

3.5.5 Opportunities for Improvement and Development

While Option 2 as currently envisaged (the inland option) initially scores poorly in terms of biodiversity and scenic amenity, it is the best outcome for residences by a wide margin. If the alignment could be modified to bring the road clear of the coastal wetlands (i.e. further to the east), and attention given to cassowary connectivity and scenic amenity, it could become a good overall solution, despite its likely cost.

Based on the above analysis and consideration of likely issues, the following overall options have been selected for detailed evaluation:

- **Option A:** High Level Option 1 (existing route) – a well-scoring "town" option,
- **Option B:** High Level Option 7 (the most promising biodiversity option),
- **Option C:** High Level Option 2 (bypass, but modified to be on a more easterly alignment – the most promising in terms of residential issues), and
- **Option D:** as for Option C but with a cut-and-cover tunnel to further address biodiversity and scenic amenity issues.

All options eventually meet at a point just south of the Fish Farm after which the Access Road follows the route of the existing Ella Bay Road which is to be upgraded.

3.6 OPTIONS FOR DETAILED EVALUATION

For this multi-criteria analysis, the following route options were considered for road solutions between the existing Flying Fish Point Road (Point A) and the Fish Farm (Point D) as shown on **Figure 7**. After Point D the road is intended to stay on the existing alignment, with the section between Points E and F being within the World Heritage Area. This is considered separately in **Section 6.2**.

To avoid confusion with earlier numbered options, these have been designated by letters.

TABLE 3.6: FLYING FISH POINT ROAD OPTIONS

ITEM	OPTION			
	OPTION A	**OPTION B**	**OPTION C**	**OPTION D**
Description	Existing Road (EIS Flying Fish Point Road Option 1)	Flying Fish Point Road Option 7 (EPA Option 6)	Inland Route – No Tunnel (variation of EIS Flying Fish Point Road Option 2)	Inland Route – Cut & Cover Tunnel (variation of EIA Flying Fish Point Road Option 2)
Points	A-C-B-D	A-C-D	A-B-D	A-B-D
Length	2540 m	2415 m	1490 m (900 m on new road)	1530 m (940 m on new road)

These route options are shown on **Figure 7**.

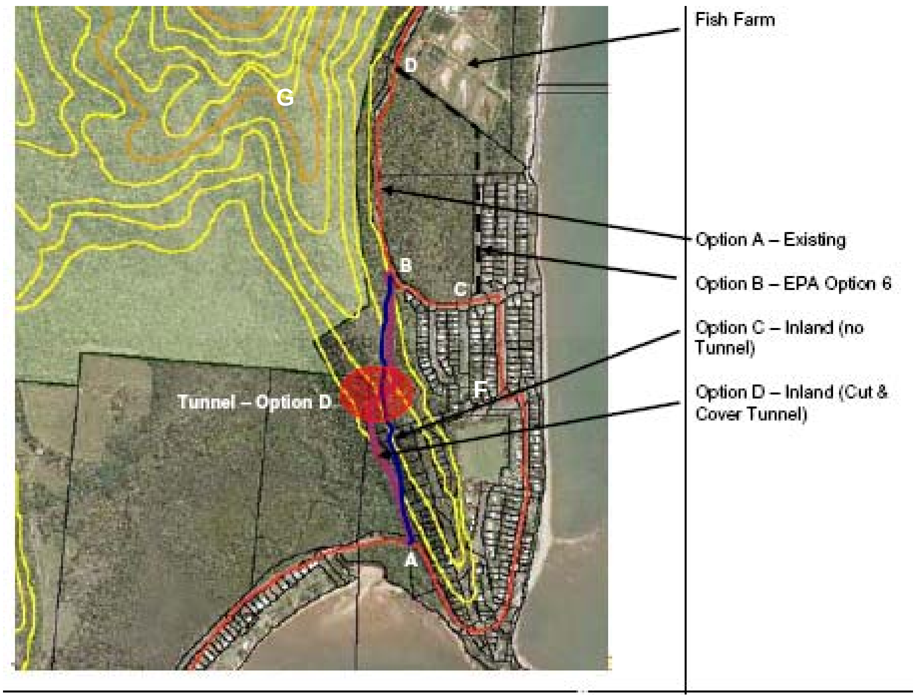


Figure 7. Flying Fish Point Road Route Options for detailed evaluation.

It has been identified that there are a number of options for the road between Points A and D but that between D and F (i.e. the resort site) the road should following the existing alignment as far as possible.

3.7 SUMMARY OF DEVELOPMENT OF PREFERRED ACCESS ROAD SOLUTION

3.7.1 Introduction

In summary, the development of a preferred solution for access to the Ella Bay Integrated Resort involved a comprehensive screening process that started in the EIS and was completed in the Access Road Strategy. Key steps were:

- **EIS Step #1 – Broad Access Options** (i.e. three broad alternative access routes to the resort),
- **EIS Step #2 – Flying Fish Point Options** (i.e. four variations on routes via Flying Fish Point),
- **Access Road Strategy Step #1 – High Level Screening** (i.e. consideration of the four EIS Flying Fish Point options plus three additional routes as proposed by the Environmental Protection Agency during consultation),
- **Access Road Strategy Step #2 – Refinement of High Level Screening Survivors** (i.e. consideration of improvements to the four options that survived the High Level Screening), and
- **Access Road Strategy Step #3 – Multi-criteria Analysis** (i.e. detailed assessment of the four refined options from the high level screening, informed by additional studies).

These steps are summarised below.

3.7.2 EIS Consideration Of Options

a) EIS Step #1 – Broad Access Options

The initial consideration documented in the EIS involved three broad route options for site access, namely:

- Option 1 – Upgrading of Flying Fish Point Road (i.e. several options were developed that follow the general alignment from Innisfail via Flying Fish Point and the existing Ella Bay Road).
- Option 2 – Mountainous Road Option (via Garradunga).
- Option 3 – Tunnel Option (direct route via existing road reserve from the Bruce Highway).

After extensive analysis and discussions with the relevant stakeholders and government agencies during the preparation of the EIS, it was concluded that the Flying Fish Point Road Option (Option 1) was the best broad route option for Ella Bay Developments Pty Ltd to pursue.

Outcome: Flying Fish Point Road Option (Option 1) selected for further consideration.

b) EIS Step #2 – Flying Fish Point Options

The EIS then considered variations on Option 1 above, with all options including a common route from Innisfail to Flying Fish Point and then following the existing route to the resort site north of Heath Point via the (upgraded) existing Ella Bay Road:

- Flying Fish Point Option 1 (via Elizabeth, George, Judy and Ruby Streets).
- Flying Fish Point Option 2 (via a new road on the western side of the existing urban area).
- Flying Fish Point Option 3 (via a new road along the esplanade and then west of the Seafarm site).

- Flying Fish Point Option 4 (via a new road along the esplanade (Option 3) then continuing east of the Seafarm site).

The EIS and supporting documents assessed these options based on a number of environmental and social criteria. However, no firm recommendation was made at the time and it was noted that further refinement of the four EIS options for access via Flying Fish Point was required to resolve these issues and consider approvals, construction, operation, environmental, social and economic view points and, on the basis of this work, develop a preferred solution.

In particular, consultation on the EIS (both community and agency) revealed divergent views on the need to protect biodiversity on the one hand and social values on the other, and the need to carefully weigh these in a more formal assessment of options.

Outcome: No conclusion. All four Flying Fish Point Road Options (Flying Fish Point Options 1 to 4) selected for further consideration (post-EIS).

3.7.3 Access Road Strategy Consideration of Options

a) Access Road Strategy Step #1 – High Level Screening

Following the analysis of agency and community comments on the EIS analysis, further refinement was undertaken in developing this Access Road Strategy, comprising:

- a workshop between project experts and officers from the Environmental Protection Agency and the Wet Tropics Management Authority (this confirmed that, of the three broad route options, the Flying Fish Point option was preferred and that further analysis be undertaken of suitable sub-options), and
- a high level screening of all Flying Fish Point options (i.e. EIS options and those arising subsequently from consultation on the EIS). The following high level criteria were used as they encapsulate the relevant issues:
  - **Biodiversity:** in particular the effect on cassowary habitat and movement (i.e. potential for roadkill), and likely loss of high value regional ecosystems (vegetation communities).
  - **Residences:** number of residences directly affected by resort traffic. This has both amenity and safety aspects.
  - **Scenic Amenity:** likely impacts of roadworks when viewed by ships at sea or from the township.
  - **Constructability:** general assessment of engineering issues (extent of earthworks, difficult construction (e.g. along foreshore)).
  - **Coastal Management:** specific coastal management issues likely to be involved with foreshore option. In particular, whether or not the works are consistent with the *Wet Tropical Coast Regional Coastal Management Plan 2003*.

In all, seven Flying Fish Point options were assessed. These included the existing route and variations via the Flying Fish Point road network (“town” Options 1 and 3-7), and a western bypass of the town (the “bypass” option, Option 2).

Outcome: Three options using the Flying Fish Point road network (“town” Options 1 and 3-7), and a western bypass of the town (the “bypass” option, Option 2) selected for further improvement and development.

b) *Access Road Strategy Step #2 – Refinement of High Level Screening Survivors*

This assessment showed that while Option 2 (the bypass option) scored poorly in terms of biodiversity and scenic amenity, it was considered to be the best outcome for Flying Fish Point residents by a wide margin. The assessment also revealed that, if the alignment could be modified to bring the road clear of the coastal wetlands (i.e. further to the east), and attention given to cassowary conservation and scenic amenity, it could become a good overall solution, despite its likely cost.

Based on the above analysis and consideration of likely issues, the following overall options were selected for detailed evaluation. These were re-labelled to avoid confusion:

- **Option A:** High Level Option 1 (existing route) – a well-scoring "town" option,
- **Option B:** High Level Option 7 (the most promising biodiversity option, also a "town option"),
- **Option C:** High Level Option 2 (bypass of Flying Fish Point, but modified to be on a more easterly alignment – the most promising in terms of residential issues), and
- **Option D:** as for Option C (Flying Fish Point bypass) but with a cut-and-cover tunnel to address biodiversity and scenic amenity issues.

All options eventually meet at a point just south of the Fish Farm after which the Access Road follows the route of the existing Ella Bay Road which is to be upgraded. Refer to **Figure 7** above.

Outcome: Two options using the Flying Fish Point road network (Option A = "town" Option 1; Option B = "town" Option 7), and a western bypass of the town (a refinement of the "bypass" option, Option 2) selected. Two variations of Option 2 selected: one without a cut-and-cover tunnel (Option C) and one with (Option D).

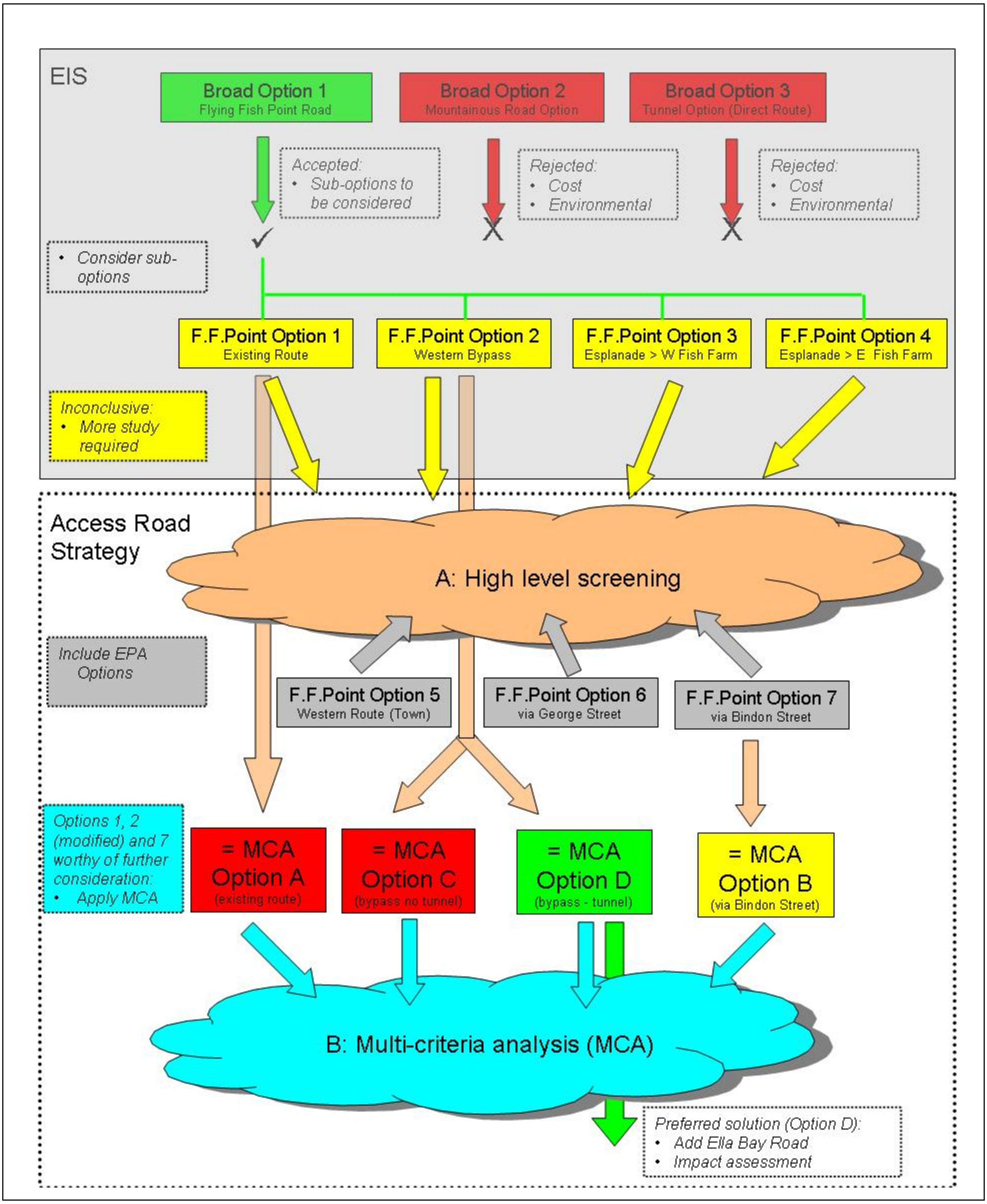
c) *Access Road Strategy Step #3 – Multi-criteria Analysis*

This step (see next chapter) involved the application of multi-criteria analysis (MCA) techniques to undertake a detailed assessment of the four refined options from the high level screening. This assessment was informed by a round of additional studies required to improve the understanding of key technical issues affecting the access road route.

Outcome: As described in the following chapter, the MCA resulted in the selection of Option D (the Flying Fish Point bypass with a cut-and-cover tunnel) as the preferred solution for a route through/past Flying Fish Point. This meets the existing Ella Bay Road just north of Flying Fish Point. Option D plus the upgrade of the Ella Bay Road through to the Little Cove site was then subjected to impact assessment.

3.7.4 Summary of Consideration of Alternatives

The following schematic demonstrates the above process graphically.


EIS
Broad Option 1
Flying Fish Point Road
Broad Option 2
Mountainous Road Option
Broad Option 3
Tunnel Option (Direct Route)
Accepted:
• Sub-options to be considered
Rejected:
• Cost
• Environmental
Rejected:
• Cost
• Environmental
• Consider sub-options
F.F.Point Option 1
Existing Route
F.F.Point Option 2
Western Bypass
F.F.Point Option 3
Esplanade > W Fish Farm
F.F.Point Option 4
Esplanade > E Fish Farm
Inconclusive:
• More study required
Access Road Strategy
A: High level screening
Include EPA Options
F.F.Point Option 5
Western Route (Town)
F.F.Point Option 6
via George Street
F.F.Point Option 7
via Bindon Street
Options 1, 2 (modified) and 7 worthy of further consideration:
• Apply MCA
= MCA Option A
(existing route)
= MCA Option C
(bypass no tunnel)
= MCA Option D
(bypass - tunnel)
= MCA Option B
(via Bindon Street)
B: Multi-criteria analysis (MCA)
Preferred solution (Option D):
• Add Ella Bay Road
• Impact assessment

4 DETAILED COMPARATIVE ASSESSMENT OF ROUTE OPTIONS

4.1 INTRODUCTION

This chapter describes the application of the multi-criteria analysis techniques documented in the previous chapter to the four short-listed options between the entrance to Flying Fish Point and the Fish Farm (Points a to D on **Figure 7**).

Following an initial analysis against all criteria, recommendations are then made for modifications to the basic options to improve their performance against the applied criteria. The analysis is then re-run on the modified options.

4.2 STEP 1 – IDENTIFY OVERALL PROJECT DESIRED OUTCOMES

For this Access Road Strategy, the following overall project desired outcomes (i.e. the desired outcomes for the Access Road) were identified, based on:

- the proponent's overall project vision for the Ella Bay Integrated Resort,
- the requirements of the environmental approval bodies (e.g. as set out in the *Wet Tropics Management Plan 1998* (Qld), the *Nature Conservation Act 1992* (Qld), the *Vegetation Management Act 1999* (Qld), the *Coastal Protection and Management Act 1995* (Qld) and other Queensland environmental legislation, and the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth)),
- social amenity outcomes based on the proponent's appreciation of social issues (largely as indicated by the community engagement program),
- transport efficiency criteria (i.e. the technical needs of the road), and
- affordability (i.e. the capital cost of the option).

4.3 STEP 2 – IDENTIFY ALTERNATIVE DEVELOPMENT SOLUTIONS

4.3.1 Opportunities and Constraints

The Study Corridor (**Figure 3**) includes a band of interest bounded to the north by the site of the Ella Bay Integrated Resort, to the south by the existing road to Flying Fish Point from Innisfail, to the west by rural land and the Ella Bay National Park/Wet Tropics World Heritage Area, and to the east by the Coral Sea and the Wet Tropical Coast section of the Queensland Marine Park/Great Barrier Reef World Heritage Area. Within this corridor are a number of features that, on the basis of the EIS assessment and subsequent analysis, constrain practical access road solutions or alternatively provide opportunities for them. These constraints and opportunities include (this is not an exhaustive list):

- opportunities:
  - existing road reserves
  - existing cleared areas
  - flat but not swampy land
  - land remote from built-up areas,

- constraints:
  - existing routes through built-up areas
  - other built-up areas
  - the Wet Tropics World Heritage Area zoning (roads are only permitted in Zones C and D)
  - regional ecosystems of conservation significance and other areas with high biodiversity values
  - steep land
  - elevated land where the road would be visible to ships at sea
  - tenure[2].

Practical alternative solutions also needed to meet minimum engineering standards including:

- grade,
- curve radii,
- lane width (capacity), and
- constructability.

4.3.2 Options Considered

The options considered are Options A to D as set out in **Table 3.6**. This includes two "town" options (one of which is the existing road) and variations on the best "inland" option adapted from the EIS on the basis of the high level screening described in the previous chapter.

It should be noted that this MCA has been performed a number of times as follows in order to take advantage of what are called "obvious mitigation actions" and then to consider sensitivity testing:

- Pass 1 (described in **Sections 4.6** to **4.9**) using what are described as "un-mitigated" options (see **Section 4.10**) – note that no overall assessment was made on the un-mitigated options.
- Pass 2 (described in **Section 4.11**) for the mitigated options.
- Pass 3 (described in **Section 4.12**) including consideration of sensitivity and weighting.

4.4 STEP 3 – IDENTIFY AND MEASURE ATTRIBUTES

4.4.1 Criteria

Based on a review of the various values of the study corridor, the multi-criteria analysis (MCA) of available options was tested against four broad criteria, namely:

- Environmental Sustainability,
- Transport Efficiency,
- Social Amenity, and
- Cost.

[2] The issue of tenure was raised with the Department of Infrastructure, the Department of Natural Resources & Water, and the Johnstone Shire Council. It was agreed that tenure was unlikely to be a serious constraint as the Johnstone Shire Council agreed in principle to take over the road once completed. This will need to be addressed as a future task.

4.4.2 Attributes

Each criterion was then broken down into attributes which deal with a particular aspect of the overall criterion and a knowledge of the likely constraints and opportunities inherent in the study corridor.

The final set of criteria and attributes is as tabulated below. Note that under the environmental sustainability criterion there are two fauna attributes, namely:

- important areas for animals other than cassowaries, and
- important areas for cassowaries.

This distinction was made in recognition of the very high conservation significance of the Southern cassowary as highlighted in Moore (2007).

TABLE 4.4.2: CRITERIA AND ATTRIBUTES

CRITERION	CODE	ATTRIBUTE
Environmental Sustainability	• E1 • E2 • E3 • E4 • E5	• Important Areas for Plants (Communities) • Important Areas for Plants (Species) • Important Areas for Animals (Other than Cassowaries) • Important Areas for Animals (Cassowaries) • Ecological Processes
Transport Efficiency	• T1 • T2 • T3 • T4 • T5 • T6 • T7	• Travel Time at Level of Service (LOS) E (see **Section 4.4.3**) • Capacity at LOS E • Accommodate Service Vehicle • Accommodate Bicycles • Stability • Safety • Constructability
Social Amenity	• S1 • S2 • S3 • S4 • S5	• Important areas for Scenic Amenity • Scenic Quality for Road Users • Noise • Construction Issues • Severance of Communities
Cost	• C1	• Cost

Source: Study team compilation.

4.4.3 Mapping of Environmental Sustainability Attributes

Detailed maps showing the intersection of each proposed solution and maps based on attributes E1 to E4 were produced by ETS based on detailed coverages provided by BAAM (**Working Paper 2**) and Moore (**Working Paper 3**). These are included in Volume 3 of the Supplementary EIS while the calculated areas are described below.

4.4.4 Level of Service

The ability of a road to carry a certain vehicular flow is determined by seal widths and geometry and traffic flow is expressed by way of a qualitative measure of the level of service. The level of service assessment by convention involves a scale of A to F and deals with conditions in terms of:

- speed and travel time,
- freedom to manoeuvre,
- traffic interruptions, and
- comfort and convenience, and
- safety.

The standard definitions or conditions associated with the various Levels of Service (LOS) of a roadway are as detailed below (Austroads 1988). The LOS is essentially a measure of the performance or operating condition of a roadway or intersection arising from particular ranges of traffic flow.

- ***Level of Service A*** **-** is a condition of free flow in which individual drivers are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high, and the general level of comfort and convenience provided is excellent.
- ***Level of Service B*** **-** is in the zone of stable flow and drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream, although the general level of comfort and convenience is a little less than with Level of Service A.
- ***Level of Service C*** **-** is also in the zone of stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience declines noticeably at this level. This is generally the point at which upgrading to networks is considered.
- ***Level of Service D*** **-** is close to the limit of stable flow and is approaching unstable flow. All drivers are severely restricted in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is poor, and small increases in traffic flow will generally cause operational problems. This is also generally the other end of the scale at which upgrading of networks is considered.
- ***Level of Service E*** **-** occurs when traffic volumes are at or close to capacity, and there is virtually no freedom to select desired speeds or to manoeuvre within the traffic stream. Flow is unstable and minor disturbances within the traffic stream will cause breakdown.
- ***Level of Service F*** **-** is in the zone of forced flow. With it, the amount of traffic approaching the point under consideration exceeds that which can pass it. Flow breakdown occurs and queuing and delays result.

Thus, Level of Service A represents the best operating conditions (free flow) while Level of Service F is the worst (forced or breakdown flow). **Generally rural roads are upgraded once Level of Service D is reached.** This is described as being close to the limit of stable flow, where all drivers are severely restricted in their freedom to select desired speed and to manoeuvre within the traffic stream. Comfort is poor and a small increase in traffic can be expected to bring on operational problems.

For the purpose of this MCA Level of Service E has been selected as it represents a standard benchmark of capacity and flow condition towards the end of the practical life of the various options.

4.5 STEP 4&5 – SCORE THE IMPACTS & STANDARDISE SCORES

Refer **Sections 4.6** to **4.9**.

In this work only the sections of road where there are alternatives are measured, i.e. between Points A and D on **Figure 7**. The performance of the balance of the Ella Bay Road (which forms part of the preferred solution) the is included in the overall impact assessment described in **Chapter 5**.

4.6 ENVIRONMENTAL SUSTAINABILITY

4.6.1 Attribute E1: Important Areas for Plants (Communities)

DESCRIPTION OF ATTRIBUTE: Areas that are important for plant communities, in a hierarchy of conservation significance based on regional ecosystem mapping.

ELEMENTS: There is only one element for this attribute, namely regional ecosystems of conservation significance. These areas used the mapping from **Working Paper 2** Figure 6 (copy included over page) using a hierarchy ranging from Category A (highest conservation values) to Category E (lowest conservation values) based on their conservation significance under the *Vegetation Management Act 1999* (Qld), namely:

- A: endangered,
- B: of concern,
- C: not of concern,
- D: non-remnant, and
- E: cleared areas.

MEASUREMENT OF IMPACTS: Areas of clearing required for earthworks for each category of conservation significance were measured by intersecting the coverages with the batter points (clearing limits) for each road option. The 0.49 ha area above the cut-and-cover tunnel (Option D) is to be rehabilitated and this area has been measured as negative Category C. Similarly, for Option B the 590 m length of the existing Ella Bay Road no longer required is assumed rehabilitated as negative 0.35 ha of Category C value (assuming a disturbed width of 6 m).

SCORING OF IMPACTS: The nett area of clearing required for each category of conservation significance was weighted on the basis of the relative importance (significance) of the value under consideration as per the following table. Note that this is a subjective approach, with inputs being based on professional subjective opinion.

Weighting of Clearing

CATEGORY	WEIGHT
Category A	6
Category B	3
Category C	2
Category D	1
Category E	0

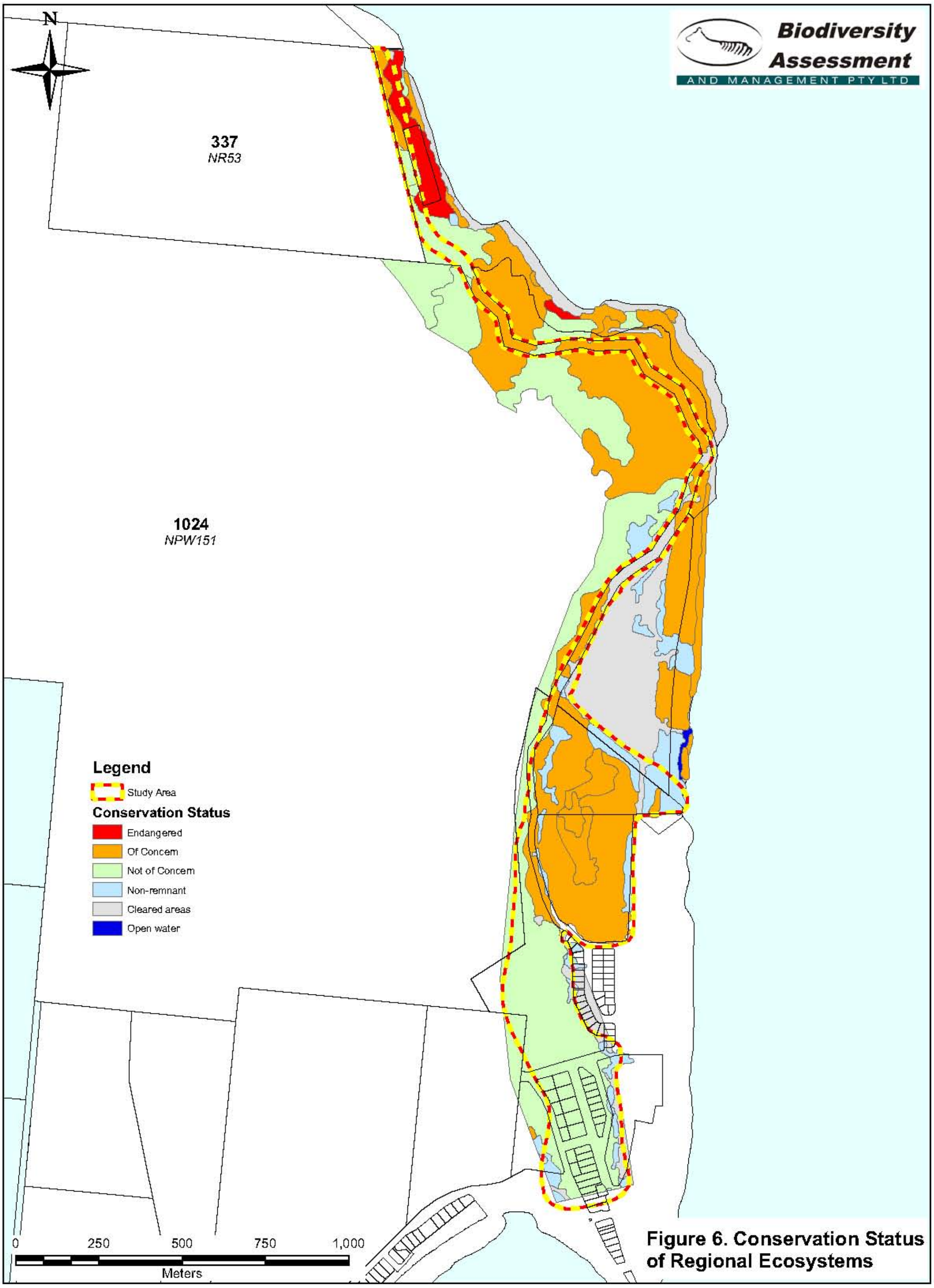


Figure 8. Attribute E1 (based on regional ecosystems). This and other similar coverages was converted to GIS layers and intersected with the road edges to produce areas of clearing. The resulting maps for Attributes E1 to E4 are include in Volume 3 of the Supplementary EIS.

Source: Working Paper 2 Figure 6.

As Category E (cleared land) has a zero value, it is not included in the following table.

Raw Measurements

OPTION	AREA BY CATEGORY (ha)				
	A	B	C	D	TOTAL
A	0.00	0.72	0.20	0.06	0.99
B	0.00	0.13	-0.35	0.10	-0.12
C	0.00	0.81	2.47	0.06	3.33
D	0.00	0.81	1.61	0.06	2.48

Weighted Measurements and Standardised Score

OPTION	WEIGHTED AREA BY CATEGORY (ha)					
	A	B	C	D	TOTAL	STANDARDISED SCORE
WEIGHT	6	3	2	1		
A	0.00	2.17	0.40	0.06	2.64	0.00
B	0.00	0.38	-0.70	0.10	-0.22	2.99
C	0.00	2.42	4.94	0.06	7.41	-5.00
D	0.00	2.42	3.23	0.06	5.70	-3.21

STANDARDISING THE SCORES: Weighted scores (areas times weight) were converted to the -5/0/+5 range. By convention, *existing* is 0, *most adverse* is –5 and *most beneficial* is +5. Intermediate scores were based on linear interpolation.

COMMENT: Option B is the preferred option from this attribute. This is because it involves very little new clearing and benefits by the rehabilitation of 0.35 ha of the existing Ella Bay Road. The worst option is Option C due to the relatively large area of new clearing and the absence of available rehabilitation.

GUIDELINES FOR DEVELOPMENT OF PREFERRED SOLUTION: Guidelines for the development of the preferred solution arising from a desire to minimise adverse impacts related to this attribute are:

- minimise clearing, especially in Category A and B areas (minimise footprint, maximise use of bridges and tunnels, maximise use of existing road and cleared areas),
- rehabilitate all previously cleared areas not needed for the road, and
- plant all cuttings and embankments to improve habitat quality (this rehabilitation has not been allowed for in the above areas).

4.6.2 Attribute E2: Important Areas for Plants (Species)

DESCRIPTION OF ATTRIBUTE: Areas that are important for individual plants of conservation significance. BAAM Figure 7 is a predictive coverage for plants of conservation significance.

ELEMENTS: There is only one element for this attribute, namely vegetation communities known to be habitat for plants of conservation significance.

The various species of plants of conservation significance (Table 4.11 of **Working Paper 2**) have different relative value (i.e. are listed as **endangered** to **rare** under the NCA and **vulnerable** under the EPBC). The value hierarchy selected ranges from Category A (highest conservation values) to Category E (lowest conservation values) as follows:

- A: endangered (NCA),
- B: vulnerable (NCA, EPBC),
- C: rare (NCA),
- D: remnant (unless in a higher category by virtue of habitat value for plants), and
- E: non-remnant or cleared (unless in a higher category by virtue of habitat value for plants).

MEASUREMENT OF IMPACTS: Areas of clearing required for earthworks for each category of conservation significance were measured. As for Attribute E1, rehabilitation allowances (Category C) have been assumed for Option B (0.35 ha) and Option D (0.49 ha).

SCORING OF IMPACTS: The nett area of clearing required for each category of conservation significance was weighted on the basis of the relative importance (significance) of the value under consideration as per the following table. Note that this is a subjective approach, with inputs being based on professional subjective opinion.

Weighting of Clearing

CATEGORY	WEIGHT
Category A	6
Category B	3
Category C	2
Category D	1
Category E	0

As Category E (non-remnant or cleared land) has a zero value, it is not included in the following table.

Raw Measurements

OPTION	AREA BY CATEGORY (ha)				
	A	B	C	D	TOTAL
A	0.20	0.74	0.00	0.10	1.04
B	0.00	0.13	-0.35	0.10	-0.12
C	2.47	0.82	0.00	0.09	3.38
D	2.10	0.82	-0.49	0.09	2.53

Weighted Measurements and Standardised Score

OPTION	WEIGHTED AREA BY CATEGORY (ha)					
	A	B	C	D	TOTAL	STANDARDISED SCORE
WEIGHT	6	3	2	1		
A	1.20	2.22	0.00	0.10	3.5	0.00
B	0.00	0.38	-0.70	0.10	-0.2	1.35
C	14.81	2.46	0.00	0.09	17.4	-5.00
D	12.62	2.46	-0.98	0.09	14.2	-3.86

STANDARDISING THE SCORES: Weighted scores (areas times weight) were converted to the -5/0/+5 range. By convention, *existing* is 0, *most adverse* is –5 and *most beneficial* is +5. Intermediate scores were based on linear interpolation.

COMMENT: Option B is the preferred option from this attribute. This is because it involves very little new clearing and benefits by the rehabilitation of 0.35 ha of the existing Ella Bay Road. The worst option is Option C due to the relatively large area of new clearing and the absence of available rehabilitation.

GUIDELINES FOR DEVELOPMENT OF PREFERRED SOLUTION: Guidelines for the development of the preferred solution arising from a desire to minimise adverse impacts related to this attribute are:

- minimise clearing, especially in Category A and B areas (minimise footprint, maximise use of bridges and tunnels, maximise use of existing road and cleared areas),
- rehabilitate all previously cleared areas not needed for the road, and
- plant all cuttings and embankments to improve habitat quality (this rehabilitation has not been allowed for in the above areas).

4.6.3 Attribute E3: Important Conservation Areas For Animals (other than cassowaries)

DESCRIPTION OF ATTRIBUTE: Areas that are important for animals (other than cassowaries) of conservation significance. As no trapping and detailed modelling has been undertaken, the habitat preferences of individual animal species have been selected from the mapped regional ecosystems (**Working Paper 2** Figure 5) such that the regional ecosystems can be considered as a surrogate for animal species of conservation significance. Refer **Working Paper 2** Table 4.11.

ELEMENTS: There is only one element for this attribute, namely vegetation communities known to be habitat for animals of conservation significance.

The various species of animals of conservation significance (Table 4.11 of **Working Paper 2**) have different relative value (i.e. are listed as **endangered** to **rare** under the NCA and **endangered** or **vulnerable** under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC)). In addition, **Working Paper 2** has assigned a particular regional ecosystem as preferred habitat for each species. Accordingly, in addition to their inherent values in terms of plant communities, regional ecosystems has been allocated a value based on the highest conservation significance of all fauna species that utilise it. The value hierarchy selected ranges from Category A (highest conservation values) to Category E (lowest conservation values) as follows:

- A: endangered (NCA, EPBC),
- B: vulnerable (NCA, EPBC),
- C: rare (NCA),
- D: remnant (unless in a higher category by virtue of habitat value for animals), and
- E: non-remnant (unless in a higher category by virtue of habitat value for animals).

Based on Table 4.11 of **Working Paper 2**, the following fauna categories were derived.

TABLE 4.6.3: FAUNA HABITAT CATEGORIES

	REGIONAL ECOSYSTEM												
	7.1.1	7.2.1	7.2.7a	7.2.8	7.3.3a	7.3.10a	7.3.25a	7.11.1	7.11.1a	7.11.26	7.11.34a	Non-remnant	Plantation
Fauna Habitat Category	B	A	B	A	A	A	A	A	A	B	A	A	A

Source: Based on Table 4.11 of **Working Paper 2**.

MEASUREMENT OF IMPACTS: Areas of clearing required for earthworks for each category of conservation significance were measured. As for Attributes E1 and E2, rehabilitation allowances (Category C) have been assumed for Option B (0.35 ha) and Option D (0.49 ha).

SCORING OF IMPACTS: The nett area of clearing required for each category of conservation significance was weighted on the basis of the relative importance (significance) of the value under consideration as per the following table. Note that this is a subjective approach, with inputs being based on professional subjective opinion.

Weighting of Clearing

CATEGORY	WEIGHT
Category A	6
Category B	3
Category C	2
Category D	1
Category E	0

Note re loss of habitat due to fencing etc.

It has been assumed that the fence allowed for along the boundaries of Options A, C and D will allow fauna movements across the Ella Bay Road from the national park to the Flying Fish Point Reserve on the basis that there are a number of small culverts that will remain and will provide some provision for small animals at least. Accordingly, it has been assumed that Options A, C and D do not involve consequential loss of the Reserve as fauna habitat. For Option B this situation does not arise.

In the case of Option C, the additional small area (0.94 ha) of habitat east of the road between the road and the Flying Fish Point township will be isolated by the road and therefore has been shown as "cleared". The land bridge included above the tunnel in Option D means that Option D avoids this loss.

Raw Measurements

As Category E (cleared land) has a zero value, it is not included in the following table.

OPTION	AREA BY CATEGORY (ha)				
	A	B	C	D	TOTAL
A	0.83	0.00	0.00	0.13	0.96
B	0.39	0.00	-0.35	0.00	0.04
C	2.34	0.00	0.00	0.13	2.47
D	2.44	0.00	-0.49	0.13	2.07

Weighted Measurements and Standardised Score

OPTION	WEIGHTED AREA BY CATEGORY (ha)					
	A	B	C	D	TOTAL	STANDARDISED SCORE
WEIGHT	6	3	2	1		
A	5.00	0.00	0.00	0.13	5.13	0.00
B	2.31	0.00	-0.70	0.00	1.61	1.94
C	14.05	0.00	0.00	0.13	14.18	-5.00
D	14.62	0.00	-0.98	0.13	13.77	-4.77

STANDARDISING THE SCORES: Weighted scores (areas times weight) were converted to the -5/0/+5 range. By convention, *existing* is 0, *most adverse* is –5 and *most beneficial* is +5. Intermediate scores were based on linear interpolation.

COMMENT: Option B is the preferred option from this attribute. This is because it involves very little new clearing and benefits by the rehabilitation of 0.35 ha of the existing Ella Bay Road. The worst option is Option C due to the relatively large area of new clearing, the absence of available rehabilitation, and the effective loss of habitat east of the road between Points A and B.

GUIDELINES FOR DEVELOPMENT OF PREFERRED SOLUTION: Guidelines for the development of the preferred solution arising from a desire to minimise adverse impacts related to this attribute are:

- minimise clearing, especially in Category A and B areas (minimise footprint, maximise use of bridges and tunnels, maximise use of existing road and cleared areas),
- rehabilitate all previously cleared areas not needed for the road,
- plant all cuttings and embankments to improve habitat quality (this rehabilitation has not been allowed for in the above areas), and
- provide habitat connectivity between points A and B where relevant.

4.6.4 Attribute E4: Important Conservation Areas For Cassowaries

DESCRIPTION OF ATTRIBUTE: Areas that are important for cassowaries in a hierarchy of conservation significance.

ELEMENTS: Important areas for cassowaries were identified on the basis of a specialist study by Moore (**Working Paper 3**). This study recognised two aspects of cassowary conservation, namely:

- habitat quality, and
- risk to cassowaries in accessing that habitat.

Moore created a system whereby an overall measure of the value of habitat to cassowaries (described as habitat value) was the product of the score of quality (on a scale of 1 (low) to 3 (high)) and risk to birds in accessing that habitat (on a scale of 0.1 (high risk) to 1.0 (low risk)). Inherent in this system is the recognition that in some cases birds do not gain from having access to particular habitat by virtue of mortality threats in the form of collisions with vehicles or attack by dogs. Moore describes such areas as "ecological traps" i.e., habitat which cannot sustain a population but nonetheless attracts individuals and elevates their extinction risk.

Using this methodology, Moore identified the habitat values of all parcels of land likely to be of relevance to the road options and the balance of the route to the resort site. In doing so, he made assumptions regarding risk (and in particular, whether or not a stretch of road was fenced). In this model:

- an unfenced road reduces the value of adjacent habitat (no matter how high) to a score of less than unity (described by Moore as negative) on the basis that cassowaries do not gain from its existence due to the threat of road-induced mortality,
- similarly, habitat that is not separated from nearby residential areas by fencing is also assigned a score of less than unity ("negative") on the basis that cassowaries do not gain from its existence due to the threat of attacks by dogs, and
- a fence to the road prevents the risk of accessing the habitat but at the same time reduces its value to zero (Moore does not deal with zero value and assigns a numerically low risk factor to reduce the overall quantitative value to a small number).

Moore recognises that fencing a road (to remove the risk of mortality) and at the same time providing traffic calming techniques (to allow access to otherwise inaccessible habitat) could theoretically restore the value of adjacent habitat to cassowaries. In determining the relative performance of Route Options A to D with respect to cassowary issues, the areas of habitat of relevance are:

- Area 4 (The Flying Fish Point Reserve) – habitat quality = 2, risk (unfenced) = 0.1; value = 0.2 ("negative"),
- Area 5 (Southern Ella Bay Access Road) – habitat quality = 3, risk (unfenced) = 0.1; value = 0.3 ("negative"),
- Area 6 (South Seymour Range) – habitat quality = 1, risk (unfenced) = 0.1; value = 0.1 ("negative"), and
- Area 7 (Flying Fish Point west) – habitat quality = 1, risk (unfenced) = 0.5; value = 0.5 ("negative").

On the basis that on-going research into the issue of fencing and safe road crossing points is proposed (see **Section 7.2** regarding the "Fence & Funnel" Strategy and **Section 7.3** regarding the overall Cassowary Management Strategy), for this MCA it has been assumed that an effective strategy can be devised to allow cassowaries to safely cross the road and otherwise access habitat of value. In Moore's model this would provide a risk factor of 1.0 (restoring the value of habitat to its intrinsic score). The revised values stated above were changed as follows:

- Area 4 (The Flying Fish Point Reserve) – habitat quality = 2, risk (Fence & Funnel) = 1.0; value = 2.0,
- Area 5 (Southern Ella Bay Access Road) – habitat quality = 3, risk (Fence & Funnel) = 1.0; value = 3.0,
- Area 6 (South Seymour Range) – habitat quality = 1, risk (Fence & Funnel) = 1.0; value = 1.0, and
- Area 7 (Flying Fish Point west) – habitat quality = 1, risk (Fence & Funnel) = 1.0; value = 1.0.

These areas were mapped using a hierarchy from Category A (highest habitat value) to Category C (lowest habitat value) as follows:

TABLE 4.6.4: CASSOWARY HABITAT CATEGORIES

CATEGORY	AREA (WORKING PAPER 3)	DESCRIPTION
A	Area 1 Area 5 Area 8	Ella Bay National Park and environs Southern Ella Bay Road Northern Ella Bay Road
B	Area 4	Flying Fish Point Reserve
C	Area 2 Area 3 Area 6 Area 7	Heath Point Beach front South Seymour Range Flying Fish Point west (swamp)

Source: **Working Paper 3** as modified above (i.e. assuming effective fencing). See footnote[3] below.

MEASUREMENT OF IMPACTS: Areas of clearing required for earthworks for each category of habitat value for cassowaries were measured. This took into account the presence of clearings formed by the existing road, together with earthworks, special treatment of fill batters, bridges and tunnels, and rehabilitation where the existing road is outside the batter points of the new road (see below). Specific additional assumptions were :

- **Tunnels:** while the cut and cover construction methodology requires clearing (habitat loss) between portals, the area is to be re-planted and restored in such a manner to provide effective cassowary connectivity. The 0.49 ha area above the cut-and-cover tunnel (Option D) is to be rehabilitated and this area has been measured as negative Category C clearing.
- **Road fencing:** it was assumed that the road (all options) is fenced on both sides to exclude cassowaries and hence prevent roadkill.
- **Other fencing**: it was also assumed that fencing will be undertaken on the eastern boundary of the Reserve to protect cassowaries from dogs (this is necessary to preserve the value of this habitat to cassowaries).
- **Funnels:** in this un-mitigated option[4], it was assumed that no effective method can be found to safely "funnel" cassowaries across or under the road and thereby cassowaries will not have access to the Flying Fish Point Reserve. In the calculations for Options A, C and D it is assumed that this area of habitat is "lost" (i.e. cleared). It was also assumed for Option C that all habitat east of the road is also lost in the section between Points A and D. For Option D this is not the case as there is to be a land bridge over the cut-and-cover tunnel.

SCORING OF IMPACTS: The nett area of clearing required for each category of conservation significance was weighted on the basis of the relative importance (significance) of the value under consideration as per the following table. As noted above, areas of key habitat that are to be restored were not included in the clearing quantities.

---

[3] This work was completed prior to the finalisation of **Working Paper 3**. In the final (November 2007) version of **Working Paper 3** Moore considered the effects of the proposed bridges and assigned a revised risk-mitigated value to the Flying Fish Point Reserve that is consistent with the above. See also **Section 4.10**. In addition, the earlier work by Moore upon which the MCA was based included only three categories of cassowary habitat (A to C) whereas in the November 2007 version a fourth category is included. The MCA is not sensitive to this change.

[4] This is an important consideration as the forthcoming discussion on "obvious mitigation actions" (**Section 4.10**) reveals.

Weighting of Clearing

CATEGORY	WEIGHT
Category A	4
Category B	2
Category C	1

Raw Measurements

OPTION	AREA BY CATEGORY (ha)			
	A	B	C	TOTAL
A	0.00	16.58	0.99	17.57
B	0.00	0.00	-0.12	-0.12
C	0.00	16.58	3.91	20.49
D	0.00	16.58	2.48	19.06

Weighted Measurements and Standardised Score

OPTION	WEIGHTED AREA BY CATEGORY (ha)				STANDARD
	A	B	C	TOTAL	
A	0.00	33.16	0.99	34.15	0.00
B	0.00	0.00	-0.12	-0.12	5.00
C	0.00	33.16	3.91	37.07	-5.00
D	0.00	33.16	2.48	35.64	-2.55

STANDARDISING THE SCORES: Weighted scores (areas times weight) were converted to the -5/0/+5 range. By convention, *existing* is 0, *most adverse* is –5 and *most beneficial* is +5. Intermediate scores were based on linear interpolation. This resulted in the following standardised scores.

COMMENT: Option B is the preferred option from this attribute. Although this option involves very little new clearing and benefits by the rehabilitation of 0.35 ha of the existing Ella Bay Road, its major advantage for this un-mitigated analysis is that it avoids the alienation of the Flying Fish Point Reserve as "safe" habitat. All other options are penalised on this consideration. The worst option is Option C due to the relatively large area of new clearing, the absence of available rehabilitation, and the effective additional loss of habitat east of the road between Points A and B.

GUIDELINES FOR DEVELOPMENT OF PREFERRED SOLUTION: Guidelines for the development of the preferred solution arising from a desire to minimise adverse impacts related to this attribute are:

- fence the road to reduce the risk of vehicle collisions with cassowaries, and
- where possible, introduce safe crossings to provide access to suitable habitat otherwise quarantined by the presence of the (fenced) road.

4.6.5 Attribute E5: Ecological Processes

DESCRIPTION OF ATTRIBUTE: Ecological processes that are important for the maintenance of flora and fauna values and that could be impacted upon by the road upgrade. Some of these occur at both the regional and local scales.

ELEMENTS: Important ecological processes were identified on the basis of a number of recognised measures including:

- ***connectivity***, i.e. geographical contiguity with other forest areas,
- ***refugial areas***, i.e. ability to withstand extreme climatic changes and thus provide relatively stable reservoirs of genetic material,
- ***critical habitat***, i.e. as a priority area for the conservation of viable populations of fauna (refer to E3 and 4),
- ***disjunct communities***, i.e. presence of isolated or outlying populations,
- ***hydrology***, i.e. role in maintaining energy and material flows through surface water and groundwater flows (both quantity and quality), and
- ***behavioural issues***, i.e. those behavioural characteristics of animals (other than those associated with the physical barrier effect) that could be affected by the upgrade, including sensitivity to noise and the effect of roadkill.

MEASUREMENT OF IMPACTS: Areas where critical processes may be impacted upon by one or more of the options were identified and counted. This took into account the presence of earthworks, special treatment of fill batters, bridges and tunnels. Elements measured were:

Connectivity:	The total length of road crossing of Category A and Category B fauna areas from E3 (i.e. subtracting length of bridge or tunnel) was measured for each option. This is effectively the barrier length for each important connectivity area.
Hydrology:	Maintenance of environmental flows (water <u>quantity</u>) at all watercourses will be a fixed design criterion (i.e. that all options must meet). Water <u>quality</u> is assumed to vary in proportion to traffic flow. This element was not measured.
Animal behaviour:	This element was not measured.

Refugial areas and ***critical habitat*** were not measured separately as they were already included in attributes E1 to E4.

SCORING OF IMPACTS: Each of the above elements were scored separately as described below.

Connectivity: The total length of road crossing of Category A and Category B areas (i.e. subtracting length of bridge or tunnel) was measured for each option. No weighting was applied for these categories on the basis that fauna can be expected to move through all vegetated areas.

STANDARDISING THE SCORES: Unweighted scores were converted to the -5/0/+5 range. By convention, *existing* is 0, *most adverse* is –5 and *most beneficial* is +5. Intermediate scores were based on linear interpolation. This resulted in the following standardised scores.

Raw Measurements and Standardised Score

OPTION	LENGTH OF BARRIER (m)	STANDARDISED SCORE
A	584	0.00
B	0	4.90
C	1180	-5.00
D	1110	-4.41

COMMENT: Option B is the preferred option from this attribute as it does not alienate the Flying Fish Point Reserve from other habitat. As later discussed, the installation of “fauna friendly” bridges in Options A, C and d removes this advantage.

GUIDELINES FOR DEVELOPMENT OF PREFERRED SOLUTION: Guidelines for the development of the preferred solution arising from a desire to minimise adverse impacts related to this attribute are:

- minimise clearing, especially in high value areas for plants and animals,
- rehabilitate all previously cleared areas and all batters,
- treat surface runoff prior to discharge to watercourses,
- maintain environmental flows to all watercourses,
- maintain aquatic habitat at watercourses, and
- incorporate special features to facilitate fauna crossing (e.g. underpasses and canopy bridges and longitudinal fences associated with these elements).

4.7 TRANSPORT EFFICIENCY

4.7.1 Attribute T1: Travel time at Level of Service (LOS) E

DESCRIPTION OF ATTRIBUTE: The time required for vehicles to travel from Point A on Flying Fish Point Road to Point D (where all options end in terms of comparative analysis). The travel times determined were based on the assumption that the roadway was operating at Level of Service ‘E’ (LOS E) as defined in **Section 4.4.3**.

ELEMENTS: (Travel time for) passenger cars and freight vehicles.

MEASUREMENT OF IMPACTS: Travel times for each class of vehicle (passenger cars commercial vehicles) for each option were estimated from average travel speeds based on AUSTROADS (1998) Part 2 Table 4.1 and the route capacity at LOS E.

SCORING OF IMPACTS: The calculated travel times for each class of vehicle was multiplied by the proportion of each class of vehicle in the traffic flow to produce a weighted travel time for each option. A 10% commercial vehicle content was assumed.

Raw Data

OPTION	TRAVEL TIME (MINUTES)	
	Passenger Cars	Commercial Vehicles
A	3.8	5.1
B	3.2	4.1
C	1.5	2.6
D	1.4	2.3

Weighted Measurements and Standardised Score

OPTION	WEIGHTED TRAVEL TIME (MINUTES)			STANDARDISED SCORE
	Passenger Cars	Commercial Vehicles	Total	
A	3.4	0.5	3.9	0.00
B	2.9	0.4	3.3	1.28
C	1.3	0.3	1.6	4.80
D	1.3	0.2	1.5	5.00

STANDARDISING THE SCORES: Raw scores were converted to the -5/0/+5 range. By convention, *existing* is 0, *most adverse* is –5 and *most beneficial* is +5. Intermediate scores were based on linear interpolation. This resulted in the following standardised scores.

Standardised Scores

OPTION	STANDARDISED SCORE
A	0.00
B	1.28
C	4.80
D	5.00

COMMENT: Option D is the preferred option from this attribute although there is very little difference between Options C and D. The existing road (Option A) is worst due to the lengthy and circuitous route through the existing township.

GUIDELINES FOR DEVELOPMENT OF PREFERRED OPTION: Guidelines for the development of the preferred solution arising from a desire to minimise adverse impacts related to this attribute are:

- reduce length of route, and
- adopt high engineering standards (e.g. gentle curves and grades).

4.7.2 Attribute T2: Capacity at LOS E

DESCRIPTION OF ATTRIBUTE: The average annual daily traffic (AADT) of each option at LOS E.

ELEMENTS: Capacity for passenger cars and 10% commercial vehicles.

MEASUREMENT OF IMPACTS: AADT values for upgrade options at LOS E were calculated for each option.

SCORING THE IMPACTS: Each option was scored on the basis of the estimated capacity.

Raw Data [estimates only, pending ETS input]

OPTION	AVERAGE CAPACITY (AADT)
A	3000
B	3500
C	4000
D	4000

STANDARDISING THE SCORES: Raw scores were converted to the -5/0/+5 range. By convention, *existing* is 0, *most adverse* is –5 and *most beneficial* is +5. Intermediate scores were based on linear interpolation. This resulted in the following standardised scores.

Standardised Scores

OPTION	STANDARDISED SCORE
A	0.00
B	2.50
C	5.00
D	5.00

COMMENTS: Options C and D are equally the preferred options for this attribute.

GUIDELINES FOR DEVELOPMENT OF PREFERRED OPTION: Guidelines for the development of the preferred solution arising from a desire to minimise adverse impacts related to this attribute are:

- reduce length of route, and

adopt high engineering standards (e.g. gentle curves and grades).

4.7.3 Attribute T3: Accommodate Service Vehicles

DESCRIPTION OF ATTRIBUTE: Suitability or otherwise of options for use by the nominated service vehicle (see **Working Paper 1**). This vehicle must be able to negotiate road grades and horizontal curves without leaving their traffic lane. In addition, it needs to be able to safely pass through the cut-and-cover tunnel (Option D).

ELEMENTS: It is a design requirement that all routes be able to accommodate the service vehicle or that an alternative route is possible should this not be the case.

MEASUREMENT OF IMPACTS: A three part scale apples, depending on whether or not an option is suitable for use by the service vehicle:

- Category A (highest) – option accommodates service vehicle,
- Category B (middle) – option does not accommodate service vehicle but an alternative route is available,
- Category C (lowest) – option does not accommodate service vehicle and an alternative route is not available.

Weighting of performance

CATEGORY	WEIGHT
Category A	2
Category B	1
Category C	0

SCORING THE IMPACTS: Each option was assessed for suitability and associated a score. The only limitation to the service vehicle is Option D where the maximum height of 7 m is available. Note that this height may be revised during detailed design.

Raw Data

OPTION	SCORE
A	2
B	2
C	2
D	1

STANDARDISING THE SCORES: Raw scores were converted to the -5/0/+5 range. By convention, *existing* is 0, *most adverse* is –5 and *most beneficial* is +5. Intermediate scores were based on linear interpolation. This resulted in the following standardised scores. As all upgrade options scored a "pass", they received a standardised score of +5.

Standardised Scores

OPTION	STANDARDISED SCORE
A	0.00
B	0.00
C	0.00
D	-5.00

COMMENT: Options A, B and C all score well on this attribute while Option D scores poorly. This is because the tunnel section imposes a 7 m height limitation that will preclude the largest of loads (although accommodating most vehicles without a problem). This analysis assumes that alternative access is available via the town and a lockable gate at the Ruby Street cul-de-sac. Note that this height may be revised during detailed design.

GUIDELINES FOR DEVELOPMENT OF PREFERRED OPTION: A guideline for the development of the preferred option arising from a desire to minimise adverse impacts related to this attribute is:

- provide greater clearance for the tunnel, or
- accept that occasional large loads may need to travel via the existing road.

4.7.4 Attribute T4: Accommodate Bicycles

DESCRIPTION OF ATTRIBUTE: Suitability or otherwise of options for use by cyclists. Bicycles must be able to negotiate road grades and horizontal curves safely.

ELEMENTS: It is a design requirement that all routes be able to accommodate bicycles or that an alternative route is possible should this not be the case.

MEASUREMENT OF IMPACTS: A three part scale apples, depending on whether or not an option is suitable for use by the bicycles:

- Category A (highest) – option accommodates bicycles,
- Category B (middle) – option does not accommodate bicycles but an alternative route is available,
- Category C (lowest) – option does not accommodate bicycles and an alternative route is not available.

Weighting of performance

CATEGORY	WEIGHT
Category A	2
Category B	1
Category C	0

SCORING THE IMPACTS: Each option was assessed for suitability and associated a score.

Raw Data

OPTION	SCORE
A	2
B	2
C	2
D	1

STANDARDISING THE SCORES: Raw scores were converted to the -5/0/+5 range. By convention, *existing* is 0, *most adverse* is –5 and *most beneficial* is +5. Intermediate scores were based on linear interpolation. This resulted in the following standardised scores. As all upgrade options scored a "pass", they received a standardised score of +5.

Standardised Scores

OPTION	STANDARDISED SCORE
A	0.00
B	0.00
C	-5.00
D	-5.00

COMMENTS: Options A and B score well on this attribute while Options C and D score poorly. This is because it has been assumed that cyclists will not be able to use the proposed bypasses (too steep and dangerous) and will need to use an alternative route.

GUIDELINES FOR DEVELOPMENT OF PREFERRED OPTION: A guideline for the development of the preferred option arising from a desire to minimise adverse impacts related to this attribute is:

- provide a cycleway on the bypass options or accept that cyclists adopt an alternative route.

Note: this attribute is misleading as it may actually be preferable to adopt a separate more suitable route for cyclists. This is discussed later in this report.

4.7.5 Attribute T5: Stability

DESCRIPTION OF ATTRIBUTE: Possible closures and delays resulting from land slippages.

ELEMENTS: Cut and fill slope heights.

MEASUREMENT OF IMPACTS: The risk of delay caused by slippages is closely correlated to the risk of a slip occurring (associated with the heights of cut and fill slopes and their extent). Each of the upgrade options was analysed and the length of cut and fill heights determined in height ranges based on the preliminary design. The un-mitigated design allowed for cut benches every 4.5 m in height so this was used as the standard step height for both cuts and fills. Design cross sections (**Working Paper 1**) were inspected and the length of each step range was calculated from cross section details and chainages.

SCORING THE IMPACTS: Since the higher slope height categories are likely to present the greatest risk of slippage, the risk of slippage was weighted for each of the four categories of height to produce a weighted risk factor.

Slope Height Category Weightings

CATEGORY	WEIGHTING
0 to 4.5 m	1
4.5 to 9.0 m	2
9.0 to 13.5 m	3
>13.5 m	4

Risk Data - Cut

OPTION	LENGTH OF SLOPE HEIGHT CATEGORIES – CUT (m)			
	0 to 4.5 m	4.5 to 9.0 m	9.0 to 13.5 m	>13.5 m
A	0	0	0	0
B	0	0	0	0
C	340	266	134	40
D	539	96	0	0

Risk Data - Fill

OPTION	LENGTH OF SLOPE HEIGHT CATEGORIES – FILL (m)			
	0 to 4.5 m	4.5 to 9.0 m	9.0 to 13.5 m	>13.5 m
A	0	0	0	0
B	0	0	0	0
C	549	44	9	24
D	295	320	20	0

Weighted Risk Factor

OPTION	WEIGHTED RISK FACTOR		
	Cut	Fill	Total
A	0	0	0
B	0	0	0
C	1434	758	2192
D	731	995	1726

STANDARDISING THE SCORES: Raw scores were converted to the -5/0/+5 range. By convention, *existing* is 0, *most adverse* is –5 and *most beneficial* is +5. Intermediate scores were based on linear interpolation. This resulted in the following standardised scores.

Standardised Scores

OPTION	STANDARDISED SCORE
A	0.00
B	0.00
C	-5.00
D	-3.94

COMMENTS: The evaluation reveals that both of the township options (A and B) are preferred for this attribute. This is due to the fact that only very minimal earthworks us required. Of the two bypass options, Option D is preferred as the tunnel section removes a significant length of large cuttings.

GUIDELINES FOR DEVELOPMENT OF PREFERRED OPTION: Options A and B are the equally preferred option from this attribute while of the two bypass options, Option D is preferred as the tunnel section removes a significant length of large cuttings.

Guidelines for the development of the preferred option arising from a desire to minimise adverse impacts related to this attribute are:

- provide extensive stabilising and/or protection works to the cut and fill slopes to reduce the potential for slope slippage.

It is important to note that for each of the bypass options there is still the opportunity for traffic to utilise the existing road network should any blockages occur. This will involve unlocking the gate at the Ruby Street cul-de-sac.

4.7.6 Attribute T6: Safety

DESCRIPTION OF ATTRIBUTE: The potential risk of accidents on the proposed routes and their possible impacts on human life, health and property.

ELEMENTS: Number of intersections with non-resort traffic.

MEASUREMENT OF IMPACTS: The number of intersections along the route.

SCORING THE IMPACTS: The score for this attribute was determined as simply the number of intersections along the route. Tee intersections were scored at 0.5 while cross intersections at 1.0 on the basis that the former includes half the number of possible conflicts.

STANDARDISING THE SCORES: Raw scores were converted to the -5/0/+5 range. By convention, *existing* is 0, *most adverse* is –5 and *most beneficial* is +5. Intermediate scores were based on linear interpolation. This resulted in the following standardised scores.

Weighted Measurements and Standardised Score

OPTION	NUMBER OF INTERSECTIONS	STANDARDISED SCORE
A	6.5	0.00
B	5.5	0.83
C	0.5	5.00
D	0.5	5.00

COMMENTS: The evaluation reveals that Options C and D are equally preferred for this attribute by a considerable margin. This is due to the fact that these options are free of intersections except at the intersection with Bay Road.

GUIDELINES FOR DEVELOPMENT OF PREFERRED OPTION: No practical guidelines for the development of the preferred option arising from a desire to minimise adverse impacts related to this attribute are apparent other than to:

- consider some intersection closures for Options A and B.

4.7.7 Attribute T7: Constructability

DESCRIPTION OF ATTRIBUTE: All options are considered constructable. However, construction difficulties and traffic management resulting in travel delays will vary for the four options being considered.

ELEMENTS: Traffic management, provision for traffic.

MEASUREMENT OF IMPACTS: The lengths of roadway that needs to be constructed under traffic.

SCORING THE IMPACTS: The score for this attribute was determined directly from the lengths described above. For this attribute the minimum value is the preferred.

Raw Data

OPTION	LENGTH (m)
A	2540
B	1615
C	590
D	590

STANDARDISING THE SCORES: Raw scores were converted to the -5/0/+5 range. By convention, *existing* is 0, *most adverse* is –5 and *most beneficial* is +5. Intermediate scores were based on linear interpolation. This resulted in the following standardised scores.

Standardised Scores

ROUTE	STANDARDISED SCORE
A	0.00
B	2.37
C	5.00
D	5.00

COMMENTS: Options C and D are preferred from this attribute on the basis that most of the work can be undertaken “off line”. Option B is preferable to Option A as a short section of road is on a new alignment.

GUIDELINES FOR DEVELOPMENT OF PREFERRED OPTION: Guidelines for the development of the preferred option arising from a desire to minimise adverse impacts related to this attribute are:

- construct as much as possible of the new road clear of the existing alignment.

4.8 SOCIAL AMENITY

4.8.1 Attribute S1: Important Areas for Scenic Amenity

DESCRIPTION OF ATTRIBUTE: Important areas for views of the road and its environment.

ELEMENTS: Important areas for views were identified on the basis of how much of the works is likely to be able to be seen from ships at sea (i.e. the extent of works that are not hidden by adjacent vegetation and topography).

MEASUREMENT OF IMPACTS: Impacts for each option were measured by determining the area of works visible from an arbitrary point in the adjacent waters. This point was chosen as the area from which the works would be most visible and it was assumed that any works above AHD 14 m on northern side of the saddle (Options C and D only) would be visible. This assumed an average height of remaining screening vegetation of 6.5 m and a natural surface of AHD 7.5 m. No allowance was made for rehabilitation of cuttings and fills.

SCORING OF IMPACTS: The area of exposure was calculated from the cross sections.

Raw Measurements

OPTION	AREA (m^2)
A	0
B	0
C	3842
D	1717

STANDARDISING THE SCORES: Weighted scores (areas times weight) were converted to the -5/0/+5 range. By convention, *existing* is 0, *most adverse* is –5 and *most beneficial* is +5. Intermediate scores were based on linear interpolation. This resulted in the following standardised scores.

Standardised Scores

OPTION	STANDARDISED SCORE
A	0.00
B	0.00
C	-5.00
D	-2.23

COMMENTS: The evaluation reveals that the two “town” options score well in that very little earthworks are involved and in any case, the roads will not be visible from the ocean. of the bypass options, Option

C is significantly more visible than Option D, due to the fat that it climbs steeper on the ridge and has larger cuttings and embankments.

GUIDELINES FOR DEVELOPMENT OF PREFERRED SOLUTION: Guidelines for the development of the preferred option arising from a desire to minimise adverse impacts related to this attribute are:

- adopt options that are lower in elevation,
- avoid (minimise) surface lighting for Options C and D, and
- rehabilitate all previously cleared areas and all batters by active replanting.

4.8.2 Attribute S2: Scenic Quality for Road Users

DESCRIPTION OF ATTRIBUTE: Important features of options from the perspective of road users.

ELEMENTS: This is a qualitative assessment based on:

- the degree of interest that the road provides to users (contrast Vs blending in; gradual transition Vs sudden change; regularity Vs variation), and
- the quality of views of the landscape itself from the road.

MEASUREMENT OF IMPACTS: Impacts for each option were measured on the basis of professional subjective opinion by assessing the degree of interest and quality of views using the following categories:

CATEGORY	DESCRIPTION
A	Contrast Vs. Blending-in
B	Gradual Transition Vs. Sudden Change
C	Regularity Vs. Variation
D	Provision of Views

SCORING OF IMPACTS: Scores were assigned as above. See below for raw scores and comments. Impacts (beneficial or adverse) on each category were assigned on the following basis:

- max beneficial +1; neutral 0; max adverse -1

Analysis of Views

CATEGORY	OPTION A		OPTION B		OPTION C		OPTION D	
A - Contrast vs. Blending-in	+.5	Road blends with natural landscape relatively well, although there are few natural features until Point B.	+.3	Road blends with natural landscape relatively well, although there are few natural features until Point C. Less contrasts than Option A.	-1	Engineered road contrasts sharply with natural landscape.	-.5	Engineered road contrasts sharply with natural landscape. Tunnel reduces this contrast.
B - Gradual Transition vs. Sudden Change	-1	No remarkable points along the road.	-1	No remarkable points along the road.	+.5	Due to steepness of terrain, road users will experience significant changes in the surrounding landscape and be exposed to surprising views along the way.	+1	Due to steepness of terrain and tunnel, road-user will experience significant changes in the surrounding landscape and be exposed to surprising views along the way.
C - Regularity vs. Variation	+.3	Some variation between built-up and natural areas along the road. Section from B to D has some interest.	+.2	Some variation between built-up and natural areas along the road. Section from C to D has little interest.	+.5	The route provide some interesting earthworks.	+1	The route provides an interesting combination of earthworks and tunnels.
D - Provision of Views	-1	No views.	-1	No views.	+1	Generous views will be available for north-bound traffic at saddle.	+1	Generous views will be available for north-bound traffic at saddle.

Weighted Measurements and Standardised Score

OPTION	SCORE BY CATEGORY)					
	A	B	C	D	TOTAL	STANDARD
A	0.5	-1.0	0.3	-1.0	-1.2	0.00
B	0.3	-1.0	0.2	-1.0	-1.5	-0.41
C	-1.0	0.5	0.5	1.0	1.0	2.97
D	-0.5	1.0	1.0	1.0	2.5	5.00

STANDARDISING THE SCORES: Weighted scores (areas times weight) were converted to the -5/0/+5 range. By convention, *existing* is 0, *most adverse* is –5 and *most beneficial* is +5. Intermediate scores were based on linear interpolation. This resulted in the following standardised scores.

Standardised Scores

OPTION	STANDARDISED SCORE
A	0.00
B	-0.41
C	2.97
D	5.00

COMMENTS: The evaluation reveals that Option D is preferred due to the high level of variation in the type of view and the maintenance of existing views of the coastal plain. For traffic travelling north towards the resort, the Option D tunnel entrance and exit will provide sudden and dramatic views towards the Coral Sea, overlooking the Coastal Plain, Cairns and the Coral Sea. By contrast, driving through the two town options (A and B) is visually uninteresting. The significant value of Options D over Option C is attributed to both the additional interest of the tunnel and the fact that the tunnel partly avoids the (undesirable) sharp contrast between the large engineered cuttings and the natural environment.

GUIDELINES FOR DEVELOPMENT OF PREFERRED SOLUTION: Guidelines for the development of the preferred solution arising from a desire to minimise adverse impacts and maximise beneficial impacts related to this attribute are:

- provide safe lookout locations for drivers of cars and cyclists, and
- rehabilitate all previously cleared areas and all batters by active replanting.

4.8.3 Attribute S3: Noise

DESCRIPTION OF ATTRIBUTE: Relative exposure to noise emissions.

ELEMENTS: As noise emissions attenuate with the square of the distance between the source and the noise sensitive site, a relative measure of noise exposure can be obtained by summing the squares of the distances between each residence and the centreline of each road option and then taking the inverse of this figure.

MEASUREMENT OF IMPACTS: The inverse of the sum of the squares of the distance between each residence and the option under consideration. Allowance is made for cases where the road is in a deep cutting, tunnel, or is otherwise shielded from the traffic.

SCORING OF IMPACTS: As above.

STANDARDISING THE SCORES: Scores were converted to the -5/0/+5 range. By convention, *existing* is 0, *most adverse* is –5 and *most beneficial* is +5. Intermediate scores were based on linear interpolation. This resulted in the following standardised scores.

OPTION	SCORE	STANDARDISED SCORE
A	37	0.00
B	34	0.64
C	15	5.00
D	15	5.00

COMMENTS: Options C and D are equally superior from this attribute as they are remote from most residences. Options A and B are substantially identical and provide a poor outcome in terms of traffic noise.

GUIDELINES FOR DEVELOPMENT OF PREFERRED SOLUTION: Guidelines for the development of the preferred option arising from a desire to minimise adverse impacts related to this attribute are:

- maximise the distance between upgrade options and noise sensitive sites,
- maximise the buffering effect of earthworks where possible, and
- incorporate noise barriers where the option is close to residences and this is possible (e.g. Bindon Street).

4.8.4 Attribute S4: Construction Issues

DESCRIPTION OF ATTRIBUTE: Short term impacts of construction on social values.

ELEMENTS: Short term impacts of construction on social values involving:

- construction noise levels,
- construction emissions affecting air quality,
- loss of access during construction,
- reduced travel times / traffic delays during construction, and
- visual presentation during construction.

MEASUREMENT OF IMPACTS: It is not possible to measure impacts on the basis of any particular characteristic of the options. Likely construction impacts associated with each attribute as follows:

- **Noise Levels:** A function of scope of works.
- **Air Quality:** A function of scope of works.
- **Loss of Access:** A function of constructability (Attribute T7).
- **Reduced Travel Times / Traffic Delays:** Allowed for in Attribute T7 (Constructability).
- **Visual Impacts:** A function of scope of works –allowed for in Attribute S1 (Important areas for Scenic Amenity).

On the basis of the above, any further analysis of construction impacts would involve double counting elements already considered.

SCORING OF IMPACTS: Not applicable.

STANDARDISING THE SCORES: Not applicable (a score of -5 would apply to all upgrade options).

COMMENTS: All upgrade options are likely to involve substantial construction impacts and loss of social/amenity values.

GUIDELINES FOR DEVELOPMENT OF PREFERRED SOLUTION: While it is likely that Options C and D would score best on such an attribute, the contributing elements have already been allowed for elsewhere. Guidelines for the development of the preferred option arising from a desire to minimise adverse impacts related to this attribute are:

- maximise the amount of construction that can be done “off-line”, and
- environmental management will be required during construction (especially dust and noise control, provision for traffic, maintenance of accesses).

4.8.5 Attribute S5: Severance of Communities

DESCRIPTION OF ATTRIBUTE: Extent to which resort traffic using each option passes between adjacent parts of the community (i.e. resulting in some degree of severance).

ELEMENTS: Number of residences separated by the road option.

MEASUREMENT OF IMPACTS: As above

SCORING OF IMPACTS: As above.

STANDARDISING THE SCORES: Scores were converted to the -5/0/+5 range. By convention, *existing* is 0, *most adverse* is –5 and *most beneficial* is +5. Intermediate scores were based on linear interpolation. This resulted in the following standardised scores.

OPTION	SCORE	STANDARDISED SCORE
A	77	0.00
B	77	0.00
C	0	5.00
D	0	5.00

COMMENTS: Options C and D are equally superior from this attribute as they are involve no severance. Options A and B are identical and provide a poor outcome in terms of this attribute.

GUIDELINES FOR DEVELOPMENT OF PREFERRED SOLUTION: Guidelines for the development of the preferred option arising from a desire to minimise adverse impacts related to this attribute are:

- avoid options that pass between residences and either other residences or commercial centres.

4.9 COST

4.9.1 Attribute C1: Capital Cost of Works

DESCRIPTION OF ATTRIBUTE: Estimated capital cost of road upgrade between Points A and D.

ELEMENTS: Present day capital (construction) costs.

MEASUREMENT OF IMPACTS: Construction costs were estimated from first principles (See **Working Paper 1**). Note that these are "mitigated" costs.

SCORING THE IMPACTS: The estimated capital cost was considered as a single lump sum.

Construction Costs (estimated)

OPTION	CONSTRUCTION COST ($M)
A	2.3
B	2.2
C	5.9
D	10.2

STANDARDISING THE SCORES: Raw scores were converted to the -5/0/+5 range. By convention, *existing* is 0, *most adverse* is –5 and *most beneficial* is +5. Intermediate scores were based on linear interpolation. This resulted in the following standardised scores.

Standardised Scores

OPTION	STANDARDISED SCORE
A	0.00
B	0.09
C	-2.30
D	-5.00

COMMENTS: Based on the preliminary estimate of cost it is clear that Option A performs best (being a minor upgrade of the existing road and requiring little or no clearing, only minor earthworks, and no expensive retaining walls). This is followed by Option B which shares much of the existing road alignment and involves only an upgrade of Bindon Street and a short section of new works more or less at grade. In contrast, the two bypass options involve extensive earthworks and (for the mitigated options as costed above) retaining walls on a new alignment.

Against these disadvantages must be weighed the simplicity of constructing "off line" and of course the range of amenity impacts of upgrading the through town options.

GUIDELINES FOR DEVELOPMENT OF PREFERRED OPTION: Guidelines for the development of the preferred option arising from a desire to minimise adverse impacts related to this attribute are:

- minimise the length of tunnels,
- minimise the length of bridges,
- minimise earthworks, especially large cuts and fills that require retaining structures, and
- maximise the use of the existing road.

4.9.2 Cost Variations

As noted in **Section 4.10.5**, the above cost should ideally be updated to allow for the "obvious" mitigation actions other than retaining walls which have already been allowed for.

It is important to note that in the context of the overall cost of the Ella Bay Integrated Resort, the differential cost of the four access road options is insignificant. As discussed later, the proponent has given no weight to cost.

4.10 APPLY OBVIOUS MITIGATION ACTIONS

4.10.1 Introduction

Normally at this stage of the MCA process the performance of the various options would be compared and a decision made about the preferred solution or solutions. However, the previous analysis has revealed a number of design changes that could reduce impacts and these have been noted for each attribute under the heading "**GUIDELINES FOR DEVELOPMENT OF PREFERRED SOLUTION**". An initial investigation of these issues revealed that significant improvement could be made in the performance of the options of certain design changes were made. It was decided to apply these mitigation options at this stage of the analysis to better reflect realistic alternatives.

These obvious mitigation actions are described below.

4.10.2 Environmental Sustainability

a) Reduce Clearing

Scores for many of the attributes within the *Environmental Sustainability* criterion are very clearly influenced by the amount of clearing, especially in vegetation communities of high value, either directly as regional ecosystems or as habitat for plants and animals of conservation significance.

An inspection of the raw road cross sections (**Working Paper 1**) reveals many instances where there are large cuttings and/or embankments that closely parallel the natural surface. The inclusion of a retaining structure in these locations would allow the amount of clearing to be dramatically reduced in some areas. An example of this situation occurs on Option D at Chainage 660 as shown below.

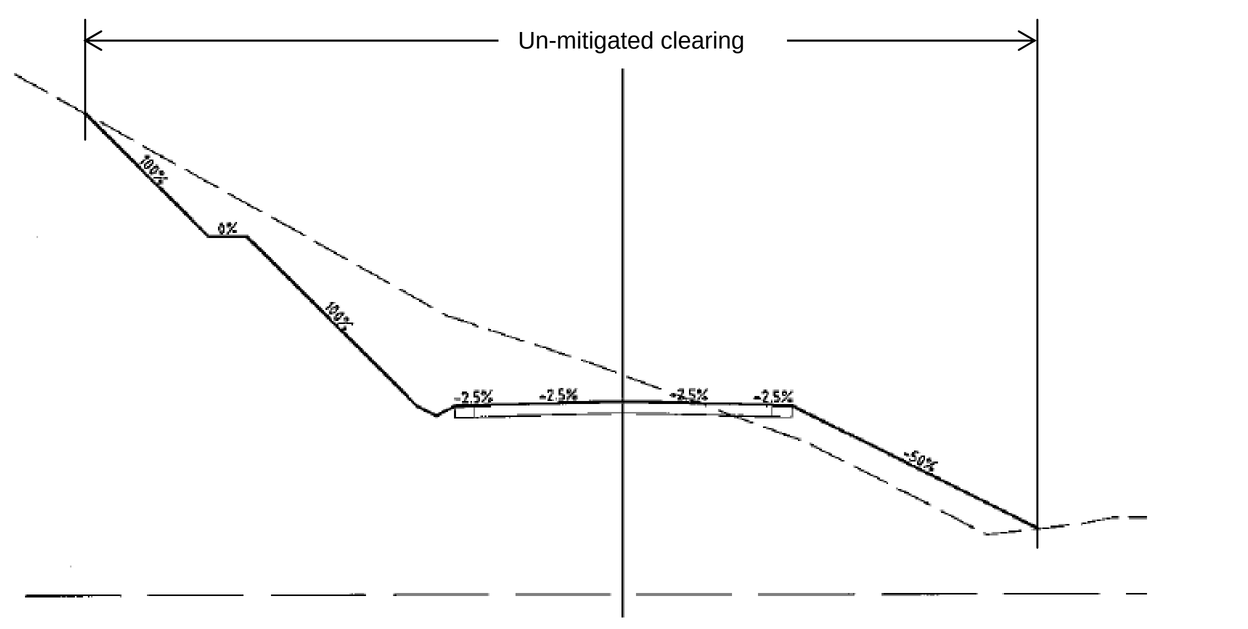


Figure 9. Chainage 660 – an example where the cut and fill slopes parallel the natural surface – resulting in extensive clearing.

Working Paper 1 includes a number of different options for reducing clearing for both cuttings and embankments. These are discussed in more detail in **Chapter 5** and one typical example of each is shown below.

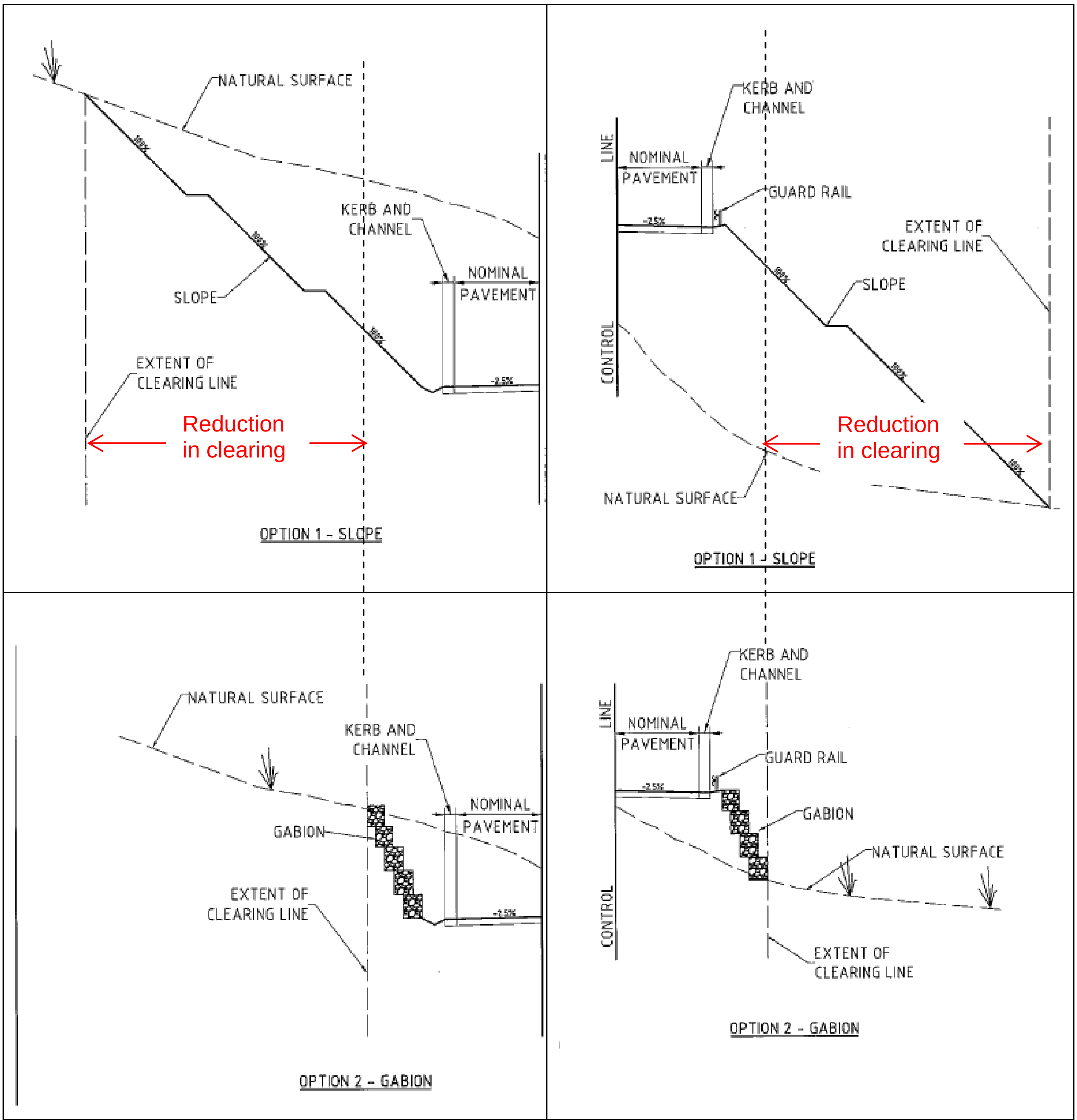


Figure 10a. Cutting. Option 1 (top) shows standard treatment as determined by initial computer run while Option 2 (bottom) is one of a suite of retaining wall options that result in reduced clearing.

Figure 10b. Embankment. Option 1 (top) shows standard treatment as determined by initial computer run while Option 2 (bottom) is one of a suite of retaining wall options that result in reduced clearing.

These techniques were applied to the raw design runs used in the previous analysis to revise the areas of clearing. The effects are quite dramatic as shown by the following extract (again in the vicinity of chainage 660 of Option D).

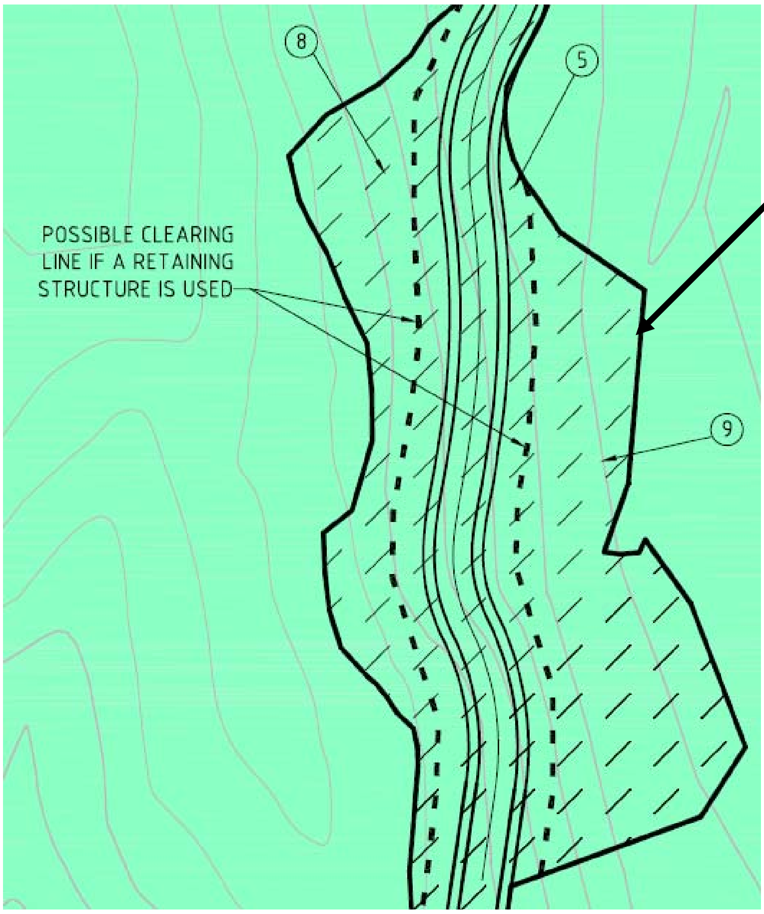


Figure 11. Example showing the reduction in clearing made possible by the use of retaining structures.

Original clearing (no retaining wall)

b) Improve Connectivity and Reduce Roadkill

Significant improvements to connectivity and reductions to roadkill can be achieved by the provision of a suitable bridge structure on the existing Ella Bay Road opposite the Flying Fish Point Reserve. Such a bridge, if designed to allow cassowaries and other fauna to pass safely under the road, would prevent the alienation of the Reserve from the national park and thereby improve the performance of Options A, C and D with respect to attributes E3 and E4.

The effect of such a bridge was considered by Moore in **Working Paper 3** and resulted in the inclusion of the Flying Fish Point Reserve as available habitat. This is consistent with the above.

Figure 12. Typical "fauna friendly" bridge (fauna underpass) between the Ella Bay National Park and the Flying Fish Point Reserve. A second bridge is proposed south of Heath Pont (see **Figure 13**).

These bridges are designed to permit cassowaries and all other fauna to safely pass under the road. They will also enhance the scenic amenity of the road and provide a sense of arrival.

Figure 13. Elements of the Fence & Funnel Strategy. This involves fencing for most of the route and provision of fauna underpasses opposite the Flying Fish Point Reserve and south of Heath Point.

c) *Summary of Effects on Scoring*

In terms of the above mitigation on the results of the MCA, the effect of mitigation resulted in some adjustment in the individual relative performances of the options for environmental attributes, although the overall order has been retained. The relative performance in descending order is:

- Option B,
- Option A,
- Option D, and
- Option C.

However, the absolute performance has improved significantly, especially with respect to clearing for Options C and D and suitability for cassowaries (Options A, C and D). As discussed in **Section 4.12.5**, the actual differences in performance of the mitigated options for biodiversity are not great. The quantitative effect of these changes for each of the options is shown below. Mitigated quantities are then used in the assessment of impacts (**Chapter 5**).

TABLE 4.10.2: EFFECT OF MITIGATION ACTIONS ON ENVIRONMENTAL SUSTAINABILITY

OPTION	E1 (ha)	E2 (ha)	E3 (ha)	E4 (ha)	E5 (m)
A	0.00	0.00	0.00	-16.58	-20.00
B	0.00	0.00	0.00	0.00	0.00
C	-0.87	-0.87	-0.83	-16.58	-20.00
D	-1.04	-1.09	-0.58	-16.58	-20.00

The main improvements are as follows for each environmental sustainability attribute:

- E1: reduction in clearing of vegetation communities of around 1 ha for both Options C and D.
- E2: reduction in clearing of habitat for plants of conservation significance of around 1 ha for both Options C and D.
- E3: reduction in clearing of habitat for animals of conservation significance of over 0.5 ha for Options C and D.
- E4: Dramatic improvement in the performance with respect to cassowaries for Options A, C and D resulting from the safe access provided to the Flying Fish Point Reserve by the fauna underpass.
- E5: small improvement to the overall barrier effect to connectivity, again due to the fauna underpass.

In addition, there is a suite of environmental sustainability actions that should be considered as part of the overall impact mitigation regime described in **Chapter 5**.

4.10.3 Transport Efficiency

The only transport efficiency improvement is the expected increase in stability provided by the gabion retaining structures. As these will be engineered structures, it has been assumed for the sake of this MCA that the *Stability* (T5) attribute (which is based on the expectation that large un-retained cuttings and embankments are at some risk of slips that could close the road on occasions) will no longer be relevant (all options would have the same score).

In addition, there is a suite of transport efficiency actions that should be considered as part of the overall impact mitigation regime described in **Chapter 5**.

4.10.4 Social Amenity

The replacement of large cuttings with retaining walls for Options C and D has had a dramatic improvement (reduction) in the area of works visible from the ocean as shown below.

TABLE 4.10.4: REDUCTION IN AREA VISIBLE FROM SHIPS AT SEA

OPTION C	OPTION C MITIGATED	OPTION D	OPTION D MITIGATED
-3842 m^2	-1493 m^2	-1717 m^2	-1305 m^2

In addition, a simple noise barrier along the eastern side of Bindon Street would reduce noise from Option B.

There is also a suite of social amenity actions that should be considered as part of the overall impact mitigation regime described in **Chapter 5**.

4.10.5 Cost

No cost mitigation actions have been identified. Please note that the previously identified costs include major mitigation (i.e. retaining walls). As noted later, cost is not given any weight by the proponent in this analysis due to the relative insignificance of the cost of any access road option in the context of the overall Ella Bay Integrated Resort.

4.11 STEP 6 – DETERMINE OVERALL SCORES

4.11.1 Details

The results of the initial screening for the mitigated options described above are tabulated below based on:

- all attributes,
- no weighting of attributes, and
- no weighting of criteria.

TABLE 4.11.1: SCORING MATRIX – INITIAL SCREENING

Criteria	Initial Score for Each Option				Comments
	A	B	C	D	Note that in the table, a "significant" margin is a difference of 20% or greater. Scores are all relative to Option A (existing road) which therefore scores zero for all criteria. "Best" option underlined.
Environmental Sustainability	0.00	<u>3.80</u>	-5.00	-3.50	Option B is clearly the best relative environmental outcome due to its modest clearing needs and the ability to rehabilitate about 700 m of the existing Ella Bay Road along the Reserve frontage. Of the bypass options, Option D is preferred by a significant margin.
Transport Efficiency	0.00	2.08	<u>5.00</u>	3.38	The bypass options are clearly superior for this criterion due to the more direct route and superior engineering standards. The town options both suffer from limitations resulting from potential conflict with local traffic. Option D will require that oversize loads pass through Flying Fish Point.
Amenity/social justice	0.00	0.09	3.12	<u>5.00</u>	The bypass options are clearly superior for this criterion, with Option D being significantly better that Option C due to fewer scenic impacts and an enhanced scenic drive experience. Both bypass options avoid social impacts on local residents (noise and severance).
Cost	<u>0.00</u>	0.09	-2.30	-5.00	All options require substantial expenditure, with the bypass options being more expensive to construct. This will be offset to some degree by the simplicity of constructing "off line".
Overall (average)[5]	0.00	<u>1.52</u>	0.21	-0.03	Overall, in this unweighted assessment, Option B scores highest by a significant margin over Option D. In essence, Option B is superior in terms of environment and cost while Option D performs best in terms of transport efficiency and amenity. As noted in the assessment of sensitivity (**Section 4.12**), the <u>relative</u> performance of options needs to be put in the context of the <u>absolute</u> performance and the ability to <u>mitigate or offset</u> adverse impacts.

Source: Study team compilation. In the above table, a "significant" margin is a difference of 20% or greater.

The individual criteria-level results can be expressed graphically as set out below.

[5] There is some argument that it is inappropriate to add (or average) criterion scores. However, this is a standard component of multi-criteria analysis. Some of the objections to this methodology can be overcome by the judicious assessment of <u>significant</u> attributes and the use of sensitivity analysis. In the final analysis, MCA is only an <u>aid</u> to decision-making and decision-makers are experienced in weighing up non-commensurate criteria.

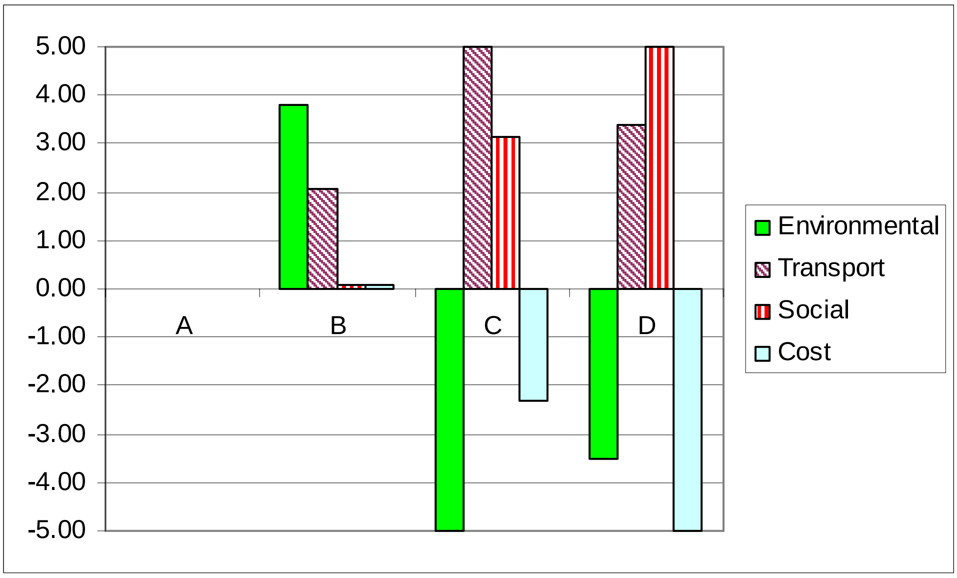


Chart 1. aggregate criterion scores (all attributes, no weighting).

4.11.2 Discussion

The MCA (all attributes, no weighting) concludes that overall, Option B scores highest by a significant margin over Option D. In essence:

- Option B is superior in terms of environment and cost, while
- Option D performs best in terms of transport efficiency and amenity.

The next step in the process is to repeat the process for significant attributes and weightings, and then to analyse the outcomes in the light of actual absolute (as opposed to relative) advantages and disadvantages of the options.

4.12 STEP 8 – SENSITIVITY ANALYSIS

4.12.1 Introduction

The sensitivity of the analysis to judgement depends on:

- the significance or importance of attributes for each criterion, and
- the weighting between criteria.

These are discussed below.

4.12.2 "Significant" Attributes

The following is an analysis of the evaluation results. This assessment includes the consideration of "significant" attributes which are those items that are considered to be of primary importance in the evaluation, based on either the degree of distinction between the options with respect to the attribute or the importance of the value under consideration.

a) *Overall*

Using the simple overall averages in **Table 4.11.1**, overall, Option B scores higher than Option D by a significant margin, while Option D is the better performing bypass option. As concluded above:

- Option B is superior in terms of environment and cost, while
- Option D performs best in terms of transport efficiency and amenity.

b) *Environmental Sustainability*

For the *Environmental Sustainability* criterion, Option B scores highest on all environmental attributes (and highest overall) while Option D has the higher score of the two bypass options but not on all attributes.

All environmental attributes are considered to be significant. Consequently, the findings of the MCA remain unchanged.

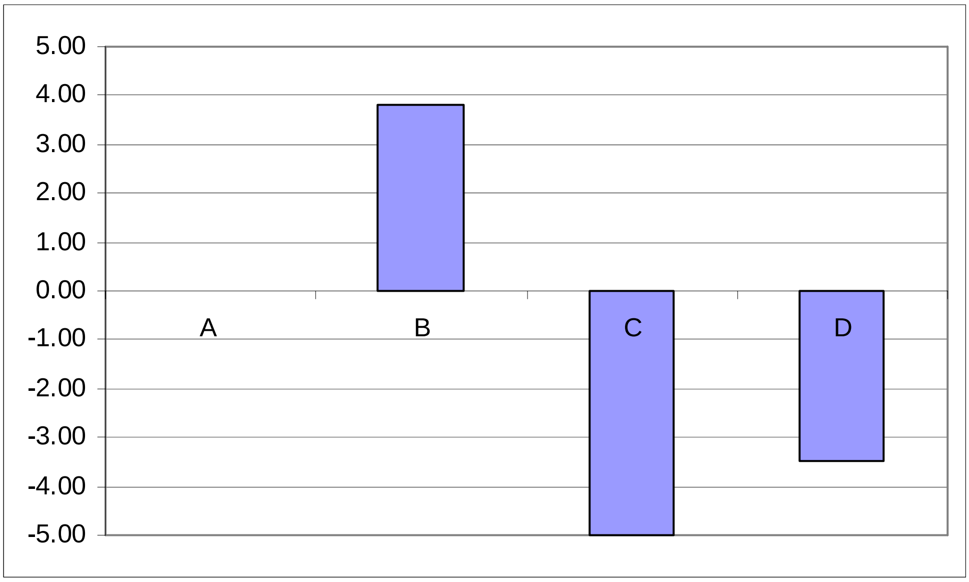


Chart 2. environmental sustainability (a attributes are significant).

Options B is clearly superior with Option D being the better of the bypass options by a significant margin.

As all attributes are significant, there has been no change of preference.

c) *Transport Efficiency*

For the *Transport Efficiency* criterion, the bypass options are clearly superior due to the more direct route and superior engineering standards. The town options both suffer from limitations resulting from potential conflict with local traffic. Option D will require that oversize loads pass through Flying Fish Point.

