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Roads & Traffic Authority

Review of Environmental Factors

Nelson Bay Road Upgrade

Volume 2 Appendices

Bobs Farm to Anna Bay

Port Stephens COUNCIL
... a community partnership

ERM

VOLUME 2

APPENDICES

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RTA

AUTHORITY CONSULTATION

Appendix A

Port Stephens COUNCIL
... a community partnership

ERM

NSW
NATIONAL
PARKS AND
WILDLIFE
SERVICE

In reply, please quote: SZT, 97/318(3)

CE/99/2690
N.S.W.
22 JUN 1999

Ron Christie
Chief Executive Officer
Roads and Traffic Authority
Box K198
HAYMARKET NSW 1238

Dear Mr Christie

Preferred route option for Nelson Bay Road Upgrade, Port Stephens

I wish to advise of the National Parks and Wildlife Service's (NPWS) support for the preferred route option for the proposed upgrade of Nelson Bay Road (MR108) Stage 3, Port Stephens, announced by Carl Scully MP, Minister for Transport and Minister for Roads on 5 March 1999.

As you may be aware, the Roads and Traffic Authority and Port Stephens Council considered two route options. One of these options, Option 2, would have passed through the proposed Stockton Bight conservation reserve, dissecting and fragmenting this land, and diminishing its natural and cultural heritage values. This reserve is part of a previous Government commitment to establish various new parks and reserves in NSW, as outlined in *Labor's Nature Conservation Strategy (1995)* and *Labor's Vision for the NSW Coast (1995).* The Government's commitment to protecting sensitive coastal environments is also clearly outlined in the *NSW Coastal Policy 1997 - A Sustainable Future for the New South Wales Coast.* The NPWS is committed to proceeding with the protection of the Stockton Bight area, subject to resolution of Aboriginal Land Claims (ALC) which cover part of the proposal.

I understand that the Road and Traffic Authority's preferred option, Option 1b, is to widen the current road alignment along Nelson Bay Road, which supports the Road and Traffic Authority's corporate policy of making use of the existing road network where possible. In addition, I wish to commend the RTA for recognising the high conservation values of the proposed conservation reserve, and ensuring that these values will not be jeopardised by fulfilling the Road and Traffic Authority's and Council's commitment to upgrading Nelson Bay Road.

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Hurstville 2220
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Tel: (02) 9585 6678

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Dir R N L
BOS. Bwalters CM Environment & CP.
Steve T. — please send to project manager. 9/8

The NPWS looks forward to being provided an opportunity to comment on the Review of Environmental Factors for this proposal. Please do not hesitate to contact Russell Couch, Manager, Sydney Zone on (02) 9585 6657 if you wish to discuss this matter further.

Yours sincerely

Brian Gilligan. 15.6.99.

Brian Gilligan
Director-General

8

Mick Loomes Cth
For your information. Please acknowledge receipt of provided copy to Bob Sharp for his information & use in the current review process.
23/6

NSW
NATIONAL
PARKS AND
WILDLIFE
SERVICE

In reply, please quote: SZT, 97/318(3)

PORT STEPHENS COUNCIL
23 JUN 1999
File No. ES420-20
Action by Michael Skinn
App. No.

23/6

Peter Gesling
General Manager
Port Stephens Council
PO Box 42
RAYMOND TERRACE NSW 2324

W.C.C.
23/6.

Dear Mr Gesling

Preferred route option for Nelson Bay Road Upgrade, Port Stephens

I wish to thank you for Council's advice earlier this year regarding its endorsement of route Option 1b for the proposed upgrade of Nelson Bay Road (MR108) Stage 3, Port Stephens.

As you may recall, one of the options previously being considered by the Roads and Traffic Authority and Port Stephens Council would have directly conflicted with the proposed Stockton Bight conservation reserve. This reserve is part of a previous Government commitment to establish various new parks and reserves in NSW, as outlined in *Labor's Nature Conservation Strategy (1995)* and *Labor's Vision for the NSW Coast (1995).* The Government's commitment to protecting sensitive coastal environments is also clearly outlined in the *NSW Coastal Policy 1997 - A Sustainable Future for the New South Wales Coast.* The NPWS is committed to proceeding with the protection of the Stockton Bight area, subject to resolution of Aboriginal Land Claims (ALC) which cover part of the proposal.

One of the preferred options, Option 2, would have passed through the proposed conservation reserve, dissecting and fragmenting this land, and diminishing its natural and cultural heritage values. The NPWS objected to this option, providing a detailed discussion of the conservation values of Stockton Bight, and the potential impact of Option 2 on these values. The NPWS further advised that its preferred option for accommodating traffic along Nelson Bay Road was a widening of the current road alignment, described as Option 1b.