Significant attributes are considered to be:

- T1: Travel Time at LOS E,
- T6: Safety, and
- T7: Constructability.

Other attributes are considered to not be significant for the following reasons:

- T2: Capacity at LOS E. The capacity figures are all quite close and it is assumed that adequate capacity will be provided.
- T3: Accommodate Service Vehicle. While the analysis shows that the tunnel in Option D is a constraint of the passage of oversize vehicles (for example, cranes and transformers), the alternative provision of having a lockable gate at the end of the proposed Ruby Street cul-de-sac to allow such vehicles to use the town road system is not considered to be a serious issue.
- T4: Accommodate Bicycles. The same applies to bicycles. Indeed, it is desirable to provide an alternative cycle route through the town in any case (see **Figure 14** below).
- T5: Stability. It is assumed that the mitigation measures applied to the bypass options (i.e. retaining walls) are effective and that stability is no longer a distinctive.

Considering the significant attributes only results in the following assessment.

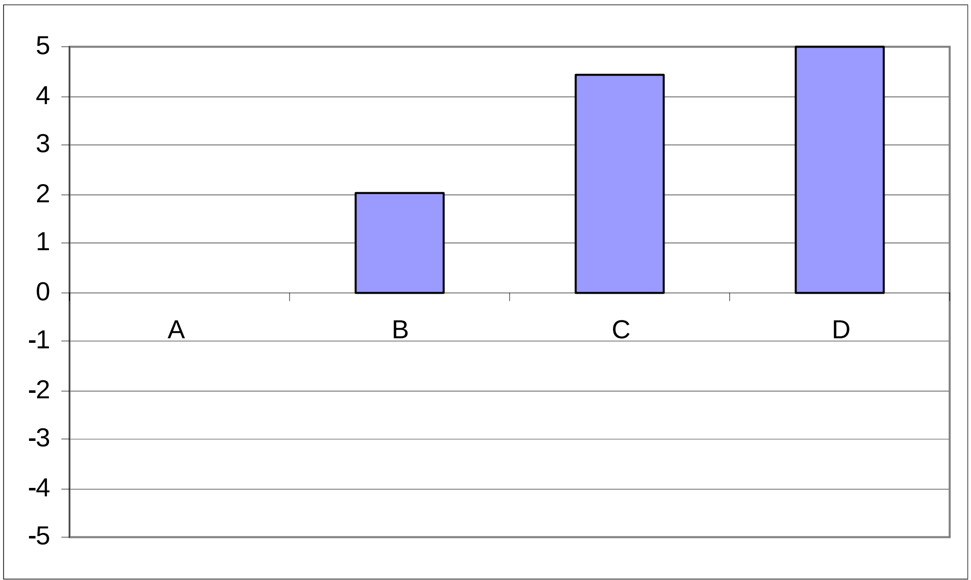


Chart 3. Transport efficiency (significant attributes only).

Options D and C are clearly superior with Option D being the best by a small margin.

Use of significant attributes only results in Options C and D swapping order with D becoming superior.

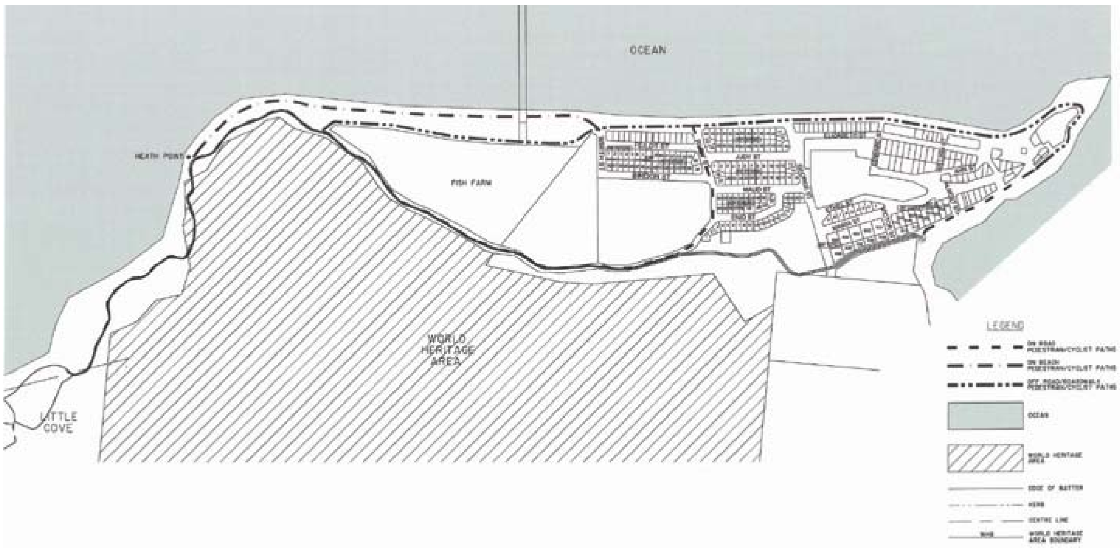


Figure 14. Preliminary pedestrian and cycle paths. It is desirable to provide separation from cars and trucks.

d) *Social Amenity*

For the *Social Amenity* criterion, significant attributes are:

- S1: Important Areas for Scenic Amenity,
- S2: Opportunities for Viewing and Presentation
- S3: Noise.
- S5: Severance of Communities.

As previously noted, it is considered that including Attribute S4 (Construction Issues) would involve double counting issues already included (e.g. T7) and for this reason there has been no change in preference.

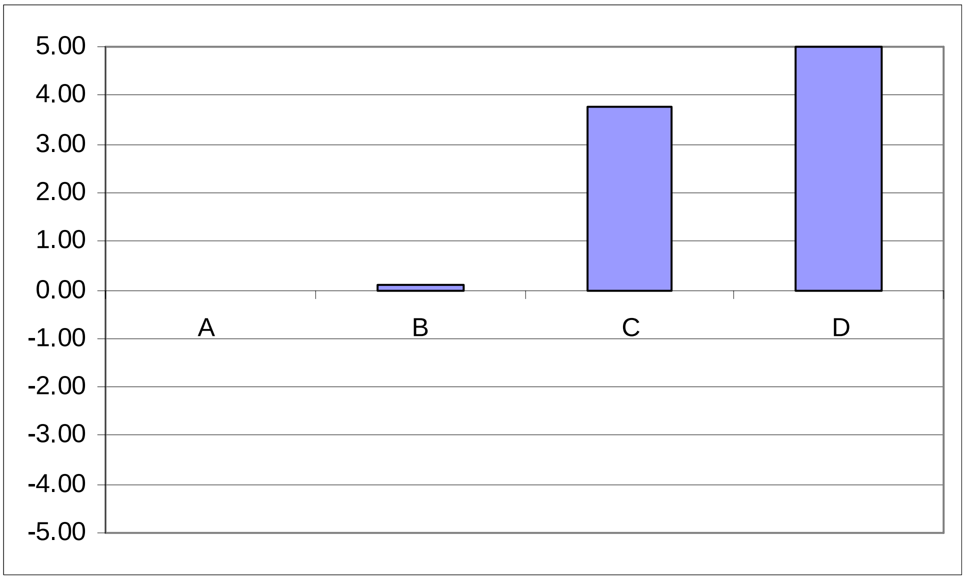


Chart 4. Social/amenity (significant attributes only).

Options D and C are clearly superior with Option D being the best by a significant margin. While the bypass options undoubtedly will involve scenic impacts, they will counter this by providing an inspiring scenic drive. They clearly avoid all conflicts with existing residents (traffic, noise, severance)

e) *Cost*

For the *Cost* criterion, all options require substantial expenditure, with the bypass options being more expensive to construct. This will be offset to some degree by the simplicity of constructing “off line”.

The significant (only) attribute is:

- capital cost.

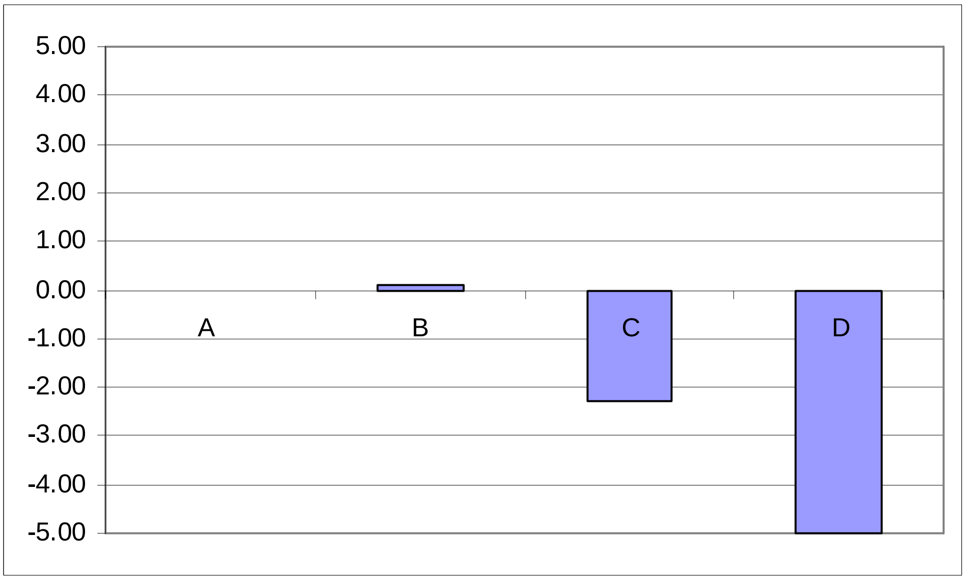


Chart 5. Cost.

Current rough estimates show that Option D will be the most expensive to construct.

4.12.3 Recalculation Using Significant Attributes

Taking into account significant attributes only, the following scores were obtained.

TABLE 4.12.3: SCORING MATRIX – SIGNIFICANT ATTRIBUTES

Criteria	Initial Score				Comments (change from using all attributes)
	A	B	C	D	Note that in the table, a "significant" margin is a difference of 20% or greater. Scores are all relative to Option A (existing road) which therefore scores zero for all criteria. "Best" option underlined.
Environmental Sustainability	0.00	<u>3.80</u>	-5.00	-3.50	All attributes were considered significant so there has been no change. Option B remains the preferred relative option.
Transport Efficiency	0.00	1.22	4.93	<u>5.00</u>	While the bypass options remain superior, Option D is now the preferred option by a small margin.
Social Amenity	0.00	0.09	3.12	<u>5.00</u>	All attributes were considered significant so there has been no change. Option D remains the preferred option.
Cost	<u>0.00</u>	0.09	-2.30	-5.00	No change.
Overall (average)	0.00	<u>1.30</u>	0.19	0.38	No change. Overall, in this unweighted assessment, Option B scores highest by a significant margin over Option D. Option B remains superior in terms of environment and cost while Option D performs best in terms of transport efficiency and amenity. As noted in the assessment of sensitivity (**Section 4.12**), the <u>relative</u> performance of options needs to be put in the context of the <u>absolute</u> performance and the ability to <u>mitigate or offset</u> adverse impacts.

Source: Study team compilation. In the above table, a "significant" margin is a difference of 20% or greater.

This analysis shows that Option B scores highest by a significant margin over Option D which is the preferred bypass option by a significant margin (i.e. compared with Option C).

This analysis also shows that taking into account only the significant attributes does not affect the result, although the margin reduces.

4.12.4 Weighting

a) Discussion

The initial evaluation described above was undertaken without weighting, either between attributes or between criteria, although the above assessment of significant attributes includes a form of weighting and sensitivity testing.

In MCA it is common practice to investigate the effect of various weighting profiles to model the political process. That is, some decision-makers often give priority to, for example, environmental protection over cost, social issues over transport efficiency or any other permutation or combination. Applying nominal weighting profiles allows the sensitivity of the outcome to such priorities to be determined.

b) Nominal Weighting Profiles

For example, some nominal weighting profiles could include:

- Equal 0.25 weighting given to all criteria,
- Environment 0.40 weighing to Environment, 0.20 to each of the balance,
- Transport 0.40 weighing to Transport, 0.20 to each of the balance,
- Social 0.40 weighing to Social, 0.20 to each of the balance, and
- Cost 0.40 weighing to Cost, 0.20 to each of the balance.

c) Community Weighting Profiles

Two weighting profiles have been developed to test likely community views on the options.

Flying Fish Point Community

It is clear from the analysis of comments on the EIS that the Flying Fish Point community has two main concerns (see **Section 2.5**):

- that the environmental values be protected (especially in terms of reducing erosion and protecting cassowaries), and
- that traffic impacts on residents be limited (in terms of pollution, accidents, noise).

This translates to a high weight being put on the following attributes:

- E4: Important Areas for Animals (cassowaries),
- E5: Ecological Processes,
- T6: Safety,
- S3: Noise, and
- S5: Severance of Communities.

It is unlikely that the Flying Fish Point community would consider that they have a stake in the cost of the project of transport efficiency criteria on the basis that they will neither use the road nor be responsible for paying for it.

Based on the above, the assigned Flying Fish Point community profile is as follows:

- Environment 0.50 weighing to Environment,
- Transport zero weighing to Transport,
- Social 0.50 weighing to Social, and
- Cost zero weighing to Cost.

The New Ella Bay Integrated Resort Community

While to date the views of this new community have not been formally considered, it is important to recognise that the 3,500 new residents of the resort (and at the Little Cove project) will be important stakeholder groups with valid needs/stakes in terms of all assessment criteria and especially transport efficiency, safety, and cost.

The latter is relevant as it is this group that will bear the cost of the Access Road as part of the overall project cost. However, in the context of the overall cost of the Ella Bay Integrated Resort, any differences in the cost of the Access Road are considered to be marginal at best.

Based on the above, the assigned Ella Bay Integrated Resort community profile is as follows by assigning a small (5%) weighting to cost and distributing the remainder evenly:

- Environment 0.32 weighing to Environment,
- Transport 0.32 weighing to Transport,
- Social 0.32 weighing to Social, and
- Cost 0.05 weighing to Cost.

d) The Proponent's Profile

The proponent supplied a profile that reflected the company's values and the recognition of the dominating value of environmental and social criteria. In the context of the overall cost of the Ella Bay Integrated Resort, the effect of the comparative cost differences between the Access Road alternatives between Points A and D is minor. This profile was obtained by assigning zero to cost and dividing the remaining criteria evenly on the basis that they are all equally important:

- Environment 0.33 weighing to Environment,
- Transport 0.33 weighing to Transport,
- Social 0.33 weighing to Social, and
- Cost 0.00 weighing to Cost.

e) Summary – Significant Attributes

The following table summarises the results for each of the above profiles based on :

- the mitigated options, and
- only significant attributes.

TABLE 4.12.4: SENSITIVITY ANALYSIS – DIFFERENT WEIGHTING PROFILES (SIGNIFICANT ATTRIBUTES ONLY)]

Criterion	Weight	A	B	C	D	Best Option	Notes
Equal Weighting to All Attributes							
Environment	0.25	0.00	0.95	-1.25	-0.87	B	
Transport	0.25	0.00	0.30	1.23	1.25	D	
Amenity	0.25	0.00	0.02	0.78	1.25	D	
Cost	0.25	0.00	0.02	-0.58	-1.25	A	
Total	1.00	0.00	1.30	0.19	0.38	B	
Priority for Environment							
Environment	0.40	0.00	1.52	-2.00	-1.40	B	
Transport	0.20	0.00	0.24	0.99	1.00	D	
Amenity	0.20	0.00	0.02	0.62	1.00	D	
Cost	0.20	0.00	0.02	-0.46	-1.00	A	
Total	1.00	0.00	1.80	-0.85	-0.40	B	
Priority for Transport Efficiency							
Environment	0.20	0.00	0.76	-1.00	-0.70	B	
Transport	0.40	0.00	0.49	1.97	2.00	D	
Amenity	0.20	0.00	0.02	0.62	1.00	D	
Cost	0.20	0.00	0.02	-0.46	-1.00	A	
Total	1.00	0.00	1.29	1.14	1.30	D	
Priority for Social Amenity							
Environment	0.20	0.00	0.76	-1.00	-0.70	B	
Transport	0.20	0.00	0.24	0.99	1.00	D	
Amenity	0.40	0.00	0.04	1.25	2.00	D	
Cost	0.20	0.00	0.02	-0.46	-1.00	A	
Total	1.00	0.00	1.06	0.78	1.30	D	

TABLE 4.12.4: SENSITIVITY ANALYSIS – DIFFERENT WEIGHTING PROFILES (SIGNIFICANT ATTRIBUTES ONLY) (CONT)

Criterion	Weight	A	B	C	D	Best Option	Notes
Priority for Cost							
Environment	0.20	0.00	0.76	-1.00	-0.70	B	
Transport	0.20	0.00	0.24	0.99	1.00	D	
Amenity	0.20	0.00	0.02	0.62	1.00	D	
Cost	0.40	0.00	0.04	-0.92	-2.00	A	
Total	1.00	0.00	1.06	-0.31	-0.70	B	
Flying Fish Point Community Profile (zero weighting to cost, highest to amenity then environment)							
Environment	0.40	0.00	1.52	-2.00	-1.40	B	
Transport	0.00	0.00	0.00	0.00	0.00	-	
Amenity	0.60	0.00	0.06	1.87	3.00	D	
Cost	0.00	0.00	0.00	0.00	0.00	-	
Total	1.00	0.00	1.58	-0.13	1.60	D	
Future Ella Bay Integrated Resort Community Profile (nominal weighting to cost, others equal)							
Environment	0.32	0.00	1.20	-1.58	-1.11	B	
Transport	0.32	0.00	0.39	1.56	1.58	D	
Amenity	0.32	0.00	0.03	0.99	1.58	D	
Cost	0.05	0.00	0.00	-0.12	-0.25	A	
Total	1.00	0.00	1.62	0.85	1.81	D	
Proponent's Profile (zero weighting to cost, others equal)							
Environment	0.33	0.00	1.27	-1.67	-1.17	B	
Transport	0.33	0.00	0.41	1.64	1.67	D	
Amenity	0.33	0.00	0.03	1.04	1.67	D	
Cost	0.00	0.00	0.00	0.00	0.00	-	
Total	1.00	0.00	1.71	1.02	2.17	D	

Source: Study team compilation.

4.12.5 Conclusions

After a consideration of the significance of all attributes (some were found to be inappropriate or to not influence the selection process) and variations in weighting between criteria to test sensitivity, the following conclusions were drawn:

- **Cost is not considered to be a significant criterion**. In the context of the overall cost of the Ella Bay Integrated Resort, the effect of the comparative cost differences between the Access Road alternatives between Points A and D is minor and is unlikely to be an important consideration to key stakeholders such as the Flying Fish Point community and the environmental agencies. The proponent has indicated a similar position (see **Section 4.12.4d)** above).
- **Option D is preferred overall.** It scores best for:
  - Priority given to *Transport Efficiency* (even when *Cost* is included)
  - Priority given to *Social Amenity* (even when *Cost* is included)
  - Flying Fish Point Community's weighting scheme (*Cost* is not included)
  - Ella Bay Integrated Resort Community's weighting scheme (even when *Cost* is included)
  - Proponent's weighting scheme (*Cost* is not included).

Three overall findings are relevant:

- Although the MCA shows that Option B scores better than Option D based on *Environmental Sustainability*, the environmental performance of Option B is not actually significantly better than that of Option D, especially with the inclusion of the fauna bridge over the tunnel and the "fauna friendly" bridge opposite the Flying Fish Point Reserve. In the MCA, Option B scores well for *Environmental Sustainability* because it contributes to the rehabilitation of a section of the Ella Bay Road. This comparative advantage diminishes to become insignificant when considered in the context of the proposed Offsets & Additional Environmental Investments Policy.
- While any minor difference in environmental performance can be remedied by environmental offsets, no such remedy is available for social amenity impacts which are all "town" options involve. Thus few of the adverse impacts of Option B can be mitigated or offset.
- While in a comparative sense the difference in costs between the options is significant (approximately $8 million between Options B and D), the proponent has decided that, in the context of the overall project, this differential cost should not be an impediment to selecting the option that bests meets the remaining criteria.

4.12.6 Proponent's Decision

On the basis of the above, the proponent has a preference for Option D, especially with mitigation and management options as later described. The balance of this Access Road Strategy (i.e. impact assessment and recommendations for mitigation) is based on Option D plus the balance of the Ella Bay Road.

4.13 GUIDELINES FOR THE DEVELOPMENT OF THE PREFERRED SOLUTION

4.13.1 Introduction

The above analysis assists in the further development of the preferred solution as it reveals the relative performance of certain components of the initial options against the project desired outcomes and assessment criteria.

The balance of this section gathers together the guidelines from each attribute and analyses these to provide a summary of desirable features of the preferred surface and tunnel solutions. Note that not all of these are relevant to Option D but are presented nonetheless.

4.13.2 Summary of Guidelines

The previously described guidelines listed for each attribute are gathered together in the following table.

TABLE 4.13.2: GUIDELINES FOR THE DEVELOPMENT OF THE PREFERRED SOLUTION

CRITERION	ATTRIBUTE	GUIDELINES
E1	Important Areas For Plants (Communities)	– Minimise clearing, especially in Category A and B areas (minimise footprint, maximise use of bridges and tunnels, maximise use of existing road and cleared areas). – Rehabilitate all previously cleared areas and all batters. – Plant all cuttings and embankments to improve habitat quality
E2	Important Areas For Plants (Species)	– Minimise clearing, especially in Category A and B areas (minimise footprint, maximise use of bridges and tunnels, maximise use of existing road and cleared areas). – Rehabilitate all previously cleared areas not needed for the road. – plant all cuttings and embankments to improve habitat quality (this Rehabilitation has not been allowed for in the above areas).
E3	Important Areas For Animals other than Cassowaries	– Minimise clearing, especially in Category A and B areas (minimise footprint, maximise use of bridges and tunnels, maximise use of existing road and cleared areas). – Rehabilitate all previously cleared areas not needed for the road. – Plant all cuttings and embankments to improve habitat quality. – Provide habitat connectivity between points A and B where relevant.
E4	Important Areas For Cassowaries	– Fence the road to reduce the risk of vehicle collisions with cassowaries. – Where possible, introduce safe crossings to provide access to suitable habitat otherwise quarantined by the presence of the (fenced) road (i.e. the “fauna friendly” bridges).
E5	Ecological Processes	– Minimise clearing, especially in high value areas for plants and animals. – Rehabilitate all previously cleared areas and all batters. – Treat surface runoff prior to discharge to watercourses. – Maintain environmental flows to all watercourses. – Maintain aquatic habitat at watercourses. – Incorporate special features to facilitate fauna crossing (e.g. underpasses and canopy bridges and longitudinal fences associated with these elements).
T1	Travel Time at LOS E	– Reduce length of route. – Adopt high engineering standards (e.g. gentle curves and grades).
T2	Capacity at LOS E	– Reduce length of route. – Adopt high engineering standards (e.g. gentle curves and grades). (continued over)

CRITERION	ATTRIBUTE	GUIDELINES
T3	Accommodate Service Vehicles	– Provide greater clearance for the tunnel (Option D). – Accept that occasional large loads may need to travel via the existing road.
T4	Accommodate Bicycles	– Provide a cycleway on the bypass options or accept that cyclists adopt an alternative route. – Note: this attribute is misleading as it may actually be preferable to adopt a separate more suitable route for cyclists. This is discussed later in this report.
T5	Stability	– Provide extensive stabilising and/or protection works to the cut and fill slopes to reduce the potential for slope slippage.
T6	Accidents	– Consider some intersection closures for Options A and B.
T7	Constructability	– Construct as much as possible of the upgrade clear of the existing alignment.
S1	Important Areas for Scenic Amenity	– Adopt options that are lower in elevation. – Avoid (minimise) surface lighting for Options C and D. – Rehabilitate all previously cleared areas and all batters by active replanting.
S2	Scenic Quality for Road Users	– Provide safe lookout locations for drivers of cars and cyclists. – Rehabilitate all previously cleared areas and all batters by active replanting.
S3	Noise	– Maximise the distance between upgrade options and noise sensitive sites. – Maximise the buffering effect of earthworks where possible. – Incorporate noise barriers where the option is close to residences and this is possible (e.g. Bindon Street).
S4	Construction Issues	– Maximise the amount of construction that can be done “off-line”. – Environmental management will be required during construction (especially dust and noise control, provision for traffic, maintenance of accesses).
S5	Severance of Communities	– Avoid options that pass between residences and either other residences or commercial centres.
C1	Total Cost of Works	– Minimise the length of tunnels. – Minimise the length of bridges. – Minimise earthworks, especially large cuts and fills that require retaining structures. – Maximise the use of the existing road.

Source: Study team compilation.

5 IMPACT ASSESSMENT AND OPPORTUNITIES FOR MITIGATION

5.1 INTRODUCTION

5.1.1 Overview of Selecting the Preferred Solutions

This chapter describes the findings of an assessment of impacts of the preferred Access Road solution, based on the criteria used in the MCA. It also includes a discussion of mitigation opportunities. The discussion draws on detailed working papers and the previous MCA and in particular:

- **Working Paper 1** – Engineering Issues (including the road drawings and clearing plans based on environmental sustainability coverages E1 to E4 – refer to Volume 3 of the Supplementary EIS),
- **Working Paper #2** – Flora and Fauna (other than cassowaries) Issues, and
- **Working Paper 3** (Cassowary Issues).

In summary, the procedure used to develop the preferred solution was:

- consideration of the impacts on nominated criteria of the four detailed alternatives (Options A to D) between Point A (on Flying Fish Point Road just south of Flying Fish Point) and Point D (just south of the Fish Farm and where all four detailed alternatives meet the current Ella Bay Road) – see **Figure 6**.
- application of "obvious mitigation actions" to improve the performance of all options (principally the use of retaining structures to reduce clearing areas as described in **Section 4.10.2**),
- determination of the preferred options based on the multi-criteria analysis (MCA) and the sensitivity analysis, and
- application of "obvious mitigation actions" for the balance of the road to the resort site (i.e. that part of the Ella Bay Road from Point D to Point F) to improve its performance.

It should be noted that for the purposes of this impact assessment, retaining walls have been included anywhere where the height of a cutting or embankment would otherwise have been greater than 5 m (i.e. the application of the "obvious mitigation actions" described in **Section 4.10**). For this reason the detailed drawings included in Volume 3 of the Supplementary EIS are all described as "mitigated". Note that this 5 m height may be revised during detailed design.

5.1.2 General Description of Preferred Solution

An analysis of the outputs of the MCA reveals that Option D was the best overall solution between Points A and D. This impact assessment considers this preferred solution defined as Option D from the MCA plus the balance of the Ella Bay Road (linking points A-B-D-F).

This road is a composite of three road segments (see **Figure 16**):

- **Segment 1**: a new road (940 m long) that bypasses Flying Fish Point to the west and includes a cut-and-cover tunnel,
- **Segment 2:** an upgrade of the existing flat section of the Ella Bay Road (840 m long) to where the road enters the World Heritage Area just south of Heath Point, and
- **Segment 3:** an upgrade of the existing winding section of the Ella Bay Road (2000 m long) through the World Heritage Area to the Little Cove resort.

Parts of the road are proposed to be fenced to exclude fauna (especially cassowaries) and lead animals to safe crossing points above the tunnel and at two “fauna friendly” bridges at locations determined by specialist studies. See Figure 15 below.

Figure 15. Elements of the Fence & Funnel Strategy. This involves fencing for most of the route and provision of fauna underpasses opposite the Flying Fish Point Reserve and south of Heath Point.

Some key statistics of the Access Road:

- length – 3.78 km,
- area of existing clearing incorporated in new road – 3.13 ha (1.95 ha in World Heritage Area),
- area of new clearing = 2.47 ha overall (2.44 ha of remnant vegetation),
- area of new clearing in World Heritage Area = 0.44 ha, and
- area of rehabilitation (over cut-and-cover tunnel) = 0.49 ha.

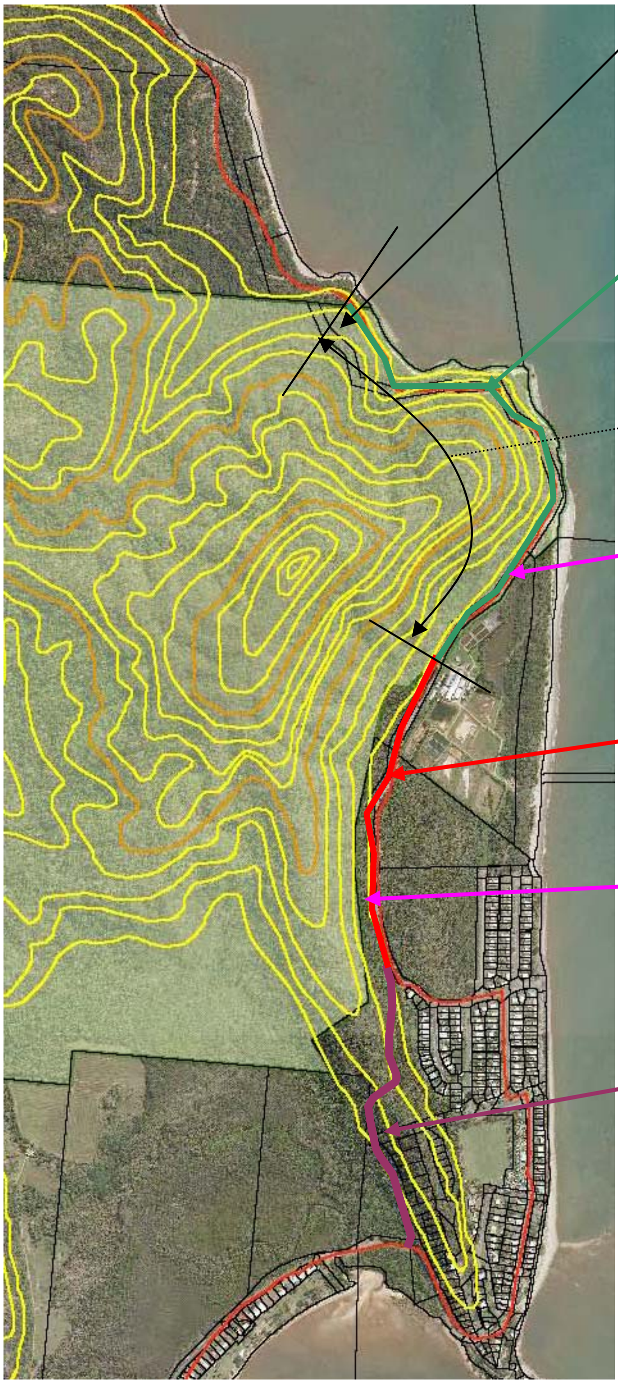
Regarding the existing access to Heath Point and Little Cove:

- resort traffic will bypass the Flying Fish Point township (the existing connection to the Ella Bay Road is proposed to be closed except for emergency vehicles),
- all of the existing Ella Bay Road is to be incorporated into the upgrade, and
- the upgrade through the World Heritage Area is proposed to be of a reduced engineering standard in order to limit speeds and a reduce the area of clearing required.

5.2 DETAILED DRAWINGS

Volume 3 of the Supplementary EIS contains detailed A3 drawings of the Access Road, showing:

- general arrangement,
- detailed plans,
- detailed longitudinal sections and cross sections,
- detailed clearing plans for each of the four key biodiversity coverages (plant communities, plant species, animal species, and cassowary habitat), and
- other details including provision for cyclists and pedestrian and miscellaneous road details.



Note that on this map the road reserve in this area is incorrectly shown This is an old depiction of the reserve which has since been revised to conform with the actual location.

Segment 3: Heath Point to Little Cove (upgrade existing road)

Road within WHA

"Fauna friendly" bridge #2 (approximate location)

Segment 2: South of Fish Farm to Heath Point (upgrade existing road)

"Fauna friendly" bridge #1 (approximate location)

Segment 1: Flying Fish Point to South of Fish Farm (Bypass)

Figure 16. Proposed Access Road.

5.2.1 Impact Assessment Criteria

Impact assessment criteria for the following analysis are essentially "significant criteria" used in the MCA as tabulated below. Note that several of the attributes selected for considering the difference between options are not relevant to impact assessment. See **Table 4.4.2** for a list of all attributes originally considered for the MCA.

TABLE 5.2.1: IMPACT ASSESSMENT CRITERIA AND ATTRIBUTES

CRITERION	CODE	ATTRIBUTE
Environmental Sustainability	• E1 • E2 • E3 • E4 • E5	• Important Areas for Plants (Communities) • Important Areas for Plants (Species) • Important Areas for Animals (Other than Cassowaries) • Important Areas for Animals (Cassowaries) • Ecological processes
Transport Efficiency	• T3 • T4 • T5 • T6 • T7	• Accommodate Service Vehicle • Accommodate Bicycles • Stability • Safety • Constructability
Social Amenity	• S1 • S2 • S3 • S4 • S5	• Important Areas for Scenic Amenity • Opportunities for Viewing and Presentation • Noise • Construction Issues • Severance of Communities

Source: Study team compilation. See **Table 4.4.2** for a list of all attributes originally considered for the MCA.

Other assessment criteria including World Heritage values are included where relevant (see below).

5.2.2 Mitigation

Mitigation options are discussed below in the context of the attribute under consideration while additional details on mitigation are provided in **Section 5.8**. Specific items included in the following assessment are:

- retaining walls have been included anywhere where the height of a cutting or embankment would otherwise have been greater than 5 m (note that this 5 m height may be revised during detailed design),
- fauna fencing has been assumed as shown on **Figure 15**, with gaps provided in two locations as follows:
  - across the top of the tunnel
  - at the “fauna friendly” bridge opposite he Flying Fish Point Reserve, and
- aquatic and riparian connectivity will be provided at two locations within Segment 3.

5.3 DESCRIPTION OF PREFERRED SOLUTION

5.3.1 Introduction

The following is a description of the preferred Access Road solution, described with respect to through distances in metres (described as “chainage” or “Ch”). Chainages shown on Drawings X31 and X32 (Supplementary EIS Volume 3) run northwards from Ch 0 (Flying Fish Point Road) to 940 which is the point at which the western bypass (Option D) meets the existing Ella Bay Road and then southwards (Drawings X33 to 38) from Ch 0 on Ella Bay Road at the Little Cove site to this point (Ch 2840). This is a consequence of the MCA methodology. Overall the road is 3780 m long.

In the following discussion, chainages north of the bypass are described as, CH1/CH2 (e.g. 1779/2001):

- CH1 (the first figure) is the calculated running chainage from Flying Fish Point, while
- CH2 (the second figure) is the (reversed) chainage shown on Drawings X33 to 38.

5.3.2 General Route Description

The Access Road starts at a “tee” intersection with the Flying Fish Point Road just south of the Flying Fish Point township. Between this point and the existing Ella Bay Road (Ch 940) the road is on a deviation west of the Flying Fish Point township, with a 70 m long cut-and cover tunnel being included between Ch 495 and Ch 565 to reduce the height of cuttings and allow feasible grades.

It then follows the route of the existing Ella Bay Road, entering the World Heritage Area (Zone C) at Ch 1779/2001 and running around Heath Point (Ch 2760/1020) before leaving the World Heritage Area at Ch 3630/150.

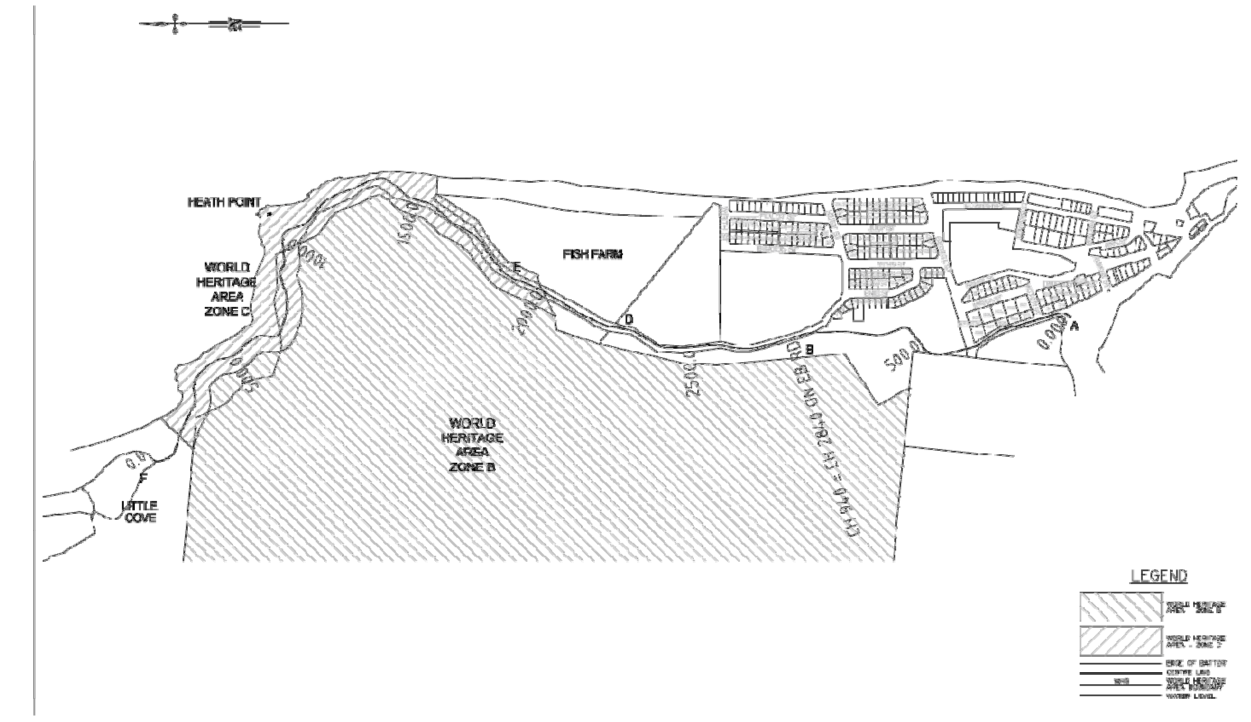


Figure 17. Layout of preferred solution showing chainages. These run from Point A to Point B and then from Point F back to Point B.

5.3.3 Horizontal Alignment

Refer **Working Paper 1** Appendix F drawings X01 and X02 (Supplementary EIS Volume 3) and the above figure.

a) Segment 1 (0.94 km: New Road)

Points A to B

From the Flying Fish Point Road to the beginning of the tunnel (Ch 495) the road is generally straight, turning sharply east at the tunnel to negotiate the saddle between the two hills.

Points B to D

After joining the existing Ella Bay Road at Ch 940 (Point B), the road has only gentle curves until it reaches Point D.

b) Segment 2 (0.84 km: Upgrade Ella Bay Road)

Points D to E

Heading north along the existing (upgraded) Ella Bay Road from Point D to Point E opposite the Fish Farm, the road has only gentle curves and runs alongside the Ella Bay National Park. Point E (Ch 1779/2001) marks the entry of the road into the Wet Tropics World Heritage Area.

c) Segment 3 (2.00 km: Upgrade Ella Bay Road)

Points E to F

From the southern boundary of the Wet Tropics World Heritage Area (Point E), the road runs along the route of the existing (upgraded) Ella Bay Road to Heath Point (Ch 2760/1020) and then through to the Little Cove site (Ch 3780/0).

From Ch 2380/1400 to the end of the road at Ch 3780/0 the road encounters a series of tight horizontal curves with radii as small as 20 m.

5.3.4 Vertical Alignment

Refer **Working Paper 1** Appendix F drawings X31 to X38 (Supplementary EIS Volume 3).

Points A to B

- The road leaves the existing road at 2.44 m (to Australian Height Datum (AHD) and quickly rises at a grade of 8.8% to Ch 130 before flattening out to 3.3%. It passes through an intermediate crest at Ch 163 (15.85 AHD) and then gently rolls towards the highest point (18.4 AHD) at Ch 515. This is within the cut-and-cover tunnel which at this point supports some 20 m of fill. The natural surface at the crest is 38 AHD and it is proposed to re-establish the natural surface above to tunnel to about 4 m lower than the natural surface (i.e. about 34 AHD).
- From this crest the road steeply falls to join the existing Ella Bay Road at up to 5.1% at a level of 7.8 AHD. In all, the deviation is 940 m long.

Points B to D

- After joining the Ella Bay Road (Ch 940 (2880 on Drawings X33 to 38 – note the reversed chainage)) the alignment then gently undulates to Point D (Ch 2250/1530)
- The first “fauna friendly” bridge is in this area.

Points D to F

- This gentle grad continues to Ch 2400 (Ch 1380), entering the WTWHA at Ch 1779/2001 and then rises steeply over a distance for some 400 m (to Ch 2800/980) at grades of up to over 13% to an elevation of 33.5 AHD. From Ch 2940/840 (elevation 38.1 AHD) the road again falls steeply (at 12.5%) to Ch 640/3140) before rising again to an elevation of 18 6 AHD at Ch 3390.
- After falling again at up to 12%, the road passes through the end of the World Heritage Area (Ch 3630/150) and then to the Little Cove site.
- The second “fauna friendly” bridge is in this area.

5.3.5 Cross Section

Refer **Working Paper 1** Appendix F drawings X39 to X63 (Supplementary EIS Volume 3).

The nominal road cross section involves:

- two traffic lanes each 3.5 m wide,
- two 1.0 m shoulders,
- a table drain on each side, and
- cut or fill batters at 1V:1H and 1V:12 respectively.

Retaining structures have been allowed to reduce the width of earthworks (hence clearing) whenever cuts or fills reach 5 m in height. Note that this 5 m height may be revised during detailed design. A cut-and-cover tunnel is included in the western bypass section between Ch 495 and 565 approximately. The three typical cross sections are as shown below.

For the purposes of this stage of the impact assessment, the standard type cross section has been adopted throughout. As later noted (**Section 5.8.3**) there is an opportunity to reduce clearing and earthworks by the use of constrained sections where some compromises are made regarding site distance and drainage to improve overall ecological performance.

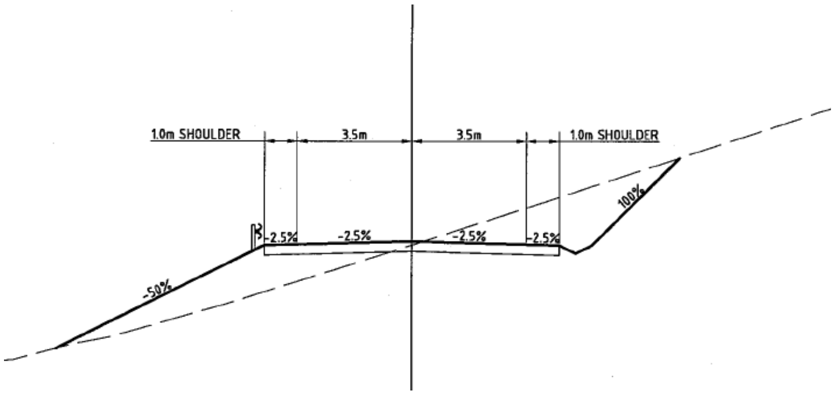


Figure 18a. Standard cross section where cuts and/or fills are less than 5 m in height. Note that this 5 m height may be revised during detailed design.

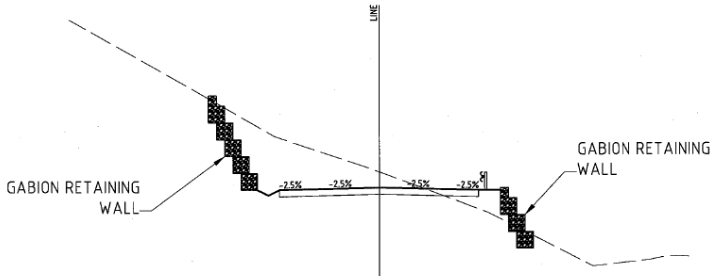


Figure 18b. Gabion (or other) retaining walls included to reduce earthworks and clearing. Retaining walls have been allowed for whenever cuts or fills reach 5 m in height. Note that this 5 m height may be revised during detailed design.

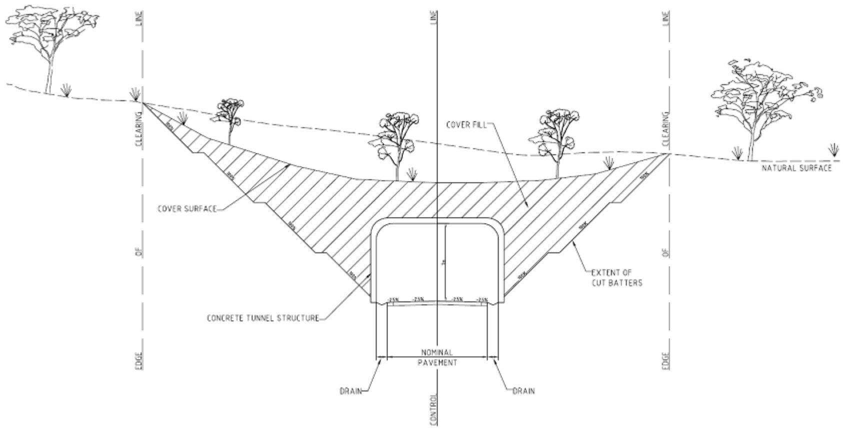


Figure 18c. Cut-and-cover tunnel section on western bypass section between Ch 495 and 565 approximately. This is to be revegetated on completion.

Source: Working Paper 1.

5.3.6 Earthworks

- Between Ch 0 and 460 the road is largely in surface formation, with some cut to fill sections less than 4 m in height. The tunnel section runs from Ch 495 to 565 after which is another section of minor cut to fill to Ch 800. After this point the road is largely on surface formation until Ch 2460/1320 at which point there is a section to Ch 2820/960 of minor cut to fill.
- The road then encounters a difficult section between Ch 2840/940 and 3500/280 where there are extensive sections of retaining wall on the western side (cut). The largest retained cutting is of the order of 10 m high.
- The last 300 m is largely on surface formation.

5.3.7 Drainage

- There are no major streams crossed by the road and from an engineering perspective pipe or box culvert structures would be adequate (see **Working Paper 1**). However, on the advice of BAAM (**Working Paper 2**) small bridges have been allowed for at creeks where there are important aquatic values, especially for frogs.
- Accordingly, minor bridges are proposed at the following locations:
  - 3140/640, and
  - 3570/210.
- These small bridges (see also **Section 5.8.6**) should be constructed with minimal disturbance of riparian vegetation and streambed morphology to protect riparian and aquatic values and maintain water quality. Advice from BAAM (Working Paper 2) is that streams to the south are ephemeral, with small catchment areas and grading fairly quickly to swampy country on the coast. These are not thought to be important to the stream-dwelling frogs of concern.

5.3.8 Fauna Management Works

The road includes provision for fencing in selected areas to exclude fauna (especially cassowaries) form the road and the installation of underpasses and overpasses to permit their safe movement across the road to access habitat and for genetic interchange. An overall concept plan (**Figure 15**) is shown above.

This is described in more detail in **Section 5.8.6**, the Fence & Funnel Strategy (**Section 7.2**), and the Cassowary Management Strategy (**Section 7.3**).

5.3.9 Provision for Cyclists and Pedestrians

Provision for cyclists and pedestrians involves a combination of on-road and off-road elements:

- Bypass – no access for cyclists and pedestrians due to safety and grade considerations. Separate access is available via existing road network.
- Ella Bay Road to Heath Point – cyclists and pedestrians may either use the upgrade road (two 1 m shoulders exist and grades and curves are gentle) or continue on the existing road network and a new link along the esplanade.
- Heath Point – no access for cyclists and pedestrians due to safety considerations (road is winding and there are environmental reasons for further reducing the width to remove the shoulders). Separate access is proposed via the coastal flat.

These elements are shown on the following figure.

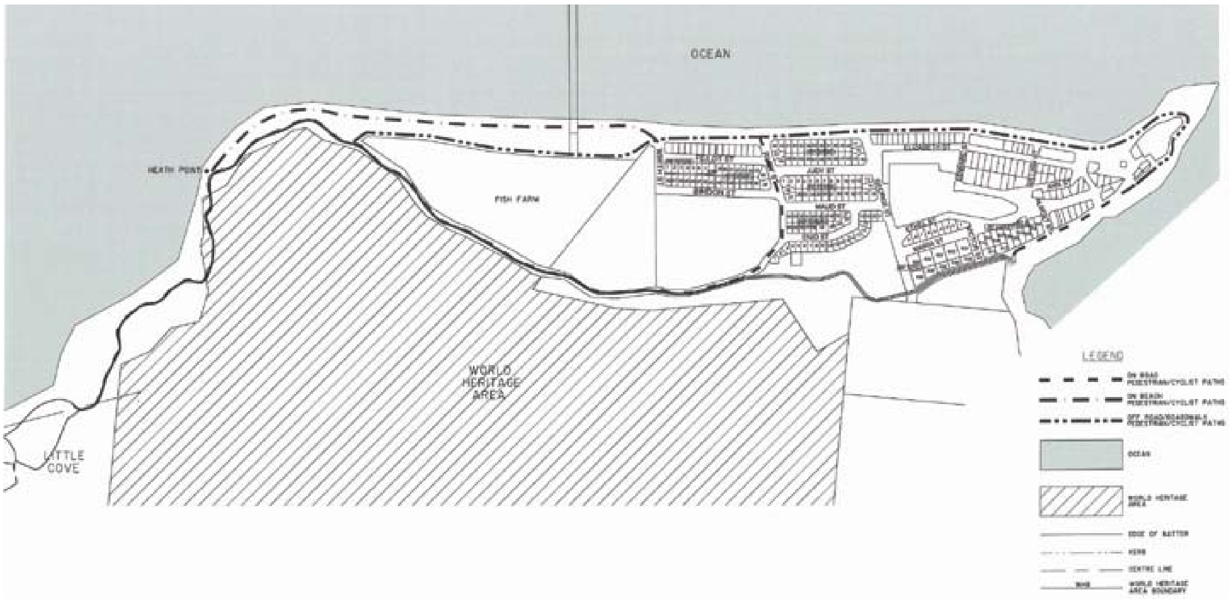


Figure 19. Proposed cyclist and pedestrian network.

5.4 ECOLOGICAL SUSTAINABILITY

5.4.1 Assessing Impacts

Maps showing the various clearing areas for environmental sustainability attributes used in the MCA (i.e. E1 to E4) were produced by ETS and the relevant areas of clearing required for earthworks for each category within each attribute were measured using AutoCAD (see **Working Paper 1** Appendix F). This took into account the presence of clearings formed by the existing road, together with earthworks, special treatment of fill batters, bridges and tunnels, and rehabilitation where the existing road is outside the batter points of the new road.

A simplified clearing plan is shown below. This shows that most of the clearing for the Access Road (1.8 ha or 73%) occurs on the bypass (Points A to B) where 0.49 ha of rehabilitation is proposed. The balance of the road is an upgrade of the existing Ella Bay Road where all of the existing road clearing is included in the footprint of the upgrade, resulting in a further 0.66 ha of clearing.

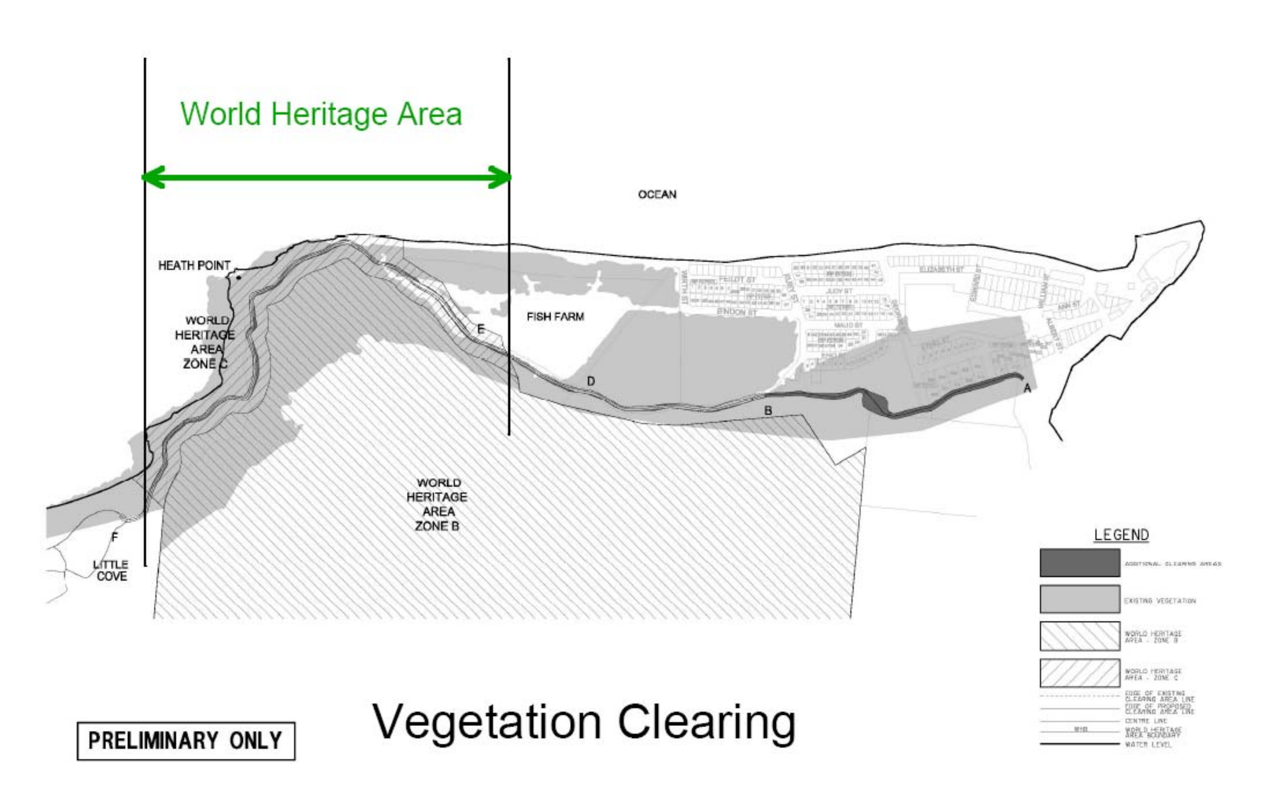


Figure 20. Clearing Plan.

Detailed maps and quantities were then supplied to the authors of **Working Paper 2** (BAAM) and **Working Paper 3** (Moore) as inputs to the impact assessment. The following is based on the subsequent analysis contained in the latter section of **Working Paper 2** and via personal communications in the case of cassowaries.

The methodology of assessing impacts on other environmental sustainability attributes (i.e. World Heritage issues) is introduced later where relevant.

5.4.2 E1: Impacts on Plants (Communities)

a) Review of Attribute

Assessment of impacts on plants (communities) is based primarily on consideration of the areas of clearing of vegetation communities, in a hierarchy of conservation significance based on EPA regional ecosystem mapping as reproduced in **Working Paper 2** Figure 6. Stratification used a hierarchy ranging from Category A (highest conservation values) to Category E (lowest conservation values) based on their conservation significance under the *Vegetation Management Act 1999* (Qld), namely:

- A: endangered,
- B: of concern,
- C: not of concern,
- D: non-remnant, and
- E: cleared areas.

This coverage, superimposed with the road clearing plan, is shown on Drawings X17 to X23 (**Working Paper 1** Appendix F – see Supplementary EIS Volume 3). Quantities are shown in **Working Paper 1** Appendix G and consolidated below.

b) Assessment of Impacts

Areas of clearing required for earthworks for each plant community category were measured, based on the intersection of the road corridor clearing between batter points and the E1 coverage. This took into account the presence of clearings formed by the existing road, together with earthworks, special treatment of fill batters, bridges and tunnels, and rehabilitation where the existing road is outside the batter points of the new road. In terms of the original data upon which this modelled coverage is based, clearing by RE is as shown below.

TABLE 5.4.2: AREA OF CLEARING BY REGIONAL ECOSYSTEM

REGIONAL ECOSYSTEM	CONSERVATION STATUS UNDER VMA	CLEARING (HA) *
7.2.8	Of Concern	0.02
7.3.10a	Of Concern	0.19
7.11.34a	Of Concern	0.31
7.11.1	Not of Concern	1.78
7.11.1a	Not of Concern	0.03
Cleared Area	n/a	0.01
Non-Remnant	n/a	0.02
TOTAL REMNANT		**2.33**

Source: **Working Paper 2**. * Please note that there are small differences in calculated areas of clearing between those shown in this table and similar figures in **Tables 5.4.3a)** and **5.4.4b)**. This is a result of slightly different methodologies. However, the differences are not significant.

BAAM (**Working Paper 2**) observe that the majority of proposed clearing works occur in regional ecosystems mapped as Not of Concern (i.e. RE 7.11.1) and that there is no clearing proposed for areas included in Endangered Regional Ecosystems.

c) Opportunities for Mitigation

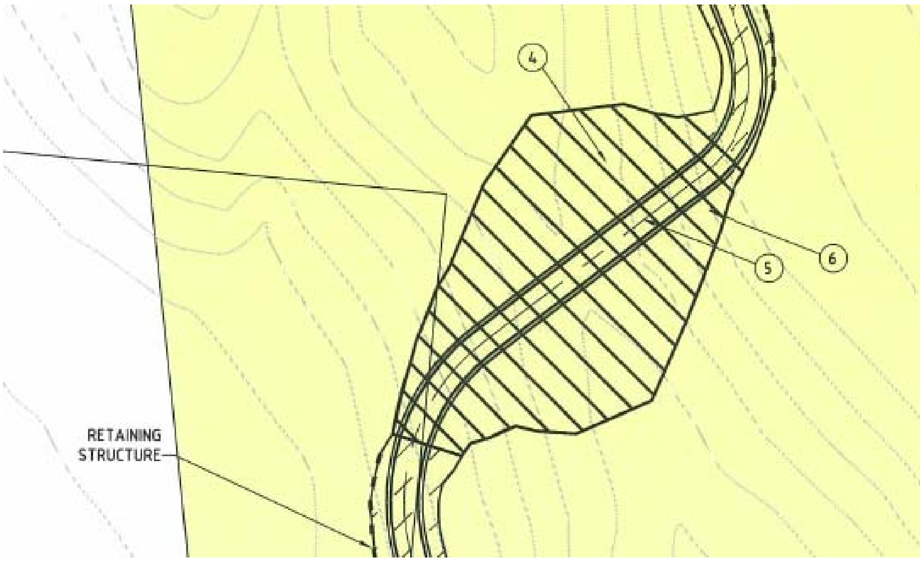
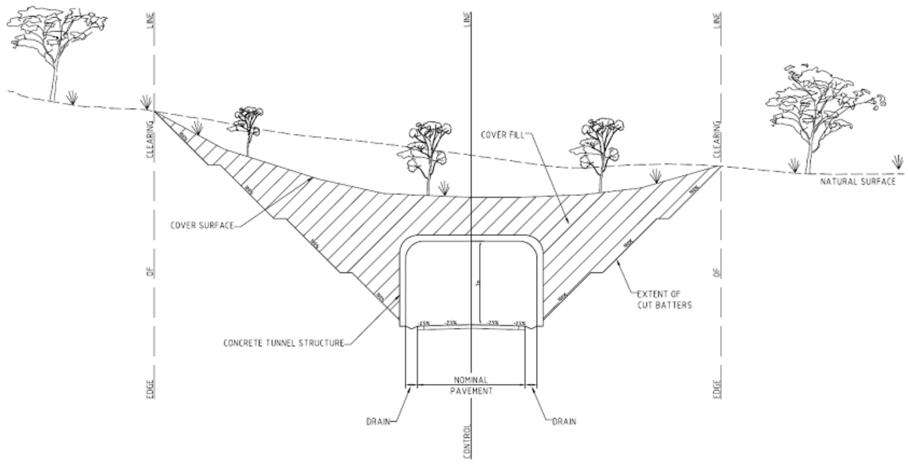
General

BAAM (**Working Paper 2**) make the following recommendation re conservation of regional ecosystems:

- Recommendation 5: Clearing works should be restricted to the proposed impact area.

Revegetation

The main opportunity for revegetation is over the cut-and-cover tunnel between Chainage Ch 495 and 565 approximately. The area of clearing required (polygons 4, 5 and 6 of Drawing X-18) is 0.49 ha. This is within the Category C vegetation unit which corresponds to the “not of concern” regional ecosystem RE 7.11.1 (simple-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 cleared area will be revegetated with vegetation corresponding to match the existing rainforest community once the tunnel has been backfilled.

	**Figure 21a.** Plan showing clearing required at cut-and-cover tunnel (Chainage 495 to 565). Cleared areas 4 5 and 6 aggregate 0.49 ha and all of this will be revegetated.
	**Figure 21b.** Once the tunnel is constructed and the area backfilled, it can be revegetated with vegetation corresponding to match the existing rainforest community.

5.4.3 E2: Impacts on Plants (Species)

a) Review of Attribute

Assessment of impacts on plants (species) is based primarily on consideration of the areas of clearing of vegetation communities in which important plants are predicted to occur, in a hierarchy of conservation significance based on **Working Paper 2** Figure 7. The various species of plants of conservation significance (Table 4.11 of **Working Paper 2**) have different relative value (i.e. are listed as **endangered** to **rare** under the NCA and **vulnerable** under the EPBC).

The value hierarchy selected ranges from Category A (highest conservation values) to Category E (lowest conservation values).

Categories are as follows:

- A: endangered (NCA),
- B: vulnerable (NCA, EPBC),
- C: rare (NCA),
- D: remnant (unless in a higher category by virtue of habitat value for plants), and
- E: non-remnant or cleared (unless in a higher category by virtue of habitat value for plants).

This coverage, superimposed with the road clearing plan, is shown on Drawings X03 to X09 (**Working Paper 1** Appendix F– see Supplementary EIS Volume 3). Quantities are shown in **Working Paper 1** Appendix G and consolidated below.

b) Assessment of Impacts

Areas of clearing required for earthworks for each plant species category were measured, based on the intersection of the road corridor clearing between batter points and the E2 coverage. This took into account the presence of clearings formed by the existing road, together with earthworks, special treatment of fill batters, bridges and tunnels, and rehabilitation where the existing road is outside the batter points of the new road. Calculated areas are shown in the following table.

TABLE 5.4.3A): AREA OF CLEARING FOR ATTRIBUTE E2

CATEGORY	A	B	C	D	E	TOTAL
Area (ha) *	1.860	0.544	0.000	0.062	0.000	2.466

Source: **Working Paper 1**. * Please note that there are small differences in calculated areas of clearing between those shown in this table and similar figures in **Tables 5.4.2** and **5.4.4b)**. This is a result of slightly different methodologies. However, the differences are not significant.

In terms of the original data upon which this modelled coverage is based, BAAM (**Working Paper 2**) made the following assessment of impacts on listed plant species based on the modelling and fieldwork.

TABLE 5.4.3B): IMPACTS ON LISTED PLANTS

CONSTRAINT/IMPACT	RE	LOCATION/COMMENT
Endangered Species		
Impacts to potentially occurring Endangered flora species.	7.3.10	Potential habitat exists for *Corronia pedicellata* (E-EPBC 1999) in RE7.3.10 in the northern and southern portions of the preferred alignment.
Vulnerable Species		
Impacts to potentially occurring Vulnerable flora species.	7.11.1, 7.11.34	Potential habitat exists for *Arenga australasica* (V-EPBC Act 1999) although no direct impact to this habitat is expected; Potential habitat for *Canarium acutifolium var. acutifolium* (V-EPBC) is found on drainage lines in RE7.11.1; and Potential habitat for *Huperzia phlegmarioides* (V-EPBC, V-NCA) in a range on coastal habitats including RE7.11.34. Direct impacts to these habitats would be expected.)

CONSTRAINT/IMPACT	RE	LOCATION/COMMENT
Rare Species		
Impacts to known Rare flora species *Endiandra globosa.*	7.3.10a	Significant direct impacts to habitat through road construction in the northern and central portions of the preferred alignment.
Impacts to known Rare flora species *Macaranga polyadenia*	7.11.1, 7.3.10.	Direct impacts to habitat would be incurred on wetter margins of vine forest, most prominently adjacent to streams. Indirect impacts may occur through degradation of potential habitat through sedimentation RE 7.11.1 is located in the northern sections of the site. Impact to potential habitat only in RE7.3.10, affecting south western areas of the preferred alignment.
Impacts to known Rare flora species *Ichnanthus pallens*	7.11.34a	Direct impacts to habitat would be incurred in RE 7.11.34, particularly in the heath point area. Indirect impacts to habitat through facilitation of weed invasion is possible (*Lantana camara* and *Panicum Maximum* are likely vectors of habitat degradation).
Impacts to potentially occurring Rare flora species.	7.11.10, 7.11.34.	High potential for impact to *Rourea brachyandra*, Polyalthia sp. (Wyvuri B. P. Hyland) and *Piper mestonii* in suitable habitats including RE 7.11.10; and High potential for impact to habitat for *Aphyllorchis queenslandica* in RE7.11.34.
Other Species		
Impacts to non-EVR significant species.	7.3.10a	Potential for direct/residual impacts to *Callyera sp.* (Barrat Creek G. Sankowsyy 428) in suitable habitats in RE7.3.10a.

Source: Working Paper 2.

In summary, on the basis of the habitat modelling undertaken, it is likely that there will be impact on the habitat of a number of listed plants. BAAM (**Working Paper 2**) make the following recommendation regarding the conservation of listed plants:

- Recommendation 6: A detailed flora survey of the proposed road alignment and impact area should be undertaken prior to any construction works to determine the presence of any significant flora that may require specific management and/or impact mitigation.

c) Opportunities for Mitigation

General

BAAM (**Working Paper 2**) make the following recommendation regarding the conservation of listed plants:

- Recommendation 7: A Vegetation Management Plan should be developed to include construction, revegetation, rehabilitation, treatment of listed significant flora, monitoring and maintenance stages of the proposed road works.

Revegetation

As noted above, the cut-and-cover tunnel section will be revegetated once it has been backfilled. If desirable, this revegetation can include appropriate plant species of conservation significance.

Species currently likely to occur in this area (see **Working Paper 2**) are:

- *Carronia pedicellata* (Endangered NCA),
- *Polyalthia* sp. (Wyvuri B. P. Hyland RFK2632) (Rare NCA), and
- and *Rourea brachyandra* (Rare NCA).

5.4.4 E3: Impacts on Animals Other Than Cassowaries

a) Review of Attribute

Assessment of impacts on animals (other than cassowaries) of conservation significance is based primarily on consideration of the areas of clearing of vegetation communities in which important animals are predicted to occur, in a hierarchy of conservation significance based on **Working Paper 2** Figure 7. As no trapping and detailed modelling has been undertaken, the habitat preferences of individual animal species have been selected from the mapped regional ecosystems (**Working Paper 2** Figure 5) such that the regional ecosystems can be considered as a surrogate for animal species of conservation significance. Refer **Working Paper 2** Table 4.11.

The various species of animals of conservation significance (Table 4.11 of **Working Paper 2**) have different relative value (i.e. are listed as **endangered** to **rare** under the NCA and **endangered** or **vulnerable** under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC)). In addition, **Working Paper 2** has assigned a particular regional ecosystem as preferred habitat for each species. Accordingly, in addition to their inherent values in terms of plant communities, regional ecosystems has been allocated a value based on the highest conservation significance of all fauna species that utilise it. The value hierarchy selected ranges from Category A (highest conservation values) to Category E (lowest conservation values) as follows:

- A: endangered (NCA, EPBC),
- B: vulnerable (NCA, EPBC),
- C: rare (NCA)
- D: remnant (unless in a higher category by virtue of habitat value for animals), and
- E: non-remnant (unless in a higher category by virtue of habitat value for animals).

Based on Table 10 of **Working Paper 2**, the following fauna categories were derived.

TABLE 5.4.4A): FAUNA HABITAT CATEGORIES

	REGIONAL ECOSYSTEM												
	7.1.1	7.2.1	7.2.7a	7.2.8	7.3.3a	7.3.10a	7.3.25a	7.11.1	7.11.1a	7.11.26	7.11.34a	Non-remnant	Plantation
Fauna Habitat Category	B	A	B	A	A	A	A	A	A	B	A	A	A

Source: Based on Table 4.11 of **Working Paper 2**.

This coverage, superimposed with the road clearing plan, is shown on Drawings X10 to X16 (**Working Paper 1** Appendix F). Quantities are shown in **Working Paper 1** Appendix G and consolidated below.

b) Assessment of Impacts

Areas of clearing required for earthworks for each animal species category were measured, based on the intersection of the road corridor clearing between batter points and the E3 coverage. This took into account the presence of clearings formed by the existing road, together with earthworks, special treatment of fill batters, bridges and tunnels, and rehabilitation where the existing road is outside the batter points of the new road. Calculated areas are shown in the following table.

TABLE 5.4.4B): AREA OF CLEARING FOR ATTRIBUTE E3

CATEGORY	A	B	C	D	E	TOTAL
Area (ha) *	2.455	0.000	0.000	0.024	0.004	2.483

Source: **Working Paper 1**. * Please note that there are small differences in calculated areas of clearing between those shown in this table and similar figures in **Tables 5.4.2 and 5.4.3a)**. This is a result of slightly different methodologies. However, the differences are not significant.

In terms of the original data upon which this modelled coverage is based, BAAM (**Working Paper 2**) made the following assessment of impacts on listed animal species based on the modelling and fieldwork.

Where habitat is physically removed by machinery, animals can be killed outright, injured or displaced. It is generally the larger, more mobile animals that are able to move to adjacent unaffected areas, although having lost all or part of their home range through clearing, these animals are forced to compete for resources within the home ranges of other individuals. In this way, displacement may eventually also lead to the death of the displaced individuals or their competitors.

The immediate injury or death of individuals during clearing can be reduced through the presence of experienced fauna spotters to flush animals from areas about to be cleared, to identify vegetations supporting nests, etc. for careful lowering and then removing and relocating animals or to halt works until such time as individuals move on from the construction area. The effects associated with displacement of individuals are impossible to ameliorate and can be considered to represent a residual impact of the project.

Regional Ecosystems within the study area representing suitable habitat for each of these significant fauna species are listed in **Table 5.4.4C)**.

TABLE 5.4.4C): EVR SPECIES HABITATS WITHIN THE STUDY AREA

SCIENTIFIC NAME	COMMON NAME	RE 7.1.1	RE 7.2.1	RE 7.2.7a	RE 7.2.8	RE7.3.3a	RE 7.3.10a	RE 7.3.25a	RE 7.11.1	RE 7.11.1a	RE 7.11.26	RE 7.11.34a	Non-	Plantation
EXPECTED														
Casuarius casuarius	Southern Cassowary		X	X	X	X	X	X	X	X		X	X	X
Cophixalus infacetus			X			X	X		X	X			X	
Litoria genimaculata	Green-eyed Treefrog						X		X	X		X		
Litoria rheocola	Common Mistfrog						X		X	X		X		
Accipiter novaehollandiae	Grey Goshawk		X		X	X	X	X	X	X		X	X	X
Eulamprus tigrinus	Rainforest Water Skink					X	X		X	X		X		X
Cyclopsitta diophthalma macleayana	Macleay's Fig-parrot		X			X	X		X	X				
Collocalia spodiopygius	White-rumped Swiftlet	X	X	X	X	X	X	X	X	X	X	X	X	X
Neochmia phaeton	Crimson Finch											X	X	X
Pteropus conspicillatus	Spectacled Flying-fox		X		X	X	X	X	X	X		X	X	
LIKELY														
Esacus neglectus	Beach Stone-curlew	X		X							X			
Coeranoscincus frontalis						X	X		X	X		X		
POSSIBLE														
Litoria nannotis	Torrent Treefrog						X		X	X		X		
Nyctimystes dayi	Australian Lacelid						X		X	X		X		
Dendrolagus lumholtzi	Lumholtz's Tree-kangaroo					X	X		X	X				

Source: Working Paper 2.

For the purposes of addressing the relevant legislation, the potential impacts of the project on those species listed under the NCA and EPBC that are known, likely or possibly present within the subject area are listed in **Table 5.4.4D)** along with the areas of each species habitat that would be cleared. The table also includes recommendations for the mitigation of impacts expected from clearing for road construction.

TABLE 5.4.4D): AREAS OF SIGNIFICANCE FOR EVR FAUNA AND IMPACTS [SEE OVER]

LIKELIHOOD OF OCCURANCE Scientific Name	Common Name	Status# NCA	EPBC	Area of potential habitat proposed for clearing (ha)	DIRECT IMPACTS OF CLEARING AND MITIGATION RECOMMENDATIONS
EXPECTED					
Cophixalus infacetus	Buzzing Nursery-Frog	R		2.15	This species inhabits deep leaf litter in rainforests, and does not require water bodies for breeding. The species is difficult to detect. It would be unable to escape the direct effects of clearing and most individuals present within the road alignment would be lost during the clearing process. Direct searches by fauna spotters through leaf litter immediately prior to clearing may allow for the relocation of some individuals. Relocated individuals and those in the receiving areas would suffer the effects of competition for resources. Overall, within the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region.
Litoria genimaculata	Green-eyed Treefrog	R		2.3	This frog is found within rainforest throughout its range and is usually found among streamside vegetation. Clearing stream habitats has the potential to impact on individuals within the road alignment corridor. Streams and streamside vegetation should be checked, and individuals found relocated prior to clearing or construction activities at these locations. Relocated individuals and those in the receiving areas would suffer the effects of competition for resources. Overall, within the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region.
Litoria rheocola	Common Mistfrog	E	E	2.3	*Litoria rheocola* occurs in lotic streams within mesic vegetation, particularly where riffle zones are present (in the upper stream reaches). Clearing stream habitats has the potential to impact on individuals within the road alignment corridor. Streams should be checked for tadpoles and adults, and those found relocated prior to clearing or construction activities at these locations. Relocated individuals and those in the receiving areas would suffer the effects of competition for resources. Overall, within the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region.
Accipiter novaehollandiae	Grey Goshawk	R		2.47	The species would most certainly be hunting over the area, although the likelihood of a nest occurring within the narrow road alignment is low. If clearing of the alignment is proposed to occur within the breeding time for this species (April to November), fauna spotter should search the alignment

LIKELIHOOD OF OCCURANCE Scientific Name	Common Name	Status[a] NCA	EPBC	Area of potential habitat proposed for clearing (ha)	DIRECT IMPACTS OF CLEARING AND MITIGATION RECOMMENDATIONS
					specifically for the nests of these species, and nesting trees tagged for avoidance until the birds vacate the nest/s. Overall, provided nesting individuals are protected, in the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region.
Eulamprus tigrinus		R		2.3	This skink species is unlikely to vacate the alignment during clearing and is likely to take refuge within suitable fallen logs, branches, etc. Fallen logs, branches and other suitable sheltering debris should be removed from the clearing corridor by hand (or using machinery where required) and carefully placed in adjacent habitat ahead of clearing activities. In this way, many individuals of this species will be relocated within the debris. Relocated individuals and those in the receiving areas would suffer the effects of competition for resources. Overall, within the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region.
Casuarius casuarius	Southern Cassowary	E	E		See separate report (Moore, 2007)
Cyclopsitta diophthalma macleayana	Macleay's Fig-Parrot	V		2.0	This species feeds on native fruits, therefore the removal of fruiting trees will directly impact on the food resources for individuals whose home ranges includes the road alignment. Replacement of fruiting trees should be undertaken in rehabilitation works. The parrots prefer nesting in trees standing at the edge of rainforest or at the edge of a clearing in rainforest, therefore the areas where the existing road is to be widened should be targeted for searches to identify nesting trees prior to clearing, with the trees being marked for avoidance until after the end of the breeding season 0.45 (May-December). Overall, provided nesting individuals are protected, in the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region.
Collocalia spodiopygius	White-rumped Swiftlet	R		2.47	Caves and rocky outcrops within the road alignment should be checked for nesting birds prior to clearing activities. Where nesting birds are found, these areas should be avoided until after the end of the breeding season (October to April). Overall, provided nesting individuals are protected, in the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region.

LIKELIHOOD OF OCCURANCE Scientific Name	Common Name	Status[a] NCA	EPBC	Area of potential habitat proposed for clearing (ha)	DIRECT IMPACTS OF CLEARING AND MITIGATION RECOMMENDATIONS
Neochmia phaeton	Crimson Finch	V		0.45	The most likely habitat for this species within the road alignment where it is common with the existing road. Breeding season is September to April, when nests can be found in Pandanus palms and melaleucas, most often only a few meters above ground. If clearing is to occur within the breeding season, proposed disturbance areas along the existing road route should be searched for nesting birds, and nests marked for avoidance until the nest/s are vacated. Overall, provided nesting individuals are protected, in the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region.
Pteropus conspicillatus	Spectacled Flying-fox	LC	V	2.47	This species would feed on fruiting and flowing vegetation within the rainforest habitat. The road alignment should be checked for the presence of camps prior to clearing activities, and these areas should be avoided, with a 100m buffer established between the camp/s and the proposed road. If camps are present, road construction should not occur within the birthing season (September to December). Overall, provided camps are protected, in the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region.
LIKELY					
Coeranoscincus frontalis		R		2.3	*Coeranoscincus frontalis* is a fossorial, limbless skink species, foraging and sheltering in the upper surfaces of the soil beneath deep leaf litter in rainforests. The species is difficult to detect. It would be unable to escape the direct effects of clearing and most individuals present within the road alignment would be lost during the clearing process. Direct searches by fauna spotters through leaf litter immediately prior to clearing may allow for the relocation of some individuals. Relocated individuals and those in the receiving areas would suffer the effects of competition for resources. Overall, within the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region.
Esacus neglectus	Beach Stone-curlew	V		0	This species is associated with shandy shorelines and beach dunes and as such its habitat would not be directly affected by clearing, although the noise of construction activities may result in short term disturbance. Clearing and construction activities should not be carried out in close proximity to beach areas (i.e north of Heath Point) during breeding season (September to November).

LIKELIHOOD OF OCCURANCE		Status[#]		Area of potential habitat proposed for clearing (ha)	DIRECT IMPACTS OF CLEARING AND MITIGATION RECOMMENDATIONS
Scientific Name	Common Name	NCA	EPBC		
POSSIBLE					
Litoria nannotis	Torrent Treefrog	E	E	2.3	*Litoria nannotis* is associated with waterfalls and cascades in rainforest streams. While it is known that a small waterfall is located immediately west of the existing road north of Heath Point, this has not been inspected for the presence of the species. The entire road alignment should be assessed for the presence of likely habitat – specifically within the southern section, where a new section of road is proposed. The road alignment should avoid these habitats where they occur.
Nyctimystes dayi	Australian Lacelid	E	E	2.3	This frog species is dependent on streams for breeding, although can be found in nearby habitats. Clearing stream habitats has the potential to impact on individuals within the road alignment corridor. Streams should be checked for tadpoles and adults, and those found relocated prior to clearing or construction activities at these locations. Relocated individuals and those in the receiving areas would suffer the effects of competition for resources. Overall, within the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region. This species will need to be excluded from the road surface.
Dendrolagus lumholtzi	Lumholtz's Tree-kangaroo	R		2.0	One record of Lumholtz's Tree-Kangaroo for the local area was noted from the Queensland Museum database. This species occurs in rainforests, but is most common in highland areas. It is not regularly observed in lowland areas. This suggests that while suitable habitat occurs, the likelihood of it occurring within the road corridor is reduced. If present, it is most likely to occur within remnant rainforest. Fauna spotters should work ahead of clearing to identify the presence of individuals within the road alignment, and clearing should not occur until such time as the individuals are moved on. Overall, within the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region.

Source: Working Paper 2.

In summary, on the basis of the habitat modelling undertaken, it is likely that there will be impact on the habitat of a number of listed animals. BAAM (**Working Paper 2**) suggest that the best approach to managing effects on fauna is to limit impacts during construction (see below).

c) Opportunities for Mitigation

BAAM (**Working Paper 2**) make the following recommendation regarding the conservation of listed animals:

- Recommendation 8: Fauna spotters are required for all vegetation clearing and works in waterways:
  - Fauna spotters should work ahead of clearing to identify the presence of individuals within the road alignment, and clearing should not occur until such time as the individuals are moved.
  - Fallen logs, branches and other suitable sheltering debris should be removed from the clearing corridor by hand (or using machinery where required) and carefully placed in adjacent habitat ahead of clearing activities.
  - Caves and rocky outcrops within the road alignment should be checked for nesting birds prior to clearing activities. Where nesting birds (i.e. Macleay's Fig Parrot) are found, these areas should be avoided until after the end of the breeding season (October to April).
  - The road alignment should be checked for the presence of camps (i.e. for the Spectacled Flying Fox) prior to clearing activities, and these areas should be avoided, with a 100m buffer established between the camp/s and the proposed road. If camps are present, road construction should not occur within the birthing season (September to December).
  - Direct searches by fauna spotters through leaf litter immediately prior to clearing may allow for the relocation of some individuals (i.e. reptiles, particularly *Coeranoscincus frontalis*).
  - Streams should be checked for tadpoles and adults of *Nyctimystes dayi* Australian Lacelid, and those found relocated prior to clearing or construction activities at these locations. This species will need to be excluded from the road surface.
- Recommendation 9: Clearing and construction activities should not be carried out in close proximity to beach areas (i.e north of Heath Point) during breeding season (September to November).
- Recommendation 10: Waterfalls and cascades provide habitat for the Torrent Treefrog *(Litoria nannotis).* The road alignment should avoid these habitat types where they occur.
- Recommendation 11: Prior to any works commencing, a detailed fauna assessment is required to be undertaken along the precise route to identify specific habitat features to be avoided or managed during construction.

Revegetation

As noted above, the cut-and-cover tunnel section will be revegetated once it has been backfilled. If desirable, this revegetation can include appropriate plant species/communities that favour the animals of conservation significance likely to occur in this area. Table 4.11 of **Working Paper 2** lists species currently likely to occur in this area.

Fauna Connectivity

Where this section of road is proposed to be upgraded, although the proposed clearing is minimal and canopy can be retained across portions of the road and although the road is not located within a major fauna movement corridor, local fauna populations will be affected by the physical presence of the road and an increased likelihood of road death due to higher traffic volumes.

To counter these effects, it is proposed to fence the road to separate fauna from the road surface and to funnel fauna to underpass areas beneath the road. The road is also planned to be a low speed road. Fauna collisions are less likely at lower speeds, and with appropriate warning signage, unfenced areas of the road are likely to represent low risks for crossing fauna.

BAAM (**Working Paper 2**) make the following recommendations regarding fauna connectivity:

- Recommendation 12: It is recommended, in areas where there is no canopy connection over the roadway, that rope bridges are fixed between trees on either side of the gap to further accommodate the passage of arboreal fauna. The number of rope bridges required would need to be determined following completion of the proposed works.
- The proposed fauna underpasses would be constructed in association with locations where the road crosses creeklines. Careful bridging at these locations, with minimal mechanical disturbance, is required to maintain creek morphology and ensure that frog and aquatic flora and fauna habitats are not affected.
- Recommendation 13: Benchmark studies and on-going monitoring and management of waterway health are required at these locations, particularly during times of high rainfall, to ensure that the creek banks are stable and that roadworks do not initiate erosion.

  Populations of frog species *Nyctimystes dayi* the on either side of the road would be restricted to movement through underpass areas. Recent research for the Tugun Bypass project in northern New South Wales has developed a form of frog-proof fencing for acid frog species (BAAM 2005).
- Recommendation 14: The frog species *Nyctimystes dayi* – which is not restricted to waterways and their surrounds, will need to be excluded from the road surface. Specific investigations would be required to determine a fencing type capable of excluding *Nyctimystes dayi.*

  The Agile Wallaby *(Macropus agilis)* is likely to be the species most often encountered along the northern-most section of the alignment. This species will cross the road to move between habitat areas, and the presence of grassed verges is an attractant to this species, and it may frequent roadside locations. Lower road speeds and warning signs will reduce the risk of vehicle strike in unfenced areas.

  Due to their mobility and ability to fly across road corridors, the majority of bird and bat species would be unaffected by the location of the Access Road, and it will not significantly sever habitat connections. Although for ground-dwelling species, such as the Orange-footed Scrubfowl *(Megapodius reinwardt),* movement will be restricted to underpass areas.

  In the southern portion of the alignment where the construction of a new road is required through rainforest habitat which is outside of the National Park and World Heritage Area, the construction of a cut and cover tunnel is proposed. This construction method places the road beneath the natural ground surface, with soil replaced above the tunnel, and revegetated to facilitate safe fauna movement. The remainder of the road is fenced to separate fauna from the road surface and funnel movement towards the overpass area.

  Once again, for this section of road it is important to retain canopy connection across the road where possible, and to join the canopies in gap areas with rope bridges.
- Recommendation 15: The proposed overpass (i.e. located at cut and cover tunnel), underpass structures (i.e. opposite Flying Fish Point Reserve and also located at creek crossings along the alignment) will need to be monitored for their effectiveness and providing safe crossing opportunities for the range of fauna species present.

5.4.5 E4: Impacts on Cassowaries

a) Review of Attribute

Assessment of impacts on cassowaries is based primarily on consideration of the areas of clearing of cassowary habitat, in a hierarchy of conservation significance based on **Working Paper 3** Figure 3. As described in **Section 4.6.4**, Moore in **Working Paper 3** recognised two aspects of cassowary conservation, namely:

- habitat quality, and
- risk to cassowaries in accessing that habitat.

For convenience, much of this discussion is repeated below.

Moore created a system whereby an overall measure of the value of habitat to cassowaries (described as habitat value) was the product of the score of quality (on a scale of 1 (low) to 3 (high)) and risk to birds in accessing that habitat (on a scale of 0.1 (high risk) to 1.0 (low risk)). Inherent in this system is the recognition that in some cases birds do not gain from having access to particular habitat by virtue of mortality threats in the form of collisions with vehicles or attack by dogs. Using this methodology, Moore identified the habitat values of all parcels of land likely to be of relevance to the road options and the balance of the route to the resort site. In doing so, he made assumptions regarding risk (and in particular, whether or not a stretch of road was fenced). In this model:

- an unfenced road reduces the value of adjacent habitat (no matter how high) to a score of less than unity (described by Moore as negative) on the basis that cassowaries do not gain from its existence due to the threat of road-induced mortality,
- similarly, habitat that is not separated from nearby residential areas by fencing is also assigned a score of less than unity (“negative”) on the basis that cassowaries do not gain from its existence due to the threat of attacks from dogs, and
- a fence prevents the risk of accessing the habitat but at the same time reduces its value to zero (Moore does not deal with zero value and assigns a numerically low risk factor to reduce the overall quantitative value to a small number).

Moore recognises that it is highly desirable to supplement fencing a road (to remove the risk of mortality) with suitable crossings (to allow access to otherwise inaccessible habitat) as this restores the value of adjacent habitat to cassowaries.

On-going research into the issue of fencing and safe road crossing points is proposed (see **Section 7.2** regarding the “Fence & Funnel” Strategy and **Section 7.3** regarding the overall Cassowary Management Strategy) and an initial solution proposed in the form of two “fauna friendly” bridges (see **Figure 10** - **Section 4.10.2b)**). For this component of the impact assessment, it has been assumed that an effective strategy can be devised to allow cassowaries to safely cross the road and otherwise access habitat of value. In Moore’s model this would provide a risk factor of 1.0 (restoring the value of habitat to its intrinsic score). This is consistent with the final (November 2007) version of **Working Paper 3** appended to this report.

The revised values stated above would be as per the following table using a hierarchy from Category A (highest habitat value) to Category C (lowest habitat value) as follows.

TABLE 5.4.5A): CASSOWARY HABITAT CATEGORIES

CATEGORY	AREA (WORKING PAPER 3)	DESCRIPTION
A	Area 1 Area 5 Area 8	Ella Bay National park and environs Southern Ella Bay Road Northern Ella Bay Road
B	Area 4	Flying Fish Point Reserve
C	Area 2 Area 3 Area 6 Area 7	Heath Point Beach front South Seymour Range Flying Fish Point west swamp

Source: **Working Paper 3** as modified above (i.e. assuming effective fencing). This work was completed prior to the finalisation of **Working Paper 3**. In earlier work Moore used only three categories of cassowary habitat (A to C) whereas in the November 2007 version a fourth category was included. This is not considered important as the higher value categories A and B have been given priority in assessment.

This coverage, superimposed with the road clearing plan, is shown on Drawings X23 to X30 (**Working Paper 1** Appendix F – See Supplementary EIS Volume 3). Quantities are shown in **Working Paper 1** Appendix G and consolidated below.

b) Assessment of Impacts

Areas of clearing required for earthworks for each category of habitat value for cassowaries were measured, based on the intersection of the road corridor clearing between batter points and the E4 coverage. This took into account the presence of clearings formed by the existing road, together with earthworks, special treatment of fill batters, bridges and tunnels, and rehabilitation where the existing road is outside the batter points of the new road (see below).

- **Tunnels:** while the cut and cover construction methodology requires clearing (habitat loss) between portals, the area is to be re-planted and restored in such a manner to provide effective cassowary connectivity. Hence this area is shown as not cleared.
- **Funnels**: as above, it was assumed that an effective method can be found to safely “funnel” cassowaries across or under the road such that road-induced mortality is not an issue.
- **Road fencing:** it was assumed that the road (all options) is fenced on both sides to exclude cassowaries and hence prevent roadkill.
- **Other fencing:** it was also assumed that fencing will be undertaken on the eastern boundary of the Reserve (Area 4) to protect cassowaries from dogs (this is necessary to preserve the value of this habitat to cassowaries).
- **Bridges:** small bridges are proposed at creeks where there are important aquatic values, especially for frogs. Minor bridges are proposed at the following locations:
  - 3140/640, and
  - 3570/210.

These small bridges (see also **Section 5.8.6**) should be constructed with minimal disturbance of riparian vegetation and streambed morphology to protect riparian and aquatic values and maintain water quality. Advice from BAAM (**Working Paper 2**) is that streams to the south are ephemeral, with small catchment areas and grading fairly quickly to swampy country on the coast. These are not thought to be important to the stream-dwelling frogs of concern.

Calculated areas are shown in the following table.

TABLE 5.4.5B): AREA OF CLEARING FOR ATTRIBUTE E4

CATEGORY	A	B	C	TOTAL
Area (ha)	2.344	0.000	0.281	2.624

Source: Working Paper 1.

Moore (**Working Paper 3**) assessed the first section of road (i.e. between points A and D) and noted that this option would be acceptable if it included a raised bridge constructed along the Reserve section of the road, to allow cassowaries to pass beneath and access the Reserve without crossing the road. This is the proposed "fauna friendly" bridge described in **Section 4.10.2b)** and which forms part of the Fence & Funnel Strategy.

In terms of the balance of the road, Moore has advised that the land in the World Heritage Area around Heath Point is unlikely to be desirable for cassowaries due to its steep slopes down to the ocean and the lack of resources for cassowaries in the area. The detailed design of the Fence & Funnel Strategy should take into account the need for fences in this and other areas.

c) Opportunities for Mitigation

Key mitigation strategies for protection of cassowaries are:

- the "fauna friendly" bridges (**Section 4.10.2b)**),
- the Fence & Funnel Strategy (**Section 7.2**), and
- the Cassowary Management Strategy (**Section 7.3**).

"Fauna friendly" Bridges

Two "fauna friendly" bridges are recommended as part of the Fence & Funnel Strategy. According to Moore (pers. comm. 11 October 2007 and as documented in the final (November 2007) version of **Working Paper 3**), the location of the bridge and its final design, including fencing along the entire road(s), would need to be carried out in collaboration with Moore (i.e. to include input on cassowary issues). Moore refers to a "*Wet Tropics Bridge*" design he has been working on that is suitable for such a bridge on the Ella Bay Road. Moore notes that this:

- has a very low visual impact (good for cassowaries who appear to be wary of solid overhead structures),
- will allow the light and rainfall to reach the ground below relatively unhindered, and
- has the potential to incorporate arboreal fauna crossing of the road at the site of the bridge.

These bridges would need to be designed and monitored as part of a research program and if successful, would have significant implications for the management of road crossing cassowaries and arboreal fauna elsewhere in the Wet Tropics.

Revegetation

As noted above, the cut-and-cover tunnel section will be revegetated once it has been backfilled. It is recommended that this revegetation include appropriate plant species/communities that favour the

Southern Cassowary. Fencing to preclude cassowary access to the Flying Fish Point township area is recommended (see **Working Paper 3**).

5.4.6 E5: Impacts on Ecological Processes

a) Review of Attribute

Assessment of impacts on ecological processes that are important for the maintenance of flora and fauna values were identified (**Working Paper 2** and **Working Paper 3**) on the basis of a number of recognised measures including:

- ***connectivity***, i.e. geographical contiguity with other forest areas,
- ***refugial areas***, i.e. ability to withstand extreme climatic changes and thus provide relatively stable reservoirs of genetic material,
- ***critical habitat***, i.e. as a priority area for the conservation of viable populations of fauna (refer to E3 and E4),
- ***disjunct communities***, i.e. presence of isolated or outlying populations,
- ***hydrology***, i.e. role in maintaining energy and material flows through surface water and groundwater flows (both quantity and quality), and
- ***behavioural issues***, i.e. those behavioural characteristics of animals (other than those associated with the physical barrier effect) that could be affected by the upgrade, including sensitivity to noise and the effect of roadkill.

b) Assessment of Impacts

Areas where critical processes may be impacted upon by the preferred solution were identified, taking into account the presence of earthworks, special treatment of fill batters, bridges and tunnels to determine:

- extent of reduced (or improved) connectivity (via the over-road corridor provided by the cut-and-cover tunnel and via the small bridges along the Ella Bay Road),
- extent of reduced (or improved) hydrology, and
- extent of reduced (or improved) animal behaviour.

In addition to fauna connectivity (described above), BAAM (**Working Paper 2**) assess a number of potential impacts that fit under this category, namely:

- edge effects,
- weeds, and
- noise.

Edge Effects

The impacts of the proposed road improvements in association with the existing road alignment are not expected to contribute significantly to existing edge effects. However, to the south, the proposal requires construction of a new road section.

The closed canopy of a rainforest provides a microclimate suitable for its specialized floral and faunal inhabitants. In areas where gaps are created in the canopy, such as when large trees fall or where there is storm damage, light and heat penetrate to the forest floor, triggering the germination of early successional stage species which flourish in the sunlight, and in turn create a microclimate within which later successional stage species can establish and eventually close the canopy gap.

Where clearings are more permanent, the pioneer or edge species are able to persist as long as sunlight is available. The seeds of weeds may be introduced by birds, allowing weeds to become established within the clearing, preventing recruitment of rainforest species, and potentially penetrating into the adjacent forest for some distance.

Adjacent to the Palmerston powerline clearing within the WTMA, Goosem and Turton (2000) found that edge-induced changes in floristic composition penetrated the rainforest to a distance of 3-7m, with early successional stage rainforest species more prevalent, and that floristic composition was altered further into the rainforest to distances varying between 25 and 45m.

Where clearing is for a road, the permanency and extent of the resulting canopy gap also creates extensive, lineal edges from which the effects radiate into the adjacent rainforest vegetation. On roads, these effects are compounded by the capacity for their long term use to continually introduce weeds and pathogens to the roadside environment.

For the proposed 9 m width road, the edge effects will potentially impact on a 100 m corridor (approximately 45 m either side of the road shoulders). Although most apparent at the road edge, the potential effects within this zone of influence are:

- Alteration to vegetation community composition, favouring early successional species. This effect would weaken with distance from the road edge
- Altered drainage conditions and soil characteristics that may result in stress to or the eventual death of plant species sensitive to such changes.
- The introduction and establishment of weed species. The weeds most likely to establish are those listed in Table 7.5 of **Working Paper 2**), recorded from the existing roadside within the study area.
- The establishment of fire increasing species, such as Guinea Grass, adjacent to fire-sensitive rainforest vegetation.
- Corresponding alteration to fauna habitats would be expected. Goosem and Turton (2000) found that grassland and feral small mammals can intrude along the grassy and woody weed verges of a narrow road traversing rainforest – although they failed to penetrate the rainforest.

Mitigation measures can be implemented to reduce or eliminate some of these impacts. In particular, the maintenance of canopy cover over the road would reduce light and heat penetration, making roadsides unsuitable for the establishment of weed species and preventing or reducing the predicted impacts on vegetation community composition along the roadsides. As a consequence, the roadside verges would not provide suitable habitat for grassland or exotic mammal fauna. Where canopy cover cannot be maintained over the road, the subsequent effects would require monitoring and management for the life of the road. In particular, rehabilitation of disturbed roadsides with rainforest vegetation and the implementation of a weed management program would be necessary.

It should be noted that for some of the significant fauna species present or likely to be present, roadside environments can create habitat opportunities. For instance:

- the White-rumped Swiftlet is known to nest within man-made structures and may make use of retaining walls, pipes and other road infrastructure,
- Macleay's Fig-Parrot prefers nesting in trees at the edge of rainforest clearings, as such it may make use of roadside habitat,

- the Crimson Finch makes use of open areas adjacent to rainforest habitat. Grasses and low, dense vegetation within roadside areas would provide resources for this species, and
- Skinks and other reptiles may make use of man-made structures in clearings for basking purposes.

Pests and Weeds

BAAM (Table 7.5 of **Working Paper 2**) include a discussions on likely pest and weed species. These need to be attended to as part of overall road management.

Noise

Goosem and Turton (2000) examined the penetration of vehicle noise into wet tropical rainforests, and found that vehicular noise penetrates well over 100 m into the rainforest at levels that may contribute to the degradation of habitat for some species of fauna. More recent research by Dawe and Goosem (2007) document field trials on the effect of traffic nose on birds, concluding *inter alia* that noise levels previously considered safe may actually impact on fauna in subtle ways such as causing them to vocalise at higher volumes or frequencies.

c) Opportunities for Mitigation

Key mitigation strategies for the protection of ecological processes are:

- the Fence & Funnel Strategy (**Section 7.2**),
- the Cassowary Management Strategy (**Section 7.3**),
- the Road Runoff Strategy (**Section 7.4**), and
- the Rehabilitation Strategy (**Section 7.5**).

BAAM (**Working Paper 2**) make the following recommendation re ecological processes:

- Recommendation 16: It is recommended that the canopy cover be maintained where possible along the preferred road alignment. On-going monitoring and maintenance to minimise edge effects is required for areas along the preferred alignment where the canopy cover cannot be maintained along the road.
- Recommendation 17: It is recommended that disturbed areas along the roadside be rehabilitated using rainforest species as part of the Vegetation Management Plan. Seed stock should be of local provenance.
- Recommendation 18: To determine if pest fish species are present it will be necessary to survey the fish populations in creeks along the road alignment and monitor species composition during and following road construction.
- Recommendation 19: Community awareness is also an important measure in the prevention of introduction of exotic fish species to waterways. The residents within the proposed integrated resort development and existing residents in the township of Flying Fish Point should be included in an awareness program that could be coordinated with local government
- Recommendation 20: It is recommended that "quite asphalt" (e.g. Stone Mastic Asphalt (SMA)) is used in road construction and that some level of noise control be incorporated into the fauna fencing design to reduce potential noise effects. Noise modelling would be required to formulate the most suitable fencing design. Note that this recommendation needs to be assessed further during detailed design as it may be that SMA is not necessary given the low traffic speed and relatively low traffic volumes.