I wish to commend Council for recognising the high conservation values of the proposed conservation reserve, and ensuring that these values will not be jeopardised by infrastructure works within Port Stephens through its support of

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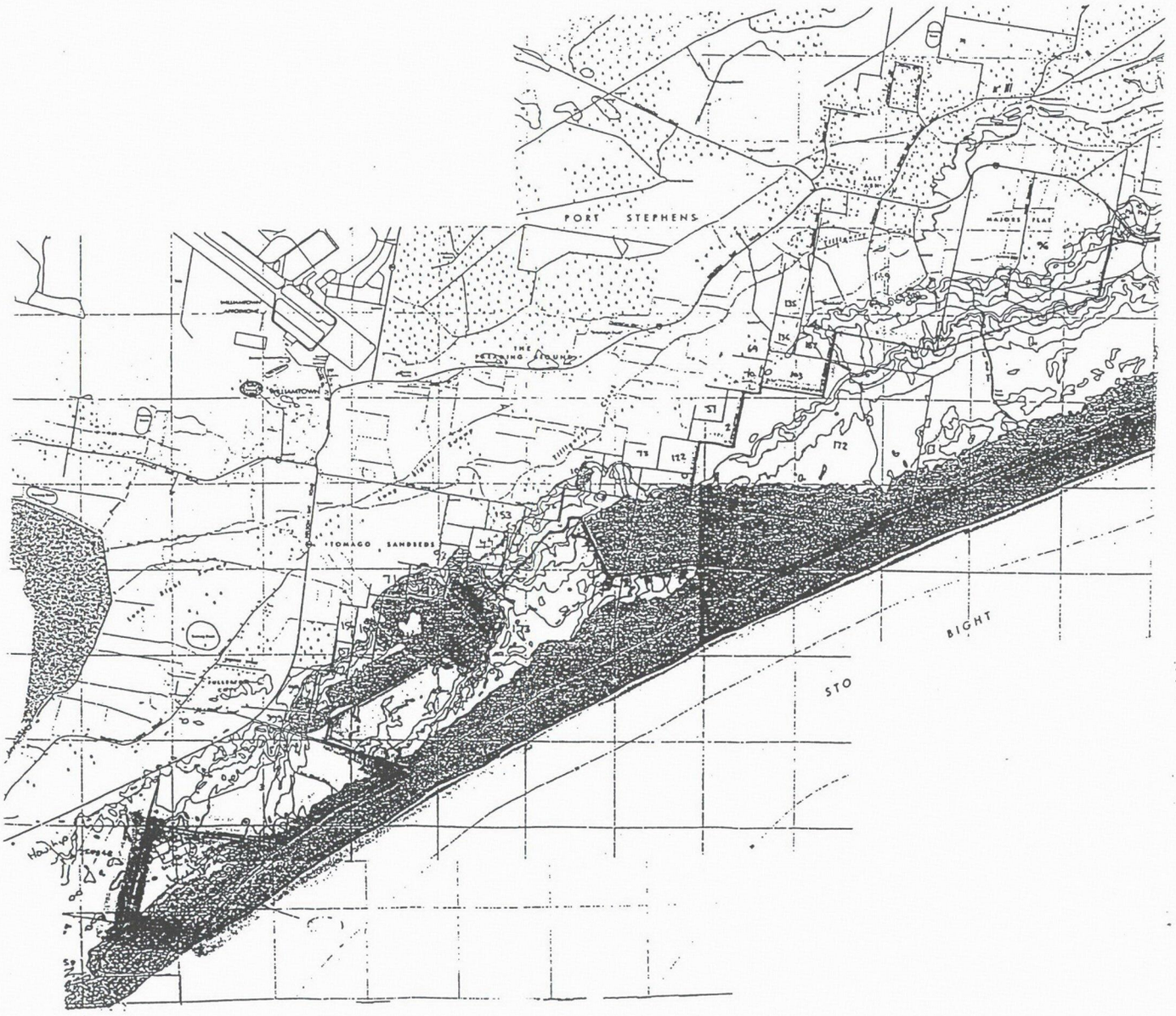
Option 1b. I understand that this option will allow the fulfilment of the Roads and Traffic Authority's and Council's commitment to upgrading Nelson Bay Road.

The NPWS looks forward to being provided an opportunity to comment on the Review of Environmental Factors for this proposal. Please do not hesitate to contact Russell Couch, Manager, Sydney Zone on (02) 9585 6657 if you wish to discuss this matter further.

Yours sincerely

Brian Gilligan.

Brian Gilligan 15.6.99.
Director-General


PORT STEPHENS
MAJOOS FLAT
THE PETTISING GROUND
TOMAGO SANDBEDS
BIGHT

Port Stephens Council

ADMINISTRATION BUILDING AND COUNCIL CHAMBERS

Telephone Enquiries:
Gary Freeland
Sustainable Development
Please Quote File No:
S9120-03
Your Reference:
57088L01GD

Mr Steve O'Connor
The Project Director
ERM Mitchell McCotter
PO Box 388
East Maitland NSW 2323

Dear Steve

Re: **NELSON BAY ROAD CONCEPT DESIGN STUDY**

Reference is made to your letter of 3 October 1997 referring to the above design study. Please note Sustainable Development Department comments below.

The design study and subsequent Development Application should address the following:

1. A Cost/ Benefit analysis of the differing options addressing economic, social and environmental issues;
2. An analysis of impacts on flora and fauna in the area with particular emphasis on the Threatened Species Act and wildlife movements;
3. An analysis of any drainage, inundation and erosion control impacts;
4. Consideration of the impacts of Potential Acid Sulphate Soils in the locality;
5. An analysis of impacts on residents in the locality from the proposals (eg. Noise, privacy, access): and
6. An assessment of the Objectives of the Port Stephens LEP and those of the 1(a) zone applying to the proposals (attached).

Should further information be required please contact Gary Freeland of Council's Sustainable Development Department.

Yours faithfully

Gary Freeland

GARY FREELAND
STRATEGIC PLANNING MANAGER

ERM Mitchell McCotter Quality System
Referred to: SOC Ref No. 57088
Date received: 29 OCT 1997
☐ refer to verification record
☐ verification not required
Signature: _____ Project Manager Date: 29/10/97

28 October 1997

P.O. Box 42 Raymond Terrace 2324. (DX 21406 Raymond Terrace)
116 Pacific Highway, Raymond Terrace Tel (02) 4980 0255 Facsimile (02) 4987 3612
Email: council@portstephens.nsw.gov.au

MINERAL RESOURCES

NSW DEPARTMENT OF MINERAL RESOURCES
Minerals and Energy House, 29-57 Christie Street
(P.O. Box 536), St Leonards, NSW 2065, Australia
Phone (02) 9901 8888 · Fax (02) 9901 8777
DX 3324 St Leonards

Steve O'Connor
ERM Mitchell McCotter
P.O. Box 388
EAST MAITLAND NSW 2323.

Your ref: L97/0486
Our ref: 57088L01GD

Dear Mr O'Connor

NELSON BAY ROAD CONCEPT DESIGN STUDY

Thank you for your letter of 3rd October, 1997 concerning the above study.

There are several mineral deposits and extractive resources (see enclosed figure) that may be adversely affected by any proposal to construct new road corridors south of Nelson Bay Road. The distribution of these resources is discussed below.

- The south-western end of the proposed deviation partly coincides with a low grade heavy mineral (predominantly rutile and zircon) deposit. The size of the resource is unknown. This deposit was originally defined by exploration conducted by BHP Titanium Minerals Pty Ltd (formerly Mineral Deposits Ltd) and subsequently by RZM Pty Ltd. Although it is unlikely that the deposit could be economically mined at present, the Department of Mineral Resources would prefer that the deviation be situated north of the deposit where possible.

- The north-eastern end of the proposed deviation is situated along the northern side of foundry sand extraction operations conducted by Metromix Pty Ltd and ACI Industrial Minerals Division. Sand mining at both localities occurs in active dunes on Crown land under titles issued by the Department of Land and Water Conservation. Access is presently by unsealed track from Nelson Bay Road. Any proposal to construct a road deviation nearby would need to ensure that access to the sites is maintained. Also, it is equally desirable that the sand deposits contained in active dunes in this area are protected from undue sterilisation by the creation of suitable buffer zones.

If you have any further inquiries pleas contact Mr John Whitehouse, Geologist, Geological Survey, on telephone (02) 9901 8513.