5.4.7 World Heritage Values – Wet Tropics of Queensland (Biological)

a) Review of Attribute

This criterion was not used in the MCA on the basis that none of the four options between Points A and D traversed the Wet Tropics World Heritage Area. The preferred solution includes most of the existing Ella Bay Road which passes through the World Heritage Area (Zone C under the *Wet Tropics Management Plan 1998* (Qld)) between Ch 1779/2001 and Ch 3630/150 (i.e. a length of 1851 m). The impact of the proposed Access Road on the World Heritage values of this area is discussed below.

Please note that World Heritage values are described in terms of:

- Wet Tropics of Queensland (Biological) – this section,
- Wet Tropics of Queensland (Scenic) – **Section 5.4.8**,
- Great Barrier Reef (Biological) – **Section 5.4.9**, and
- Great Barrier Reef (Scenic) – **Section 5.4.10**.

The Wet Tropics of Queensland, more commonly known as the Wet Tropics World Heritage Area (WTWHA) was inscribed on the World Heritage List in recognition of its outstanding natural universal values (DEW 2007):

- as an outstanding example representing the major stages in the earth's evolutionary history,
- as an outstanding example representing significant ongoing ecological and biological processes,
- as an example of superlative natural phenomena, and
- containing important and significant habitats for in situ conservation of biological diversity.

The Wet Tropics World Heritage property lies between Townsville and Cooktown on the north-east coast of Queensland and covers an area of approximately 894,000 hectares. The Wet Tropics rainforest is just a small fragment of what was once a vast forest stretching all the way to the red centre approximately 65 million years ago. The remaining tropical rainforest retreated to a long narrow strip along the north eastern coast. There are at least 390 species of plants that can be classified as rare or very restricted and, of these, 74 are regarded as threatened (DEW 2007).

This small remnant of our Gondwanan forest has been fragmented further since European settlement. Significant areas have been cleared for agriculture and urban development, particularly along the coast and on the tablelands (DEW 2007).

Impacts from this type of external fragmentation can include: restricting the movement of species between habitat fragments; altering historic natural patterns of gene flow among populations; reducing the ability of a populations to adapt and change; reducing seed and pollen dispersal; and impacts on the long term preservation of evolutionary diversity. In addition, species found in ‘Island’ habitats are more susceptible to extinction (WTMA 2004a).

The protection of existing vegetation which supports connectivity between habitats is of the utmost importance and rehabilitation in suitable areas is recommended where feasible. Although rehabilitation is central to the community efforts for restoring biodiversity, it is more cost effective to maintain the existing vegetation and connectivity than it is to undertake detailed rehabilitation of an area. It is equally as important to maintain and/or rehabilitate areas outside or World Heritage Areas to establish landscape linkages for wildlife and vegetation (WTMA 2004a).

Internal fragmentation is caused by infrastructure corridors, clearing and/or natural features (i.e. gorges or rivers) which act as a barrier to wildlife movement, disrupt connectivity and provide a means for weed and feral animal invasion. Clearing associated with linear infrastructure such as roads or electricity distribution account for at least 4,475 ha, more than half of which are ongoing maintained clearing (WTMA 2004a).

Advice from the WTMA (Steve Goosem pers. comm.) is that, for projects such as the Ella Bay Integrated Resort and this Access Road, the key World Heritage value is integrity. Schedule 3 of the WTMP defines 'integrity' as the 'extent to which the world heritage values:

- are in their natural ecological, physical or aesthetic condition, and
- are capable of sustaining themselves in the long term.'

b) Assessment of Impacts

The following table provides a snapshot of key areas of clearing within the World Heritage Area.

TABLE 5.4.7B): SUMMARY OF KEY STATISTICS (WHA)

ITEM	STATISTIC
Length of upgraded road in World Heritage Area	1.85 km
New clearing for construction of road (remnant vegetation)	0.44 ha
Area of existing clearing incorporated within new road	1.95 ha
Area of revegetation (planted gabions)	0.40 ha
Area of revegetation (cuttings and embankments)	Not calculated

Source: Study team compilation based on **Working Paper 1**.

Ignoring the revegetation of retaining walls, cuttings and embankments (the benefits of which are mainly erosion control and visual amenity), the construction of the preferred solution will involve new clearing of 0.44 ha within the World Heritage Area. In terms of conservation issues relevant to regional ecosystems:

- no clearing is required in regional ecosystems deemed to be "endangered",
- 0.35 ha of "of concern" regional ecosystems will be cleared, and
- 0.09 ha of "not of concern" regional ecosystems will be cleared.

Within the World Heritage Area, the road is generally proposed to be cut into the existing alignment in order to widen the available formation and avoid the need for embankments which would be difficult to construct on the steep coastal slopes. As for the balance of the road, where cuttings would otherwise have been greater than 5 m high, retaining walls have been used. Note that this 5 m height may be revised during detailed design. Within the World Heritage Area the maximum height of retaining walls is approximately 10 m (at Ch 3140/640). No embankments are required for the alignment chosen.

According to BAAM (**Working Paper 2**), impacts on world heritage values relate to actions that degrade habitat, resulting in loss of species diversity, including floristic, faunal (including aquatic) and marine habitat values. These are all within the ambit of "integrity". **In the absence of mitigation**, impacts on

World Heritage Values for areas included in WTWHA around Heath Point though the construction, operation and maintenance of the upgraded Access Road to Ella Bay may arise from:

- vegetation clearing and fragmentation of habitat,
- inhibition or prevention of wildlife movement in important arboreal, terrestrial and aquatic ecosystems,
- potential increase in roadkill mortality rates,
- increased human access to remote areas,
- the potential for altered water flows and drainage of waterways and wetlands,
- sedimentation of streams, seasonal wetland habitats, and adjacent marine habitats,
- landslides and slope instability caused by slope incision and landform interference, directly causing landscape fragmentation and sedimentation,
- loss of biodiversity through facilitation of weed, pest and disease invasion into adjacent and peripheral vegetation communities, and
- 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.

Any combination of the impacts listed above can act to reduce the ecological integrity of the WTWHA. The mitigation measures specified in **Section 5.4.7c)** below are designed to address these potential impacts.

Table 6.2 of **Working Paper 2** includes a summary of specific World Heritage values that may be relevant in the study area and is presented below.

TABLE 5.4.7C): IMPACTS ON WORLD HERITAGE VALUES

Category	Sub-category	Total numbers of species in Area		
		World Heritage Area	Study Area No.	%
Evolutionary history				
Age of ferns	Earliest living ancestors of two main branches of land plants	16 species	0	(0%)
	Diversity within ancient families of true ferns	41 species	3	(7%)
	Primitive fern families	10 species	3	(30%)
	Area being a major centre of fern diversity	247 species	3	(1%)
	Area being a major centre of endemism for East Gondwanan fern taxa	48 species	2	(4%)
Age of conifers and cycads	Diversity of cone bearing cycads and southern conifers which are the most ancient of living seed plants and were widespread in the Jurassic	7 species	3	(42%)
	Cycads' association with the most primitive pollination systems	7 species	3	(42%)
	Area having the highest diversity of cycad genera in Australia	7 species	3	(42%)
	Diversity of southern conifers in the Area and the Australian sector of Gondwana being considered the site of the austral conifers	4 species	0	(0%)
Age of flowering plants	Richest assemblage of families of primative flowering plants	40 species	25	(62%)
	Species belonging to small, relict primative angiosperm families	98 species	1	(1%)
	Orders occupying nodal positions in the evolution of the angiosperms	221 species	31	(14%)
	Gondwanan angiosperm families of Cretaceous origin	217 species	45	(20%)
	East Gondwanan families or genera	133 species	0	(0%)
Final breakup of the super continent of Gondwana	Relicts of early descendants of Gondwanic frog fauna	15 species	5	(15%)
	Relicts of early descendants of Gondwanic reptile fauna	17 species	8	(47%)
	Relicts of early descendants of Gondwanic bird fauna	1 species	1	(1%)
	Relicts of early descendants of Gondwanic insect fauna	Not yet determined	Not yet determined	
The origins of the Australian scllerophyll flora and marsupial fauna	Ancestral stock from which the sclerophyll Proteaceae and Myrtaceae component of Australia's flora evolved	61 species	15	(24%)
	Ancestral stock from which the sclerophyll Casuarinaceae component of Australia's flora evolved	1 species	0	(0%)
	Ancestral stock from which the sclerophyll Rutaceae component of Australia's flora evolved	26 species	9	(34%)
	Ancestral stock from which the marsupial component of Australia's fauna evolved	38 species	4	(10%)
The origin and radiation of the songbirds	Ancestral lineages of the Passerines (Oscines)	nil	nil	
	Close links with the diverse bird fauna of PNG	nil	nil	
The mixing of the continental biota of the Australian and Asian continental plates	Unique record of the mixing of two continental floras that has no parallel Plants from the Asian plate constituted both old Gondwanan and Asian elements	71 species	6	(8%)
	The unique record of the mixing of two continental faunas	84 species	14	(16%)
The extreme effects of the Pleistocene glacial periods on tropical rainforest vegetation	Evolutionary history is represented by relict taxa that survived the Pleistocene ice ages	13 species	1	(7%)
Significant ongoing ecological and biological processes				
Processes leading to areas of high endemism and speciation	Biogeographic processes leading to areas of high endemism	500 species		
	Speciation processes- disjunct populations within Wet Tropics region	74 species	41	(55%)
	Speciation processes- disjunct populations extra-Wet Tropics region	20 species	5	(25%)
	Processes of genetic differentiation	nil	nil	
	Ecological continua: spectrum of biological diversity present within a range of elevation climate and substrates	To be determined	To be determined	
Superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance				
	Natural phenomena	Not listed		
	Beauty and aesthetics	Not listed		
Important habitats for the in situ conservation of biological diversity including threatened species				
Habitats for conserving biodiversity and rare or threatened species of flora	Vegetation diversity	To be determined	To be determined	
	Plant diversity/ rare or threatened plants	433 species	1	(0.2%)
Habitats for conserving faunal diversity and rare or threatened faunal species	Animal diversity/ rare or threatened fauna	55 species	7	(12%)

Source: Working Paper 2 (Table 6.2).

c) Opportunities for Mitigation

The following table summarises the potential impacts described above and proposed mitigation measures.

TABLE 5.4.7C): PROPOSED MITIGATION MEASURES

POTENTIAL IMPACT	PROPOSED MITIGATION
Vegetation clearing and fragmentation of habitat.	• Constrained (narrow) sections to further reduce clearing. • Installation of fauna underpasses and overpasses to provide safe access to otherwise fragmented habitat.
Inhibition or prevention of wildlife movement in important arboreal, terrestrial and aquatic ecosystems.	• Fauna underpasses and overpasses.
Potential increase in roadkill mortality rates.	• Road fencing.
Increased human access to remote areas.	• Fencing will prevent access to the World Heritage Area from the road.
The potential for altered water flows and drainage of waterways and wetlands.	• No changes to drainage proposed.
Sedimentation of streams, seasonal wetland habitats, and adjacent marine habitats.	• Construction management (see Environmental Management Plan (**Section 7.6**)).
Landslides and slope instability caused by slope incision and landform interference, directly causing landscape fragmentation and sedimentation.	• Appropriate engineering design based on geotechnical analysis. • Planted retaining wall sections to enhance stability.
Loss of biodiversity through facilitation of weed, pest and disease invasion into adjacent and peripheral vegetation communities.	• Construction management (see Environmental Management Plan (**Section 7.6**)).
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.	• No changes to drainage proposed. • See Road Runoff Strategy (**Section 7.4**).

Source: Working Paper 2 and Study team compilation.

Key items described above are expanded upon below and as elsewhere referenced.

Reduction of Roadkill and Enhanced Fauna Connectivity Initiatives

The Fence & Funnel Strategy (**Section 7.2**) and Cassowary Management Strategy (**Section 7.3**) are designed to reduce roadkill of fauna (and especially cassowaries) and reduce habitat fragmentation by the provision of safe overpasses and underpasses for fauna.

Revegetation

While the proposed revegetation of gabion retaining walls (see below) and un-retained cuttings will improve scenic values, these are unlikely to have much of an effect on biological values.

Further Alignment Optimisation

A review of the preliminary design documented for this Access Road Strategy shows that there may be some opportunity to reduce clearing and earthworks by detailed optimisation of the vertical and horizontal alignment to make the most use of the existing disturbance. This is a complex process and will need to be undertaken on the basis of detailed ground survey during the detailed design stage.

Use of Constrained Sections

The extent of clearing and earthworks can be reduced if the road cross section is made more narrow by removing or reducing the width of shoulders and/or changes to the drainage methodology. Details of options and consequences are explored in **Section 5.8.4**.

Again, it is not practical to undertake this work until detailed ground survey is available.

5.4.8 World Heritage Values – Wet Tropics of Queensland (Scenic)

a) Review of Attribute

As noted above, the Wet Tropics of Queensland was declared as a World Heritage Area partly on the basis of its scenic values ("contain superlative natural phenomena, formations or features").

Scenic Values

The scenic values of the Wet Tropics World Heritage Area were assessed in the compilation of the Wet Tropics Plan (Wet Tropics Management Agency[6] 1992) on the basis of a specialist study undertaken by Scenic Spectrums (1992). This study noted that the World Heritage Area is viewed from within and outside its boundaries by many people, and classified its scenic values on the basis of a 1 to 5 rating (from highest to lowest quality).

The following points which have been derived from the above study concerning the WHA adjacent to the site are relevant.

Scenic Routes

The above assessment included an assessment of scenic routes (Appendix C of WTMA 1992). In this assessment, the following relevant routes are considered to be of 'Very High' *Public Sensitivity* (see definition below):

- offshore sea routes of the Coral Sea, and
- Flying Fish Point Road.

---

6 The Wet Tropics Management Agency has since been renamed the Wet Tropics Management Authority. At the time when the Agency existed the Authority was the name given to what is now the Board of the Wet Tropics Management Authority.

Scenic Assessment Units

The study area includes (Appendix 2 of Scenic Spectrums 1992):

- Unit 70 – Ella Bay (Lowland swamps/Coastal Swamps-Headlands) is rated as Class 2 (i.e. secondary scenic quality).

Management Areas

The Ella Bay unit is in Scenic Management Area 20 (High Priority 2) described as "High Scenic Significance". Under WTMA (1992), for Scenic Management Areas rated 'High Priority 2', the Scenic Quality Objective is to restrict future alterations to those developments that are not visually apparent.

In terms of the definition of scenic amenity under the *Wet Tropics Management Plan*, there are no individual natural features of note in the area and the identified values are at the landscape level. Refer to the following image.

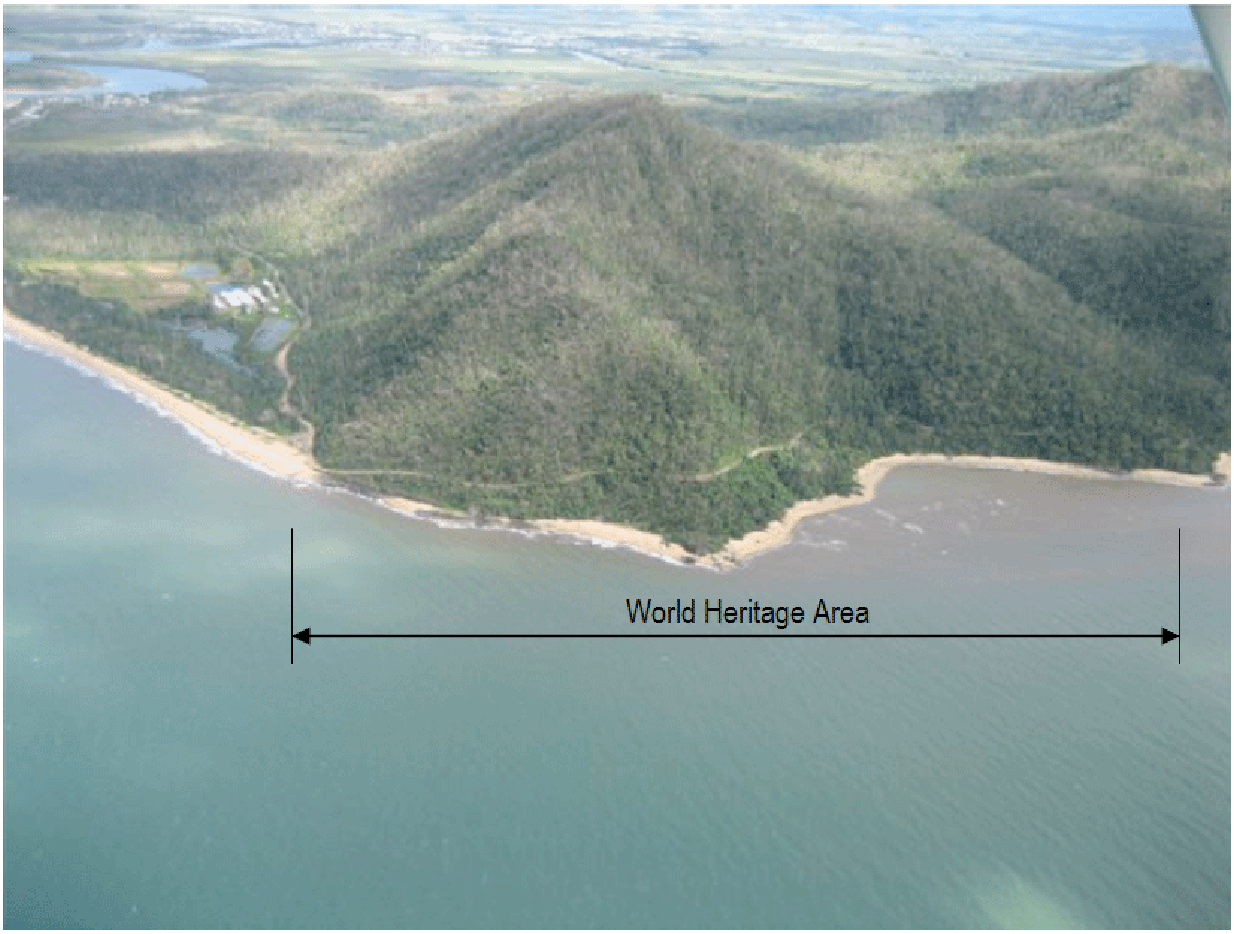


Plate 1. Arial view of Heath Point showing the existing Ella Bay Road.

b) Assessment of Impacts

Impacts on scenic values of the whole route (i.e. including the World Heritage Area) are described in **Section 5.6.2** (Impacts) and **Section 5.6.3** (Presentation).

c) Opportunities for Mitigation

Mitigation options for impacts on scenic values of the whole route (i.e. including the World Heritage Area) are described in **Section 5.6.2**. Mitigation options for reducing the impacts of roadworks on scenic amenity include:

- minimisation of earthworks through design of horizontal and vertical alignment,
- additional minimisation of earthworks by the use of retaining walls and reducing the cross section width (i.e. constrained sections),
- planting retaining walls to make them blend better into the background, and
- avoiding route lighting and shielding headlights from viewsheds.

These are all described in **Section 5.8**.

5.4.9 World Heritage Values – Great Barrier Reef (Biological)

a) Review of Attribute

World Heritage Area / Commonwealth Marine Park

The Great Barrier Reef was nominated as a World Heritage Area in 1981, meeting all four of the World Heritage criteria for the assessment of outstanding universal value:

- Contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance
- Be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features
- Be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals
- Contain the most important and significant natural 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.

These criteria can be summarised as follows:

- geological processes/features,
- ecological and biological processes,
- aesthetics/natural beauty, and
- biological diversity/threatened species.

In the vicinity of the site, the Great Barrier Reef World Heritage Area is within the Great Barrier Reef Marine Park managed by the Great Barrier Reef Marine Park Authority (GBRMPA) and the Queensland Parks and Wildlife Service (QPWS). Values at the local level are usually reflected in zoning, which, by reference to the zoning plan for the area (see below) is "General Use" (i.e. the lowest level of protection).

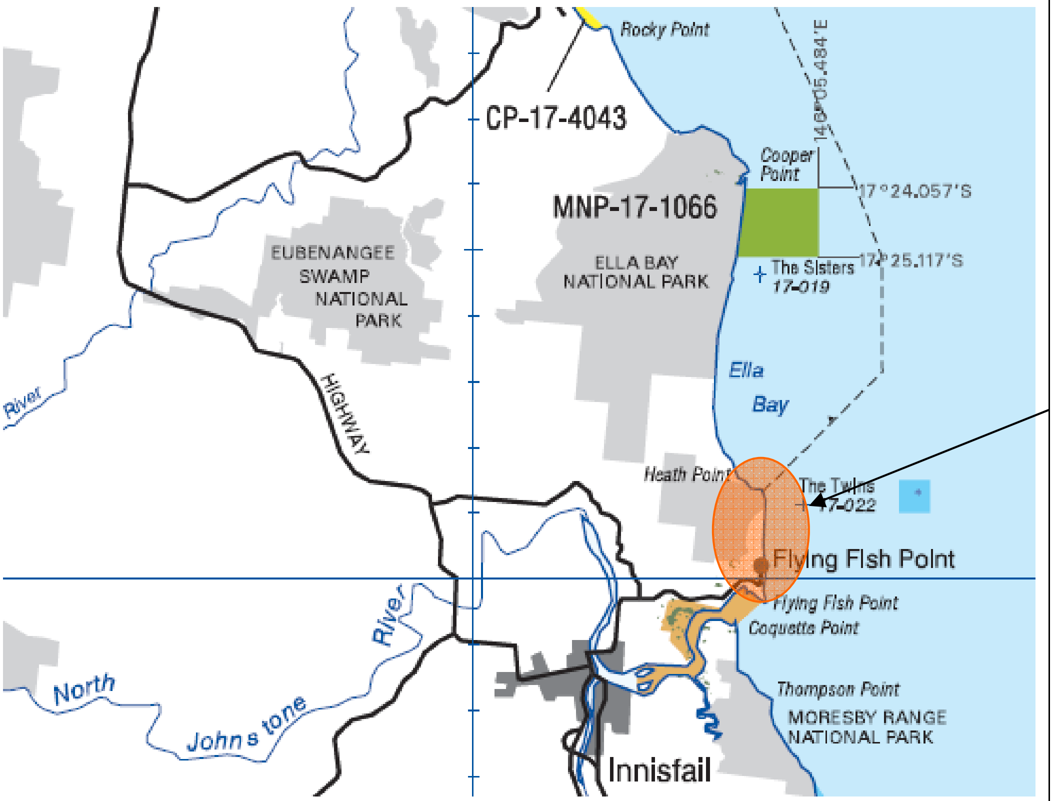


Figure 22. Extract of GBRWHA Zoning Plan in the vicinity of the proposed Access Road.

Zoning adjacent to the shore at this point is "General Use".

Route of Access Road

State Marine Park

Under the joint management arrangements between GBRMPA and QPWS, the coastal area in the vicinity of the resort site is covered by the Wet Tropical Coast Regional Coastal Management Plan implemented under the *Coastal Protection and Management Act 1995* (Qld). Under this plan, the study area is included in the Ella Bay Key Coastal Site (Locality 5.1 Flying Fish Point). Aspects of this plan relevant to biological issues are:

- the coastal area between Flying Fish Point and the resort is shown as containing significant coastal wetlands (Map 27), with the Ella Bay Swamp Wetland north of the resort site being singled out for specific reference (this wetland is listed in the national Directory of Important Wetlands),
- it is not shown on Map 28 (significant coastal dune systems),
- it is shown on Map 29 (endangered regional ecosystems) although detailed site level assessment has shown that the Access Road will not encounter these areas, and
- reference to Map 30 (coastal wetlands – see below) shows that the Access Road is not within close proximity to:
  - coral reefs
  - significant sites for birds
  - seagrass beds
  - estuarine wetlands
  - freshwater wetlands.
- the plan notes that rare and threatened fauna such as the Irrawaddy and Indo-Pacific humpback dolphins, dugong and turtles inhabit the inshore marine area.

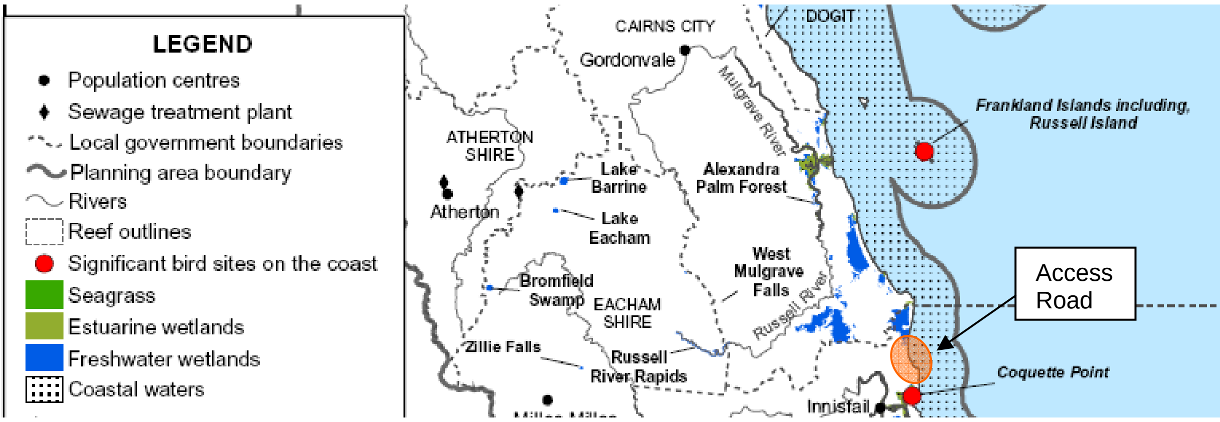


Figure 23. Extract from Map 30 (Coastal Wetlands) contained within the Wet Tropical Coast Regional Coastal Management Plan.

b) Assessment of Impacts

Discussions with the GBRMPA (J. Rainbird pers. comm.) reveal that the issues of concern with respect to the Access Road are:

- water quality (during construction and operation), and
- visual impacts (see **Section 5.4.10**).

Referring to water quality issues, there are no major watercourses entering the Great Barrier Reef lagoon adjacent to the Access Road, and the existing small creeks are intended to remain unaltered by the road. Existing culverts are proposed to be removed and replaced with small bridges to better protect aquatic habitat and water quality.

It is also relevant to note that the existing Ella Bay Road is unsealed with un-retained cuttings and embankments and there are no measures in place to reduce or control erosion and subsequent sedimentation. In addition, a condition of approval for the Little Cove resort that is situated immediately to the south of the Ella Bay Integrated Resort is that the Ella Bay Road be sealed from Flying Fish Point to the Little Cove site. However, there are no requirements that there be any special pollution control measures. Thus in terms of this impact assessment, the change due to the proposed Ella Bay Integrated Resort is:

- widening of the existing seal from 4 m to 9 m,
- increase in traffic, and
- stabilisation of all cuttings and embankments greater than 5 m in height (note that this 5 m height may be revised during detailed design).

A review of the possible impacting processes on the Great Barrier Reef World Heritage Area reveals that possible direct water quality impacts are limited to the construction process (i.e. erosion and sedimentation) and operation (i.e. pollution).

Construction

During the construction phase, there is the potential for earthworks to lead to erosion and subsequent sedimentation of watercourse and at the extreme, the reef lagoon itself.

Operation

During the operations phase, potential water quality impacts are:

- "normal" i.e. chronic release of pollutants from motor vehicles, and
- "emergency" i.e. arising from accidents, oil spills etc.

In terms of **"normal" pollution**, compared with the existing road, there is likely to be an increase in pollutants from in runoff due to increased traffic levels. Pollutant runoff from roads contains a mixture of heavy metals derived from tyres, catalytic converters and fuel. Increased pollutant runoff could result in loss of water quality with a possible consequent loss of aquatic habitat. Control of road-based pollutant runoff at critical locations (i.e. where high water quality values or aquatic habitat have been identified) is required to mitigate these impacts.

Stormwater pollution from road surfaces typically comprises fine particles, dissolved materials (metals and nutrients), litter and vegetation. The following table lists expected contaminants along with their sources. This was derived from a major study of water quality issues as part of the proposed Kuranda Range Road Upgrade (see GHD 2003).

TABLE 5.4.9B)(I): POLLUTANTS ASSOCIATED WITH ROADWAYS

POLLUTANT	SOURCE OF POLLUTANTS
Sediment	Pavement surfacing residue, tyre rubber, bearings and brake wear residue, erosion of batters and unprotected surfaces.
Nutrients (N&P)	Roadside fertiliser.
Oil and Grease	Lubricants and motor fluids (spills leaks).
Heavy Metals	Cr, Cu, Pb, Zn, Fe, CD Ni, Mn – emissions, lubricants, corrosion, tyres rubber, bearing and brake residue.
Organics (other)	Herbicides, pesticides.
Gross Pollutants	Litter and organics (leaves and vegetation).

Source: GHD (2003).

Austroads (2001) notes that work undertaken in the USA has observed a relationship between the concentration of pollutants generated and traffic volumes. Other research in Brisbane (*ibid.*) has observed higher concentrations of certain pollutants (e.g. copper which is associated with brake linings) where vehicles are braking heavily. Once released, these contaminants can be transported by runoff, with studies suggesting that higher levels of contaminants are transported in the initial part of a rainfall and runoff event – the so-called 'first flush'. This is confirmed in relation to dissolved heavy metal concentrations through in column leach testing conducted by Pratt (2003).

First flush is notionally regarded as the initial peak in contaminants that can occur in the early stages of a rainfall and runoff event[7]. Concentration peak and decay functions vary from site to site depending on contaminant sources within the catchment, the pollutants of interest, and the characteristics of the

[7] First flush treatment is a means of intercepting these contaminants. Rather than treating 100% of the flow, the devices are designed such that they have the capacity to treat the first flush flow as a minimum.

drainage basin, such as the amount of imperviousness, type of stormwater conveyance system, and the length. The impervious road surfaces will tend to cause the accumulation of pollutants such as leaf litter, oil, grease, and heavy metals, which can then be carried into waterways after rainfall.

It is difficult to assess pollution levels in stormwater as normal or typical as they vary so much due to great differences in pollutant bio-availability, rainfall intensity and duration. Therefore the concept of first flush cannot be assumed in all cases. The following table considers the various characteristics of a rural highway project in the context of the first flush phenomenon.

TABLE 5.4.9B)(II): FACTORS AFFECTING FIRST FLUSH

CHARACTERISTIC	DESCRIPTION	FIRST FLUSH
Catchment	Treatment confined to impervious road area. Catchment is homogenous.	Accumulated pollutants likely to be mobile.
Pollutant availability	Supply of pollutants limited by usage since last flush.	Cleansing effect of initial runoff on road pavement provide distinct first flush.
Conveyance system	K&C and open channel surface flow direct to treatment. Negligible storage in conveyance system.	Very little attenuation (or smoothing) in runoff, therefore distinct first flush event and peak discharge events.
Length	Relatively short drainage lengths up to a maximum of 90 m with short, single peaked runoff hydrographs.	Very short time lag to peak pollutant concentration after commencement of rainfall burst.

Source: GHD (2003).

In terms of **"emergency" pollution**, the degree of impact depends on the nature of the pollutant, the quantity released, the location of the release, and the effectiveness of clan-up operations.

c) Opportunities for Mitigation

Water quality impacts arising from **construction** are expected to be able to be managed through a mixture of design and through specific construction management measures to be documented in the proposed EMP (Construction) (see **Section 7.6.4**). This includes the implementation of a Soil and Water Management Plan to include all key issues such as:

- diversion of water away from and around works areas
- use of contour banks and drains
- use of temporary soil stabilisation works
- use of silt fences, sedimentation ponds and other similar structures to contain soil and runoff
- scheduling of roadworks and soil handling
- control of the clearing sequence and treatment of felled timber and roots, and

At the **operation** stage:

- the proposed EMP (Maintenance) (see **Section 7.6.5**) includes the development of a contingency plan for the control of environmental impacts of emergencies (i.e. fuel spills and control of any water contaminated by wash down or firefighting activities), and
- the proposed Road Runoff Strategy (see **Section 7.4**) includes a strategic approach to all aspects of runoff management.

Together, these initiatives are expected to adequately protect water quality values of the Great Barrier Reef World Heritage Area.

5.4.10 World Heritage Values – Great Barrier Reef (Scenic)

a) Review of Attribute

Commonwealth Marine Park

As noted above, one of the four criteria for which the Great Barrier Reef was listed as a World Heritage Area was Aesthetics/natural beauty. Expanding on this (DEW 2007b):

The Great Barrier Reef provides some of the most spectacular scenery on earth and is of exceptional natural beauty. The World Heritage values include:

- *the vast extent of the reef and island systems which produces an unparalleled aerial vista;*
- *islands ranging from towering forested continental islands complete with freshwater streams, to small coral cays with rainforest and unvegetated sand cays;*
- *coastal and adjacent islands with mangrove systems of exceptional beauty;*
- *the rich variety of landscapes and seascapes including rugged mountains with dense and diverse vegetation and adjacent fringing reefs;*
- *the abundance and diversity of shape, size and colour of marine fauna and flora in the coral reefs;*
- *spectacular breeding colonies of seabirds and great aggregations of over-wintering butterflies; and*
- *migrating whales, dolphins, dugong, whale sharks, sea turtles, seabirds and concentrations of large fish.*

At the local level, the Ella Bay National Park (especially) and Heath Point are key areas, especially when viewed from ships at sea.

State Marine Park

Under the Wet Tropical Coast Regional Coastal Management Plan, the study area is included in the Ella Bay Key Coastal Site (Locality 5.1 Flying Fish Point). Aspects of this plan relevant to scenic issues are:

- the coast adjacent to the Access Road is shown on Map 26 (Scenic Coastal Landscapes) as being of “very high” significance and is subject to Policy 2.7.1,
- Policy 2.7.1 notes the following:
  - “The scenic backdrop of the Seymour Range, vegetated rocky headlands, extensive melaleuca wetlands and adjacent coastal due forests and sandy beaches combine to form a landscape of very high scenic quality. Heath Point and Flying Fish Point provide panoramic views of the coast.”
  - Heath Point is listed as one of a number of readily accessible vantage points to view the region’s internationally recognised scenic coastal landscapes.

– The key aim of the policy is that "areas of existing or new development in these locations are not to increase their level of visual impact."

The previous discussion of these scenic values in the context of the Wet Tropics World Heritage Area (**Section 5.4.8**) is relevant to the similar values of (actually viewed from) the Great Barrier Reef World Heritage Area.

Plate 2. View of the Ella Bay Road taken from within the Great Barrier Reef World Heritage Area. This shows the "scenic backdrop of the Seymour Range, vegetated rocky headlands, extensive melaleuca wetlands and adjacent coastal due forests and sandy beaches" referred to above.

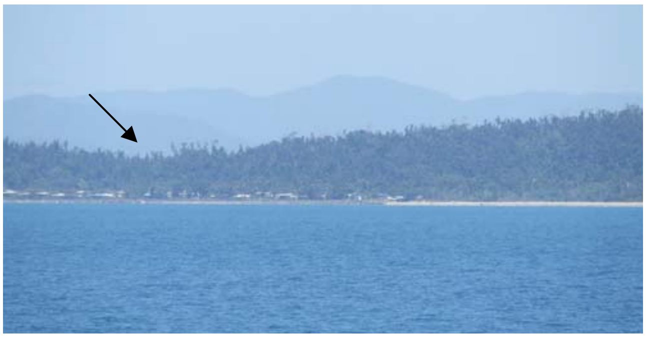


Plate 3. Location of northern tunnel portal viewed from the GBRWHA.

b) Assessment of Impacts

Impacts on scenic values of the whole route (i.e. including the two World Heritage Areas) are described in **Section 5.6.2** (Impacts) and **Section 5.6.3** (Presentation).

c) Opportunities for Mitigation

Mitigation options for impacts on scenic values of the whole route (i.e. including the two World Heritage Areas) are described in **Section 5.6.2** and **Section 5.8**.

5.5 TRANSPORT EFFICIENCY

5.5.1 Introduction

The following transport efficiency attributes used in the MCA are assessed below for impacts. The remaining attributes (T1 – Travel time and T2 – Capacity) are not considered relevant to the impact assessment and were include in the MCA in order to undertake a comparative assessment of performance of alternatives). In addition, attribute T5 – Stability is not considered to be an issue on the basis that the gabion retaining structures will be engineered structures based on a comprehensive geotechnical investigation. Attributes assessed below are:

- T3: Accommodate service vehicle,
- T4: Accommodate bicycles,
- T6: Safety, and
- T7: Constructability.

5.5.2 T3: Accommodate Service Vehicle

a) Review of Attribute

The MCA explored any limitations that route options might pose to heavy vehicles. The preferred solution includes a tunnel section which has a 7 m height limitation that will preclude the largest of loads such as large cranes and transformers (although accommodating most vehicles without a problem). Note that this height may be revised during detailed design. In practice, it is assumed that alternative access will be available via the town and a lockable gate at the Ruby Street cul-de-sac.

b) Assessment of Impacts

Vehicles too large to traverse the tunnel are required to utilise the existing road and Ruby Street cul-de-sac. This will involve minor disruptions to Flying Fish Point traffic and residents. Such loads will be under the control of patrol vehicles and it is expected that impacts will be minor and short term.

c) Opportunities for Mitigation

The most effective mitigation is education and it is recommended that a comprehensive communication program be in place to handle any disruptions likely to be caused by the transit of service vehicles.

5.5.3 T4: Accommodate Bicycles

a) Review of Attribute

As noted in **Section 5.3.9**, provision for cyclists and pedestrians involves a combination of on-road and off-road elements as follows:

- Bypass – no access for cyclists and pedestrians due to safety and grade considerations. Separate access is available via existing road network.
- Ella Bay Road to Heath Point – cyclists and pedestrians may either use the upgrade road (two 1 m shoulders exist and grades and curves are gentle) or continue on the existing road network and a new link along the esplanade.
- Heath Point – no access for cyclists and pedestrians due to safety considerations (road is winding and there are environmental reasons for further reducing the width to remove the shoulders). Separate access is proposed via the coastal flat.

Also of relevance to cyclists and pedestrians is the proposed lookouts at [details]. These lookouts will enhance the experience and help present World Heritage values.

b) Assessment of Impacts

It is expected that the proposed provision for cyclists and pedestrians will lead to an enhanced opportunity for recreation and presentation for Flying Fish Point residents, tourists and resort users.

c) Opportunities for Mitigation

The provisions for cyclists and pedestrians will need to be clearly indicated by appropriate signage to ensure that cyclists and pedestrians do not attempt to use the sections of road where they are not accommodated.

It is also recommended that interpretive signage be included along the route to enhance the presentation opportunities.

5.5.4 T6: Safety

a) Review of Attribute

The MCA assessment of safety was based on an estimate of the number of intersections along the route and the potential for these to contribute to conflicts and possibly accidents.

For the whole road, safety is a key consideration taken into account for:

- the horizontal and vertical alignment (sight distance),
- cross section (width of traffic lanes and shoulders),
- posted speed (including consideration of the above),
- measures to separate vehicles from cyclists and pedestrians (see T4 - **Section 5.5.3**), and
- measures to reduce the risk of collisions with fauna, especially cassowaries (see **Section 5.8.6**).

b) Assessment of Impacts

The engineering report (**Working Paper 1**) addresses these issues and it can be assumed that the proposed road will provide a safe environment for all users.

c) Opportunities for Mitigation

Mitigation will involve a suite of road safety measures to be considered in detailed design and including:

- design alignment and cross section,
- provision for cyclists and pedestrians,
- provision for fauna crossings,
- signage, and
- monitoring.

5.5.5 T7: Constructability

a) Review of Attribute

The MCA considered constructability of the four options in a simple manner related to the length of the option that could be built off-line.

For the whole road, constructability has yet to be assessed. at the detailed design stage it will be necessary to prepare a detailed construction plan that takes into account:

- mass haul considerations (i.e. the detailed material handling arrangements associated with constructing earthworks, retaining walls, and the tunnel),
- provision for traffic, especially on the section around Heath Point and the need for side roads and pull-off areas,
- timing issues associated with the Little Cove and Ella Bay Integrated Resort projects and commitments regarding the Access Road,

- installation of services within the road cross section, and
- revegetation and interim stabilisation works.

b) Assessment of Impacts

Not assessed. It is expected that all of the issues described above will be able to be accommodated.

c) Opportunities for Mitigation

It is recommended that all mitigation opportunities be investigated during detailed design and incorporated into the Environmental Management Plan for the construction phase (see **Section 7.6.4**).

5.6 SOCIAL AMENITY

5.6.1 Introduction

All social amenity attributes used in the MCA are considered relevant and area assessed below for impacts:

- S1: Important areas for Scenic Amenity,
- S2: Scenic Quality for Road Users,
- S3: Noise,
- S4: Construction issues, and
- S5: Severance of Communities.

5.6.2 S1: Important Areas for Scenic Amenity

a) Review of Attribute

The first aspect of visual amenity is views of the road from specified vantage points. In the MCA, this attribute was assessed by measuring how much of the works is likely to be able to be seen from ships at sea (i.e. the extent of works that are not hidden by adjacent vegetation and topography).

In the broader assessment of impacts of the whole Access Road (i.e. Option D plus the balance of the Ella Bay Road), this includes the more remote parts of the landscape (i.e. the World Heritage Area and especially Heath Point).

The scenic values of the area traversed by the Access Road have been described above in terms of the Wet Tropics World Heritage Area (Section **5.4.8**) and the Great Barrier Reef World Heritage Area (**Section 5.4.10**) respectively. This GBR discussion also included consideration of the Queensland Marine Park under the Wet Tropical Coast Regional Coastal Management Plan. Together, these assessments concluded that the route of the Access Road has very high scenic values that can be summarised as follows:

- The scenic backdrop of the Seymour Range, vegetated rocky headlands, extensive melaleuca wetlands and adjacent coastal due forests and sandy beaches combine to form a landscape of very high scenic quality. Heath Point and Flying Fish Point provide panoramic views of the coast.
- Heath Point is listed as one of a number of readily accessible vantage points to view the region's internationally recognised scenic coastal landscapes.

b) *Assessment of Impacts*

Although the quantitative approach to the assessment of impacts as undertaken in the MCA is appropriate for the comparative assessment of the performance of the four route options, when considering impacts this approach is not relevant as it ignores the mitigation which is proposed.

The following is a summary of the assessment of impacts and mitigation by the proponent for each of the three sections of road.

Flying Fish Point Bypass

This area involves a new section of road. Much of the visual impact of this section has been mitigated through the use of vegetated retaining walls and verges, and the cut-and-cover tunnel. The tunnel involves tunnel construction followed by revegetation of the area above the tunnel. Initially there will be some loss of visual amenity until such time as the plantings have developed. After plantings are established the impact of this section is considered to be minimal. The only likely residual impact may be the tunnel portal which will be approximately seven metres high and nine metres wide.

Flying Fish Point to Heath Point

This section involves minimal road widening and limited vegetation clearing, predominantly consisting of weeds surrounding the existing road. This is an existing, flat road section and there will be little visual impact arising as a result of the proposed road improvements. The design will ensure minimum amounts of vegetation clearing is conducted with a series of constrained or reduced width road sectors where required. Vegetated retaining walls and verges will be used to mitigate the impact of the minimal widening required. In addition, the proposed bitumen road surface is likely to have less visual impact than the current dirt surface.

The World Heritage Area

This section also involves only limited road widening and is a relatively short section of existing road. The visual amenity impact is considered to be low. As with the Flying Fish Point to Heath Point section, the impact of the minimal road widening required will be mitigated with the use of vegetated retaining walls and verges.

c) *Opportunities for Mitigation*

Mitigation options for reducing the impacts of roadworks on scenic amenity are discussed above and include:

- minimisation of earthworks through design of horizontal and vertical alignment,
- additional minimisation of earthworks by the use of retaining walls and reducing the cross section width (i.e. constrained sections),
- planting retaining walls to make them blend better into the background, and
- avoiding route lighting and shielding headlights from viewsheds.

These are all described in **Section 5.8**.

5.6.3 S2: Scenic Quality for Road Users

a) Review of Attribute

The second aspect of visual amenity is views from the road. In the MCA, this attribute was assessed by considering a number of qualitative aspects based on:

- the degree of interest that the road provides to users (contrast Vs blending in; gradual transition Vs sudden change; regularity Vs variation), and
- the quality of views of the landscape itself from the road.

Principles of assessment used in the MCA were:

- Contrast Vs. Blending-in,
- Gradual Transition Vs. Sudden Change,
- Regularity Vs. Variation, and
- Provision of Views.

These principles can be expanded to consider the balance of the road north to the resort site.

b) Assessment of Impacts

Impacts under this attribute are all beneficial as they enhance the visual amenity of the area to motorists, cyclists and pedestrians by the presentation of views available from the road/cycleway. Some elements of this aspect have been described for Option D (which forms the first section of the preferred solution), namely:

- the engineered road contrasts sharply with natural landscape (the tunnel beneficially reduces this contrast),
- due to steepness of terrain and tunnel, road users will experience significant changes in the surrounding landscape and be exposed to surprising views along the way,
- the route provides an interesting combination of earthworks and tunnels, and
- generous views will be available for north-bound traffic at saddle.

The balance of the route through to the resort will include additional points of visual interest, namely:

- the rainforest canopy leading up to Heath Point,
- coastal views from the winding road around Heath Point itself,
- the sense of arrival at the destination once the Little Cove site is reached, and
- the ultimate arrival at the resort site itself.

Elements of the trip that contribute to the scenic values are:

- intact lowland rainforest,
- steep terrain sloping abruptly to the Coral Sea,
- the engineered elements (tunnel, planted retaining walls),
- the glimpses of the Flying Fish Point township and Fish Farm, and
- the man-made environment of the Little Cove and Ella Bay Integrated Resort sites.

c) *Opportunities for Mitigation*

Mitigation in this context involves further initiatives to enhance presentation opportunities. These are further discussed in **Section 5.8.7b)**.

Plate 4. The existing Ella Bay dirt road with weed infested verges

Plate 5. It is recommended that the detailed design of the Access Road make provision for access to views such as this (taken from the existing road at Heath Point), subject of course to engineering and safety concerns. Such opportunities will help present the two world heritage areas and add to the amenity of motorists.

5.6.4 S3: Noise

a) *Review of Attribute*

In the absence of a quantitative assessment of noise levels generated by resort traffic using noise modelling techniques, the MCA adopted a semi-quantitative approach based on noise exposure to noise sensitive sites. Not unexpectedly, this assessment revealed that the town options (A and B) involved substantially greater exposure to noise than the bypass options which are remote from residences in most cases.

b) *Assessment of Impacts*

No quantitative assessment of noise has been undertaken. However, it is considered that the selection of the bypass option that involves the construction of the first kilometre of the road on a new alignment remote from the Flying Fish Point township represents an effective response to mitigation of noise impacts. The shielding effect of the topography is expected to reduce sound propagation and limit nuisance.

There are expected to be some biological effects of noise (see **Section 5.4.4b)**) but these cannot be quantified.

c) Opportunities for Mitigation

In terms of human responses to noise, the following mitigation opportunities should be investigated:

- maximise the buffering effect of earthworks where possible,
- consider noise barriers where the road is close to residences (e.g. at the western end of Ruby Street),
- utilise "quite asphalt" (e.g. Stone Mastic Asphalt) to minimise noise generation near noise sensitive sites, and
- provide educational signage to encourage drivers or heavy vehicles to minimise the use of compression braking near noise sensitive sites.

BAAM (**Working Paper 2**) include a recommendation regarding ecological aspects of noise (Recommendation 20 – see **Section 5.4.6**), namely:

- It is recommended that "quite asphalt" (e.g. Stone Mastic Asphalt) is used in road construction and that some level of noise control be incorporated into the fauna fencing design to reduce potential noise effects. Noise modelling would be required to formulate the most suitable fencing design. Note that this recommendation needs to be assessed further during detailed design as it may be that SMA is not necessary given the low traffic speed and relatively low traffic volumes.

5.6.5 S4: Construction Issues

a) Review of Attribute

The MCA did not quantify this attribute which was expected to involve short term impacts of construction on social values involving:

- construction noise levels,
- construction emissions affecting air quality,
- loss of access during construction,
- reduced travel times / traffic delays during construction, and
- visual presentation during construction.

These issues, likely impacts, and recommended mitigation are discussed below. It is recommended that all these issues be elements of the road's Environmental Management Plan for the construction phase (see **Section 7.6.4**). This EMP should include a comprehensive construction plan setting out all construction activities and considering mass haul, temporary access and control measures for all construction impacts.

b) Assessment of Impacts and Mitigation

Construction Noise

Most construction noise is expected to be buffered by the terrain separating the first kilometre of the road from Flying Fish Point. However, construction north of the tunnel is expected to be audible from parts of the township.

Although limits are set for many sources of noise under the Environmental Protection (Noise) Policy in terms of a maximum permissible noise level component during an appropriate time period, there is no regulatory limit for construction noise in Queensland. The noise levels generated by the various construction activities would vary in intensity and character depending upon the combination of plant in operation at any one time, as well as the location and duration of the individual activities.

While it is too early to fully evaluate construction noise, the principle of using Best Available control Technology (BACT) should be required for any construction plant. The construction plan will need to address receptors, intervening terrain, sources, predict impacts, plan to meet the performance criteria and develop a plan for blasting operations. It is likely the plan will contain background noise levels, source noise level surveys, installation of temporary barriers, condition surveys and measured trial blast results. It will also show timing, who is the responsible party and to whom they report. In addition any monitoring, auditing and reporting functions should be specified.

The effective control of construction noise requires that a high level of consultation be maintained between the construction contractor and the community. There should be an appointed contact person available all hours. The contact person should deal with sympathetically and with sensitivity all issues raised by the community. Should there be a complaint of noise or vibration then monitoring should be immediately carried out at the location.

It is suggested that the approach to construction noise involve:

- limit construction hours near residential areas to 6 am - 6 pm Monday - Saturday with no work at night, on Sundays or public holidays,
- estimate likely noise issues and develop a specific plan to mitigate these,
- implement a comprehensive information program about construction activities, and
- monitor and respond to complaints.

Air Quality

The only construction air quality issue is likely to be dust generated by earthworks. This can be readily controlled by standard construction measures such as watering and wash down and the regular sweeping of access roads.

Loss of Access

No access to existing residences or businesses are expected to be affected by the construction of the Access Road.

There will be times during the upgrading of the Ella Bay Road that access to Heath Point will be affected by roadworks. This will affect those residents of Flying Fish Point and tourists wishing to access these areas.

The key mitigation strategy is education and a comprehensive information program on the state of the road and any future roadworks.

Traffic Delays

The selection of the bypass option for the first kilometre of the proposed Access Road means that this section can be built free of traffic, this avoiding delays and inconvenience during construction. As noted above, there will undoubtedly be delays to traffic during construction. These are likely to be of most concern to new residents at the Little Cove site if the works are not complete before people take up residence.

This is a timing issue that the proponent intends to consider in more detail due to involvement in both the Little Cove and Ella Bay Integrated Resort projects and joint interests in the Access Road.

Visual Presentation

The visual impacts of the works will be at their worst during construction where there is nothing that can be done. The overall impact can be reduced by ensuring that rehabilitation commences as early as possible following earthworks and that an intensive maintenance program be pout in place to ensure that all plantings become established as quickly as possible.

5.6.6 S5: Severance of Communities

a) Review of Attribute

In the MCA, this was assessed as the extent to which resort traffic using each option passes between adjacent parts of the community (i.e. resulting in some degree of severance). It was quantified by counting the number of residences separated by the road option.

b) Assessment of Impacts

The Access Road composed of Option D plus the balance of the Ella Bay Road does not result in any severance of the Flying Fish Point community.

The one proposed change to the existing road system is the closure of Ruby Street where it meets the new Ella Bay Road at Point B. Here it is proposed to construct a cul-de-sac with an emergency link to the Ella Bay Road (with a lockable gate) to allow oversize vehicles (for example, cranes and transformers) to bypass the tunnel if required. This will also allow emergency vehicles a shortcut between Flying Fish Point and the resort.

This closure means that Flying Fish Point traffic will need to backtrack top Point A (Bay Road) in order to access Heath Point and the two resorts.

c) Opportunities for Mitigation

No mitigation is necessary.

5.7 SUMMARY AND RECOMMENDATIONS

5.7.1 Summary

The impact assessment reveals that there will be very little clearing (2.44 ha of new clearing of remnant vegetation will be involved) and that there is an opportunity to revegetate 0.49 ha over the cut-and-cover tunnel. No “endangered” regional ecosystems will be affected.

It is likely that some listed plants and animals will be affected, and specific mitigation measures are proposed for key species including the Southern Cassowary and the stream-dwelling frogs of most concern.

Ecological processes are expected to continue largely unaffected, providing that the recommended mitigation measures regarding fauna connectivity, management of fauna/vehicle interactions, and attention to maintaining aquatic habitat are adopted.

Visual amenity (especially when viewed from ships at sea) will initially be reduced but this impact will lessen over time as the proposed revegetation of the retaining walls becomes established. The new road will provide new opportunities for presentation and is expected to become a high quality scenic drive.

Impacts on the residential community of Flying Fish Point will be negligible, and arguably beneficial as the proposed road will mean that existing Ella Bay Road traffic will bypass the town, along with the new traffic.

5.7.2 Recommendations

It is recommended that the mitigation measures described above be implemented. Further detail on key measures is provided below.

5.8 KEY MITIGATION AND MANAGEMENT OPPORTUNITIES

5.8.1 Introduction

The above analysis has revealed that there are many opportunities to mitigate impacts by further refinements to the design and by associated management. Design items are described below while key management matters are described in **Chapter 7**. Design items described below are:

- retaining wall options,
- revegetation,
- use of constrained sections,
- stormwater drainage,
- fauna-sensitive design, and
- improving scenic amenity.

5.8.2 Retaining Wall Options

a) Overview – Typical Sections

As discussed briefly in **Section 4.10**, the use of retaining walls can dramatically reduce the need for clearing and the volume of earthworks. Some options for the use of retaining walls in cuttings and embankments are included in **Working Paper 1**. These are shown in the following figures. It should be noted that for the purposes of this impact assessment, retaining walls have been included anywhere where the height of a cutting or embankment would otherwise have been greater than 5 m (i.e. the application of the “obvious mitigation actions” described in **Section 4.10**). Note that this 5 m height may be revised during detailed design.

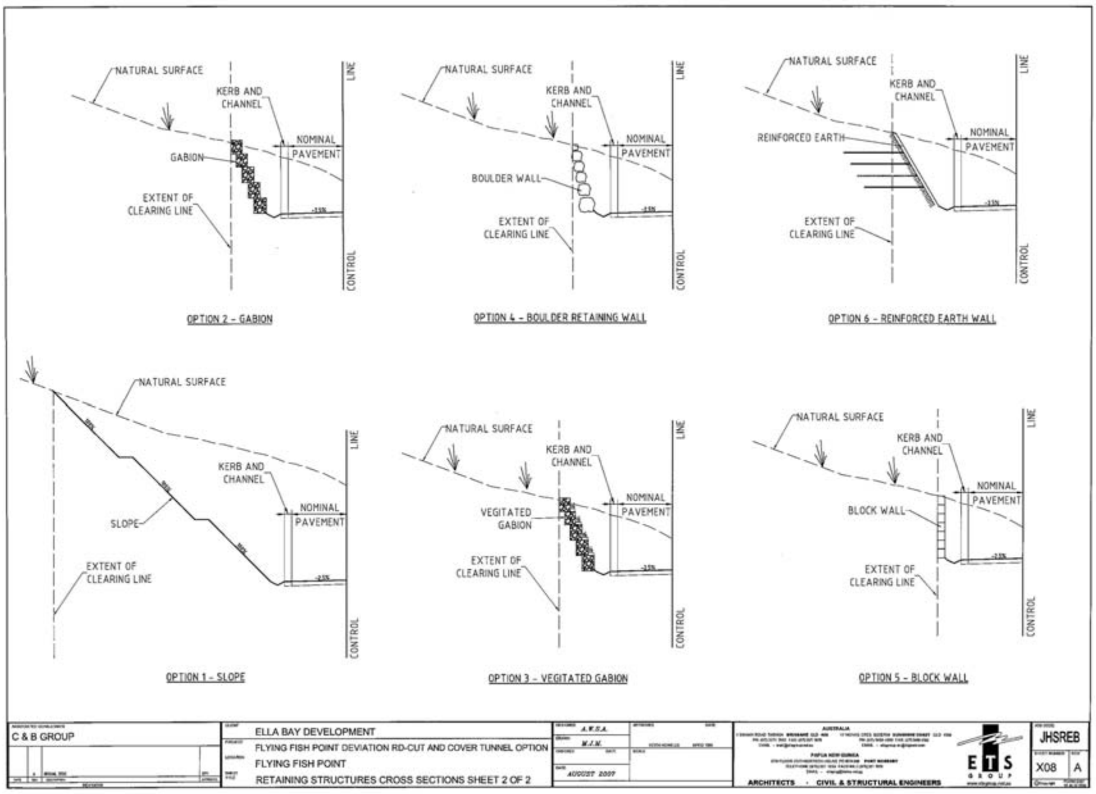


Figure 24a. Retaining wall options for cuttings (see **Working Paper 1)**.

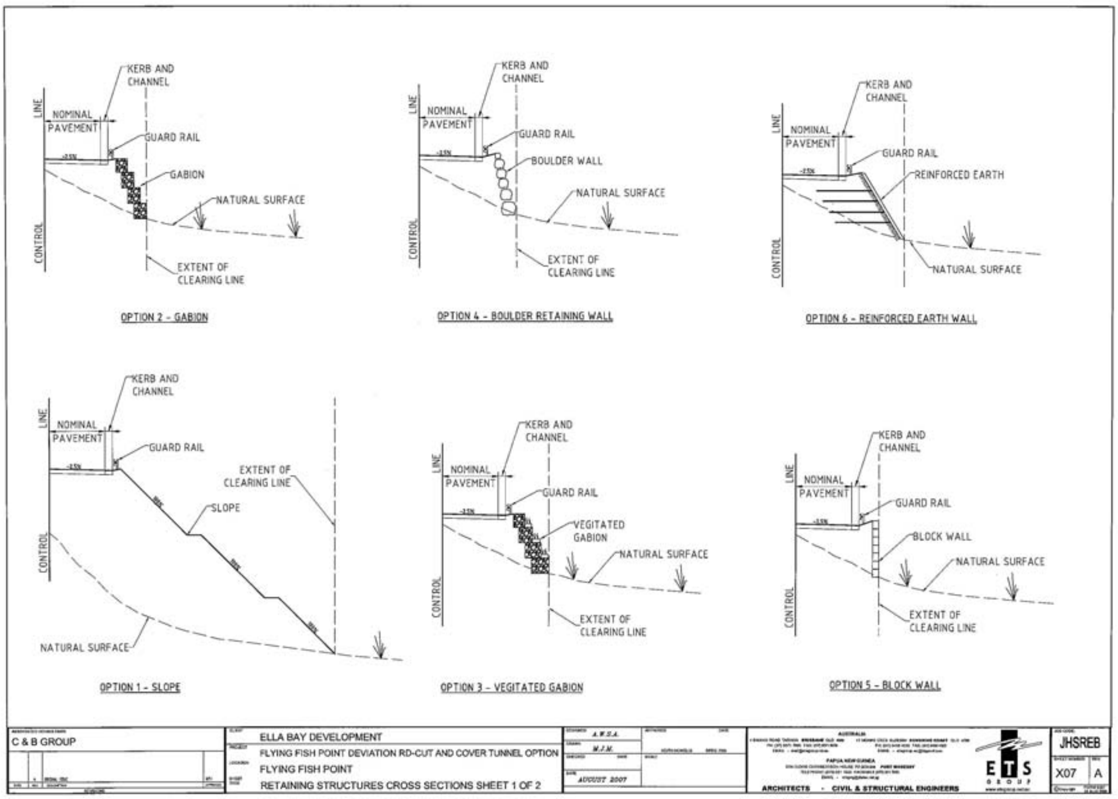


Figure 24b. Retaining wall options for embankments (see **Working Paper 1)**.

b) Planting of Retaining Walls

The visual impact of cuttings or embankments and those engineered retaining structures including reinforced earth embankments and gabion walls for cuttings and embankments can be improved by planting.

Reinforced Earth Embankments

Reinforced earth (**Figure 12b** Option 6) is a system whereby embankments are built up in layers separated by wire or plastic mesh. This mesh is anchored by the fill above and provides tensile strength to the layer. The mesh can also be used to retain a facing panel or structure that can include plantings. A typical product is Green Terramesh® produced by Maccaferri. This is a proprietary product designed to be used in constructing reinforced earth embankments. It is proposed to be used for the Kuranda Range Road Upgrade (if the project proceeds) for up to 6 ha (surface area) of large embankments (i.e. in the range 3 to 15 m). In Green Terramesh® construction (see left hand image below (**Figure 25a**)):

- The “welded steel panel” is not part of the reinforced earth structure and serves to hold the unit stiff during construction. It plays no structural role other than to retain the “coconut fibre blanket” which in turn retains the exposed surface of the earthworks and a layer of potting mix during construction.
- The “anchor” (constructed of galvanised steel Terramesh with an aperture size of 80 mm x 100 mm) ties the bottom of the facing to the fill and its continuation within the structure of the compacted embankment reinforces it as an engineered reinforced earth structure.
- The “top rail” Terramesh laps with the anchor in the next “lift” to tie the top of the facing to the fill.

Embankment are typically made up of a number of 600 mm high “lifts” (i.e. layers of compacted fill) as shown in the right hand image below (**Figure 25b**).

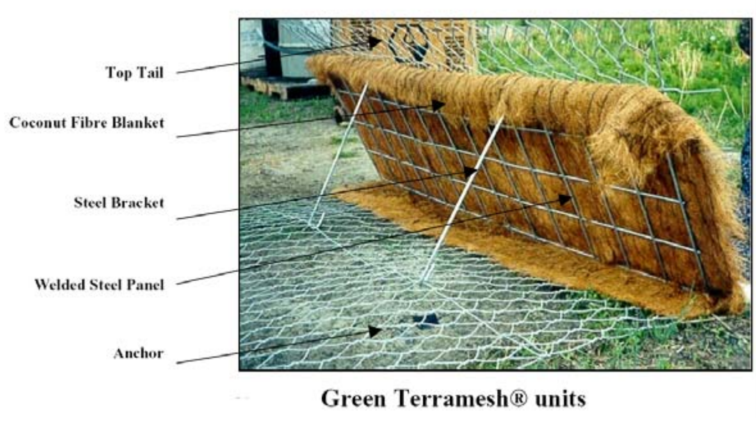


Figure 25a. Detail of the elements of a single “lift”.

Source: Maccaferri (2004)

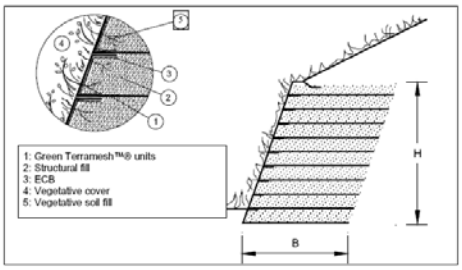


Figure 25b. Many “lifts” (layers) make up the embankment.

Source: Maccaferri (2004)

Recent planting trials have been undertaken by the Department of Main Roads (Environment North 2007a) of a trial Green Terramesh® wall on the Kennedy Highway at Fallon Road near Kuranda. The following images and comments are derived from that report.

	
Plate 6. Installing Fallon Road Terramesh units (December 2005). Fallon Road is on the Kennedy Highway just west of Kuranda.	**Plate 7.** Fallon Road Terramesh units after 2 months (February 2006). The structural component is the diagonal 100 mm (v) x 80 mm (h) galvanised steel mesh while the 200 mm square mesh is required for construction support only.
	
Plate 8. Fallon Road Terramesh units after 20 months (August 2007). Shows northern end where establishment has been very successful.	**Plate 9.** Fallon Road Terramesh (August 2007). Shows successful establishment of septic fig (*Ficus septica*).

Plate 10. Fallon Road – example of integrity of mesh with tree growing through. It remains to be seen what effect the stiff steel grid will have on the trunk once it is encountered by the growing tree.

Plate 11. Fallon Road – example of successful establishment of moss on surface.

Maccaferri (2004) states that soil bioengineering systems (i.e. Green Terramesh®) and Terramesh gabions:

- are strong initially and grow stronger with time as the vegetation becomes established,
- reinforce the soil as roots develop, adding significant resistance to shallow sliding and shear displacement for smaller slopes, and
- are durable (as the structure becomes filled with soil and plant roots, its durability is no longer restricted to the life of the inert materials).

Plate 12. Large trees growing through Green Terramesh®.

Photo Maccaferri (D Chaychuk *pers. comm.*)

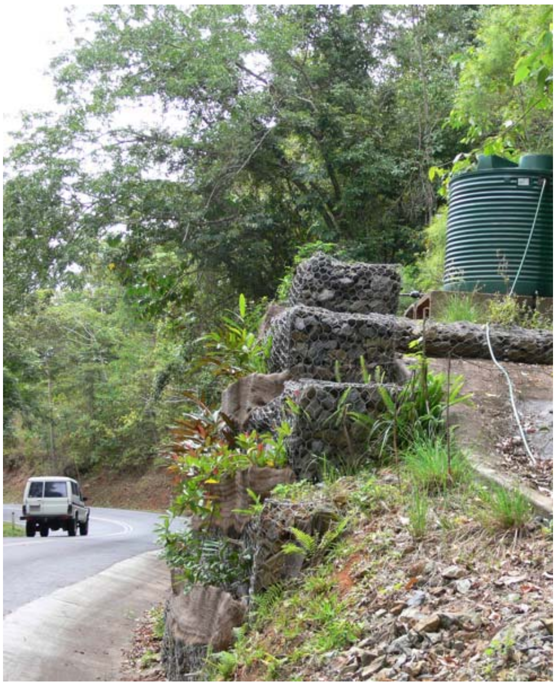


Plate 13. Sometimes a temporary water supply may be desirable as was the case for this example on the Kuranda Range Road (August 2007). In this case the tank could be filled by gravity from a nearby permanent stream.

According to Environment North (2007a), the Kuranda Range Road trials of the Green Terramesh® were successful and show that, providing appropriate irrigation and weed control is undertaken, an attractive and stable surface can be produced.

Planted Gabions

Planted gabions (Option 3 in **Figures 12a** and **12b** above) can be used for both cuttings and embankments. Gabions are rock-filled wire baskets that are stacked in a near-vertical and their weight supports the adjacent earthworks. Recent trials undertaken by the Department of Main Roads (Environment North 2007a) have involved various planting trials for gabions.

In the first trial on the Kuranda Range Road, some of the gabion units were installed with different types of geotextile liners as part of the revegetation experiment (see **Plate 11**) while the balance were unlined. Geotextiles used were :

- black woven polyethylene geofabric,
- coconut fibre matting – unwoven, and
- coconut fibre matting – heavy woven fabric.

A small layer of potting mix was inserted between the geotextile and the rocks during construction. Fish-bone Fern (*Nephrolepis cordifolia*) and Mat Rush (*Lomandra longifolia*) were planted across the face of the wall by puncturing the geotextile where fitted or inserting small clumps and some dirt in the cracks between the stones elsewhere.

Plate 14. Gabion units during construction (March 2004).

Plate 15. The wall under construction (March 2004).

Plate 16. Close-up of section of unlined gabion showing establishment of ferns.

Plate 17. Close-up of section of lined gabion showing build-up of leaf litter on the gabion ledge and denser establishment of ferns.

The second trial, also on the Kuranda Range Road, involved un0lined gabions retro-fitted with a geotextile lined wire "planter box" filled with potting mix and then planted with a variety of vines and trees.

Plate 18. Lower trial on completion of planting (December 2006). Irrigation system not installed at this time.

Plate 19. Close-up of planting (December 2006).

As for Green Terramesh®, Terramesh gabions are able to withstand plant growth. Some examples from Maccaferri (2004) are shown below.

	
Plate 20. Large trees growing through Terramesh gabions (overseas project). **Source:** Maccaferri (2004) (both images).	**Plate 21.** Close-up of a large trees growing through Terramesh gabions (overseas project). The mesh becomes integrated into the plant structure, apparently without causing weakness to either the plant or the gabions.

Advice from Maccaferri (D. Chaychuk *pers. comm.* 22 August 2007) is that large tress can be safely incorporated into Green Terramesh® and Terramesh gabions.

Overall, the Main Roads trials of Green Terramesh® and planted gabions demonstrated that suitable rainforest ferns, vines, shrubs and trees can be planted and established on the faces of these structures, providing that appropriate attention is given to species selection, the use of an appropriate potting mix, irrigation and weed control, at least in the early stages. Long term experience by Maccaferri suggests that large trees can safely grow in these structures.

Mass Bloc Walls

"Mass Bloc" retaining walls are composed of large (approximately 1 m^3) pre-cast units made of no-fines concrete. These are free-draining structures that can be coloured and textured and can have voids installed as planter boxes. Trials are underway for these units on the Captain Cook Highway t Red Cliff Point and Turtle Cove. The flowing images and text is based on the rehabilitation strategy for the Red Cliff Point site (Environment North 2007b).

Trials have been completed to investigate means of reducing visual impacts from the *Mass Bloc* wall involving:

- Texturing and painting. On 5 June 2007 Main Roads undertook trials to texture and paint a section of the wall to reduce its visual impact. The results (see below) are promising. Main Roads is also considering rendering the face of the blocks in an attempt to lessen the impact of the visual texture. The render could be coloured to avoid the need for painting.
- Planting in voids constructed in the top of the blocks. Also on 5 June 2007 a planting trial was undertaken to experiment with plants introduced into 15 blocks with specially formed voids in their top surface.
- Artistic approach? Main Roads is also considering the merit in asking a local artist, perhaps with an indigenous interest or background, or at least in consultation with the traditional owners, to do a specific design which might provide a better match. Negotiations on this issue with WTMA are continuing.

Refer to the following images.

	
Plate 22. Mass Bloc wall with established plantings (Turtle Cove).	**Plate 23.** Close-up of planting (Red Cliff Point).

5.8.3 Revegetation

a) Retaining Walls

Opportunities and options for revegetating retaining walls have been described in **Section 5.8.2b)** above. See also **Section 7.5** for the outline of the Revegetation Strategy. It should be noted that while some ecological benefits will be derived from this work, its primary focus will be on improving the aesthetic appeal of the structures.

b) Cut-and-cover Tunnel

The main opportunity for revegetation is over the cut-and-cover tunnel between Chainage Ch 495 and 565 approximately. The area of clearing required is 0.49 ha and this is within the “not of concern” regional ecosystem RE 7.11.1 (simple-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 cleared area will be revegetated with vegetation corresponding to match the existing rainforest community once the tunnel has been backfilled. Revegetation in this location will achieve the following objectives:

- stabilisation of disturbed soil,
- provision of replacement habitat for plants and animals of conservation significance,
- reinstatement of safe fauna connectivity over the road, and
- improved visual amenity.

c) Other Revegetation Opportunities

Other revegetation opportunities include attention to the cuttings and embankments throughout the road. Revegetation of these batters will achieve the following objectives:

- stabilisation of disturbed soil,
- provision of replacement habitat for plants and animals of conservation significance, and
- improved visual amenity.

d) Summary of Areas

The following table provides a snapshot of key areas of clearing and revegetation.

TABLE 5.8.3D): SUMMARY OF CLEARING AND REVEGETATION AREAS

ITEM	AREA (ha)
New clearing for construction of road and cut-and-cover tunnel (remnant vegetation)	2.44
Area of existing clearing incorporated within new road	3.13
Area of revegetation (cut and cover tunnel)	0.49
Area of revegetation (planted gabions)	0.52
Area of revegetation (cuttings and embankments)	tbc

Source: Study team compilation based on **Working Paper 1**.

Ignoring the revegetation of retaining walls, cuttings and embankments (the benefits of which are mainly erosion control and visual amenity), the construction of the preferred solution will involve a net clearing (after revegetation) of just under 2 ha. In terms of conservation issues:

- no clearing is required in regional ecosystems deemed to be “endangered”,
- 0.58 ha of “of concern” regional ecosystems will be cleared, and
- 1.86 ha of “not of concern” regional ecosystems will be cleared and 0.49 ha revegetated (i.e. a net area of 1.37 ha after revegetation).

5.8.4 Use of Constrained Sections

In parts of the Ella Bay Road north of the fish farm, the existing alignment is extremely narrow and winding. In such areas, establishing the full cross section of the upgraded road could result in substantial earthworks, requiring clearing and disturbance of existing steep cuttings and embankments. This impact could be reduced by the judicious use of retaining structures as well as other techniques.

For example, there is the potential to introduce “constrained sections”, that is, sections of road where the full cross section is not constructed and compromises are made with respect to drainage, shoulder width and consequently speed environment. This is a standard engineering technique and is common in heavily constrained areas.

An example is the Cape Tribulation road between the Daintree River and Cape Tribulation in Far North Queensland. In many ways the Cape Tribulation Road is similar to the Ella Bay Road and it is likely that the techniques used on the Cape Tribulation Road will be applicable.

	
Plate 24. The "Mirror Bend" on the Cape Tribulation Road. While this image was taken in March 2005 before widening works were undertaken to remove a blind corner, it is representative of a suitable solution involving no table drain, one-way crossfall to the outside edge, and the use of a hot-mix "kerb" to lead runoff to batter chutes.	**Plate 25.** Close-up of a similar hot-mix "kerb" on the Kuranda Range Road (August 2007).
	**Plate 26** Gabion wall supporting a section of the Cape Tribulation Road (March 2005). Note how this causes little interference to the down-hill vegetation.

These recommendations should be taken into account in the detailed design of the Access Road.

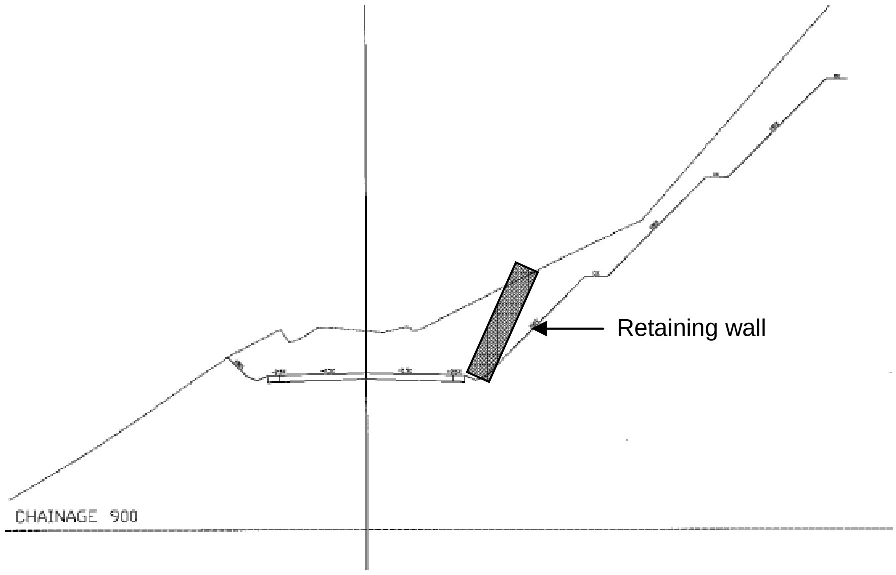


Figure 26. Example of initial earthworks (and clearing) on the Ella Bay Road at Chainage 2880/900. This cutting, which is within the World Heritage Area, would extent past the Zone C road allowance and require a rezoning. Such earthworks can be avoided by the use of retaining structures (see **Figures 19a** and **19b**) and other techniques described below.

Techniques that could be used to reduce the width of road in difficult areas are as tabulated below.

TABLE 5.8.3: TECHNIQUES FOR USE IN CONSTRAINED SECTIONS

TECHNIQUE	CONSEQUENCES / COMMENTS
Replace large cuttings and embankment with bridges.	• Cost. • Delays to traffic during construction. • Possible visual impacts (consider plantings).
Replace large cuttings and embankment with retaining structures.	• Cost. • Delays to traffic during construction. • Possible visual impacts (consider plantings).
Compromise vertical alignment to minimise difference in level between existing road and the upgrade.	• Could require a drop in design speed. • Signage to warn motorists.
Compromise horizontal alignment to minimise difference in level between existing road and the upgrade.	• Could require a drop in design speed. • Signage to warn motorists. • Mirrors to reveal on-coming traffic.
Reduce width of cross section by not having tabledrains on the cut side and the use of one-way crossfalls.	• Install hot-mix or concrete kerb units on downhill side and channel water to inlets or batter chutes (cost premium, maintenance). • Utilise kerb inlets and piped drainage in lieu of surface drains (cost premium, maintenance).
Reduce width of cross section by reducing shoulder width on one or both sides.	• Could require a drop in design speed. • Signage to warn motorists. • Requires separate bicycle route or shared lanes.

5.8.5 Stormwater Drainage

Although no detailed design for the Access Road has been undertaken, it is clear that there will be a need for creek crossings at a number of points. While culverts will be suitable for small crossings, the need to maintain fauna connectivity at watercourses for both aquatic and terrestrial fauna (see **Working Paper 2** and the discussion in **Section 5.4.4**) means that small bridges will be needed at several locations (see **Section 5.8.6**).

In addition, consideration will need to be given to an overall Road Runoff Strategy to protect water quality. This is described in **Section 7.4**.

5.8.6 Fauna-Sensitive Design

Techniques exist for improving the performance of roads with respect to fauna. This includes terrestrial fauna (especially cassowaries) and aquatic species.

a) Land Bridges and Tunnels

The preferred access road solution involves a cut and cover tunnel designed to reduce the visual impacts of large earthworks as well as the maintenance of habitat connectivity over the road.

b) Rope Bridges

BAAM (**Working Paper 2**) recommend (Recommendation 12) that, in areas where there is no canopy connection over the roadway, that rope bridges are fixed between trees on either side of the gap to further accommodate the passage of arboreal fauna. The number of rope bridges required would need to be determined following completion of the proposed works.

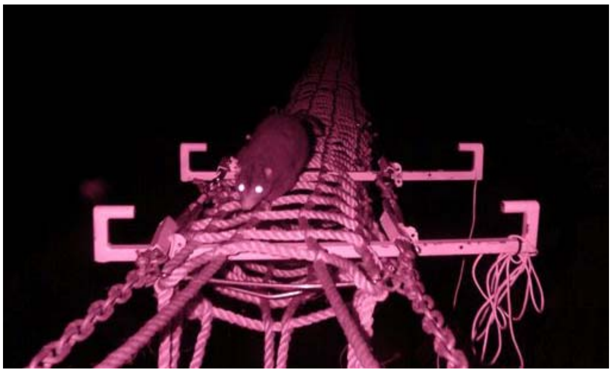
Main Roads has had experience with these structures over the Palmerston Highway and it appears that they are effective for some species. Inclusion of such structures will create public interest in the conservation measures implemented over the whole road and at the resort site. The following extract from a recent paper on the Kuranda Range Road Upgrade (Rivett 2007) shows some relevant details of work by the Rainforest CRC on the Palmerston Highway

Kuranda Range Road Upgrade: Canopy Bridges (from Rivett (2007))

Central to the use of bridges for fauna connectivity and to reduce roadkill is a system of fences that prevent access to the road and which lead any animals to gaps in the fence ("funnels") which correspond to the high bridges. The so-called Fence & Funnel Strategy is also intended to allow for temporal effects (i.e. to fence an area proposed to be cleared and funnel affected animals to other areas deemed to be safer for them.

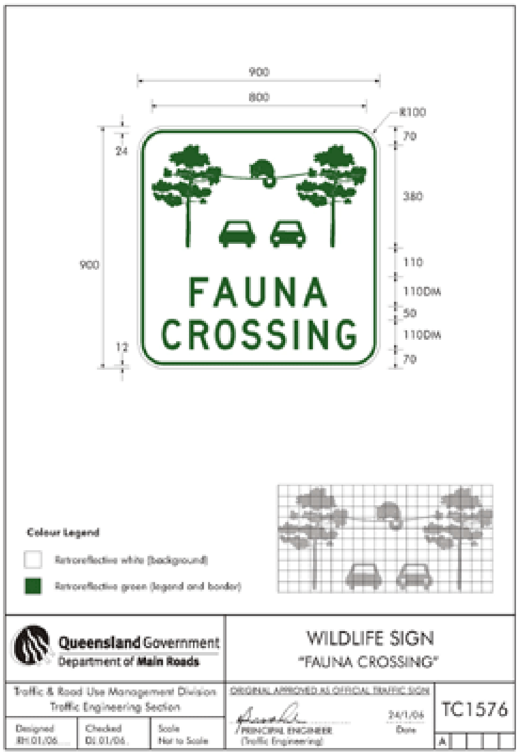
Installing one of the Palmerston Highway Canopy Bridges. Similar bridges may be part of the Fence & Funnel Strategy for the Kuranda Range Road Upgrade.

Photo B Kuehn



The first crossing of the Palmerston Highway Canopy Bridges by a Herbert River Ringtail possum. As expected, it has taken about six months for arboreal animals to get used to the new structures. This individual was photographed crossing the bridge and then returning several hours later on 17 August 2006.

Photo M Cohen



Main Roads has also created a special "Fauna Crossing" sign. Such signs draw attention to the environmental credentials of the proponent and adds to interest.

c) Creek Crossings

It is well known that small bridges are preferable to culverts for maintaining riparian connectivity and the continuity of aquatic habitat and fish passage.

The following figure extracted from recent work undertaken for the Department of Local Government, Planning, Sport & Recreation at Myola in FNQ (Buckley Vann 2006) demonstrates some of the principles. Further guidance is provided in the Department of Main Roads' *Roads in the Wet Tropics* manual (DMR 1997). This manual is undergoing revision and a new draft is expected soon. It contains many practical guidelines for the ecological design of roads.

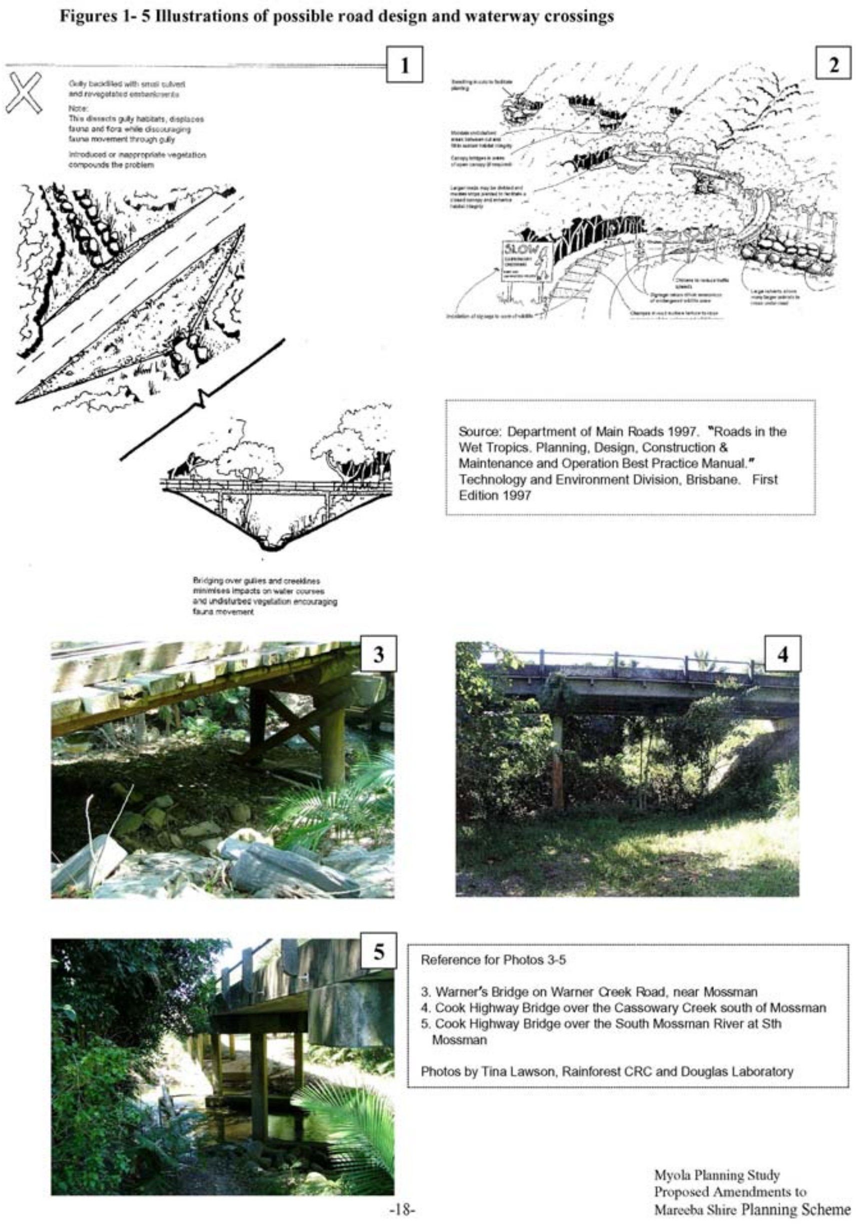


Figure 27.

Maintaining connectivity along watercourses is an important aspect of biodiversity conservation.

Many techniques are available (e.g. Main Roads' best practice *Roads in the Wet Tropics* manual (DMR 1997). In general, small bridges are preferred to culverts at creek crossings.

Source: Myola Planning Study (Buckley Vann 2006).

d) *Other Aspects*

Fauna-sensitive road elements are also describe elsewhere as noted:

- the Fence & Funnel Strategy (**Section 7.2**),
- the Cassowary Management Strategy (**Section 7.3**),
- Road Runoff Strategy (**Section 7.4**), and
- the Rehabilitation Strategy (**Section 7.5**).

5.8.7 Improving Scenic Amenity

a) *Reducing Impacts*

Mitigation options for reducing the impacts of roadworks on scenic amenity include:

- minimisation of earthworks through design of horizontal and vertical alignment,
- additional minimisation of earthworks by the use of retaining walls (refer **Section 5.8.2a)** above),
- planting retaining walls to make them blend better into the background (**Section 5.8.2b)** above),
- revegetation of all other cuttings and embankments (refer **Section 5.8.3** above),
- additional minimisation of earthworks by reducing the cross section width to create constrained sections (refer **Section 5.8.4** above), and
- avoiding route lighting and shielding headlights from viewsheds.

In terms of the concept design developed of this Access Road Strategy:

- the major mitigation works have already been included in the concept level design, namely the use of retaining walls),
- there is some scope to refine the horizontal and vertical alignment and to utilise constrained sections, and
- the proposed Revegetation Strategy is intended to address the planting of retaining walls and other earthworks.

It is recommended that the remaining recommendation (avoiding route lighting and shielding headlights from viewsheds – especially ships at sea) be addressed during detailed design.

b) *Enhancing Presentation Opportunities*

The second aspect of visual amenity is the presentation of views available from the road. Some elements of this aspect have already been included, namely:

- the views of the Coral Sea as framed by the northern tunnel portal (for north-bound traffic),
- the interest created by the “fauna friendly” bridges opposite the Flying Fish Point Reserve and south of Heath Point,
- the winding mountainous section of road around Heath Point, and
- the perception of “arriving” once the road enters the Little Cove site.

It is recommended that further opportunities be explored to incorporate specific lookouts where these can be provided safely and without excessive earthworks for:

- motorists using the road, and
- cyclists using the road and sections of dedicated cycleway around the Flying Fish Point township and Heath Point.

Plate 27. It is recommended that the detailed design of the Access Road make provision for access to views such as this (taken from the existing road at Heath Point), subject of course to engineering and safety concerns.

6 ISSUES FOR ENVIRONMENTAL APPROVALS

6.1 INTRODUCTION

This section addresses the key considerations relating to the approval to construct the Access Road under:

- the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth),.
- the *Wet Tropics Management Plan 1998* (Qld),
- the *Vegetation Management Act 1999* (Qld),
- the *Nature Conservation Act 1992* (Qld), and
- the *Coastal Protection and Management Act 1995* (Qld).

6.2 EPBC ACT

6.2.1 Introduction

The *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) protects what are termed matters of national environmental significance by requiring that actions that pose significant impacts be subject to assessment by the Minister for the Environment and Water Resources.

Under the EPBC Act, a person must not take an action that has, will have, or is likely to have a significant impact on a matter of national environmental significance without Commonwealth approval. An action includes a project, undertaking or an activity or series of activities. What is a 'significant impact' is not defined and is determined by the Commonwealth Environment Minister on a case by case basis.

Although a referral for the road has yet to be issued (DEW has indicated that a separate referral to that submitted for the Ella Bay Integrated Resort is required), it is clear that the relevant matters of national environmental significance are those defined under the following sections of the EPBC Act:

- Sections 12 and 15A (significant impacts on a **world heritage property**), and
- Sections 18 and 18A (significant impacts on a listed **threatened species** or on a listed **threatened ecological community**).

Referring to Department of the Environment and Water Resources (DEW) comments on the EIS and the original EIS Terms of Reference, the key issues identified are:

- impacts on the values of the Wet Tropics World Heritage Area (biological and scenic),
- impacts on the values of the Great Barrier Reef World Heritage Area (biological and scenic), and
- impacts on the listed flora and fauna (especially the Southern Cassowary).

These are discussed below. Please note that the following sections are a summary of a more detailed assessment undertaken in **Chapter 5**.

6.2.2 Impacts on the Wet Tropics World Heritage Area

a) Impacts on Biological Values

Impacts on the biological values of the Wet Tropics World Heritage Area are addressed in **Section 5.4.7**. In summary, it was concluded that while there will be some minor impacts on species associated with World Heritage values, in terms of the key values present on the route of the Access Road:

- integrity will be affected only slightly as the upgrade incorporates almost all of the existing road clearings,
- provision is to be made for reducing habitat fragmentation and roadkill via the Fence & Funnel Strategy, and
- specific measures are proposed for the Southern Cassowary via the Cassowary Management Strategy (see **Section 6.2.4** below).

b) Impacts on Scenic Values

Visual amenity (especially when viewed from ships at sea) will initially be reduced but this impact will lessen over time as the proposed revegetation of the retaining walls becomes established. Visual impacts are proposed to be managed by the revegetation of cuttings, embankments, and retaining walls in accordance with the Revegetation Strategy.

The new road will provide new opportunities for presentation and is expected to become a high quality scenic drive.

There are opportunities to enhance the presentation values of the area by the inclusion of lookouts and interpretive signage for drivers on the Access Road and cyclists and pedestrians on the dedicated paths.

6.2.3 Impacts on the Great Barrier Reef World Heritage Area

a) Impacts on Biological Values

There are no major watercourses entering the Great Barrier Reef lagoon adjacent to the Access Road, and the existing small creeks are intended to remain unaltered by the road. Existing culverts are proposed to be removed and replaced with small bridge s to better protect aquatic habitat and water quality.

A review of the possible impacting processes on the Great Barrier Reef World Heritage Area reveals that possible direct water quality impacts are limited to the construction process (i.e. erosion and sedimentation) and operation (i.e. pollution):

- during the **construction** phase, there is the potential for earthworks to lead to erosion and subsequent sedimentation of watercourse and at the extreme, the reef lagoon itself, and
- during the **operations** phase, potential water quality impacts are:
  - “normal” i.e. chronic release of pollutants from motor vehicles, and
  - “emergency” i.e. arising from accidents, oil spills etc.

Water quality impacts arising from **construction** are expected to be able to be managed through a mixture of design and through specific construction management measures to be documented in the proposed EMP (Construction) (see **Section 7.6.4**). This includes the implementation of a Soil and Water Management Plan to include all key issues such as:

- diversion of water away from and around works areas
- use of contour banks and drains
- use of temporary soil stabilisation works
- use of silt fences, sedimentation ponds and other similar structures to contain soil and runoff
- scheduling of roadworks and soil handling
- control of the clearing sequence and treatment of felled timber and roots, and

At the **operation** stage:

- the proposed EMP (Maintenance) (see **Section 7.6.5**) includes the development of a contingency plan for the control of environmental impacts of emergencies (i.e. fuel spills and control of any water contaminated by wash down or firefighting activities), and
- the proposed Road Runoff Strategy (see **Section 7.4**) includes a strategic approach to all aspects of runoff management.

Together, these initiatives are expected to adequately protect water quality values of the Great Barrier Reef World Heritage Area.

b) Impacts on Scenic Values

See above (WTWHA).

6.2.4 Impacts on Listed Species

a) Flora

The following species are expected or are likely to occur in the study area and to be affected to some extent by the works.

- *Corronia pedicellata* (E),
- *Arenga australasica* (V),
- *Canarium acutifolium var. acutifolium* (V), and
- *Huperzia phlegmarioides* (V).

b) Fauna

The following species are expected or are likely to occur in the study area and to be affected to some extent by the works.

Expected

- *Litoria rheocola* (Common Mistfrog) (E),
- *Casuarius casuarius* (Southern Cassowary) (E), and
- *Pteropus conspicillatus* (Spectacled Flying-fox) (V).

Possible

- *Litoria nannotis* (Torrent Treefrog) (E), and
- *Nyctimystes dayi* (Australian Lacelid) (E).

A number of stream-dwelling frogs were located. In general, these can be protected by the proposed construction of bridge s at key creeks and protection of water quality,

The most important species is considered to be the Southern Cassowary. For this reason, the development of a strategy to reduce risks to the Southern Cassowary was one of the major aspects of this Access Road Strategy. This has involved:

- selection of a route option between Flying Fish Point and the Fish Farm that provides for cassowary movement and protects cassowary habitat,
- the development of a Cassowary Management Strategy for the entire Access Road that includes a Fence & Funnel Strategy and specific initiatives to reduce vehicle/cassowary collisions, and
- a comprehensive Offsets & Additional Environmental Investments Policy to investigate suitable on-site and off-site works or actions that could mitigate or offset project impacts on all matters of national environmental significance.

It is considered that these measures will adequately address the conservation of the Southern Cassowary.

6.3 WET TROPICS MANAGEMENT PLAN

6.3.1 Introduction

Part of the current road passes through the Wet Tropics World Heritage Area. While the preferred option for the new Access Road remains generally on this alignment, any works will require a permit under the *Wet Tropics Management Plan 1998* (Qld).

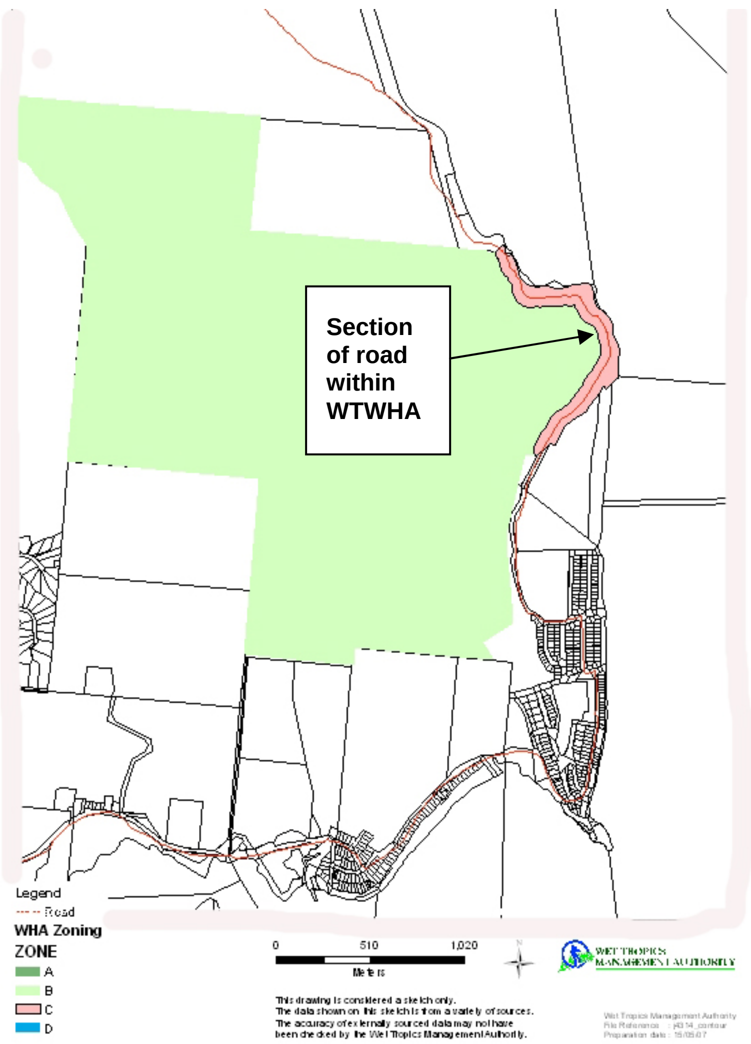


Figure 28. Zoning under the *Wet Tropics Management Plan 1998* (Qld).

Please note that the following sections are a summary of a more detailed assessment undertaken in **Chapter 5**.

6.3.2 Nature of Approvals Required

With respect to the *Wet Tropics Management Plan*:

- the existing road is currently within Zone C (disturbed for community infrastructure),
- roads can only be built in Zones C and D, for which a **permit** is required, and
- roads cannot be built within Zone B (i.e. a **rezoning** is necessary to convert such areas to Zone C or D should the proposed road lie outside the Zone C boundary).

6.3.3 Overview of Permit Assessment Criteria

The *Wet Tropics Management Plan* includes a number of policy statements and guidelines that set out the basis for issuing a permit for the proposed works. The principles which would be applied in considering the above situation are summarised below and discussed in detail in the balance of this section.

a) The Activity

In the context of the WTMP, "the activity" is the provision of access to the Ella Bay Integrated Resort and in particular upgrading the section of the Ella Bay Road that passes through the World Heritage Area. It is not the development of the resort itself although WTMA does have interests in the larger project and regional biodiversity issues.

b) General Principles

- s56(1): most important consideration (likely impact on area's integrity),
- s56(2): have regard to the intended physical and social setting and management purpose for the particular zone, particularly the impact on nearby zones,
- s57: application of the precautionary principle,
- s58: prudent and feasible alternatives to the proposed activity,
- s59: minimising the likely impact on the area's World Heritage values,
- s60: community considerations, and
- s61: carrying capacity.

c) Section 62 Guidelines

s62 includes provision for the creation of guidelines. To date two documents have been produced:

- Guideline 3: Guidelines for Consulting with Aboriginal People Particularly Concerned with Land in the Wet Tropics Area, and
- Guideline 6: Guidelines for Community Consultation.

d) Permit Applications for Particular Activities – Roadworks

- s65(1): no net adverse impact on the integrity of the area if there is no prudent and feasible alternative (s58),
- s65(2): works should, to the greatest possible extent, be confined to land already cleared or degraded, and
- s65(3): canopy clearing should be avoided.

The following sections describe how each relevant requirement of the *Wet Tropics Management Plan* has been addressed in the preliminary design and the associated documentation.

6.3.4 Intended Physical and Social Setting of Relevant Zones – s10-21

a) Zone A

Analysis – no Zone A land will be affected by the upgrade.

b) Zone B – s13-15

Land included in zone – s13

Zone B is comprised of land that is mostly of high integrity but not necessarily remote from disturbance.

Intended physical and social setting – s14

It is intended that, in zone B:

a) land be undergoing recovery or rehabilitation towards its natural state or becoming remote from disturbance by activities associated with modern technological society; and

b) a visitor may expect opportunities for solitude in a natural area requiring a degree of self reliance; and

c) management presence be limited mainly to activities required for the recovery or rehabilitation of the area.

Management purpose – s15

The management purpose of zone B is, to the greatest possible extent:

a) to protect and enhance the integrity of land in the zone;

b) if the land is disturbed:
   - i) to restore land in the zone to its natural state, as opportunities arise; and
   - ii) to include the land in zone A once it is sufficiently recovered or rehabilitated.

Analysis – the existing road and proposed upgrade run past Zone B land. At it closest point the cut batter on the upgraded road will be about 14 m from the Zone C/Zone B boundary.

c) Zone C – s16-18

Land included in zone – s16

Zone C is comprised of land on which, or adjacent to which, there is disturbance associated with community services infrastructure.

Intended physical and social setting – s17

It is intended that, in zone C:

a) land be mostly natural, but with some disturbance associated with community services infrastructure, other community facilities and visitor facilities; and

b) a visitor may expect various low-key opportunities for nature appreciation and social interaction in a natural setting, but with some disturbance by activities associated with modern technological society; and

c) management presence may be obvious.

Management purpose – s18

The management purpose of zone C is:

a) to accommodate community services infrastructure, other community facilities and visitor facilities; but

b) to the greatest possible extent:

   i) to ensure any adverse impact of activities carried out in the zone on the area's integrity is minimal and acceptable under this plan; and

   ii) to otherwise protect and enhance the integrity of land in the zone.

Analysis – the proposed upgrade within the World Heritage Area runs through Zone C land – this allows roadworks subject to a permit.

d) Zone D – s19-21

Land included in zone – s19

Zone D is comprised of land on which there are, or are planned to be, developed facilities to enable visitors to appreciate and enjoy the wet tropics area.

Intended physical and social setting – s20

It is intended that, in Zone D:

a) land be mostly natural, with visitor facilities integrated into the surrounding landscape; and

b) a visitor may expect many opportunities to appreciate and enjoy the area and interact socially in a natural setting; and

c) management presence may be obvious.

Management purpose – s21

The management purpose of zone D is:

a) to accommodate facilities for:

   i) presenting the area to visitors; and

   ii) enabling visitors to enjoy land in the zone and in nearby parts of the area; but

b) to the greatest possible extent:

   i) to ensure any adverse impact of activities carried out in the zone on the area's integrity is minimal and acceptable under this plan; and

   ii) to otherwise protect and enhance the integrity of the land in the zone.

Analysis – there is no Zone D land in the vicinity of the works and none is proposed. Should it be decided during detailed design to construct a lookout, it is expected that this can be accommodated within the Zone C land.

6.3.5 s56: Most Important Consideration

a) Overview

The 'most important consideration' (s56) for deciding an application is the 'likely impact of the proposed activity on the area's integrity'. Schedule 3 defines 'integrity' as the 'extent to which the world heritage values:

- are in their natural ecological, physical or aesthetic condition, and
- are capable of sustaining themselves in the long term.'

s56(2)(b) requires that the impact must be considered having regard to the intended physical and social setting and the management purposes and the circumstances of the zone in which the activity is proposed to be carried out. Details of zones are provided above.

b) World Heritage Values and Integrity

The WTWHA is exceptional in that it is one of relatively few World Heritage Areas which meets all four criteria for natural heritage listings (WTMA 1997). These are:

(a) an outstanding example representing the major stages of the earth's evolutionary history,

(b) an outstanding example representing ongoing geological processes, biological evolution and man's interaction with his natural environment,

(c) contain superlative natural phenomena, formations or features, and

(d) contain the most important and significant natural habitats where threatened species of animals or plants of outstanding universal value live.

While the values of the WTWHA are generally derived from consideration of the area at a bioregional level (it is the overall estate that contains all the values), impact assessment studies are often required to comment on the existence of World Heritage values at a project or sub-regional level. Unfortunately, there has been no comprehensive assessment of the sub-regional distribution of World Heritage values across the WTWHA apart from some attributes scored by Keto and Scott (1987) based on 10 minute grids across the Wet Tropics. These data are now quite out of date for comparative purposes. It is difficult to assess values that are derived at the landscape level and which may not necessarily apply uniformly in each sub-region or local component of the estate.

It is common for major projects (e.g. the Kuranda Range Road Upgrade proposal) to refer to a paper by S. Goosem (2000) which lists Wet Tropics natural heritage values, and indicator species (based on rare or threatened species) and to compare the occurrence of indicator species in the study area compared with the occurrence of indicator species in the WTWHA. **Working Paper 2** includes such an assessment which demonstrates that many of the indicator species are likely to occur on the existing Ella Bay Road. See **Section 5.4.7**.

The Seymour Range forms a coast enclave, pinching into the coast at Coopers Point and Heath Point. Extensive vegetation occurs along the Seymour Range and within Ella Bay National Park to the north. Vertebrate movement and dispersal for rainforest species is likely to be restricted to this corridor. The proposed road alignment is located at the very south-eastern tip of this largely vegetated area.

Referring to the WTMA's Conservation Strategy (WTMA 2004), **Working Paper 2** notes that the protection of existing vegetation which supports connectivity between habitats is of the utmost importance and rehabilitation in suitable areas is recommended where feasible. Although rehabilitation is central to the community efforts for restoring biodiversity, it is more cost effective to maintain the existing vegetation and connectivity than it is to undertake detailed rehabilitation of an area. It is equally as important to maintain and/or rehabilitate areas outside or World Heritage Areas to establish landscape linkages for wildlife and vegetation (WTMA 2004).

For the Ella Bay Road, the approach has been to utilise the existing clearings and widen as little as possible.

c) Assessing Integrity

For the major Kuranda Range Road Upgrade project, the Rainforest CRC (2004) developed a comprehensive set of indicators of integrity and the measured the relative performance of the proposed project and the existing road. Indicators were developed for ecological processes, physical condition, and aesthetic condition, namely:

- **Ecological Process** – stratified by categories of areas important for plants and animals and comprising:
  - Canopy connectivity – length of connectivity greater than 10 m in height
  - Surface connectivity for cassowaries and macropods – length of connectivity with no barriers greater than 1 m in height or less than 3 m under bridge s/culverts
  - Surface connectivity for small animals – length of connectivity with no barriers greater than 1 m in height
  - Aquatic connectivity – the number of creek and gully crossings with retention of significant natural features such as natural streambed conditions
  - Area of clearing
  - Length of edge
  - Penetration of edge effects from the road clearing.
- **Physical Condition**:
  - Slope Disturbance – metres of landform disturbance in terms of cut and fill
  - Catchment integrity – % of runoff within a catchment sourced from the road.
- **Aesthetic Condition**:
  - Visual dominance and scenic alteration including views of the road from coastal areas
  - Presentation of World Heritage Values.

The proposed Access Road is a very minor project compared with the Kuranda Range Road Upgrade and the detailed quantitative assessment undertaken for the latter project is not warranted in this case. However, the indicators are useful and have been used qualitatively below.

d) *Findings*

TABLE 6.3.5: QUALITATIVE ASSESSMENT OF IMPACTS ON INTEGRITY

INDICATOR	COMMENT
(A) Ecological Process	
Canopy connectivity – length of connectivity greater than 10 m in height	Will be reduced significantly as road width (disturbed area) will increase from about 6 m to about 12 m including drains etc. for surface formation and up to 15 m where cuttings are involved. Mitigation is proposed in the form of rope bridge s. Locations and details to be confirmed.
Surface connectivity for cassowaries and macropods – length of connectivity with no barriers greater than 1 m in height or less than 3 m under bridge s/culverts	Will be significantly enhanced by the "fauna friendly" bridge s, one of which is within the World Heritage Area. Associated fencing (or natural barriers such as steep slopes and cuttings) will reduce the risk of roadkill.
Surface connectivity for small animals – length of connectivity with no barriers greater than 1 m in height	As above.
Aquatic connectivity – the number of creek and gully crossings with retention of significant natural features such as natural streambed conditions	Will be significantly enhanced by bridge s at the two important creeks at Chainage 3140/640 and 3570/210. These bridge s are designed to protect riparian and aquatic values and maintain water quality.
Area of clearing	Little additional clearing (existing road clearing – 1.95 ha; new road clearing – 0.44 ha extra). All existing clearing to be incorporated in the upgrade.
Length of edge	Slight reduction in length of impacted edge due to proposed fauna friendly bridge and two new creek crossings.
Penetration of edge effects from the road clearing	Increase in edge effects due to the higher traffic and wider opening. To be mitigated by weed control and revegetation.
(B) Physical Condition	
Slope Disturbance – metres of landform disturbance in terms of cut and fill	There will be over 4000 m^2 of vegetated retaining walls within the World Heritage Area compared with zero currently. Whilst the construction of these increases slope disturbance initially, it will ensure that the cuttings are more stable in the long term.
Catchment integrity – % of runoff within a catchment sourced from the road	No catchment modifications are proposed (i.e. existing drainage patterns will remain). Road Runoff Strategy designed to protect water quality. (continued over)

INDICATOR	COMMENT
(C) Aesthetic Condition	
Visual dominance and scenic alteration including views of the road from coastal areas	Visual amenity (especially when viewed from ships at sea) will initially be reduced but this impact will lessen over time as the proposed revegetation of the retaining walls becomes established. Visual impacts are proposed to be managed by the revegetation of cuttings, embankments, and retaining walls in accordance with the Revegetation Strategy
Presentation of World Heritage Values	Presentation will be improved via the sealing of the road, the control of weeds, and the opportunities for additional views (to be conformed subject to engineering and safety considerations). Proposed rope bridge s and “fauna friendly” bridge s will add to scenic values and interest as will visible elements of the Cassowary Management Strategy (e.g. signage).

Source: Study team compilation.

Analysis – Providing that the recommended mitigation works are implemented effectively, there will be little adverse impact in integrity.

6.3.6 s57: Application of the Precautionary Principle

The precautionary principles involves dealing cautiously with uncertainty or more specifically: ‘that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation’[8].

It is considered that the analysis that underpins this Access Road Strategy and expert opinion brought to bear is adequate in the context of the scale of likely impacts.

While most of the adverse and beneficial impacts likely to occur with building and operating the Access Road will persist, many construction impacts are reversible as they are in general temporary. By the application of construction management via the EMP (Construction) for which an outline is provided in **Section 7.6**, and by the implementation of the Revegetation Strategy (**Section 7.5**), many potentially serious impacts can be avoided and reversed.

Analysis – It is concluded that due cognisance has been given to the precautionary principle. Specifically, attention has been given to the reversibility of impacts through the environmental management and mitigation strategies to ensure that reversibility of adverse impacts has been maximised.

[8] Definition from the explanatory notes of the Wet Tropics Management Plan.

6.3.7 s58: Prudent and Feasible Alternatives

a) Overview

Section 58(1): requires the Authority to consider whether there is any prudent and feasible alternative to a proposed activity.

Section 58(2): in deciding whether there is an alternative, the WTMA may have regard to:

(a) any alternative site for the activity, either elsewhere in the WTWHA area or outside the area,

(b) any alternative use for the proposed site of the activity,

(c) any alternative way of carrying out the proposed activity, and

(d) the alternative of not carrying out or postponing the carrying out of the proposed activity.

Section 58(3): in deciding whether or not an alternative is prudent, the Authority must consider the likely impact of the alternative on the area's integrity, compared with that of the proposed activity. 'Integrity' (Schedule 3 of the *Wet Tropics Management Plan*) means the extent to which the world heritage values of the area or land:

(a) are in their natural ecological, physical and aesthetic condition; and

(b) are capable of sustaining themselves in the long term.

In deciding whether an alternative is feasible, the Authority (S58(4)):

(a) may have regard to issues of safety, health, economics, convenience, public interest and community disruption and any other relevant issues, and

(b) must decide that the alternative is not feasible if it involves unproven technology or is impractical to implement.

According to the Explanatory Note to the *Wet Tropics Management Plan*, alternatives must be both prudent and feasible to be considered.

b) Consideration of Alternatives

Alternatives to the current proposal which is to upgrade the existing Ella Bay Road have been considered in the EIS (Ella Bay Developments 2007a) and in this Access Road Strategy. these alternatives were considered on the basis of four criteria, namely:

- environmental sustainability,
- transport efficiency,
- social / amenity, and
- cost.

In the language of the *Wet Tropics Management Plan* and in particular s58(3) and (4),

- the test for prudent alternatives was based on environmental sustainability of the World Heritage Area (as well as ecological values outside the World Heritage Area), while
- the test for feasible alternatives included assessment of transport efficiency, social / amenity, and cost.

The process and key outcomes are summarised below. See also schematic in **Section 3.7.4**.

TABLE 6.3.7B): SUMMARY OF CONSIDERATION OF ALTERNATIVES

REPORT	LEVEL OF ALTERNATIVE	ALTERNATIVES CONSIDERED	ALTERNATIVE ADOPTED
EIS	Broad route options (summarised in **Section 2.2** of this report).	Three options including a route via Flying Fish Point Road and two inland alternatives (one with a tunnel).	Broad Route Option 1 (Flying Fish Point Road).
	Flying Fish Point Road Options (summarised in **Section 2.3** of this report).	Four options including one western bypass, the existing road, and two esplanade options.	Inconclusive (Flying Fish Point Road Option 1 was preferred overall but other options had some attractive features). Commitment to undertake further studies and analysis.
Post-EIS Agency Workshop	Broad route options (as per EIS). See **Section 2.6**.	Broad route options (as per EIS).	Broad Route Option 1 (Flying Fish Point Road).
	Flying Fish Point Road Options.	EIS options and western alternatives.	Inconclusive. Commitment to undertake further studies and analysis of suitable bypass and town options.
Access Road Strategy	Consideration of agency comments on Flying Fish Point Road options (**Section 2.4**).	Comments were made on 3 of the 4 EIS options and three new town options were suggested for consideration.	No decision made – comments included in high level screening (see below).
	Consideration of community comments on Flying Fish Point Road options (**Section 2.5**).	General comments made on impacts (especially biodiversity, impact in residences, and impacts on scenic amenity).	No decision made – comments included in high level screening (see below).
	High level screening of seven Flying Fish Point Road options derived from the EIS and agency suggestions (**Section 3.5**),	Seven options based on EIS and agency comments plus new work.	Four options: • A - existing road, • B - town variation • C - western option • D - western option with short tunnel.
	Evaluation of four Flying Fish Point Road options A to D via a multi-criteria analysis (MCA) informed by additional studies and analysis (**Chapter 4**).	Options A to D.	Options A to D. (continued over)

REPORT	LEVEL OF ALTERNATIVE	ALTERNATIVES CONSIDERED	ALTERNATIVE ADOPTED
Access Road Strategy (cont)	Refinement of the four MCA options to improve performance, especially with respect to environmental sustainability considerations (**Section 4.10**).	Options A to D (refined to improve performance).	Options A to D.
	Sensitivity analysis and further consideration to select the preferred option (**Section 4.12**).	Refined Options A to D.	Option D.
	Detailed impact assessment and consideration of mitigation and management needs of the preferred option (**Chapter 5**).	Preferred solution plus upgraded Ella Bay Road	Option D plus upgraded Ella Bay Road with recommendations for refinement, mitigation and management.

Source: Study team compilation.

Analysis – There are no prudent and feasible alternatives to the preferred solution.

c) *s58(2)(a): Alternative Sites*

Section 58(2)(a)) requires that alternative sites for the proposed activity, either elsewhere in the area or outside the Wet Tropics area, be investigated.

This was addressed in the consideration of broad options (summarised above and described in **Section 2.2**). This concluded that there were no prudent or feasible alternative sites. This conclusions was accepted:

- in formal responses by the Environmental Protection Agency, Wet Tropics Management Authority, and Department of the Environment and Water Resources (see **Section 2.4**), and
- in the post-EIS Access Road Strategy workshop (see **Section 2.6**).

Analysis – Alternative sites were ruled out in the EIS and this was accepted by the key approval agencies.

d) *s58(2)(b): Alternative Use for the Site*

The site (of the upgraded road) is currently used by the existing road and the area is appropriately zoned for this activity under the WTMP.

Analysis – There does not appear to be any land use that is competing with the road (other than the existing road and conservation) and, should the project not proceed, it is highly unlikely that any alternative use will arise.

e) s58(2)(c): Alternative Ways of Carrying out the Proposed Activity

Alternatives could be considered at both the macro level (i.e. is there another site for the road?) and the micro level (i.e. are minor adjustments to the alignment, different construction techniques etc. prudent and feasible?). Macro alternatives were ruled out as described in the previous section while **Section 5.8** documents the consideration of design alternatives and techniques to mitigate impacts.

Analysis – All other access alternatives were found to be not prudent on the basis of unacceptable impact on the integrity of the World Heritage Area and other areas. The environmental design process considered in this Access Road Strategy involved increasing the level of prudence without sacrificing feasibility.

f) s58(2)(d): The Alternative of Not Carrying Out or Postponing the Carrying Out of the Activity

The consideration of alternatives is consistent with the 'feasibility' test as set out in s58(4) of the *Wet Tropics Management Plan*. Two sub-tests are relevant, namely that the Authority:

(a) may have regard to issues of safety, health, economics, convenience, public interest and community disruption and any other relevant issues, and

(b) must decide that the alternative is not feasible if it involves unproven technology or is impractical to implement.

Further expansion on these is provided below with respect to the existing road (the only remaining alternative to the proposed upgrade after the comprehensive consideration of alternatives described above).

1 – Not Carrying Out the Activity

The existing road cannot adequately handle the design traffic generated by the project.

Analysis – Not carrying out the activity (i.e. not upgrading the access road link) would not be feasible as the existing road would not meet transport efficiency criterion for the access.

2 – Postponing the Activity

Postponing the project is also not feasible, as the upgrade is needed in advance of the resort development (i.e. during the construction phase).

Analysis – It is not feasible to postpone the upgrading of the Access Road.

g) Summary of Assessment of Prudent and Feasible Alternatives

The following table summarises the previous discussion.

TABLE 6.3.7G): SUMMARY OF ALTERNATIVES

ALTERNATIVE	PRUDENT?	FEASIBLE?
s58(2)(a) Alternative Sites for the Proposed Activity		
Broad Route Option – Mountainous Road Option (via Garradunga).	✗	✗
Broad Route Option 3 – Tunnel Option (direct route via existing road reserve from the Bruce Highway)	✗	✗
s58(2)(b) Alternative Use for the Proposed Site of the Activity		
Existing road (does not meet transport efficiency criteria).	✗	✗
Conservation (does not meet transport efficiency criteria).	✓	✗
s58(2)(c) Alternative Way of Carrying Out the Activity		
Broad route options ruled out.	✗	✗
Further refinement of preferred route / road option. Concept design as proposed.	✓	✓
S58(2)(d) Alternative of Not Carrying Out / Postponing Activity		
No upgrade or deferred upgrade. Ruled out.	✗	✗

Source: Study team compilation.

Analysis – Many alternatives were considered through the evolution of the Access Road through the EIS and in this Access Road Strategy.

It is concluded that the proposed Access Road is the only one that is both prudent and feasible.

6.3.8 s59: Minimising Impacts on World Heritage Values

Part 1 of this section requires the Authority to decide the application in a way that minimises the likely impact of the proposed activity on the area's world heritage values, including (but not restricted to):

- s59(3)(a) ecological issues:
  - rare and threatened species under the *Nature Conservation Act*,
  - habitats of these species,
  - other threatened plant and animal communities, and
  - natural ecological processes.
- s59(3)(b) the potential cumulative impacts on the area's integrity of the proposed activity and another activity carried out, or that may be carried out, lawfully in the area (particularly if the activities are close together or affect the same, or similar, world heritage values, and
- s59(3)(c) the likely impact of a proposed activity on the area's scenic amenity including, in particular, the degree of visual dominance of the activity or any alteration of the landscape arising from the activity.

Subsection s59(4) requires that the Authority must consider any action that could be taken to:

- (a) prevent, minimise or monitor any adverse impact the proposed action may have on the area's integrity, or
- (b) rehabilitate the area while carrying out the activity or after the activity has ended.

a) s59(3)(a): Ecological Issues

The following is based on **Section 5.4** regarding flora, fauna, and ecological processes.

s59(3)(a)(i) – Rare and Threatened Species Under the *Nature Conservation Act*

Nearly all of the *indicator species* used to assess World Heritage values (S. Goosem 2000) are also species of conservation significance. Accordingly, the impact of the proposal on this indicator of World Heritage values is identical to that described in **Sections 5.4.3** (*Impact on Plant Species of Conservation Significance*), **Section 5.4.4** (*Impact on Animal Species of Conservation Significance other than Cassowaries*), and **Section 5.4.5** (*Impact on Animal Species of Conservation Significance – Cassowaries).* On the basis of observations and modelling of likely occurrence of listed plants and animals, it is likely that there will be some impacts on the following species listed under the *Nature Conservation Act 1992* (Qld).

<u>Flora</u>

- *Corronia pedicellata* (E),
- *Arenga australasica* (V),
- *Canarium acutifolium var. acutifolium* (V),
- *Huperzia phlegmarioides* (V),
- *Endiandra globosa* (R),
- *Macaranga polyadenia* (R), and
- *Ichnanthus pallens* (R).

<u>Fauna</u>

Expected

- *Cophixalus infacetus* (Buzzing Nursery-Frog) (R),
- *Litoria genimaculata* (Green-eyed Treefrog) (R),
- *Litoria rheocola* (Common Mistfrog) (E),
- *Accipiter novaehollandiae* (Grey Goshawk) (R),
- *Eulamprus tigrinus* (Rainforest Water Skink) (R),
- Casuarius casuarius (Southern Cassowary) (E),
- *Cyclopsitta diophthalma macleayana* (Macleay's Fig Parrot) (V),
- *Collocalia spodiopygius* (White-rumped Swiftlet) (R),
- *Neochmia phaeton* (Crimson Finch) (V), and
- *Pteropus conspicillatus* (Spectacled Flying-fox) (LC).

Likely

- *Coeranoscincus frontalis* (R), and
- *Esacus neglectus* (Beach Stone curlew) (V).

Possible

- *Litoria nannotis* (Torrent Treefrog) (E),
- *Nyctimystes dayi* (Australian Lacelid) (E)
- *Dendrolagus lumholtzi* (Lumholtz's Tree-kangaroo) (R).

The following comments are relevant:

- Frogs – a number of stream-dwelling frogs were located. In general, these can be protected by the proposed construction of bridge s at key creeks and protection of water quality.
- Mammals – Lumholtz's Tree Kangaroo may occur. The proposed Fence & Funnel Strategy will reduce the risk of roadkill of this species and other mammals.
- Birds – the key bird is the Southern Cassowary. It is considered that the following measures will adequately address the conservation of this animal:
  - selection of a route option between Flying Fish Point and the Fish Farm that provides for cassowary movement and protects cassowary habitat
  - the development of a Cassowary Management Strategy for the entire Access Road that includes a Fence & Funnel Strategy and specific initiatives to reduce vehicle/cassowary collisions
  - a comprehensive Offsets & Additional Environmental Investments Policy to investigate suitable on-site and off-site works or actions that could mitigate or offset project impacts on all matters of national environmental significance.

Analysis – With the proposed design elements and mitigation strategies (Road Runoff Strategy, Fence & Funnel Strategy) and the Offsets & Additional Environmental Investments measures, it is considered that listed species are not under serious threat.

s59(3)(a)(ii) – Habitats of Rare and Threatened Species

The modelling of habitat for plants and animals of conservation significance shows that only small areas will be lost (i.e. only 2.44 ha of remnant vegetation is to be cleared and of this only 0.44 ha is in the World Heritage Area) and attention is being given to connectivity, both in terms of the Fence & Funnel Strategy (two dedicated crossings) and the construction of bridge s at the key creek crossings where important frogs have been located.

Analysis – No serious loss of habitat will occur (only 0.44 ha of new clearing and utilisation of 1.95 ha of existing clearing).

s59(3)(a)(iii) – Other Threatened Plant and Animal Communities

The definition of rare and threatened species under the *Wet Tropics Management Plan* is restricted to those listed under the *Nature Conservation Act*.

Analysis – No impacts expected.

s59(3)(a)(iv) – Natural Ecological Processes

Natural ecological processes have been described in **Section 5.4.6**. From this discussion and subsequent work on mitigation and management it is concluded that there are likely to be beneficial effects in terms of:

- connectivity (via the over-road corridor provided by the cut-and-cover tunnel and via the small bridge s along the Ella Bay Road),
- hydrology (improvements in water quality and connectivity),
- animal behaviour (reduced roadkill due to the Fence & Funnel Strategy), and
- weeds (reduced by revegetation strategy and on-going maintenance).

Ecological processes that are expected to decline are:

- edge effects due to canopy loss, and
- noise.

Analysis – Overall, it is expected that ecological processes will improve. This assumes that all recommended mitigation and management is undertaken and that this is effective.

b) s59(3)(b): Cumulative Impacts

Section 59(3)(b) requires that the WTMA have regard to the potential cumulative impact on the area's integrity of the proposed activity and another activity carried out, or that may be carried out, lawfully in the area (particularly if the activities are close together or affect the same, or similar, world heritage values).

This has been covered in the Offsets & Additional Environmental Investments Policy (**Working Paper 5**).

Analysis – Cumulative impacts are offset by the initiatives of the Offsets & Additional Environmental Investments Policy.

c) s59(3)(c): Aesthetic Condition

According to Schedule 3 of the *Wet Tropics Management Plan*, 'scenic amenity' includes the visual appeal of landscapes or individual natural features.

Visual amenity (especially when viewed from ships at sea) will initially be reduced but this impact will lessen over time as the proposed revegetation of the retaining walls becomes established. Visual impacts are proposed to be managed by the revegetation of cuttings, embankments, and retaining walls in accordance with the Revegetation Strategy.

The new road will provide new opportunities for presentation and is expected to become a high quality scenic drive.

There are opportunities to enhance the presentation values of the area by the inclusion of lookouts and interpretive signage for drivers on the Access Road and cyclists and pedestrians on the dedicated paths.

Analysis – Visual amenity (especially when viewed from ships at sea) will initially be reduced but this impact will lessen over time. The new road will provide new opportunities for presentation (for drivers of vehicles and pedestrians and cyclists) and is expected to become a high quality scenic drive.

d) s59(4): Actions Taken to Minimise Impacts

Subsection s59(4) requires that the Authority must consider any action that could be taken to:

(a) prevent, minimise or monitor any adverse impact the proposed action may have on the area's integrity, or

(b) rehabilitate the area while carrying out the activity or after the activity has ended.

In developing the concept design, attention has been given to ways to minimise impacts through route selection, design, construction, operation and maintenance. Future work will involve the development of a detailed rehabilitation strategy.

Analysis – Significant actions to minimise and offset impacts are proposed via a suite of management and mitigations strategies.

e) Overall

Analysis – It is concluded that there will be minimal impacts on World Heritage values providing that the recommended mitigation works are implemented effectively.

6.3.9 s60: Community Considerations

Section 60 requires that the Authority must have regard to the effects a proposed decision on the application may have for the following persons and matters:

(a) for affected land:
   i) the likely effect on the land-holder, any native title holder and any other Aboriginal persons particularly concerned with the land
   ii) the likely effect on the amenity of the land, having regard to the current uses of the land the experiences currently enjoyed by visitors.

(b) the community need for the proposed activity,

(c) the likely effect on the community's ability to continue to participate in the management, protection, presentation, enjoyment and ecologically sustainable use of the area, and

(d) any other relevant social, economic and cultural effects.

a) s60(a)(i): Land-Holders, Native Title Holders and any other Aboriginal Persons etc.

1 – Land-Holders

The proponent has consulted with all affected landholders.

2 – Native Title Holders

The proponent has consulted with all affected native title holders.

3 – Other Aboriginal Persons

The proponent has consulted extensively with the Ma:Mu people.

Analysis – All relevant Aboriginal people have been consulted.

b) s60(a)(ii): Amenity

The likely effect on the amenity of the land, having regard to the current uses of the land the experiences currently enjoyed by visitors is briefly assessed below.

TABLE 6.3.8E)B): EFFECT ON AMENITY OF CURRENT USERS

GROUP	**CHANGE IN AMENITY**	**NET CHANGE** ✓= beneficial ✕= adverse ≈ = no change
Road users – cars	• Improved flow, safety, reliability, speed. • Improved views of adjacent forests and coastal plain	✓
Road users – cyclists	• 1 m shoulder provided. • Separate cycle paths are proposed.	✓
Road users – pedestrians	• Separate pedestrian paths are proposed.	✓
All users – views	• Lookout opportunities to be enhanced. • Views from the road generally improved.	✓
Beach users	• Degree of isolation will be reduced. • Quality of access will be improved.	✕ ✓

Analysis – All current users will benefit with the example for beach users for whom the degree of isolation will be reduced.

c) s60(b): Community Need for the Project

The community need for the proposed upgrade arises from the fact that it is the only access available to the site. The completion of the Ella Bay Integrated Resort will result in a new community of some 3,000 people. The existing road is unsuitable for supporting a community of this size.

Analysis – As an adjunct to the main project (the Ella Bay Integrated Resort), the Access Road is needed.

d) s60(c): Community Participation in Management

A decision to grant a permit for the construction and operation of the proposed upgrade is unlikely to adversely affect the community's ability to continue to participate in the management, protection, presentation, enjoyment and ecologically sustainable use of the area.

Analysis – No loss expected in the community's ability to continue to participate in the management, protection, presentation, enjoyment and ecologically sustainable use of the area.

e) s60(d): Other Relevant Social, Economic and Cultural Effects

1 – Social/Cultural

The social impact assessment (SIA) undertaken for the project considered potential impacts on selected key stakeholder and community groups. In addition to the procedural issue of information access and exchange, the two issues of concern to most stakeholders, special interest groups and the community are:

- conflicts with local traffic in the Flying Fish Point town area, and
- the environmental impacts of the upgrade.

These are most likely followed by impacts of construction on road use and residential areas and the aesthetic impacts of the upgrade which include the visual impacts of the upgrade.

Analysis – Key social concerns (conflicts with local traffic in the Flying Fish Point town area, and the environmental impacts of the upgrade) have been addressed and mitigated.

2 – Economic

The EIS concludes that there is likely to be substantial economic benefits accruing from the resort project.

Analysis – Economic impact will be beneficial.

f) Overall

Analysis – All relevant Aboriginal people have been consulted; all current users will benefit with the example for beach users for whom the degree of isolation will be reduced; need has been demonstrated; no loss expected in the community's ability to continue to participate in the management, protection, presentation, enjoyment and ecologically sustainable use of the area; key social concerns (conflicts with local traffic in the Flying Fish Point town area, and the environmental impacts of the upgrade) have been addressed and mitigated; and economic impact will be beneficial.

6.3.10 s61(1): Carrying Capacity

Under this section the Authority must have regard to the carrying capacity of land in the area that may be affected by the proposed activity.

Analysis – This does not appear to be relevant to this project.

6.3.11 s62: Guidelines

Section 62 includes provision for the creation of guidelines. To date two documents have been produced, namely:

- Guideline 3: Guidelines for Consulting with Aboriginal People Particularly Concerned with Land in the Wet Tropics Area, and
- Guideline 6: Guidelines for Community Consultation.

These both deal with consultation.

a) s62: Guideline 3

Guideline 3 (*Guidelines For Consulting Aboriginal People Particularly Concerned With Land In The Wet Tropics Area*) has been adopted by the Wet Tropics Board as a 'Guideline' under Section 62. Its purpose is to ensure that the Authority complies with Section 60 of the *Wet Tropics Management Plan* and Section 10(5) of the *Wet Tropics World Heritage Protection and Management Act 1993.* The guideline sets out the following key elements:

- the identification of relevant Aboriginal people,
- whether the relevant Aboriginal people were provided with sufficient information about the proposed activity so they can advise WTMA of potential cultural and social impacts and impacts on the natural values of the area,
- whether the relevant Aboriginal people were made aware of the permit application,
- whether the relevant Aboriginal people have a clear understanding of the location, nature and extent of the proposed activity, and
- whether joint site inspections were arranged.

The following checklist shows how the above guidelines have been addressed throughout this project.

TABLE 6.3.11A): SUMMARY OF COMPLIANCE WITH GUIDELINE 3

ISSUE	ELLA BAY INTEGRATED RESORT PHASE	
	EIS	SUPPLEMENTARY EIS
1. Identification of relevant Aboriginal people	✓	✓
2. Provision of sufficient information to the community	✓	✓
3. Aboriginal community awareness of permit application	N/A	Not yet *
4. Aboriginal community understanding of the location, nature and extent of the proposed activity	✓	✓
5. Undertaking of joint site inspections	✓	✓
6. Consultation on the final alignment	N/A	✓

Source: Study team compilation.

* to be undertaken as part of permit consultation.

b) *s62: Guideline 6*

Guideline 6 (Guidelines for Community Consultation) has been adopted by the Wet Tropics Board as a 'Guideline' under Section 62 of the Wet Tropics Management Plan. Its purpose is to ensure that the Authority complies with Section 60 of the *Wet Tropics Management Plan* when assessing permit applications. The guideline sets out the following key elements:

- the identification of community sectors to be consulted,
- how the community needs to be notified,
- whether sufficient information has been provided to the community,
- whether the community interests consulted are aware of the permit application; and
- whether community members consulted have a clear understanding of the location, nature and extent of the proposed activity.

The proponent's assessment of its consultation with the broader community against these six criteria is as follows.

TABLE 6.3.110: SUMMARY OF COMPLIANCE WITH GUIDELINE 6

ISSUE	ELLA BAY INTEGRATED RESORT PHASE	
	EIS	SUPPLEMENTARY EIS
1. Identification of community sectors	✓	✓
2. Notification of the community	✓	Not yet *
3. Provision of sufficient information to the community	✓	Not yet *
4. Community/stakeholder awareness of permit application	N/A	Not yet *
5. Community understanding of the location, nature and extent of the proposed activity	✓	Not yet *
6. Consultation on the final alignment	N/A	Not yet *

Source: Study team compilation.

* to be undertaken as part of permit consultation.

c) *Conclusion*

Analysis – These guidelines will be met during the permit process (the Access Road Strategy is to be advertised as part of the Supplementary EIS process).

6.3.12 s65: Roadworks

a) *s65(1): No Net Adverse Impact on the Integrity of the Area or No Prudent and Feasible Alternative*

This section specifically relates to roadworks and s65(1) states that the Authority may issue a permit to build a road only if building the road under the permit would not have a net adverse impact on the integrity of the World Heritage Area <u>or</u> there is no prudent and feasible alternative. <u>These requirements are alternatives (not additive) such that only one needs to be met.</u>

1 – No Net Adverse Impact on the Integrity of the Area

It is considered that the construction and operation of the Ella Bay Road upgrade will involve a small loss of integrity. This is despite the proposed mitigation measures. However, the Offsets & Additional Environmental Investments Policy (**Working Paper 5**) is designed to compensate for this.

2 – No Prudent and Feasible Alternative

The discussion under s58 above clearly demonstrates that there is no prudent and feasible alternative at either the macro (corridor and route) and micro (detailed) level. Similarly, the 'no upgrade' option (i.e. not carrying out the activity) has been shown to be neither prudent nor feasible.

Analysis – The above analysis shows that while there will be a net adverse impact on the integrity of the area, no prudent and feasible alternative exists.

b) *a65(2): Confine Roadworks to Land Already Cleared or Degraded*

This subsection notes that the Authority must, to the greatest extent possible, confine roadworks to land already cleared or otherwise degraded.

The upgrade follows the existing route of the Ella Bay Road and makes use of all clearings.

Analysis – The design confines roadworks to land already cleared or otherwise degraded, to the greatest possible extent.

c) *s65(3)a: Avoid Canopy Clearing*

This subsection allows the Authority to issue a permit for roadworks that require canopy clearing only if it is satisfied that the works:

- are needed for public safety, provision of a community service, access to a residence or an activity that the Authority considers necessary to properly manage the area under this [the *Wet Tropics Management Plan*] plan,
- will reduce the impact on the area's integrity of other activities being carried out or likely to be carried out.

Canopy clearing is required in order to upgrade the road to the desired standard. However, the need for the project for reasons of public safety and community service has been demonstrated under s58 (**Section 6.3.7**).

Analysis – While canopy clearing is required, the road is a service to a future community. Canopy connectivity will be addressed as part of the detailed Fence & Funnel Strategy (**Section 7.2**) which includes rope bridge s.

d) s65(3)b: Cumulative impacts

s65(3)(b) requires that the WTMA have regard to the potential cumulative impact on the area's integrity of the proposed activity and another activity carried out or likely to be carried out. This has been covered in section 59(3)(b) and will be addressed by the Offsets & Additional Environmental Investments Policy (**Working Paper 5**).

Analysis – Cumulative impacts are offset by the initiatives of the Offsets & Additional Environmental Investments Policy.

6.3.13 Summary of Compliance with Permit Assessment Criteria

The following table summarises the above responses.

TABLE 6.3.12D): COMPLIANCE WITH PERMIT ASSESSMENT CRITERIA

CONDITION	EXTENT OF COMPLIANCE
s56: Most important consideration (likely impact on the area's integrity)	Complies. Providing that the recommended mitigation works are implemented effectively, there will be little adverse impact in integrity.
s57: Precautionary principle	Complies. It is concluded that due cognisance has been given to the precautionary principle. Specifically, attention has been given to the reversibility of impacts through the environmental management and mitigation strategies to ensure that reversibility of adverse impacts has been maximised.
s58: No prudent and feasible alternatives	Complies. There are no prudent and feasible alternatives to the preferred solution.
s59: Minimal impact on World Heritage values	Complies. It is concluded that there will be minimal impacts on World Heritage values providing that the recommended mitigation works are implemented effectively.
s60: Community considerations	Complies. All relevant Aboriginal people have been consulted; all current users will benefit with the example for beach users for whom the degree of isolation will be reduced; need has been demonstrated; no loss expected in the community's ability to continue to participate in the management, protection, presentation, enjoyment and ecologically sustainable use of the area; key social concerns (conflicts with local traffic in the Flying Fish Point town area, and the environmental impacts of the upgrade) have been addressed and mitigated; and economic impact will be beneficial.
s61: Carrying capacity	N/A.
s62: Consultation guidelines	Complies. These guidelines will be met during the permit process (the Access Road Strategy is to be advertised as part of the Supplementary EIS process).
s65(1): No net adverse impact on the integrity of the area or no prudent and feasible alternatives.	Complies. While there will be a net adverse impact on the integrity of the area, no prudent and feasible alternative exists. (continued over)

CONDITION	EXTENT OF COMPLIANCE
s65(2): Confine roadworks (to the greatest extent possible) to existing cleared or otherwise degraded areas	Complies. The design confines roadworks to land already cleared or otherwise degraded, to the greatest possible extent.
s65(3)(a): Permit canopy clearing if the roadworks are needed for the provision of a community service	Complies. While canopy clearing is required, the road is a service to a future community. Canopy connectivity will be addressed as part of the detailed Fence & Funnel Strategy which includes rope bridge s.
s65(3)(b): Have regard to the potential cumulative impact on the area's integrity of the proposed activity and another activity carried out or likely to be carried out.	Complies. Cumulative impacts are offset by the initiatives of the Offsets & Additional Environmental Investments Policy.

Source: Study team compilation based on above discussion.

6.4 THE VEGETATION MANAGEMENT ACT 1999 (QLD)

6.4.1 Impacts

The key issue addressed by the *Vegetation Management Act 1999* (Qld) (VMA) is the protection of regional ecosystems of conservation significance and mitigation requirements (offsets) if any threatened or "of concern" regional ecosystems are to be impacted.

The quantities of clearing required by the Access Road are documented in **Section 5.4.1**. This analysis shows that the following clearing will be required.

TABLE 6.4.1: AREA OF CLEARING BY REGIONAL ECOSYSTEM

REGIONAL ECOSYSTEM	CONSERVATION STATUS UNDER VMA	CLEARING (HA)
7.2.8	Of Concern	0.02
7.3.10a	Of Concern	0.19
7.11.34a	Of Concern	0.31
7.11.1	Not of Concern	1.78
7.11.1a	Not of Concern	0.03
Cleared Area	n/a	0.01
Non-Remnant	n/a	0.02
TOTAL REMNANT		**1.81**
Revegetation (Tunnel)		-0.49
Net clearing after revegetation		**1.32**

Source: Study team compilation based on **Working Paper 2**.

BAAM (**Working Paper 2**) observe that the majority of proposed clearing works occur in regional ecosystems mapped as Not of Concern (i.e. RE 7.11.1) and that there is no clearing proposed for areas included in Endangered Regional Ecosystems.

6.4.2 Consequences and Mitigation

The legislative implications of this clearing are described in **Working Paper 5** and are an important component of the Offsets & Additional Environmental Investments Policy.

With respect to the VMA:

- the (currently) preferred solution has been selected to minimise the need to clear regional ecosystems with a high conservation value,
- the proposed mitigation strategy (retaining walls, constrained sections etc.) further reduce the need to clear vegetation communities of conservation significance, and
- the comprehensive Offsets & Additional Environmental Investments Policy includes suitable on-site and off-site works or actions to mitigate or offset impacts on regional ecosystems of significance.

6.5 THE NATURE CONSERVATION ACT 1992 (QLD)

6.5.1 Impacts

The *Nature Conservation Act 1992* (Qld) provides legislative protection to plant and animal species of conservation significance as listed in the *Nature Conservation Regulation 1994*. The species likely to be affected have been described in **Section 5.4.3** to **5.4.5**.

The key consideration is the conservation of significant plant and animal species and the provision of offsets where impacts cannot be avoided.

The modelling of habitat for plants and animals of conservation significance shows that only small areas will be lost (i.e. only 2.44 ha of remnant vegetation is to be cleared) and attention is being given to connectivity, both in terms of the Fence & Funnel Strategy (two dedicated crossings) and the construction of bridge s at the key creek crossings where important frogs have been located.

On the basis of observations and modelling of likely occurrence of listed plants and animals, it is likely that there will be some impacts on the following species listed under the *Nature Conservation Act 1992* (Qld).

a) Flora

<u>Flora</u>

- *Corronia pedicellata* (E),
- *Arenga australasica* (V),
- *Canarium acutifolium var. acutifolium* (V),
- *Huperzia phlegmarioides* (V),
- *Endiandra globosa* (R),
- *Macaranga polyadenia* (R), and
- *Ichnanthus pallens* (R).

b) Fauna

Expected

- *Cophixalus infacetus* (Buzzing Nursery-Frog) (R),
- *Litoria genimaculata* (Green-eyed Treefrog) (R),
- *Litoria rheocola* (Common Mistfrog) (E),
- *Accipiter novaehollandiae* (Grey Goshawk) (R),
- *Eulamprus tigrinus* (Rainforest Water Skink) (R),
- Casuarius casuarius (Southern Cassowary) (E),
- *Cyclopsitta diophthalma macleayana* (Macleay's Fig Parrot) (V),
- *Collocalia spodiopygius* (White-rumped Swiftlet) (R),
- *Neochmia phaeton* (Crimson Finch) (V),
- *Pteropus conspicillatus* (Spectacled Flying-fox) (LC),

Likely

- *Coeranoscincus frontalis* (R),
- *Esacus neglectus* (Beach Stone curlew) (V),

Possible

- *Litoria nannotis* (Torrent Treefrog) (E),
- *Nyctimystes dayi* (Australian Lacelid) (E)
- *Dendrolagus lumholtzi* (Lumholtz's Tree-kangaroo) (R).

6.5.2 Consequences and Mitigation

Specific permits will be required to take native wildlife.

Proposed mitigation works include:

- revegetation above the cut-and-cover tunnel (0.49 ha),
- cassowary conservation and Fence & Funnel Strategy initiatives as described above,
- attention to maintaining important ecological processes via:
  - the Fence & Funnel Strategy
  - attention to aquatic and riparian connectivity
  - the Road Runoff Strategy
  - the Revegetation Strategy, and
- the Offsets & Additional Environmental Investments Policy of suitable on-site and off-site works or actions to mitigate or offset impacts on listed species.

6.6 COASTAL PROTECTION AND MANAGEMENT ACT 1995 (QLD)

6.6.1 Overview

The *Coastal Protection and Management Act 1995* (Qld) has established the *Wet Tropical Coast Regional Coastal Management Plan 2003* (Regional Coastal Plan).

The Regional Coastal Plan provides a regional direction for the implementation of the State Coastal Management Plan – Queensland's Coastal Policy (State Coastal Plan) in the Wet Tropical Coast Region, including Ella Bay. The Plan has been developed by the Queensland Government and describes how the costal zone of the Wet Tropical Coast Region is to be managed.

The State Coastal Plan has the effect of a State Planning Policy under the Integrated Planning Act 1997 (IPA) and is therefore a matter of State interest. The Plan is one of the matters coordinated and integrated into new planning schemes during their preparation, with regard to and for impact assessment applications, and considered in Ministerial community infrastructure designations.

The Regional Coastal Plan applies to the coastal zone defined as '…coastal waters and all areas to the landward side of coastal waters in which there are physical features, ecological or natural processes or human activities that affect, or potentially affect, the coast or coastal resources'.

The Regional Coastal Plan identifies and incorporates the principles of conserving nature, taken from the Coastal Plan into the regional policies for the Wet Tropics bioregion which are listed as:

- 8A: The biological diversity of marine, freshwater and terrestrial systems and the ecological processes essential for their continued existence are conserved;
- 8B: Further loss or degradation of native vegetation on the coast, particularly of endangered regional ecosystems, is avoided wherever possible;
- 8C: Further loss or degradation of coastal wetlands, including the loss of biological diversity and abundance of wetland-dependant wildlife, is avoided wherever possible;
- 8D: Further loss or degradation of coastal habitats for rare, threatened and migratory species, is avoided wherever possible;
- 8E: The biophysical values of coastal dunes are conserved;
- 8F: Opportunities for rehabilitation of degraded coastal resources are included in evaluating management options for those resources; and
- 8G: The Indigenous Traditional Owner peoples' association with components of biological diversity and their traditional knowledge are recognised.

The principles of nature Conservation and, Research and Information relevant to this site are incorporated in the following sections of the Regional Coastal Plan:

- 2.8.1: Areas of State Significance,
- 2.8.3: Biodiversity,
- 2.8.4: Rehabilitation of coastal resources,
- 2.8.5: Pest species management, and
- 2.10.3: Monitoring.

Under the Wet Tropical Coast Regional Coastal Management Plan, the subject site is within a Key Coastal Site – Key Coastal Site 5: Ella Bay. The key coastal site is:

> *"largely framed by the rugged and forested Seymour Range and incorporates Flying Fish, Heath and Cooper Points, the township of Coconuts and Ella Bay National Park (listed on the Register of the National Estate)."*

Key Coastal Sites have values that are recognised as of regional, state, national and international importance and may have specific coastal management needs. While Key Coastal Sites are not regulatory areas that trigger involvement from the State, the plan provides useful information on values and management intent. Under the plan, the study area is included in the Ella Bay Key Coastal Site (Locality 5.1 Flying Fish Point). Relevant issues are:

- the coast adjacent to the Access Road is shown on Map 26 (Scenic Coastal Landscapes) as being of "very high" significance,
- the coastal area between Flying Fish Point and the resort is shown as containing significant coastal wetlands (Map 27), with the Ella Bay Swamp Wetland north of the resort site being singled out for specific reference (this wetland is listed in the national Directory of Important Wetlands),
- it is not shown on Map 28 (significant coastal dune systems),
- it is shown on Map 29 (endangered regional ecosystems) although detailed site level assessment has shown that the Access Road will not encounter these areas, and
- reference to Map 30 (coastal wetlands – see below) shows that the Access Road is not within close proximity to:
  - coral reefs
  - significant sites for birds
  - seagrass beds
  - estuarine wetlands
  - freshwater wetlands,
- the plan notes that rare and threatened fauna such as the Irrawaddy and Indo-Pacific humpback dolphins, dugong and turtles inhabit the inshore marine area.

In terms of the Access Road Strategy, the key issue covered by the plan is scenic amenity. This is covered in **Section 5.6.2** (Impacts) and **Section 5.6.3** (Presentation).

6.6.2 Impacts

This analysis reveals that the proposed Access Road complies with the Regional Coastal Plan with respect to all biological criteria. As previously noted, visual amenity (especially when viewed from ships at sea) will initially be reduced but this impact will lessen over time as the proposed revegetation of the retaining walls becomes established.

6.6.3 Consequences and Mitigation

Visual impacts are proposed to be managed by the revegetation of cuttings, embankments, and retaining walls in accordance with the Revegetation Strategy.

The new road will provide new opportunities for presentation and is expected to become a high quality scenic drive.

There are opportunities to enhance the presentation values of the area by the inclusion of lookouts and interpretive signage for drivers on the Access Road and cyclists and pedestrians on the dedicated paths.

7 DETAILED MANAGEMENT CONSIDERATIONS

7.1 INTRODUCTION

The previous analysis reveals that the impacts of the proposed Access Road can be mitigated by:

- a Fence and Funnel Strategy (comprising fauna corridors, fencing, and associated road ecology initiatives),
- a Cassowary Management Strategy (i.e. to reduce conflict with traffic and thereby promote the conservation of this species),
- a Road Runoff Strategy (to document the approach to road drainage and pollution control),
- a Revegetation Strategy,
- an overall Environmental Management Plan for the road (an overview of the recommended approach to minimise road impacts through the design, construction and operational phases), and
- the Offsets & Additional Environmental Investments Policy of suitable on-site and off-site works or actions to mitigate or offset impacts on listed species, vegetation communities, and ecological processes.

7.2 FENCE & FUNNEL STRATEGY

7.2.1 Introduction

Road ecology research by the Rainforest CRC (e.g. Rainforest CRC 2004b) recommends that "fence and funnel" strategies are likely to be effective in reducing road-kill and reducing the barrier effect of roads on fauna movement. The barrier effect is relevant to those animals that die trying to cross roads as well as those that are not prepared to take the risk or which are unable to (for example arboreal fauna once the tree canopy connectivity is broken).

A Fence & Funnel Strategy involves fencing to prevent animals from accessing the road formation (to prevent them being hit by vehicles or trapped on the roadway). The only gaps in the fence system should be at bridge s or designated crossing points where fauna will be "funnelled" under or over the road or otherwise protected from roadkill (by, for example, specially designed crossing points as later described). This strategy is required for driver safety reasons as well as reduction in the road kill "harvest". The following describes the recommended strategy for the Ella Bay Road. This is based on a number of sources including:

- research for the Kuranda Range Road Upgrade project by the Rainforest CRC (2004b) and documented in Environment North (2004b),
- work by Moore & Moore (1998) for a number of roads in the Mission Beach area, and
- specific recommendations for the Ella Bay Road (**Working Paper 3**).

It describes the key aspects of the proposed strategy, namely:

- fence aspects,
- funnel aspects (including controlled access points),
- canopy bridge s, and
- temporal issues.

7.2.2 Fence

- Fences and other smaller vertical barriers must be provided to prevent fauna entering onto the roadway wherever there is no man-made or natural barrier such as a bridge or steep cutting/embankment.
- Fence design needs to ensure that there is no access at all to the road or bridge s and that animals can follow the outside of the fence to an area where there is under-road or over-road connectivity.
- If steep cuttings through rock have a catch-fence at the road surface to prevent rocks falling onto the road, these must be tall enough to prevent any animals wandering onto the road surface.
- Ramps or one-way gates should be provided where fauna may (despite fencing) stray onto the roadway to prevent trapping individuals.
- Fences may be able to be built to induce more natural movement along to underpasses by allowing vines to cover them so they look more like natural barriers.
- Provision of some cover for escape of animals adjacent to the road is also required where box cuttings occur (e.g. in the approaches to the cut and cover tunnel).
- All fences should include fine mesh or a solid barrier at the base to prevent smaller animals accessing the road surface (buried for several centimetres to prevent animals digging underneath).
- Where Cassowaries occur, fine mesh such as shade cloth should be used rather than wire mesh fence that may damage the birds.
- Consideration should be given to the appearance of fences (i.e. to protect scenic amenity).
- Fences require regular maintenance to remove fallen branches and repair holes.

7.2.3 Funnels

- As many fauna-accessible under-road connections (bridge s, underpasses and culverts) as possible need to be incorporated in the overall design.
- Under low bridge s, rocks and logs and other such furniture should be placed to form refuges for moving animals and vegetation should be maintained as close to the bridge as possible as refuge against predators.
- Culverts should be designed to maximise potential use by fauna for connectivity by avoiding drop structures at entrances and sudden drops at exits on steep slopes as these prevent access to small animals.
- Where possible they should include dry passage and refuges. Provision of dry passage at culverts wherever possible is recommended in the form of wider openings with dry areas that do not carry water or by ledges above water level.
- Refuges in the form of rocks and logs or brush along dry passage areas should be included. Fencing should reach up to the culvert mouth.
- Vegetation cover should also be provided to the culvert mouth where possible, even if this only comprises canopy cover (so as not to restrict water-carrying capacity with low-growing vegetation).
- Vegetation cover to underpass mouths should include low-growing shrubs and refuges from predators (in the form of rock piles, logs, brush etc.) should be provided near underpass entrances and within the underpass.

Current proposals for suitable locations include:

- over the cut-and-cover tunnel,
- opposite the Flying Fish Point Reserve, and
- south of Heath Point.

Refer to **Figures 10** and **11** (**Section 4.10.2b)**) for images of the fence and funnel components (reproduced as thumbnails below).

	
Refer to Figure 11. The Fence & Funnel Strategy involves fencing for most of the route and provision of fauna underpasses opposite the Flying Fish Point Reserve and south of Heath Point.	**Refer to Figure 10.** “Fauna friendly bridge s” (fauna underpasses) between the Ella Bay National Park and the Flying Fish Point Reserve and south of Heath Point. These bridge s are designed to permit cassowaries and all other fauna to safely pass under the road. They will also enhance the scenic amenity of the road and provide a sense of arrival.

7.2.4 Fauna Overpasses

Fauna overpass structures (i.e. canopy bridge s) could be considered in areas where bridge s do not provide canopy connectivity and there are established or likely movements of arboreal fauna.

Recommendation 12 from BAAM (**Working Paper 2**) included in **Section 5.4.4** above is for additional research to locate suitable positions for rope bridge s in areas where there is no canopy connection over the roadway to further accommodate the passage of arboreal fauna. The number of rope bridge s required will need to be determined following completion of the proposed works.

Details have already been provided in **Section 5.8.6b)**.

7.2.5 Temporal Issues

- It is essential that the “fence and funnel” strategy be in place before traffic numbers on the Ella Bay Road begins to carry significant traffic so that animals are progressively led away from traffic to safe “funnels” as soon as they are available.
- This requires consideration in construction planning and may involve the installation of temporary fences to keep animals clear of construction works, especially at major bridge sites on important corridors.

It is recommended that the above measures be further considered during the detailed design phase and that specific attention be given to facilitating safe fauna movement during construction.

7.2.6 Future Research

Finally, the Cassowary Management Strategy involves a suite of research projects to be funded by the proponent under a number of collaborative programs.

7.3 CASSOWARY MANAGEMENT STRATEGY

7.3.1 Introduction

The conservation of the Southern Cassowary is a key biodiversity objective of the Ella Bay Integrated Resort project. The issue of design and management needs of the Access Road was raised in Moore (2007) and assessed in more detail in **Working Paper 3.**

The following is a brief summary based largely on those two bodies of work. This work is still in preparation and will inform the detailed design of the road.

7.3.2 Key Habitats and Linkages

Key habitats and movement corridors for the local cassowary population are described in **Working Paper 3**. The following is extracted from that report.

Figure 29. Habitat mapping and movement corridors – Ella Bay Road.

Source: Moore (2007).

7.3.3 Road Management Needs

Moore (2007) recommended that a road management plan for known and likely cassowary crossing points on the Ella Bay Road should be developed and implemented. Moore noted that while the points currently used by cassowaries to cross the Ella Bay Road have been identified and mapped, the exact placement of traffic calming points etc. will be dependent on the final location and form of the new road.

More (2007) also included an example of a Mission Beach Road crossing indicating possible traffic calming suitable for use on the Ella Bay Road (see **Figure 30**). This crossing has been designed to comply with Queensland Department of Main Roads standards.

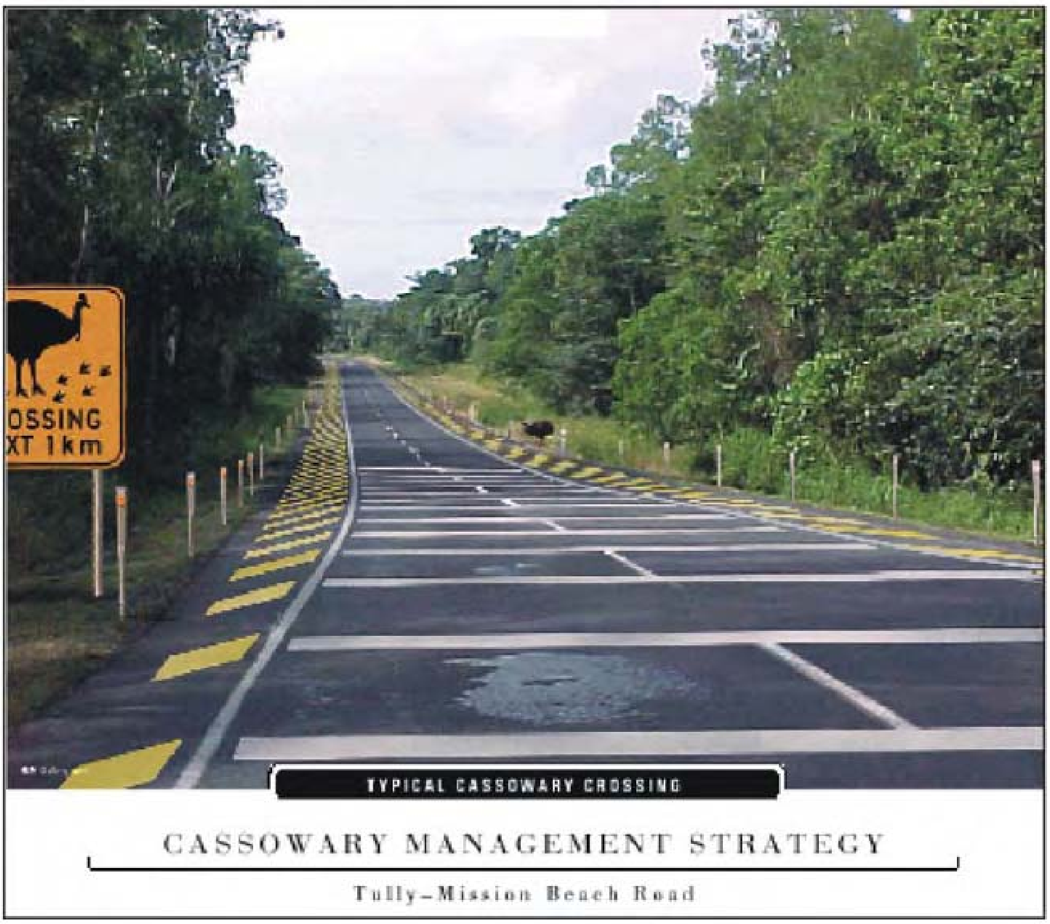


Figure 30. Example of possible cassowary crossing treatment.

Source: Moore (2007)

7.3.4 Wildlife Protection System

According to Moore (2007), another wildlife collision prevention strategy that may be suitable for the Ella Bay Road cassowary road crossings is a "Wildlife Protection System" (WPS). This technology has been used extensively in Canada and is designed to alert approaching drivers with real time information of the presence of wildlife on the road. The WPS uses infrared cameras to detect the presence of wildlife on or near the roadway. When the cameras detect wildlife, flashing lights at both ends of the road segment are triggered, thus allowing drivers to reduce speed and anticipate wildlife on the road.

7.3.5 Roads in the Wet Tropics Manual

All upgrade works should be undertaken with reference to the best practice guidelines as presented in DMR's *Roads in the Wet Tropics* manual (1997 and as updated.)

7.4 ROAD RUNOFF STRATEGY

7.4.1 Introduction

The following describes a strategic approach to road runoff on the Access Road. By way of background:

- There are no major watercourses entering the Great Barrier Reef lagoon adjacent to the Access Road, and the existing small creeks are intended to remain unaltered by the road.
- Existing culverts are proposed to be removed and replaced with small bridge s to better protect aquatic habitat and water quality.
- The existing Ella Bay Road is unsealed with un-retained cuttings and embankments and there are no measures in place to reduce or control erosion and subsequent sedimentation.
- A condition of approval for the Little Cove resort that is situated immediately to the south of the Ella Bay Integrated Resort is that the Ella Bay Road be sealed from Flying Fish Point to the Little Cove site. However, there are no requirements that there be any special pollution control measures. Thus in terms of this impact assessment, the change due to the proposed Ella Bay Integrated Resort is:
  - widening of the existing seal from 4 m to 9 m,
  - increase in traffic, and
  - stabilisation of all cuttings and embankments greater than 5 m in height (note that this 5 m height may be revised during detailed design).

7.4.2 Future Tasks

Some future detailed investigations and design will be required but this information is not critical to this assessment stage. Future tasks involve work to determine:

- an acceptable level of contaminants that will allow ecosystems adjacent to the road to be sustainable,
- where anticipated water quality from the road will meet the required water quality standard without treatment (i.e. where no special work is required),
- the necessary capture rates for contaminants in order to achieve the required water quality standard,
- the need to match final catchment flows of all pipes (large and small) with the current flows carried by existing drainage paths in order to maintain existing moisture regimes without overloading streams and risking erosion, and
- the soil moisture needs of vegetation under bridge s and opportunities to meet these needs with water of an acceptable quality and without causing erosion.

The final design should also give consideration to soil and water management devices, general removal of rubbish and litter, energy dissipaters and permanent erosion control devices as required. It is also noted that side drains along the road that accumulate water and then become breeding sites for frogs should be avoided so that frogs do not aggregate near the road surface.

7.4.3 Overview of Drainage Design Approach

The means by which road runoff is collected will influence both the need for treatment and in the cases where treatment is required, the appropriate methods of treatment. As a result the selection, design and specification of treatment devices cannot be a straightforward 'one-type suits all' approach. The general philosophy for the <u>macro</u> catchments should be to divert as much of the flow as possible to these cross drainage structures, reducing the need for large culvert crossings that concentrate outlet flows. This will also provide a number of secondary benefits to water quality management by separating contaminated flow paths as follows:

- undisturbed catchments intercepted by the road embankments are diverted to the cross drainage structures, thus generally avoiding mixing with contaminated pavement runoff, and
- pavement runoff structures are kept to minimum sizes as dilution with major external catchment flows are avoided.

The general aim at the micro catchment level should be to collect separately two catchment types, namely:

- the runoff from cuts via a table drain along the top and toe of each cut batter, and
- the pavement runoff along the edge of the pavement, piped to a common pollutant trap (if required) and then discharged to the surrounding environment. These capture points should be located at frequent enough intervals to capture sufficient flows so that water spreading on to the road and risk of aquaplaning are minimised.

7.4.4 Catch Banks & Drains/Diversion Drains

Catch banks should be designed along the top of all cut embankments to redirect flow that would have otherwise run over bank either to diversion drains or cross road culverts.

Diversion drains (where possible using the drainage system of the existing road) should catch flows prior to them reaching the new road and its surrounds and directing it to a suitably sized cross drainage structure.

7.4.5 Side Drains

Formation side drains along the toe of cut batters should collect drainage from the cut batter faces and some discharges of road runoff from piped systems.

7.4.6 Pavement Catchment

The pavement catchment is expected to mostly be captured by table drains. However, in some areas there will be a need to install kerbs along the outside of the road (see **Section 5.8.3**) to prevent water running down embankments and causing erosion. Where kerb or kerb and channel ends, a turnout or capture pit will need to be provided so that all flow within the channel may be directed off to the side of the road. Batter chutes will probably need to be provided in certain locations.

7.4.7 Stormwater Treatment

Consideration will need to be given to some form of treatment of road runoff to extract gross pollutants (litter, sediment) prior to it being discharged to the environment. Standard designs exist for gross pollution traps (GPTs) and these should be installed where local water quality needs are high (e.g. in the key watercourses identified in **Working Paper 2**). It is suggested that the following approach to stormwater treatment be followed:

- determine an acceptable level of contaminants that will allow ecosystems within roadside corridors (especially in the WTWHA) to be sustainable,
- determine where anticipated water quality from the Access Road will meet the required water quality standard without treatment, and
- determine the necessary capture rates for contaminants in order to achieve the required water quality standard.

It is recommended that these matters be integrated into the detailed design phase.

7.4.8 Maintenance Needs

Maintenance of stormwater quality control devices will typically involve:

- removal of litter and pollutants from trash rack screens and/or litter baskets,
- dewatering of sediment collection basins followed by sediment removal using lifting machinery, and
- replacement of adsorbent material.

The large volumes of organic material such as leaves and sticks generated by the surrounding rainforest presents a particular maintenance challenge for road. The suggested approach is for grates on field inlet pits to be designed to exclude the majority of organic material. This will allow easy identification by maintenance crews when action is required.

Cleaning of open trash racks would usually be undertaken on an annual basis in an environment without such a significant volume of organic material. For this reason it is expected that more frequent maintenance will be required for the Access Road. Sediment removal would typically occur approximately every six months. Intensive monitoring of devices post construction would assist in establishing an optimal maintenance regime.

7.5 REVEGETATION STRATEGY

7.5.1 Introduction

As noted in the assessment of impacts in **Chapter 5**, there are opportunities for revegetation in a number of areas and in particular:

- the cut-and-cover tunnel (0.49 ha),
- the various retaining walls (approximately 0.52 ha in total), and
- earth cuttings and embankments.

While a detailed revegetation plan will be required to be developed during detailed design, the following is an outline of the elements of such a plan.

7.5.2 Aims

Overall, the aims of the rehabilitation program are to mitigate adverse impacts and maximise beneficial impacts of the works on the ecological and scenic values of the works area and surrounding areas.

7.5.3 Objectives

The final rehabilitation strategy is to be designed to meet a number of short term and long term objectives, namely:

- improvement of the habitat value of existing road (paved areas, cuttings and embankments) not incorporated into the new works,
- stabilisation of the new works immediately following construction and in the long term,
- improvement of the habitat value of new cuttings,

- improvement of the habitat value of new embankments,
- improvement of canopy connectivity across/under the new road,
- improvement of surface connectivity across/under the new road,
- improvement of riparian connectivity across/under the new road, and
- improvement of scenic values, especially on retaining walls and large cuttings and embankments.

7.5.4 Meeting Objectives

Designed carefully, it should be possible to undertake rehabilitation works that meet all of these objectives. However, there could be a trade-off between complete rehabilitation of the existing road formation and the need for ongoing access to maintain drainage structures and undertake ongoing planting/ weed control etc.

7.5.5 Overview of Rehabilitation Needs

In summary, rehabilitation will include (where appropriate) a suite of measures, namely:

- reforming some land surfaces,
- reinstatement of drainage lines,
- replanting rainforest species, and
- controlling weed species.

These measures will begin the process of restoring parts of the existing alignment to rainforest and will lessen the impacts of the overall project by providing new habitat and reducing edge effects and fragmentation of habitat along the existing road. The major challenges with rehabilitation are likely to be:

- reinstatement of near natural drainage lines (some drainage structures may remain),
- establishing plants in compacted road formation,
- maintaining plants (i.e. watering, weed control),
- developing rehabilitation outcomes and measuring them, and
- monitoring progressive performance towards the achievement of outcomes.

In summary, extensive effort has been taken in the design and conception of the project to ensure that adverse impacts are reduced as far as possible by attention to mitigating environmental threats during the route selection, design, construction, operation, and maintenance phases of the project.

In addition, a detailed rehabilitation strategy is to be developed during detailed design to restore and enhance World Heritage and other values.

7.6 ENVIRONMENTAL MANAGEMENT PLAN

7.6.1 Introduction

It is recommended that all aspects of the upgraded Ella Bay Road be undertaken under the auspices of an Environmental Management Plan (EMP). This EMP should consider the following phases:

- **investigations** (site works associated especially with geotechnical and surveying data collection),
- **design** (further features to be integrated into the permanent works) and an associated detailed construction planning task,
- **construction** (management of the construction works), and
- **operation and maintenance** (on-going maintenance, management of other operational activities, and monitoring).

The following is an outline of the recommended approach. This is expected to be expanded into full management plans prior to implementation of the road upgrade.

7.6.2 Investigations Phase

Should the project proceed to the next phase (detailed design) and then construction, further investigations will be required to confirm various design parameters. These will include:

- additional field survey,
- geotechnical investigations,
- additional ecological investigations associated with the above, and
- general field inspections.

Specific EMPs will be required for these tasks and should provide a brief statement of <u>values to be protected</u> (based on investigations undertaken to date and other relevant research) and <u>constraints of the project corridor</u> and then consider for each of the four types of investigations described above:

- outline of possible impacts and amelioration guidelines,
- checklist for specific investigation management plans,
- permit processes, and
- details of an environmental induction to be given to all field workers.

It is likely that detailed activity-specific Management Plans will need to be prepared in advance of all fieldwork. In addition, it is also likely that various agencies will require detailed Management Plans for work covered by Queensland legislation (e.g. *Wet Tropics Management Plan 1998* (Qld), *Water Act 2000* (Qld), *Nature Conservation Act 1992* (Qld), and *Environmental Protection Act 1994* (Qld)).

7.6.3 Planning Phase

In parallel with and then following the investigations work, there will be a period of detailed planning and design to develop the concept design to the extent that it can be built safely, economically, and in accordance with all environmental commitments.

This will involve a multidisciplinary approach drawing on all previous work, ongoing research, and inputs from the approving agencies.

It is recommended that an EMP (Planning) be prepared to enable a detailed consideration of environmental matters to be undertaken throughout the project as follows:

- **design** – via design advice contained in the Planning EMP,
- **documentation** – via contact specifications prepared by the designer to expand on environmental requirements,
- **construction** – via specifications for a Construction EMP prepared by the contractor prior to commencing work, and
- **maintenance** – via specifications for an Main & Operations EMP prepared by the operations contractor or Johnstone Shire Council maintenance manager as applicable.

The aims of the Planning EMP are to inform the detailed design process with relevant findings from the impact assessment phase. While this EMP will focus on design, it should also consider impacts that could occur during the implementation and operational phases and specifies procedures to be adopted in those phases. These recommendations would then be expanded upon and given effect by detailed EMPs as more information comes to light.

Thus the Planning EMP will include an outline of the future Construction and Operation & Maintenance EMPs setting out details of issues relevant to those phases. Further detail can be added as the project progresses and more is known.

7.6.4 Construction Phase

The primary document for construction management is expected to be a Construction EMP prepared by the Contractor. This should stipulate a formal integrated management approach established to deal with:

- policy,
- performance standards,
- strategies,
- actions,
- monitoring,
- reporting, and
- corrective action.

The aims of the Construction EMP are to:

- Provide practical and achievable plans for the project to ensure that environmental requirements are complied with by producing a program for comprehensive monitoring and control of operational impacts.
- Provide the proponent with a management system to ensure compliance with permits, policies and other requirements.
- Provide the community with evidence of the environmentally responsible management of the project.

7.6.5 Operation & Maintenance Phase

The operational phase also requires environmental management. The Operation & Maintenance EMP is proposed to be the primary document covering the environmental management actions required during the operations and maintenance phases of the project. This should include management of scheduled maintenance and a contingency response to emergencies or major problems such as earth slips, tree falls, traffic accidents, and oil spills.

Key issues are:

- maintenance of rehabilitation works (watering, weed control),
- maintenance of drainage structures (removal of silt, repair of erosion),
- maintenance of fills and cuts, including repair of slips,
- control of environmental impacts of emergencies (i.e. fuel spills and control of any water contaminated by wash down or firefighting activities),
- monitoring of key items including:
  - road kill data (especially for cassowaries)
  - use and efficiency of fauna corridors and connectivity devices such as canopy bridge s, underpasses, and longitudinal fences
  - accidents.

A detailed plan for this work should be developed during the detailed design phase as part of the Planning EMP.

7.7 OFFSETS AND ADDITIONAL ENVIRONMENTAL INVESTMENTS POLICY

Working Paper 5 provides the necessary policy and procedural basis for the allocation of offsets and explores the concept of additional environmental investments (i.e. over and above those required to offset un-mitigated impacts).

In general, offsets are to be considered once all on-site mitigation options are exhausted and are to compensate for the residual impacts of the works on key biodiversity indicators including regional ecosystems, habitat for plants and animals of conservation significance, and specific conservation initiatives for the Southern Cassowary.

With respect to the Access Road, this Offsets and Additional Environmental Investments Policy provides remedies for mitigating residual road impacts not able to be further ameliorated.

8 REFERENCES

Austroads. 2001. Road Runoff and Drainage: Environmental Impacts and Management Options.

Biodiversity Assessment and Management. 2005. *Can a fence stop a frog? Frog exclusion fencing trials*. Report prepared for Parsons Brinckerhoff Australia Pty Ltd. November 2005.

Biodiversity Assessment and Management. 2007. *Terrestrial and Freshwater Flora And Fauna Impact Assessment Ella Bay Integrated Resort Project, Innisfail.* Appendix A6.4 to Ella Bay Developments (2007e).

Buckley Vann. 2006. *Myola Planning Study Project Report.* Consultancy report prepared for the Department of Local Government, Planning, Sport & Recreation, June 2006. Includes Structure Plan, Codes and Policies.

Dawe, G. and Goosem, M. 2007. *Noise Disturbance along Highways: Kuranda Range Road Upgrade Project.* Co-operative Research Centre for Tropical Rainforest ecology and Management.

Department of Main Roads. 1997. *Roads in the Wet Tropics*. Planning, Design, Construction, Maintenance and Operation Best Practice Manual. Technology and Environment Division, Brisbane.

Department of the Environment and Water Resources. 2007a. Comments on Environmental Impact Statement. 1 June 2007.

Department of the Environment and Water Resources. 2007b. http://www.environment.gov.au/heritage/worldheritage/sites/gbr/values.html accessed 20 October 2007.

Ella Bay Developments. 2007a. *Ella Bay Integrated Resort Proposal Environmental Impact Statement: Volume 1 – Introduction.* Draft EIS submitted to Office of the Coordinator General, February 2007.

Ella Bay Developments. 2007b. *Ella Bay Integrated Resort Proposal Environmental Impact Statement: Volume 2 – Project Need and Alternatives.* Draft EIS submitted to Office of the Coordinator General, February 2007.

Ella Bay Developments. 2007c. *Ella Bay Integrated Resort Proposal Environmental Impact Statement: Volume 3 – Description of Project.* Draft EIS submitted to Office of the Coordinator General, February 2007.

Ella Bay Developments. 2007c. *Ella Bay Integrated Resort Proposal Environmental Impact Statement: Volume 3 – Description of Project.* Draft EIS submitted to Office of the Coordinator General, February 2007.

Ella Bay Developments. 2007d. *Ella Bay Integrated Resort Proposal Environmental Impact Statement: Volume 4 – Environmental Values and Management of Impacts.* Draft EIS submitted to Office of the Coordinator General, February 2007.

Ella Bay Developments. 2007e. *Ella Bay Integrated Resort Proposal Environmental Impact Statement: Volume 8 – Appendices.* Draft EIS submitted to Office of the Coordinator General, February 2007.

Environment North 2007b. *Captain Cook Highway Red Cliff Point Stabilisation Works Rehabilitation Strategy.* Prepared for Department of Main Roads, July 2007.

Environment North. 2004. *Integrated Transport Study for Kuranda Range – Impact Assessment Study IAS Addendum (Draft).* Prepared for Department of Main Roads, September 2004.

Environment North. 2007a. *Integrated Transport Study for Kuranda Range – Restoration Trials Status Report.* Prepared for Department of Main Roads, August 2007.

Environmental Protection Agency. 2007. Comments on Environmental Impact Statement. 21 May 2007.

Goosem, M.W. and Turton, S.M. 2000. Impacts of Roads and Powerlines on the Wet Tropics of Queensland World Heritage Area - Report 2 Stage II. Wet Tropics Management Authority and Rainforest CRC, Cairns. July 2000.

Goosem, S. 2000. *The Hierarchical Derivation of Natural Heritage Criteria, Values and Attributes as they relate to the Wet Tropics World Heritage Area.* Internal paper for the Wet Tropics Management Authority.

Gutteridge Haskins & Davey. 2003b. *Kuranda Range Project Stormwater Quality Report on Design Principles.* Concept Phase Report for DMR, December 2003.

Maccaferri. 2004. *Kuranda Range Proposal Reinforced Soil Wall Solutions.* Prepared for Main Roads, February 2004.

Maunsell McIntyre Proprietary Limited & Environment North. 2000. Integrated Transport Study for Kuranda Range Impact Assessment Study Impact Assessment Study Report (Final). Prepared for the Department of Main Roads, August 2000.

Moore, L. 2007. *Cassowary Assessment Of The 'Ella Bay Integrated Resort Project' North Queensland 6 – 14 November 2006.* Appendix A6.7 to Ella Bay Developments (2007e).

Moore, L.A. & Moore, N.J. 1998. *Cassowary Conservation Roads – A Cassowary Management Strategy and Road Upgrade Assessment for El Arish and Tully-Mission Beach Roads, Mission Beach.* Consultancy report prepared for Department of Main Roads.

Pratt, C. 2003. *Report Update: The Dispersal and Bioavailability of Automotive Contaminants in Roadside Corridors in a Section of the Wet Tropics World Heritage Area (WTWHA) in Far North Queensland (FNQ).* Progress Report September 2003.

Pratt, C. 2004. *Report Update: The Dispersal and Bioavailability of Automotive Contaminants in Roadside Corridors in a Section of the Wet Tropics World Heritage Area (WTWHA) in Far North Queensland (FNQ).* Progress Report May 2004.

Rainforest CRC. 2004a. *Assessment of Net Adverse Impacts*. Supplementary Study #11 to Environment North (2004).

Rainforest CRC. 2004b. *Design Review*. Supplementary Study #10 to Environment North (2004).

Rivett, D. 2007. *Kuranda Range Road Upgrade: A "no net adverse impact" infrastructure solution in the Wet Tropics World Heritage Area.* Paper presented at 2007 Planning Institute of Australia Queensland State Conference - Theme: Designing for the Tropics, Townsville September 2007.

Scenic Spectrums. 1992 (in association with ESRI Australia Pty Ltd, Geographic Systems and Siteplan Landscape Architects). *Supporting Paper 10, Scenic Resource Evaluation of the Wet Tropics Heritage Area.* Wet Tropics Plan, Strategic Directions, Wet Tropics Management Agency.

Wet Tropics Management Authority. 1992. *Wet Tropics Strategic Directions*. Wet Tropics Management Authority, Cairns.

Wet Tropics Management Authority. 2004. *Wet Tropics Conservation Strategy.* Queensland Government, Cairns.

Wet Tropics Management Authority. 2007. Comments on Environmental Impact Statement. 28 May 2007.

ADDENDUM 17 MARCH 2008

This Addendum has been prepared to expand on the assessment of prudent and feasible alternatives and in particular to expand the multi-criteria analysis to consider two additional route options in the vicinity of the Flying Fish Point Reserve. These were suggested by the environmental agencies in an initial review of the Access Road Strategy.

The new analysis confirms that the preferred solution (Option D – bypass of Flying Fish Point with a cut-and-cover tunnel) is the best option for the access road. Some improvements to fauna connectivity are suggested.

The Executive Summary included with the Main Report has been amended to describe this work.

ELLA BAY INTEGRATED RESORT PROPOSAL

SUPPLEMENTARY EIS

ACCESS ROAD STRATEGY

(ADDENDUM)

ENVIRONMENT NORTH

PROJECT NUMBER 413B

17 MARCH 2008

ENVIRONMENT NORTH

DOCUMENT CONTROL CERTIFICATE

PROJECT AND CLIENT DETAILS

Project name:	Ella Bay Integrated Resort Proposal	Job Number:	413b
Title:	Supplementary EIS – Access Road Strategy (Addendum)		
Client:	Satori Resorts Ella Bay Pty Ltd		
Contact:	Paul Sparshott		
Description of report:	The Access Road Strategy describes the access road to the Ella Bay Integrated Resort. Environmental agency review of the process (by the Environmental Protection Agency, the Wet Tropics Management Authority and the Department of the Environment, Water, Heritage and the Arts) has resulted in the evolution of two further options for alignments in the vicinity of the Flying Fish Point Reserve for assessment. This Addendum report has been prepared to document the consideration of these two additional route options which were suggested by the environmental agencies on the basis that they offer some environmental benefits. Specifically, this Addendum: • compares the performance of the new options with the original four options by re-running the multi-criteria analysis process for all six routes, and • discusses the relative merits of the two new options and the preferred solution from the Access Road Strategy.		

PREPARATION AND DISTRIBUTION DETAILS

Version	Purpose	Prepared by	Checked by	Date
1-3	Internal drafts	David Rivett	Paul Sparshott	12 February 2008
4	Consultation draft	David Rivett	Paul Sparshott	17 March 2008

© **Environment North**
P.O. Box 616N
NORTH CAIRNS Q 4870
Telephone: (07) 4031 6619
Facsimile: (07) 4051 5386

Form ENDQ/01 (D) 30 March 1998

CONTENTS

EXECUTIVE SUMMARY – see Main Report

1 INTRODUCTION

1.1 NATURE OF THIS ADDENDUM

The Access Road Strategy (Environment North 2007) describes the access road to the Ella Bay Integrated Resort and in particular:

- a high level screening of Flying Fish Point options considered in the EIS or as raised in post-EIS consultation,
- a detailed multi-criteria analysis (MCA) of the four most promising options from the high level screening,
- impact assessment of the preferred solution from the MCA, and
- recommendations for mitigation and management to further reduce adverse impacts.

Further environmental agency review of the process (by the Environmental Protection Agency, the Wet Tropics Management Authority and the Department of the Environment, Water, Heritage and the Arts) in December 2007 has resulted in the evolution of two further options for alignments in the vicinity of the Flying Fish Point Reserve for assessment.

This Addendum report has been prepared to document the consideration of these two additional route options which were suggested by the environmental agencies on the basis that they offer some environmental benefits. Specifically, this Addendum:

- compares the performance of the new options with the original four options by re-running the multi-criteria analysis process for all six routes, and
- discusses the relative merits of the two new options and the preferred solution from the Access Road Strategy.

Reference should be made to the main Access Road Strategy for detailed descriptions of the matters dealt with in this Addendum. However, some material is repeated here for clarity in order to explain the assessment methodology and findings.

1.2 DESCRIPTION OF PREVIOUS PREFERRED ALIGNMENT

The (previous) preferred solution for providing access to the site is a composite of three segments (refer to **Figure 1**) and this is described in detail in the Access Road Strategy.

The two alternative options are only relevant to Segment 2, that is the section from where the bypass meets the Ella Bay Road and the south-west corner of the Fish Farm.

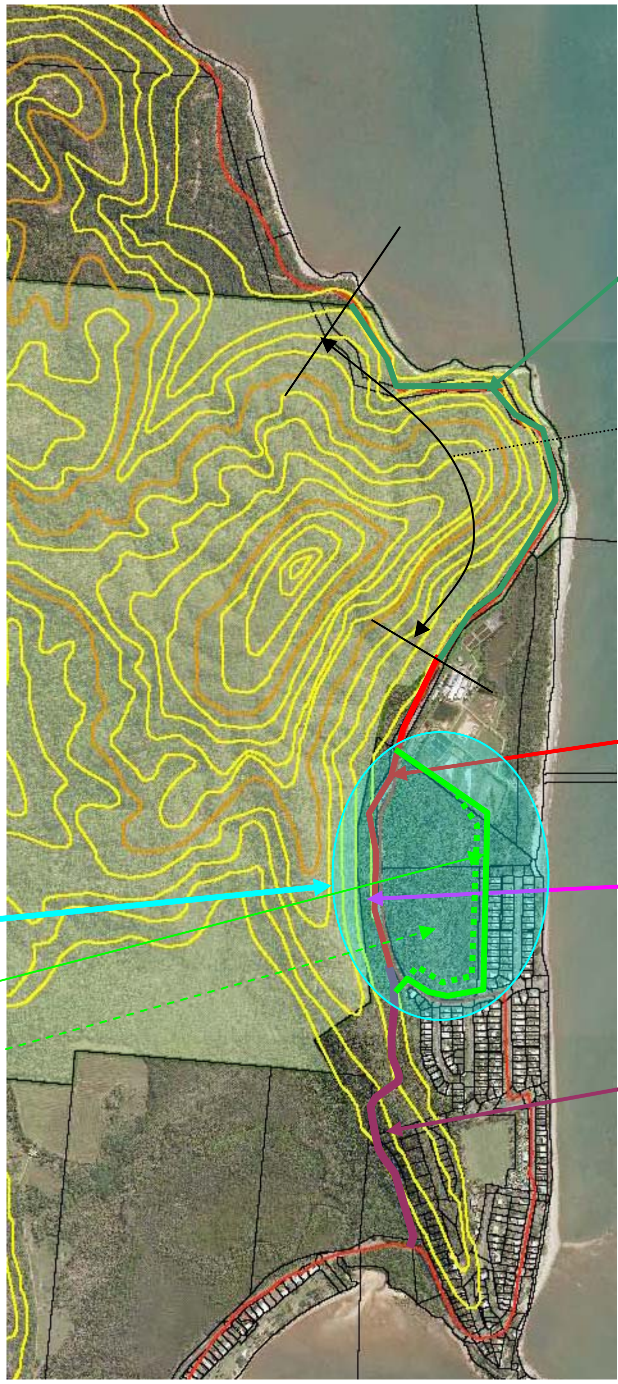


Figure 1. Proposed Access Road as per Access Road Strategy.

2 NEW OPTIONS FOR ASSESSMENT

2.1.1 Option RB1

This option varies from Access Road Strategy Option D (the preferred solution) in the vicinity of the Flying Fish Point Reserve where it passes to the east of the Ella Bay Road. Features include:

- western bypass with cut and cover tunnel (as per Segment 1 of the preferred solution (Option D of the multi-criteria analysis),
- use of a short section of Ruby Street running east to the Bindon Street intersection,
- use of the existing Bindon Street road and road reserve east of the Flying Fish Point Reserve and construction of a new road on a new reserve along the southern side of the Fish Farm (as per Option B of the multi-criteria analysis), and
- use of the balance of the Ella Bay Road north from the Fish Farm (as per Segment 2 (part) and Segment 3 of the preferred solution).

Features of this route (described as RB1 as it uses Ruby and Bindon Streets) are indicated in the following figure.

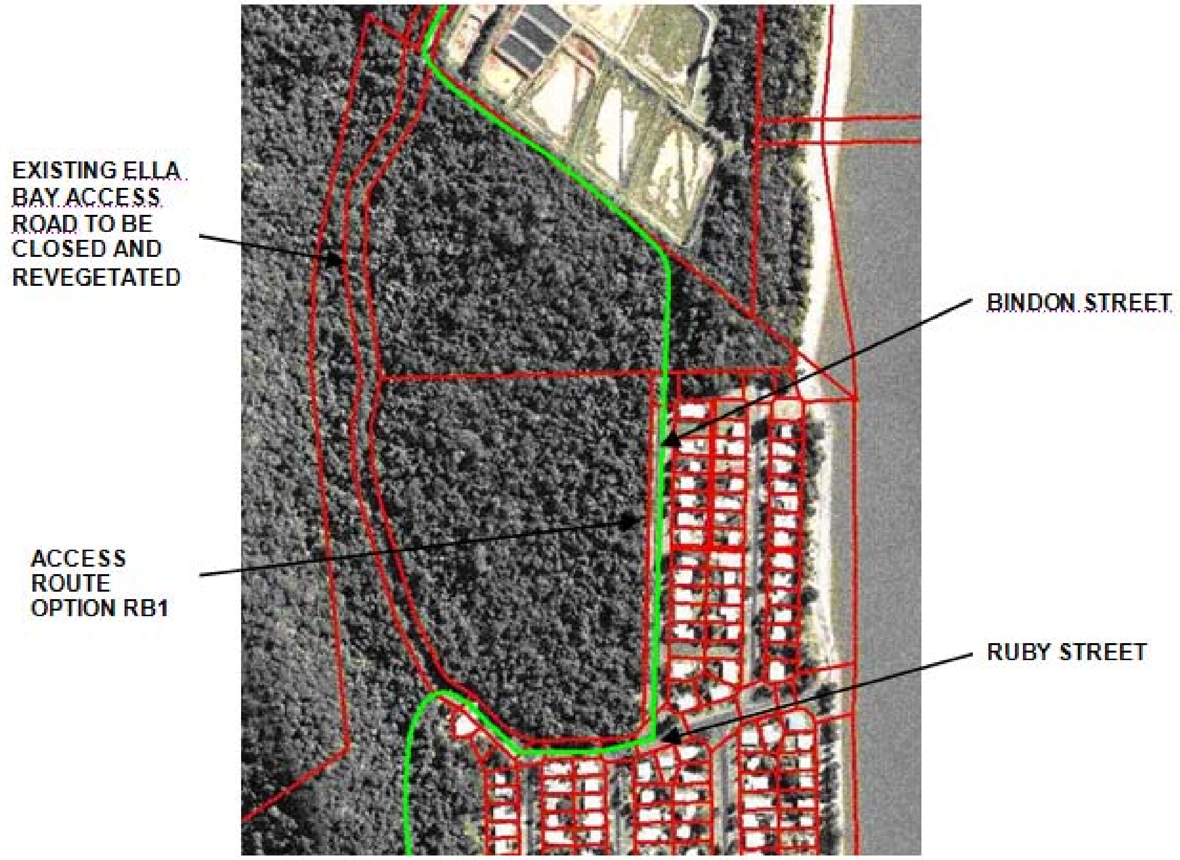


Figure 2. Access Road Option RB1

2.1.2 Option RB2

This option varies from Access Road Strategy Option D (the preferred solution) in the vicinity of the Flying Fish Point Reserve where it passes to the east of the Ella Bay Road but not as close to the existing houses along Bindon Street as Option RB1. It does not directly use the Ruby Street corridor. Features include:

- western bypass with cut and cover tunnel (as per Segment 1 of the preferred solution),
- construction on a new alignment within the Flying Fish Point Reserve on a more westerly alignment than RB1 (buffered from Bindon Street by a 20 m minimum separation), and construction of a new road on a new reserve along the southern side of the Fish Farm,
- inclusion of a fauna underpass to provide habitat connectivity under the road within the Flying Fish Point Reserve, and
- use of the balance of the Ella Bay Road north from the Fish Farm (as per Segment 2 (part) and Segment 3 of the preferred solution).

Features of this route are indicated in the following figure.

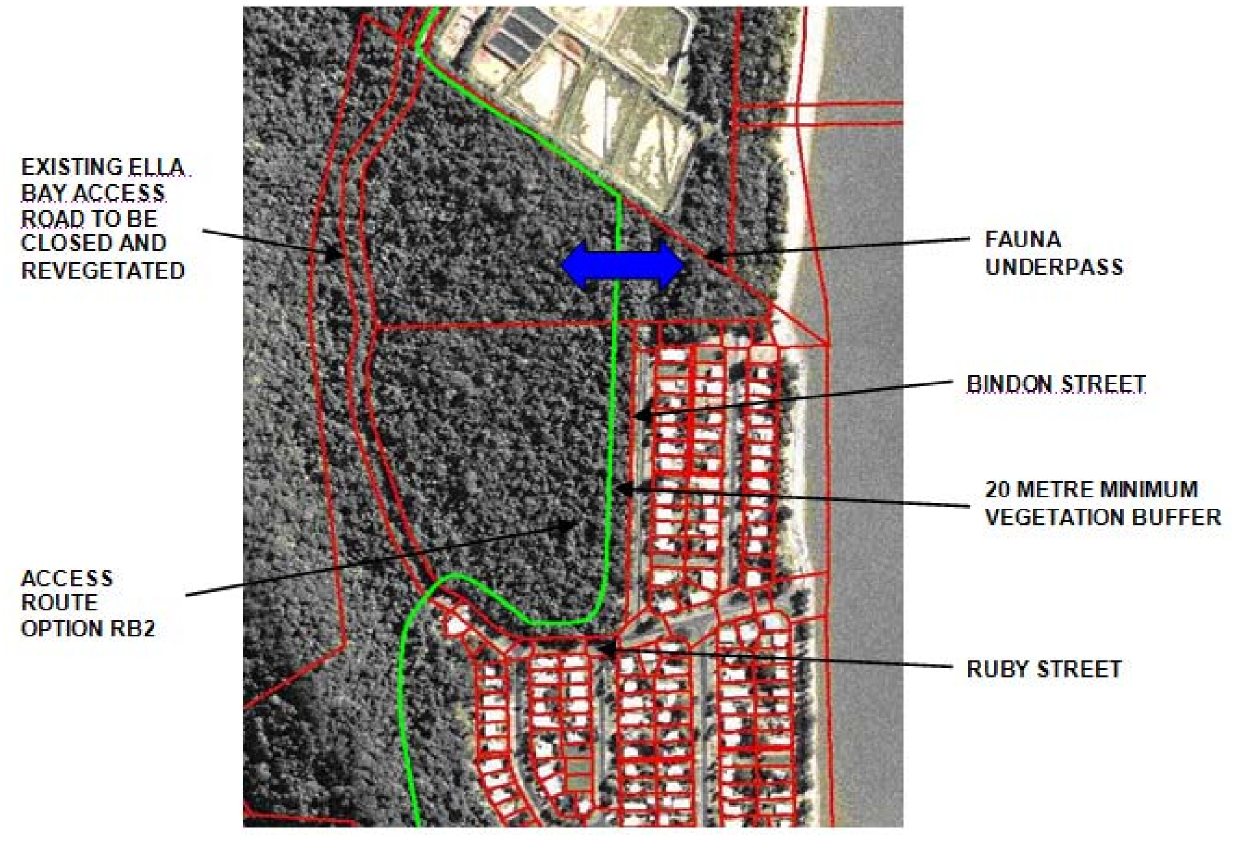


Figure 3. Access Road Option RB2.

3 DETAILED ASSESSMENT – MCA

3.1 MULTI-CRITERIA ANALYSIS – OVERVIEW

In the Access Road Strategy, the four options developed during the high level screening (Options A to D) were further refined on the basis of additional studies and subjected to a multi-criteria analysis (MCA). MCA is a formal assessment process wherein a number of criteria are selected (each broken down into attributes) against which the performance of each of a number of options are then quantitatively measured. The selected criteria and attributes are as tabulated below.

Note that only those attributes found in the Access Road Strategy to be significant (see Access Road Strategy Section 4.12.2) were used. These are shown bold in the following table.

TABLE 3.1: SIGNIFICANT CRITERIA AND ATTRIBUTES

CRITERION	CODE	ATTRIBUTE
Environmental Sustainability	• **E1** • **E2** • **E3** • **E4** • **E5**	• **Important Areas for Plants (Communities)** • **Important Areas for Plants (Species)** • **Important Areas for Animals (Other than Cassowaries)** • **Important Areas for Animals (Cassowaries)** • **Ecological Processes**
Transport Efficiency	• **T1** • *T2* • *T3* • *T4* • *T5* • **T6** • **T7**	• **Travel Time at Level of Service (LOS) E** • Capacity at LOS E [not significant] • *Accommodate Service Vehicle [not significant]* • *Accommodate Bicycles [not significant]* • *Stability [not significant]* • **Safety** • **Constructability**
Social Amenity	• **S1** • **S2** • **S3** • *S4* • **S5**	• **Important areas for scenic amenity** • **Opportunities for viewing and presentation** • **Noise** • *Construction Issues [not significant]* • **Severance of Communities**
Cost	• *C1*	• *Cost [not significant]*

Source: Study team compilation.

For this Addendum, Options RB1 and RB2 were subjected to an identical analysis to that undertaken for the Access Road Strategy, whereby the performance of each option against each attribute was measured, weighted as appropriate, standardised (i.e. adjusted to a score of -5 to +5 when compared with the existing situation) and then subjected to a sensitivity analysis to determine the effect of various weighting profiles. The process is discussed in detail in Access Road Strategy Chapter 4.

3.2 FINDINGS AND SENSITIVITY ANALYSIS

3.2.1 Introduction

The sensitivity of the analysis to judgement depends on:

- the significance or importance of attributes for each criterion, and
- the weighting between criteria.

These are discussed below.

3.2.2 Findings – "Significant" Attributes and no Weighting

The following is an analysis of the evaluation results. This assessment includes the consideration of the above "significant" attributes which are those items that are considered to be of primary importance in the evaluation, based on either the degree of distinction between the options with respect to the attribute or the importance of the value under consideration.

a) *Environmental Sustainability*

All environmental attributes are considered to be significant.

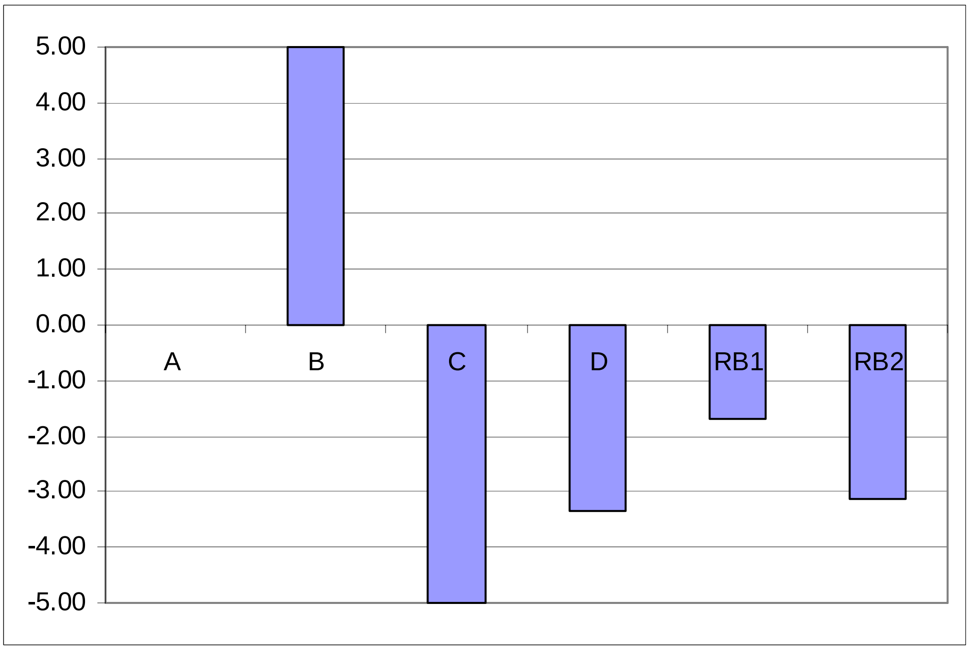


Chart 1. Environmental sustainability (all attributes are significant).

Option B remains clearly superior for this criterion.

RB1 scores significantly better than the preferred solution (Option D) but this requires discussion (See **Section 4.2**).

For the *Environmental Sustainability* criterion, Option B scores highest on all environmental attributes (and highest overall) while Option RB1 has the higher score of the four bypass options but not on all attributes. However, there are some un-assessed biodiversity impacts associated with Option RB1 as noted in **Section 4.2**.

b) Transport Efficiency

Significant attributes are considered to be:

- T1: Travel Time at LOS E,
- T6: Safety, and
- T7: Constructability.

Other attributes were considered to not be significant (see Access Road Strategy Section 4.12.2).

Considering the significant attributes only results in the following assessment.

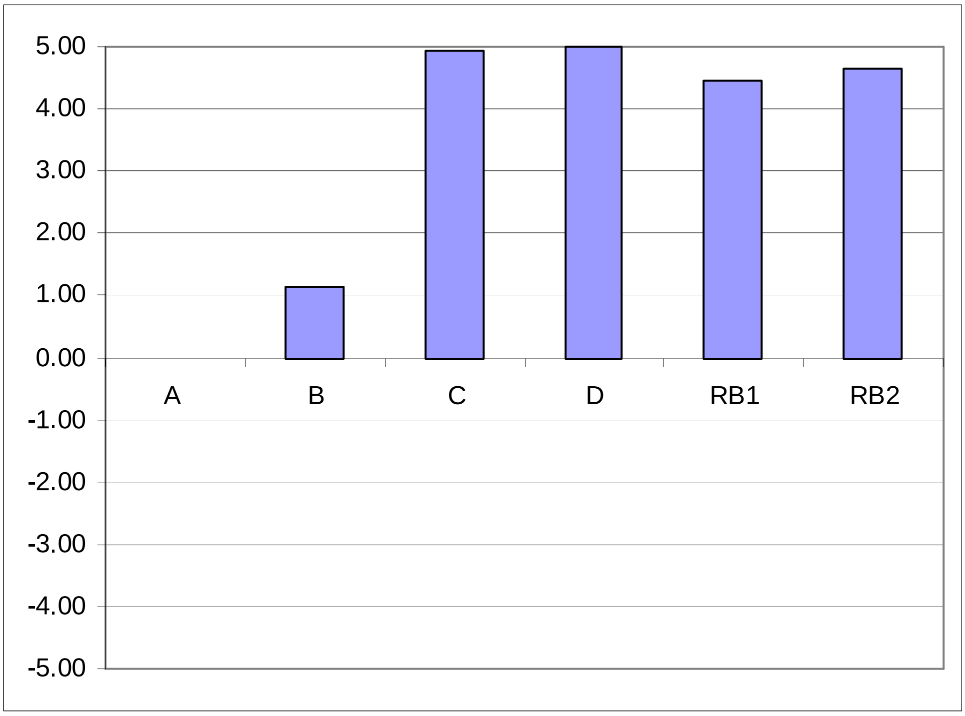


Chart 2. Transport efficiency (significant attributes only).

Options C, D, RB1 ad RB2 are clearly superior with Option D being the best by a small margin.

The two new options are slightly (but not significantly) inferior to the preferred solution (Option D).

For the *Transport Efficiency* criterion, all bypass options are clearly superior to "town" options due to the more direct route and superior engineering standards. The town options both suffer from limitations resulting from potential conflict with local traffic. Options RB1 and RB2 are both more circuitous than the preferred option and to some extent the transport efficiency benefits derived from the bypass are negated by the deviation to the east.

c) *Social Amenity*

For the *Social Amenity* criterion, significant attributes (see Access Road Strategy Section 4.12.2) are:

- S1: Important Areas for Scenic Amenity,
- S2: Opportunities for Viewing and Presentation,
- S3: Noise, and
- S5: Severance of Communities.

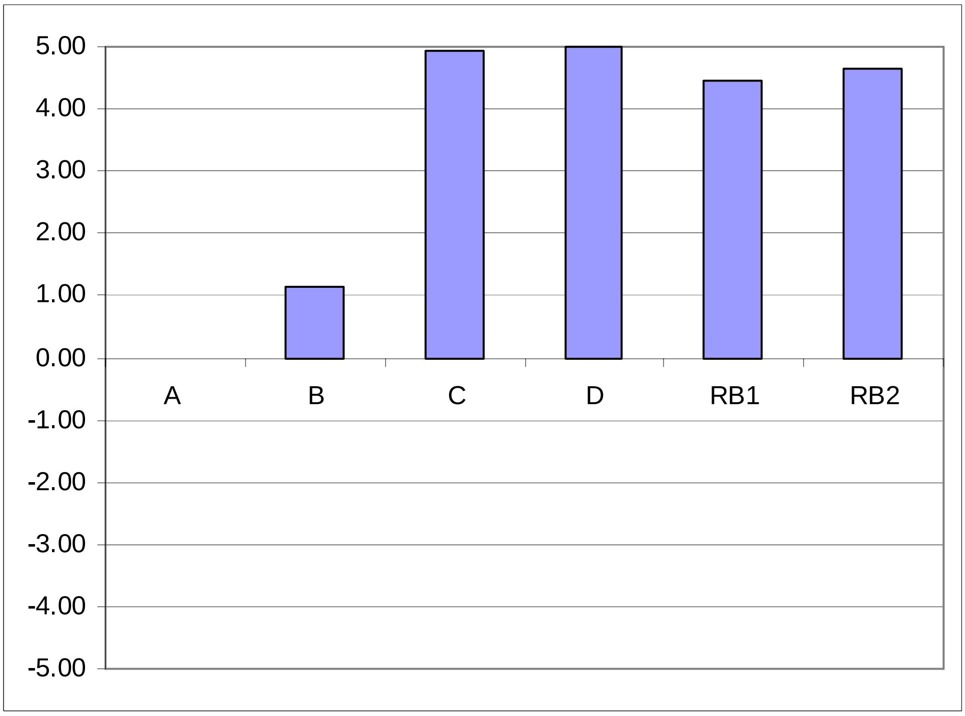


Chart 3. Social/amenity (significant attributes only).

It is believed that the MCA understates the disadvantages of the two new options compared with the preferred solution for social issues. This is further discussed in **Section 4.4**.

Options C, D, RB1 ad RB2 are clearly superior, with Option D being the best by a small margin. While the bypass options undoubtedly will involve scenic impacts, they will counter this by providing an inspiring scenic drive. They clearly avoid all conflicts with existing residents (traffic, noise, severance).

The two new options score better than the “through town” options but not as well as the preferred solution.

The key social disadvantage of RB1 and RB2 is the increased proximity to residences along Ruby and Bindon Streets and associated noise. This is further discussed in **Section 4.4**.

d) *Cost*

As for the Access Road Strategy, the proponent has determined that the *Cost* criterion is not significant. However, it should be noted that this decision was made on the basis that the key benefit of the preferred solution (i.e. that it bypassed the Flying Fish Point township) would be negated by the two new options that still impact on some residents in the Ruby Street and Bindon Street area.

In addition, there are likely to be significant costs in constructing Option RB2 through the low-lying wetland within the Reserve, These have not been quantified at this stage and may become an issue in final route selection.

3.2.3 Summary (Significant Attributes Only)

Taking into account significant attributes only, the following scores were obtained. Note that no weighting between criteria or attributes has been applied.

TABLE 3.2.3: SCORING MATRIX – SIGNIFICANT ATTRIBUTES

Criteria	Initial Score						Summary
	A	B	C	D	RB1	RB2	Note that in the table, a "significant" margin is a difference of 20% or greater. Scores are all relative to Option A (existing road) which therefore scores zero for all criteria. "Best" option underlined.
Environmental Sustainability	0.00	<u>5.00</u>	-5.00	-3.36	-1.69	-3.12	Option B remains the best option for this criterion, mainly due to the lower clearing needs, lack of fragmentation of the Flying Fish Point Reserve, and ability to close and rehabilitate a section of the Ella Bay Road.
Transport Efficiency	0.00	1.13	4.93	<u>5.00</u>	4.44	4.64	Option D remains the highest scoring route for transport efficiency due to the more direct route.
Social Amenity	0.00	-0.39	3.75	<u>5.00</u>	3.89	4.55	Option D remains the highest scoring route for social amenity because it avoids all Flying Fish Point residences. Both new options score better than the full town options as conflicts are limited to the Ruby Street/Bindon Street area.
Overall (average)	0.00	1.91	1.23	<u>2.21</u>	2.20	2.03	Overall, Option D scores best by a small margin.

This analysis shows that all bypass/tunnel options (i.e. Option D, RB1 and RB2) score best, although by the above test (i.e. a margin greater than 20%) the differences between these and Option B are not significant. Further discussion is provided in **Chapter 4**.

3.2.4 Findings – Weighting

a) Discussion

In MCA it is common practice to investigate the effect of various weighting profiles to model the political process. That is, some decision-makers often give priority to, for example, environmental protection over cost, social issues over transport efficiency or any other permutation or combination. Applying nominal weighting profiles allows the sensitivity of the outcome to such priorities to be determined.

As described in the Access Road Strategy, a number of weighting schemes were investigated. These have been adjusted slightly to remove *Cost* as a criterion.

b) Nominal Weighting Profiles

The nominal weighting profiles include:

- Equal 0.33 weighting given to all criteria,
- Environment 0.50 weighing to Environment, 0.25 to each of the remaining criteria,
- Transport 0.50 weighing to Transport, 0.25 to each of the remaining criteria, and
- Social 0.50 weighing to Social, 0.25 to each of the remaining criteria.

c) Community Weighting Profiles

Two weighting profiles were developed to test likely community views on the options.

Flying Fish Point Community

It is clear from the analysis of comments on the EIS that the Flying Fish Point community has two main concerns (see Section Access Road Strategy Section 2.5):

- that the environmental values be protected (especially in terms of reducing erosion and protecting cassowaries), and
- that traffic impacts on residents be limited (in terms of pollution, accidents, noise).

This translates to a high weight being put on the following attributes:

- E4: Important Areas for Animals (cassowaries),
- E5: Ecological Processes,
- T6: Safety,
- S3: Noise, and
- S5: Severance of Communities.

It is unlikely that the Flying Fish Point community would consider that they have a stake in the cost of the project of transport efficiency criteria on the basis that they will neither use the road nor be responsible for paying for it.

Based on the above, the assigned Flying Fish Point community profile is as follows:

- Environment 0.50 weighing to Environment,
- Transport zero weighing to Transport, and
- Social 0.50 weighing to Social.

The New Ella Bay Integrated Resort Community

While to date the views of this new community have not been formally considered, it is important to recognise that the 3,500 new residents of the resort (and at the Little Cove project) will be important stakeholder groups with valid needs/stakes in terms of all assessment criteria and especially transport efficiency and safety.

As noted in the Access Road Strategy, in the context of the overall cost of the Ella Bay Integrated Resort, any differences in the cost of the Access Road are considered to be marginal at best.

Based on the above, the assigned Ella Bay Integrated Resort community profile is as follows:

- Environment 0.30 weighing to Environment,
- Transport 0.40 weighing to Transport, and
- Social 0.30 weighing to Social.

d) The Proponent's Profile

The proponent supplied a profile that reflected the company's values and the recognition of the dominating value of environmental and social criteria. In the context of the overall cost of the Ella Bay Integrated Resort, the effect of the comparative cost differences between the Access Road alternatives between Points A and D is minor. This profile was obtained by assigning zero to cost and dividing the remaining criteria evenly on the basis that they are all equally important:

- Environment 0.33 weighing to Environment,
- Transport 0.33 weighing to Transport, and
- Social 0.33 weighing to Social.

This is identical to the un-weighted profile, meaning that there are six unique weighting profiles.

e) Summary – Significant Attributes

The following table summarises the results for each of the above profiles based on :

- the mitigated options, and
- only significant attributes.

TABLE 3.2.4: SENSITIVITY ANALYSIS – DIFFERENT WEIGHTING PROFILES (SIGNIFICANT ATTRIBUTES ONLY)]

Criterion	Weight	A	B	C	D	RB1	RB2	Best Option	Notes
Equal Weighting to All Attributes									
Environment	0.33	0.00	1.67	-1.67	-1.12	-0.56	-1.04	B	
Transport	0.33	0.00	0.38	1.64	1.67	1.48	1.55	D	
Amenity	0.33	0.00	-0.13	1.25	1.67	1.30	1.52	D	
Total	1.00	0.00	1.91	1.23	2.21	2.20	2.03	D	Option D is the preferred option by a small (not significant) margin.
Priority for Environment									
Environment	0.50	0.00	2.50	-2.50	-1.68	-0.85	-1.56	B	
Transport	0.25	0.00	0.28	1.23	1.25	1.11	1.16	D	
Amenity	0.25	0.00	-0.10	0.94	1.25	0.97	1.14	D	
Total	1.00	0.00	2.69	-0.33	0.82	1.24	0.74	B	Option B is the preferred option by a significant margin.
Priority for Transport Efficiency									
Environment	0.25	0.00	1.25	-1.25	-0.84	-0.42	-0.78	B	
Transport	0.50	0.00	0.56	2.46	2.50	2.22	2.32	D	
Amenity	0.25	0.00	-0.10	0.94	1.25	0.97	1.14	D	
Total	1.00	0.00	1.72	2.15	2.91	2.77	2.68	D	Option D is the preferred option by a small (not significant) margin.
Priority for Social Amenity									
Environment	0.25	0.00	1.25	-1.25	-0.84	-0.42	-0.78	B	
Transport	0.25	0.00	0.28	1.23	1.25	1.11	1.16	D	
Amenity	0.50	0.00	-0.19	1.88	2.50	1.95	2.28	D	
Total	1.00	0.00	1.34	1.86	2.91	2.63	2.66	D	Option D is the preferred option by a small (not significant) margin.

TABLE 3.2.4: SENSITIVITY ANALYSIS – DIFFERENT WEIGHTING PROFILES (SIGNIFICANT ATTRIBUTES ONLY) (CONT)

Criterion	Weight	A	B	C	D	RB1	RB2	Best Option	Notes
Flying Fish Point Community Profile (highest to environment and amenity)									
Environment	0.50	0.00	2.50	-2.50	-1.68	-0.85	-1.56	B	
Transport	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	
Amenity	0.50	0.00	-0.19	1.88	2.50	1.95	2.28	D	
Total	1.00	0.00	2.31	-0.62	0.82	1.10	0.72	B	Option B is the preferred option by a significant margin.
Future Ella Bay Integrated Resort Community Profile (highest to transport, environment and amenity equal)									
Environment	0.30	0.00	1.50	-1.50	-1.01	-0.51	-0.94	B	
Transport	0.40	0.00	0.45	1.97	2.00	1.78	1.86	D	
Amenity	0.30	0.00	-0.12	1.13	1.50	1.17	1.37	D	
Total	1.00	0.00	1.84	1.60	2.49	2.43	2.29	RB2	Option D is the preferred option by a small (not significant) margin.
Proponent's Profile (equal weighting to all attributes)									
Environment	0.33	0.00	1.67	-1.67	-1.12	-0.56	-1.04	B	
Transport	0.33	0.00	0.38	1.64	1.67	1.48	1.55	D	
Amenity	0.33	0.00	-0.13	1.25	1.67	1.30	1.52	D	
Total	1.00	0.00	1.91	1.23	2.21	2.20	2.03	RB2	Option D is the preferred option by a small (not significant) margin.

Source: Study team compilation.

3.2.5 Conclusions

After re-running the MCA to include the two new options, and considering variations in weighting between criteria to test sensitivity, the analysis shows that:

- Option D scores best overall and for four of the six unique weighting schemes,
- Option B remains the superior environmental option, and
- Option D remains the preferred option for social amenity and transport efficiency.

However, in few cases are the differences shown by the MCA to be significant and furthermore, the analysis has revealed a number of issues that are not shown up by the MCA. These are discussed in the next chapter.

4 DISCUSSION

4.1 INTRODUCTION

This chapter includes a brief discussion of the relative performance of the preferred solution and the two new options in terms of the key criteria used in the MCA, namely:

- environmental sustainability,
- transport efficiency, and
- social amenity.

An overall assessment is also included. Labels in parentheses (e.g. E4) refer to specific attributes described in the MCA and the detailed impact assessment in the Access Road Strategy. Issues not directly assessed in the MCA are also discussed.

Although not assessed in the MCA, constructability and cost are also relevant.

4.2 ENVIRONMENTAL SUSTAINABILITY

4.2.1 Preferred Solution (Access Road Strategy)

The key reason for considering the two new options was to avoid fragmenting the Ella Bay Reserve for fauna habitat (E3, E4). The Preferred Solution (Option D) addresses this issue by proposing a “fauna friendly” bridge on the existing Ella Bay Road to provide habitat connectivity (especially for cassowaries) (E4) between the Reserve and the Ella Bay National Park and instigating a fencing strategy to prevent cassowaries from accessing the road and directing them to the bridge location. In further discussions with environmental agencies and based on additional investigations, an alternative scheme utilising four fauna underpasses providing some 68 m of under-road connectivity and associated fencing is proposed.

In the area where the three options diverge, there is very little clearing required (E1, E2) and therefore little loss of habitat (E3).

4.2.2 Option RB1

Option RB1 proposes to address the fragmentation issue by adopting an alignment east of the Reserve on the existing Bindon Street alignment. This will not require the clearing of any remnant vegetation in the body of the Reserve although clearing is still required along the southern boundary of the Fish Farm (E1, E2, E3).

In this regard this option is identical to Option B. Also similar to Option B, this route allows for the rehabilitation of a 590 m length of the existing Ella Bay Road that would be no longer required (approximately 0.35 ha assuming a disturbed width of 6 m), (E1, E2, E3), effectively integrating the Reserve and national park. As an environmental solution this is ideal and conforms with recommendations from cassowary specialist Les Moore (see Working Paper #3 of the Access Road Strategy).

However, as described below, this environmental performance is at the cost of a reduction in transport efficiency and social amenity.

As analysed, RB1 does not include a fauna underpass near the fish farm (neither does Option B). The performance of both of these options would improve should such a structure be installed, as it would provide fauna access between the Reserve and the beach.

4.2.3 Option RB2

Option RB2 also addresses the issue of fragmenting the Reserve (E3, E4, E5) but is a compromise solution that provides a greater clearance to existing residences at the cost of clearing a strip of remnant vegetation within the Reserve parallel to Bindon Street (E1, E2, E3) and along the southern boundary of the Fish Farm as for Option RB1.

The fragmentation that this would entail is proposed to be mitigated by the introduction of a fauna underpass (E4, E5).

One potentially significant un-assessed impact is the presence of a wetland along the route of Option RB2. As Photo 1 below shows, drainage in this area is impeded and the environmental impacts of addressing this issue were not included in the MCA (on the basis that the new analysis is a re-run of the Access Road Strategy MCA with no new criteria).

Photo 1: Inundated area along the route of Option RB2.

Un-assessed impacts will include:

- additional clearing to provide a firm base for roadworks,
- dewatering of surface and groundwater, and
- permanent impacts to surface and groundwater hydrology.

4.2.4 Overall

Overall, **Option B** performs best under the MCA for environmental sustainability in that it:

- involves only a small area of new clearing of remnant vegetation (E1, E2, E3),
- does not rely on a fauna underpass to connect the Reserve and the national park (E4, E5),
- does not rely on fencing the Ella Bay Road to minimise roadkill (E4, E5), and
- allows for the rehabilitation of the existing Ella Bay Road between the Reserve and the national park along the Reserve frontage (E1, E2, E3).

Fencing along the road boundary on the Reserve side along Ruby Street, Bindon Street and the Fish Farm will be required to prevent cassowaries and other fauna from accessing the road (E4, E5). Fencing will also be required on the eastern side of the road along the small section of road between the northern end of Bindon Street and the Fish Farm to prevent fauna accessing the road from the beach. The performance of this option would improve with the inclusion of a fauna underpass near the Fish Farm to allow access between the Reserve and the beach.

4.3 TRANSPORT EFFICIENCY

4.3.1 Preferred Solution (Access Road Strategy)

The Preferred Solution includes a total bypass of the Flying Fish Point township and the avoidance of all conflict with existing traffic (T6) other than on the short section of the Ella Bay Road that runs between the Reserve and the national park. It is a relatively straight road and contains no tight bends, and therefore provides a minimum travel time (T1).

It scores less well in terms of constructability (T7), due to the need to construct the section between the Reserve and the national park under traffic. However, traffic numbers on this road are small and this is only a short term impact.

4.3.2 Option RB1

Option RB1 introduces four relatively tight bends in the vicinity of the Reserve (with a "hairpin" bend at the southern intersection with the Ella Bay Road) and adds a further 500 m of length, thereby increasing overall travel time slightly (T1). In addition, this option introduces three potential points of conflict with existing traffic at the Enid, Maud and Bindon Street intersections (T6).

This option will require earthworks along the Bindon Street alignment and then along the southern boundary of the Fish Farm. It will also permit the closure and rehabilitation of a section of the Ella Bay Road. The short section between the bypass and Bindon Street will need to be constructed under traffic (T7). However, as noted above, traffic numbers on this road are small and this is only a short term impact.

4.3.3 Option RB2

Option RB2 also includes the "hairpin" bend and. although it on a slightly larger radius, is not significantly different in terms of travel time compared with Option RB1 (T1). It adds a 380 m of length to the Preferred Option, thereby increasing overall travel time slightly (T1). Unlike Option RB1, this option avoids any potential points of conflict with existing traffic as Ruby Street will presumably be closed east of the RB2 alignment (T6).

This option will require earthworks through the Reserve and most probably will encounter very soft ground conditions and impeded drainage. It will also permit the closure and rehabilitation of a section of the Ella Bay Road.

This option can be built largely clear of existing traffic (T7) – however, as noted above, this is not a major issue.

4.3.4 Overall

Overall, the **Preferred Solution** performs best for transport efficiency in that it:

- is a direct route with no tight bends (T1),
- avoids points of potential conflict with existing traffic (T6),
- does not require construction of a road on a new alignment (only minor widening and pavement works is required), and
- does not require rehabilitation of the Ella Bay Road.

However, it scores less well in terms of constructability (T7), due to the need to construct the section between the Reserve and the national park under traffic. As noted above, this is not a major issue. In addition, the proponent intends to upgrade this section of road to the ultimate standard as part of the Little Cove works, meaning that this impact will be not relevant to any of the bypass options and should be discounted.

4.4 SOCIAL AMENITY

4.4.1 Preferred Solution (Access Road Strategy)

The Preferred Solution scores highly in terms of social amenity on the basis that it avoided conflicts with residences (i.e. minimum traffic noise and severance impact) (S3, S5). This is despite the fact that the cuttings associated with the bypass will have a short term adverse impact on scenic amenity (S1). This applies to all three options being considered in this Addendum.

In terms of views from the road (S2), all three options score well because of the views afforded from the crest, but the Preferred Solution performs marginally better due to the better views through the Ella Bay Road section.

4.4.2 Option RB1

This option shares the disadvantages of former Option B in that it is very close to the Bindon Street residences, resulting in potential noise impacts (S3). It is believed that the MCA understates the social impacts of this option on residences, especially noise but also dust and air pollution (not measured). Further, it does not consider impacts during construction.

This option scores lowest by a small margin for views (S2), on the basis that the route long the rear of the Bindon Street residences is of little interest.

A logical disadvantage of this option is that many of the amenity advantages of the Flying Fish Point bypass section are effectively “squandered” by returning the route back to the residential area. Should it be decided that Option RB1 has merit (and this is if the approving agencies believe that the differential environmental performance is significantly better than for the Preferred Option), then it would be more logical to further consider Option B and dispense with the expensive bypass west of the town.

4.4.3 Option RB2

Option RB2 is a slight improvement over RB1 in that it provides a slightly greater (but unlikely to be significant) noise buffer to the Bindon Street residences (S3). It also provides slightly more interesting views (S2) through the remnant forests of the Reserve although this is not a significant factor.

As for RB1, it is believed that the MCA also understates the social impacts of this option on residences and does not consider impacts during construction.

4.4.4 Overall

Overall, the **Preferred Solution** scores best for social amenity, in that it:

- offers the best views from the road (S2), and
- has the least noise impacts (S3).

Of the new options, RB2 is preferred to RB1 due to its more interesting views (S2) and increased separation from residences (S3). No option involves severance (S5). It is believed that the MCA understates the impacts of RB1 and RB2 on residences and does not consider impacts during construction.

4.5 OVERALL

It is apparent that the final decision will be one that decides between:

- environmental sustainability (E) where **Option B** is superior, and
- transport efficiency (T) and social amenity (S) where the **Preferred Solution** prevails.

Of the two new options, RB1 scores better than RB2 in terms of environmental sustainability but worse in terms of transport efficiency and social amenity.

One of the drivers for considering Options RB1 and RB2 was to reduce fragmentation of the Reserve from the national park where the existing and upgraded Ella Bay Road passes between the two. The solution to this issue in the Access Road Strategy was the installation of a purpose-designed “fauna friendly” bridge and associated fencing. This is still a viable option which is being further considered (see **Section 4.6**).

The whole idea of considering Options C and D in the Access Road Strategy was to bypass the Flying Fish Point township and hence reduce impacts on residents. To construct the bypass and cut and cover tunnel and then return to the residential area is an inefficient solution, although the points of conflict are still better than a pure “town” option.

As noted earlier, should it be decided that Option RB1 or RB2 have merit (and this would only be if the approving agencies believe that the differential environmental performance is significantly better than for the Preferred Option), then it would be more logical to further consider Option B and dispense with the expensive bypass west of the town.

4.6 FURTHER IMPROVEMENT OF PREFERRED OPTION

4.6.1 Enhancing Fauna Connectivity

As previously noted, additional investigations have been undertaken into the critical environmental issue of maintaining fauna (and especially cassowary) access between the Ella Bay National Park and the Ella Bay Reserve. The solution to this issue in the Access Road Strategy was the installation of a purpose-designed “fauna friendly” bridge and associated fencing.

Further investigations have been undertaken and plans are being considered to provide four separate fauna underpasses to replace this single bridge structure where there the terrain offers opportunities to slightly elevate the road. Four separate structures are proposed with lengths of 3.6, 18, 32.4 and 3.6 m.

Details of the enhanced fauna underpasses are shown below.

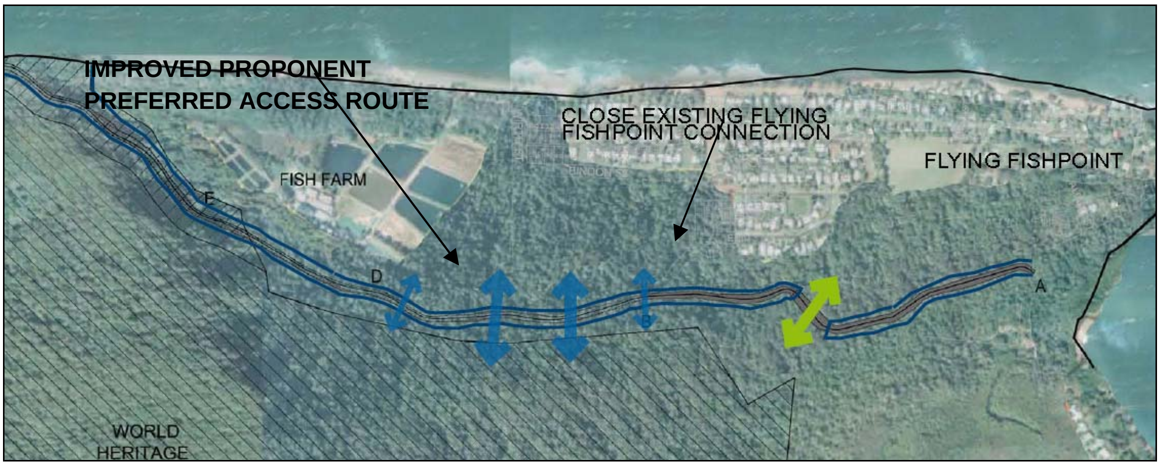


Figure 4: Aerial photo of improved access route D plus balance of road.

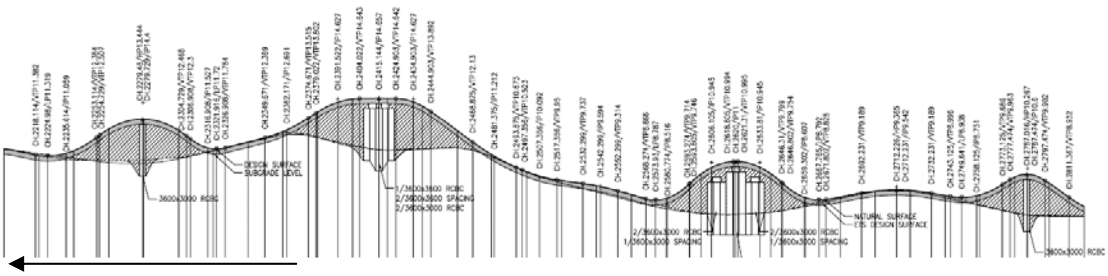


Figure 5: Longitudinal section of the improved preferred access route option D. Note that a vertical exaggeration of 10 has been applied.

4.6.2 Details of Cassowary Underpasses

In recent research for the Department of Main Roads' Cardwell Range Upgrade project, Biotropica Australia (2008) describe the attributes of feasible underpass designs, citing a range of road ecology research projects undertaken in the region. This work found that box culverts are suitable if they have the attributes described in the following extract from the Biotropica Australia report.

- Dimensions of at least 3m x 3m
- maximum 25-30m long
  (to enable habitat to be sufficiently visible at either end)
- a ledge to provide dry passage during minor flood events;
- fitted 'furniture': vertical timber/large branches and thick rope strung through the top section, attached to substantial trees at the entrances to provide above-ground refuge for arboreal species,
- dead logs and rocks to provide protection for smaller species.

Complementary plantings of key food plant species for target animals at the entrances were found to be highly beneficial, and provision of suitable structures for attachment/installation of monitoring equipment is desirable for design evaluation purposes.

Figure 4-7: Faunal underpasses depicting 'furniture', including escape pole (vertical tree branch), dry ledge, sand bed, attractive habitat at exit, soil, litter, rocks and logs to simulate rain forest floor conditions (Biotropica; Goosem et. al. 2005)

Fauna underpasses – some design aspects.

Source: Biotropica Australia (2008).

Research by the DMR in association with the former Rainforest CRC at the James Cook University has confirmed the use of such structures by cassowaries (and other fauna) at the following locations (M Goosem pers. comm. February 2008):

- Streets Creek on the Kuranda Range Road,
- Laceys Creek and the Hull River Bridge on the Tully – Mission Beach Road, and
- Fauna Underpass on the East Evelyn Road.

5 REFERENCES

Biotropica Australia. 2008. *Habitat Connectivity and Proposed Fauna Crossing Locations Cardwell Range Upgrade.* Consultancy report prepared for Department of Main Roads, February 2008.

Environment North. 2007. Ella Bay Integrated Resort Access Road Strategy. Draft November 2007. prepared for Satori Resorts Pty Ltd 19 November 2007.

WORKING PAPER 1

ENGINEERING ISSUES

ETS GROUP

[Less Appendix A and B (Drawings)]]

(THESE ARE AVAILABLE IN VOLUME 3 OF THE SUPPLEMENTARY ENVIRONMENTAL IMPACT STATEMENT)

ELLA BAY INTERGRATED RESORT ACCESS ROAD STRATEGY

FROM FLYING FISH POINT TO ELLA BAY

FOR

Ella Bay Development Pty Ltd

ISSUE DETAILS

Issue 1 Original Issue September 2007

Reviewed by..Date ....
Approved for issue by..Date ....

TABLE OF CONTENTS

1. Introduction

The Ella Bay Integrated Resort requires a higher standard of road access from Flying Fish Point, than that which currently exists. This report investigates several suitable road access options to achieve the desired road access standards. All these options and the required upgrading of Ella Bay Road are detailed bellow.

This report sets out the assumptions and design standards used during the preliminary design of the access road strategy options.

2. Options

There were 7 option considered in the EIS or suggested by environmental agencies. A early screening process was implemented to reduce the amount of preliminary designs required. This screening process narrowed the required preliminary design options to 4,. From these options it was apparent that two require geometric modelling and the other 2 required traffic analysis to determine the required upgrades.

The preliminary design for the 2 options requiring Geometric modelling, called up as deviation road options, were analysed using a 3d modelling program called 12D. Using 12D we were able to analyse exactly what impacts these options have on clearing. These two options were also analysed using two scenarios called mitigated and unmitigated. The mitigated option uses retaining structures to minimise the clearing area and the un-mitigated uses only earth embankments. These clearing figures were provided to Environment North for use in the multi-criteria analysis.

From this Multi Criteria analysis a preferred solution was determined, this preferred solution entails the option 2a (option D) detailed bellow and the upgrading of Ella Bay Road from the flying fish point town ship to the resort site. Please refer Appendix F for Preliminary Design drawing of this route.

The options analysed are as follows:

a. Deviation Road Options

i. **Option 2 A.** Cut And Cover Tunnel. (Option D)

This option was investigated so that traffic to the development is diverted around Flying Fish Point. This also allows for a fauna crossing of the road via a re-vegetated area over a tunnel structure. This option also reduces road grades, and reduces the need for extensive retaining structures. However the cost of building the tunnel is high. Please refer Appendix A for the preliminary design drawings.

ii. **Option 2 B.** Over The Ridge (Option C)

This option investigates the construction of a deviation road up and over the ridgeline to divert traffic away from Flying Fish Point. It involves the use of maximum grades and large cuts and fills to traverse the steep slopes. Please refer Appendix A for the preliminary design drawings.

b. Through Flying Fish Point Options

i. **Option 1.** (Option A) Through Flying Fish Point Via Ruby Street

As this option was previously investigated in the EIS. a schematic design was implemented to investigate the route. As this option does not deviate around Flying Fish Point it will have a large impact on the existing residences. It is expected that all the roads along this route will need upgrading to cater for the increased traffic. Traffic lights may need to be installed at major intersections along the route. There may also be a need to resume land to accommodate these larger road networks. Detailed traffic studies would need to be undertaken to determine exactly what upgrading may be required.

ii. **Option 3.** Through Flying Fish Point Via An Esplanade Road And Around The Fish Farm To The West.

Similar to option 1, however, it does propose to construct mainly new roads through Flying Fish Point rather than upgrading some existing roads. This option proposes to construct a beach side esplanade road which would be constructed along the back of the dunes and extend to the fish farm before connecting with Ella Bay Road via a link road, running along the fish farms western boundary. This option will also have impacts on the existing residents as they will have to cross a highly trafficked road to gain access to the beach. There will also be problems constructing this road between the existing properties and the beach, as erosion of the dunes is now that severe that the dunes are totally eroded in some areas. There would be additional requirement imposed on this option as it would be within the costal zone and would require works on the beach.

iii. **Option 4.** Through Flying Fish Point And Around The Fish Farm Via An Esplanade Road And Around The Fish Farm To The East.

Similar to option 3, however rather than constructing a link road along the fish farm's western boundary it proposes to continue the esplanade road along the eastern boundary of the fish farm before connecting back into Ella Bay Road. This option will have greater impact than option 3 as it would require the construction of more esplanade road along the beach.

iv. **Option 5.** Via A New Road On The Western Side Of The Existing Urban Area

This option requires the construction of a new road at the back of existing residences and would require construction within a highly vegetated area. It will also require extensive earthworks for a large portion of its length due to the topography. A preliminary analysis was performed, that indicated cuts of up to 20m would be required for its construction.

v. **Option 6.** (Option B) Similar To Option 1 But Using George Street Instead Of Ruby Street.

   Again similar to option 1. This directs all the traffic through Flying Fish Point. This option would also require similar upgrading to the existing roads and would possibly require intersection signalisations. There would need to be extensive alteration to intersections to accommodate the additional traffic and larger vehicles.

vi. **Option7.** Similar To Option 1 But Connection East Via Bindon Street.

   The same comments as option 6 apply to this option.

The preliminary designs for all options have been displayed on drawings. Please refer Appendix A for further details.

3. Ella Bay Road

A preliminary design for the upgrading of Ella Bay Road has been performed. During this preliminary design it was found that there are sections that have substandard geometry and will require alterations to the geometry, both horizontally and vertically. The sections at Heath Point and to the north are considered to be the worst effected. These alterations, along with curve widening, will impact on the existing vegetation. Alternative batter and retaining treatments will be put into place to minimise the impacts. Refer drawings in Appendix B for the engineering detailed drawing and Appendix F for the ultimate batter and retaining wall configuration drawings.

4. Design Traffic.

Traffic flow calculations have been performed to set the road width, design speed and geometry requirements. These have been detailed in the EIS. The results of this have shown that the access road (Ella Bay Road and Deviation Road) will require a 2 way single carriageway containing 3.5m wide lanes and a minimum of 1m wide shoulders on both sides. This road profile is the standard profile that has been used in all preliminary designs.

Refer to Appendix C for an extract of the design traffic requirements from the EIS.

5. Transport Statistics

A series of calculations have been performed for each option to determine the travel time for various routes, and when the road capacity reaches Level of Service E (LOS E) as stated in Aust Roads. The following table is the results as determined by the calculations.

Cars

Road options	Design speed/ traffic delays	Road capacity at LOS E	Travel time
Deviation option 1	60km/h		Tba
Deviation option 2	60km/h		Tba

Through town option 1	50km/h		Tba
Through town option 2	50km/h		Tba
Trucks			
Road options	Design speed/ traffic delays	Road capacity at LOS E	Travel time
Deviation option 1	60km/h		Tba
Deviation option 2	60km/h		Tba
Through town option 1	50km/h		Tba
Through town option 2	50km/h		Tba

6. Design Standards And Their Derivation, Including Justification For Any Reduced Standards.

The following is a list of authority standards that have been used during the preliminary design of the access road strategy.

a. Basic AUST Roads standards have been applied to all road options. There are some sub-standard bends mostly along Ella Bay Road, which will require reduced speeds.
b. The road cross section is as per the traffic calculations outlined in the EIS document with the reduced shoulders to minimise the impact of the road.
c. Design Standards from Queensland Streets and Department of Main Roads have been applied where applicable. There are a few locations where substandard sight distances occur. With the application of reduced speed limits at these locations additional cutting to improve sight distances can be avoided. Further analysis of this will be performed during the detailed design.
d. The design speed was assumed to be 60km/h. Both the Over the Ridge and the Cut and Cover Tunnel options have reduced speed curves, because of the geography. The design speed through Flying Fish Point would vary but it is assumed to be 50km/h.
e. The road grades for the 'Over the Ridge' option were kept to a maximum of 16% as per the Aust Roads requirements. Road grades for the Cut and Cover Tunnels option are not at a maximum making travel for heavy vehicles easier.
f. It has been assumed that the current road grades through Flying Fish Point will meet the requirements of Aust Roads, etc.
g. The cut and cover Tunnel will limit the height to 6.9m and width of vehicle to 10m, This will cause vehicle with dimensions greater than this to still travel through Flying Fish Point, but this will be a rare event (<1%).
h. All batters and retaining structures are to be designed in accordance with Goulder Geotechnical Soil Stability Report.

7. Major Quantities And Costs

Probable cost estimates have been performed for all 7 options as well as the Ella Bay Road upgrade to form an order of guide as to their costs. These costing's, are based on preliminary and sketch designs and should not be used for funding purposes. Detailed survey and design would need to be undertaken to determine accurate construction costs. The following is a list of assumptions and comments in relation to these costing's.

a. No allowance has been made for re-vegetation costs.
b. It has been assumed that small bridges will be used for any major drainage crossings of the proposed roads. An allowance has been made for these in the costing's.
c. It has been assumed that any cut or fill greater than 5m in hight will be retained. These costings are based on the use of standard gabion wall construction for all retaining walls.
d. There has been no allowance made for the construction of services. Alteration to existing services will impact on the costs of the through Flying Fish Point options.
e. Stormwater drainage has been allowed for on all options through Flying Fish Point.
f. No allowances have been made for the setup and clearing of a stockpile site, nor have there been allowances for carting material to and from this site.
g. Option 2b,the major cost for this option would be in earthworks and retaining structures. The quantum of earthworks is in the order of 40,000cum. This option would also require additional pavements, and construction would be more difficult because of the grades.
h. The construction of road for the through Flying Fish Point options will be similar but the amount of road widening required is an unknown and would impact on the costs significantly. An assumption of a minimum of 2m widening has been made in the costings to generate likely construction costs for these options.
i. The through Flying Fish Point options would require traffic control. Also, as previously stated, these options are likely to require traffic signalisation, which increase installation and on going maintenance costs.
j. No allowance has been made for venting systems for the cut and cover tunnel.

Please refer to Appendix E for the probable construction costs for each option.

8. The Accuracy Of The Survey

The contours were compiled from aerial and field surveys. To ensure ground truthing is correct a field survey was performed along the entire length of Ella Bay Road. These surveys have been combined into one survey for the preliminary designs of the Flying Fish Point deviation road options and the Ella Bay Road upgrade.

The aerial survey over Flying Fish Point appears to be quite accurate with the comparative levels having an accuracy tolerance of 0.5m. The aerial survey over Ella Bay Road through the World Heritage areas is, however, a little less accurate. There are sections around Heath Point which, on the aerial survey, have discrepancies of approximately 1.5m. These areas seemed to be in small pockets and have been manually adjusted to better resemble the field survey levels.

Because the survey is based on a combination of field and aerial survey we would recommend that, prior to the detailed design of the roads, full detailed survey is undertaken.

9. Other Relevant Issues

Acid sulphate soils are not likely to be encountered for the deviation road but may be an issue for Ella Bay Road north of Heath Point, and for the esplanade road options through Flying Fish Point.

The 'Over the Ridge' and the 'Cut and Cover Tunnel' options traverse through various properties. Permission from these property owners will need to be gained if these options are persued.

The pedestrian links between the site and Flying Fish Point have been produced as schematic design. The alignment and location of these links can vary and may be constructed with minimal impact to the environment. The use of boardwalks and on road allowances will help with this. However there may be a need to separate the pedestrian movements from the access road due possible safety issues. Detailed ground and tree survey would need to be provided to design a route for these pedestrian links. Please refer to appendix D for the Pedestrian Link Schematic

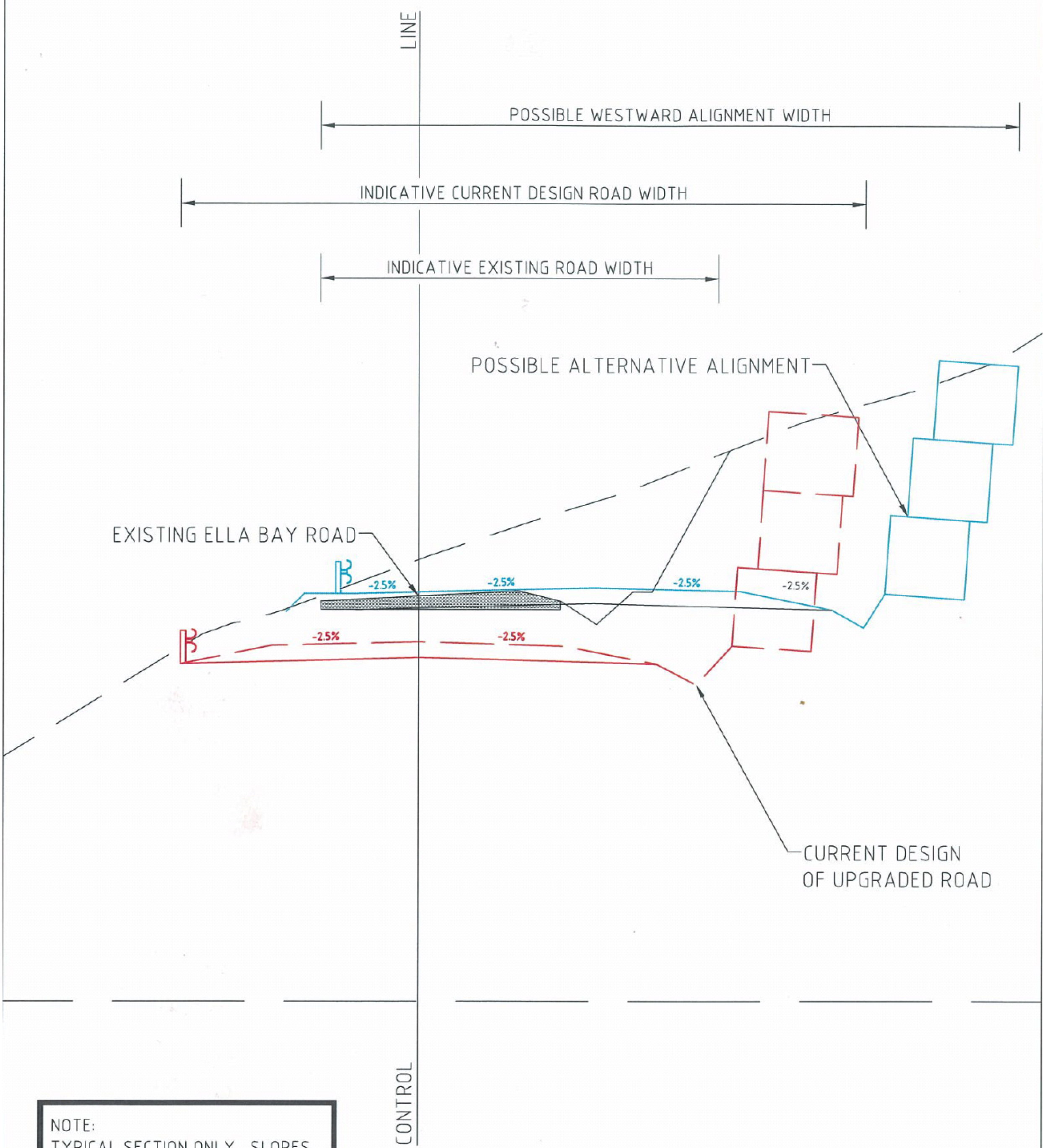
As it is proposed that the Ella Bay Road be the only access to the development there is an increased safety risk to the development. Usually a development with greater than 100 dwelling would require a secondary road access in case of emergencies such as bush fires and flooding.

There are a few major streams which the access road will cross. It is proposed that bridges be constructed across these streams, to ensure there is no riparian disturbance, and to keep the aquatic values of these streams intact. Saying this, a number of these streams already have culverts installed. These culverts will be removed in favour of constructing bridges and repairing, and / or improving the riparian values of these streams. These bridges may also create better fauna crossing of the access road, allowing more opportunities for animals to cross the road safely.

The cut and cover tunnel option would more than likely require blasting, which is expensive, but would be the most efficient form of earthworks, consideration will need to be taken to ensure the existing residents within close proximity will not be adversely effected. This option will require a stockpile site to be established, which may cause some problems. The location of this stockpile site will have a bearing on costs. The construction of the tunnel structure and the revegetation will be expensive and is difficult to quantify.

10. Possible Design Changes to improve Constructability and environment.

The design of Ella Bay that has been included in this report is based on survey information available at this present time. It is anticipated that when more detailed survey and geotechnical information becomes available the design will be refined to further reduce any potential impacts. Consideration will also be given to upgrading the existing road under traffic. The current design generally follows the centreline of the existing Ella Bay Road. During the detailed design phase there could be a number of slightly different road alignments as shown on the following sketch. The impacts of this possible alternative is considered to be very similar to the current design. A calculation of the vegetation clearing for the possible alternative alignment shown bellow was undertaken and is the same quantity of clearing as the current design. In some instances the road alignment could cantilever east of the existing road.



NOTE:
TYPICAL SECTION ONLY. SLOPES ALIGNMENTS, GEOTECHNICAL CONDITIONS, RETAINING WALLS ALL WILL VARY. ALL SUBJECT TO DETAILED DESIGN.

DESIGNED A.W.S.A.	APPROVED DATE	CLIENT SATORI RESORTS ELLA BAY PTY LTD	JOB CODE: WBPREB01
DRAWN A.W.S.A.	KEITH HOWELLS RPEQ 7295	PROJECT ELLA BAY ACCESS ROAD STRATEGY	
CHECKED DATE	SCALE 0 0.5 1 1.5 2 2.5m 1 : 100	LOCATION ELLA BAY ROAD, ELLA BAY	SHEET NUMBER: SK1 REV: A
DATE DECEMBER 2007		SHEET TITLE TYPICAL SECTION SKETCH	© Copyright FORM E027 5 OCT 1995

ETS GROUP

Appendix A
The Options Preliminary Design Drawings

Appendix B
Ella Bay Road Upgrade Preliminary Design Drawings

Appendix C
Design Traffic Extract From The EIS

3.5.1.2.2 Traffic generated

As established in Section 2.2.1, Ella Bay Road would form the sole connection for movements between the proposed development and Flying Fish Point by motor vehicles. The traffic generated by the development has been calculated as follows.

1 The traffic generating characteristics of the proposed development during its operational phase have been assessed in accordance with Main Roads' Resort Traffic Surveys (1989). This report uses data from traffic count and guest interview surveys conducted at 22 resorts in Queensland to develop guidelines for quantifying the traffic generating characteristics of new tourist accommodation facilities.

2 The size and characteristics of the proposed development were compared to similar facilities surveyed for the Main Roads report. These were found to include:

- Port Douglas
- Capricorn Iwasaki
- Kooralbyn Valley

3 This assessment takes into account:

- the expected scale of the development (ie 860 resort apartments + 540 residential lots);
- the range of on-site facilities (ie retail, commercial, educational, restaurant and dining, recreation and personal services);
- its function as a destination in itself (as opposed to a base for extensive day trip activities);
- the relative remoteness of the resort from major urban conurbations; and
- the expected number of guest, resident, staff, service and bus trips generated during an average day.

4 The number of daily vehicle trips generated by guests and residents (ie to/from the resort) during peak holiday times has been estimated accordingly:

- Guest Trip Rate: 0.7 - 1.5 vpd / occupied room
- Number of Rooms: 1400 rooms (ie apartments + residential dwellings)
- Design Occupancy: 90%
- Guest Trips: 880 - 1890 vpd

5 The number of resort staff expected during peak holiday times has been estimated accordingly:

- Staff Ratio: 1.2 – 1.6 staff / fully serviced occupied room
- Number of Rooms: 860 rooms (ie apartments only)
- Design Occupancy: 90%
- Number of Staff: 930 - 1240 staff

6 Staff are expected to reside off-site and commute to the resort on a daily basis. Thus, the number of daily vehicle trips generated by staff (ie to/from the resort) during peak holiday times has been estimated accordingly:

- Staff Trip Rate: 20 + 1.32 * No Staff
- Number of Staff: 930 - 1240 staff
- Staff Trips: 1250 - 1,660 vpd

7 The number of daily service vehicle trips (ie to/from the resort) during peak holiday times has been estimated accordingly:

- Service Vehicle Trip Rate: 0.6 * No. Staff + 14 (for up to 450 staff)
- Staff numbers are 930 – 1240 and economies of scale apply beyond 450 staff. Therefore 450 staff is used in the calculation.
- Service Vehicle Trips: 280 vpd

8 The number of bus/coach trips (ie to/from the resort) during peak holiday times has been estimated accordingly:

- Bus/coach Trip Rate: 0.2 vpd / occupied room
- Number of Rooms: 860 rooms (ie apartments only)
- Design Occupancy: 90%
- Bus/coach Trips: 160 vpd

9 The total number of daily vehicle movements to/from the resort during peak holiday times is summarised in Table 3.3. This equates to 2570 – 3,990 vpd.

Component	Low	High
Guests	880	1,890
Staff	1250	1,660
Service Vehicles	280	280
Buses / Coaches	160	160
Total	2,570	3,990

Table 3.3 Daily Trip Generation – Operational Phase (vpd two-way)

Anticipated times at which movements may occur.

The distribution of resort traffic by time of day during peak holiday times has been estimated based on the data presented in Main Roads' Resort Traffic Surveys (1989) and is shown in Figure 3.32. On average, traffic flows to/from the resort are expected to peak during the late morning (ie 11am to 12noon). Significantly lower volumes are expected during the traditional commuter peak periods. The expected variation in these figures is shown in Figure 3.32

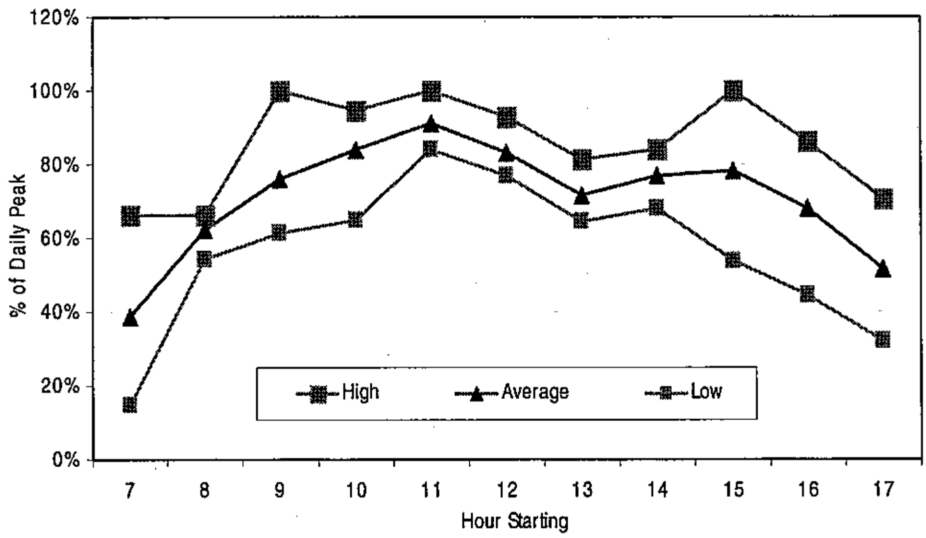


Figure 3.32 Hourly Trip Generation Profile (two-way)

The distribution in resort occupancy, and hence resort traffic, by month of year has been estimated based on the data presented in Main Roads' Resort Traffic Surveys (1989). This is shown in Figure 3.33. On average, traffic flows to/from the resort are expected to peak during the summer months / school holiday periods (eg July to October). Significantly lower volumes are expected during cooler / non-school holiday times (eg February to May).

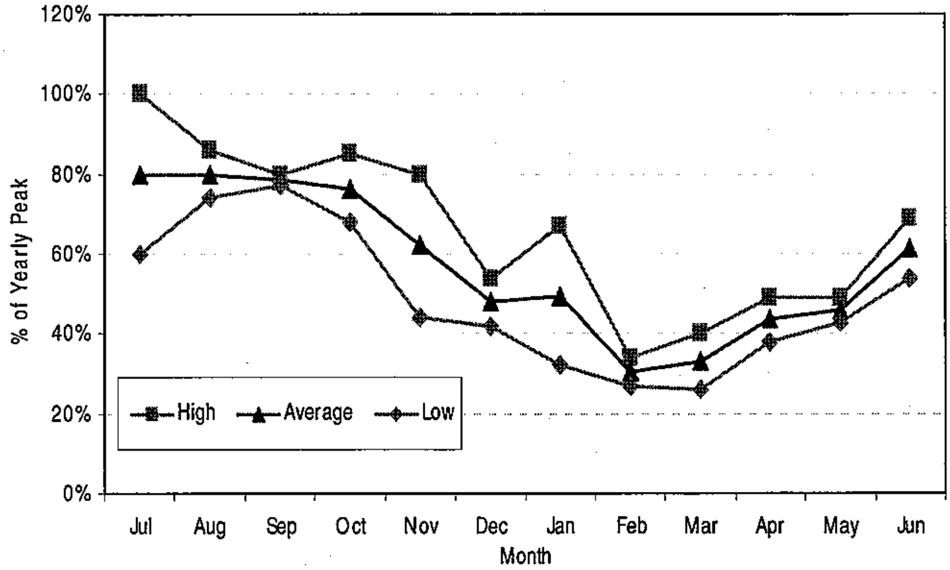


Figure 3.33 Monthly Variation in Occupancy and Vehicle Trips

3.5.1.2.3 Impacts on Ella Bay Road

Based on the calculations in Section 2.2.2, the total number of daily movements to/from the proposed development during **peak** holiday times is expected to be in the order of 2570 – 3990vpd.

A review of AUSTROADS' *Rural Road Design – A Guide to the Geometric Design of Rural Roads* suggests single carriageway road widths as shown in Table 3.4.

Element	Design AADT 1,000-3,000	Design AADT >3,000
Traffic Lanes	7.0m (2 x 3.5m)	7.0m (2 x 3.5m)
Total Shoulder	2.0m	2.5m
Shoulder Seal	1.0m	1.5m
Source: AUSTROADS "Rural Road Design		

Table 3.4 Single Carriageway Road Widths

It should be noted that the road widths presented in Table 3.4 are based on *average annual daily traffic (AADT)* volumes. Given that the proposed development's traffic volumes have been estimated for:

- peak holiday times, and
- a higher number of staff than is likely as not all rooms are fully serviced on a daily basis, it would be reasonable to expect that AADT volumes generated by the proposed development would be somewhat less than that calculated.

Therefore, as the volumes can be expected to be on average less than 3,000 AADT it is concluded that Ella Bay Road, which connects the proposed development to Flying Fish Point, would need to exhibit (and be maintained at) the following road widths:

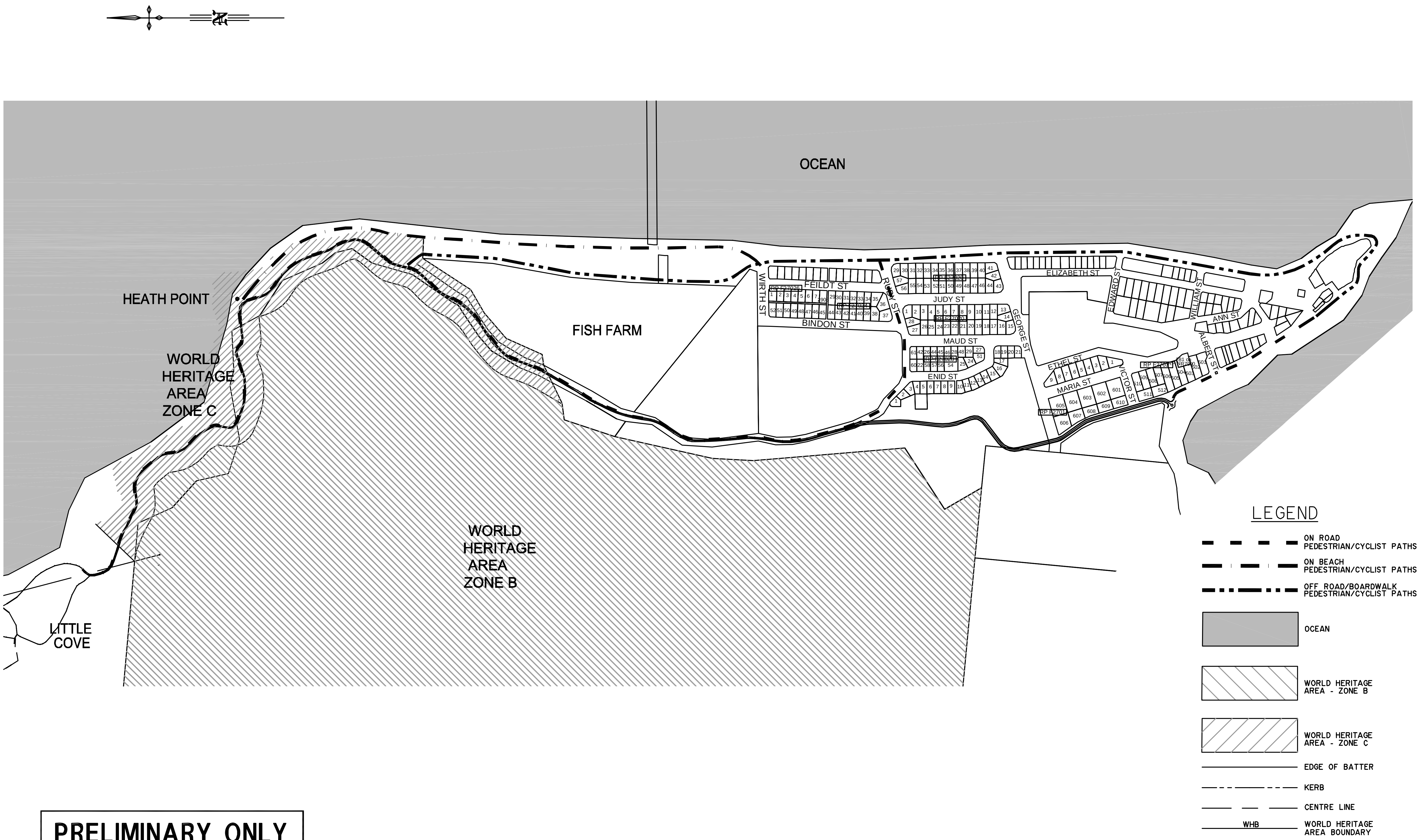
- Traffic Lanes: 7.0m (2 x 3.5m)
- Total shoulder: 2.0m (unless the terrain and fauna does not allow)
- Shoulder seal: 1.0m

The locations at which this road would need to be upgraded consistent with the above requirements will be identified through a detailed design process. However it is envisaged that construction work at any location where additional road width (above that already provided) is required will be sympathetic with the existing fauna and topography to ensure there is little to no impact on the surrounding environment. The upgrading of the road to the above standards will be done on a staged process with the timing of such works determined by the actual traffic generated by the community population.

3.5.1.2.4 Impacts on Flying Fish Point

Once Ella Bay Developments Pty Ltd had decided to upgrade the existing Ella Bay Road, a number of alternatives for possible transport routes through Flying Fish Point were considered. Ella Bay Developments is currently in the evaluating process in determining the best environmental, social and economic option for the road development.

Appendix D
Pedestrian Link Schematic



PRELIMINARY ONLY

ASSOCIATED CONSULTANTS: C & B GROUP

DATE	REV	DESCRIPTION	APPROVED
	A	ORIGINAL ISSUE	KPH

REVISIONS

CLIENT: ELLA BAY DEVELOPMENT

PROJECT: ELLA BAY DEVELOPMENT-ELLA BAY ROAD UPGRADE

LOCATION: ELLA BAY

SHEET TITLE: PEDESTRIAN LINK

DESIGNED: A.W.S.A.

DRAWN: M.J.M.

CHECKED / DATE

DATE: AUGUST 2007

APPROVED / DATE: KEITH HOWELLS RPEQ 7295

SCALE: 0 50 100 150 200 250m — 1 : 5000 (A1 SIZE)

AUSTRALIA
1 SWANN ROAD TARINGA BRISBANE QLD 4068 PH: (07) 3371 7000 FAX: (07) 3371 5679 EMAIL - mail@etsgroup.net.au
17 MONKS CRES BUDERIM SUNSHINE COAST QLD 4556 PH: (07) 5456 4550 FAX: (07) 5456 4582 EMAIL - etsgroup.sc@bigpond.com
PAPUA NEW GUINEA
5TH FLOOR CUTHBERTSON HOUSE PO BOX 908 PORT MORESBY
TELEPHONE (675) 321 1333 FACSIMILE (675) 321 7653
EMAIL - etspng@datec.net.pg
ARCHITECTS · CIVIL & STRUCTURAL ENGINEERS
ETS GROUP
www.etsgroup.net.au

JOB CODE: WBPREB01

SHEET NUMBER: EB42 REV: A

 FORM E027 10 AUG 2006

Appendix E
Probable Costs Assumptions

ETS GROUP

FLYING FISH POINT - THROUGH TOWN OPTION 6
for ELLA BAY DEVELOPMENT PTY LTD 10-Sep-07
PLAN No. WBPREB_X30 (Prepared by ETS Group) JOB CODE: WBPREB

This is not a quotation for the work and is aguide to possible construction costs only. These figures have been prepared based on historical data collected from previous projects in similar situations. The information provided herein is not based on exact details necessarily pertaining to this particular site and has been calculated without the benefit of detailed site information such as, but not limited to, detailed site survey, geotechnical reports,authority approval conditions, or special and unique site or planning features. This evaluation is provided on the basis that it is a guide and assistance only and the client should verify its accuracy before relying in any way on the figures provided.
ETS GROUP's Professional Indemnity insurance does not extend cover to the provision of cost estimates and as a result we attach this disclaimer for your notice.

Roadworks and Drainage

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
1	Traffic Control	1.00	Item	10,000.00	10000
2	Clearing & grubbing of road reserve	0.80	ha	40,000.00	32000
3	Sediment & diversion fence	880.00	m	8.60	7600
4	Catch drain & bank	1389.00	m	7.00	9800
5	Earth diversion drain	1389.00	m	20.00	27800
6	Earthworks				
	(a) on leads	9002.00	m^3	8.24	74200
	(b) spoil		m^3	25.00	
7	Removal and Replacement of unsuitable material as specified	350.00	m^3	25.30	8900
8	Trim and compact subgrade	7726.00	m^2	2.60	20100
9	Final trim	1389.00	m	33.00	45900
10	Top course Pavement (100mm)	1554.00	m^3	77.50	120500
11	Intermed. course pavement (100mm)	1554.00	m^3	75.00	116600
12	Bottom course pavement	1554.00	m^3	82.50	128300
13	AC surfacing				
	(a) 25mm thick	3820.00	m^2	17.00	65000
	(b) 50mm thick	3906.00	m^2	27.00	105500
14	Standard Kerb and Channel complete including compaction of the foundation and concrete cylinder testing				
	(a) Type 'M3'	1910.00	m	39.50	75500
	(b) Type 'B1'		m	39.50	
15	Culvert Crossing / Bridge	2.00	item	20,000.00	40000
16	RCP				
	300mm dia (class "2")		m	97.43	
	375mm dia (class "2")	320.00	m	120.00	38400
	450mm dia (class "2")	300.00	m	140.00	42000
	525mm dia (class "2")	300.00	m	165.00	49500
	600mm dia (class "2")	70.00	m	203.00	14300
	675mm dia (class "2")		m	225.00	
	750mm dia (class "2")		m	258.00	
	825mm dia (class "2")		m	299.00	
	900mm dia (class "2")		m	330.00	
	1050mm dia (class "2")		m	420.00	
	1200mm dia (class "2")		m	495.00	
	1350mm dia (class "2")		m	608.00	
17	RCP headwalls				
	375mm dia pipe	1.00	no	800.00	800
	600mm dia pipe	1.00	no	1,200.00	1200
18	Gully pits	18.00	m	2,095.00	37800
19	Side drains	868.00	m	170.00	147600
20	Intersection Upgrade (Traffic Signals)	2.00	item	150,000.00	300000
21	Retaining Structures		m	400.00	
22	Cut and Cover Tunnel		m		
23	Guardrail		m	200.00	
24	Animal Fencing	435.00	m	140.00	60900
25	Hydro Mulch	4340.00	m^2	1.00	4400
26	Revegetation	4340.00	m^2	30.00	130200
27	Testing	1.00	item	12,500.00	12500
28	Maintenance	1.00	item	5,000.00	5000
29	Signs and linemarking by LA	1.00	item	2,500.00	2500
30	Contingency (10%)				173480
	Roadworks and Drainage Total				**$1,908,300**

ETS GROUP

FLYING FISH POINT - THROUGH TOWN OPTION 5
for ELLA BAY DEVELOPMENT PTY LTD 10-Sep-07
PLAN No. WBPREB_X30 (Prepared by ETS Group) JOB CODE: WBPREB

This is not a quotation for the work and is aguide to possible construction costs only. These figures have been prepared based on historical data collected from previous projects in similar situations. The information provided herein is not based on exact details necessarily pertaining to this particular site and has been calculated without the benefit of detailed site information such as, but not limited to, detailed site survey, geotechnical reports,authority approval conditions, or special and unique site or planning features. This evaluation is provided on the basis that it is a guide and assistance only and the client should verify its accuracy before relying in any way on the figures provided. ETS GROUP's Professional Indemnity insurance does not extend cover to the provision of cost estimates and as a result we attach this disclaimer for your notice.

Roadworks and Drainage

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
1	Traffic Control	1.00	Item	10,000.00	10000
2	Clearing & grubbing of road reserve	0.78	ha	40,000.00	31200
3	Sediment & diversion fence	864.00	m	8.60	7500
4	Catch drain & bank	1063.00	m	7.00	7500
5	Earth diversion drain	1063.00	m	20.00	21300
6	Earthworks				
	(a) on leads	10302.00	m^3	8.24	84900
	(b) spoil		m^3	25.00	
7	Removal and Replacement of unsuitable material as specified	350.00	m^3	25.30	8900
8	Trim and compact subgrade	6412.00	m^2	2.60	16700
9	Final trim	1063.00	m	33.00	35100
10	Top course Pavement (100mm)	1418.00	m^3	77.50	109900
11	Intermed. course pavement (100mm)	1418.00	m^3	75.00	106400
12	Bottom course pavement	1418.00	m^3	82.50	117000
13	AC surfacing				
	(a) 25mm thick	2524.00	m^2	17.00	43000
	(b) 50mm thick	3888.00	m^2	27.00	105000
14	Standard Kerb and Channel complete including compaction of the foundation and concrete cylinder testing				
	(a) Type 'M3'	1262.00	m	39.50	49900
	(b) Type 'B1'		m	39.50	
15	Culvert Crossing / Bridge	2.00	item	20,000.00	40000
16	RCP				
	300mm dia (class "2")		m	97.43	
	375mm dia (class "2")	350.00	m	120.00	42000
	450mm dia (class "2")	250.00	m	140.00	35000
	525mm dia (class "2")		m	165.00	
	600mm dia (class "2")		m	203.00	
	675mm dia (class "2")		m	225.00	
	750mm dia (class "2")		m	258.00	
	825mm dia (class "2")		m	299.00	
	900mm dia (class "2")		m	330.00	
	1050mm dia (class "2")		m	420.00	
	1200mm dia (class "2")		m	495.00	
	1350mm dia (class "2")		m	608.00	
17	RCP headwalls				
	375mm dia pipe	1.00	no	800.00	800
	600mm dia pipe		no	1,200.00	
18	Gully pits	9.00	m	2,095.00	18900
19	Side drains	864.00	m	170.00	146900
20	Intersection Upgrade (Traffic Signals)	1.00	item	150,000.00	150000
21	Retaining Structures		m	400.00	
22	Cut and Cover Tunnel		m		
23	Guardrail		m	200.00	
24	Animal Fencing	432.00	m	140.00	60500
25	Hydro Mulch	4320.00	m^2	1.00	4400
26	Revegetation	4320.00	m^2	30.00	129600
27	Testing	1.00	item	12,500.00	12500
28	Maintenance	1.00	item	5,000.00	5000
29	Signs and linemarking by LA	1.00	item	2,500.00	2500
30	Contingency (10%)				140240
	Roadworks and Drainage Total				**$1,542,600**

ETS GROUP

FLYING FISH POINT - THROUGH TOWN OPTION 4
for ELLA BAY DEVELOPMENT PTY LTD 10-Sep-07
PLAN No. WBPREB_X30 (Prepared by ETS Group) JOB CODE: WBPREB

This is not a quotation for the work and is aguide to possible construction costs only. These figures have been prepared based on historical data collected from previous projects in similar situations. The information provided herein is not based on exact details necessarily pertaining to this particular site and has been calculated without the benefit of detailed site information such as, but not limited to, detailed site survey, geotechnical reports,authority approval conditions, or special and unique site or planning features. This evaluation is provided on the basis that it is a guide and assistance only and the client should verify its accuracy before relying in any way on the figures provided.
ETS GROUP's Professional Indemnity insurance does not extend cover to the provision of cost estimates and as a result we attach this disclaimer for your notice.

Roadworks and Drainage

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
1	Traffic Control	1.00	Item	10,000.00	10000
2	Clearing & grubbing of road reserve	1.65	ha	40,000.00	66000
3	Sediment & diversion fence	1832.00	m	8.60	15800
4	Catch drain & bank	2436.00	m	7.00	17100
5	Earth diversion drain	2436.00	m	20.00	48800
6	Earthworks				
	(a) on leads	30362.00	m^3	8.24	250200
	(b) spoil		m^3	25.00	
7	Removal and Replacement of unsuitable material as specified	350.00	m^3	25.30	8900
8	Trim and compact subgrade	19488.00	m^2	2.60	50700
9	Final trim	2436.00	m	33.00	80400
10	Top course Pavement (300mm)	5846.00	m^3	77.50	453100
11	Intermed. course pavement (300mm)	5846.00	m^3	75.00	438500
12	Bottom course pavement	5846.00	m^3	82.50	482300
13	AC surfacing				
	(a) 25mm thick		m^2	17.00	
	(b) 50mm thick	19488.00	m^2	27.00	526200
14	Standard Kerb and Channel complete including compaction of the foundation and concrete cylinder testing				
	(a) Type 'M3'	3040.00	m	39.50	120100
	(b) Type 'B1'		m	39.50	
15	Culvert Crossing / Bridge	5.00	item	20,000.00	100000
16	RCP				
	300mm dia (class "2")		m	97.43	
	375mm dia (class "2")	670.00	m	120.00	80400
	450mm dia (class "2")	300.00	m	140.00	42000
	525mm dia (class "2")	300.00	m	165.00	49500
	600mm dia (class "2")	40.00	m	203.00	8200
	675mm dia (class "2")		m	225.00	
	750mm dia (class "2")		m	258.00	
	825mm dia (class "2")		m	299.00	
	900mm dia (class "2")		m	330.00	
	1050mm dia (class "2")		m	420.00	
	1200mm dia (class "2")		m	495.00	
	1350mm dia (class "2")		m	608.00	
17	RCP headwalls				
	375mm dia pipe	1.00	no	800.00	800
	600mm dia pipe	1.00	no	1,200.00	1200
18	Gully pits	24.00	m	2,095.00	50300
19	Side drains	1832.00	m	170.00	311500
20	Intersection Upgrade (Traffic Signals)	1.00	item	150,000.00	150000
21	Retaining Structures	1520.00	m	800.00	1216000
22	Cut and Cover Tunnel		m		
23	Guardrail	1520.00	m	200.00	304000
24	Animal Fencing	920.00	m	140.00	128800
25	Hydro Mulch	6412.00	m^2	1.00	6500
26	Revegetation	6412.00	m^2	30.00	192400
27	Testing	1.00	item	20,000.00	20000
28	Maintenance	1.00	item	5,000.00	5000
29	Signs and linemarking by LA	1.00	item	15,000.00	15000
30	Contingency (10%)				524970
	Roadworks and Drainage Total				**$5,774,700**

ETS GROUP

FLYING FISH POINT - THROUGH TOWN OPTION 3

for ELLA BAY DEVELOPMENT PTY LTD 10-Sep-07

PLAN No. WBPREB_X30 (Prepared by ETS Group) JOB CODE: WBPREB

This is not a quotation for the work and is aguide to possible construction costs only. These figures have been prepared based on historical data collected from previous projects in similar situations. The information provided herein is not based on exact details necessarily pertaining to this particular site and has been calculated without the benefit of detailed site information such as, but not limited to, detailed site survey, geotechnical reports,authority approval conditions, or special and unique site or planning features. This evaluation is provided on the basis that it is a guide and assistance only and the client should verify its accuracy before relying in any way on the figures provided.
ETS GROUP's Professional Indemnity insurance does not extend cover to the provision of cost estimates and as a result we attach this disclaimer for your notice.

Roadworks and Drainage

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
1	Traffic Control	1.00	Item	10,000.00	10000
2	Clearing & grubbing of road reserve	0.80	ha	40,000.00	32000
3	Sediment & diversion fence	892.00	m	8.60	7700
4	Catch drain & bank	1966.00	m	7.00	13800
5	Earth diversion drain	1966.00	m	20.00	39400
6	Earthworks				
	(a) on leads	19660.00	m^3	8.24	162000
	(b) spoil		m^3	25.00	
7	Removal and Replacement of unsuitable material as specified	350.00	m^3	25.30	8900
8	Trim and compact subgrade	15728.00	m^2	2.60	40900
9	Final trim	1966.00	m	33.00	64900
10	Top course Pavement (100mm)	4718.00	m^3	77.50	365700
11	Intermed. course pavement (100mm)	4718.00	m^3	75.00	353900
12	Bottom course pavement	4718.00	m^3	82.50	389300
13	AC surfacing				
	(a) 25mm thick		m^2	17.00	
	(b) 50mm thick	15728.00	m^2	27.00	424700
14	Standard Kerb and Channel complete including compaction of the foundation and concrete cylinder testing				
	(a) Type 'M3'	3040.00	m	39.50	120100
	(b) Type 'B1'		m	39.50	
15	Culvert Crossing / Bridge	3.00	item	20,000.00	60000
16	RCP				
	300mm dia (class "2")		m	97.43	
	375mm dia (class "2")	670.00	m	120.00	80400
	450mm dia (class "2")	300.00	m	140.00	42000
	525mm dia (class "2")	300.00	m	165.00	49500
	600mm dia (class "2")	40.00	m	203.00	8200
	675mm dia (class "2")		m	225.00	
	750mm dia (class "2")		m	258.00	
	825mm dia (class "2")		m	299.00	
	900mm dia (class "2")		m	330.00	
	1050mm dia (class "2")		m	420.00	
	1200mm dia (class "2")		m	495.00	
	1350mm dia (class "2")		m	608.00	
17	RCP headwalls				
	375mm dia pipe	1.00	no	800.00	800
	600mm dia pipe	1.00	no	1,200.00	1200
18	Gully pits	24.00	m	2,095.00	50300
19	Side drains	892.00	m	170.00	151700
20	Intersection Upgrade (Traffic Signals)	1.00	item	150,000.00	150000
21	Retaining Structures	1520.00	m	800.00	1216000
22	Cut and Cover Tunnel		m		
23	Guardrail		m	200.00	
24	Animal Fencing	446.00	m	140.00	62500
25	Hydro Mulch	3122.00	m^2	1.00	3200
26	Revegetation	3122.00	m^2	30.00	93700
27	Testing	1.00	item	15,000.00	15000
28	Maintenance	1.00	item	5,000.00	5000
29	Signs and linemarking by LA	1.00	item	10,000.00	10000
30	Contingency (10%)				403280
	Roadworks and Drainage Total				**$4,436,100**

ETS GROUP

FLYING FISH POINT - THROUGH TOWN OPTION 1

for ELLA BAY DEVELOPMENT PTY LTD 10-Sep-07

PLAN No. WBPREB_X30 (Prepared by ETS Group) JOB CODE: WBPREB

This is not a quotation for the work and is aguide to possible construction costs only. These figures have been prepared based on historical data collected from previous projects in similar situations. The information provided herein is not based on exact details necessarily pertaining to this particular site and has been calculated without the benefit of detailed site information such as, but not limited to, detailed site survey, geotechnical reports,authority approval conditions, or special and unique site or planning features. This evaluation is provided on the basis that it is a guide and assistance only and the client should verify its accuracy before relying in any way on the figures provided. ETS GROUP's Professional Indemnity insurance does not extend cover to the provision of cost estimates and as a result we attach this disclaimer for your notice.

Roadworks and Drainage

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
1	Traffic Control	1.00	Item	10,000.00	10000
2	Clearing & grubbing of road reserve		ha	40,000.00	
3	Sediment & diversion fence		m	8.60	
4	Catch drain & bank	1520.00	m	7.00	10700
5	Earth diversion drain	1520.00	m	20.00	30400
6	Earthworks				
	(a) on leads	1824.00	m^3	8.24	15100
	(b) spoil		m^3	25.00	
7	Removal and Replacement of unsuitable material as specified	350.00	m^3	25.30	8900
8	Trim and compact subgrade	6080.00	m^2	2.60	15900
9	Final trim	1520.00	m	33.00	50200
10	Top course Pavement (100mm)	608.00	m^3	77.50	47200
11	Intermed. course pavement (100mm)	608.00	m^3	75.00	45600
12	Bottom course pavement	608.00	m^3	82.50	50200
13	AC surfacing				
	(a) 25mm thick	6080.00	m^2	17.00	103400
	(b) 50mm thick		m^2	27.00	
14	Standard Kerb and Channel complete including compaction of the foundation and concrete cylinder testing				
	(a) Type 'M3'	3040.00	m	39.50	120100
	(b) Type 'B1'		m	39.50	
15	Culvert Crossing / Bridge		item	20,000.00	
16	RCP				
	300mm dia (class "2")		m	97.43	
	375mm dia (class "2")	620.00	m	120.00	74400
	450mm dia (class "2")	300.00	m	140.00	42000
	525mm dia (class "2")	300.00	m	165.00	49500
	600mm dia (class "2")	70.00	m	203.00	14300
	675mm dia (class "2")		m	225.00	
	750mm dia (class "2")		m	258.00	
	825mm dia (class "2")		m	299.00	
	900mm dia (class "2")		m	330.00	
	1050mm dia (class "2")		m	420.00	
	1200mm dia (class "2")		m	495.00	
	1350mm dia (class "2")		m	608.00	
17	RCP headwalls				
	375mm dia pipe	1.00	no	800.00	800
	600mm dia pipe	1.00	no	1,200.00	1200
18	Gully pits	24.00	m	2,095.00	50300
19	Side drains		m	170.00	
20	Intersection Upgrade (Traffic Signals)	2.00	item	150,000.00	300000
21	Retaining Structures		m	400.00	
22	Cut and Cover Tunnel		m		
23	Guardrail		m	200.00	
24	Animal Fencing		m	140.00	
25	Hydro Mulch		m^2	1.00	
26	Revegetation		m^2	30.00	
27	Testing	1.00	item	12,500.00	12500
28	Maintenance	1.00	item	5,000.00	5000
29	Signs and linemarking by LA	1.00	item	2,500.00	2500
30	Contingency (10%)				106020
	Roadworks and Drainage Total				**$1,166,200**

ETS GROUP

ELLA BAY DEVELOPMENT - ELLA BAY ROAD UPGRADE
for ELLA BAY DEVELOPMENT PTY LTD 10-Sep-07
PLAN No. WBPREB_EB00 - EB42 (Prepared by ETS Group) JOB CODE: WBPREB

This is not a quotation for the work and is aguide to possible construction costs only. These figures have been prepared based on historical data collected from previous projects in similar situations. The information provided herein is not based on exact details necessarily pertaining to this particular site and has been calculated without the benefit of detailed site information such as, but not limited to, detailed site survey, geotechnical reports,authority approval conditions, or special and unique site or planning features. This evaluation is provided on the basis that it is a guide and assistance only and the client should verify its accuracy before relying in any way on the figures provided. ETS GROUP's Professional Indemnity insurance does not extend cover to the provision of cost estimates and as a result we attach this disclaimer for your notice.

Roadworks and Drainage

ITEM	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
1	Traffic Control	1.00	Item	10,000.00	10000
2	Clearing & grubbing of road reserve	3.90	ha	40,000.00	156000
3	Sediment & diversion fence	3000.00	m	8.60	25800
4	Catch drain & bank	3000.00	m	7.00	21000
5	Earth diversion drain	3000.00	m	20.00	60000
6	Earthworks				
	(a) on leads	4651.00	m^3	8.24	38400
	(b) spoil	28745.00	m^3	25.00	718700
7	Removal and Replacement of unsuitable material as specified	1500.00	m^3	25.30	38000
8	Trim and compact subgrade	30733.50	m^2	2.60	80000
9	Final trim	2927.00	m	33.00	96600
10	Top course Pavement (300mm)	7903.00	m^3	77.50	612500
11	Intermed. course pavement (300mm)	7903.00	m^3	75.00	592800
12	Bottom course pavement	7903.00	m^3	82.50	652000
13	AC surfacing				
	(a) 25mm thick		m^2	17.00	
	(b) 50mm thick	26343.00	m^2	27.00	711300
14	Standard Kerb and Channel complete including compaction of the foundation and concrete cylinder testing				
	(a) Type 'M3'		m	39.50	
	(b) Type 'B1'		m	39.50	
15	Culvert Crossing / Bridge	14.00	item	20,000.00	280000
16	RCP				
	300mm dia (class "2")		m	97.43	
	375mm dia (class "2")		m	120.00	
	450mm dia (class "2")		m	140.00	
	525mm dia (class "2")		m	165.00	
	600mm dia (class "2")		m	203.00	
	675mm dia (class "2")		m	225.00	
	750mm dia (class "2")		m	258.00	
	825mm dia (class "2")		m	299.00	
	900mm dia (class "2")		m	330.00	
	1050mm dia (class "2")		m	420.00	
	1200mm dia (class "2")		m	495.00	
	1350mm dia (class "2")		m	608.00	
17	RCP headwalls				
	375mm dia pipe		no	800.00	
	600mm dia pipe		no	1,200.00	
18	Gully pits		m	2,095.00	
19	Side drains	2927.00	m	170.00	497600
20	Intersection Upgrade (Roundabout)		item	150,000.00	
21	Retaining Structures	633.00	m	400.00	253200
22	Cut and Cover Tunnel		m		
23	Guardrail	1500.00	m	200.00	300000
24	Animal Fencing	1500.00	m	140.00	210000
25	Hydro Mulch	20000.00	m^2	1.00	20000
26	Revegetation	20000.00	m^2	30.00	600000
27	Testing	1.00	item	25,000.00	25000
28	Maintenance	1.00	item	5,000.00	5000
29	Signs and linemarking by LA	1.00	item	30,000.00	30000
30	Contingency (10%)				603390
	Roadworks and Drainage Total				**$6,033,900**

WORKING PAPER 2

FLORA AND FAUNA

(OTHER THAN CASSOWARIES)

BIODIVERSITY ASSESSMENTS AND MANAGEMENT

TERRESTRIAL FLORA AND FAUNA ASSESSMENT and PREFERRED ALIGNMENT IMPACT ASSESSMENT

Access Road, Ella Bay Integrated Resort

Report prepared for

Satori Resorts Ella Bay Pty Ltd

Prepared by:	**Mark Sanders and David Stanton**
Checked by:	**Paulette Jones**
Date:	**17 October, 2007**
File no:	**0157-001**

Biodiversity Assessment and Management Pty Ltd
38 Middle Street
CLEVELAND 4163

Biodiversity Assessment AND MANAGEMENT PTY LTD

NOTICE TO USERS OF THIS REPORT

Copyright and reproduction

This report and all indexes, schedules, annexures or appendices are subject to copyright pursuant to the *Copyright Act 1968* (Cth). Subject to statutory defences, no party may reproduce, publish, adapt or communicate to the public, in whole or in part, the content of this report without the express written consent of Biodiversity Assessment and Management Pty Ltd.

Purpose of Report

Biodiversity Assessment and Management Pty Ltd have produced this report in its capacity as consultants for and on the request of Satori Resorts Ella Bay Pty Ltd (the "**Client**") for the sole purpose of assessing terrestrial flora and fauna values along access road options and providing an impact assessment for the preferred option for the access road for the Ella Bay Integrated Resort development (the "**Specified Purpose**"). This information and any recommendations in this report are particular to the Specified Purpose and are based on facts, matters and circumstances particular to the subject matter of the report and the Specified Purpose at the time of production. This report is not to be used, nor is it suitable, for any purpose other than the Specified Purpose. Biodiversity Assessment and Management Pty Ltd disclaims all liability for any loss and/or damage whatsoever arising either directly or indirectly as a result of any application, use or reliance upon the report for any purpose other than the Specified Purpose.

This report has been produced solely for the benefit of the Client. Biodiversity Assessment and Management Pty Ltd do not accept that a duty of care is owed to any party other than the Client. This report is not to be used by any third party other than as authorised in writing by Biodiversity Assessment and Management Pty Ltd and any such use shall continue to be limited to the Specified Purpose. Further, Biodiversity Assessment and Management Pty Ltd does not make any warranty, express or implied, or assume any legal liability or responsibility for any third party's use in whole or in part of the report or application or use of any other information or process disclosed in this report and to the full extent allowed by law excludes liability in contract, tort or otherwise, for any loss or damage sustained by any person or body corporate arising from or in connection with the supply or use of the whole part of the report through any cause whatsoever.

Biodiversity Assessment and Management Pty Ltd has used information provided to it by the Client and governmental registers, databases, departments and agencies in the preparation of this report. Biodiversity Assessment and Management Pty Ltd does not know, nor does it have any reason to suspect, that the information provided to it was false, inaccurate, incomplete or misleading at the time of its receipt. This report is supplied on the basis that while Biodiversity Assessment and Management Pty Ltd believes all the information in it is deemed reliable at the time of publication, it does not warrant its accuracy or completeness and to the full extent allowed by law excludes liability in contract, tort or otherwise, for any loss or damage sustained by any person or body corporate arising from or in connection with the supply or use of the whole or any part of the information in this report through any cause whatsoever.

Signed on behalf of
Biodiversity Assessment and Management Pty Ltd

Date: 17 October 2007

Managing Director

TERRESTRIAL FLORA AND FAUNA ASSESSMENT

Access Road, Ella Bay Integrated Resort

Table of Contents

List of Figures

List of Tables

List of Appendices

List of Abbreviations

BAAM	Biodiversity Assessment and Management Pty Ltd
CRCTREM	Cooperative Research Centre for Tropical Rainforest Ecology and Management
DEWR	Department of Environment and Water Resources (Commonwealth)
EPA	Queensland Environmental Protection Agency
EPBC	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
EVR	Endangered, Vulnerable or Rare
LPA	*Land Protection (Pest and Stock Route Management) Act 2002*
NCA	*Nature Conservation Act 1992* (Queensland)
NRW	Queensland Department of Natural Resources and Water
QM	Queensland Museum
RE	Regional Ecosystem
VMA	V*egetation Management Act 1999* (Queensland)
WTMA	Wet Tropics Management Authority
WTMP	*Wet Tropics Management Plan 1998*
WTWHA	Wet Tropics World Heritage Area

1.0 INTRODUCTION

Biodiversity Assessment and Management Pty Ltd (BAAM) has prepared this report for Satori Resorts Ella Bay Pty Ltd to describe flora and fauna values present within the area of the proposed Ella Bay access road between Flying Fish Point and Heath Point near Innisfail and to provide an assessment of the client's preferred option for the access road**.** This road is required to provide access to the proposed Ella Bay Integrated Resort.

An existing road is currently present through the study area, although its location and design are being reviewed to allow for increased traffic movement with the least social and environmental impacts. Accordingly, potential impacts associated with the construction and operation of this roadway on the existing flora and fauna values need to be assessed for inclusion in the Ella Bay Resort Environmental Impact Study (EIS) Supplementary Report.

This report is divided into two parts: Part One: Terrestrial Flora and Fauna Assessment, and Part Two: Preferred Alignment Impact Assessment. A preferred alignment for the location and treatment of the access road for the Ella Bay Road was decided upon following client review of relevant documentation including the completed Part One: Terrestrial Flora and Fauna Assessment in this report. Part Two of this report is designed to specifically address the potential impacts and recommended mitigation strategies for the preferred alignment of the access road through the study area.

The specific aims of **Part One: Terrestrial Vertebrate Flora and Fauna Assessment** are to:

- Undertake a field inspection of flora values;
- Develop a vegetation map of the area through which the road location is being considered;
- Identify and list flora species within the mapped area;
- Discuss identified flora species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) and *Nature Conservation Act 1994* (NCA);
- Use desktop information including current vegetation mapping and previous survey results from the Ella Bay flora and fauna survey (BAAM 2006) to evaluate existing fauna values;
- Discuss likely fauna species listed under the EPBC and NCA; and
- Discuss World Heritage values for the Wet Tropics World Heritage Areas (WTWHA) (terrestrial) surrounding the study area.

The specific aims of **Part Two: Preferred Alignment Impact Assessment** are to:

- Outline the statutory planning framework for the conservation of flora, fauna and habitat in the area;
- Discuss potential impacts of the construction of a road on identified values; and
- Develop mitigation strategies to assist in alleviating identified impacts.

This report does not assess road options for the Southern Cassowary *Casuarius casuarius* which is the subject of a separate report (Moore, 2007). Nor does it address impacts on the Great Barrier Reef World Heritage Area or impacts to visual amenity along the access road.

PART A: TERRESTRIAL FLORA AND FAUNA ASSESSMENT

2.0 SITE DESCRIPTION

2.1 LOCATION

The Ella Bay access road is located approximately four km to the north-west of Innisfail within the Wet Tropics bioregion of Queensland. It commences from the soutern end of Flying-Fish Point and runs north for approximately three km where it ends at the proposed Ella Bay Integrated Resort site **(Figure 2.1)**.

This road alignment follows an existing gazetted unsealed road as it passes through, or adjacent to, Ella Bay National Park. The study area includes the gazetted road as well as Lot 246 on NR3550 and Lot 18 on USL35566.

The northern and southern sections of the road are located on comparatively low-lying land with little undulation. However the central portion of the road skirts the coastal fall of the Seymour Range negotiating the coastal headland of Heath Point where it is incised into the steep hillside. An option to bypass the township of Flying Fish Point by crossing the narrow southern extension of the Seymour Range immediately west of the township is a considered option.

Several creeklines of various sizes cross the road. The largest has permanent water and is located within the National Park towards the northern end of the road alignment. This creekline has few riffle zones, replaced by pools of water with a sandy or sediment bedload, terminating seaward in a sandy swale which breaches the coastal foredune. Other smaller watercourses do not appear to contain permanent water, but are likely to run regularly with rainfall. These are typically steep, fast flowing streams with rock or boulder bedloads.

The study area which will contain the preferred road alignment is within the Wet Tropics World Heritage Area (WTWHA) and adjacent to the World Heritage Great Barrier Reef Zone.

2.2 PROPOSED ACTIVITIES

North of the Flying Fish Point township, it is proposed that the access road will follow the existing road alignment. This section, referred to throughout this report as **Section 1,** will require widening to service the proposed Ella Bay Integrated Resort development. This widening will necessitate a considerable cut into the steeper areas on coastal headlands and subsequent disturbance to adjacent vegetation. South of the township (**Section 2**) there is a range of options from route placement through the Flying Fish Point township along the existing road, to bypassing of the township, taking a route over a relatively undisturbed section of the Seymour Range prior to a junction with the existing easement. Additional infrastructure, including the construction of bicycle laneways is also being considered, necessitating a broader floristic survey in the general study area. Road sections are illustrated in **Figure 2.2.**

Legend:

Existing Road

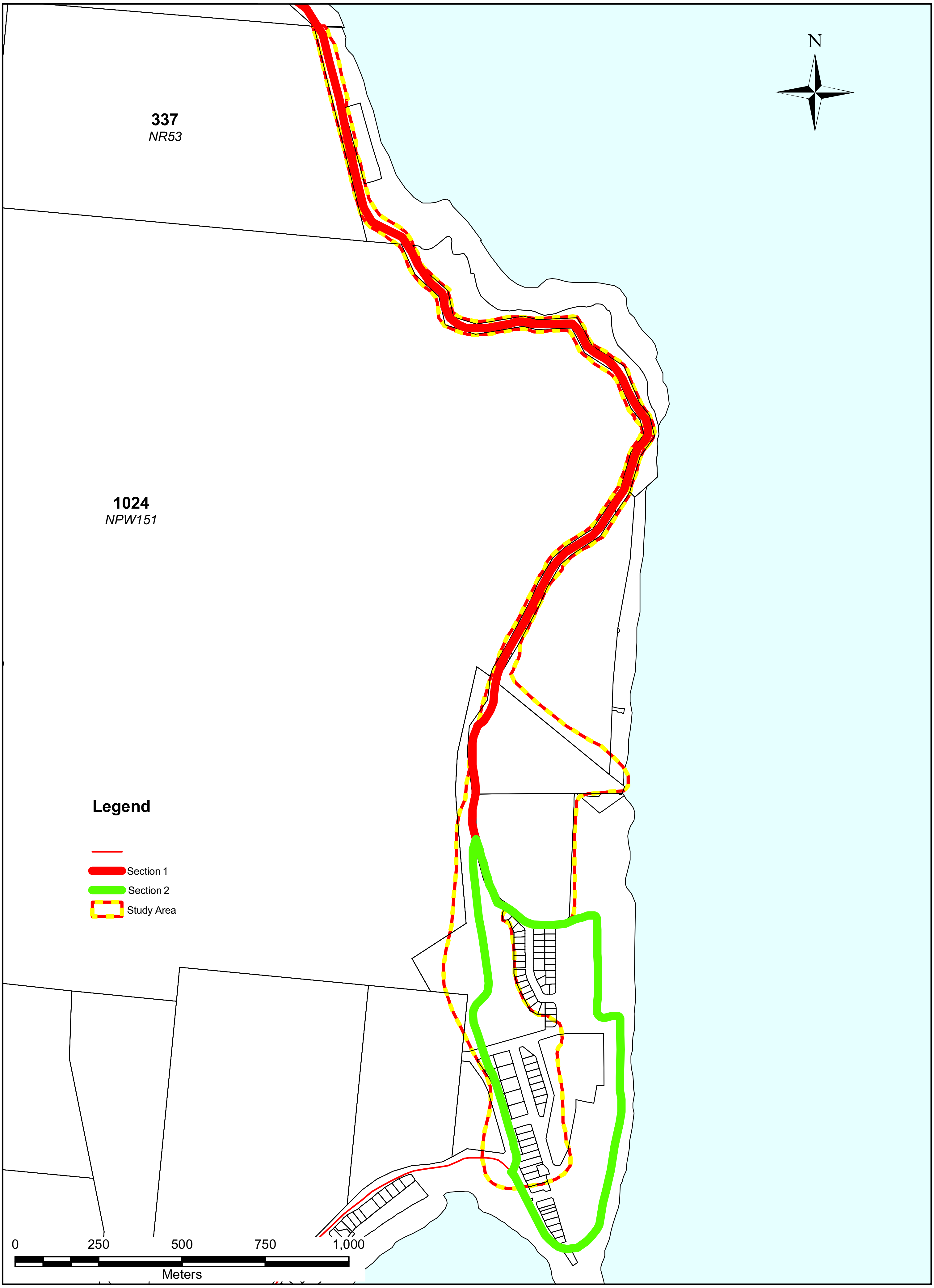
Study Area

Approximate stream locations

Biodiversity Assessment AND MANAGEMENT PTY LTD

FIGURE 2.1
STUDY AREA

PART A: TERRESTRIAL FLORA AND FAUNA ASSESSMENT
ACCESS ROAD, ELLA BAY INTEGRATED RESORT



Biodiversity Assessment AND MANAGEMENT PTY LTD

PART A: TERRESTRIAL FLORA AND FAUNA ASSESSMENT
ACCESS ROAD, ELLA BAY INTEGRATED RESORT

FIGURE 2.2
ROAD SECTIONS

2.3 GEOLOGY AND LANDFORM

The geology is relatively simple, with steeper landforms comprising highly deformed quartz-mylonites and green schists of the Barron River Metamorphic group (de Keyser *et al*. 1962). Broad colluvial fans are formed at the footslopes of the Seymour Range in the southern section of the study area, overlapping with areas of finer alluvial sediment and degraded parallel coastal dunes wherever the coastal plain is developed to any degree. The central portion of the road corridor falls steeply to a narrow zone of tidal beaches and coastal headlands to the immediate north and south of Heath Point.

2.4 WET TROPICS WORLD HERITAGE AREA

The road alignment traverses a portion of the WTWHA that contains one of the regions finest lowland national parks in terms of size and complexity of habitats (Peter Stanton. pers. comm.).

The floristic values are of the area are poorly understood and relatively under-sampled from a regional perspective. The scarcity of floristic information is particularly relevant to the broader floristic assessment, being located in a bio-region noteworthy for its high level of endemism and floristic diversity. World Heritage Values are discussed in **Section 4.2.4**.

3.0 METHODOLOGY

Collection of data for the assessment included two phases; the review of background literature and databases (flora and fauna) and a field inspection (flora only). Data collected during the field inspection was restricted to floristic information.

3.1 DATABASE SEARCH AND LITERATURE REVIEW

Database Search

Prior to the field investigation, public databases were searched in order to provide background information on terrestrial flora and fauna species known from the region. The search included the Commonwealth's EPBC Online Protected Matters Search Tool, data from the Queensland Museum (QM), and the Environmental Protection Agency's (EPA) WildNet database. Floristic searches included analysis of the Queensland Herbarium's Herbrecs database.

Literature Review

Known studies conducted within the local area were reviewed in order to supplement information from the database review. In some cases, the review of such documents may illuminate records of significant species identified in public databases, providing additional information such as the number of individuals, area of occupation and breeding status. The level of detail in many cases depends on the level of reporting provided within the reviewed document. In particular, the review included examination of the Terrestrial and Freshwater Fauna Impact Assessment (BAAM 2006), and Ella Bay flora assessment reports by 3D Environmental (3D Environmental 2006a and 2006b) and any other supporting documents.

Other documents relevant to the project including government guidelines and policies are also referenced. Relevant aerial photos, topographic maps, vegetation maps and geological maps have been assessed.

3.2 FLORISTIC SURVEY METHODOLOGY AND FIELD SURVEY TECHNIQUE

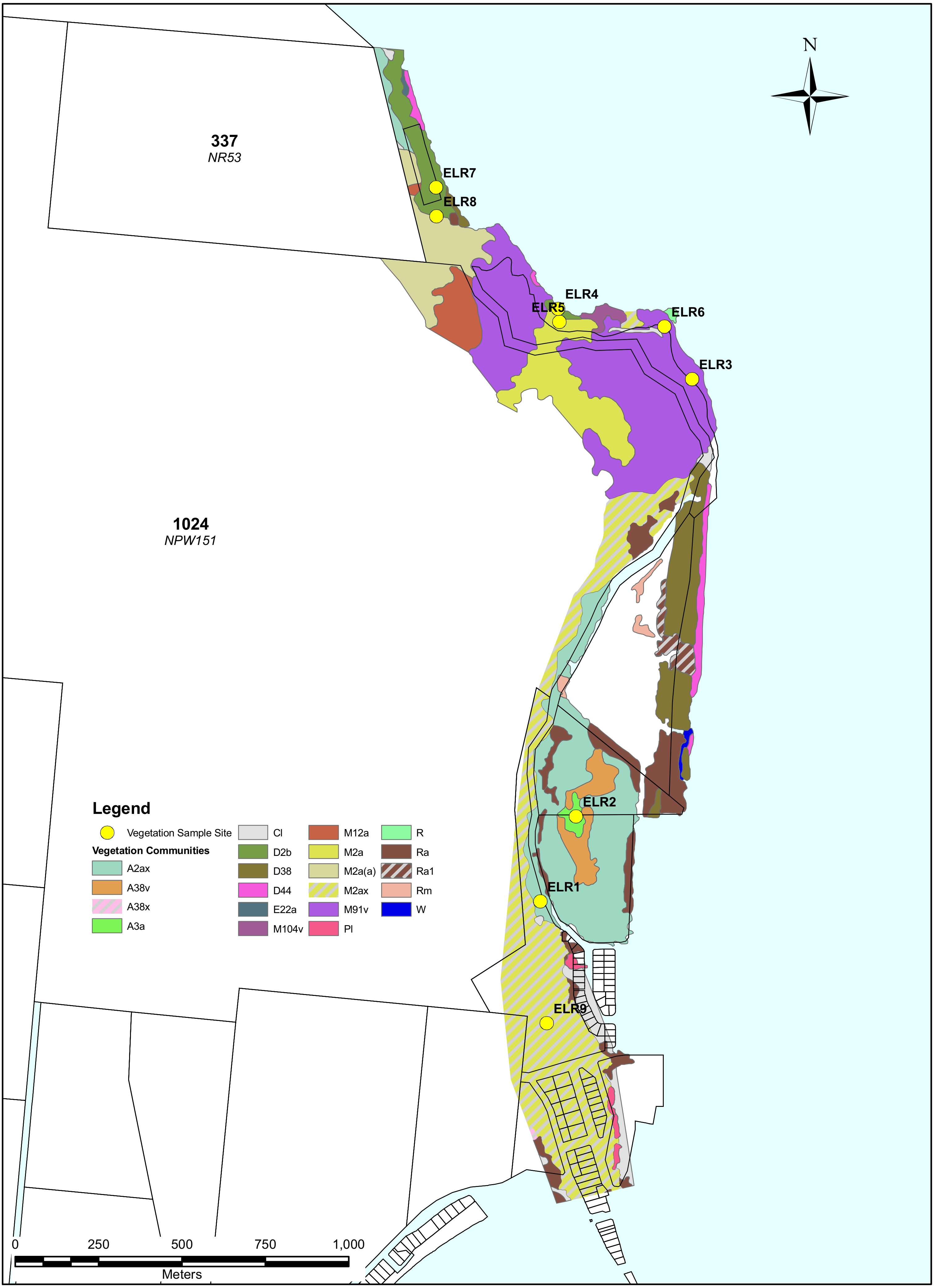
The study utilised 1:12 000 scale aerial photography as a basis for the mapping exercise. Aerial photographs were examined stereoscopically to determine vegetation complexity and suitable sample locations.

Field survey was completed in July 2007 over a two day period. Due to the extreme wind disturbance created by the incursion of Cyclone Larry into the study area in March 2006, standard traverse searches for rare and threatened species proved ineffective. Site assessment therefore consisted of detailed floristic survey in identified communities in accessible locations. This was followed by general roadside traverse along formed sections of the existing road corridor. Due to collection permit limitations, floristic collection focused on communities within the road reserve and within Unallocated State Land, although all tenures were assessed on foot for habitat suitability and floristic representation. The dense nature of the forest regrowth meant full traverse of the entire route was not feasible.

Detailed sites were surveyed using the Bitterlich method with a radial sweep recording intercepts with canopy (T1), sub-canopy (T2) and shrubs (S1). A full record of species from all structural layers was then recorded from within the sweep area. This method allowed an assessment of the basal area of individual structural layers and defined an area over which detailed botanical investigation was made. Standard 50 m by 10 m vegetation transect plots proved an unfeasible method of assessment for the rainforest communities, and the method was modified to allow an easier negotiation of windfall and dense thickets of *Calamus* (wait-a-while). A total of nine detailed (secondary) survey sites were recorded in the study areas, not including floristic information recorded during general traverse and summaries of these are provided in **Appendix 1.** Locations of detailed survey sites are shown in **Figure 3.1**.

Vegetation community boundaries were marked directly on the hard copy aerial photographs and attributed with a specific descriptor of vegetation structure, floristic type and landform association. Aerial photographs were registered against the existing DCDB using the Arc Gis geo-registration extension and photographic linework was then captured in Arc Info GIS format to generate a series of maps including Regional Ecosystem, Conservation Status, and habitat suitability.

As a final study phase, additional local botanical expertise in species identification, habitat assessment and landform ecology was sought from Bob Jago and Peter Stanton. Both individuals are recognised experts in the field of Wet Tropics ecology and contributed to the habitat assessment provided in this report.



Biodiversity Assessment AND MANAGEMENT PTY LTD

PART A: TERRESTRIAL FLORA AND FAUNA ASSESSMENT
ACCESS ROAD, ELLA BAY INTEGRATED RESORT

FIGURE 3.1
VEGETATION SURVEY SITES

4.0 RESULTS

4.1 FLORISTICS

4.1.1 Desktop Literature Review

Existing NRW Certified Regional Ecosystems

The existing 1: 50 000 scale regional ecosystem mapping of the study area indicates six Regional Ecosystems (RE) are present. The majority of these REs are listed as '*Of Concern'* with one '*Endangered',* and one *'Not of Concern'* as per Queensland's *Vegetation Management Act, 1999* (VMA). Regional Ecosystems represented within the study area are listed in **Table 4.1** below. The certified Regional Ecosystems mapping also indicates that the vegetated portions of the study area are considered *Essential Habitat* for the Southern Cassowary as defined in Queensland's VMA.

Table 4.1: Existing NRW Certified Mapping for the Access Corridor

RE	Status	Description (REDD)
7.2.1	*Endangered*	Mesophyll vine forest. Beach ridges and sand plains of beach origin, mainly in small patches in the lee of coastal beach ridges in very high rainfall areas.
7.2.8	*Of Concern*	*Melaleuca leucadendra* open forest to woodland. Sands of beach origin
7.3.10	*Of Concern*	Simple-complex mesophyll to notophyll vine forest on metamorphics
7.11.1	*Not of Concern*	Simple-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.
7.11.10	*Not of Concern*	*Acacia celsa* open to closed forest on metamorphics
7.11.25	*Of Concern*	Simple-complex mesophyll to notophyll vine forest on amphibolites of the very wet lowlands and foothills.

Significant Species

An online search of the EPBC database indicates that 14 nationally significant plant species, or habitats for these plants, occur within the locality of the subject site[1]. Six of these species are listed as Endangered and eight as Vulnerable. A search of the EPA Queensland Herbarium's Herbrecs database and the Wildlife Online database reveals 22 species listed on the Schedule of the NCA[2]. Four of these species are listed as Endangered, four species as Vulnerable, and 12 as Rare.

Species of conservation significance (derived from database searches) with potential to occur within the study area are listed in **Table 4.2**.

[1] Search area of 10 km radius from site.
[2] Herbrecs search area of 10 km radius from site (17 24' 0" – 17 34' 46.2" S 145 57' 00" – 146 06' 00' E).

Table 4.2: Potential Significant Flora Species

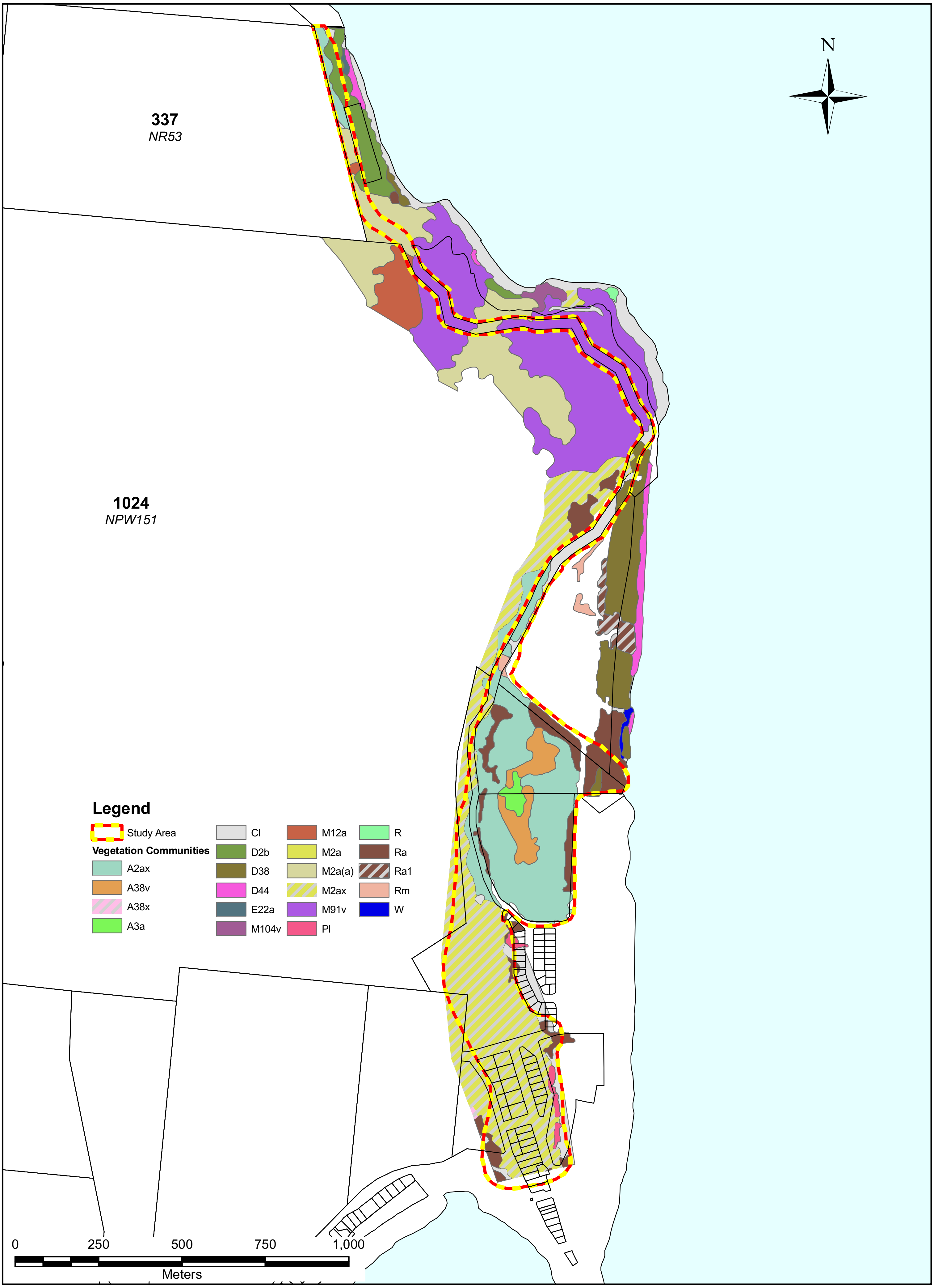
Species Name	Common Name	EPBC	NCA
Aphyllorchis queenslandica			Rare
Aponogeton bullosus		Endangered	
Aponogeton cuneatus			Rare
Aponogeton proliferus		Endangered	Endangered
Arenga australasica	Australian Arenga Palm	Vulnerable	
Canarium acutifolium var. *acutifolium*		Vulnerable	
Carronia pedicellata		Endangered	
Dendrobium mirbelianum	Dendrobium orchid	Endangered	Endangered
Dendrobium superbiens	Dendrobium orchid	Vulnerable	
Dioclea hexandra			Vulnerable
Eleocharis retroflexa		Vulnerable	Vulnerable
Elaeocarpus stellaris			Rare
Endiandra globosa	Ball-fruited Walnut		Rare
Fimbristylis adjuncta		Endangered	Endangered
Garnotia stricta var. longiseta			Rare
Hodgkinsonia frutescens		Vulnerable	Vulnerable
Hupzeria phlegmatioides	A Tassel Fern	Vulnerable	Vulnerable
Hupzeria prolifera	A Tassel Fern	Vulnerable	Vulnerable
Ilex sp. (Gadgarra B.P.Hyland RFK2011)			Rare
Macaranga polyadenia			Rare
Microsorum membranifolium			Rare
Nepenthes mirabilis	Pitcher Plant		Endangered
Phaius tancarvilleae	Swamp Lily	Endangered	
Piper mestonii	Long Pepper		Rare
Polyalthia sp. (Wyvuri B.P.Hyland RFK2632)			Rare
Polyscias bellendenkerensis		Vulnerable	Vulnerable
Pseuduvaria villosa			Rare
Rourea brachyandra			Rare

4.1.2 Floristic Survey

Vegetation Communities

Aerial photographic analysis identifies 10 vegetation communities with a range of geological associations, not including non-remnant classifications. The classification of these communities follows the system devised by Tracey (1982) and Stanton and Stanton (in prep.) for ease of reference to available mapping information. A further descriptor is given within **Appendix 1**, indicating a severely disturbed community whose structural attributes are sufficient to allow retention of a remnant status. This disturbance can be introduced via a range of causes including severe wind disturbance, mechanical disturbance, or weed invasion.

Vegetation communities, community descriptions, and associated landforms are indicated in **Table 4.3**. The spatial distribution of vegetation communities in the study area is provided in **Figure 4.1**.



Biodiversity Assessment AND MANAGEMENT PTY LTD

PART A: TERRESTRIAL FLORA AND FAUNA ASSESSMENT
ACCESS ROAD, ELLA BAY INTEGRATED RESORT

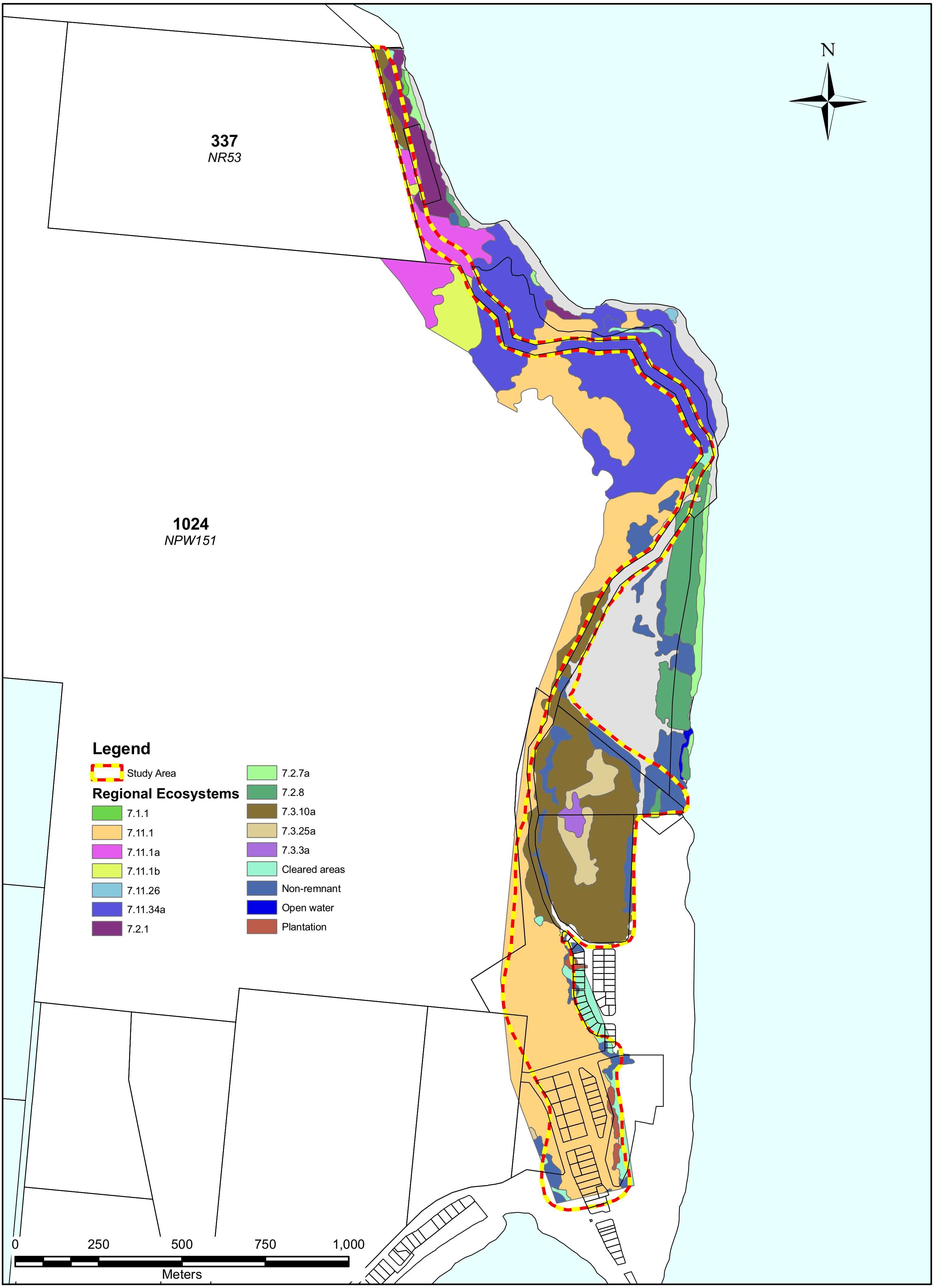
FIGURE 4.1
VEGETATION COMMUNITIES

Table 4.3: Vegetation Communities Within the Access Corridor

Community No.	Description	Landform	Reference Sites
Vine Forest Communities			
A2ax	Mesophyll to complex mesophyll vine forest	Alluvial outwash plains	ELR1
M2a/M2ax	Notophyll to mesophyll vine forest.	Footslopes on metamorphic rocks	ELR9
M2a(a)	Mesophyll to complex mesophyll vine forest	Metamorphic hillslopes	ELR5 ELR8
D2b	Mesophyll vine forest on beach ridges.	Relict parallel beach ridges (D).	ELR4 ELR7
A3a	Mesophyll vine forest with dominant feather palms (*Archontophoenix alexandrae).*	Seasonally inundated lowland swamps/drainage depressions (A).	ELR2
M12a	Notophyll vine forest with dominant *Acacia celsa* (disturbance community)	Metamorphic slopes- mainly ridge crests	API only- Outside area of proposed disturbance
Melaleuca Dominant Communities			
A38v/D38	Tall open forest dominated by *Melaleuca leucadendra.*	Seasonally inundated dune swales (D) and alluvial drainage depressions (A).	ELR2 (peripheral)
Coastal Foredune Communities and Shrublands			
D44	Foredune complex dominated by shrubland and low open forest of *Casuarina equisetifolia.*	Coastal foredune on beach sands (D).	API only- Outside area of proposed disturbance
M91v	Low woodland and open forest of coastal headlands, often dominated by *Lophostemon suaveolens*	Coastal Headland (M)	ELR3 ELR6
Mangrove Communities			
E22a	Closed forest dominated by *Hibiscus tiliaceus* and mixed mangrove species.	Estuarine drainage lines (E)	API and observation only. Outside area of direct impact
Non-Remnant Vegetation Communities			
Ra	Secondary vegetation communities dominated by vine forest species	A variety of lithologies	API and observation only.
Rs	Secondary vegetation communities dominated by vine forest species	A variety of lithologies	API and observation only.
Pl.	Cultivated areas including *Pinus* and eucalypt plantations	A variety of lithologies	API and observation only.

Identified Regional Ecosystems

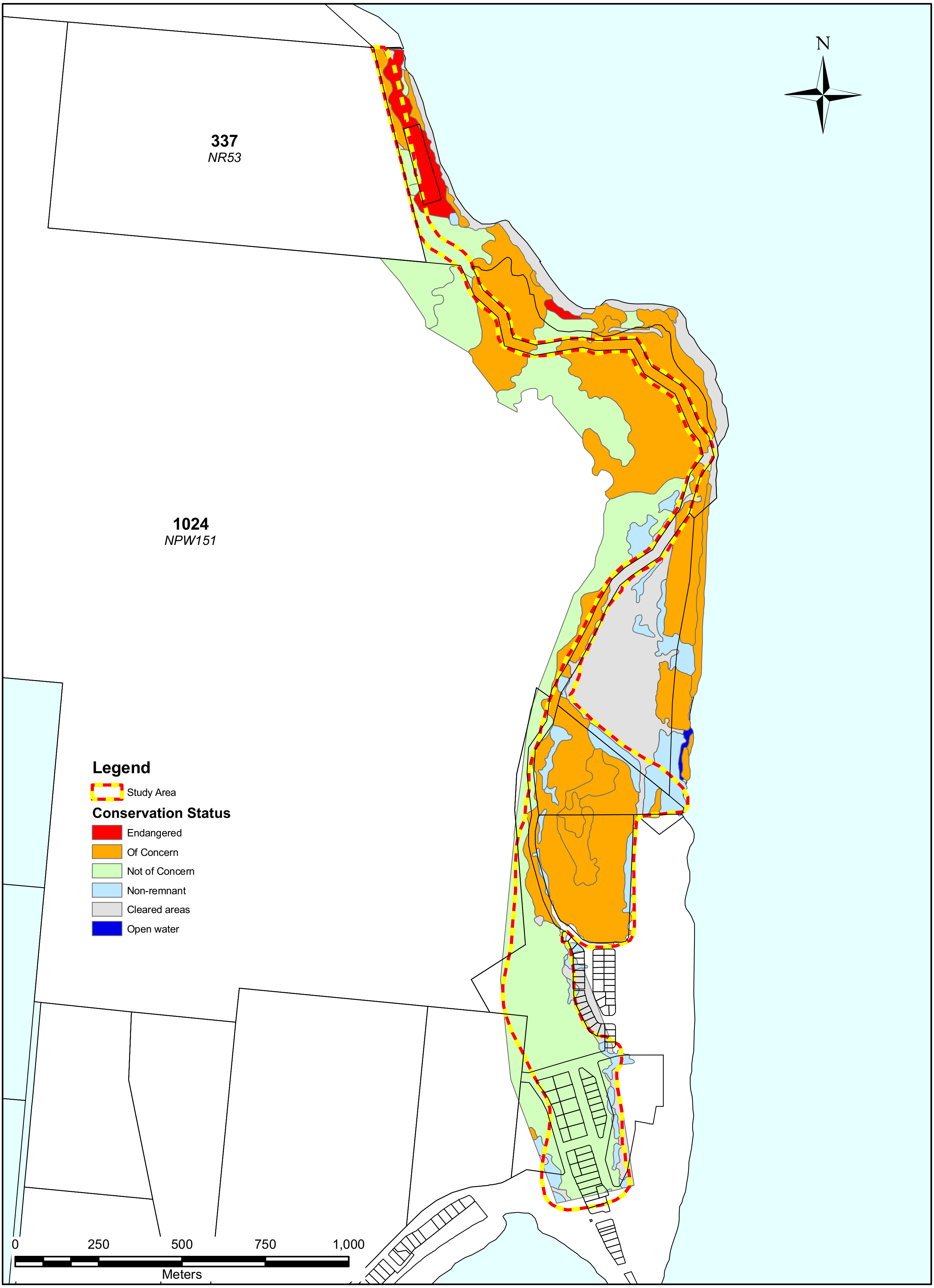
Identified vegetation communities are classified into REs based on structural types and landform associations. (**Table 4.4**). Ten (10) REs are identified on the site, not including floristic sub-communities and non-remnant classifications. Spatial distribution of these REs with their component vegetation communities is provided in **Figure 4.2**. The vegetation management status (VMA) of these REs is illustrated in **Figure 4.3**.



Biodiversity Assessment AND MANAGEMENT PTY LTD

PART A: TERRESTRIAL FLORA AND FAUNA ASSESSMENT
ACCESS ROAD, ELLA BAY INTEGRATED RESORT

FIGURE 4.2
IDENTIFIED REGIONAL ECOSYSTEMS



Biodiversity Assessment AND MANAGEMENT PTY LTD

PART A: TERRESTRIAL FLORA AND FAUNA ASSESSMENT
ACCESS ROAD, ELLA BAY INTEGRATED RESORT

FIGURE 4.3 CONSERVATION STATUS of IDENTIFIED REGIONAL ECOSYSTEMS

Table 4.4: Identified Regional Ecosystems in the Study Area

Regional Ecosystem	Description	Vegetation Management Status	Component Vegetation Communities	Reference Sites
Land Zone 1- Estuarine Muds and Sands				
7.1.1	Mangrove low closed forest to open shrubland	Not of Concern	E22a	API and observation only. Outside area of direct impact
Land Zone 2-Sand Dunes and Dune Swales				
7.2.1	Mesophyll vine forest. Beach ridges and sand plains of beach origin, mainly in small patches in the lee of coastal beach ridges in very high rainfall areas	Endangered	D2b	ELR4 ELR7
7.2.7a	Coastal foredune complex with *Casuarina equisetifolia*	Of Concern	D44	API only-Outside area of proposed disturbance
7.2.8	*Melaleuca leucadendra* (weeping tea tree) open forest to woodland. Sands of beach origin.	Of Concern	D38/D38v	API only-Outside area of proposed disturbance
Land Zone 3- Alluvial plains, riverine flood plains, drainage depression and swamps (excluding dune swales)				
7.3.3a	Mesophyll vine forest with *Archontophoenix alexandrae* (feather palm).	Of Concern	A3a	ELR2
7.3.10a	Simple to complex mesophyll to notophyll vine forest on moderate to poorly drained alluvial plains of moderate fertility.	Of Concern	A2a/A2ax	ELR1
7.3.25a	*Melaleuca leucadendra* open forest and woodland.	Of Concern	A38	ELR2 (peripheral)
Land Zone 11- Metamorphic Rocks				
7.11.1	Simple-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	Not of Concern	M2a	ELR9
7.11.1a	Mesophyll vine forest. Very wet and wet lowlands and foothills.	Not of Concern	M2a(a)	ELR5 ELR8
7.11.1b	Notophyll vine forest dominated by *Acacia celsa*	Not of Concern	M12a	API only-Outside area of proposed disturbance
7.11.26	Rock pavement	Of Concern	M21	API only-Outside area of proposed disturbance
7.11.34a	Complex of shrubland, low heathy or shrubby woodlands or open forests dominated by *Corymbia tessellaris* and *Lophostemon suaveolens*	Of Concern	M91v	ELR3 ELR6

Regional Ecosystem Characteristics and Distribution

Regional Ecosystem 7.1.1: Mangrove low closed forest to open shrubland

Status - Not of Concern (VMA)

A narrow fringe of mangrove woodland is mapped on the seaward breach of a perennial stream in the northern portion of **Section 1**. This community is dominated by *Hibiscus tiliaceus* with a limited range of mangrove species, including *Excoecaria agallocha* indicative of brackish conditions and frequent flushing during high rainfall events. The RE would not be directly impacted during road construction although it may be subject to increased sedimentation associated with stormwater run-off.

Regional Ecosystem 7.2.1: Mesophyll vine forest. Beach ridges and sand plains of beach origin, mainly in small patches in the lee of coastal beach ridges in very high rainfall areas.

Status - Endangered (VMA)

This RE, being a highly restricted type in the Wet Tropics Bioregion, is limited to two linear strips of vegetation, formed on coastal foredunes in the central and northern portions of **Section 1**. Dominant canopy species include *Intisia bijuga, Acacia mangium, Dysoxylum mollissimum, Syzigium forte* subsp. *forte,Calophyllum australianum* and *Beilshmedia obtusifolia.* The ground cover is heavily degraded in some sections with invasion of *Panicum maximum* into disturbed areas, particularly in the vicinity of the council camping grounds. The current unsealed access road skirts the western fringes of this community and direct impacts during road construction would not be expected. The community may however be subject to further degradation associated with facilitated weed invasion along the access route and increased human presence. Changes to the hydrology of streams including flow diversions and channel modification have potential to result in detrimental ecological impact, facilitating erosion of the unconsolidated beach sands which support this community.

Photo 1. Well developed (although degraded) vine forest on coastal foredune at Site ELR 4.

Regional Ecosystem 7.2.7a: Coastal foredune complex with *Casuarina equisetifolia.* Sands of beach origin.

Status - Of Concern (VMA)

Narrow, linear strips of this regional ecosystem occupy coastal foredunes north of the Flying Fish Point Township. The community is located outside the area of proposed impact and has been included in the report to provide an indication of the full range of vegetation communities in the study area.

Regional Ecosystem 7.2.8**:** *Melaleuca leucadendra* (weeping tea tree) open forest to woodland. Sands of beach origin and dune swales.

Status - Of Concern (VMA)

This regional ecosystem occupies a relatively large area behind the coastal foredune at the northern end of Flying Fish Point as well as several minor occurrences on foredunes north of Heath Point. This community would not be impacted during road construction. Several of the areas mapped have suffered severe canopy disturbance related to partial clearing.

Regional Ecosystem 7.3.3a:**-** Mesophyll Vine Forest with *Archontophoenix alexandrae* (feather palms).

Status - Of Concern (VMA)

Feather palm forest is located east of the proposed road corridor in the southern portion of **Section 1** where it occurs on Unallocated State Land (USL 35566). The canopy of this community is dominated by an even mix of feather and fan palms (*Archontophoenix alexandrae* and *Licuala ramsayi* respectively) with *Acmena hemilampra, Acacia mangium* and *Alstonia muellerii.* The type merges with tall *Melaleuca leucadendra* open forest (RE 7.3.25a) with little change in the floristic nature of the sub-canopy and ground covers. The community would not be directly affected by road construction although may be subject to peripheral effects of sedimentation generated as a result of increased stormwater run-off. As this community is a seasonal swamp, it should be avoided in the location of any associated infrastructure including bicycle paths and pedestrian access points.

Photograph 2. Feather palm swamp sampled at site ELR2

Regional Ecosystem 7.3.10**:** Simple to complex mesophyll to notophyll vine forest on moderate to poorly drained alluvial plains of moderate fertility.

Status – Of Concern (VMA)

Rainforest types on alluvium are rare vegetation types in the Wet Tropics Bioregion having been severely impacted by clearing on lowland coastal plains. This community forms a relatively intact (although severely wind disturbed) remnant on USL35566 and NR3550 at the northern end of a road option that bypasses flying fish point within **Section 2** and is traversed by the current unsealed access road at the southern end of **Section 1**. Significant impacts to the integrity of this community would be expected if this option was constructed.

Photograph 3. Wind disturbed mesophyll vine forest on alluvium.

Regional Ecosystem 7.3.25a: *Melaleuca leucadendra* open forest and woodland.

Status – Of Concern (VMA)

Tall *Melaleuca* woodlands on alluvium are located east of the southern portion of **Section 1**, central to the large tract of vine forest on Lot 18 USL35566. The RE is found in association with feather palm forest (RE7.3.3) and is similarly indicative of seasonal waterlogging (seasonal swampland). Direct impacts to this RE would not be expected during construction of **Section 1** or the options within **Section 2**. Indirect impacts associated with increased sedimentation and degradation of ground cover could occur through increased sedimentation. This community provides potential habitat to the Rare (NCA) *Macaranga polyadenia* and may be subject to invasion by Pond Apple.

Photograph 4. RE7.3.25 in swampland adjacent to site ELR2. This community is particularly well developed and largely free of exotic species.

Regional Ecosystem 7.11.1: Simple-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.

Status – Not of Concern (VMA)

This community is relatively extensive in the study area on footslopes and associated colluvial aprons with extensive areas within the western portion of **Section 2,** also forming well developed communities in sheltered locations along **Section 1**. The type has suffered from extreme wind disturbance. Better developed variants located on sheltered gully lines have been mapped as RE7.11.1a whilst those communities with a canopy dominance of *Acacia celsa*, generally indicative of historic wind disturbance, are mapped as RE 7.11.1b. These variants, with the exception of RE 7.11.1b, would be directly impacted by construction of a western route within **Section 2** and widening of the road in **Section 1**.

Photograph 5. Severely wind disturbed mesophyll vine forest on metamorphic rocks at site ELR9. This community is located in the western portion of Section 2.

Regional Ecosystem 7.11.26*:* Rock Pavement Communities

Status – Of Concern (VMA)

Small areas of this RE are mapped in the vicinity of Heath Point where the community is comprised of a mosaic of shrubland and bare metamorphic rock face. The floristic composition of this community has not been determined and communities fall outside the area of direct impact.

Regional Ecosystem 7.11.34a*:* Complex of shrubland, low heathy or shrubby woodlands or open forests dominated by *Corymbia tessellaris* and *Lophostemon suaveolens.*

Status – Of Concern (VMA)

This community occupies steep coastal headlands in the vicinity of Heath Point in the central and central-northern portions of **Section 1.** The type occurs as an open forest dominated by *Lophostemon suaveolens* with a developing vine forest sub-canopy and shrub layer. Canopy heights range from 8 to 15m. Direct impacts would result from construction of **Section 1** through road widening and associated cut into steeper portions of the coastal escarpment. The Rare (NCA, 1992) listed grass *Ichnanthus pallens* was recorded in this community (ELR6) although more fertile material is required to confirm the identification and extent of this species. *Aphyllorchis queenslandica*, a Rare (NCA, 1992) herb, has also previously been recorded in this community (Qld Herbarium Herbrecs extract, 2006).

Photograph 6. Lophostemon suaveolens open forest forming a coastal headland community adjacent to the formed road at Heath Point (corridor Section 1). The community here is mapped as RE 7.11.34.

Recorded Significant Flora Species

Three species recorded in the survey are listed under the NCA as significant species being *Macaranga polyadenia, Endiandra globosa,* and *Ichnanthus pallens. Callyera sp*.(Barrat Creek G. Sankowsky 428) collected in Site ELR 2 (RE 7.3.3) is also considered to be a an extremely significant species, endemic to the region, and previously known from one locality. The Queensland Herbarium holds no floristic material for this species (Bob Jago, pers. comm., 2007). *Ichnanthus pallens* was matched with herbarium specimens although lacked sufficient fertile material to confirm its identification. The identification presented here must be considered preliminary in this regard, and subject to the availability of further fertile material.

Based on site records, the distribution of habitats known to EVR species is provided in **Figure 4.4**. Details regarding the location and habitats of these species are provided as follows:

***Macaranga polyadenia* (No Common Name)**

Status: Rare (NCA) and Not Listed (EPBC)

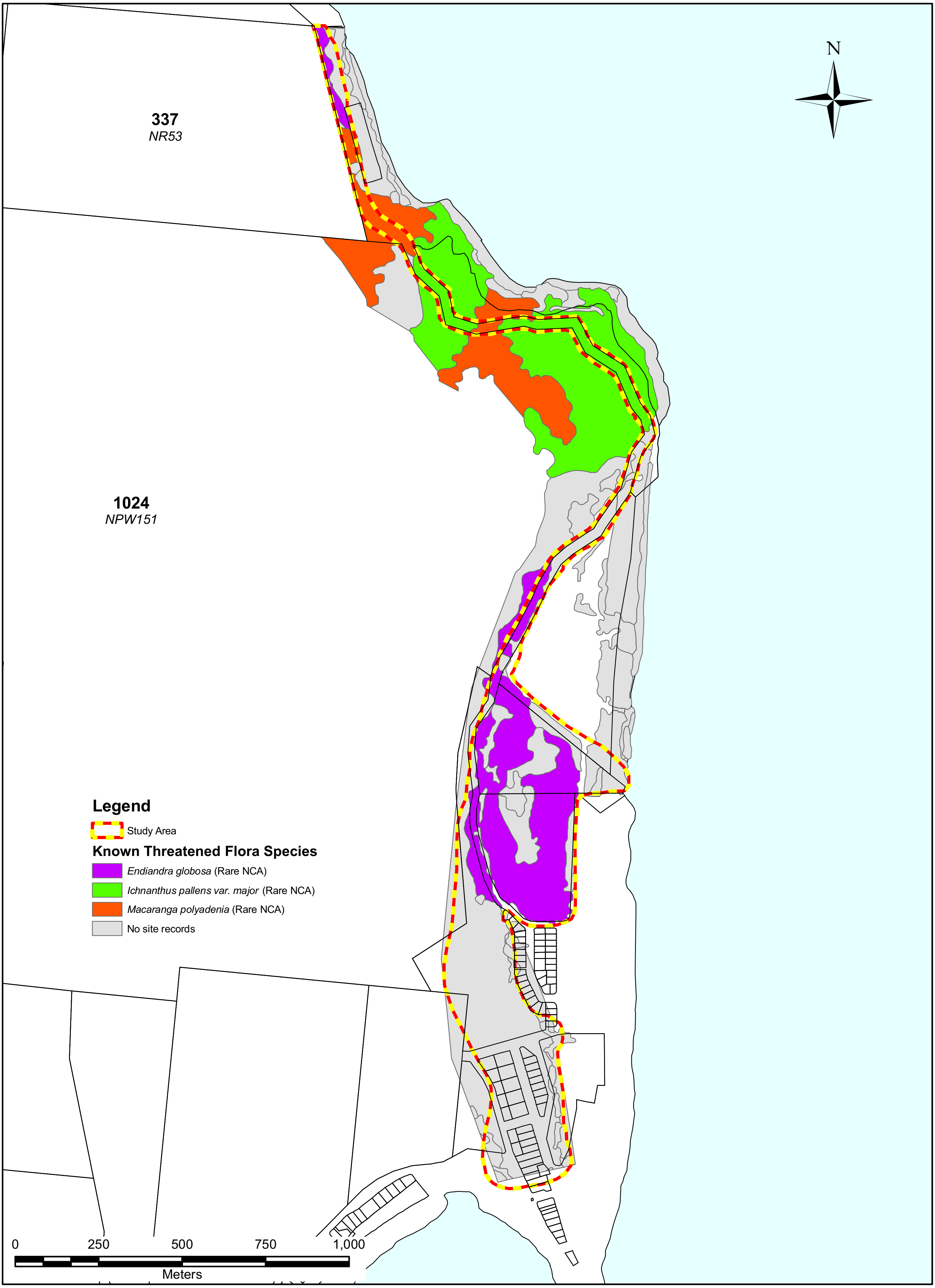
Description: Small tree.

Habitat Preferences: Occurs from near sea level to about 100m in well developed rainforest which is periodically flooded or in situations close to permanent water (Hyland et al. 1993).

Distribution: Occurs in north eastern Cape York Peninsula and north eastern Queensland. Three Herbarium records in the vicinity of the subject site as follows:

- Garadunga in rainforest regrowth;
- Johnstone River, habitat unspecified;
- Warrina Conservation Reserve, Innisfail, in lowland swamp forest.

Distribution on Subject Site: The species was collected in mesophyll vine forest on metamorphic rocks (RE 7.11.1 [Site ELR5]. It also has potential to occur in a range of swamp forest types including RE7.3.3 and 7.3.25 within the study area.



Biodiversity Assessment AND MANAGEMENT PTY LTD

PART A: TERRESTRIAL FLORA AND FAUNA ASSESSMENT
ACCESS ROAD, ELLA BAY INTEGRATED RESORT

FIGURE 4.4
KNOWN THREATENED FLORA SPECIES

***Endiandra globosa* (Ball Fruited Walnut)**

Status: Rare (NCA), Not Listed (EPBC)

Description: A tree to 30m x 40 cm dbh, usually small to medium sized (Hyland 1989).

Habitat Preferences: In north eastern Queensland it occurs in well developed lowland rainforests from sea level to 360m (Hyland 1989; Hyland et al. 1993).

Distribution: Occurs in north eastern Queensland and also occurs in north eastern New South Wales and southern Queensland (Hyland 1989; Hyland et al. 1993). The nine herbarium records are some distance from the subject site:

- Tropical Trials Unit, Pin Gin Hill (6 records);
- Australian Insect Farm, Seymour Range, tributary of Polly Creek, NNW of Daradgee. Complex mesophyll rainforest along creek on krasnozem soil with schist boulders;
- Erbacher property, tributary of Horans Creek, off Hernon road, NW of Innisfail. Complex mesophyll rainforest on a combination of krasnozem and spew clay soil. Canopy of: *Backhousia bancroftiii, Acmena graveolens, Alstonia muelleriana, Cardwellia, Endiandra montana* and *Elaeocarpus grandis*;
- Gregory Falls near Innisfail in complex mesophyll vine forest on basaltic krasnozem.

Distribution on Subject Site: The species was recorded observed in Site ELR1 B5 within wind damaged mesophyll vine forest on alluvium (7.3.10) where its abundance as a shrub and sub-canopy tree was noted as uncommon. Impact to the species would be likely to occur with the construction of a western route within **Section 2** and widening of the existing road alignment in the southern portion of **Section 1.**

Ichnanthus pallens

Status: Rare (NCA), Not Listed (EPBC)

Description: A low prostrate sprawling ground cover.

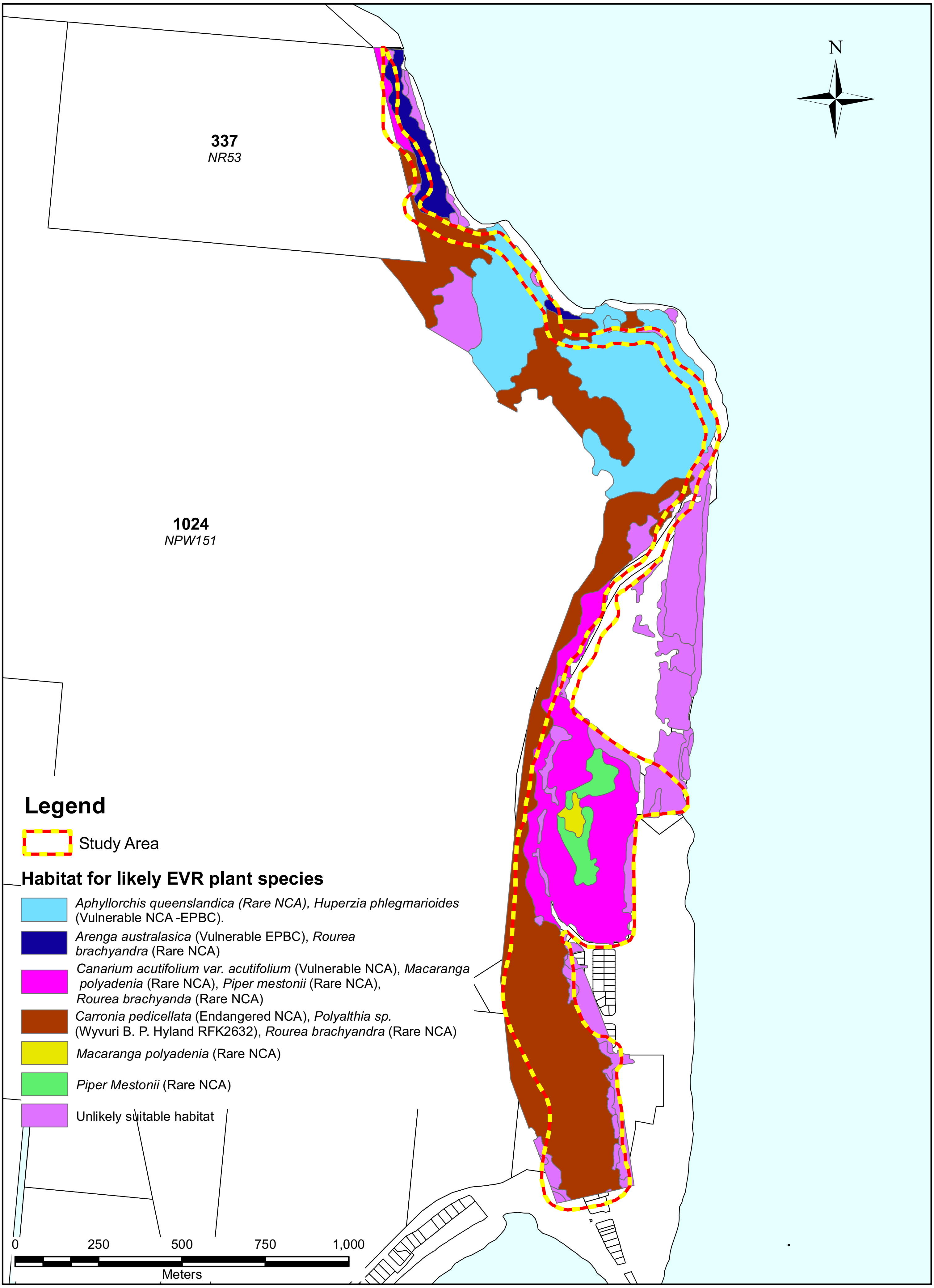
Habitat Preferences: In north eastern Queensland it occurs in ecotonal areas within sclerophyll vine forests and adjacent to vine forest margins.

Distribution: Occurs in the Cook (11 records) and North Kennedy (2 records) districts of northern and central Queensland (EPA, 2007) extending northward into Papua New Guinea. No herbarium records are recorded in the search area.

Distribution on Subject Site: The species was recorded at Site ELR6 within *Lophostemon suaveolens* open forest (RE7.11.34). Additional fertile material is required to confirm identification and species extent within this RE. Impacts to the species would result from road-widening associated with construction of **Section 1**, particularly near Heath Point.

<u>Potential Significant Flora Species</u>

In addition to species discussed above, a number of flora species with special conservation significance are likely to occur with vegetation communities present in the survey area. Habitats for EVR species likely to occur within the project area, although not recorded in the flora survey, are shown in **Figure 4.5** and discussed in **Table 4.5.** The table includes detail on additional species which have a possible occurrence within the project site, although are outside their generally known range or the habitat is marginal, and; significant species known from within the search area but considered not likely to occur within the subject site. The table was compiled with input provided by local botanical experts.



Biodiversity Assessment AND MANAGEMENT PTY LTD

PART A: TERRESTRIAL FLORA AND FAUNA ASSESSMENT
ACCESS ROAD, ELLA BAY INTEGRATED RESORT

FIGURE 4.5
HABITAT FOR LIKELY EVR PLANT SPECIES

Table 4.5: Potential Significant Flora Species

Species Name	EPBC	NCA	Habit	Likely	Possible	Unlikely	Comments
Aphyllorchis queenslandica	Not Listed	R	A herb.	X			Known from a single specimen Herbrecs specimen (Wannan) on a metamorphic hillslope dominated by *Lophostemon suaveolens* at Ella Bay. Highly likely in 7.11.34.
Aponogeton bullosus	E	Not Listed	Rooted, submerged, perennial aquatic.			X	Grows in cool rapidly flowing freshwater rivers and streams. Confined to northern Queensland in fast-flowing rivers on and running off the Atherton Tableland and in the Palmerston, South Johnstone and Mirriwinni districts (Hellquist and Jacobs 1998). Closest known record to subject site is to the north at Josephine Creek near Mt Bartle Frere (S. Jacobs 8249, B.Hellquist, J.Wiersema, 14 Aug 1997, BRI, NASC, NSW) (Hellquist and Jacobs 1998). No Herbrecs record from 10 km radius of subject site. The species was not observed during the survey.
Aponogeton cuneatus	Not Listed	R	Perennial freshwater herb.		X		Two Herbrecs records at Victory Creek near its junction with the North Johnstone River growing in water from 1-2m in depth, and an imprecise record from Innisfail. Note that this species is not recognised in the Revision of the Aponogeton by Hellquist and Jacobs (1998). The species was not observed during the survey.
Aponogeton proliferus	E	E	Perennial freshwater herb.		X		An extremely rare species known only from the Innisfail region in narrow shallow and heavily shaded coastal streams, presumably now restricted because of extensive clearing and habitat loss (Hellquist and Jacobs 1998). One record in Herbrecs from Innisfail district in creek through rainforest (S. Jacobs 7148) (Hellquist and Jacobs 1998). Observations within potential habitat during the field survey did not locate this species. There remains a possibility however that the species occurs within the subject site.
Arenga australasica	V	Not listed	A Palm	X			Known from Type 2b forests in the Mission Beach area and from MVF on basalt at Clump Point to the south of the study area. No Herbrecs records however areas mapped as RE 7.2.1 are considered high potential habitat for this species. Not recorded in Site ERL4 or ERL7. In the absence of additional search effort throughout the community the potential for this species should be considered as high.
Canarium acutifolium var. *acutifolium*	V	Not listed	A tree.	X			Occurs in NEQ and restricted to coastal lowlands between Mossman and Tully between sea level and 100m where it is confined to creek and river banks (Hyland *et al.* 2002). Not observed during the survey however potential habitat exists.
Carronia pedicellata	E	Not listed	A vine.	X			Occurs in NEQ in well developed lowland rainforest between sea level and 150m. Recorded in targeted surveys of proposed Tully – Innisfail 274 kva powerline (http://biotropica.com.au/PROJECTS/targeted.html). No Herbrecs records in the 10km radius search area. Not recorded in this survey however potential habitat occurs within the site in rainforest of metamorphic footslopes (RE7.11.1) and well-developed vine forest on alluvium (RE7.3.10).

Species Name	EPBC	NCA	Habit	Likely	Possible	Unlikely	Comments
Dendrobium mirbelianum	E	Not listed	Epiphytic orchid.		X		Grows on trees or exposed rocks from sea level to 600m often in mangroves and on trees overhanging beaches and in coastal forests (Laverack et al. 2006). One imprecise Herbrecs record from Babinda area. Not recorded in this survey. Potential occurencein RE7.2.1, RE7.11.34 and RE7.1.1.
Dendrobium superbiens	V	Not listed	Epiphytic orchid.			X	No Herbrecs records in the 10km radius search area. Not recorded in this survey.
Dioclea hexandra	Not listed	V	A vine with deep purple red flowers.		X		Occurs in NEQ and PNG from sea level to 50m in lowland rainforest and swamp forest (Hyland et al. 2002). One Herbrecs record from Etty Bay in rainforest and swamps (C.T. White 11691). Potential habitat occurs within the subject site.
Eleocharis retroflexa	V	V	A small tufted and mat-forming sedge.			X	Five Herbrecs records all from Eubanangee Swamp. No suitable habitat within the subject site.
Elaeocarpus stellaris	Not listed	R	A small tree.		X		Endemic to NEQ, restricted to the Alexandra Ck-McDowall Range Area and just south of Mt Bartle Frere on the Nth and Sth Johnstone Rivers where it grows in a variety of well-developed rainforests between 50-500m (Hyland et al. 2002). Three Herbrecs records (2 from Gregory Falls on basalt, and one imprecise record from Innisfail). Not recorded in this survey.
Fimbristylis adjuncta	E	E	A tufted, oblique to erect sedge 4-6 in.			X	A single Herbarium record from Eubenangee Swamp N of Garradunga. No suitable habitat within the study corridor area.
Garnotia stricta var. *longiseta*	Not listed	R	Erect grass with inconspicuous spikelets, rooting at nodes.		X		Two Herbrecs records both located in the Seymour Range, NNW of Daradgee. Habitat is simple notophyll-mesophyll rainforest on poorly drained clay spew derived from schist; and Notophyll-mesophyll rainforest along creek with schist rocks. Similar habitat exists in the subject site in rainforest of metamorphic footslopes.
Hodgkinsonia frutescens	V	V	A shrub.			X	No Herbrecs records from the vicinity of the site. Known from the understorey in upland and lowland rainforest in NEQ and CYP (Hyland et al. 2002). Unlikely to occur as this species generally prefers basalt soils typically in type 5b forests of the Atherton Tableland.
Hupzeria phlegmarioides	V	V	A pendulous epiphyte.	X			In Australia, restricted to north-eastern Qld; also from Indonesia to the Pacific. In Qld, it occurs as an epiphyte in rainforest. Potential suitable habitat in RE7.11.34, 7.3.25 as well as general habitat in the study corridor.

Species Name	EPBC	NCA	Habit	Likely	Possible	Unlikely	Comments
Hupzeria prolifera	Not listed	R	A pendulous epiphyte.			X	In Australia, restricted to north-eastern Qld; also from Indonesia to the Pacific. In Qld, it occurs as an epiphyte in rainforest. Records indicate unsuitable habitat within the subject site (*Flora of Australia* Volume 48 (1998).
Ilex sp. (Gadgarra B.P.Hyland RFK2011)	Not listed	R	A tree.		X		Endemic to NEQ known only from a few collections from Mission Beach, Wyvuri and the Mulgrave River, to Gadgarra on the Atherton Tableland. Grows in well-developed rainforest between sea level and 700m. A single herbarium record from Seymour Range, NNW of Daradgee in SMNVF on clay spew derived from schist, poorly drained. (Herbrecs Data). Similar habitat occurs on the site however not recorded in the field survey.
Nepenthes mirabilis	Not listed	E	A Pitcher Plant.			X	No suitable habitat occurs within the subject site. A number of records well to north in Wyvuri Swamp.
Phaius tancarvilleae	E		Terrestrial Orchid.		X		Potential habitat occurs within the subject site in RE7.11.25. No Herbrecs records. Not recorded in field survey.
Piper mestonii	Not listed	R	A vine.	X			Grows in well developed lowland rainforest between sea level and 350m (Hyland et al. 2002). Two Herbrecs records: 1) 17 km N of Innisfail and 1 km S of Rocky Point, Bramston Beach, in dense mixed swamp forest dominated by *Melaleuca* and *Pandanus*; 2) Eubenangee Swamp. Potential to occur in RE7.3.25 and RE7.3.10. Further pre-construction survey work required.
Polyalthia sp. (Wyvuri B.P.Hyland RFK2632)	Not listed	R	A shrub with glossy simple alternate leaves and fibrous twig bark.	X			Occurs near sea level to 200m in lowland rainforest (Hyland et al. 2002). North eastern Queensland and restricted to the area between Cairns and Innisfail. The plant is known from 16 collections within the Cook botanical district (Henderson 2002) with a single record from the Herbrecs search area at Berner Creek Innisfail (W.R. Petrie 39). Habitat not prescribed. Based on its occurrence in the locality in wind disturbed rainforest on metamorphics in the locality at Jubilee Grove area, this species has a high potential to occur in rainforest on metamorphic foothills particularly in RE 7.11.1.
Polyscias bellendenkerensis	V	V	A tall shrub.			X	Known only from mountain top areas of Bartle Frere, Bellenden Kerr, and Daintree (Hyland et al. 2002). Discounted on the basis of unsuitable habitat.
Pseuduvaria villosa	Not listed	R	An understorey shrub.		X		Endemic to NEQ where it is restricted to between the Nth Johnstone R. and Liverpool Ck in well developed lowland and foothill rainforests frequently on soils derived from basalt. One Herbrecs record from Gregory Falls, Lower Palmerston via Innisfail on basalt and another from Bermer Creek, Innisfail. Not recorded in field survey. CMVF on basaltic krasnozem does not occur within the site.
Rourea brachyandra		Rare	Vine	X			General habitat provided by lowland mesophyll vine forest. High potential in RE7.3.10. 7, 7.11.1 and possibly RE7.2.1.

Exotic Species

A limited number of declared weeds under the provisions of the *Land Protection (Pest and Stock Route Management) Act 2002* (LPA) were recorded within the study area. Sickle Pod (*Senna obtusifolia*), a class 2 weed is prominent along much of the road alignment, particularly in moist fertile areas with sufficient light penetration. This species is known to form dense stands in the open paddocks of the integrated development site. *Lantana camara,* a class 3 weed, forms groves in open forests (RE12.11.34) along the central and northern portions of **Section 1**. Singapore Daisy (*Sphagneticola trilobata)* has invaded foreshore communities, particularly on foreshore dunes to the north of Heath Point.

Of the environmental weeds, Guinea Grass (*Panicum maximum)* is the most destructive, colonizing road margins and penetrating into adjacent woodland and vine forest margins. Snakeweed (*Stachytarpheta sp.)* is a pervasive environmental weed penetrating the margins of the majority of vegetation communities, being particularly prominent on disturbed roadside margins. Full lists of exotic species recorded in the survey are provided in **Appendix 1** with site survey data.

4.2 FAUNA

Species records obtained from the Queensland Museum database, EPA WildNet database, Birds Australia Atlas and EPBC Online Protected Matters Search Tool are listed in **Appendix 2**. These searches are based on a larger area than the study area to capture as many records as possible for the local area.

It should be noted that the EPBC online Protected Matters Search Tool database lists not only those species that have been recorded within the local area, but also those species that might occur, based on the distribution of potential habitat. Therefore, species included in the results of this database search may not actually have ever been recorded from the local area or region.

In total, 27 species listed as Endangered, Vulnerable or Rare under legislation are known from the local area (Queensland Museum Database, WildNet and Birds Australia) or may occur (EPBC Online). This includes five (5) amphibians, two (2) reptiles, 11 birds and six (6) mammals. Endangered, Vulnerable or Rare species within each of these groups are discussed below.

There are an additional two species of concern to the Wet Tropics Management Authority, Spotted-tailed Quoll and Red-legged Pademelon. Williams (2006) mapped the distributions of many of the rainforest vertebrate fauna species found in the WTWHA. The study location is mapped as being within the range of the Red-legged Pademelon but is not mapped as either core or marginal habitat. This, combined with the lack of database records, indicates that the species is very unlikely to be present. The area is considered to provide marginal habitat for the Spotted-tailed Quoll, a species listed as Endangered both at the state and national level.

4.2.1 Endangered, Vulnerable or Rare Fauna Species

Significant Amphibian Species

Five (5) amphibians listed as Endangered, Vulnerable or Rare under legislation were recorded within the local area on public databases (**Table 4.6**). Studies by BAAM Pty Ltd in the local area have confirmed the presence of three species within Seymour Range, *Cophixalus infacetus*, *Litoria genimaculata* and *Litoria rheocola*. All three have been identified within the Ella Bay Resort area and several have been recorded elsewhere within the range (M. Sanders *pers data*).

Table 4.6: Endangered, Vulnerable or Rare Amphibians Known from the Local Area

		Status#		Source*			
Scientific Name	**Common Name**	**NCA**	**EPBC**	**QM**	**WN**	**EPBC**	**Lit**
Cophixalus infacetus		R		X			X
Litoria genimaculata	Green-eyed Treefrog	R			X		X
Litoria nannotis	Torrent Treefrog	E	E			X	
Litoria rheocola	Common Mistfrog	E	E		X		X
Nyctimystes dayi	Australian Lacelid	E	E			X	

* QM = Queensland Museum; WN = WildNet; EPBC = EPBC Online; Lit = Literature
# E = Endangered; R = Rare

Cophixalus infacetus is a small terrestrial frog species that, unlike many amphibians, is not reliant on standing water for tadpole development. Rather, eggs are laid in a moist situation away from water and the entire tadpole development and metamorphosis takes place within the egg membrane (Tyler *et al*. 1995). It is therefore not restricted to waterbodies and can potentially be found in any patch of rainforest. Consequently it is likely to be widely distributed along the road alignment route. It will not be restricted to any one particular area or habitat, but may be more abundant in moist locations such as gully lines.

Litoria genimaculata is a moderate sized treefrog that is restricted to the Wet Tropics region of north Queensland. The species breeds in rainforest streams, usually those with rocky substrates. Studies have demonstrated that tadpoles of *L. genimaculata* are dislodged in fast-flowing turbulent waters (Richards 2002) and hence the species is usually only located breeding in lentic (non-flowing) sections. Richards and Alford (2005) found that individuals located along stream sections were heavily biased towards males in the breeding season, few females were located along streams and most that were located were gravid females. The research suggests that surrounding vegetation may be important to other periods of the species life cycle, although there is no information to date regarding the extent to which this species utilises habitats away from streams.

Litoria genimaculata has been located by BAAM Pty Ltd on the nearby Ella Bay Integrated Resort site. Surveys of habitat along the road alignment have not been undertaken and hence it is difficult to determine if particular habitat characteristics are suitable. However, given the close proximity of records, it is expected that the species will occur within the road alignment. Along the road alignment, it is likely to be most readily observed or detected in conjunction with streams, although as discussed above, surrounding habitats may also be of importance.

Litoria rheocola is a stream dwelling species, similar to *L. genimaculata,* that is restricted to the Wet Tropics region of north Queensland. Unlike *L. genimaculata*, the tadpoles of *L. rheocola* have highly modified suctorial mouth parts which allow them to occupy fast-flowing, turbid sections of streams (Haas and Richards 1998). It is in this situation that most adults are located. The species has significantly decreased throughout its range, particularly in high altitude areas (Ingram and McDonald 1993; Hodgkinson and Hero 2003) but has persisted in lowland areas (McDonald and Alford 1999). It appears that highland declines may be due to infection by an aquatic fungus which causes adult mortality. While other species have been able to survive this pressure, *L. rheocola* has a small clutch size and subsequently less resilience to such pressure.

Litoria rheocola has been located in the adjacent Ella Bay Resort area (BAAM 2006) and suitable habitat is present within the study area. It is therefore likely that this species will occur in suitable streams along any road alignment through this area. Due to the decline of highland populations, lowland populations such as those within the Seymour Range may be of greater long-term importance.

Two other species were listed on the EPBC Online database, *Litoria nannotis* and *Nyctimystes dayi*. Both these species are stream dwelling frogs with similar life histories to *L. rheocola*. All three are sympatric in many locations within tropical Queensland (e.g. Hodgkinson and Hero 2003). *L. nannotis* is known to occur approximately 23 km to the west of the road corridor in Wooroonooran National Park. These factors indicate that both species may occur.

Significant Reptile Species

Two species were located in the database search (**Table 4.7**). One, *Eulamprus tigrinus* has also been recorded one the western slopes of the Seymour Ranges not far from the road alignment corridor (M. Sanders *pers. data*).

Table 4.7: Endangered, Vulnerable or Rare Reptiles Known from the Local Area

		Status#		**Source***			
Scientific Name	**Common Name**	**NCA**	**EPBC**	**QM**	**WN**	**EPBC**	**Lit***
Coeranoscincus frontalis		R		X			
Eulamprus tigrinus		R			X		X

* QM = Queensland Museum; WN = WildNet; EPBC = EPBC Online; Lit = Literature
# R = Rare

Coeranoscincus frontalis is a fossorial species, foraging and sheltering in the upper surfaces of the soil beneath deep leaf litter in rainforests of the Wet Tropics area. It is highly cryptic and difficult to detect. Several surveys may be necessary to confirm the presence of this species. The species was identified as occurring in the region from the Queensland Museum database, which is based on specimens held in their collection. The presence of local records and suitable habitat suggest that the species may occur. It could be present along most areas of the roadway corridor.

Eulamprus tigrinus as a terrestrial rainforest reptile that is often found in association with fallen, rotting logs which provide shelter for the species. It seems highly likely, given the close proximity of records and presence of suitable habitat that this species would occur. In particular, sections of the road that pass through areas of low relief may contain the highest abundance of this species.

Significant Bird Species

Eleven (11) EVR bird species were identified in the database search (**Table 4.8**), more than any other group. However some of these species known from the local area are not likely to occur within the study area due to the lack of suitable habitat. Such species include Cotton Pygmy-goose (*Nettapus coromandelianus*), Black-necked Stork (*Ephippiorhynchus asiaticus*) and Painted Snipe (*Rostratula australis*). These three species are associated with waterbodies, particularly (but not exclusively) freshwater. Red Goshawks *Erythrotriorchis radiatus* and Little Terns *Sterna albifrons* are very scarce within this region and hence they are very unlikely to occur. Any individuals that have been recorded are likely to represent transient records. Both species are highly mobile would not be likely to be affected by the road project.

Table 4.8: Endangered, Vulnerable or Rare Birds Known from the Local Area

		Status#		Source*				
Scientific Name	**Common Name**	**NCA**	**EPBC**	**QM**	**WN**	**BA**	**EPBC**	**Lit***
Casuarius casuarius	Southern Cassowary	E	E	X	X	X	X	X
Nettapus coromandelianus	Cotton Pygmy-goose	R			X			
Esacus neglectus	Beach Stone-curlew	V			X	X		X
Ephippiorhynchus asiaticus	Black-necked Stork	R			X			
Accipiter novaehollandiae	Grey Goshawk	R			X			X
Erythrotriorchis radiatus	Red Goshawk	V	V				X	
Rostratula australis	Painted Snipe	V	V				X	
Sterna albifrons	Little Tern	E	E		X			
Cyclopsitta diophthalma macleayana	Macleay's Fig-Parrot	V			X	X		X
Collocalia spodiopygius	White-rumped Swiftlet	R			X	X		X
Neochmia phaeton	Crimson Finch	V			X	X		X

* QM = Queensland Museum; WN = WildNet; BA = Birds Australia; EPBC = EPBC Online; Lit = Literature
# E = Endangered; V = Vulnerable; R = Rare

Beach Stone-curlews occur along beaches, inlets and estuaries where they forage on a variety of invertebrates and some vertebrates. The species is well known from the Ella Bay beach where it has been recorded in several databases and by BAAM (2006). It is also likely to occur along the beach adjacent to or within the road study area.

Grey Goshawks and Macleay's Fig-Parrots are known to occur in rainforest habitats. Both species are well known from the Seymour Range where they can be located with some ease. The presence of suitable habitat and local records indicate that these species are likely to be present within the study area.

Crimson Finches forage in open habitats where long grass occurs. They are relatively easy to observe in modified agricultural land to the west of the Seymour Range. Suitable habitat along the road corridor is not abundant, but is still present. In particular, areas along the southern portion of the existing road alignment include some open land (in proximity to the sewage treatment plant). These areas are most likely to be suitable for this species. However they cannot be discounted from other locations along the alignment where seeding grass species occur.

The White-rumped Swiftlet is a highly mobile species that can occur over most habitat types including rainforest and cultivated land. They are readily observed around the Seymour Range and are highly likely to be present foraging within the aerial space above the proposed road alignment.

The Southern Cassowary is well known from the local area and is likely to occur. This species is addressed in Moore (2007) and is consequently not considered in this report

Significant Mammal Species

Six (6) mammals listed as Endangered, Vulnerable or Rare under legislation were recorded within the local area on public databases. **Table 4.9** lists mammal species of special conservation significance recorded from databases.

Table 4.9: Endangered, Vulnerable or Rare Mammals Known from the Local Area

Scientific Name	Common Name	Status[#]		Source*			
		NCA	EPBC	QM	WN	EPBC	Lit
Dendrolagus lumholtzi	Lumholtz's Tree-Kangaroo	R		X			
Pteropus conspicillatus	Spectacled Flying-fox	LC	V		X	X	X
Dasyurus hallucatus	Northern Quoll	LC	V			X	
Rhinolophus philippinensis	Large-eared Horseshoe Bat	E	E			X	
Hipposideros semoni	Semons Leaf-nosed Bat	E	V			X	
Saccolaimus saccolaimus	Bare-rumped Sheathtail Bat	E	CE			X	

* QM = Queensland Museum; WN = WildNet; EPBC = EPBC Online; Lit = Literature
[#] LC = Least Concern; CE = Critically Endangered; E = Endangered; V = Vulnerable

One record of Lumholtz's Tree-Kangaroo was noted in the Queensland Museum database. This species occurs in rainforests, but is most common in highland areas. It is not regularly observed in lowland areas. This suggests that while suitable habitat occurs, the likelihood of it occurring within the road corridor is reduced. If present, it is most likely to occur within remnant rainforest.

The Spectacled Flying-fox is well known from the local area and has been recorded nearby at Ella Bay (BAAM 2006). It may be found in a variety of habitats including rainforest, parks and gardens and dry eucalypt forests, wherever suitable foraging resources such as fruits and blossom is present. Resources along the road alignment are generally restricted to fruiting trees. It may occur at any location along the route where these resources are present.

The remaining species, Northern Quoll, Large-eared Horseshoe Bat, Semon's Leaf-nosed Bat and Bare-rumped Sheathtail Bat are not represented by local records, rather they are present within the EPBC Online database which includes species whose distribution overlaps with the area of question. All four of these EPBC listed species can occur in rainforest, but the lack of confirmed local records indicates that they may not be present.

4.2.2 Summary of EVR Species Likelihood of Occurring

Table 4.10 shows the likelihood of each potential EVR vertebrate species occurring within the study area. The species are ranked from Expected to Unlikely. Further survey effort to clarify the occurrence of these species should focus on those species Likely or Possible and take into consideration seasonal variation.

Table 4.10: Likelihood of Occurrence for EVR Species in the Study Area

LIKELIHOOD OF OCCURANCE Scientific Name	**Common Name**	**Status#** NCA	**EPBC**
EXPECTED			
Cophixalus infacetus		R	
Litoria genimaculata	Green-eyed Treefrog	R	
Litoria rheocola	Common Mistfrog	E	E
Accipiter novaehollandiae	Grey Goshawk	R	
Eulamprus tigrinus		R	
Casuarius casuarius	Southern Cassowary	E	E
Cyclopsitta diophthalma macleayana	Macleay's Fig-Parrot	V	
Collocalia spodiopygius	White-rumped Swiftlet	R	
Neochmia phaeton	Crimson Finch	V	
Pteropus conspicillatus	Spectacled Flying-fox	LC	V
LIKELY			
Coeranoscincus frontalis		R	
Esacus neglectus	Beach Stone-curlew	V	
POSSIBLE			
Litoria nannotis	Torrent Treefrog	E	E
Nyctimystes dayi	Australian Lacelid	E	E
Dendrolagus lumholtzi	Lumholtz's Tree-kangaroo	R	
UNLIKELY			
Nettapus coromandelianus	Cotton Pygmy-goose	R	
Ephippiorhynchus asiaticus	Black-necked Stork	R	
Erythrotriorchis radiatus	Red Goshawk	V	V
Rostratula australis	Painted Snipe	V	V
Sterna albifrons	Little Tern	E	E
Dasyurus hallucatus	Northern Quoll	LC	V
Rhinolophus philippinensis	Large-eared Horseshoe Bat	E	E
Hipposideros semoni	Semon's Leaf-nosed Bat	E	V
Saccolaimus saccolaimus	Bare-rumped Sheathtail Bat	E	CE

LC = Least Concern; CE = Critically Endangered; E = Endangered; V = Vulnerable; R = Rare

Table 4.11 indicates the Regional Ecosystems from the study area with which the EVR fauna species are most commonly associated and are most likely to inhabit.

Table 4.11: EVR Species Habitats within the Study Area and Associated Conservation Significance

Scientific Name	**Common Name**	**RE 7.1.1**	**RE 7.2.1**	**RE 7.2.7a**	**RE 7.2.8**	**RE7.3.3a**	**RE 7.3.10a**	**RE 7.3.25a**	**RE 7.11.1**	**RE 7.11.1a**	**RE 7.11.26**	**RE 7.11.34a**	**Non-remnant**	**Plantation**
AMPHIBIANS														
Cophixalus infacetus			X			X	X		X	X			X	
Litoria genimaculata	Green-eyed Treefrog						X		X	X		X		
Litoria nannotis	Torrent Treefrog						X		X	X		X		
Litoria rheocola	Common Mistfrog						X		X	X		X		
Nyctimystes dayi	Australian Lacelid						X		X	X		X		
REPTILES														

Scientific Name	Common Name	RE 7.1.1	RE 7.2.1	RE 7.2.7a	RE 7.2.8	RE7.3.3a	RE 7.3.10a	RE 7.3.25a	RE 7.11.1	RE 7.11.1a	RE 7.11.26	RE 7.11.34a	Non-remnant	Plantation
Coeranoscincus frontalis						X	X		X	X		X		
Eulamprus tigrinus						X	X		X	X		X		X
BIRDS														
Casuarius casuarius	Southern Cassowary		X	X	X	X	X	X	X	X		X	X	X
Nettapus coromandelianus	Cotton Pygmy-goose	Will not occur												
Esacus neglectus	Beach Stone-curlew	X		X							X			
Ephippiorhynchus asiaticus	Black-necked Stork	Unlikely to occur												
Accipiter novaehollandiae	Grey Goshawk		X		X	X	X	X	X	X		X	X	X
Erythrotriorchis radiatus	Red Goshawk	Unlikely to occur												
Rostratula australis	Painted Snipe	Will not occur												
Sterna albifrons	Little Tern	Highly unlikely foreshore/beach species.												
Cyclopsitta diophthalma macleayana	Macleay's Fig-Parrot		X			X	X		X	X				
Collocalia spodiopygius	White-rumped Swiftlet	X	X	X	X	X	X	X	X	X	X	X	X	X
Neochmia phaeton	Crimson Finch											X	X	X
MAMMALS														
Dendrolagus lumholtzi	Lumholtz's Tree-kangaroo					X	X		X	X				
Pteropus conspicillatus	Spectacled Flying-fox		X		X	X	X	X	X	X		X	X	
Dasyurus hallucatus	Northern Quoll		X		X	X	X	X	X	X		X	X	X
Rhinolophus philippinensis	Large-eared Horseshoe Bat	Highly Unlikely to occur												
Hipposideros semoni	Semons Leaf-nosed Bat	Highly Unlikely to occur												
Saccolaimus saccolaimus	Bare-rumped Sheathtail Bat	Highly Unlikely to occur												

Table Key
Highest Conservation Status (NCA and/or EPBC): Green = Critically Endangered
Red = Endangered
Orange = Vulnerable
Blue = Rare

4.2.3 Habitat and Corridor Values

Habitat Values

The largest remnant habitat type within the roadway corridor is rainforest vegetation. Tropical rainforests typically have a tall, dense canopy that reduces light penetration to the ground. This provides abundant shelter and foraging opportunities for arboreal and aerial species within the canopy. Species may feed on insects, leaves or fruit within the canopy.

While the canopy is dense, the understorey can be patchy, often dependant on canopy breaks. In locations were dense vegetation occurs, it provides sheltering opportunities for terrestrial species such as rodents. While sheltering opportunities are present within the community, basking opportunities for reptile species are scarce, generally restricted to ecotonal areas. Consequently reptiles are relatively poorly represented in these dense habitats.

Rainforest habitats along the road alignment are likely to be typical of areas of remnant vegetation in the surrounding areas (i.e. the Seymour Range within Ella Bay National Park). Lowland rainforest habitats have been extensively cleared in the wet-tropics region. Consequently, large remnant tracts such as those within the study area are uncommon and of high conservation value.

Corridor Values

The Seymour Range forms a coast enclave, pinching into the coast at Coopers Point and Heath Point. Extensive vegetation occurs along the Seymour Range and within Ella Bay National Park to the north. Vertebrate movement and dispersal for rainforest species is likely to be restricted to this corridor. The proposed road alignment is located at the very south-eastern tip of this largely vegetated area.

The proposed location of the road alignment does not fragment large areas of habitat the Seymour Range. Rather, minor forested areas and coastal habitats to the east of the alignment would be separated from the core habitat area by a road corridor.

4.3 WORLD HERITAGE VALUES

The Wet Tropics of Queensland, more commonly known as the Wet Tropics World Heritage Area (WTWHA) was inscribed on the World Heritage List in recognition of its outstanding natural universal values (DEWR 2007):

- As an outstanding example representing the major stages in the earth's evolutionary history;
- As an outstanding example representing significant ongoing ecological and biological processes;
- As an example of superlative natural phenomena; and
- Containing important and significant habitats for in situ conservation of biological diversity.

The Wet Tropics World Heritage property lies between Townsville and Cooktown on the north-east coast of Queensland and covers an area of approximately 894,000 hectares. The

Wet Tropics rainforest is just a small fragment of what was once a vast forest stretching all the way to the red centre approximately 65 million years ago. The remaining tropical rainforest retreated to a long narrow strip along the north eastern coast. There are at least 390 species of plants that can be classified as rare or very restricted and, of these, 74 are regarded as threatened (DEWR 2007).

This small remnant of our Gondwanan forest has been fragmented further since European settlement. Significant areas have been cleared for agriculture and urban development, particularly along the coast and on the tablelands (DEWR 2007).

Impacts from this type of external fragmentation can include: restricting the movement of species between habitat fragments; altering historic natural patterns of gene flow among populations; reducing the ability of a populations to adapt and change; reducing seed and pollen dispersal; and impacts on the long term preservation of evolutionary diversity. In addition, species found in 'Island' habitats are more susceptible to extinction (WTMA 2004).

The protection of existing vegetation which supports connectivity between habitats is of the utmost importance and rehabilitation in suitable areas is recommended where feasible. Although rehabilitation is central to the community efforts for restoring biodiversity, it is more cost effective to maintain the existing vegetation and connectivity than it is to undertake detailed rehabilitation of an area. It is equally as important to maintain and/or rehabilitate areas outside or World Heritage Areas to establish landscape linkages for wildlife and vegetation (WTMA 2004).

Internal fragmentation is caused by infrastructure corridors, clearing and/or natural features (i.e. gorges or rivers) which act as a barrier to wildlife movement, disrupt connectivity and provide a means for weed and feral animal invasion. Clearing associated with linear infrastructure such as roads or electricity distribution account for at least 4,475ha, more than half of which are ongoing maintained clearing (WTMAa).

<u>Proposed Access Road</u>

The road alignment is located within the Wet Tropics World Heritage Area. Extending from near Townsville in the south north to near Cooktown, this area is for its high number of endemic species and outstanding biodiversity. Many of the endemic species are restricted to the tops of mountains or individual ranges, occurring nowhere else in the world.

The Seymour Range and associated vegetation has a relatively low altitude by comparison and none of the vertebrate species located within this area are endemic. Rather, most species can be found in other locations within the Wet Tropics Region. However, several species have declined significantly in the Wet Tropics area and now may be more common in lowland rainforest areas such as the Seymour Range. In particular, *Litoria rheocola* has declined significantly in areas above 300m. Furthermore, the Southern Cassowary (*Casuarius casuarius*) has declined generally throughout the region and is now most common in large lowland patches of rainforest including the Ella Bay area. Lowland populations of these species may be important to their long-term survival.

PART B: IMPACT ASSESSMENT OF PROPOSED ROAD ALIGNMENT

5.0 INTRODUCTION

The results of Part A, in conjunction with other relevant documents, reports and legislation, was reviewed by the proponent and a preferred alignment for the access road to Ella Bay was chosen based on the information provided (**Figure 5.1**). This section of the report summarises the potential impacts to flora, fauna and associated habitats specifically for the preferred alignment.

Starting from its southern limit on the Flying Fish Point Road just south of the township, the proposed road alignment traverses approximately 0.94 km of forest, within unallocated state land, where no road currently exists. The alignment then joins with the existing Ella Bay Road alignment north-west of Flying Fish Point, following that road for approximately 3.7 km northwards within road reserve before reaching the southern end of Heath Point, some 2.76km from its starting point. From this location the proposed route runs northward along the existing road alignment to the southern boundary of the Ella Bay Integrated Resort area. The road enters the Wet Tropics World Heritage Area (Zone C) 1.78 km from the starting point of the road and leaves it at 3.63 km.

The proposed road pavement width is 9m, although the clearing width varies with topography. Where the proposed road is aligned with the existing road, clearing is restricted to only those areas necessary for driver safety and road stability. The proposed areas of clearing are:

- New road section (i.e. 0-0.94km) =1.8 ha (0.49 ha of this will be rehabilitated over the cut and cover tunnel). This area is outside of the World Heritage Area.
- Existing road section (outside of the World Heritage Area) = 0.22 ha.
- Existing road section (within Zone C of the World Heritage Area) = .044 ha

The total areas of clearing and associated impacts included in this section are based on documentation provided by the proponent including "Ella Bay Access Road Strategy Preferred Option Clearing Quantities' (ETS Group 2007). An 'Overall Clearing Plan' with regard to the preferred alignment is shown in **Figure 5.2**.

Legend:

- Existing Road
- Approximate stream locations
- Study Area
- Preferred Route Option

Biodiversity Assessment
AND MANAGEMENT PTY LTD

FIGURE 5.1: PREFERRED ALIGNMENT

PART B: PREFERRED ALIGNMENT IMPACT ASSESSMENT
ACCESS ROAD, ELLA BAY INTEGRATED RESORT

FIGURE 5.2
OVERALL CLEARING PLAN

PART B: PREFERRED ALIGNMENT IMPACT ASSESSMENT
ACCESS ROAD, ELLA BAY INTEGRATED RESORT

PRELIMINARY ONLY

Biodiversity Assessment AND MANAGEMENT PTY LTD

ASSOCIATED CONSULTANTS	C & B GROUP
CLIENT	ELLA BAY DEVELOPMENT PTY LTD
PROJECT	FLYING FISH POINT DEVIATION ROAD - ELLA BAY ROAD
LOCATION	ELLA BAY
SHEET TITLE	OVERALL CLEARING PLAN - OPTION A-B-D-E-F
DESIGNED	A.W.S.A.
DRAWN	M.J.M.
CHECKED	
DATE	AUGUST 2007
APPROVED	KEITH HOWELLS RPEQ 7295
SCALE	0 50 100 150 200 250m — 1 : 5000 (A1 SIZE)
JOB CODE	WBPREB01
SHEET NUMBER	Q00
REV	A

DATE	REV	DESCRIPTION	APPROVED
	A	ORIGINAL ISSUE	KPH

REVISIONS

AUSTRALIA
1 SWANN ROAD TARINGA BRISBANE QLD 4068 PH: (07) 3371 7000 FAX: (07) 3371 5679 EMAIL • mail@etsgroup.net.au
17 MONKS CRES BUDERIM SUNSHINE COAST QLD 4556 PH: (07) 5456 4550 FAX: (07) 5456 4582 EMAIL • etsgroup.sc@bigpond.com
PAPUA NEW GUINEA
5TH FLOOR CUTHBERTSON HOUSE PO BOX 908 PORT MORESBY
TELEPHONE (675) 321 1333 FACSIMILE (675) 321 7653
EMAIL • etspng@datec.net.pg
ARCHITECTS · CIVIL & STRUCTURAL ENGINEERS
ETS GROUP
www.etsgroup.net.au

6.0 LEGISLATION AND PLANNING INSTRUMENTS

The environmental planning framework for the Commonwealth and Queensland State includes several pieces of legislation that must be addressed with regard to conservation in and around the subject area.

The project is subject to the assessment process under the *State Development and Public Works Organisation Act 1971* (Qld) and via a bilateral agreement, the assessment incorporates requirements for assessment under the *Environment Protection and Biodiversity Protection Act 1999*.

Other legislation and planning documents applicable to the proposal are the *Nature Conservation Act 1992*, the *Vegetation Management Act 1999,* the *Wet Tropics Management Plan 1998* , the *Land Protection (Pest and Stock Route Management) Act 2002* (LPA) and the *Coastal Protection and Management Act 1995.*

6.1 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

At the Commonwealth level, the *Environment Protection and Biodiversity Conservation Act 1999* recognises Matters of National Environmental Significance relevant to the subject area that will require assessment regarding s impacts to the Wet Tropics World Heritage Area (WTWHA) and/or listed species of conservation significance that may be present in the subject area.

The proposed road works partially traverse the WTWHA in the northern section of the subject area and adjacent to WTWHA in the central section of the subject area. There are 25 threatened and 33 migratory species listed under the EPBC as threatened species that have the potential to occur in the subject area (see **Section 4.0** and **Appendix 2**).

6.2 NATURE CONSERVATION ACT 1992

Planning for the proposed development must address the guidelines and provisions of Queensland's *Nature Conservation Act* 1992 which identifies species of significance at a state level. Several species listed under the NCA either are known or are likely to be found in the subject area (see Section 4.0).

The NCA states that:

> 'Protected wildlife is to be managed to—
> (a) conserve the wildlife and its values and, in particular to—
> (i) ensure the survival and natural development of the wildlife in the wild; and
> (ii) conserve the biological diversity of the wildlife to the greatest possible extent; and
> (iii) identify, and reduce or remove, the effects of threatening processes relating to the wildlife; and
> (iv) identify the wildlife's critical habitat and conserve it to the greatest possible extent; and …'

Protected wildlife is linked to the VMA through the mapping of *Remnant Vegetation* and associated *Essential Habitat* (see Section 5.3). In addition, permits under the Wet Tropics Management Plan 1998 are issued by the Wet Tropics Management Authority for works and require that permits be granted taking into account the impacts to significant species listed under the NCA.

6.3 VEGETATION MANAGEMENT ACT 1999

The purpose of the *Vegetation Management Act 1999* is to regulate the clearing of native vegetation (i.e. remnant vegetation mapped as Endangered, of Concern and Not of Concern) to maintain ecological processes, ensure there is no loss of biodiversity or increase in land degradation from vegetation clearing and manage the effects of clearing. The VMA is implemented through the NRW certified mapping of remnant vegetation as Regional Ecosystems and NRW assessment against the relevant Regional Vegetation Management Codes.

Due to the 'Significant Project Status' under the *State Development and Public Works Organisation Act 1971*, section 26 of this project, clearing of remnant vegetation along the preferred alignment is subject to assessment by the NRW against the Regional Vegetation Management Code for Coastal Bioregions: Part S (NRW 2006). **Table 6.1** demonstrates the compliance with Part S of the abovementioned code.

Table 6.1: Compliance with Part S of the Regional Vegetation Management Code for Coastal Bioregions

Performance Requirement
PRS.1: Limits to clearing To regulate the clearing of vegetation in a way that conserves remnant regional ecosystems, does not cause land degradation, prevents the loss of biodiversity and maintains ecological processes – subject to the limitations required to meet PR S.2 to PR S.10 – clearing is limited to the extent that is necessary for the project, any associated ancillary works, and the operation of works that comprise a project declared to be a significant project under the *State Development and Public Works Organisation Act 1971* section 26.

Performance Requirement	Acceptable Solution *(applicants can propose an alternative solution to meet the performance requirement)*	Proposed Development
PR S.2: Wetlands To regulate the clearing of vegetation in a way that prevents the loss of biodiversity and maintains ecological processes – maintain the current extent of assessable vegetation associated with any natural significant wetland and/or natural wetland to provide – a) water quality by filtering sediments, nutrients and other pollutants; and b) aquatic habitat; and c) terrestrial habitat.	**AS S.2** S.2.1 Clearing does not occur – a) in any natural wetland; and b) within 100 metres from any natural wetland; and c) in any natural significant wetland; and d) within 200 metres from any natural significant wetland.	The proposed clearing does not occur within, or closer than 200 metres to any natural wetland or natural significant wetland.
PR S.3: Watercourses To regulate the clearing of vegetation in a way that does not cause land degradation, prevents the loss of	**AS S.3** S.3.1 Clearing does not occur – a) in any watercourse; and b) within the relevant	The distance specified in Table 1 is 25m from Stream Order 1, 2,3 & 4. Clearing for the proposed road

Performance Requirement	**Acceptable Solution** *(applicants can propose an alternative solution to meet the performance requirement)*	**Proposed Development**
biodiversity and maintains ecological processes – maintain the current extent of assessable vegetation associated with any watercourse to provide – a) bank stability by protecting against bank erosion; and b) water quality by filtering sediments, nutrients and other pollutants; and c) aquatic habitat; and d) terrestrial habitat.	distance stipulated in Table 1, of each high bank of each watercourse.	alignment in the section common with the existing road requires road works at four minor creek crossings north of Heath Point. Minimal additional clearing is proposed in these areas. Bridging structures are preferred over culvert structures to retain existing stream characteristics. In the southern section of the proposed road alignment, clearing of a 9m wide corridor will be required for road construction including clearing of areas within 25m of stream banks. Bridging structures are proposed in these areas to retain the existing stream characteristics.
PR S.4: Connectivity To regulate the clearing of vegetation in a way that prevents the loss of biodiversity and maintains ecological processes – areas of remnant vegetation are – a) of sufficient size and configured in a way to maintain ecosystem functioning; and b) of sufficient size and configured in a way to remain in the landscape in spite of any threatening processes; and c) located on the lot(s) that are the subject of the application to maintain connectivity to remnant vegetation on adjacent properties.	**AS S.4** S.4.1 Where clearing is less than – a) 10 metres wide; or b) 2 hectares Clearing does not i) reduce the width of remnant vegetation to less than 200 metres; and ii) occur where the width of remnant vegetation is less than 200 metres; OR S.4.2 Clearing does not – a) reduce areas of contiguous remnant vegetation to less than 10 hectares; and b) occur in areas of contiguous remnant vegetation that are less than 10 hectares; and c) reduce the width of remnant vegetation to less than 200 metres; and d) occur where the width of remnant remnant vegetation is less than 200 metres; and e) reduce the total extent of remnant vegetation to less	Remnant vegetation to the east of the road alignment where it is common with the existing road will not be further fragmented from the extensive habitats to the west as a result of the proposed road works. A new road section is proposed west of Flying Fish Point through remnant vegetation (REs 7.11.1 Not of Concern and 7.3.10a Of Concern). Proposed clearing in these areas is restricted to a total of 1.78ha in RE 7.11.1, 0.03ha in RE 7.11.1a and 0.19ha in RE 7.3.10a) (see **Section 7.1.2**) This may reduce the width of remnant vegetation to the east to less than 200m. To retain habitat connectivity, it is proposed to construct a cut and cover tunnel which is to be replanted and install a fauna underpass to function as ecological corridors across the road alignment. Vegetation offsets for clearing associated with the project include dedication of significant areas of remnant rainforest to National Park and rehabilitation

Performance Requirement	**Acceptable Solution** *(applicants can propose an alternative solution to meet the performance requirement)*	**Proposed Development**
	than 30%; and f) occur where the total extent of remnant vegetation is less than 30%.	of important habitat connections in the Ella Bay area (Client Ref)
PR S.5: Soil erosion To regulate the clearing of vegetation in a way that does not cause land degradation and maintains ecological processes – the effect of clearing does not result in – a) mass movement, gully erosion, rill erosion, sheet erosion, tunnel erosion, stream bank erosion, wind erosion or scalding; and b) any associated loss of chemical, physical or biological fertility – including, but not limited to water holding capacity, soil structure, organic matter, soil biology, and nutrients within and/or outside the lot(s) that are the subject of the application.	**AS S.5** S.5.1 Mechanical clearing only occurs on – a) stable soils on a slope less than 30%; and b) unstable soils on a slope less than 10%; and c) very unstable soils on a slope less than 1%.	The topography, particularly in the southern section of the road alignment, will require mechanical clearing on slopes that do not meet with the specified acceptable solution. Geotechnical and soils studies will guide road design and will address the performance requirements as per . Queensland Department of Main Roads: Roads in the Wet Tropics: Planning, Design, Construction, Maintenance and Operation Best Practice Manual. An approved Erosion and Sedimentation Control Plan will be prepared and implemented to protect soil characteristics and downstream ecological processes.
PR S.6: Salinity To regulate the clearing of vegetation in a way that does not cause land degradation and maintains ecological processes – clearing does not contribute to – a) waterlogging; or b) the salinisation of groundwater, surface water or soil.	**AS S.6** S.6.1 Where clearing is less than – a) 2 hectares; or b) 10 metres wide; Clearing does not occur in any discharge area. OR S.6.2 Where clearing is less than a) 5 hectares; or b) 50 metres wide – Clearing does not occur – i) in any discharge area; and ii) within 200 metres of any discharge area.	Short, steep catchments such as those along the road alignment have a low salinity hazard. Areas proposed for clearing do not occur within a discharge area, or within 200 metres of a discharge area.
PR S.7: Conserving remnant *endangered* regional ecosystems and *of concern* regional ecosystems To regulate the clearing of	**AS S.7** Clearing only occurs in *endangered* regional ecosystems or *of concern* regional ecosystems that are	The certified RE mapping (NRW 2005) shows the *Of Concern* RE subject to a proposal for clearing of an area greater than 10 metres wide as RE 7.11.25.

Performance Requirement	Acceptable Solution *(applicants can propose an alternative solution to meet the performance requirement)*	Proposed Development
vegetation in a way that conserves remnant endangered regional ecosystems and remnant of concern regional ecosystems – maintain the current extent of *endangered* regional ecosystems and *of concern* regional ecosystems.	not listed in Table 2 and where the clearing within those regional ecosystems is less than – a) 10 metres wide; or b) 0.5 hectares.	The revised RE mapping (3D Environmental 2006a) shows RE 7.3.10a (Of Concern) as being subject to a total of 0.19ha of clearing. This RE is listed in Table 2. (see **Section 7.1.2**) Within this RE clearing will be less than 10m wide.
PR S.8: Essential Habitat To regulate the clearing of vegetation in a way that prevents the loss of biodiversity – maintain the current extent of essential habitat.	**AS S.8** S.8.1 Clearing does not occur in an area shown as essential habitat on the essential habitat map.	The areas proposed for clearing are mapped under the VMA as *Essential Habitat* for the Southern Cassowary (*Casuarius casuarius johnsonii*). The proposed road has been specifically designed to ensure habitat linkages and safe movement opportunities for the Southern Cassowary. Habitat offsets for clearing associated with the project include dedication of significant areas of remnant rainforest to National Park and rehabilitation of important habitat links for the Southern Cassowary in the Ella Bay area (Client Ref)
PR S.9: Conservation Status Thresholds To regulate the clearing of vegetation in a way that prevents the loss of biodiversity and conserves remnant regional ecosystems – maintain the current extent of regional ecosystems listed in Table 3.	**AS S.9** S.9.1 Clearing in a regional ecosystem listed in Table 3, does not occur unless the clearing is less than – a) 10 metres wide; or b) 2 hectares.	The vegetation proposed for clearing areas greater than 10m wide are not listed in Table 3.
PR S.10: Acid sulfate soils To regulate the clearing of vegetation in a way that does not cause land degradation and maintains ecological processes – clearing activities do not result in disturbance of acid sulphate soils or changes to the hydrology of the location that will either – a) aerate horizons containing iron sulfides; or	**AS S.10** S.10.1 Clearing in land zone 1, land zone 3 or land zone 3 in areas below 5 metres Australian Height Datum – a) is carried out in accordance with an acid sulphate soils environmental management plan as outlined in the State	Two areas proposed for clearing for the road alignment are located within landzone 2 and are likely to be below 5m AHD. These areas are located at the northern section of the proposed alignment and immediately south of Heath Point. The Acceptable Solutions as recommended will be applied to the road works.

Performance Requirement	**Acceptable Solution** *(applicants can propose an alternative solution to meet the performance requirement)*	**Proposed Development**
b) mobilise acid and/or metals.	Planning Policy 2/02 Guideline: Planning and Managing Development involving Acid Sulfate Soils; and b) follows management principles in accordance with the Soil Management Guidelines in the Queensland Acid Sulphate Soil Technical Manual.	

Recommendation 1: The identified Regional Ecosystems mapping prepared for this assessment by 3D Environmental has been based on intensive ground-truthing. A request for a mapping amendment should be made to the Queensland Herbarium.

6.4 WET TROPICS MANAGEMENT PLAN 1998

The provisions of the *Wet Tropics World Heritage Protection and Management Act 1993* set out the role for the Wet Tropics Management Authority (WTMA) in managing the World Heritage Area . *The Wet Tropics Management Plan 1998*, developed as a requirement of the abovementioned Act, has established four distinct zones (A, B, C, D) based on integrity, remoteness from disturbance, intended physical and social setting and management purpose of different parts of the area.

The authority must decide the application in a way that minimises the likely impact of the proposed activity on the area's World Heritage values.

The WTMP may issue a permit for roadworks in the Wet Tropics based on the WTMP (2005: Section 65 p35). which states the following:

> (1) The authority may issue a permit to build a road only if building the road under the permit would not have a net adverse impact on the integrity of the area or there is no prudent and feasible alternative.
>
> (2) The authority must, to the greatest possible extent, confine roadworks to land already cleared or otherwise degraded.
>
> (3) The authority may issue a permit for roadworks that will require canopy clearing only if it is satisfied the roadworks—
>
> > (a) are needed for public safety, provision of a community service, access to a residence or an activity the authority considers necessary to properly manage the area under this plan; or
> >
> > b) will reduce the impact on the area's integrity of other activities being carried out or likely to be carried out.

The proposed road alignment passes through areas located in World Heritage Zone C in the northern section of the road alignment and passes within 50m of World Heritage Zone B in the central section of the road alignment.

Zone B is defined in the WTMP (2005:8) as: '…land that is mostly of high integrity but not necessarily remote from disturbance.' It is intended that land included in this area is being restored and/or rehabilitated for future inclusion in zone A.

The WTMP (2002:9) describes this land as:

> Like land in zone A, it has a high degree of ecological integrity and it is in a natural state but is not necessarily remote from disturbance. There is a reasonable expectation that it could be restored to a condition which would qualify for inclusion in Zone A. Visitors can expect solitude and limited evidence of a management presence (infrastructure, etc.). Lands in zone B must:
>
> - be less than 500 metres from all roads, cableways, powerlines, pipelines, towers, mines, quarries and other structure; or,
> - be less than 700 metres from clearings; or
> - include an area of up to 150 hectares of undisturbed habitat;
> - have some obvious signs of disturbance in the last 40 years; and
> - not overlap with Zones A, C and D. (WTMA website)

Zone C is define as (WTMA 2005: 9) '…land on which, or adjacent to which, there is disturbance associated with community services infrastructure.' Land in these areas is mostly natural with some disturbance. The management purpose for land identified as Zone C includes accommodation of community services infrastructure with the intent to minimise impacts that adversely affect the integrity of the zone.

The WTMP (2005:10) describes this land as:

> Land in zone C already contains disturbances, which are often associated with existing community infrastructure. Visitor facilities may be located in this zone. While there is some disturbance in this zone, the land is in a mostly natural state and will be managed to minimise any adverse impact of these facilities and associated activities, while protecting the integrity of the land.
>
> Cleared areas which are associated with existing use rights have been included in zone C. It is intended that the majority of new and existing infrastructure and facilities will be accommodated in this zone and zone D. Zone C includes areas where there are clearings, roads…

Ella Bay National Park is also listed on the Register of the National Estate.

The WTWHA values outlined in **Section 4.3** are compared against plant species known and/or likely to occur in the vicinity of the proposed road works and shown in **Table 6.2**. The information in **Table 6.2** can be included in an application to the WTMA to conduct works in the areas included in Zone C and in the vicinity of Zone B.

Recommendation 2: An application for a permit under the *Wet Tropics Management Plan 1998* must be lodged with the Wet Tropics Management Authority to conduct works in land designated as Zone C and in the near vicinity (i.e. less than 50m) of land designated as Zone B of the WTMP.

Table 6.2: World Heritage Values that may be Relevant in the Study Area

Category	Sub-category	Total numbers of species in Area		
		World Heritage Area	Study Area No.	%
Evolutionary history				
Age of ferns	Earliest living ancestors of two main branches of land plants	16 species	0	(0%)
	Diversity within ancient families of true ferns	41 species	3	(7%)
	Primitive fern families	10 species	3	(30%)
	Area being a major centre of fern diversity	247 species	3	(1%)
	Area being a major centre of endemism for East Gondwanan fern taxa	48 species	2	(4%)
Age of conifers and cycads	Diversity of cone bearing cycads and southern conifers which are the most ancient of living seed plants and were widespread in the Jurassic	7 species	3	(42%)
	Cycads' association with the most primitive pollination systems	7 species	3	(42%)
	Area having the highest diversity of cycad genera in Australia	7 species	3	(42%)
	Diversity of southern conifers in the Area and the Australian sector of Gondwana being considered the site of the austral conifers	4 species	0	(0%)
Age of flowering plants	Richest assemblage of families of primative flowering plants	40 species	25	(62%)
	Species belonging to small, relict primative angiosperm families	98 species	1	(1%)
	Orders occupying nodal positions in the evolution of the angiosperms	221 species	31	(14%)
	Gondwanan angiosperm families of Cretaceous origin	217 species	45	(20%)
	East Gondwanan families or genera	133 species	0	(0%)
Final breakup of the super continent of Gondwana	Relicts of early descendants of Gondwanic frog fauna	15 species	5	(15%)
	Relicts of early descendants of Gondwanic reptile fauna	17 species	8	(47%)
	Relicts of early descendants of Gondwanic bird fauna	1 species	1	(1%)
	Relicts of early descendants of Gondwanic insect fauna	Not yet determined	Not yet determined	
The origins of the Australian scllerophyll flora and marsupial fauna	Ancestral stock from which the sclerophyll Proteaceae and Myrtaceae component of Australia's flora evolved	61 species	15	(24%)
	Ancestral stock from which the sclerophyll Casuarinaceae component of Australia's flora evolved	1 species	0	(0%)
	Ancestral stock from which the sclerophyll Rutaceae component of Australia's flora evolved	26 species	9	(34%)
	Ancestral stock from which the marsupial component of Australia's fauna evolved	38 species	4	(10%)

Category	Sub-category	Total numbers of species in Area		
		World Heritage Area	Study Area No.	%
Evolutionary history				
The origin and radiation of the songbirds	Ancestral lineages of the Passerines (Oscines)	nil	nil	
	Close links with the diverse bird fauna of PNG	nil	nil	
The mixing of the continental biota of the Australian and Asian continental plates	Unique record of the mixing of two continental floras that has no parallel Plants from the Asian plate constituted both old Gondwanan and Asian elements	71 species	6	(8%)
	The unique record of the mixing of two continental faunas	84 species	14	(16%)
The extreme effects of the Pleistocene glacial periods on tropical rainforest vegetation	Evolutionary history is represented by relict taxa that survived the Pleistocene ice ages	13 species	1	(7%)
Significant ongoing ecological and biological processes				
Processes leading to areas of high endemism and speciation	Biogeographic processes leading to areas of high endemism	500 species		
	Speciation processes- disjunct populations within Wet Tropics region	74 species	41	(55%)
	Speciation processes- disjunct populations extra-Wet Tropics region	20 species	5	(25%)
	Processes of genetic differentiation	nil	nil	
	Ecological continua: spectrum of biological diversity present within a range of elevation climate and substrates	To be determined	To be determined	
Superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance				
	Natural phenomena	Not listed		
	Beauty and aesthetics	Not listed		
Important habitats for the in situ conservation of biological diversity including threatened species				
Habitats for conserving biodiversity and rare or threatened species of flora	Vegetation diversity	To be determined	To be determined	
	Plant diversity/ rare or threatened plants	433 species	1	(0.2%)
Habitats for conserving faunal diversity and rare or threatened faunal species	Animal diversity/ rare or threatened fauna	55 species	7	(12%)

6.4.1 Impacts to World Heritage Areas

In the vicinity of the subject site, the WTWHA is adjacent to the eastern boundary of property described as Lot 1024 on NPW151, included in Ella Bay National Park. The north-eastern part of Section A at Heath Point is located within the WTWHA. Southern portions of Section 1 and all of Section 2 are excluded from the WTWHA (Figure X). Impacts to world heritage values in these areas will relate to actions that degrade habitat, resulting in loss of species diversity, including floristic, faunal (including aquatic) and marine habitat values.

Impacts to world heritage values relate to actions that degrade habitat, resulting in loss of species diversity, including floristic, faunal (including aquatic) and marine habitat values. Impacts to World Heritage Values for areas included in WTWHA around Heath Point though the construction, operation and maintenance of an access road to Ella Bay may be facilitated by:

- Vegetation clearing and fragmentation;
- Inhibition or prevention of wildlife movement in important arboreal, terrestrial and aquatic ecosystems;
- Potential increase in ‘Road Kill’ mortality rates;
- Increased access to remote areas;
- The potential for altered water flows and drainage of waterways and wetlands;
- Sedimentation of streams, seasonal wetland habitats, and adjacent marine habitats;
- Landslides and slope instability caused by slope incision and landform interference, directly causing landscape fragmentation and sedimentation;
- Loss of biodiversity through facilitation of weed, pest and disease invasion into adjacent and peripheral vegetation communities; and
- 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.

Any combination of the impacts listed above can act to affect the ecological integrity of the WTWHA. The recommendations made throughout this report are designed to protect the existing ecological integrity of the areas of the WTWHA affected by the proposed road alignment.

Scenic amenity is also an important heritage value that may be impacted during road construction. The potential for long term visible scarring through the removal of vegetation and earthworks on coastal headlands, particularly in the advent of slope instability, needs to be addressed with mitigating measures proposed.

The potential impacts to World Heritage Area values are discussed in more detail in Section 7.0: General Impacts of Roads on Flora and Fauna.

Recommendation 3:The proponent should enter into discussions with the QPWS and WTMA regarding the potential for the proposed road alignment to generate increased visitors to Ella Bay National Park and the Wet Tropics World Heritage Area, and to determine any need for additional infrastructure to protect the environment from increased visitor numbers.

6.5 LAND PROTECTION (PEST AND STOCK ROUTE MANAGEMENT) ACT 2002

The main purpose of this legislation is to provide pest management for land. The LPA lists several species of flora and fauna that are considered Class 1, 2 or 3 pests under the Act. Several species were either recorded and/or are likely to occur in this area. These species are discussed further in **Section 7.4**.

A limited number of declared weeds under the provisions of the *Land Protection (Pest and Stock Route Management) Act 2002* (LPA) were recorded within the study area including Sickle Pod (*Senna obtusifolia*), (class 2), *Lantana camara,* (class 3) and Singapore Daisy (*Sphagneticola trilobata)* (class 3) (**see Section 4.1**).

Of the environmental weeds not listed under the LPA, Guinea Grass (*Panicum maximum* and Snakeweed (Stachytarpheta sp.) are present. Full lists of exotic species recorded in the survey are provided in **Appendix 1** with site survey data

Only one listed feral species was recorded from the Ella Bay Integrated Resort Development Site during the October 2006 survey by BAAM Pty Ltd which was the Feral Pig (class 2).

Recommendation 4: A Weed and Pest Management Plan is prepared for the construction and operational phases of the development. Control measures for Pond Apple and other weed species present (in particular Sicklepod and Lantana) should be incorporated into the Weed Management Plan for both the construction and operational phases of the project. Issue identification, actions, responsibilities and monitoring procedures are to be incorporated into the Plan. The Plan should be in accordance with the Johnstone Shire Pest Management Plan 2004 and in consultation with other relevant agencies including the Johnstone Shire Council, WTMA and QPWS.

6.6 COASTAL PROTECTION AND MANAGEMENT ACT 1995

The *Wet Tropics Coast Regional Coastal Management Plan* (Regional Coastal Plan) (EPA 2003) provides a regional direction for the implementation of the *State Coastal management Plan – Queensland's Coastal Policy* (State Coastal Plan) in the Wet Tropical Coast Region, including Ella Bay. The Plan has been developed by the Queensland Government under the *Coastal Protection and Management Act 1995,* and describes how the costal zone of the Wet Tropical Coast Region is to be managed.

The State Coastal Plan has the effect of a State planning policy under the *Integrated Planning Act 1997* (IPA) and is therefore a matter of State interest. The Plan will be one of the matters that are coordinated and integrated into new planning schemes during their preparation, with regard to and for impact assessment applications, and considered in Ministerial community infrastructure designations.

The Regional Coastal Plan applies to the coastal zone defined as '…coastal waters and all areas to the landward side of coastal waters in which there are physical features, ecological or natural processes or human activities that affect , or potentially affect, the coast or coastal resources' (EPA 2003:3).

The Regional Coastal Plan identifies and incorporates the principles of conserving nature, taken from the Coastal Plan (EPA 2003) into the regional policies for the Wet Tropics bioregion which are listed as:

- 8A: The biological diversity of marine, freshwater and terrestrial systems and the ecological processes essential for their continued existence are conserved;
- 8B: Further loss or degradation of native vegetation on the coast, particularly of endangered regional ecosystems, is avoided wherever possible;
- 8C: Further loss or degradation of coastal wetlands, including the loss of biological diversity and abundance of wetland-dependant wildlife, is avoided wherever possible;
- 8D: Further loss or degradation of coastal habitats for rare, threatened and migratory species, is avoided wherever possible;
- 8E: The biophysical values of coastal dunes are conserved;
- 8F: Opportunities for rehabilitation of degraded coastal resources are included in evaluating management options for those resources; and
- 8G: The Indigenous Traditional Owner peoples' association with components of biological diversity and their traditional knowledge are recognised.

The principles of nature Conservation and, Research and Information relevant to this site are incorporated in the following sections of the Regional Coastal Plan:

- 2.8.1: Areas of State Significance;
- 2.8.3: Biodiversity;
- 2.8.4: Rehabilitation of coastal resources;
- 2.8.5: Pest species management;
- 2.10.3: Monitoring

Under the Regional Coastal Plan, the subject site is within a Key Coastal Site – Key Coastal Site 5: Ella Bay. The key coastal site is:

> *"largely framed by the rugged and forested Seymour Range and incorporates Flying Fish, Heath and Cooper Points, the township of Coconuts and Ella Bay National Park (listed on the Register of the National Estate)."*

Key Coastal Sites have values that are recognised as of regional, state, national and international importance and may have specific coastal management needs. Key Coastal Sites are not regulatory areas that trigger involvement from the State.

However, **Sections 6 and 7** of this report addresses the principles of Nature Conservation for the preferred alignment and the Key Coastal Site 5 Ella Bay.

7.0 GENERAL IMPACTS OF ROADS ON FLORA AND FAUNA

Road construction and operation have both direct and indirect effects on the environment traversed. Clearing for road construction directly removes habitat for flora and fauna, with impacts associated primarily with the loss of species or communities of significance and offsite construction impacts such as sedimentation of waterways. Effects can reach significantly beyond the construction phase, and beyond the site of original impact, specifically:

- Roads can act as a barrier to fauna movement through physical impassibility or though death due to collision with vehicles, with long term implications for fauna populations isolated by roads and local populations of those species vulnerable to vehicle collision;
- Increased light and heat penetration where the canopy is removed, with associated changes to microclimate and shifts in plant species composition within the area of influence, altering fauna populations and favouring the establishment of colonising species and introduced woody weeds, herbs and grasses;
- Where new roads are constructed through previously undisturbed habitat, they can provide access for feral fauna species, with resultant detrimental impacts on ecological processes.
- Changes to stream hydrology and flow regime, resulting in loss of habitat or biodiversity.
- Ongoing erosion, sedimentation and other water quality issues relating to contaminated runoff from road surfaces.
- Landslides and slope instability caused by slope incision and landform interference, directly causing landscape fragmentation and sedimentation.
- Possible noise impacts on fauna populations from passing vehicles.

The following sections examine the potential for these impacts to occur within the subject area, the species that would be affected, and the proposed mitigation measures that would be implemented to ameliorate effects. Residual impacts, those effects that cannot be ameliorated, will be described.

7.1 HABITAT LOSS

7.1.2 Potential Impact on Significant Flora

<u>Significant Flora Communities</u>

The total area of vegetation clearing through the proposed road works is 2.36ha (**Table 7.1).** Of that, Calculations provided here are indicative only, and based on constructed road corridor indicated by the proponent. The preferred road alignment has been overlayed with identified regional ecosystem mapping and is shown if **Figure 7.1**. Clearing areas were calculated from this figure.

Table 7.1: Loss of Vegetation through Clearing along the Preferred Road Alignment

Regional Ecosystem	Conservation Status under the VMA	Proposed Area of Disturbance (ha)
7.11.1	Not of Concern	1.78
7.11.1a	Not of Concern	0.03
7.11.34a	Of Concern	0.31
7.2.8	Of Concern	0.02
7.3.10a	Of Concern	0.19
Cleared Area	n/a	0.01
Non-Remnant	n/a	0.02
Total		**2.36**

The majority of proposed clearing works occur in regional ecosystems mapped as Not of Concern (i.e. RE 7.11.1). There is no clearing proposed for areas included in Endangered Regional Ecosystems.

Recommendation 5: Clearing works should be restricted to the proposed impact area.

Potential Impacts on Significant Flora Species

Potential impacts to known and potential significant flora species associated with the preferred road alignment are listed in **Table 7.2** . The distribution of known significant flora species is shown in **Figure 4.4** and potential species in **Figure 4.5**.

Table 7.2: Impacts to Known and Potentially Occurring Flora Species

Constraint/ Impact	Comments	
	RE	**Location**
Impacts to known Rare species *Endiandra globosa.*	7.3.10a	Significant direct impacts to habitat through road construction in the northern and central portions of the preferred alignment.
Impacts to known Rare species *Macaranga polyadenia*	7.11.1, 7.3.10.	Direct impacts to habitat would be incurred on wetter margins of vine forest, most prominently adjacent to streams. Indirect impacts may occur through degradation of potential habitat through sedimentation RE 7.11.1 is located in the northern sections of the site. Impact to potential habitat only in RE7.3.10, affecting south western areas of the preferred alignment.
Impacts to known Rare species *Ichnanthus pallens*	7.11.34a	Direct impacts to habitat would be incurred in RE 7.11.34, particularly in the heath point area. Indirect impacts to habitat through facilitation of weed invasion is possible (*Lantana camara* and *Panicum Maximum* are likely vectors of habitat degradation*)*.
Impacts to potentially occurring Endangered flora species.	7.3.10	Potential habitat exists for *Corronia pedicellata* (E-EPBC 1999) in RE7.3.10 in the northern and southern portions of the preferred alignment.
Impacts to potentially occurring Vulnerable flora species.	7.11.1, 7.11.34	• Potential habitat exists for *Arenga australasica* (V-EPBC 1999) although no direct impact to this habitat is expected; • Potential habitat for *Canarium acutifolium var. acutifolium* (V-EPBC) is found on drainage lines in RE7.11.1; and • Potential habitat for *Hupzeria phlematioides* (V-EPBC, V-NCA) in a range on coastal habitats including RE7.11.34. Direct impacts to these habitats would be expected.
Impacts to potentially occurring Rare flora species.	7.11.10, 7.11.34	• High potential for impact to *Rourea brachyandra*, Polyalthia sp. (Wyvuri B. P. Hyland) and *Piper mestonii* in suitable habitats including RE 7.11.10; and • High potential for impact to habitat for *Aphyllorchis queenslandica* in RE7.11.34
Impacts to non-EVR significant species	7.3.10a	Potential for direct/residual impacts to *Callyera sp.* (Barrat Creek G. Sankowsyy 428) in suitable habitats in RE7.3.10a.

Recommendation 6: A detailed flora survey of the proposed road alignment and impact area should be undertaken prior to any construction works to determine the presence of any significant flora that may require specific management and/or impact mitigation.

Recommendation 7: A Vegetation Management Plan should be developed to include construction, revegetation, rehabilitation, treatment of listed significant flora, monitoring and maintenance stages of the proposed road works.

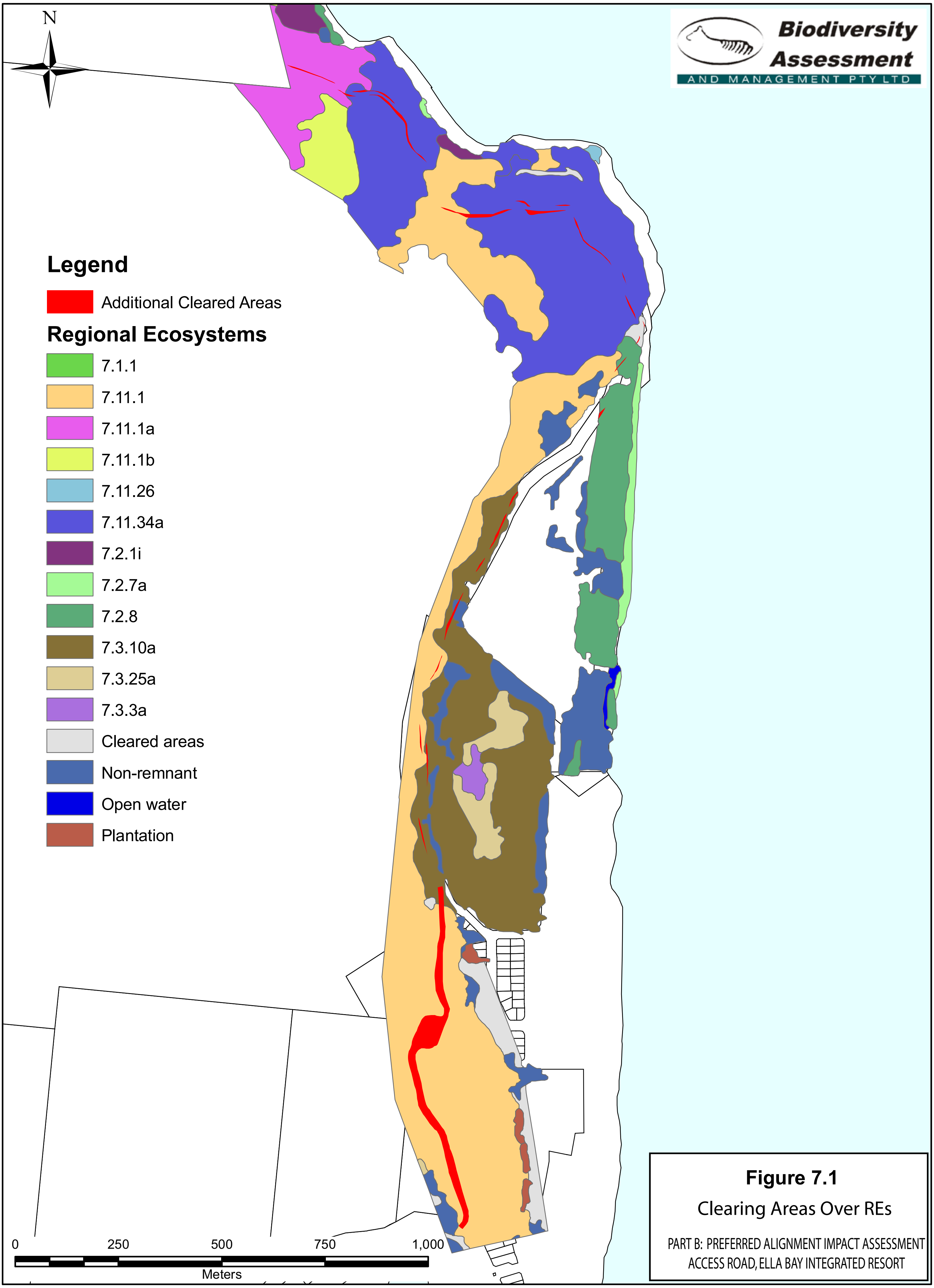


Figure 7.1

Clearing Areas Over REs

PART B: PREFERRED ALIGNMENT IMPACT ASSESSMENT
ACCESS ROAD, ELLA BAY INTEGRATED RESORT

7.1.3 Potential Impact on Significant Fauna

Where habitat is physically removed by machinery, animals can be killed outright, injured or displaced. It is generally the larger, more mobile animals that are able to move to adjacent unaffected areas, although having lost all or part of their home range through clearing, these animals are forced to compete for resources within the home ranges of other individuals. In this way, displacement may eventually also lead to the death of the displaced individuals or their competitors.

The immediate injury or death of individuals during clearing can be reduced through the presence of experienced fauna spotters to flush animals from areas about to be cleared, to identify vegetations supporting nests, etc. for careful lowering and then removing and relocating animals or to halt works until such time as individuals move on from the construction area. The effects associated with displacement of individuals are impossible to ameliorate and can be considered to represent a residual impact of the project.

Regional Ecosystems within the study area representing suitable habitat for each of these significant fauna species are listed in **Table 7.3**.

For the purposes of addressing the relevant legislation, the potential impacts of the project on those species listed under the NCA and EPBC that are known, likely or possibly present within the subject area are listed in **Table 7.4** along with the areas of each species habitat that would be cleared. The table also includes recommendations for the mitigation of impacts expected from clearing for road construction.

Table 7.3: EVR Species Habitats within the Study Area

Scientific Name	**Common Name**	**RE 7.1.1**	**RE 7.2.1**	**RE 7.2.7a**	**RE 7.2.8**	**RE7.3.3a**	**RE 7.3.10a**	**RE 7.3.25a**	**RE 7.11.1**	**RE 7.11.1a**	**RE 7.11.26**	**RE 7.11.34a**	**Non-remnant**	**Plantation**
EXPECTED														
Cophixalus infacetus			X			X	X		X	X			X	
Litoria genimaculata	Green-eyed Treefrog						X		X	X		X		
Litoria rheocola	Common Mistfrog						X		X	X		X		
Accipiter novaehollandiae	Grey Goshawk		X		X	X	X	X	X	X		X	X	X
Eulamprus tigrinus						X	X		X	X		X		X
Cyclopsitta diophthalma macleayana	Macleay's Fig-Parrot		X			X	X		X	X				
Collocalia spodiopygius	White-rumped Swiftlet	X	X	X	X	X	X	X	X	X	X	X	X	X
Neochmia phaeton	Crimson Finch											X	X	X
Pteropus conspicillatus	Spectacled Flying-fox		X		X	X	X	X	X	X		X	X	
LIKELY														
Coeranoscincus frontalis						X	X		X	X		X		
Esacus neglectus	Beach Stone-curlew	X		X							X			
POSSIBLE														
Litoria nannotis	Torrent Treefrog						X		X	X		X		
Nyctimystes dayi	Australian Lacelid						X		X	X		X		
Dendrolagus lumholtzi	Lumholtz's Tree-kangaroo					X	X		X	X				

Table 7.4: Areas of Significant Fauna Habitat Proposed for Removal, Potential Impacts and Mitigation Recommendations

LIKELIHOOD OF OCCURANCE Scientific Name	Common Name	Status# NCA	EPBC	Area of potential habitat proposed for clearing (ha)	DIRECT IMPACTS OF CLEARING AND MITIGATION RECOMMENDATIONS
EXPECTED					
Cophixalus infacetus	Buzzing Nursery-Frog	R		2.15	This species inhabits deep leaf litter in rainforests, and does not require water bodies for breeding. The species is difficult to detect. It would be unable to escape the direct effects of clearing and most individuals present within the road alignment would be lost during the clearing process. Direct searches by fauna spotters through leaf litter immediately prior to clearing may allow for the relocation of some individuals. Relocated individuals and those in the receiving areas would suffer the effects of competition for resources. Overall, within the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region.
Litoria genimaculata	Green-eyed Treefrog	R		2.3	This frog is found within rainforest throughout its range and is usually found among streamside vegetation. Clearing stream habitats has the potential to impact on individuals within the road alignment corridor. Streams and streamside vegetation should be checked, and individuals found relocated prior to clearing or construction activities at these locations. Relocated individuals and those in the receiving areas would suffer the effects of competition for resources. Overall, within the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region.
Litoria rheocola	Common Mistfrog	E	E	2.3	*Litoria rheocola* occurs in lotic streams within mesic vegetation, particularly where riffle zones are present (in the upper stream reaches). Clearing stream habitats has the potential to impact on individuals within the road alignment corridor. Streams should be checked for tadpoles and adults, and those found relocated prior to clearing or construction activities at these locations. Relocated individuals and those in the receiving areas would suffer the effects of competition for resources. Overall, within the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region.
Accipiter novaehollandiae	Grey Goshawk	R		2.47	The species would most certainly be hunting over the area, although the likelihood of a nest occurring within the narrow road alignment is low. If clearing of the alignment is proposed to occur within the breeding time for this species (April to November), fauna spotter should search the alignment

LIKELIHOOD OF OCCURANCE		**Status#**		**Area of potential habitat proposed for clearing (ha)**	**DIRECT IMPACTS OF CLEARING AND MITIGATION RECOMMENDATIONS**
Scientific Name	**Common Name**	**NCA**	**EPBC**		
					specifically for the nests of these species, and nesting trees tagged for avoidance until the birds vacate the nest/s. Overall, provided nesting individuals are protected, in the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region.
Eulamprus tigrinus		R		2.3	This skink species is unlikely to vacate the alignment during clearing and is likely to take refuge within suitable fallen logs, branches, etc. Fallen logs, branches and other suitable sheltering debris should be removed from the clearing corridor by hand (or using machinery where required) and carefully placed in adjacent habitat ahead of clearing activities. In this way, many individuals of this species will be relocated within the debris. Relocated individuals and those in the receiving areas would suffer the effects of competition for resources. Overall, within the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region.
Casuarius casuarius	Southern Cassowary	E	E		See separate report (Moore, 2007)
Cyclopsitta diophthalma macleayana	Macleay's Fig-Parrot	V		2.0	This species feeds on native fruits, therefore the removal of fruiting trees will directly impact on the food resources for individuals whose home ranges includes the road alignment. Replacement of fruiting trees should be undertaken in rehabilitation works. The parrots prefer nesting in trees standing at the edge of rainforest or at the edge of a clearing in rainforest, therefore the areas where the existing road is to be widened should be targeted for searches to identify nesting trees prior to clearing, with the trees being marked for avoidance until after the end of the breeding season 0.45 (May-December). Overall, provided nesting individuals are protected, in the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region.
Collocalia spodiopygius	White-rumped Swiftlet	R		2.47	Caves and rocky outcrops within the road alignment should be checked for nesting birds prior to clearing activities. Where nesting birds are found, these areas should be avoided until after the end of the breeding season (October to April). Overall, provided nesting individuals are protected, in the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region.

LIKELIHOOD OF OCCURANCE		Status#		Area of potential habitat proposed for clearing (ha)	DIRECT IMPACTS OF CLEARING AND MITIGATION RECOMMENDATIONS
Scientific Name	**Common Name**	**NCA**	**EPBC**		
Neochmia phaeton	Crimson Finch	V		0.45	The most likely habitat for this species within the road alignment where it is common with the existing road. Breeding season is September to April, when nests can be found in Pandanus palms and melaleucas, most often only a few meters above ground. If clearing is to occur within the breeding season, proposed disturbance areas along the existing road route should be searched for nesting birds, and nests marked for avoidance until the nest/s are vacated. Overall, provided nesting individuals are protected, in the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region.
Pteropus conspicillatus	Spectacled Flying-fox	LC	V	2.47	This species would feed on fruiting and flowing vegetation within the rainforest habitat. The road alignment should be checked for the presence of camps prior to clearing activities, and these areas should be avoided, with a 100m buffer established between the camp/s and the proposed road. If camps are present, road construction should not occur within the birthing season (September to December). Overall, provided camps are protected, in the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region.
LIKELY					
Coeranoscincus frontalis		R		2.3	*Coeranoscincus frontalis* is a fossorial, limbless skink species, foraging and sheltering in the upper surfaces of the soil beneath deep leaf litter in rainforests. The species is difficult to detect. It would be unable to escape the direct effects of clearing and most individuals present within the road alignment would be lost during the clearing process. Direct searches by fauna spotters through leaf litter immediately prior to clearing may allow for the relocation of some individuals. Relocated individuals and those in the receiving areas would suffer the effects of competition for resources. Overall, within the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region.
Esacus neglectus	Beach Stone-curlew	V		0	This species is associated with shandy shorelines and beach dunes and as such its habitat would not be directly affected by clearing, although the noise of construction activities may result in short term disturbance. Clearing and construction activities should not be carried out in close proximity to beach areas (i.e north of Heath Point) during breeding season (September to November).

LIKELIHOOD OF OCCURANCE Scientific Name	Common Name	Status# NCA	EPBC	Area of potential habitat proposed for clearing (ha)	DIRECT IMPACTS OF CLEARING AND MITIGATION RECOMMENDATIONS
POSSIBLE					
Litoria nannotis	Torrent Treefrog	E	E	2.3	*Litoria nannotis* is associated with waterfalls and cascades in rainforest streams. While it is known that a small waterfall is located immediately west of the existing road north of Heath Point, this has not been inspected for the presence of the species. The entire road alignment should be assessed for the presence of likely habitat – specifically within the southern section, where a new section of road is proposed. The road alignment should avoid these habitats where they occur.
Nyctimystes dayi	Australian Lacelid	E	E	2.3	This frog species is dependent on streams for breeding, although can be found in nearby habitats. Clearing stream habitats has the potential to impact on individuals within the road alignment corridor. Streams should be checked for tadpoles and adults, and those found relocated prior to clearing or construction activities at these locations. Relocated individuals and those in the receiving areas would suffer the effects of competition for resources. Overall, within the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region. This species will need to be excluded from the road surface.
Dendrolagus lumholtzi	Lumholtz's Tree-kangaroo	R		2.0	One record of Lumholtz's Tree-Kangaroo for the local area was noted from the Queensland Museum database. This species occurs in rainforests, but is most common in highland areas. It is not regularly observed in lowland areas. This suggests that while suitable habitat occurs, the likelihood of it occurring within the road corridor is reduced. If present, it is most likely to occur within remnant rainforest. Fauna spotters should work ahead of clearing to identify the presence of individuals within the road alignment, and clearing should not occur until such time as the individuals are moved on. Overall, within the context of the extensive surrounding habitat, the loss of habitat within the road alignment will not endanger a safe future for this species in the local area or in the region.

Recommendation 8: Fauna spotters required for all vegetation clearing and works in waterways:

- **Fauna spotters should work ahead of clearing to identify the presence of individuals within the road alignment, and clearing should not occur until such time as the individuals are moved.**

- **Recommendation   Fallen logs, branches and other suitable sheltering debris should be removed from the clearing corridor by hand (or using machinery where required) and carefully placed in adjacent habitat ahead of clearing activities.**

- **Caves and rocky outcrops within the road alignment should be checked for nesting birds prior to clearing activities. Where nesting birds (i.e. Macleay's Fig Parrot) are found, these areas should be avoided until after the end of the breeding season (October to April).**

- **The road alignment should be checked for the presence of camps (i.e. for the Spectacled Flying Fox) prior to clearing activities, and these areas should be avoided, with a 100m buffer established between the camp/s and the proposed road. If camps are present, road construction should not occur within the birthing season (September to December).**

- **Direct searches by fauna spotters through leaf litter immediately prior to clearing may allow for the relocation of some individuals (i.e. reptiles, particularly *Coeranoscincus frontalis*)**

- **Streams should be checked for tadpoles and adults of *Nyctimystes dayi* Australian Lacelid, and those found relocated prior to clearing or construction activities at these locations . This species will need to be excluded from the road surface.**

Recommendation 9: Clearing and construction activities should not be carried out in close proximity to beach areas (i.e north of Heath Point) during breeding season (September to November).

Recommendation 10: Waterfalls and cascades provide habitat for the Torrent Treefrog (*Litoria nannotis*). The road alignment should avoid these habitat types where they occur.

Recommendation 11: Prior to any works commencing, a detailed fauna assessment is required to be undertaken along the precise route to identify specific habitat features to be avoided or managed during construction.

7.2 Barrier to Fauna Movement

The existing road, situated adjacent to the far eastern boundary of Ella Bay National Park and the World Heritage area, does not currently represent a significant barrier to fauna movement in that:

- There is only a narrow strip of rainforest habitat located between the existing road and the coastline, therefore there is no major corridor interruption;

- The existing road is narrow and therefore has many areas where the canopy is closed above the road surface; and
- The existing road is a low-use road, currently carrying very little traffic.

Where this section of road is proposed to be upgraded, although the proposed clearing is minimal and canopy can be retained across portions of the road and although the road is not located within a major fauna movement corridor, local fauna populations will be affected by the physical presence of the road and an increased likelihood of road death due to higher traffic volumes.

To counter these effects, it is proposed to fence the road to separate fauna from the road surface and to funnel fauna to underpass areas beneath the road. The road is also planned to be a low speed road. Fauna collisions are less likely at lower speeds, and with appropriate warning signage, unfenced areas of the road are likely to represent low risks for crossing fauna.

Recommendation 12: It is recommended, in areas where there is no canopy connection over the roadway, that rope bridges are fixed between trees on either side of the gap to further accommodate the passage of arboreal fauna. The number of rope bridges required would need to be determined following completion of the proposed works.

The proposed fauna underpasses would be constructed in association with locations where the road crosses creeklines. Careful bridging at these locations, with minimal mechanical disturbance, is required to maintain creek morphology and ensure that frog and aquatic flora and fauna habitats are not affected.

Recommendation 13: Benchmark studies and on-going monitoring and management of waterway health are required at these locations, particularly during times of high rainfall, to ensure that the creekbanks are stable and that roadworks do not initiate erosion.

Populations of frog species *Nyctimyste*s *dayi* the on either side of the road would be restricted to movement through underpass areas. Recent research for the Tugan Bypass project in northern New South Wales has developed a form of frog-proof fencing for acid frog species (BAAM 2005).

Recommendation 14: The frog species *Nyctimyste*s *dayi* – which is not restricted to waterways and their surrounds, will need to be excluded from the road surface. Specific investigations would be required to determine a fencing type capable of excluding *Nyctimystes dayi.*

The Agile Wallaby (*Macropus agilis*) is likely to be the species most often encountered along the northern-most section of the alignment. This species will cross the road to move between habitat areas, and the presence of grassed verges is an attractant to this species, and it may frequent roadside locations. Lower road speeds and warning signs will reduce the risk of vehicle strike in unfenced areas.

Due to their mobility and ability to fly across road corridors, the majority of bird and bat species would be unaffected by the location of the access road, and it will not significantly sever habitat connections. Although for ground-dwelling species, such as the Orange-footed Scrubfowl (*Megapodius reinwardt*), movement will be restricted to underpass areas.

In the southern portion of the alignment where the construction of a new road is required through rainforest habitat which is outside of the National Park and World Heritage Area, the construction of a cut and cover tunnel is proposed. This construction method places the road beneath the natural ground surface, with soil replaced above the tunnel, and revegetated to facilitate safe fauna movement. The remainder of the road is fenced to separate fauna from the road surface and funnel movement towards the overpass area.

Once again, for this section of road it is important to retain canopy connection across the road where possible, and to join the canopies in gap areas with rope bridges.

Recommendation 15: The proposed overpass (i.e. located at cut and cover tunnel), underpass structures (i.e. opposite Flying Fish Point Reserve and also located at creek crossings along the alignment) will need to be monitored for their effectiveness and providing safe crossing opportunities for the range of fauna species present.

7.3 EDGE EFFECTS

The impacts of the proposed road improvements in association with the existing road alignment are not expected to contribute significantly to existing edge effects. However, to the south, the proposal requires construction of a new road section.

The closed canopy of a rainforest provides a microclimate suitable for its specialized floral and faunal inhabitants. In areas where gaps are created in the canopy, such as when large trees fall or where there is storm damage, light and heat penetrate to the forest floor, triggering the germination of early successional stage species which flourish in the sunlight, and in turn create a microclimate within which later successional stage species can establish and eventually close the canopy gap.

Where clearings are more permanent, the pioneer or edge species are able to persist as long as sunlight is available. The seeds of weeds may be introduced by birds, allowing weeds to become established within the clearing, preventing recruitment of rainforest species, and potentially penetrating into the adjacent forest for some distance.

Adjacent to the Palmerston powerline clearing within the WTMA, Goosem and Turton (2000) found that edge-induced changes in floristic composition penetrated the rainforest to a distance of 3-7m, with early successional stage rainforest species more prevalent, and that floristic composition was altered further into the rainforest to distances varying between 25 and 45m.

Where clearing is for a road, the permanency and extent of the resulting canopy gap also creates extensive, lineal edges from which the effects radiate into the adjacent rainforest vegetation. On roads, these effects are compounded by the capacity for their long term use to continually introduce weeds and pathogens to the roadside environment.

For the proposed 9m width road, the edge effects will potentially impact on a 100m corridor (approximately 45m either side of the road shoulders). Although most apparent at the road edge, the potential effects within this zone of influence are:

- Alteration to vegetation community composition, favouring early successional species. This effect would weaken with distance from the road edge.

- Altered drainage conditions and soil characteristics that may result in stress to or the eventual death of plant species sensitive to such changes.
- The introduction and establishment of weed species. The weeds most likely to establish are those listed in Table 7.5, recorded from the existing roadside within the study area.
- The establishment of fire increasing species, such as Guinea Grass, adjacent to fire-sensitive rainforest vegetation.
- Corresponding alteration to fauna habitats would be expected. Goosem and Turton (2000) found that grassland and feral small mammals can intrude along the grassy and woody weed verges of a narrow road traversing rainforest – although they failed to penetrate the rainforest.

Mitigation measures can be implemented to reduce or eliminate some of these impacts. In particular, the maintenance of canopy cover over the road would reduce light and heat penetration, making roadsides unsuitable for the establishment of weed species and preventing or reducing the predicted impacts on vegetation community composition along the roadsides. As a consequence, the roadside verges would not provide suitable habitat for grassland or exotic mammal fauna.

Where canopy cover cannot be maintained over the road, the subsequent effects would require monitoring and management for the life of the road. In particular, rehabilitation of disturbed roadsides with rainforest vegetation and the implementation of a weed management program would be necessary.

It should be noted that for some of the significant fauna species present or likely to be present, roadside environments can create habitat opportunities. For instance:

- The White-rumped Swiftlet is known to nest within man-made structures and may make use of retaining walls, pipes and other road infrastructure;
- Macleay's Fig-Parrot prefers nesting in trees at the edge of rainforest clearings, as such it may make use of roadside habitat.
- The Crimson Finch makes use of open areas adjacent to rainforest habitat. Grasses and low, dense vegetation within roadside areas would provide resources for this species.
- Skinks and other reptiles may make use of man-made structures in clearings for basking purposes.

Recommendation 16: It is recommended that the canopy cover be maintained where possible along the preferred road alignment. On-going monitoring and maintenance to minimise edge effects is required for areas along the preferred alignment where the canopy cover cannot be maintained along the road.

Recommendation 17: It is recommended that disturbed areas along the roadside be rehabilitated using rainforest species as part of the Vegetation Management Plan. Seed stock should be of local provenance.

7.4 PEST SPECIES

7.4.4 Weed Species

Table 7.5 lists the weed species that were recorded from the subject area (**Recommendations 3, 15 and 16**). These are the species that are most likely to colonise disturbed areas within the road alignment corridor.

Table 7.5: Recorded Weed Species from the Subject Area

Species Name	Common Name
Axonopus compressus	Broadleaf Carpetgrass
Carica papaya	Papaya
Commelina ensiifolia	
Crassocephalum crepidioidesare	Thickhead
Lantana camara (Class 3 Pest)	Lantana
Mangifera indica	Mango
Mecardonia procumbens	Baby Jump-up
Mimosa pudica	Sensitive Plant
Panicum maximum	Guinea Grass
Passiflora foetida	Stinking Passion Vine
Senna obtusifolia (Class 2 Pest)	Sicklepod
Sida rhombifolia	Paddy's Lucern
Solanum mauritianum	Wild Tobacco
Sphagneticola trilobata (Class 3 Pest)	Singapore Daisy
Stachytarpheta cayennensis	Cayanne Snakeweed
Tristemma mauritianum	
Urena lobata	Urena Weed

7.4.5 Feral Fauna Species

Only two feral species were recorded from the Ella Bay Integrated Resort Development Site during the October 2006 survey by BAAM Pty Ltd. These were the Feral Pig and House Mouse.

Harrison and Congdon (2002) describe the Feral Pig as the highest profile pest of the Wet Tropics Bioregion, destroying habitats, competing directly with endangered fauna for resources, and transmitting disease and parasites. It is also one of the most difficult pest species to control.

It is not considered that the upgrading of the existing road and construction of a new section of road in the southern section of the alignment will significantly advantage Feral Pigs as they are easily able to infiltrate rainforest habitat without the aid of roads. However, as Feral Pig control is a priority management issue within the Wet Tropics Bioregion, the proponent should consider consultation with the relevant management authorities (including Johnstone Shire Council, WTMA and QPWS) to coordinate activities for the monitoring and management of the species (see **Recommendation 4**).

Harrison and Congdon (2002) consider the House Mouse to have a low to moderate impact potential in that it does not have sufficient grain resources in the bioregion to become a serious pest and it's population may be held in check by competition from native rodents.

There are a number of species considered by WTMA (1998) to be current or potential pests within the bioregion. These are listed in **Table 7.6.**

Table 7.6: Vertebrate Pests of the Wet Tropics Bioregion (WTMA 1998)

Family	**Common Name**	***Scientific Name***
Poeciliidae	Gambusia	*Gambusia holbrooki*
Poeciliidae	Guppies	*Poecilia reticulata*
Poeciliidae	Swordtails	*Xiphorphorus hellerii*
Poeciliidae	Platys	*Xiphorphorus macularta*
Cichlidae	Tilapia	*Tilapia mariae*
Cichildae	Tilapia	*Oreochromis mossambicus*
Bufonidae	Cane Toad	*Bufo marinus*
Gekkonidae	Asian House Gecko	*Hemidactylus frenatus*
Columbidae	Rock Dove	*Columba livia*
Columbidae	Spotted Turtle-dove	*Streptopelia chinensis*
Passerdiae	Nutmeg Manikin	*Lonchura punctulata*
Passeridae	House Sparrow	*Passer domesticus*
Sturnidae	Common Myna	*Acridotheres tristis*
Muridae	House mouse	*Mus musculus*
Muridae	Brown Rat	*Rattus norvegicus*
Muridae	Black Rat	*Rattus rattus*
Canidae	Dog	*Canis familiaris*
Canidae	Dingo	*Canis familiaris dingo*
Canidae	Red Fox	*Vulpes vulpes*
Felidae	Cat	*Felis catus*
Leporidae	Rabbit	*Oryctolagus cuniculus*
Leporidae	Brown hare	*Lepus capensis*
Equidae	Horse	*Equus caballus*
Suidae	Pig	*Sus scrofa*
Cervidae	Rusa Deer	*Cervus elaphus*
Cervidae	Fallow Deer	*Dama dama*
Cervidae	Chital Deer	*Cervus axis*
Bovidae	Goat	*Capra hircus*

Cats and Dogs (including Dingos) are also listed by Harrison and Congdon (2002) as difficult to control species with high impact potential. Where the proposed road alignment is common with the existing road it is not expected that any advantage will be offered to these species. Where a new section of road is proposed in the southern section of the alignment the roadway will provide access for these species to new habitats. Fencing along the roadsides to guide fauna to crossing points may alleviate this potential to some degree. It is recommended that monitoring of vertebrate pest species is undertaken once the road is constructed to guide any necessary pest animal control programs (see **Recommendation 4**).

None of the fish species listed were recorded from the Ella Bay Development Site (BAAM 2006), and they may not be present in creeks along the road alignment.

Recommendation 18: To determine if pest fish species are present it will be necessary to survey the fish populations in creeks along the road alignment and monitor species composition during and following road construction.

Recommendation 19: Community awareness is also an important measure in the prevention of introduction of exotic fish species to waterways. The residents within the proposed integrated resort development and existing residents in the township of Flying

Fish Point should be included in an awareness program that could be coordinated with local government.

7.5 ROAD NOISE

Goosem and Turton (2000) examined the penetration of vehicle noise into wet tropical rainforests, and found that vehicular noise penetrates well over 100m into the rainforest at levels that may contribute to the degradation of habitat for some species of fauna. They recommended that, as the relationship between noise and faunal behaviour is uncertain, the precautionary principle has been invoked to suggest that a minimum 200m buffer zone could be modeled in the Wet Tropics Management Authority geographical information system to delineate a possible disturbance zone.

Using a 200m buffer distance, road noise from the proposed alignment would impact on Zone B of the World Heritage Area for much of the length of the road.

Recommendation 20: It is recommended that "quite asphalt (e.g. Stone Mastic Asphalt is used in road construction) and that some level of noise control be incorporated into the fauna fencing design to reduce potential noise effects. Noise modelling would be required to formulate the most suitable fencing design.

8.0 RECOMMENDATIONS

8.1 VEGETATION MANAGEMENT ACT 1999

Recommendation 1:	The identified Regional Ecosystems mapping prepared for this assessment by 3D Environmental has been based on intensive ground-truthing. A request for a mapping amendment should be made to the Queensland Herbarium.

8.2 WET TROPICS MANAGEMENT PLAN 1998

Recommendation 2:	An application for a permit under the *Wet Tropics Management Plan 1998* must be lodged with the Wet Tropics Management Authority to conduct works in land designated as Zone C and in the near vicinity (i.e. less than 50m) of land designated as Zone B of the WTMP.
Recommendation 3:	The proponent to enter into discussions with the QPWS regarding the potential for the proposed road alignment to generate increased visitors to Ella Bay National Park, and to determine any need for additional infrastructure to protect the environment from increased visitor numbers.

8.3 LAND PROTECTION (PEST STOCK ROUTE MANAGEMENT ACT 2002

Recommendation 4:	A Weed and Pest Management Plan is prepared for the construction and operational phases of the development. Control measures for Pond Apple and other weed species present (in particular Hymenache, Sicklepod and Lantana) should be incorporated into the

Weed Management Plan for both the construction and operational phases of the project. Issue identification, actions, responsibilities and monitoring procedures are to be incorporated into the Plan. The Plan should be in accordance with the Johnstone Shire Pest Management Plan 2004 2004 and in consultation with other relevant agencies including the WTMA and QPWS..

8.4 General Flora Recommendations:

Recommendation 5: Clearing works should be restricted to the proposed impact area.

Recommendation 6: A detailed flora survey of the proposed road alignment and impact area should be undertaken prior to any construction works to determine the presence of any significant flora that may require specific strategies for management and/or impact mitigation.

Recommendation 7: A Vegetation Management Plan should be developed to include construction, revegetation, rehabilitation, treatment of listed significant flora and maintenance stages of the proposed road works. No species attractive to the Southern Cassowary should be included in the vegetation works.

8.5 General Fauna Recommendations

Recommendation 8: Fauna spotters required for all vegetation clearing and works in waterways:

- Fauna spotters should work ahead of clearing to identify the presence of individuals within the road alignment, and clearing should not occur until such time as the individuals are moved.
- Recommendation Fallen logs, branches and other suitable sheltering debris should be removed from the clearing corridor by hand (or using machinery where required) and carefully placed in adjacent habitat ahead of clearing activities.
- Caves and rocky outcrops within the road alignment should be checked for nesting birds prior to clearing activities. Where nesting birds (i.e. Macleay's Fig Parrot) are found, these areas should be avoided until after the end of the breeding season (October to April).
- The road alignment should be checked for the presence of camps (i.e. for the Spectacled Flying Fox) prior to clearing activities, and these areas should be avoided, with a 100m buffer established between the camp/s and the proposed road. If camps are present, road construction should not occur within the birthing season (September to December).
- Direct searches by fauna spotters through leaf litter immediately prior to clearing may allow for the relocation of some individuals (i.e. reptiles, particularly *Coeranoscincus frontalis*)
- Streams should be checked for tadpoles and adults of *Nyctimystes dayi* Australian Lacelid, and those found relocated prior to

clearing or construction activities at these locations . This species will need to be excluded from the road surface.

Recommendation 9: Clearing and construction activities should not be carried out in close proximity to beach areas (i.e north of Heath Point) during breeding season (September to November)

Recommendation 10: The road alignment should avoid habitat for the Torrent Treefrog (*Litoria nannotis*) where they occur

Recommendation 11: Prior to any works commencing, a detailed fauna assessment is required to be undertaken along the preferred road alignment to identify the presence of significant species and/or specific habitat features to be avoided or managed during construction.

Recommendation 12: It is recommended, in areas where there is no canopy connection over the roadway, that rope bridges are fixed between trees on either side of the gap to further accommodate the passage of arboreal fauna. The number of rope bridges required would need to be determined following completion of the proposed works.

Recommendation 13: Benchmark studies and on-going monitoring and management of waterway health are required at these locations, particularly during times of high rainfall, to ensure that the creekbanks are stable and that roadworks do not initiate erosion.

Recommendation 14: The frog species *Nyctimystes dayi* – which is not restricted to waterways and their surrounds, will need to be excluded from the road surface. Specific investigations would be required to determine a fencing type capable of excluding *Nyctimystes dayi*.

Recommendation 15: The proposed overpass (i.e. located at cut and cover tunnel) and underpass structures (i.e. located at creek crossings) will need to be monitored for their effectiveness and providing safe crossing opportunities for the range of fauna species present.

Recommendation 16: It is recommended that the canopy cover be maintained where possible along the preferred road alignment. On-going monitoring and maintenance to minimise edge effects is required for areas along the preferred alignment where the canopy cover cannot be maintained along the road.

Recommendation 17: It is recommended that disturbed areas along the roadside be rehabilitated using rainforest species as part of the Vegetation Management Plan. Seed stock should be of local provenance.

Recommendation 18: To determine if these pest fish species are present it will be necessary to survey the fish populations in creeks along the road alignment and monitor species composition during and following road construction.

Recommendation 19: Community awareness is also an important measure in the prevention of introduction of these species to waterways. The residents within the proposed integrated resort development and existing residents in the township of Flying Fish Point should be included in an awareness program that could be coordinated with local government.

8.6 GENERAL RECOMMENDATIONS FOR THE PROPOSED ROAD WORKS

Recommendation 20: It is recommended that some level of noise control be incorporated into the fauna fencing design to reduce potential noise effects. Noise modelling would be required to formulate the most suitable fencing design.

Recommendation 21: All upgrade works should be undertaken with reference to the best practice guidelines as presented in *Queensland Department of Main Roads: Roads in the Wet Tropics: Planning, Design, Construction, Maintenance and Operation Best Practice Manual* (2000)".

Recommendation 22: Ensure that road speeds are maintained at no greater than 50km/hr.

Recommendation 23: A Fire Management Plan to be prepared that calculates appropriate setbacks for development from the adjacent vegetation. The buffer distances can then be negotiated with NRW based on the findings of the study. The Fire Management Plan should also be relevant to the operational phase of the development, and include guidelines for land managers.

Recommendation 24: An Environmental Code of Conduct is prepared for construction workers to ensure that responsibilities for vegetation protection, fire management and weed management are clear and that National Park regulations are understood. The Environmental Code of Conduct should be incorporated into the induction of any site workers, and should be the subject of community information sessions.

Recommendation 25: A Stormwater and Sedimentation Management Plan is prepared for the proposed road works to protect the integrity of the receiving environments.

Recommendation 26: A Surface Water and Groundwater Quality Management Plan is prepared for the operational phase of the project. Water quality standards must be set to protect native terrestrial and aquatic flora, including regular monitoring of receiving waters to detect levels of chemicals and sediment entering natural waterways, and planned responses to adverse results.

Recommendation 27: Development design to incorporate recommendations by Moore (2007)

Recommendation 28: All soil and other materials to be used for rehabilitation or landscaping purposes (both by the developer during construction and on private property during operation) to be restricted to materials certified as free of pathogens and weeds.

Recommendation 29: A Fencing Strategy is required that meets the needs of the project to separate fauna and vehicles and to funnel fauna to safe crossing points. It is also recommended that the fence be designed to act as a noise barrier to reduce impacts to adjacent habitat.

9.0 BIBLIOGRAPHY

3D Environmental (2006b). 'Vegetation Survey Report of the Proposed Ella Bay Integrated Resort Project' Report prepared for BAAM. Brisbane.

3D Environmental (2006b). 'Ella Bay Integrated Resort Project' Supplementary Section: Southern Access Corridor Vegetation Mapping'. Report prepared for BAAM. Brisbane.

Airy Shaw, A. K. (1980). 'The Euphorbiaceae of Australia.' Kew Bulletin Vol 35 No. 3.

Andrews, S. B. (1990). 'Ferns of Queensland.' Queensland Department of Primary Industries, Brisbane.

BAAM (2005). Can a fence stop a frog? Frog exclusion fencing trials. Report prepared for Parsons Brinckerhoff Australia Pty Ltd. November 2005.

BAAM (2006) 'Terrestrial and Freshwater Flora and Fauna Impact Assessment' Report prepared for Ella Bay Developments Pty Ltd. Cleveland, Australia.

Bell, R. (1996). 'Johnstone River Catchment Revegetation Strategy'. Johnstone River Catchment Management Association, Queensland.

Beruldsen, G (2003). *Australian birds, their nests and eggs.* Phoenix Offset, China.

Birt, P, Markus, N, Collins, L and Hall, L (1998). 'Urban Flying-foxes.' *Nature Australia*, **26**: 54-59.

Churchill, S (1998). 'Australian bats'. Reed New Holland, Sydney

Commonwealth of Australia. (1986). 'Tropical Rainforests of North Queensland: Their Conservation Significance.' Special Australian Heritage Publication Series No. 3. A Report to the Australian Heritage Commission by the Rainforest Conservation Society of Queensland. Australian Government Publishing Service, Canberra.

Cooperative Research Centre for Tropical Rainforest Ecology and Management. (CRCTREM) (2006). 'Monitoring Revegetation Projects for Biodiversity in Rainforest Landscapes, Toolkit Version 1'. CRCTREM and Griffith University School of Environmental Sciences, Brisbane.

CSIRO (1998). 'Flora of Australia'**.** Volume 12, Mimosaceae (excl. Acacia), Caesalpinaceae. ABRS/CSIRO Melbourne.

CSIRO (1998). 'Flora of Australia'**.** Volume 48, Gymnospermae, Pteridophyta. ABRS/CSIRO, Melbourne.

Csurhes, S.M., Mackey, A.P. and Fitzsimmons, L. (1999) 'Hymenachne (*Hymenachne amplexicaulis*) in Queensland', Pest Status Review Series, Land Protection, Department of Natural Resources, Brisbane.

de Keyser, K., Mikolajczak, A. S (1962). 'Geology of the Innisfail 1:250 000 Map Sheet', Bureau of Mineral Resources, Brisbane, Qld.

Department of Environment and Water Resources (DEWR)(Commonwealth) (2007). **'**World Heritage: Wet Tropics of Queensland.' http://www.environment.gov.au/heritage/worldheritage/sites/wettropics/index.html Viewed on 06-09-07.

Department of Main Roads (DMR) (2000). 'Fauna Sensitive Road Design – Volume I Past and Existing Practices.' Queensland Department of Main Roads.

Downes, SJ, Handasyde, KA and Elgar, MA (1997). 'The use of corridors by mammals in fragmented Australian eucalypt forests.' *Conservation Biology*, **11**: 718-725.

Dryden, B., (2003). 'Strategy for the Conservation of Biodiversity in the Johnstone Shire'. Johnstone Shire Council, Innisfail.

Duncan, A., Barker, G.B. and Montgomery, N. (1999). *The action plan for Australian bats*. Environment Australia, Canberra.

Environment Australia (1999). Legislation, Environment Protection and Biodiversity Conservation Act 1999. Commonwealth of Australia. http://www.environment.gov.au

Environment Australia (2001). *A Directory of Important Wetlands in Australia, Third Edition.* Environment Australia, Canberra.

EPA(1999). Strategy for the Conservation and Management of Queensland Wetlands. Queensland Environmental Protection Agency, Brisbane.

EPA (2000). Characteristics of Important Wetlands in Queensland. Queensland Environmental Protection Agency, Brisbane.

EPA (2003). Wet Tropical Coast Regional Coastal Management Plan. Queensland Government – Environmental Protection Agency Queensland Parks and Wildlife Service.

EPA (2006a) WildNet database. Online search conducted 23 August 2006. EPA, Brisbane.

EPA (2006b) HERBRECS database. Search request received 6 August 2006. Queensland Herbarium, EPA, Brisbane.

ETS Group (2007) 'Ella Bay Access Road Strategy, Preferred Option Clearing Quantities. Report Prepared for Satori Resorts Ella Bay Pty Ltd.

Garnett, S (ed.) (1993). *Threatened and extinct birds of Australia*. Royal Australasian Ornithologists Union and Australian National Parks and Wildlife Service, Moonee Ponds.

Garnett, ST and Crowley, GM (2000). *The action plan for Australian birds*. Environment Australia, Canberra.

Gillespie, GR and Hero, J (1999). 'Potential impacts of introduced fish and fish translocations on Australian amphibians.' In: A Campbell (ed.), *Declines and disappearances of Australian frogs*. Environment Australia, Canberra. pp. 131-144.

Goosem, M.W. and Turton, S.M. (2000). Impacts of roads and powerlines on the Wet Tropics of Queensland World Heritage Area - Report 2 Stage II. Wet Tropics Management Authority and Rainforest CRC, Cairns. July 2000.

Goosem, M.W. and Turton, S.M. (2006). Weed incursions along roads and powerlines in the Wet Tropics World Heritage Area. Cooperative Research Centre for Tropical Rainforest Ecology and Management. Rainforest CRC, Cairns.

Hariono, B Ng, J and Sutton, RH (1993). 'Lead concentrations in tissues of fruit bats (*Pteropus* sp.) in urban and non-urban areas.' *Wildlife Research,* **20**: 315-320.

Harrison, D.A. and Congdon, B.C. (2002). 'Wet Tropics Vertebrate Pest Risk Assessment Scheme.' Cooperative Research Centre for Tropical Rainforest Ecology and Management. Cairns.

Hartley, T. G. (2001). "On the Taxonomy and Biogeography of *Euodia* and *Melicope* (Rutaceae)." Allertonia Vol. 8. National Botanic Gardens of Hawaii.

Hellquist, C. B. and Jacobs, S. W. L. (1998). 'Aponogetonaceae of Australia, with descriptions of six new taxa.' Telopea 8(1): 7—19.

Henderson, R. J. F. (2002). 'Names and Distribution of Queensland Plants, Algae and Lichens.' Queensland Herbarium, Environmental Protection Agency, Brisbane, Queensland**.**

Higgins, PJ (ed.) (1999). *Handbook of Australian, New Zealand and Antarctic birds,* Vol 4*, Parrots to dollarbird.* Oxford University Press, Melbourne.

Hines, H, Mahony, M and McDonald, K (1999). 'An assessment of frog declines in wet subtropical Australia.' In: A Campbell (ed.), *Declines and disappearances of Australian frogs*. Environment Australia, Canberra. pp. 44-63.

Hodgkison, S.C. and Hero, J.-M. (2003). 'Seasonal, sexual and ontogenetic variations in the diet of the declining frogs, Litoria nannotis, L. rheocola and Nyctimystes dayi.' Wildlife Research. 30(4):345-354.

Hyland, B. P. H. (1989). 'A Revision of Lauraceae (excluding *Cassytha*).' Australian Systematic Botany Vol. 2, Number 2, 3.

Hyland, B. P. H., Whiffin, T., Christophel, D., Gray, B., and Elick, R.W. (2002). 'Australian Tropical Rainforest Plants: Trees, Shrubs and Vines. CSIRO, Atherton, Qld.

Ingram, GJ and McDonald, KR (1993). 'An update on the decline of Queensland's frogs.' *Herpetology in Australia,* **6**: 297-303.

Johnstone Shire Council (2004). Pest Management Plan July 2002 – 2006 - Version 1 - 7 May, 2004. Accessed 26 September 2006.

Jones, D. L., (1988). 'Native Orchids of Australia.' Reed Books Pty. Ltd. NSW.

Laverack, P. S., Harris, W., and Stocker, G. (2001). 'Dendrobium and its relatives.' Kangaroo Press, Pymble NSW.

Loyn, RH, McNabb, EG, Volodina, L and Willig, R (2001). 'Modelling landscape distributions of large forest owls as applied to managing forests in north-east Victoria, Australia.' *Biological Conservation,* **97(3)**: 361-376.

Mackey, A. P., Miller. E. N., and Palmer, W. A. (1997). 'Sicklepod (*Senna obtusifolia*) in Queensland', Pest Status Review Series, Land Protection, Department of Natural Resources, Brisbane.

Maxwell, S, Burbidge, AA and Morris, K (1996). *The action plan for Australian marsupials and monotremes.* Wildlife Australia, Canberra.

McDonald R.C., Isbell, R.F., Speight, J.G., Walker, J., Hopkins, M.S. (1990) Australian Soil and Land Survey Field Book. Inkata Press Melbourne.

Moore, L.A. (2007). 'Cassowary Assessment of the 'Ella Bay Integrated Resort Project' North Queensland 6 – 14 November 2006: Volume I Cassowary Field Survey; Volume II – Impacts and Mitigation; Volume III – Population Viability Analysis. Millaa Millaa, Queensland.

Murtha, G. G. (1986). *Soils of the Tully-Innisfail Area North Queensland*, CSIRO, Australia.

Neldner, V.J., Wilson, B.A., Thompson, E.J., Dillewaard, H.A. (2004). 'Methodology for Survey and mapping of Regional Ecosystems and Vegetation Communities in Queensland.' Version 3.0. Queensland Herbarium, Queensland Environmental Protection Agency, Brisbane.

Nelson, J. E. (1965). Movements of Australian Flying Foxes (Pteropodidae: Megachiroptera). *Australian Journal of Zoology*. **13**: 53-73.

NRW (2006). Regional Vegetation Management Code for Coastal Bioregions. The Queensland Department of Natural Resources and Water, Brisbane.

Pizzey, G and Knight, F (2003). *The field guide to the birds of Australia.* HarperCollins, Sydney.

Prestige Property Partnership (2005). Ella Bay, A Master Planned Integrated Tourism Community. Initial Advice Statement. Accessed 26 September 2006 http://www.ellabay.com.au/files/Initial%20Advice%20Statement.pdf

Queensland Department of Natural Resources and Mines (2006). 'Consultation Draft Regional Vegetation Management Code for Coastal Bioregions.' http://www.nrm.qld.gov.au/vegetation/pdf/2006_06_02_coastal_code.pdf

Queensand Government (2005) 'Wet Tropics Management Plan 1998' Queensland Government, Brisbane. http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/W/WetTropMgmtP98.pdf

Queensland Parks and Wildlife Service (2004). 'Adaptive Management: Pond Apple Control in the Catchments of the Russell-Mulgrave and Tully-Murray River Systems.' Unpublished report to the Commonwealth Department of Environment and Heritage Funded by National Heritage Trust.

Rainforest CRC (2004). Kuranda Range – No Net Adverse Impact. Version 7, June 2004. Rainforest CRC, Cairns.

Sainty, G.R. & Jacobs, S.W.L. (4th Edition 2003). 'Water Plants in Australia, A Field Guide.' Sainty & Associates Pty Ltd., Sydney.

Sattler, P. S. & Williams, R. D. (eds)(1999). 'The Conservation Status of Queensland's Bioregional Ecosystems.' EPA. Brisbane.

Sharpe, P. R. (1986). 'Keys to Cyperaceae, Restionaceae and Juncaceae of Queensland.' Qld. Botany Bull. No. 5. QDPI Brisbane.

Simon, B. (1993). 'A Key to Australian Grasses.' 2nd Edition. Qld. D.P.I. Brisbane.

Stanton, J. P. (1998). Abstract, "Environmental Weeds", Proceedings of The weed Society of Queensland Inc. 5th Weed Symposium, Paradise Lost? Will You Let it Happen? 22-24 September 1998. The Weed Society of Queensland.

Stanton, J. P. and Stanton, D. J. (in prep.). The vegetation of the Wet Topics Bioregion. Wet Tropics Management Authority, Cairns.

Tracey, J. G. (1982). "The Vegetation of the Humid Tropical Region of North Queensland.' CSIRO, Division of Plant Industry, Atherton, Qld.

Wet Tropics Management Authority. (WTMA) (2004). 'Wet Tropics Conservation Strategy.'Queensland Government, Cairns.

Wet Tropics Management Authority. (WTMA) (2005). 'Wet Tropics Management Plan 1998 Reprint No. 1A (QG 2005).'Queensland Government, Cairns

Wet Tropics Management Authority (2006). 'Managing a World Heritage Area' http://www.wettropics.gov.au/mwha/mwha_zones.html . http://www.wettropics.gov.au/sitemap.html#, viewed on 10/10/07.

Wet Tropics Management Authority. (2007). 'Managing a World Heritage Area.' http://www.wettropics.gov.au/mwha/ 1 viewed on 06-09-07.

Williams, S.E. (2006). 'Vertebrates of the Wet Tropics Rainforests of Australia: Species Distributions and Biodiversity.' Cooperative Research Centre for Tropical Rainforest Ecology and Management. Rainforest CRC, Cairns, Australia (282pp).

Appendix 1-
Summary Vegetation Site Data and Floristic Survey Records

Site Number: ERL1
Survey Intensity: Secondary
Date: 19/07/07
Location GPS: 0401955 E, 806552 N
Landform and Geology: Sloping alluvial outwash plain
Slope: 5º
Aspect: W
Structure: Wind damaged mesophyll vine forest
Significant Flora: Endiandra globosa (Rare)
Regional Ecosystem: 7.3.10
Vegetation Community Code: A2a

Site Number: ELR2
Survey Intensity: Secondary
Date: 19/07/07
Location GPS: 0400457 E 8068970 N
Landform and Geology: Alluvial outwash (swamp)
Slope: 0
Aspect: 0
Structure: Feather palm vine forest
Regional Ecosystem: 7.3.3a
Vegetation Community Code: A3a

Site Number: ELR3
Survey Intensity: Secondary
Date: 19/07/07
Location GPS: 0400398 E, 8068967 N
Photo #: DS 50, 51
Landform and Geology: Metamorphic slope (coastal headland)
Slope: 25ºº
Aspect: NW
Structure: Low Lophostem suaveolens dominant open forest
Regional Ecosystem: 7.11.34
Vegetation Community Code: M91v

Site Number: ELR4
Survey Intensity: Secondary
Date: 19/07/07
Location GPS: 0401606E, 8067429 N
Landform and Geology: Coastal foredune
Slope: 0
Aspect: 0
Structure: Mesophyll vine forest
Regional Ecosystem: 7.2.1
Vegetation Community Code: D2b
Descriptive Notes: Heavily degraded ground cover through pedestrian traffic

Site Number: ELR5
Survey Intensity: Secondary
Date: 19/07/07
Location GPS: 0401526 E 8067336 N
Landform and Geology: Steep metamorphic footslope (drainage line)
Slope: 30º
Aspect: WNW
Structure: Regional Ecosystem: 7.11.34
Vegetation Community Code: M91v
Significant Flora: Macaranga polyadenia (Rare)
Descriptive Notes: Protected pocket in sheltered gully line

Site Number: ELR6
Survey Intensity: Secondary
Date: 20/07/07
Location GPS: 0401415 E, 8067651 N
Landform and Geology: Metamorphic slope (coastal headland)
Slope: 25º
Aspect: NW
Structure: Low Lophostem suaveolens dominant open forest
Regional Ecosystem: 7.11.34
Vegetation Community Code: 2a
Significant Flora: Ichnanthus pallens (Rare)
Descriptive Notes: Heavily degraded on road margins by Panicum maximum

Site Number: ELR7
Survey Intensity: Secondary
Date: 20/07/07
Location GPS: 0401125 E, 8067970 N
Landform and Geology:
Structure: Mesophyll vine forest
Regional Ecosystem: 7.2.1
Vegetation Community Code: D2b
Significant Flora: None recorded
Descriptive Notes: Heavily wind disturbed

Site Number: ELR8
Survey Intensity: Secondary
Date: 20/07/07
Location GPS: 0401187 E, 8067841 N
Landform and Geology: Metamorphic footslope
Slope: 15º
Aspect: WNW
Structure: Mesophyll vine forest
Regional Ecosystem: 7.11.1
Vegetation Community Code: M2a
Significant Flora: None recoded.
Descriptive Notes: Moderate wind disturbance.

Site Number: ELR9
Survey Intensity: Secondary
Date: 20/07/07
Location GPS: 0401649 E, 8064925 N
Landform and Geology: Metamorphic footslope
Slope: 25º
Aspect: WSW
Structure: Mesophyll Vine Forest
Regional Ecosystem: 7.11.1
Vegetation Community Code: M2a
Significant Flora: None recoded.
Descriptive Notes: Extremely heavy wind disturbance.

Ella Bay Road Survey - Flora Species List Per Site

Coll: No.	Species	Flw /Ft	Status	ELR 1	ELR 2	ELR 3	ELR 4	ELR 5	ELR 6	ELR 7	ELR 8	ELR 9
	Acacia celsa				T1(1)	T1(4)			T1			
	Acacia flavescens					T1(1)			T2			
	Acacia mangium						T1					
	Acmena hemilampra				T1(1)			T1	T2	T1	T1	
	Achronychia acidula										T2	
	Achronychia laevis											
	Acronychia vestita					S1						
	**Aegeratum conyzioides*											
	Aleurites mollucana			S1	S1							
	Aleurites moluccana			S1	S1							
	Allangium villosum subsp. *polyosmoides*											
	Alphitonia incana			S1						S1		S1
	Alpinia caerulea			S1	S1	G						
	Alstonia meulleriana			T2	T1(1)	T2			T2			T1
	Alyxia spicata				V	V			G			
	Alstonia scholaris			T1		S1						
	Aneilema acuminatum									G		
	Antidesma erostre				S1							
	Archidendron grandiflorum									T1		
	Archirhodomyrtus beckleri											S1
	Archontophoenix alexandrae				T1(7)							
	Ardisia brevipedata											
	Argusia argentea						T2					
	Arytera divaricata											S1
	Aslpenium nidus			HE				HE				
	Atractocarpus fitzalanii								S1	S1		
	Austrosteenisia blackii			V	V							V
	Axonopus compressus		Exotic									
	Barringtonia racemosa			T1	T1							
	Beilschmedia obtusifolia									T1	T1	T2
	Blechnum cartilagineum											G
	Bowenia spectabilis			G								G
	Breynia oblongifolia				S1							

Coll: No.	Species	Flw /Ft	Status	ELR 1	ELR 2	ELR 3	ELR 4	ELR 5	ELR 6	ELR 7	ELR 8	ELR 9
	Brombya platynema			S1								S1
	Calamus australis			S1				S1	S1	S1	S1	S1
	Calamus caryotoides			S1	G			G		G	G	
	Calamus moti			S1				S1			S1	
	Callerya sp. (Barrat Creek G. Sankowsky 428)				V							
	Callicarpa longifolia				V							
	Calophyllum australianum			S1	S1					T1	T1	
	Calophyllum sil											T1
	Calopogonium mucunoides											
	Cananga odorata				S1						T1	
	Canarium australianum								T2	T2		
	Canarium vitiense			T1		S1		T1	T2	T2		
	Carallia brachiata				S1							
	Carica papaya		Exotic	S1	S1							
	Castanospermum australe			T1			T1					
	Castanopora alphandii			T2	T2			T2				
	Cayratia japonica				V							
	Cerbera florbinda			S1								T2
	Chionanthus ramiflorus					T2	T1		T1	T1		
	Cissus penninervis								V			
	Cissus repens											
	Citronella smythii											
	Claoxylon tenerifolium											S1
	Clerodendrum tracyanum			S1								S1
	Cocos nucifera									E		
	Commelina ensiifolia		Exotic									
	Commersonia bartramia									G		
	Connarus conchocarpus			V	V							
	Coveniella poecilophlebia			S1								
	Cordyline manners-suttoniae									S1	S1	
	Crassocephalum crepidioidesare		Exotic									
	Cryptocarya cunninghamiana					S1				T2		
	Cryptocarya grandis			S1	S1						T1	T1
	Cryptocarya hypospodia			T2		S1				T1		T1

Coll: No.	Species	Flw /Ft	Status	ELR 1	ELR 2	ELR 3	ELR 4	ELR 5	ELR 6	ELR 7	ELR 8	ELR 9
	Crytocarya leavigata			S1								
	Cryptocarya murrayi			T2	T2	T2						
	Cryptocarya mackinnoniana											T1
	Cryptocarya oblata			T1	T1(1)							
	Cryptocarya pleurosperma											
	Cryptocarya triplinervis										S1	
	Cryptocarya vulgaris					T2			S1			T1
	Cupaniopsis flagelliformis								S1			
	Cupaniopsis foveolata					S1						
	Cyathea rebeccae											S1
	Cycas media					S1						
	Cyclophyllum multiflorum								T2		S1	
	Davidsonia pruriens			S1	T2						T2	T2
	Decaspermum humile			T2					S1			S1
	Deplanchea tetraphylla				T2							
	Dianella caerulea var. *vannata*								G	G		
	Dillenia allata				T2	T2						
	Diospyros cupulosa									S1		
	Diplocyslos palmatus				V							
	Diploglottis bracteata			T1				T2				
	**Drymaria cordata*											
	Drypetes deplanchei				S1					T2	T2	
	Dysoxylum alliaceum			T1								
	Dysoxylum mollissimum subsp. *molle*						T1			T1		
	Dysoxylum oppositifolium											
	Dysoxylum pettigrewianum			T1				T1				
	Elaeocarpus grandis			T1	S1			T1			T1	
	Embelia caulialata			V								
	Endiandra cowleyana			T2					S1			
	Endiandra globosa		Rare	S1								
	Endiandra hypotephra				T1(1)	S1			S1			T1
	Endiandra impressicosta			T1								
	Endiandra monothyra											S1
	Endiandra montana											T1

Coll: No.	**Species**	**Flw /Ft**	**Status**	**ELR 1**	**ELR 2**	**ELR 3**	**ELR 4**	**ELR 5**	**ELR 6**	**ELR 7**	**ELR 8**	**ELR 9**
	Endospermum myrmecophilum											S1
	Epipremnum pinnatum				S1			S1		HE		
	Entada phaseoloides			S1	S1							
	Eupomatia bennettii			S1		S1		S1				
	Euroschinus falcate var. *falcata*								S1			
	Fagraea cambagei				S1							
	Faradraya splendida											
	Ficus congesta			S1	S1							
	Ficus copiosa							S1				
	Ficus destruens					T1					T1	
	Ficus drupacea			T1								
	Ficus leptoclada			S1	S1							
	Ficus variegata							T2				
	Ficus virens var. virens							T1				
	Flindersia bourjottiana											T1
	Flagellaria indica							V	V	V		
	Freycinetia excelsa					HE		HE				HE
	Freycinetia scandens											
	Ganophyllum falcatum			T1				T2		T1	T1	
	Glochidion harveyanum											S1
	Glochidion lobocarpum					S1						
	Glochidion sumatranum				S1							
	Gmelina fasciculiflora							S1				S1
	Gomphandra australiana											
	Grevillea baileyana			S1		T2						T1
	Guioa lasioneura				S1							T1
	Guoia acutifolia								T2			
	Gynochtodes sessilis				V							
	Hedicarya loxycarya					S1						
	Helicia nortoniana				S1							S1
	Hibbertia scandens											
	Hibiscus tiiaceous						T2			T2		
	Hypserpa decumbens								V			
	Homolanthus novoguinensis			S1	S1							

Coll: No.	Species	Flw /Ft	Status	ELR 1	ELR 2	ELR 3	ELR 4	ELR 5	ELR 6	ELR 7	ELR 8	ELR 9
	Hugonia jenkinsii				V							
	Hydriastele wendlandiana				S1			S1	S1		S1	T2
	Hypserpa decumbens											
	Hypserpa laurina											
	Ichnanthus pallens var. majus		Rare						G			
	Ichnocarpus frutescens			S1	G							
	Intsia bijuga						T1	T1		T1		
	Ixora timorense									S1		
	Lantana camara (Class 3 Pest)		Exotic			S1						
	Lepidozamia hopeii										S1	
	Leptaspis banksii											
	Licuala ramsayi				T1(4)						T2	
	Linospadix minor			S1	S1							S1
	Litsea bindoniana					S1			S1		S1	
	Litsea fawcettiana					T2						
	Litsea leefeana			T1		T2		T2	T2			T1
	Lophostemon suaveolens					T1(11)			T1			
	Lygodium reticulatum				G				G			G
	Lygodium microphyllum					S1						
	Macaranga inanaema			S1							S1	
	Macaranga involucrata var. *mallotoides*				S1	S1			S1	S1		S1
	Macaranga polyadenia		Rare									
	Macaranga subdentata							S1			S1	S1
	Macaranga tanarius					S1					S1	
	Mackinlaya confusa					S1			S1			S1
	Maesa dependens var. *dependens*			V								S1
	Mallotus discolor											T2
	Mallotus paniculatus			S1	S1							
	Mallotus polyadenos											
	Mangifera indica		Exotic				T1		T2	T1		
	Mapania macrocephala				V							V
	Mecardonia procumbens		Exotic		G							
	Melicope elleryana				T2							
	Melicope vitiflora			T1	T2			T1				T1

Coll: No.	Species	Flw /Ft	Status	ELR 1	ELR 2	ELR 3	ELR 4	ELR 5	ELR 6	ELR 7	ELR 8	ELR 9
	Melicope xanthoxyloides					S1						
	Melodinus australis					S1						
	Melodorum uhrii											
	Merremia peltata			V				V				
	Millettia pinnata						T2			T2		
	Mimosa pudica		Exotic									
	Mischocarpus exangulatus											
	Mischocarpus lachnocarpus			T2		S1						
	Morinda citrifolia									S1		
	Musa banksii			S1				S1				
	Myristica insipida			T1				T2				
	Myrsine porosa											
	Neimeyera prunifera											
	Neosepiciea jucunda				S1							S1
	Neolitsea brassii											
	Neprolepis obliterata									S1	S1	
	Omolanthus nutans											
	Palmeria hypotephra											V
	Pandanus monticola			S1	S1	S1				S1	S1	S1
	Pandanus tectorius						T2		S1			
	Panicum maximum		Exotic			G						
	Parapachygone longifolia			V								
	Parsonsia velutina								V			
	Passiflora foetida		Exotic		V							
	Pilidiostigma tetramerum										S1	
	Pilidiostigma tropicum							S1				S1
	Piper caninum											
	Piper novae-hollandiae			V				V	V			V
	Pittosporum ferrugineum								T2			
	Pittosporum revolutum											
	Platycerium superbum											
	Podocarpus greyae									S1		
	Polyscias australianum				S1			S1				S1
	Polyscias elegans			S1						S1		

Coll: No.	Species	Flw /Ft	Status	ELR 1	ELR 2	ELR 3	ELR 4	ELR 5	ELR 6	ELR 7	ELR 8	ELR 9
	Polyscias murrayi				S1	S1			S1			
	Pothos longipes			HE								
	Pouteria chartacea				S1		T1			T2		
	Pouteria xerocarpa			S1	S1							S1
	Premna serratifolia						T2					
	Pseuderanthemum variable					S1						S1
	Ptychosperma elegans										T2	T2
	Pycnarrhena novoguineensis											
	Pyrosia longifolia				S1							
	Rapanea acrodiifolia											S1
	Rapanea porosai											S1
	Rhodamnia sessiliflora				S1		S1					
	Rhodamnia spongiosa											S1
	Rhodomyrtus macrocarpa											
	Rhus taitensis					T2						
	Rubus moluccanas var. *trilobus*				G							G
	Sarcopteryx martyana				S1							S1
	Schizoea dichotoma											S1
	Scleria polycarpa					G						
	Semecarpus australiensis									S1		
	Senna obtusifolia (Class 2 Pest)		Exotic									
	Sida rhombifolia		Exotic									
	Siphonodon membranaceum			S1								
	Smilax australis					G			G	G		
	Solanum mauritianum		Exotic	S1								
	Sphagneticola trilobata (Class 3 Pest)		Exotic									
	Stachytarpheta cayennensis		Exotic									
	Stephania japonica				G							
	Symplocos cochinchinensis subsp. *thwaitesii var. pilosciuscula*			S1								S1
	Syzygium alliiligneum			T1			S1					T2
	Syzygium cormiflorum				T2							
	Syzygium forte subsp. *forte*				T2	S1	T2			T1		
	Syzigium luehmannii				T2							
	Synima cordierorum											

Coll: No.	**Species**	**Flw /Ft**	**Status**	**ELR 1**	**ELR 2**	**ELR 3**	**ELR 4**	**ELR 5**	**ELR 6**	**ELR 7**	**ELR 8**	**ELR 9**
	Tabernaemontana pandacqui			S1	S1	S1				S1		
	Tarenna dallachiana			S1								S1
	Terminalua arenicola									T2		
	Terminalia sericocarpa			S1								
	Tetracera nordtiana var. *nordtiana*			V								
	Tetracera daemelianum			V								V
	Tetrastigma sp.											
	Tetrasynandra pubescens								S1			
	Timonius timon											
	Toechima daemelianum			T1		S1		S1				
	Toechima erythrocarpum			S1								
	Trema cannabina			S1								
	Trema orientalis			S1	S1					S1		
	Trichospermum pleiostigma								S1			
	Tristemma mauritianum		Exotic									
	Urena lobata		Exotic				G					
	Vandasina retusa											
	Wrightia laevis subsp. *millgar*			T1				S1				
	Xanthophyllum octandrum			T1								
	Zanthoxylum nitidum				V							

Appendix 2:
Fauna Database Search Results

QUEENSLAND MUSEUM DATABASE

GROUP *Scientific Name*	**Location**	**Lat**	**Long**	**Date**
AMPHIBIAN				
Bufo marinus	Innisfail General Hospital Grounds	17.32	146.01	07-Mar-66
Cophixalus infacetus	**Stone Ck**	**17.28**	**146.01**	**06-Feb-96**
Cophixalus ornatus	Stone Ck	17.28	146.01	01-Nov-00
Limnodynastes ornatus	Innisfail	17.32	146.01	02-Aug-74
Litoria caerulea	Innisfail	17.32	146.01	04-Apr-73
Litoria inermis	Innisfail	17.32	146.01	08 Nov 1885
Litoria infrafrenata	Innisfail, nr river	17.32	146.02	04-Apr-73
Litoria latopalmata	Innisfail	17.32	146.01	08 Nov 1885
Litoria rubella	Innisfail	17.32	146.01	04-Apr-73
REPTILES				
Carlia rubrigularis	Stone Ck, Hasenpusch Property	17.28	146.01	06-Feb-96
Coeranoscincus frontalis	**Innisfail**	**17.32**	**146.01**	
Crocodylus porosus	Innisfail	17.32	146.01	
Cryptoblepharus literalis	Polly Ck, Seymour Ra	17.28	146.02	12-Sep-91
Cryptophis nigrescens	Innisfail	17.32	146.01	
Elseya latisternum	Johnstone R, cibor camp site	17.3	146	
Eulamprus quoyii	Innisfail	17.32	146.01	26-Oct-68
Eulamprus tigrinus	**Stone Ck**	**17.28**	**146.01**	**01-Nov-95**
Glaphyromorphus fascicaudis	Polly Creek (Hasenpusch)	17.28	146.01	25-Nov-94
Hypsilurus boydii	Innisfail	17.32	146.01	
Lampropholis coggeri	Stone Ck, Hasenpusch Property	17.28	146.01	06-Feb-96
Saltuarius cornutus	Innisfail	17.32	146.01	
Saproscincus basiliscus	Stone Ck, via Carradinga	17.28	146.01	19-Apr-97
BIRDS				
Alcedo azurea	Innisfail	17.32	146.01	04-Aug-65
Amaurornis olivacea	Innisfail	17.32	146.01	03-Feb-65
Aplonis metallica	Innisfail	17.32	146.01	20-Dec-76
Arses kaupi	Innisfail	17.32	146.01	01-Oct-70
Cacomantis flabelliformis	Jordan Ck, near Innisfail	17.32	146.01	
Casuarius casuarius	Innisfail	17.32	146.01	14-Oct-32
Ceyx pusillus	Innisfail	17.32	146.01	13-Aug-65
Cisticola exilis	Innisfail	17.32	146.01	
Colluricincla megarhyncha	Innisfail area	17.32	146.01	07-Jul-65
Coracina tenuirostris	Ella Bay, Innisfail	17.27	146.05	09-Aug-65
Cracticus quoyi	Innisfail area	17.32	146.01	01-Jul-65
Dicaeum hirundinaceum	Innisfail	17.32	146.01	26-Jun-65
Gallinago hardwickii	Innisfail	17.32	146.01	28-Sep-65
Gerygone magnirostris	Innisfail	17.32	146.01	18-Aug-65
Gerygone palpebrosa	Innisfail	17.32	146.01	27-Oct-70
Meliphaga gracilis	Innisfail	17.32	146.01	31-Aug-65
Meliphaga notata	Innisfail area	17.32	146.01	13-Jul-65
Monarcha trivirgatus	Innisfail	17.32	146.01	21-Jul-65
Myiagra alecto	Innisfail	17.32	146.01	01-Oct-70
Myiagra rubecula	Innisfail	17.32	146.01	08-Nov-64
Myzomela obscura	Ella Bay, Innisfail	17.27	146.05	04-Aug-65
Nectarinia jugularis	Ella Bay, Innisfail	17.27	146.05	12-Aug-71

QUEENSLAND MUSEUM DATABASE

GROUP *Scientific Name*	**Location**	**Lat**	**Long**	**Date**
Pachycephala griseiceps	Innisfail	17.32	146.01	18-Aug-65
Pachycephala pectoralis	Innisfail	17.32	146.01	
Pitta versicolor	Innisfail area	17.32	146.01	04-Aug-65
Platycercus elegans	Jordan Ck, near Innisfail	17.32	146.01	18-Aug-65
Ptilinopus magnificus	Innisfail area	17.32	146.01	10-Aug-65
Rhipidura rufifrons	Innisfail	17.32	146.01	24-Jun-65
Rhipidura rufiventris	Innisfail	17.32	146.01	13-Jul-65
Sericornis magnirostris	Innisfail	17.32	146.01	19-Aug-65
Todiramphus sanctus	Innisfail	17.32	146.01	03-Aug-65
Tregellasia capito	Innisfail area	17.32	146.01	10-Sep-65
Xanthotis macleayana	Ella Bay, Innisfail	17.27	146.05	12-Aug-65
Zosterops lateralis	Innisfail area	17.32	146.01	21-Jul-65
MAMMALS				
Dactylopsila trivirgata	Innisfail	17.32	146.01	09-Feb-66
Dendrolagus lumholtzi	**Innisfail**	**17.32**	**146.01**	**00-Jan-00**
Isoodon macrourus	Innisfail	17.32	146.01	00-Jan-00
Melomys burtoni	Innisfail Common	17.32	146.01	08-Nov-66
Melomys cervinipes	Innisfail Common	17.32	146.01	08-Nov-66
Rattus fuscipes	Palmerston SF	17.32	146.01	20-Sep-69
Syconycteris australis	Innisfail	17.32	146.01	19-Dec-64

Queensland Government
Environmental Protection Agency
Queensland **Parks and Wildlife Service**

WildNet

CLASS Scientific Name	Common Name	Status NCA	Status EPBC	Records
AMPHIBIAN				
Bufo marinus	Cane Toad	I		3
Litoria rothii	Northern Laughing Treefrog	C		2
Litoria bicolor	Northern Sedgefrog	C		2
Litoria rheocola	**Common Mistfrog**	**E**	**E**	**4**
Litoria genimaculata	**Tapping Green Eyed Frog**	**R**		**1**
Litoria caerulea	Common Green Treefrog	C		1
Litoria infrafrenata	White Lipped Treefrog	C		1
Cophixalus ornatus	Ornate Nurseryfrog	C		5
Cophixalus infacetus	**Creaking Nurseryfrog**	**R**		**4**
Limnodynastes peronii	Striped Marshfrog	C		3
Rana daemeli	Australian Woodfrog	C		3
REPTILE				
Hypsilurus boydii	Boyd's Forest Dragon	C		2
Physignathus lesueurii	Eastern Water Dragon	C		1
Morelia amethistina	Amethystine Python	C		1
Boiga irregularis	Brown Tree Snake	C		1
Hemidactylus frenatus	House Gecko	I		2
Eulamprus tigrinus		**R**		**1**
Carlia rubrigularis		C		10
Lampropholis coggeri		C		1
Saproscincus basiliscus		C		3
Cryptoblepharus virgatus		C		1
Cyclodomorphus gerrardii	Pink-Tongued Lizard	C		1
Cryptoblepharus litoralis		C		1
Saproscincus tetradactylus		C		4
Varanus varius	Lace Monitor	C		1
BIRD				
Milvus migrans	Black Kite	C		2
Haliastur indus	Brahminy Kite	C		7
Pandion haliaetus	Osprey	C		9
Aviceda subcristata	Pacific Baza	C		5
Haliaeetus leucogaster	White-Bellied Sea-Eagle	C		5
Accipiter novaehollandiae	**Grey Goshawk**	**R**		**3**
Haliastur sphenurus	Whistling Kite	C		4
Circus approximans	Swamp Harrier	C		1
Alcedo azurea	Azure Kingfisher	C		9
Anas superciliosa	Pacific Black Duck	C		3
Chenonetta jubata	Australian Wood Duck	C		1
Dendrocygna eytoni	Plumed Whistling-Duck	C		1
Dendrocygna arcuata	Wandering Whistling-Duck	C		3
Nettapus pulchellus	Green Pygmy-Goose	C		2
Anas gracilis	Grey Teal	C		1

Queensland Government
Environmental Protection Agency
Queensland Parks and Wildlife Service

WildNet

CLASS		Status		
Scientific Name	Common Name	NCA	EPBC	Records
Anas castanea	Chestnut Teal	C		1
Nettapus coromandelianus	**Cotton Pygmy-Goose**	**R**		**1**
Malacorhynchus membranaceus	Pink-Eared Duck	C		1
Anhinga melanogaster	Darter	C		4
Anseranas semipalmata	Magpie Goose	C		1
Apus pacificus	Fork-Tailed Swift	C		2
Hirundapus caudacutus	White-Throated Needletail	C		1
Collocalia spodiopygius	**White-Rumped Swiftlet**	**R**		**11**
Ardea alba	Great Egret	C		5
Ardea ibis	Cattle Egret	C		2
Egretta sacra	Eastern Reef Egret	C		1
Ardea intermedia	Intermediate Egret	C		4
Egretta garzetta	Little Egret	C		2
Ixobrychus flavicollis	Black Bittern	C		3
Egretta novaehollandiae	White-Faced Heron	C		4
Cracticus quoyi	Black Butcherbird	C		20
Strepera graculina	Pied Currawong	C		1
Artamus leucorynchus	White-Breasted Woodswallow	C		13
Esacus neglectus	**Beach Stone-Curlew**	**V**		**6**
Cacatua galerita	Sulphur-Crested Cockatoo	C		9
Coracina lineata	Barred Cuckoo-Shrike	C		1
Lalage leucomela	Varied Triller	C		27
Coracina papuensis	White-Bellied Cuckoo-Shrike	C		6
Coracina novaehollandiae	Black-Faced Cuckoo-Shrike	C		2
Coracina tenuirostris	Cicadabird	C		3
Caprimulgus macrurus	Large-Tailed Nightjar	C		1
Casuarius casuarius johnsonii	**Southern Cassowary (Sth Pop)**	**E**	**E**	**12**
Centropus phasianinus	Pheasant Coucal	C		16
Vanellus miles	Masked Lapwing	C		9
Charadrius leschenaultii	Greater Sand Plover	C		1
Charadrius mongolus	Lesser Sand Plover	C		1
Elseyornis melanops	Black-Fronted Dotterel	C		1
Vanellus miles miles	Masked Lapwing	C		2
Charadrius ruficapillus	Red-Capped Plover	C		1
Ephippiorhynchus asiaticus	**Black-Necked Stork**	**R**		**3**
Ducula bicolor	Pied Imperial-Pigeon	C		5
Geopelia humeralis	Bar-Shouldered Dove	C		5
Streptopelia chinensis	Spotted Turtle-Dove	I		9
Macropygia amboinensis	Brown Cuckoo-Dove	C		4
Ptilinopus magnificus	Wompoo Fruit-Dove	C		2
Chalcophaps indica	Emerald Dove	C		8
Geopelia striata	Peaceful Dove	C		17
Ptilinopus regina	Rose-Crowned Fruit-Dove	C		2
Eurystomus orientalis	Dollarbird	C		1
Corvus orru	Torresian Crow	C		1
Cuculus saturatus	Oriental Cuckoo	C		1
Chrysococcyx lucidus	Shining Bronze-Cuckoo	C		1

Queensland Government
Environmental Protection Agency
Queensland Parks and Wildlife Service

WildNet

CLASS Scientific Name	Common Name	Status NCA	EPBC	Records
Cacomantis variolosus	Brush Cuckoo	C		2
Chrysococcyx minutillus	Little Bronze-Cuckoo	C		6
Scythrops novaehollandiae	Channel-Billed Cuckoo	C		1
Chrysococcyx russatus	Gould's Bronze-Cuckoo	C		3
Eudynamys scolopacea	Common Koel	C		5
Dicaeum hirundinaceum	Mistletoebird	C		17
Myiagra alecto	Shining Flycatcher	C		2
Monarcha leucotis	White-Eared Monarch	C		2
Grallina cyanoleuca	Magpie-Lark	C		8
Rhipidura rufifrons	Rufous Fantail	C		7
Rhipidura rufiventris	Northern Fantail	C		2
Rhipidura leucophrys	Willie Wagtail	C		12
Monarcha trivirgatus	Spectacled Monarch	C		12
Monarcha melanopsis	Black-Faced Monarch	C		1
Dicrurus bracteatus	Spangled Drongo	C		13
Myiagra rubecula	Leaden Flycatcher	C		12
Myiagra inquieta	Restless Flycatcher	C		1
Haematopus longirostris	Pied Oystercatcher	C		1
Dacelo novaeguineae	Laughing Kookaburra	C		8
Todiramphus sanctus	Sacred Kingfisher	C		8
Todiramphus macleayii	Forest Kingfisher	C		13
Todiramphus chloris	Collared Kingfisher	C		3
Hirundo ariel	Fairy Martin	C		1
Hirundo neoxena	Welcome Swallow	C		12
Irediparra gallinacea	Comb-Crested Jacana	C		4
Sterna bergii	Crested Tern	C		6
Sterna hirundo	Common Tern	C		1
Chlidonias hybridus	Whiskered Tern	C		1
Sterna albifrons	**Little Tern**	**E**		**7**
Malurus amabilis	Lovely Fairy-Wren	C		4
Megapodius reinwardt	Orange-Footed Scrubfowl	C		11
Meliphaga notata	Yellow-Spotted Honeyeater	C		26
Philemon buceroides	Helmeted Friarbird	C		11
Philemon argenticeps	Silver-Crowned Friarbird	C		1
Xanthotis macleayana	Macleay's Honeyeater	C		6
Lichenostomus chrysops	Yellow-Faced Honeyeater	C		1
Lichenostomus versicolor	Varied Honeyeater	C		1
Philemon corniculatus	Noisy Friarbird	C		2
Ramsayornis modestus	Brown-Backed Honeyeater	C		1
Lichenostomus flavus	Yellow Honeyeater	C		2
Meliphaga gracilis	Graceful Honeyeater	C		10
Myzomela obscura	Dusky Honeyeater	C		15
Merops ornatus	Rainbow Bee-Eater	C		11
Anthus novaeseelandiae	Richard's Pipit	C		2
Nectarinia jugularis	Yellow-Bellied Sunbird	C		22
Oriolus flavocinctus	Yellow Oriole	C		15
Sphecotheres viridis	Figbird	C		20

CLASS Scientific Name	Common Name	Status NCA	EPBC	Records
Colluricincla megarhyncha	Little Shrike-Thrush	C		9
Pachycephala simplex peninsulae	Grey Whistler	C		5
Gerygone palpebrosa	Fairy Gerygone	C		12
Gerygone magnirostris	Large-Billed Gerygone	C		7
Sericornis magnirostris	Large-Billed Scrubwren	C		4
Neochmia phaeton	**Crimson Finch**	**V**		**4**
Lonchura punctulata	Nutmeg Mannikin	I		6
Neochmia temporalis	Red-Browed Finch	C		5
Lonchura castaneothorax	Chestnut-Breasted Mannikin	C		5
Passer domesticus	House Sparrow	I		1
Pelecanus conspicillatus	Australian Pelican	C		3
Tregellasia capito	Pale-Yellow Robin	C		1
Phalacrocorax carbo	Great Cormorant	C		5
Phalacrocorax melanoleucos	Little Pied Cormorant	C		3
Phalacrocorax sulcirostris	Little Black Cormorant	C		3
Phalacrocorax varius	Pied Cormorant	C		3
Pitta versicolor	Noisy Pitta	C		1
Puffinus tenuirostris	Short-Tailed Shearwater	C		3
Alisterus scapularis	Australian King-Parrot	C		4
Trichoglossus haematodus	Rainbow Lorikeet	C		8
Cyclopsitta diophthalma macleayana	**Macleay's Fig-Parrot**	**V**		**8**
Ailuroedus melanotis	Spotted Catbird	C		3
Porzana pusilla	Baillon's Crake	C		1
Rallina tricolor	Red-Necked Crake	C		1
Porphyrio porphyrio	Purple Swamphen	C		3
Amaurornis olivaceus	Bush-Hen	C		1
Himantopus himantopus	Black-Winged Stilt	C		1
Tringa nebularia	Common Greenshank	C		1
Heteroscelus brevipes	Grey-Tailed Tattler	C		2
Numenius phaeopus	Whimbrel	C		2
Aplonis metallica	Metallic Starling	C		16
Acridotheres tristis	Common Myna	I		12
Cisticola exilis	Golden-Headed Cisticola	C		3
Platalea regia	Royal Spoonbill	C		3
Threskiornis spinicollis	Straw-Necked Ibis	C		3
Threskiornis molucca	Australian White Ibis	C		5
Plegadis falcinellus	Glossy Ibis	C		1
Zosterops lateralis	Silvereye	C		4
MAMMAL				
Cercartetus caudatus	Long-Tailed Pygmy-Possum	C		1
Antechinus flavipes rubeculus	Yellow-Footed Antechinus	C		1
Taphozous sp.				4
Saccolaimus flaviventris	Yellow-Bellied Sheathtail Bat	C		1
Macropus agilis	Agile Wallaby	C		7
Tadarida australis	White-Striped Freetail Bat	C		1

Queensland Government
Environmental Protection Agency
Queensland Parks and Wildlife Service

WildNet

CLASS		Status		
Scientific Name	Common Name	NCA	EPBC	Records
Mormopterus beccarii	Beccari's Freetail Bat	C		2
Chaerephon jobensis	Northern Freetail Bat	C		2
Rattus sp.				1
Rattus fuscipes	Bush Rat	C		2
Melomys cervinipes	Fawn-Footed Melomys	C		6
Uromys caudimaculatus	Giant White-Tailed Rat	C		2
Rattus leucopus	Cape York Rat	C		3
Mus musculus	House Mouse	I		1
Perameles nasuta	Long-Nosed Bandicoot	C		2
Pteropus conspicillatus	Spectacled Flying-Fox	C	V	4
Rhinolophus megaphyllus	Eastern Horseshoe-Bat	C		5
Sus scrofa	Pig	I		2
Myotis macropus	Large-Footed Myotis	C		3
Nyctophilus sp.				5
Vespadelus pumilus	Eastern Forest Bat	C		1
Chalinolobus gouldii	Gould's Wattled Bat	C		1
Scoteanax rueppellii	Greater Broad-Nosed Bat	C		1
Miniopterus australis	Little Bent-Wing Bat	C		8
Miniopterus schreibersii oceanensis	Eastern Bent-Wing Bat	C		3

Nature Conservation Act (1992) Status: Presumed Extinct (PE), Endangered (E), Vulnerable (V), Rare (R), Common (C) Or Not Protected ( ).
Environment Protection And Biodiversity Conservation Act (1999) Status: Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct In The Wild (XW) And Vulnerable (V).

BIRDS AUSTRALIA DATABASE

Scientific name	Common name	Location	Lat	Lon	Date
Casuarius casuarius	**Southern Cassowary**	**Coquette Point, Innisfail**	**-17.5167**	**146.067**	**31/10/1999**
Casuarius casuarius	**Southern Cassowary**	**Coquette Point, Innisfail**	**-17.5167**	**146.067**	**21/08/1999**
Casuarius casuarius	**Southern Cassowary**	**Coquette Point, Innisfail**	**-17.5167**	**146.067**	**30/09/1999**
Casuarius casuarius	**Southern Cassowary**	**Coquette Point, Innisfail**	**-17.5167**	**146.067**	**30/08/2000**
Casuarius casuarius	**Southern Cassowary**	**Coquette Point, Innisfail**	**-17.5167**	**146.067**	**31/10/2000**
Casuarius casuarius	**Southern Cassowary**	**Coquette Point, Innisfail**	**-17.5167**	**146.067**	**10/09/2001**
Alectura lathami	Australian Brush-turkey	Coquette Point, Innisfail	-17.5167	146.067	31/10/2000
Megapodius reinwardt	Orange-footed Scrubfowl	Ella Bay	-17.4669	146.065	21/07/2000
Phalacrocorax sulcirostris	Little Black Cormorant	Flying Fish Point old tip	-17.5017	146.071	21/10/2000
Egretta novaehollandiae	White-faced Heron	Flying Fish Point	-17.4986	146.075	5/09/2001
Egretta sacra	Eastern Reef Egret	Ella Bay	-17.4753	146.069	21/07/2000
Threskiornis molucca	Australian White Ibis	adj Fish Farm	-17.4978	146.076	16/10/2003
Threskiornis spinicollis	Straw-necked Ibis	Flying Fish Point	-17.4986	146.075	5/09/2001
Pandion haliaetus	Osprey	Ella Bay	-17.4581	146.063	21/07/2000
Haliastur indus	Brahminy Kite	Ella Bay	-17.4403	146.064	21/07/2000
Haliaeetus leucogaster	White-bellied Sea-Eagle	Flying Fish Point old tip	-17.5014	146.071	22/01/2001
Amaurornis olivaceus	Bush-hen	Coquette Point, Innisfail	-17.5167	146.067	31/10/1999
Numenius phaeopus	Whimbrel	Flying Fish Point	-17.4986	146.075	5/09/2001
Tringa nebularia	Common Greenshank	Flying Fish Point	-17.4986	146.075	5/09/2001
Heteroscelus brevipes	Grey-tailed Tattler	Flying Fish Point	-17.4986	146.075	5/09/2001
Burhinus neglectus	**Beach Stone-curlew**	**Ella Bay NP**	**-17.4547**	**146.074**	**1/04/2000**
Burhinus neglectus	**Beach Stone-curlew**	**Ella Bay**	**-17.4581**	**146.063**	**21/07/2000**
Burhinus neglectus	**Beach Stone-curlew**	**Ella Bay**	**-17.4669**	**146.065**	**21/07/2000**
Burhinus neglectus	**Beach Stone-curlew**	**Ella Bay**	**-17.4403**	**146.064**	**21/07/2000**
Burhinus neglectus	**Beach Stone-curlew**	**Flying Fish Point**	**-17.4986**	**146.075**	**5/09/2001**
Charadrius ruficapillus	Red-capped Plover	Flying Fish Point	-17.4986	146.075	5/09/2001
Charadrius mongolus	Lesser Sand Plover	Flying Fish Point	-17.4986	146.075	5/09/2001

BIRDS AUSTRALIA DATABASE

Scientific name	Common name	Location	Lat	Lon	Date
Vanellus miles	Masked Lapwing	Ella Bay	-17.4581	146.063	21/07/2000
Sterna bergii	Crested Tern	Flying Fish Point	-17.4986	146.075	5/09/2001
Streptopelia chinensis	Spotted Turtle-Dove	Coquette Point, Innisfail	-17.5167	146.067	31/10/2000
Streptopelia chinensis	Spotted Turtle-Dove	Flying Fish Point	-17.4986	146.075	5/09/2001
Streptopelia chinensis	Spotted Turtle-Dove	Coquette Point, Innisfail	-17.5167	146.067	10/09/2001
Macropygia amboinensis	Brown Cuckoo-Dove	Ella Bay	-17.4753	146.069	21/07/2000
Chalcophaps indica	Emerald Dove	Coquette Point, Innisfail	-17.5167	146.067	10/09/2001
Geopelia striata	Peaceful Dove	Coquette Point, Innisfail	-17.5167	146.067	31/10/1999
Geopelia humeralis	Bar-shouldered Dove	adj Fish Farm	-17.4978	146.076	16/10/2003
Ptilinopus magnificus	Wompoo Fruit-Dove	Coquette Point, Innisfail	-17.5167	146.067	30/08/2000
Ptilinopus regina	Rose-crowned Fruit-Dove	Ella Bay	-17.4753	146.069	21/07/2000
Ducula bicolor	Pied Imperial-Pigeon	Ella Bay NP	-17.4547	146.074	1/04/2000
Cacatua galerita	Sulphur-crested Cockatoo	Flying Fish Point old tip	-17.5014	146.071	22/01/2001
Trichoglossus haematodus	Rainbow Lorikeet	Flying Fish Point old tip	-17.5017	146.071	21/10/2000
Psittaculirostris diophthalma	**Double-eyed Fig-Parrot**	**Flying Fish Point old tip**	**-17.5017**	**146.071**	**21/10/2000**
Psittaculirostris diophthalma	**Double-eyed Fig-Parrot**	**Flying Fish Point old tip**	**-17.5014**	**146.071**	**22/01/2001**
Alisterus scapularis	Australian King-Parrot	Coquette Point, Innisfail	-17.5167	146.067	31/10/1999
Cuculus saturatus	Oriental Cuckoo	Coquette Point, Innisfail	-17.5167	146.067	10/09/2001
Chrysococcyx minutillus	Little Bronze-Cuckoo	Flying Fish Point old tip	-17.5014	146.071	10/07/2001
Eudynamis scolopacea	Common Koel	Coquette Point, Innisfail	-17.5167	146.067	31/10/2000
Collocalia spodiopygia	**White-rumped Swiftlet**	**Flying Fish Point old tip**	**-17.5014**	**146.071**	**10/07/2001**
Dacelo novaeguineae	Laughing Kookaburra	Ella Bay	-17.4669	146.065	21/07/2000
Todiramphus macleayii	Forest Kingfisher	adj Fish Farm	-17.4978	146.076	16/10/2003
Todiramphus sanctus	Sacred Kingfisher	Ella Bay	-17.4581	146.063	21/07/2000
Todiramphus chloris	Collared Kingfisher	Flying Fish Point old tip	-17.5014	146.071	10/07/2001
Merops ornatus	Rainbow Bee-eater	Ella Bay NP	-17.4547	146.074	1/04/2000
Pitta versicolor	Noisy Pitta	Ella Bay	-17.4753	146.069	21/07/2000

BIRDS AUSTRALIA DATABASE

Scientific name	Common name	Location	Lat	Lon	Date
Malurus amabilis	Lovely Fairy-wren	Flying Fish Point old tip	-17.5017	146.071	21/10/2000
Gerygone magnirostris	Large-billed Gerygone	Flying Fish Point	-17.4986	146.075	5/09/2001
Philemon buceroides	Helmeted Friarbird	Coquette Point, Innisfail	-17.5167	146.067	31/10/1999
Xanthotis macleayana	Macleay's Honeyeater	Coquette Point, Innisfail	-17.5167	146.067	10/09/2001
Meliphaga notata	Yellow-spotted Honeyeater	Coquette Point, Innisfail	-17.5167	146.067	31/10/1999
Meliphaga gracilis	Graceful Honeyeater	Polly Creek 4.8km km N Innisfail	-17.4792	146.03	25/04/2002
Lichenostomus chrysops	Yellow-faced Honeyeater	Coquette Point, Innisfail	-17.5167	146.067	30/09/1999
Lichenostomus flavus	Yellow Honeyeater	Daradgee	-17.4825	146.003	26/10/1999
Ramsayornis modestus	Brown-backed Honeyeater	adj Fish Farm	-17.4978	146.076	16/10/2003
Myzomela obscura	Dusky Honeyeater	Coquette Point, Innisfail	-17.5167	146.067	31/10/1999
Tregellasia capito	Pale-yellow Robin	Ella Bay	-17.4753	146.069	21/07/2000
Colluricincla megarhyncha	Little Shrike-thrush	Coquette Point, Innisfail	-17.5167	146.067	30/08/2000
Monarcha trivirgatus	Spectacled Monarch	Flying Fish Point old tip	-17.5014	146.071	10/07/2001
Myiagra rubecula	Leaden Flycatcher	Coquette Point, Innisfail	-17.5167	146.067	21/08/1999
Myiagra alecto	Shining Flycatcher	Polly Creek 4.8km km N Innisfail	-17.4792	146.03	25/04/2002
Grallina cyanoleuca	Magpie-Lark	Daradgee	-17.4825	146.003	26/10/1999
Rhipidura rufifrons	Rufous Fantail	Polly Creek 4.8km km N Innisfail	-17.4792	146.03	25/04/2002
Rhipidura rufiventris	Northern Fantail	Coquette Point, Innisfail	-17.5167	146.067	21/08/1999
Rhipidura leucophrys	Willie Wagtail	Daradgee	-17.4825	146.003	26/10/1999
Dicrurus hottentottus	Spangled Drongo	adj Fish Farm	-17.4978	146.076	16/10/2003
Coracina novaehollandiae	Black-faced Cuckoo-Shrike	Coquette Point, Innisfail	-17.5167	146.067	21/08/1999
Coracina lineata	Barred Cuckoo-Shrike	adj Fish Farm	-17.4978	146.076	16/10/2003
Coracina papuensis	White-bellied Cuckoo-Shrike	Ella Bay NP	-17.4547	146.074	1/04/2000
Coracina tenuirostris	Cicadabird	Flying Fish Point old tip	-17.5017	146.071	21/10/2000
Lalage leucomela	Varied Triller	Ella Bay NP	-17.4547	146.074	1/04/2000
Oriolus flavocinctus	Yellow Oriole	Polly Creek 4.8km km N Innisfail	-17.4792	146.03	25/04/2002
Sphecotheres viridis	Figbird	Daradgee	-17.4825	146.003	26/10/1999

BIRDS AUSTRALIA DATABASE

Scientific name	Common name	Location	Lat	Lon	Date
Artamus leucorynchus	White-breasted Woodswallow	adj Fish Farm	-17.4978	146.076	16/10/2003
Cracticus quoyi	Black Butcherbird	Coquette Point, Innisfail	-17.5167	146.067	31/10/1999
Ailuroedus melanotis	Spotted Catbird	Polly Creek 4.8km km N Innisfail	-17.4792	146.03	25/04/2002
Passer domesticus	House Sparrow	Coquette Point, Innisfail	-17.5167	146.067	30/08/2000
Neochmia phaeton	**Crimson Finch**	**Daradgee**	**-17.4825**	**146.003**	**26/10/1999**
Neochmia phaeton	**Crimson Finch**	**Coquette Point, Innisfail**	**-17.5167**	**146.067**	**30/08/2000**
Neochmia temporalis	Red-browed Finch	Daradgee	-17.4825	146.003	26/10/1999
Lonchura punctulata	Nutmeg Mannikin	Flying Fish Point old tip	-17.5014	146.071	10/07/2001
Lonchura castaneothorax	Chestnut-breasted Mannikin	Daradgee	-17.4825	146.003	26/10/1999
Nectarinia jugularis	Yellow-bellied Sunbird	Daradgee	-17.4825	146.003	26/10/1999
Dicaeum hirundinaceum	Mistletoebird	Flying Fish Point old tip	-17.5014	146.071	9/04/2001
Hirundo neoxena	Welcome Swallow	adj Fish Farm	-17.4978	146.076	16/10/2003
Hirundo nigricans	Tree Martin	Daradgee	-17.4825	146.003	26/10/1999
Hirundo ariel	Fairy Martin	Daradgee	-17.4825	146.003	26/10/1999
Zosterops lateralis	Silvereye	Daradgee	-17.4825	146.003	26/10/1999
Aplonis metallica	Metallic Starling	Coquette Point, Innisfail	-17.5167	146.067	10/09/2001
Acridotheres tristis	Common Myna	Daradgee	-17.4825	146.003	26/10/1999

Australian Government
Department of the Environment and Water Resources

Protected Matters Search Tool

You are here: Environment Home > EPBC Act > Search

25 July 2007 10:35

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

You may wish to print this report for reference before moving to other pages or websites.

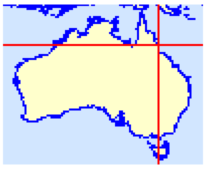
The Australian Natural Resources Atlas at http://www.environment.gov.au/atlas may provide further environmental information relevant to your selected area. Information about the EPBC Act including significance guidelines, forms and application process details can be found at http://www.environment.gov.au/epbc/assessmentsapprovals/index.html

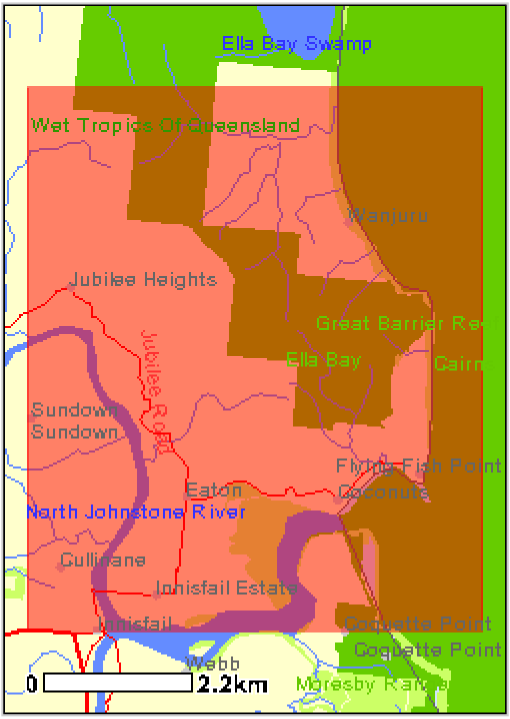
---

Search Type: Area

Buffer: 0 km

Coordinates: -17.44888,146.0216, -17.44888,146.0847, -17.52416,146.0847, -17.52416,146.0216





Report Contents:

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html.

World Heritage Properties:	2
National Heritage Places:	2
Wetlands of International Significance: (Ramsar Sites)	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	None
Threatened Species:	25
Migratory Species:	33

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html.

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.au/epbc/permits/index.html.

Commonwealth Lands:	1
Commonwealth Heritage Places:	None
Places on the RNE:	7
Listed Marine Species:	84
Whales and Other Cetaceans:	12
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	4
Other Commonwealth Reserves:	1
Regional Forest Agreements:	None

Details

Matters of National Environmental Significance

World Heritage Properties [Dataset Information]

Great Barrier Reef QLD

Wet Tropics of Queensland QLD

National Heritage Places [Dataset Information]

Great Barrier Reef QLD

Wet Tropics of Queensland QLD

Threatened Species [Dataset Information]	Status	Type of Presence
Birds		
*Casuarius casuarius johnsonii** Southern Cassowary (Australian)	Endangered	Species or species habitat known to occur within area
Erythrotriorchis radiatus * Red Goshawk	Vulnerable	Species or species habitat likely to occur within area
Rostratula australis * Australian Painted Snipe	Vulnerable	Species or species habitat may occur within area
Frogs		
Litoria nannotis * Waterfall Frog, Torrent Tree Frog	Endangered	Species or species habitat may occur within area
Litoria rheocola * Common Mistfrog	Endangered	Species or species habitat may occur within area
Nyctimystes dayi * Lace-eyed Tree Frog, Australian Lacelid	Endangered	Species or species habitat may occur within area
Mammals		
Balaenoptera musculus * Blue Whale	Endangered	Species or species habitat may occur within area
Dasyurus hallucatus * Northern Quoll	Endangered	Species or species habitat may occur within area
Hipposideros semoni * Semon's Leaf-nosed Bat, Greater Wart-nosed Horseshoe-bat	Endangered	Species or species habitat may occur within area
Megaptera novaeangliae * Humpback Whale	Vulnerable	Breeding known to occur within area

Pteropus conspicillatus * Spectacled Flying-fox	Vulnerable	Species or species habitat may occur within area
Rhinolophus philippinensis (large form) * Greater Large-eared Horseshoe Bat	Endangered	Species or species habitat may occur within area
*Saccolaimus saccolaimus nudicluniatus** Bare-rumped Sheathtail Bat	Critically Endangered	Species or species habitat may occur within area
Reptiles		
Caretta caretta * Loggerhead Turtle	Endangered	Species or species habitat may occur within area
Chelonia mydas * Green Turtle	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea * Leathery Turtle, Leatherback Turtle, Luth	Vulnerable	Species or species habitat may occur within area
Eretmochelys imbricata * Hawksbill Turtle	Vulnerable	Species or species habitat may occur within area
Lepidochelys olivacea * Pacific Ridley, Olive Ridley	Endangered	Species or species habitat may occur within area
Natator depressus * Flatback Turtle	Vulnerable	Species or species habitat may occur within area
Sharks		
Rhincodon typus * Whale Shark	Vulnerable	Species or species habitat may occur within area
Plants		
Arenga australasica * Australian Arenga Palm	Vulnerable	Species or species habitat likely to occur within area
Dendrobium mirbelianum * dendrobium orchid	Endangered	Species or species habitat likely to occur within area
Dendrobium superbiens *	Vulnerable	Species or species habitat likely to occur within area
Huperzia phlegmarioides * Layered Tassel-fern	Vulnerable	Species or species habitat likely to occur within area
Polyscias bellendenkerensis *	Vulnerable	Species or species habitat likely to occur within area
Migratory Species [Dataset Information]	Status	Type of Presence
Migratory Terrestrial Species		
Birds		
Haliaeetus leucogaster White-bellied Sea-Eagle	Migratory	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail	Migratory	Species or species habitat may occur within area
Hirundo rustica Barn Swallow	Migratory	Species or species habitat may occur within area
Merops ornatus * Rainbow Bee-eater	Migratory	Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch	Migratory	Breeding may occur within area

Monarcha trivirgatus Spectacled Monarch	Migratory	Breeding likely to occur within area
Myiagra cyanoleuca Satin Flycatcher	Migratory	Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail	Migratory	Breeding may occur within area

Migratory Wetland Species

Birds

Ardea alba Great Egret, White Egret	Migratory	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Migratory	Species or species habitat may occur within area
Gallinago hardwickii * Latham's Snipe, Japanese Snipe	Migratory	Species or species habitat may occur within area
Nettapus coromandelianus albipennis Australian Cotton Pygmy-goose	Migratory	Species or species habitat may occur within area
Numenius minutus Little Curlew, Little Whimbrel	Migratory	Species or species habitat may occur within area
Rostratula benghalensis s. lat. Painted Snipe	Migratory	Species or species habitat may occur within area

Migratory Marine Birds

Apus pacificus Fork-tailed Swift	Migratory	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Migratory	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Migratory	Species or species habitat may occur within area
Sterna albifrons Little Tern	Migratory	Species or species habitat may occur within area

Migratory Marine Species

Mammals

Balaenoptera edeni Bryde's Whale	Migratory	Species or species habitat may occur within area
Balaenoptera musculus * Blue Whale	Migratory	Species or species habitat may occur within area
Dugong dugon Dugong	Migratory	Species or species habitat likely to occur within area
Megaptera novaeangliae * Humpback Whale	Migratory	Breeding known to occur within area
Orcaella brevirostris Irrawaddy Dolphin	Migratory	Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca	Migratory	Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin	Migratory	Species or species habitat may occur within area

Reptiles

Caretta caretta * Loggerhead Turtle	Migratory	Species or species habitat may occur within area
Chelonia mydas * Green Turtle	Migratory	Species or species habitat may occur within area
Crocodylus porosus Estuarine Crocodile, Salt-water Crocodile	Migratory	Species or species habitat likely to occur within area
Dermochelys coriacea * Leathery Turtle, Leatherback Turtle, Luth	Migratory	Species or species habitat may occur within area
Eretmochelys imbricata * Hawksbill Turtle	Migratory	Species or species habitat may occur within area
Lepidochelys olivacea * Pacific Ridley, Olive Ridley	Migratory	Species or species habitat may occur within area
Natator depressus * Flatback Turtle	Migratory	Species or species habitat may occur within area
Sharks		
Rhincodon typus Whale Shark	Migratory	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Dataset Information]	Status	Type of Presence
Birds		
Anseranas semipalmata Magpie Goose	Listed - overfly marine area	Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift	Listed - overfly marine area	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Listed - overfly marine area	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Listed - overfly marine area	Species or species habitat may occur within area
Gallinago hardwickii * Latham's Snipe, Japanese Snipe	Listed - overfly marine area	Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle	Listed	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail	Listed - overfly marine area	Species or species habitat may occur within area
Hirundo rustica Barn Swallow	Listed - overfly marine	Species or species habitat may occur within area

	area	
Merops ornatus * Rainbow Bee-eater	Listed - overfly marine area	Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch	Listed - overfly marine area	Breeding may occur within area
Monarcha trivirgatus Spectacled Monarch	Listed - overfly marine area	Breeding likely to occur within area
Myiagra cyanoleuca Satin Flycatcher	Listed - overfly marine area	Species or species habitat likely to occur within area
Nettapus coromandelianus albipennis Australian Cotton Pygmy-goose	Listed - overfly marine area	Species or species habitat may occur within area
Numenius minutus Little Curlew, Little Whimbrel	Listed - overfly marine area	Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail	Listed - overfly marine area	Breeding may occur within area
Rostratula benghalensis s. lat. Painted Snipe	Listed - overfly marine area	Species or species habitat may occur within area
Sterna albifrons Little Tern	Listed	Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong	Listed	Species or species habitat likely to occur within area
Ray-finned fishes		
Acentronura tentaculata Hairy Pygmy Pipehorse	Listed	Species or species habitat may occur within area
Bulbonaricus davaoensis Davao Pughead Pipefish	Listed	Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish	Listed	Species or species habitat may occur within area
Choeroichthys sculptus Sculptured Pipefish	Listed	Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish	Listed	Species or species habitat may occur within area

Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish	Listed	Species or species habitat may occur within area
Corythoichthys flavofasciatus Yellow-banded Pipefish, Network Pipefish	Listed	Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish	Listed	Species or species habitat may occur within area
Corythoichthys ocellatus Orange-spotted Pipefish, Ocellated Pipefish	Listed	Species or species habitat may occur within area
Corythoichthys paxtoni Paxton's Pipefish	Listed	Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish	Listed	Species or species habitat may occur within area
Cosmocampus maxweberi Maxweber's Pipefish	Listed	Species or species habitat may occur within area
Doryrhamphus dactyliophorus Ringed Pipefish	Listed	Species or species habitat may occur within area
Doryrhamphus excisus Indian Blue-stripe Pipefish, Blue-stripe Pipefish	Listed	Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish	Listed	Species or species habitat may occur within area
Festucalex cinctus Girdled Pipefish	Listed	Species or species habitat may occur within area
Festucalex gibbsi Gibbs' Pipefish	Listed	Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish	Listed	Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish	Listed	Species or species habitat may occur within area
Halicampus macrorhynchus Whiskered Pipefish, Ornate Pipefish	Listed	Species or species habitat may occur within area
Halicampus mataafae Samoan Pipefish	Listed	Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish	Listed	Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish	Listed	Species or species habitat may occur within area
Hippichthys cyanospilos Blue-speckled Pipefish, Blue-spotted Pipefish	Listed	Species or species habitat may occur within area
Hippichthys heptagonus Madura Pipefish, Reticulated Freshwater Pipefish	Listed	Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish	Listed	Species or species habitat may occur within area
Hippichthys spicifer Belly-barred Pipefish, Banded Freshwater Pipefish	Listed	Species or species habitat may occur within area
Hippocampus bargibanti Pygmy Seahorse	Listed	Species or species habitat may occur within area

Hippocampus histrix Spiny Seahorse	Listed	Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse	Listed	Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse	Listed	Species or species habitat may occur within area
Hippocampus zebra Zebra Seahorse	Listed	Species or species habitat may occur within area
Micrognathus andersonii Anderson's Pipefish, Shortnose Pipefish	Listed	Species or species habitat may occur within area
Micrognathus brevirostris Thorn-tailed Pipefish	Listed	Species or species habitat may occur within area
Microphis brachyurus Short-tailed Pipefish, Short-tailed River Pipefish	Listed	Species or species habitat may occur within area
Nannocampus pictus Painted Pipefish, Reef Pipefish	Listed	Species or species habitat may occur within area
Phoxocampus diacanthus Pale-blotched Pipefish, Spined Pipefish	Listed	Species or species habitat may occur within area
Siokunichthys breviceps Soft-coral Pipefish	Listed	Species or species habitat may occur within area
Solegnathus hardwickii Pipehorse	Listed	Species or species habitat may occur within area
Solenostomus cyanopterus Blue-finned Ghost Pipefish, Robust Ghost Pipefish	Listed	Species or species habitat may occur within area
Solenostomus paradoxus Harlequin Ghost Pipefish, Ornate Ghost Pipefish	Listed	Species or species habitat may occur within area
Syngnathoides biaculeatus Double-ended Pipehorse, Alligator Pipefish	Listed	Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bend Stick Pipefish, Short-tailed Pipefish	Listed	Species or species habitat may occur within area
Trachyrhamphus longirostris Long-nosed Pipefish, Straight Stick Pipefish	Listed	Species or species habitat may occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake	Listed	Species or species habitat may occur within area
Aipysurus duboisii Dubois' Seasnake	Listed	Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake	Listed	Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake	Listed	Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake	Listed	Species or species habitat may occur within area
Caretta caretta * Loggerhead Turtle	Listed	Species or species habitat may occur within area

Chelonia mydas * Green Turtle	Listed	Species or species habitat may occur within area
Crocodylus porosus Estuarine Crocodile, Salt-water Crocodile	Listed	Species or species habitat likely to occur within area
Dermochelys coriacea * Leathery Turtle, Leatherback Turtle, Luth	Listed	Species or species habitat may occur within area
Disteira kingii Spectacled Seasnake	Listed	Species or species habitat may occur within area
Disteira major Olive-headed Seasnake	Listed	Species or species habitat may occur within area
Enhydrina schistosa Beaked Seasnake	Listed	Species or species habitat may occur within area
Eretmochelys imbricata * Hawksbill Turtle	Listed	Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake	Listed	Species or species habitat may occur within area
Hydrophis mcdowelli	Listed	Species or species habitat may occur within area
Hydrophis ornatus a seasnake	Listed	Species or species habitat may occur within area
Lapemis hardwickii Spine-bellied Seasnake	Listed	Species or species habitat may occur within area
Laticauda colubrina a sea krait	Listed	Species or species habitat may occur within area
Laticauda laticaudata a sea krait	Listed	Species or species habitat may occur within area
Lepidochelys olivacea * Pacific Ridley, Olive Ridley	Listed	Species or species habitat may occur within area
Natator depressus * Flatback Turtle	Listed	Species or species habitat may occur within area
Pelamis platurus Yellow-bellied Seasnake	Listed	Species or species habitat may occur within area
Whales and Other Cetaceans [Dataset Information]	Status	Type of Presence
Balaenoptera acutorostrata Minke Whale	Cetacean	Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale	Cetacean	Species or species habitat may occur within area
Balaenoptera musculus * Blue Whale	Cetacean	Species or species habitat may occur within area
Delphinus delphis Common Dolphin	Cetacean	Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus	Cetacean	Species or species habitat may occur within area
Megaptera novaeangliae * Humpback Whale	Cetacean	Breeding known to occur within area
Orcaella brevirostris	Cetacean	Species or species habitat may occur

Irrawaddy Dolphin		within area
Orcinus orca Killer Whale, Orca	Cetacean	Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin	Cetacean	Species or species habitat may occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin	Cetacean	Species or species habitat may occur within area
Tursiops aduncus Spotted Bottlenose Dolphin	Cetacean	Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin	Cetacean	Species or species habitat may occur within area

Commonwealth Lands [Dataset Information]

Defence

Places on the RNE [Dataset Information]
Note that not all Indigenous sites may be listed.

Historic

Commonwealth Bank QLD

Innisfail Courthouse QLD

Johnstone Shire Hall QLD

Our Lady of Good Counsel Catholic Church QLD

Natural

Ella Bay National Park (1978 boundary) QLD

Great Barrier Reef Region QLD

Moresby Range National Park (1978 boundary) QLD

Extra Information

State and Territory Reserves [Dataset Information]

Cairns Marine Park, QLD

Carello Palm Swamp Conservation Park, QLD

Ella Bay National Park, QLD

Moresby Range National Park, QLD

Other Commonwealth Reserves [Dataset Information]

Great Barrier Reef Marine Park, COM

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the *Environment Protection and Biodiversity Conservation Act 1999*. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under "type of presence". For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the migratory and marine provisions of the Act have been mapped.

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites;
- seals which have only been mapped for breeding sites near the Australian continent.

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgments

This database has been compiled from a range of data sources. The Department acknowledges the following custodians who have contributed valuable data and advice:

- New South Wales National Parks and Wildlife Service
- Department of Sustainability and Environment, Victoria
- Department of Primary Industries, Water and Environment, Tasmania
- Department of Environment and Heritage, South Australia Planning SA
- Parks and Wildlife Commission of the Northern Territory
- Environmental Protection Agency, Queensland
- Birds Australia
- Australian Bird and Bat Banding Scheme
- Australian National Wildlife Collection

- Natural history museums of Australia
- Queensland Herbarium
- National Herbarium of NSW
- Royal Botanic Gardens and National Herbarium of Victoria
- Tasmanian Herbarium
- State Herbarium of South Australia
- Northern Territory Herbarium
- Western Australian Herbarium
- Australian National Herbarium, Atherton and Canberra
- University of New England
- Other groups and individuals

ANUCliM Version 1.8, Centre for Resource and Environmental Studies, Australian National University was used extensively for the production of draft maps of species distribution. Environment Australia is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Last updated:

Department of the Environment and Water Resources
GPO Box 787 Canberra ACT 2601 Australia
Telephone: +61 (0)2 6274 1111

WORKING PAPER 3

CASSOWARY ISSUES

LES MOORE

CASSOWARY HABITAT ASSESSMENT AND PREFERRED ALIGNMENT IMPACT ASSESSMENT

Access Road, Ella Bay Integrated Resort

Report prepared

for

Satori Resorts Ella Bay Pty Ltd

L.A. MOORE
'Cloudhill'
63 Wooleys Road,
Millaa Millaa 4886
Queensland, Australia
Phone +61 7 4097 2107
Email: cloudhill@bigpond.com; lesmoore3@bigpond.com

CASSOWARY HABITAT ASSESSMENT

AND PREFERRED ALIGNMENT IMPACT ASSESSMENT

Access Road, Ella Bay Integrated Resort

Table of Contents

TABLES

FIGURES

BOX

APPENDIX A

CASSOWARY HABITAT ASSESSMENT
ACCESS ROAD, ELLA BAY INTEGRATED RESORT

1. INTRODUCTION

This cassowary habitat assessment provides a characterisation of the quality and value to cassowaries of habitat present within the corridor of the Ella Bay access road between Flying Fish Point and Ella Bay, near Innisfail. Using the results of previous cassowary field surveys of the coastal area (Moore 2003, 2005, 2006a-c, 2007a), cassowary habitat mapping provided by the Environmental Protection Agency (February 2004), and recent vegetation mapping carried out by 3D Environmental (2007), this report evaluates the capacity and suitability of remaining habitat to support cassowaries. The report specifically addresses:

1. Assessment of Road Alignment Options A – D
2. Description of the site in context of its local and regional context;
3. Data sources and methodology;
4. Weighting factors for vegetation categories;
5. Impact assessment and mitigation of preferred road alignment;
6. Uncertainties.

1.1 CONTEXT OF THE ELLA BAY ACCESS ROAD

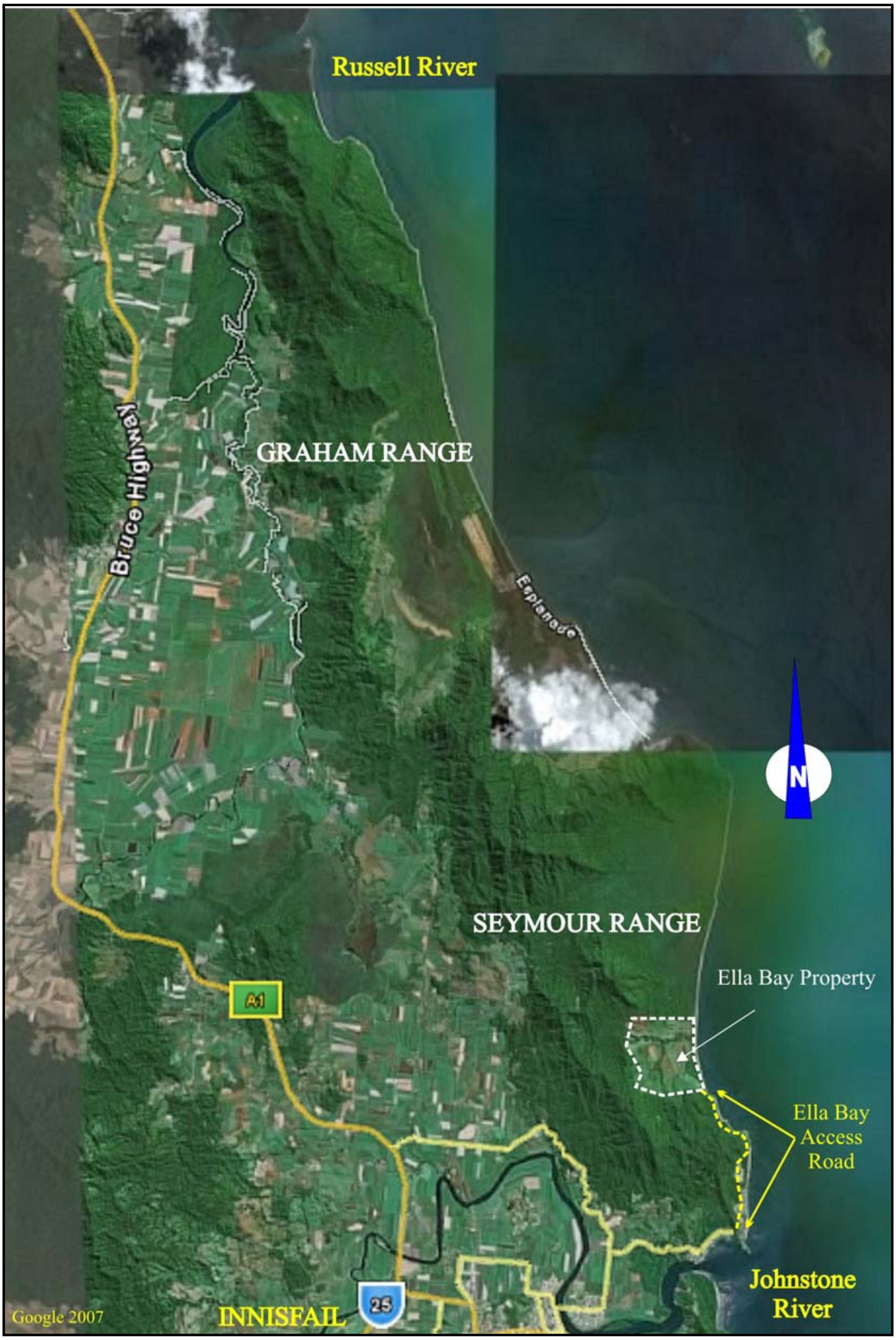
1.1.1 Location and Description

The following road description is from BAAM (2007). The Ella Bay access road is located approximately four kilometres to the north-west of Innisfail within the Wet Tropics bioregion of Queensland (Figure 1). It commences from the southern end of Flying-Fish Point and runs north for approximately three kilometres where it ends at the proposed Ella Bay Integrated Resort site. This road alignment follows an existing gazetted unsealed road as it passes through, or adjacent to, Ella Bay National Park. The study area includes the gazetted road as well as Lot 246 on NR3550 and Lot 18 on USL35566. The northern and southern sections of the road are located on comparatively low-lying land with little undulation. However the central portion of the road skirts the coastal fall of the Seymour Range negotiating the coastal headland of Heath Point where it is incised into the steep hillside (BAAM 2007).

Several creek-lines of various sizes cross the road. The largest has permanent water and is located within the National Park towards the northern end of the road alignment. This creek-line has few riffle zones, replaced by pools of water with a sandy or sediment substrate, terminating seaward in a sandy swale which breaches the coastal foredune. Other smaller watercourses do not appear to contain permanent water, but are likely to run regularly with rainfall. These are typically steep, fast flowing streams with rock or boulder substrate. The study area which will contain the preferred road alignment is within the Wet Tropics World Heritage Area (WTWHA) and adjacent to the World Heritage Great Barrier Reef Zone.

FIGURE 1

Location of Ella Bay Access Road



1.1.2 Cassowary values

The Ella Bay access road is located at the southeast end of the Graham-Seymour Range (Figure 1), and adjacent to the Ella Bay National Park. The size of the Graham-Seymour Range cassowary subpopulation is tentatively estimated to be 51-73 independent birds i.e., adults and subadults. The Seymour Range section of this subpopulation is tentatively estimated to be 28-40 independent birds (Moore 2007a, 2007b). Population viability analyses indicate that along with the other coastal cassowary subpopulations south of Cairns, the Graham-Seymour Range cassowary population is undergoing a population decline. It is postulated that this decline is caused by inadequate patch size, isolation from the main habitat blocks to the west, cyclone-induced mortality, and high levels of historical and contemporary anthropogenic impact exacerbating the naturally low reproductive rate of cassowaries. The study also showed, however, that given adequate funding, appropriate management strategies were available to stabilise the population(s).

2. DATA SOURCES AND METHODOLOGY

All references used as a basis for this assessment are listed in the bibliography. The more recent reports which specifically addressed the site include:

- 3D Environmental (2006a). 'Vegetation Survey Report of the Proposed Ella Bay Integrated Resort Project' Report prepared for BAAM. Brisbane.

- 3D Environmental (2006b). 'Ella Bay Integrated Resort Project' Supplementary Section:

- BAAM (2006) 'Terrestrial and Freshwater Flora and Fauna Impact Assessment' Report prepared for Ella Bay Developments Pty Ltd. Cleveland, Australia.

- BAAM (2007) Terrestrial flora and fauna assessment and preferred alignment impact assessment access road, Ella Bay Integrated Resort. Report prepared for Satori Resorts Ella Bay Pty Ltd.

- Moore, L.A. (2007). 'Cassowary Assessment of the 'Ella Bay Integrated Resort Project' North Queensland 6 – 14 November 2006: Volume I Cassowary Field Survey; Volume II – Impacts and Mitigation; Volume III – Population Viability Analysis. Millaa Millaa, Queensland.

- ETS Group (2007) 'Ella Bay Access Road Strategy, Preferred Option Clearing Quantities.Report Prepared for Satori Resorts Ella Bay Pty Ltd.

2.1 CASSOWARY HABITAT CLASSIFICATION

It is unlikely that the classification of cassowary habitat by EPA (2004) was meant to be applied at the small scale required for evaluating the relative importance of cassowary habitat along the Ella Bay access road. As such, the assessment reported here was conducted as a pilot study of possible ways in which risk analysis could be used to classify the value of potential cassowary habitat. The following factors for each polygon were analysed:

- Cassowary habitat quality of existing vegetation;
- Risk to birds in accessing that vegetation.

These two factors will be considered in turn and used to devise weighting factors to inform the multi-criteria analysis.

In this study, cassowary habitat quality was assigned to three categories: High Quality Habitat, Moderate Quality Habitat, and Low Quality Habitat. Goosem (1992) prepared a management plan for Mission Beach in which the existing vegetation was classified according to its perceived significance to cassowaries. Some of his habitat zone definitions are extremely useful, particularly when mapping at a scale smaller than the regional ecosystem level used by EPA. As such, habitat quality criteria from his work are paraphrased in this report where appropriate.

High Quality Habitat (*sensu* '*Essential Habitat*' – *EPA*)

EPA (2004) described this category as "Regional ecosystems known to be preferentially used by cassowaries for breeding, feeding and general activity". It can be more fully described as possessing high cassowary population densities, containing known preferred breeding areas, providing refuge areas after natural catastrophes i.e., cyclones, and furnishing adequate food resources during lean times (Goosem 1992).

Moderate Quality Habitat (*sensu* '*General Habitat*' – *EPA*)

This habitat category includes 'General Habitat' as described by EPA (2004) i.e., "…sometimes provides linking habitat or movement corridors to traverse between regional ecosystems of essential habitat and is capable of supporting cassowaries infrequently but not during times of food shortage". Moderate quality areas generally comprise vegetation which is more disturbed and with less habitat complexity than 'High Quality' habitat.

Low Quality Habitat (*sensu Marginal or Alternative Habitat – EPA*)

These areas comprise native woodland or forest containing non-rainforest vegetation i.e., coastal woodland associations and *Melaleuca* communities with impeded drainage and coastal woodland associations. Although these areas are known to be visited by cassowaries, it is unlikely they can support permanent populations. In some circumstances, however, standing water present in *Melaleuca* communities provide an important source of water in dry periods and may be sought out by cassowaries. In these situations the otherwise marginal habitat takes on an increased importance in maintaining the local cassowary population.

2.2. HABITAT QUALITY VERSUS HABITAT VALUE

There is confusion regarding what constitutes cassowary habitat and what does not. This uncertainty arises when evaluations are made of small areas of relatively intact rainforest vegetation adjacent to, or contiguous with, areas where cassowaries are known to occur. In general, the decision to allow or facilitate cassowary access to such areas is made without taking into account the level of risk faced by birds in doing so. There is often a direct conflict between what habitat cassowaries can exploit i.e., capacity, and what is safe for them to make use of i.e., its suitability. A prosaic example of this reality might be that children will happily play on the road, but such behaviour is certain to decrease their survival probabilities. So it is with cassowaries. By allowing cassowaries into areas with high risk levels, the probability of death or injury increases to an unacceptable level. Areas of vegetation, therefore, although appearing superficially important to cassowaries, may instead function as ecological traps i.e., habitat which cannot sustain a population but nonetheless attracts individuals and elevates their extinction risk. It is important, therefore, to develop a weighting system which, while recognising habitat quality, incorporates the existing risk level if cassowaries utilise such habitat.

2.3 RISK ASSESSMENT METHODOLOGY

As the level of anthropogenic threat increases, the usefulness of otherwise suitable cassowary habitat decreases. The level of existing risk, therefore, should be factored into any assessment of cassowary habitat. The risk assessment approach used in this assessment attempts to establish the **Habitat Value** i.e., the true contribution made by habitat to conserving the cassowary populations in an area, and represents the weighting given to each vegetation category. The evaluation method also assists in identifying those areas that may be of increased benefit to cassowaries if successful mitigation is implemented. Table 1 presents the habitat quality and risk ratings used to arrive at Habitat Values for the vegetation adjoining Ella Bay access road.

As this is a pilot analysis which will be explored further in forthcoming cassowary studies, the risk levels have been limited to three to match those used in previous population viability analyses of the region (PVA) i.e.,' Low', 'Moderate', and 'High' (Moore and Moore 2007). It was established in previous PVA studies that the 'No Risk' category does not occur in coastal cassowary subpopulations of the Wet Tropics south of Cairns (Moore 2007a, Moore and Moore 2007).

TABLE 1

Habitat and Risk Ratings

Habitat quality	Rating	Risk Level	Rating
High Quality Habitat (i.e., essential/critical habitat)	3	High risk [1]	0.1
Moderate Quality Habitat (i.e., general/corridor habitat)	2	Medium risk [2]	0.5
Low Quality Habitat (i.e., marginal/alternative habitat)	1	Low risk [3]	1

[1] *High risk:* Birds subject to high levels of human generated risk on a daily basis.

[2] *Moderate risk:* Birds subject to high levels of human generated risk regularly.

[3] *Low risk:* Birds subject to some level of human generated risk regularly.

The possible outcomes of the habitat quality and risk rating system for all habitat scenarios are presented in Box 1. The Habitat Value increases from 0.1 for low quality-high risk habitat, to a maximum of 3.0 indicating the best quality for lowest risk habitat. These habitat values can provide a relative ranking or weighting of the vegetation along the road alignment.

BOX 1

HABITAT QUALITY x RISK LEVEL = HABITAT VALUE

High Quality Habitat		Risk Level	Habitat Value/Vegetation Category	
3	x	1.0 (Low Risk)	3.0	High Value
	x	0.5 (Moderate Risk)	1.5	Moderate Value
	x	0.1 (High Risk)	0.3	Negative Value
Moderate Quality Habitat				
2	x	1.0 (Low Risk)	2.0	Moderate Value
	x	0.5 (Moderate Risk)	1.0	Low Value
	x	0.1 (High Risk)	0.2	Negative Value
Low Quality Habitat				
1	x	1.0 (Low Risk)	1.0	Low Value
	x	0.5 (Moderate Risk)	0.5	Negative Value
	x	0.1 (High Risk)	0.1	Negative Value

3. RESULTS

3.1 CASSOWARY HABITAT QUALITY

Using the results of a field survey (Moore 2007a) and a fauna assessment by BAAM (2007), the vegetation within the study area was mapped as ‘High’, ‘Moderate’, or ‘Low’ Quality cassowary habitat (Figure 2). ‘High’ quality cassowary habitat occurs in the Ella Bay National Park (Location 1), the southern and northern sections of the Ella Bay road corridor (Locations 5 and 8), and the Little Cove development area. The Flying

Fish Point Reserve (Location 4) is classified as ‘Moderate’ quality cassowary habitat. The southern end of the Seymour Range (Location 6), although not given a cassowary habitat status in the EPA (2004) habitat mapping, has been classified as ‘Low’ quality habitat in this study.

3.2 CASSOWARY HABITAT VALUES

The potential outcomes of the habitat and risk assessment model for all habitat scenarios are presented in Box 1. The results show that any Habitat Value < 1 has a negative ecological value for cassowaries i.e., although such vegetation may comprise high quality cassowary habitat, the risk attached to using it makes it less suitable and is likely to lead to injury or death. Such a situation is recognised in the literature as an ecological trap. Habitat Values incrementally increase to a maximum value of 3, representing the highest value habitat that can achieved using this model. These values have then been attributed to specific vegetation blocks in the study area (Tables 2 and 3), and the cassowary habitat mapping revised in light of those results. To illustrate the mapping process used in this study, three cassowary habitat maps are included in Figure 2 i.e., **2a)** Cassowary Habitat Mapping of EPA (2004); **2b)** Habitat <u>Quality</u> mapping (LM this report); **2c)** Cassowary Habitat <u>Value</u> (LM this report).

TABLE 2

Habitat Value and Vegetation Categories along Ella Bay Access Road

Area Code	Location	Habitat Quality (capacity)	Risk Level	Habitat Value (suitability)	Vegetation Category
1	Ella Bay National Park	3	1.0	3.0	A
2	Heath Point	1	0.5	0.5	C
3	Beach front	1	0.1	0.1	D
4	**Flying Fish Point Reserve**	**2**	**0.1**	**0.2**	**D (B)***
5	Southern EB Road verge	3	0.1	0.3	D
6	South Seymour Range	1	0.1	0.1	D
7	Flying Fish Point west swamp	1	0.5	0.5	C
8	Northern EB Road verge	3	0.1	0.3	D

**** High risk habitat will be mitigated to Category B (Moderate Value Habitat) with raised bridges and fencing proposed by proponent.***

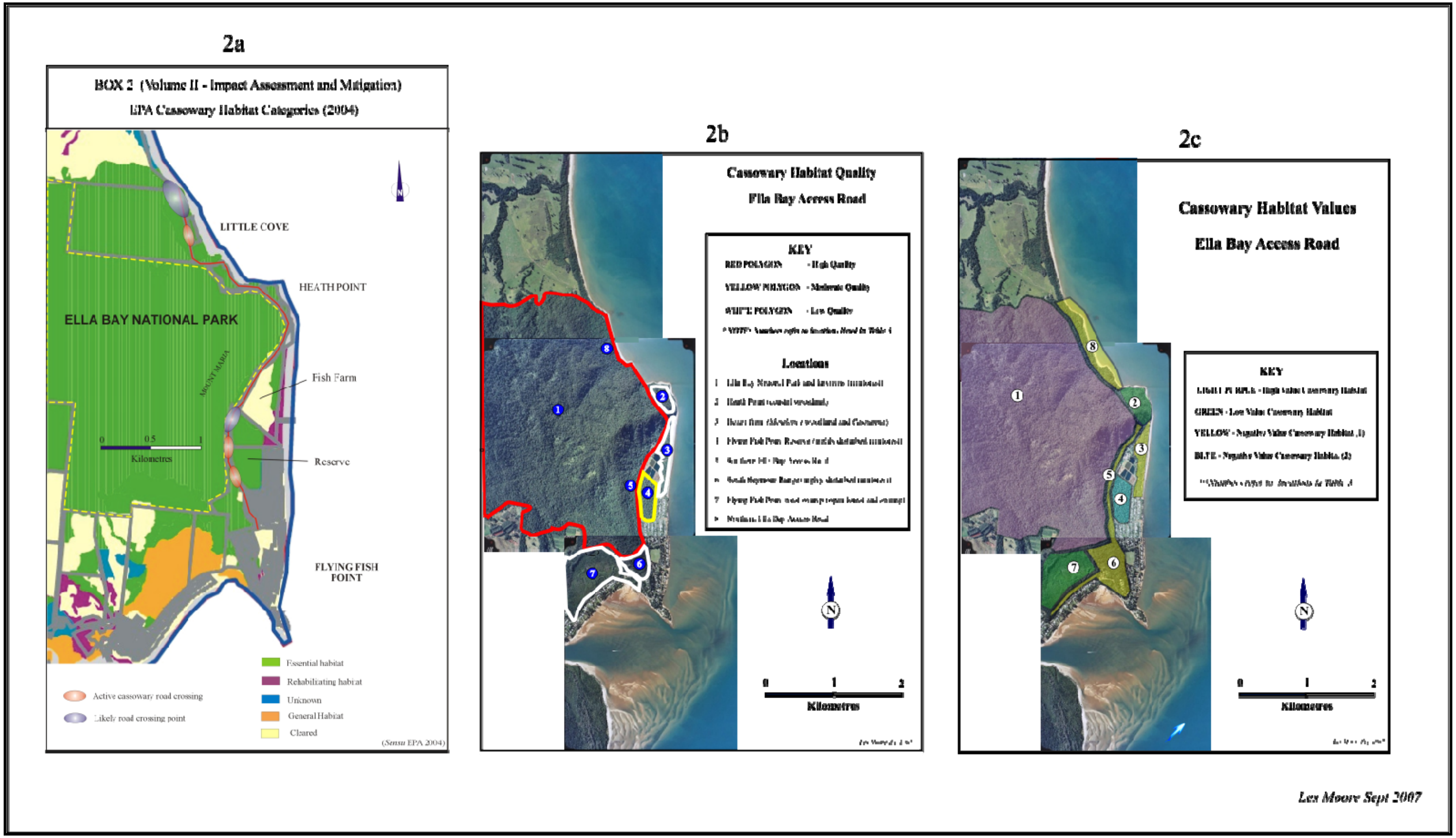
TABLE 3

Habitat values along Ella Bay Road (see Fig 1)

Cassowary Habitat Value	Location Codes	Comments
High Value	1	▪ no risk (away from boundaries) ▪ moderate risk adjacent to boundaries
Moderate Value	-	▪ not present in study area
Low Value	2, 7	▪ alternative habitat (unknown importance) ▪ moderate risk area (road, dogs, humans) ▪ non-rainforest woodland
Negative Value	3, 4, 5, 6, 8	▪ high risk area (roads, dogs, humans) ▪ habitat value of locations 4 and 5 (Reserve and adjacent road) can be increased to 'Moderate' using mitigation.

FIGURE 2a – 2c

Cassowary habitat values – Ella Bay access road



3.3 VEGETATION CATEGORIES

These results have been plotted onto the vegetation polygons along the Ella Bay Access Road using the ETS polygons as a baseline (Figures 3a-g). Four vegetation categories have been recognised as follows:

- Category A – High value (high quality and low risk)
- Category B – Moderate value (moderate quality and moderate risk)
- Category C – Alternative habitat (low quality, steep terrain)
- Category D – Negative value (varying quality and high risk)

3.4 OTHER CONSIDERATIONS

The following areas outside of the Ella Bay National Park would have functioned as high quality cassowary habitat prior to the existing road being built:

- The southern and northern sections of the Ella Bay Road;
- Flying Fish Point Reserve;
- Southern end of the Seymour Range west of the town of Flying Fish Point.

Currently all these areas pose great risks to those cassowaries using them, for what is minimal ecological benefit. Although categorised as Negative Value Habitat in this assessment, the Flying Fish Point Reserve may be pivotal to the continued presence of cassowaries in this south-east section of Seymour Range. Cassowaries must drink a number of times during the day and the streams between Flying Fish point and Heath

Point are ephemeral. The *Melaueca leucadendron* and featherpalm (*Archontophoenix alexandrae)* dominated communities within the Reserve, therefore, may hold the only water source available to cassowaries in this area during dry periods. Thus, the Reserve probably provides both food and water resources for cassowaries.

Figure 3a-g presents cassowary habitat values for the preliminary polygons mapped for the Ella Bay access road by ETS (2007).

FIGURE 3a

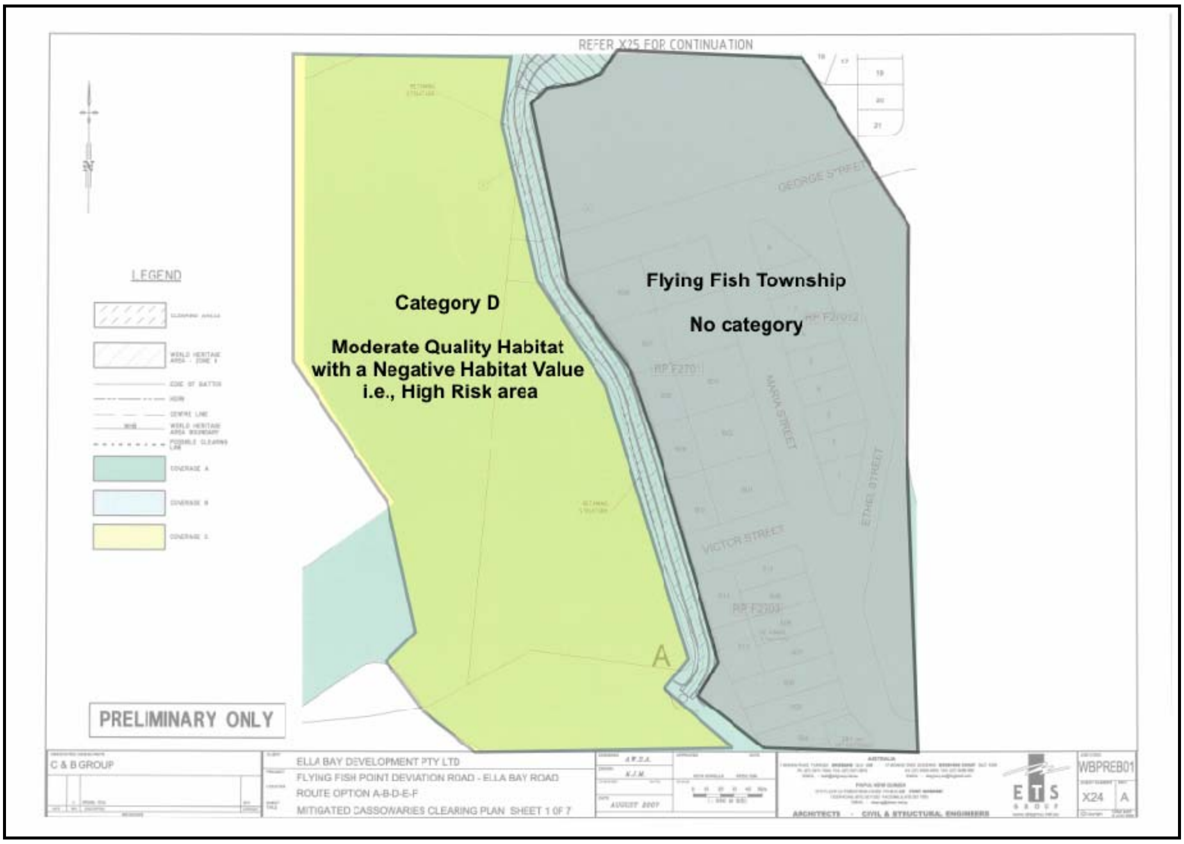


FIGURE 3b

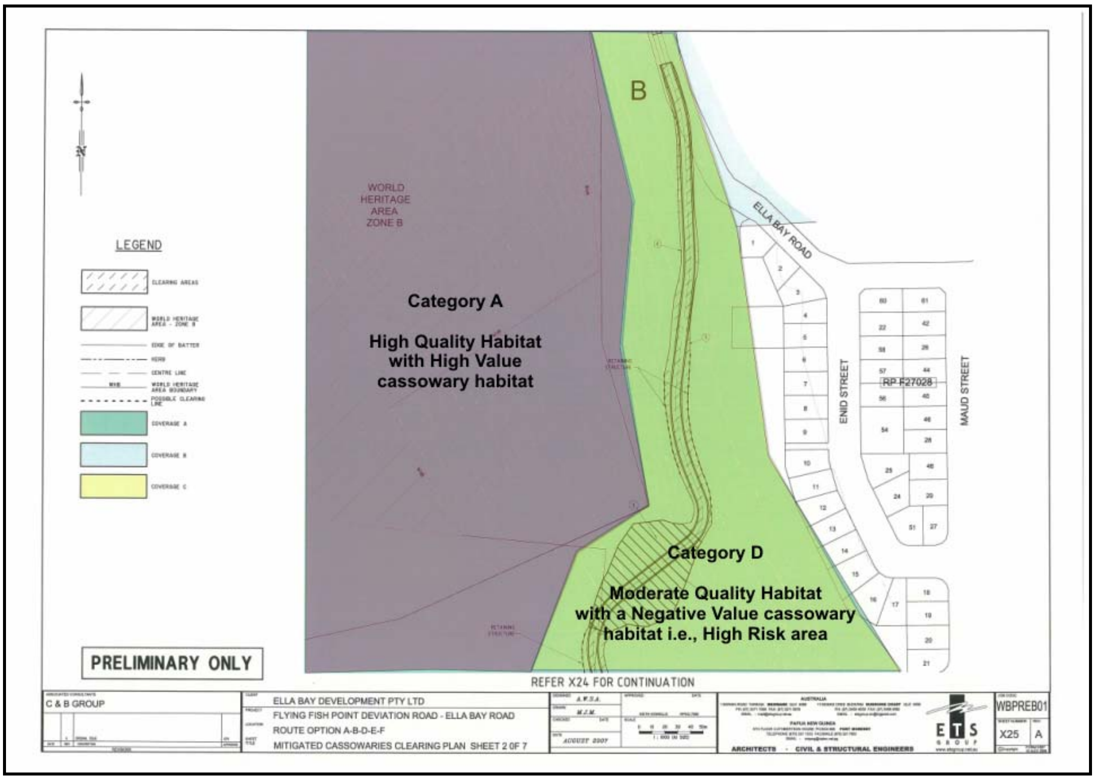


FIGURE 3c

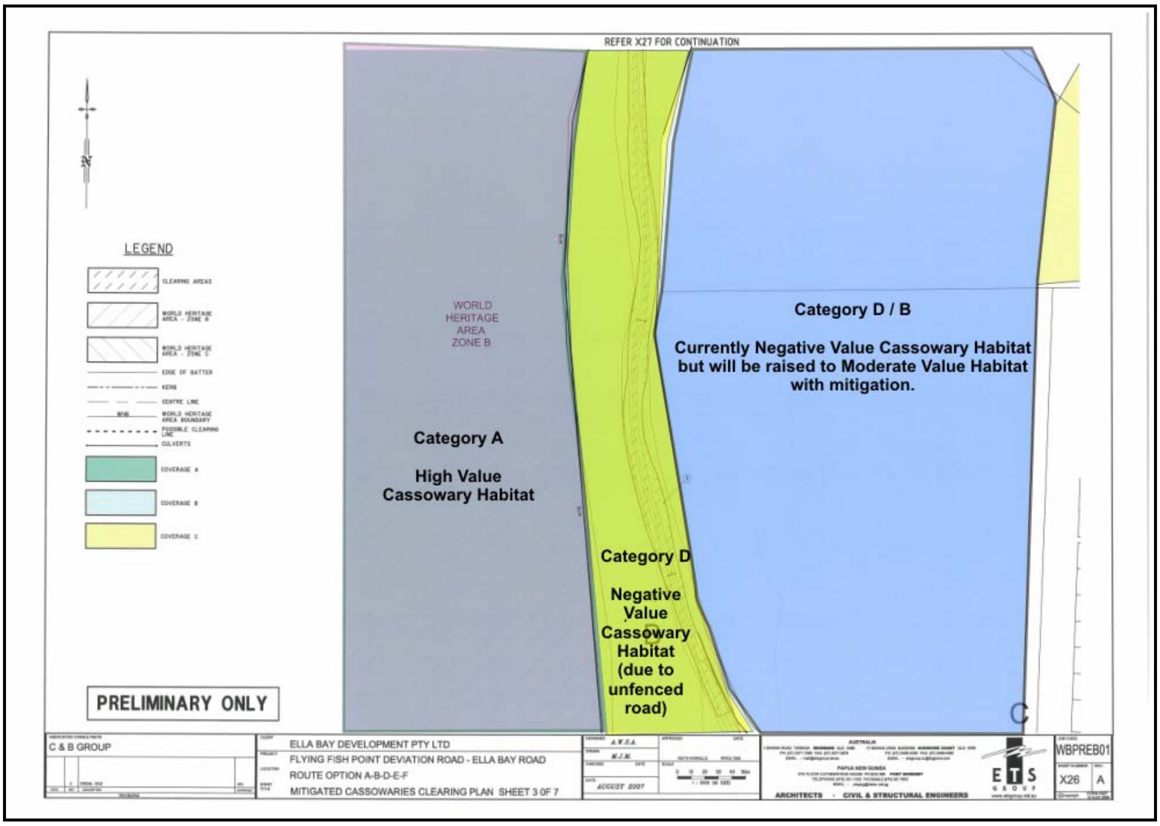


FIGURE 3d

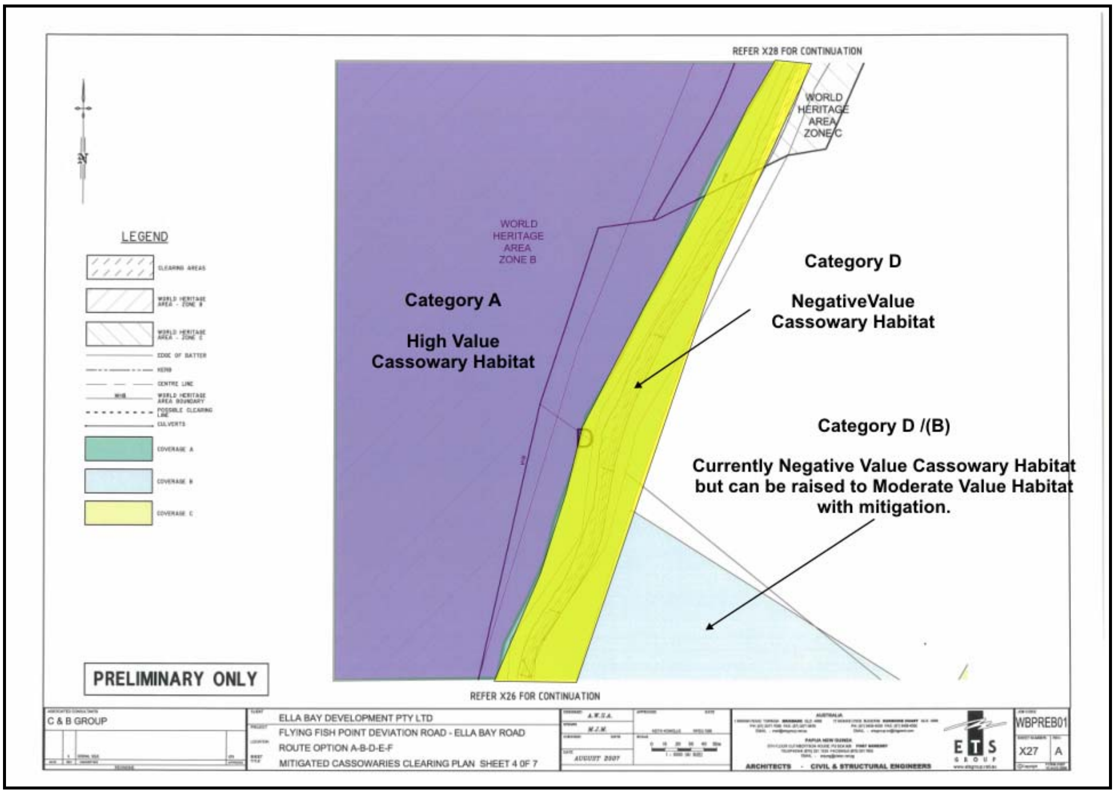


FIGURE 3e

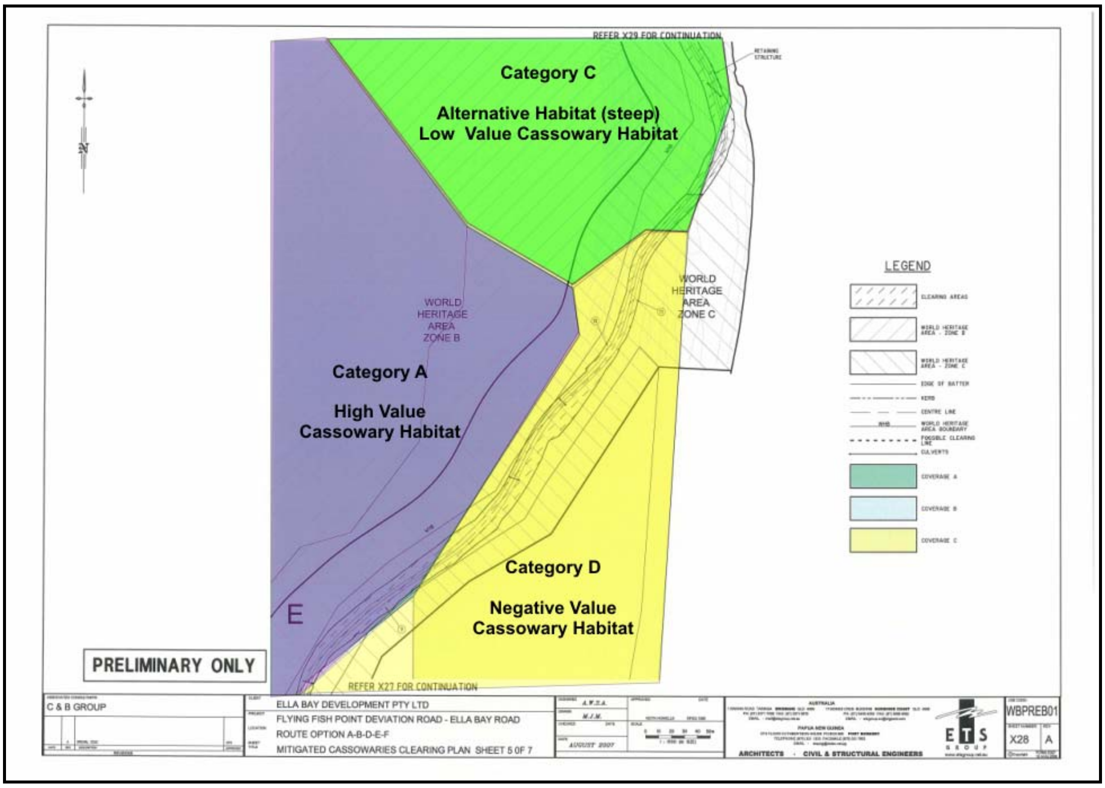


FIGURE 3f

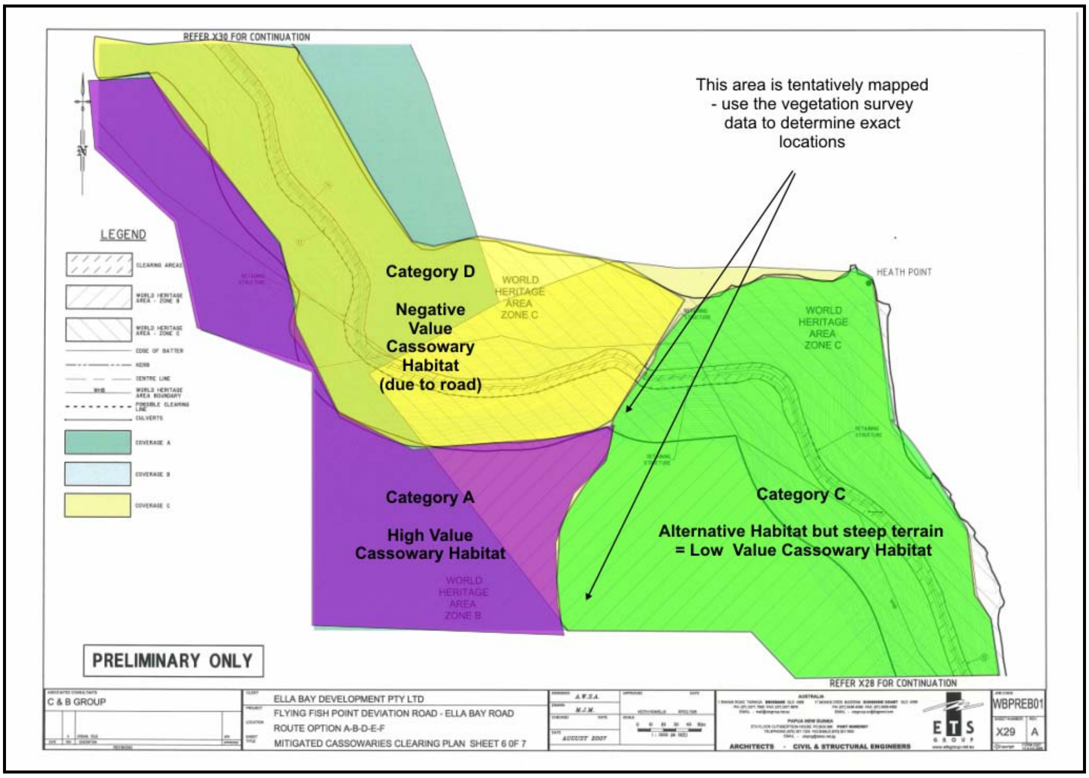
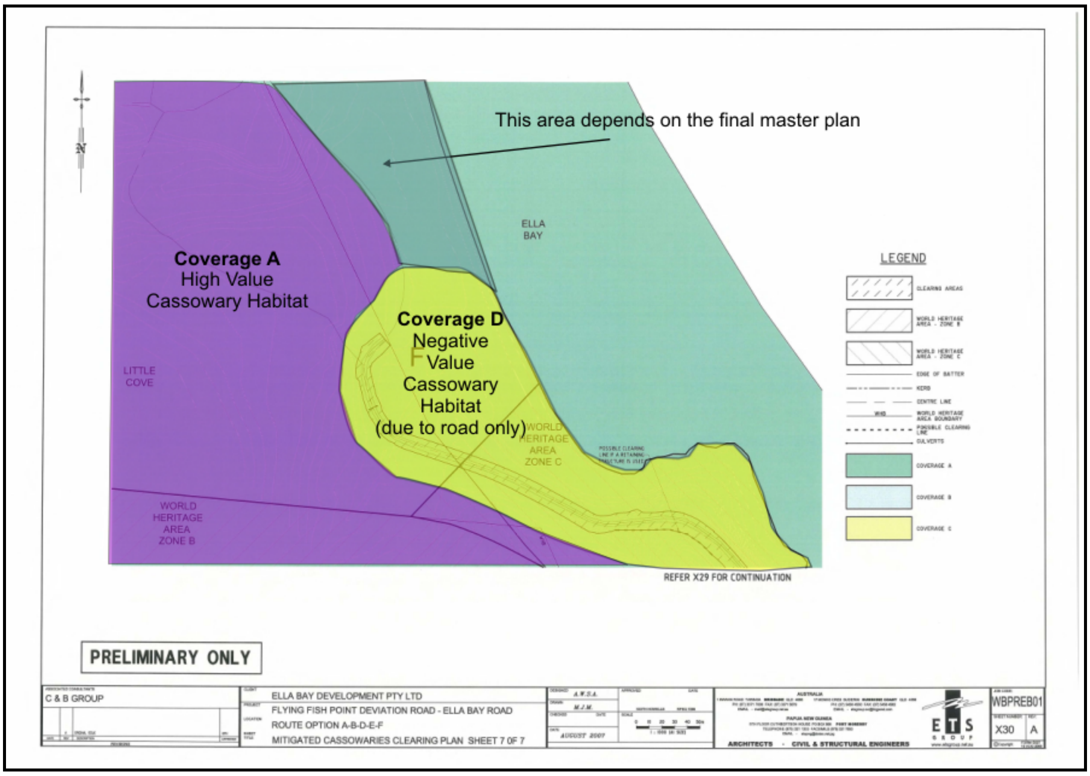


FIGURE 3g



4. IMPACT ASSESSMENT AND MITIGATION STRATEGIES

An assessment of the impacts on the local cassowary population of each of the original alignment options is provided in Appendix A. Proposed mitigation strategies have removed the risk issues associated with Option A [ACBD] and Options C & D [ABDE], with the addition of raised bridges and exclusion fencing allowing birds to safely cross the road into the Reserve.

4.1 ASSESSMENT OF PREFERRED ROAD ALIGNMENT

The preferred road alignment (previous Option D) is shown in Figure 4. Starting from its southern limit on the Flying Fish Point Road just south of the township, the proposed road alignment traverses approximately 0.94 km of forest, within unallocated state land, where no road currently exists. The alignment then joins with the existing Ella Bay Road alignment north-west of Flying Fish Point, following that road for approximately 3.7 km northwards within road reserve before reaching the southern end of Heath Point, some 2.76km from its starting point. From this location the proposed route runs northward along the existing road alignment to the southern boundary of the Ella Bay Integrated Resort area. The road enters the Wet Tropics World Heritage Area 1.78 km from the starting point of the road and leaves it at 3.63 km. The proposed road pavement width is 9m, although the clearing width varies with topography. Where the proposed road is aligned with the existing road, clearing is restricted to only those areas necessary for driver safety and road stability (BAAM 2007).

FIGURE 4

PREFERRED ROAD ALIGNMENT (<u>OPTION D: A-B-D-E-F Raised bridge and exclusion fencing)</u>

4.2 ROAD CROSSING CASSOWARIES

In previous work (Moore 2007a), three active cassowary road-crossing points and two likely road-crossing areas were identified along Ella Bay Access Road. The locations of these cassowary road crossing points are shown on Figure 5.

FIGURE 5

Cassowary Road Crossing Points 6 – 14 November 2006

4.3 THREATS ALONG SECTIONS A – E (Flying Fish Point to Heath Point)

The status of the cassowary habitat and the increased risks to birds using the road crossings are quantified in this report (Section whatever) and two threats are identified:

1. A reduced carrying capacity from loss of habitat leading to pressures on reproductive productivity and recruitment i.e., isolation of the Flying Fish Point Reserve.
2. An increased risk of road death to cassowaries occupying adjacent or nearby habitat due to increased traffic flows.

4.3.1 Mitigation

Cut and cover tunnel (A-B)

The proposed construction of a cut and cover tunnel between A and B will preserve connectivity to the southern tip of Seymour Range for cassowaries. As the construction and revegetation phases will restrict the use of the area by birds, the following recommendations are made:

- Best time to construct May-August – dry season
- Cassowary proof fence to be erected around the construction envelope to prevent birds entering the area during construction and revegetation phases;
- Education program for workers to prevent hand-feeding and other disturbances;
- Fencing on both sides of finished road to prevent access to road by cassowaries.

Fencing

To mitigate the risk of cassowary road death, fencing will be constructed along the entire length of Ella Bay access road, excluding section E – F, which will be subject to traffic calming studies (see below). Cassowaries are extremely strong, and birds are known to scale fences when upset or excited. As part of the proposed mitigation for the access road, therefore, a cassowary road-management research program will be undertaken to determine the appropriate height, structure, and screening methods for a cassowary-proof fence. It will also look at techniques to encourage the safe movement of small mammals and other terrestrial animals across the road. On-going monitoring of the efficacy of the fence will be included in the cassowary research program.

Elevated Bridge Overpasses (B-E)

Raised bridge overpasses will be constructed to allow cassowaries to pass beneath and access the Reserve without crossing the road (Figure 4). The bridges and their locations will be designed and constructed with regard to encouraging their use by cassowaries, and a planting program undertaken if required. The design of the raised bridge will incorporate low visual impact (cassowaries are wary of solid overhead structures), and allow light and rainfall to reach the ground below relatively unhindered.

4.3.2 Uncertainties

The bridges will be part of the cassowary road monitoring program to look at their efficacy using camera surveillance and ground survey. It is uncertain whether the northern bridge i.e., immediately prior to Heath Point, is beneficial to cassowaries. Although it facilitates cassowary access to the beach area, which possesses very little in the way of food resources, it potentially brings them into contact with humans and dogs. The road monitoring studies will need to assess whether this across-road access should be kept open for cassowaries or fenced off to protect the birds.

4.4 THREATS ALONG SECTION E – F (Heath Point to Ella Bay property gate)

The area of Heath Point comprises steep coastal headlands dominated by a complex of shrubland, low heathy or shrubby woodlands or open forests dominated by *Corymbia tessellaris* and *Lophostemon suaveolens* (BAAM 2007). Although probably visited by cassowaries it is categorised as marginal or alternative habitat. North of Heath Point to Point F, the vegetation comprises a mosaic of mesophyll vine forest on beach ridges, complex mesophyll vine forest, and non-remnant vegetation communities (BAAM 2007). Much of the area along the beach and east of the existing road has been a traditional camping area for local people from Innisfail and tourists. The threats identified in this area include:

1. An increased risk of road death to cassowaries occupying adjacent or nearby habitat due to increased traffic flows.
2. Adverse cassowary-human interactions.

4.4.1 Mitigation

This section of road is used extensively by cassowaries to move along and cross in a number of locations (Moore 2007a). Although there is a major crossing at a small stream 0.6 kilometres south of the Ella Bay Property gate, the birds may cross at many points, from the foot of the Heath Point headland to the gate. Due to the traditional use of this area by locals and tourists, there is a possibility of adverse interactions between cassowaries and humans. As use of the road and the beach will increase when the EBIR is constructed, this threat may need to be addressed. As such, the following mitigation strategy is recommended:

- Program to develop, trial, and monitor traffic calming strategies.

4.4.2 Uncertainties

If the monitoring of the area shows an unacceptable incidence of adverse cassowary-human interactions, the road will need to be fenced to prevent cassowaries accessing the beachfront.

4.5 SUMMARY

The proposed fence and funnel mitigation reduces the current high risk of road death for local cassowaries along the entire length of the Ella Bay access road. Along the southern road section, the construction of exclusion fencing and raised bridges will permit cassowaries to safely cross the road and access food and water resources within Flying Fish Point Reserve. In doing so it will increase the value of the cassowary habitat in the Reserve from its current assessment as Negative Value Habitat i.e., High Risk (0.2), to Moderate Value Habitat i.e., Moderate to Low Risk (>1.0).

The following recommendations were given in Moore (2007a) and have been included in the proponents offset package:

1. A detailed cassowary management strategy for the Graham-Seymour Range coastal subpopulation should be developed, and its implementation supported by adequate funding. This management strategy should include:

i. The maintenance and protection of the existing movement corridors linking the two range populations.

ii. The development and implementation of a cassowary road management strategy for the Bramston Beach Road.

iii. The implementation of an effective dog control program for the communities adjoining the Graham-Seymour Range. As council funding is limited for policing uncontrolled dogs, it may be necessary to request support from the developers for this action.

REFERENCES

3D Environmental (2006a). 'Vegetation Survey Report of the Proposed Ella Bay IntegratedResort Project' Report prepared for BAAM. Brisbane.

3D Environmental (2006b). 'Ella Bay Integrated Resort Project' Supplementary Section:

BAAM (2006) 'Terrestrial and Freshwater Flora and Fauna Impact Assessment' Report prepared for Ella Bay Developments Pty Ltd. Cleveland, Australia.

BAAM (2007) Terrestrial flora and fauna assessment and preferred alignment impact assessment access road, Ella Bay Integrated Resort. Report prepared for Satori Resorts Ella Bay Pty Ltd.

Buckley Vann (2006). Myola Planning Study: Proposed Amendments to Mareeba Shire Planning Scheme. Consultants report to Mareeba Shire Council.

Moore, L.A. (2006). 'Cassowary Assessment of the 'Ella Bay Integrated Resort Project' North Queensland 6 – 14 November 2006: Volume I Cassowary Field Survey; Volume II – Impacts and Mitigation; Volume III – Population Viability Analysis. Millaa Millaa, Queensland.

EPA (2004). Distribution of Cassowary *Casuarius casuarius johnsonii* Habitat in the Wet Tropics Bioregion, Queensland.

ETS Group (2007) 'Ella Bay Access Road Strategy, Preferred Option

Goosem, S (1992). Draft Management Plan Mission Beach Area, North Queensland. Queensland Department of Environment and Heritage Report, Far Northern Region, Cairns.

Moore, L.A (1998). Cassowary Conservation Roads: A Management Strategy and Road Upgrade Assessment for El Arish and Tully-Mission Beach Roads, Mission Beach. *Report for Queensland Department of Main Roads.*

Moore, L.A., (2003). Ecology and population viability analysis of the Southern Cassowary (*Casuarius casuarius johnsonii*): Mission Beach, North Queensland. Masters of Science thesis, Department of Zoology and Tropical Ecology, James Cook University, Townsville, Queensland.

Moore, L.A. (2005). Review of cassowary issues and management strategies and EPBC referral, Oasis Beachfront Resort, Mission Beach, North Queensland. Consultancy report for Biodiversity Assessment and Management Pty Ltd, Brisbane.

Moore, L.A. (2006a). Review of cassowary issues and management strategies and EPBC referral, Oasis Beachfront Resort, Mission Beach, North Queensland. Consultancy report for Biodiversity Assessment and Management Pty Ltd, Brisbane.

Moore, L,A. (2006b). Desktop assessment for Oasis Resort offset land at Mt Edna, Mission Beach, North Queensland. Consultancy report for Biodiversity Assessment and Management Pty Ltd, Brisbane.

Moore, L,A (2006c). Cassowary survey and impact assessment of Jubilee Grove – Stage 2, Innisfail, North Queensland. Consultancy report for Biodiversity Assessment and Management Pty Ltd, Brisbane.

Moore, L,A. (2007a). Cassowary assessment of the 'Ella Bay Integrated Resort Project' North Queensland:
Volume I – Cassowary field survey
Volume II – Impacts and mitigation
Volume III – Population viability analysis
Consultancy reports for John Holland Pty. Ltd.

Moore L.A. (2007b). Population ecology of the Southern Cassowary *Casuarius casuarius johnsonii*, Mission Beach, north Queensland. J. Ornithol (2007) 148: 357-366.

Moore L.A. and Moore N.J. (2007). Implications of environmental catastrophes and climate change for the management of an endangered species: the Southern Cassowary *Casuarius casuarius johnsonii*. Austral Ecology.

Moore, L.A. (2007d – in prep). Does the history of the Moa suggest a future for the cassowary? The dilemma of slow birds in a fast world. Animal Conservation.

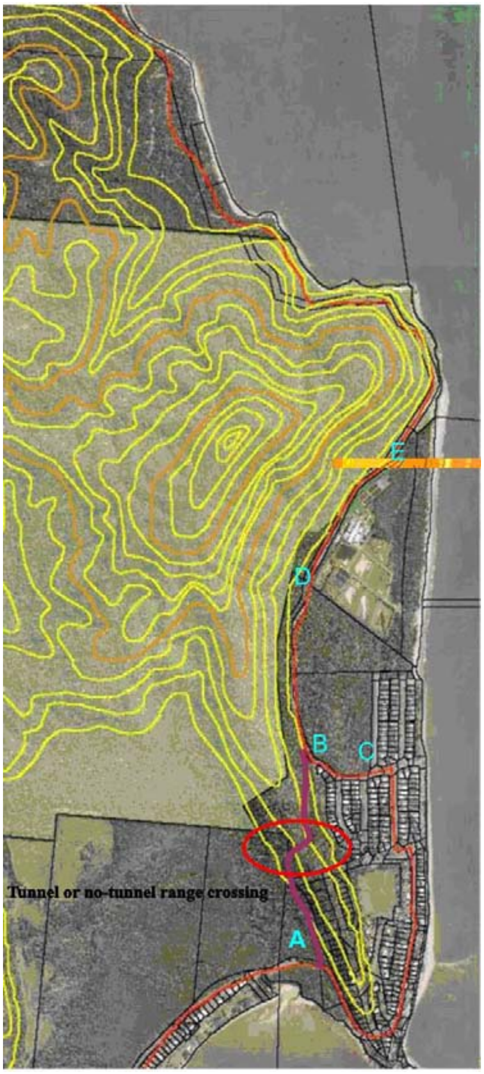
APPENDIX A

5. COMMENTS ON PROPOSED ROAD OPTIONS

Potential road alignments were examined using supplied variations of the route locations shown in Figure 4, and an assessment of their potential impacts on cassowaries xyz are given below:

FIGURE 4

Ella Bay Access Road Alignment Options



5.1 OPTION A: POINTS A-C-B-D (FIGURE 4)

This option does not address the high level of risk faced by cassowaries' crossing over the Ella Bay access road to forage in the Reserve. The current alignment of the road is the primary cause of the road and adjacent Reserve being classified as Negative Value Habitat i.e., birds utilising the vegetation in this area have an unacceptably high risk of injury or death.

5.1.1 Summary

Unless cassowaries are excluded (fenced) out of the road corridor and hence the Reserve, this option does nothing to reduce the risk level of local cassowaries along the Ella Bay access road. If the road is fenced to exclude cassowaries, the Reserve will be permanently lost to cassowaries for foraging. As such, this option is not supported.

5.2 OPTION B: POINTS A-C-D (FIGURE 4)

This route option uses the existing road through the Flying Fish Point township but is then re-aligned east of the Reserve and along the south and west boundaries of the fish farm to the north (Figure 4). Although this route effectively 'recovers' the cassowary habitat of the Reserve and adjacent section of Ella Bay access road, it does not remedy the problem of dog attacks on cassowaries at the southern end of Seymour Range and on the outskirts of Flying Fish Point. In addition, fencing will be required to prevent birds crossing the busy Innisfail Road to access the small area of mangroves to the south. Apparently, community resistance to an upgrading of the road corridor and an increased traffic flow through the township makes it uncertain whether this option will be adopted. Notwithstanding, it is an acceptable option and decreases the risk level of cassowaries considerably i.e., it is probable that with this option the cassowary habitat value in the Reserve can be improved from Negative to Moderate Habitat Value with appropriate mitigation.

5.2.1 Summary

This is an acceptable road alignment which will contribute significantly to reducing the risk level to cassowaries and will increase the Habitat Value of the Reserve and adjacent vegetation. However, it is dependent on community support for its placement. In the planning process, it would be valuable to address the problems of cassowaries crossing the Innisfail Road and the risk of dog attacks at the southern end of the Seymour Range and environs of Flying Fish Point.

5.3 OPTION C: INLAND ROUTE: NO TUNNEL - POINTS A-B-D (FIGURE 4)
OPTION D: INLAND ROUTE: CUT AND COVER TUNNEL (FIGURE 4)

While both of these options have the potential to reduce the risk of birds accessing the Innisfail Road to the south of Flying Fish Point, neither route option addresses the high risk area of the Reserve and adjacent fish farm. If the existing alignment through that area is unchanged and an exclusion fence erected, the Reserve will be permanently lost as a food resource and possible future breeding area for cassowaries. Although it is theoretically feasible to reduce the risk of road crossing birds by using various traffic calming techniques, there are no known traffic calming strategies that could guarantee the safety of birds crossing the road to access the Reserve.

5.3.1 Summary

These two options, while having a beneficial affect at the southern end of Seymour Range, will increase the risk level for cassowaries in the area of the Reserve and adjacent fish farm and, as such, is not supported.

5.4 OPTION E: POINTS A-B-C-D (FIGURE 4)

Option B (Points A-C-D) is an acceptable alignment option and results in a positive contribution to cassowary conservation in the area of the Reserve and fish farm. To reduce potential impacts to cassowaries and other fauna in the area of the range crossing, the road would need to be located as closely as possible to existing residential area and disturbed habitat. The route in this option includes the both Option C and Option D i.e., ‘no tunnel’ and ‘cut and cover tunnel’. Although an impact assessment of both options would need to be conducted prior to choosing which method to use to cross the range, the ‘cut and cover tunnel’ is likely to create less environmental impacts, both visually and ecologically, than the ‘no tunnel’ option.

5.4.1 Summary

If Option B is rejected by the Flying Fish Point community (i.e., road travelling through Flying Fish Point township), this route is considered an acceptable alternative. Prior to recommending the range crossing method however, an impact assessment would need to be conducted exploring any potential impacts on cassowaries, other fauna, and on the hydrology of the swamp and associated vegetation to the west of the proposed route. As the southern end of Seymour Range is classified as “Negative Value Habitat’ i.e., unacceptably high risk of road death and dog attacks for cassowaries using it, consideration should be given to fencing at the point of the range crossing to prevent cassowaries from accessing the area. Such exclusion involves the loss of only an extremely small area of low quality and high risk habitat to the south of the range crossing (predominantly comprising houses and a busy road), while increasing the Habitat Value to the north of the crossing considerably (cassowary habitat contiguous with the Ella Bay National Park).

5.5. SUMMARY OF ROAD OPTIONS

The proposed road options and their appropriateness for cassowaries have been rated from Ranking 1 i.e., High Impact for cassowaries, to Ranking 2 i.e., Low Impact for cassowaries. Specific mitigation strategies are suggested for Options A, C, and D, which will significantly reduce the risk for cassowaries that cross the road to access the Flying Fish Point Reserve i.e., preferred option.

5.5.1 Ranking 1 – High Impact Options

- ***OPTION A: A-C-B-D (road-based traffic calming)***

This option is not supported i.e., with road-based traffic calming strategies, due to the permanent separation of the Reserve from the main forest block to the west, and a continuing, although lowered, risk to road crossing cassowaries.

- ***OPTION C:*** ***A-B-D (no tunnel – road-based traffic calming)***

So far as cassowaries are concerned, this option is no different than Option A.

- ***OPTION D :*** ***A-B-D (cut & cover tunnel – road-based traffic calming***

Refer to above comments.

5.5.2 Ranking 2 – Low Impact Options

- ***OPTION B:*** ***A-C-D***

This option is supported by EPA. The reserve will need to be fenced off from the road and the old road revegetated.

- ***OPTION 'B1': A-B-C-D***

This not considered a lesser option than Option B. If adopted, it would allow for cassowaries to be excluded from the southern tip of Seymour Range by cassowary-proof fencing.

WORKING PAPER 4

GEOTECHNICAL ISSUES

GOLDER ASSOCIATES

6.0 ELLA BAY ROAD

6.1 Site Observations

A brief visual inspection of the first section of Ella Bay Road from Flying Fish Point to Heath Point indicated that local topography was relatively level. Works to upgrade and/or widen this section of road should require minimal cut/fill earthworks or other disturbance of the existing relatively shallow slopes. No specific geotechnical engineering design is considered necessary for this section of road and no further assessment is provided.

Geotechnical conditions present along the remaining alignment of Ella Bay Road north from Heath Point were observed and recoded at thirty eight locations during a walkover inspection. Inspection record locations are shown on Figure 3 and summarised in Appendix A.

Key observations comprised:

- Existing cut slopes generally range in height between 1 m and 6 m, with batters between 1:1 (v:h) up to 4:1 (v:h).
- Natural slopes above and below existing road cuttings were generally steep, with gradients typically between 1:2 (v:h) and 1:1 (v:h), with local areas up to 2:1 (v:h).
- Large rocks up to 1.5 m is size were observed above the existing road near Heath Point. Observations of slopes above the existing road were generally limited by thick rainforest vegetation.
- Existing cut slopes generally exposed a surface layer of colluvial soils and residual soils to a maximum depth of approximately 2 m overlying weathered metamorphic rock.
- The colluvial soil layer was generally less than 1 m thick and comprised firm to stiff gravely clays.
- Weathering of underlying rock was variable along the access road with residual soils comprising stiff to very stiff clay present to depths up to 2 m overlying low to medium strength, extremely weathered to moderately weathered rock.

- Observed rock structure was generally limited to foliation with a consistent orientation (60° to 80o dipping towards the north west) and one other main joint set (70° dipping towards 250°).
- Localised erosion and slumping of cut slopes within the near surface colluvial and residual soils was evident to depths of up to 1.5 m.
- Larger scale erosion and slumping was evident at a concentrated surface water flow discharge areas.
- Localised rotation of large trees was observed adjacent to the crest of some road cuttings, with root balls exposed by surface erosion and slumping.
- Localised erosion and slumping of fill material supporting the road formation was also evident on down slope areas.

There were no observations of existing large scale slope movement or potential immediate high risk failure areas along the road cuttings. It is noted, however, that localised slumping and failure of slopes has occurred and that the condition of these slopes is likely to continue to deteriorate over time.

6.2 Engineering Design

It is understood that upgrading of Ella Bay Road north of Heath Point will require the construction of a duel carriageway approximately 4 m wide. Such works are likely to require cut and fill earthworks as indicated on preliminary plans prepared by ETS for the road upgrade.

Recommended cut slope and fill batters for weathered rock discussed in Section 5 are considered valid for upgrading of Ella Bay Road, i.e. unsupported cut batters up to 3 m high:

- Firm the stiff soils and fill material: 1:2 (v:h)
- Weathered rock 1:1 (v:h)

It is understood, however, that vegetation and other constraints are likely to restrict opportunities to use earthworks reduce overall existing batter slope gradients as part of the road upgrade.

Engineering design to provide long term stability for the road is likely to require to use of slope stabilisation measures such as soil nails/passive dowels in conjunction with protective mesh and/or use of retaining structures.

Large boulders were observed above the road adjacent to Heath Point, however, further observations along the road alignment were generally limited by dense vegetation. Where present, large rock at the surface represent a risk of future movement onto the road below. Detailed inspection of the slopes above the road alignment are required during construction works to identify, assess and, where required, stabilise or remove such individual rocks.

A number of unstable large trees were observed adjacent to the crest of existing cut slopes. Such trees will require removal or stabilisation as part of the proposed works.

Areas of existing fill material supporting the downslope side of the road are not considered to have been placed to current engineering standards. All such fill material should be removed, keyed into underlying weathered rock and replaced as engineered fill material.

Alternatively the elevation of the road should be lowered as part of widening works to avoid or reduce the need for fill material adjacent to down slopes.

Unsupported fill batters up to about 3 m high at 1:1 (v:h) and keyed into underlying weathered rock can be achieved in fill comprising the weathered rock at the site. Overfilling prior to trimming to the design profile should be adopted.

Soil nails/passive dowels and/or retaining walls (i.e. gabions) could also be installed to support higher or steeper fill profiles.

6.3 Further Geotechnical Input

It is considered essential that engineering designs to be prepared for each section of road upgrade incorporate appropriate geotechnical stability measures described above. Such designs should be reviewed by a qualified and experienced geotechnical engineered to confirm the prepared designs are appropriate and in accordance with the design guidelines provided.

Geotechnical input is also essential during construction in order to confirm that the ground conditions encountered are consistent with these on which the geotechnical design guidelines (eg. batter slopes and heights, drainage requirements, etc) were based, or to modify the guidelines as required.

All earthworks will need to be carried out under an Erosion and Sediment Control Plan. A number of the existing low-lying culvert crossings located at the northern end of Ella Bay Road may require disturbance of acid sulfate soils. Where creek crossings require disturbance of soils below 5 m AHD, acid sulfate soil investigations should be undertaken to assess whether management measures are required.

7.0 IMPORTANT INFORMATION

Your attention is drawn to the document - "Important Information About Your Geotechnical Engineering Report", which is included in Appendix D of this report. This document has been prepared by the ASFE *(Professional Firms Practicing in the Geosciences)*, of which Golder Associates is a member. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risks associated with the groundworks for this project.

WORKING PAPER 5

OFFSETS & ADDITIONAL ENVIRONMENTAL INVESTMENTS (EXECUTIVE SUMMARY)

TERRAIN NRM