Yours faithfully

SR Lishmund
for Director General.
3/11/97

ERM Mitchell McCotter Quality System
Referred to: SOC | Ref. No. 57088
Date received 10 NOV 1997
☐ Refer to verification record
☑ Verification not required
Signature: _____ Date: _____
Project Manager

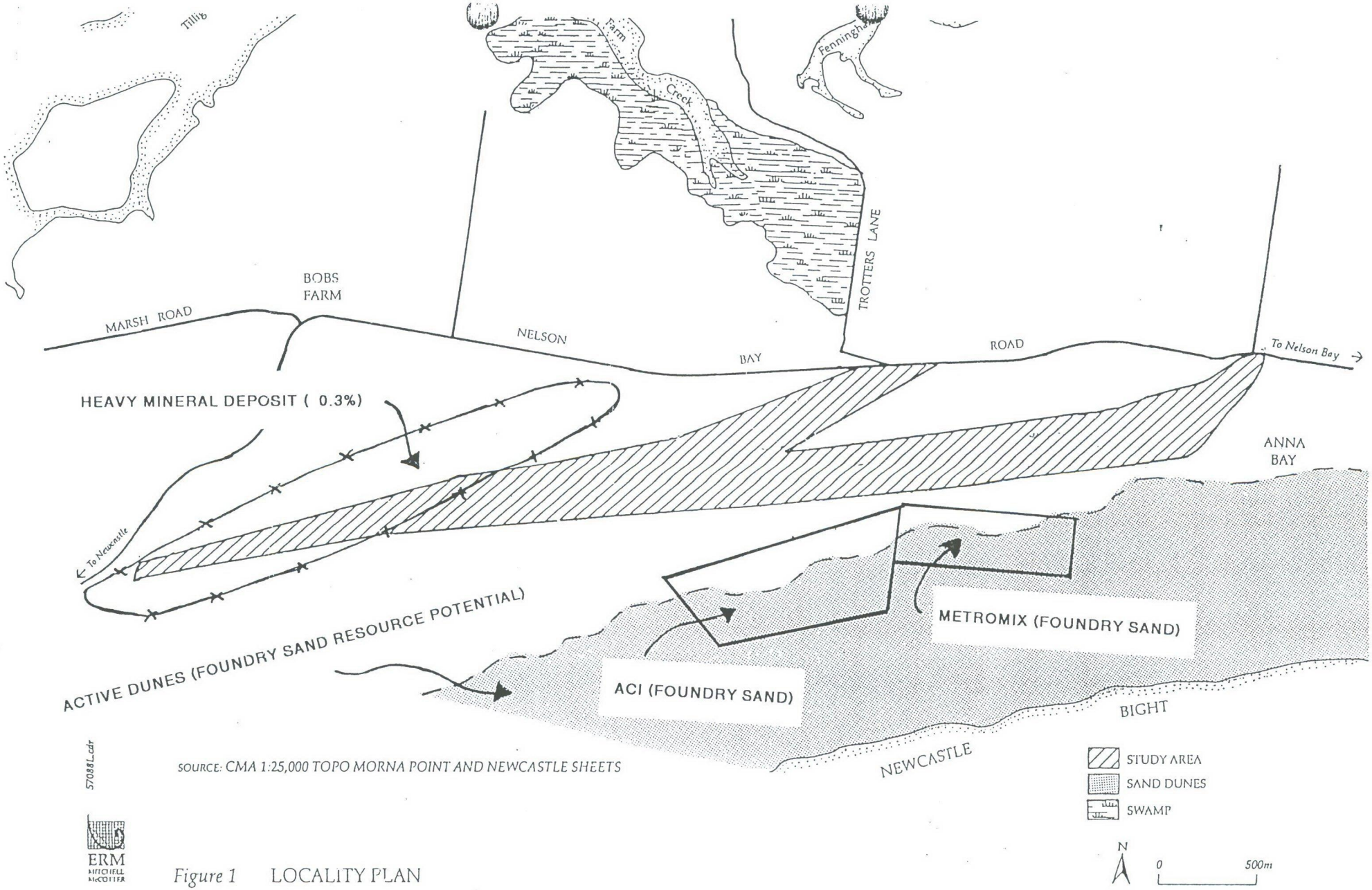


Figure 1 LOCALITY PLAN

NSW FISHERIES

ERM Mitchell McCotter Quality System

Referred to	SO'C	Ref No.	570YY

Date received 24 NOV 1997

☐ refer to verification record
☑ verification not required

Signature: SOC Date: 24/11/97
Project Manager

Mr Steve O'Connor
Project Director
ERM MITCHELL McCOTTER PTY LTD
PO Box 388
EAST MAITLAND NSW 2323

Dear Mr O'Connor

Thank you for your letter of 3 October 1997 regarding proposed Nelson Bay Road Concept Design Study. I apologise for the lateness of my reply.

I would like to make the following comments regarding the preparation of the concept design study for this project. A description of the fish and fish habitat affected by this project should be included in the concept design study. There should also be a description of what the predicted impacts are and any mitigating or remedial action that will be undertaken. If it is proposed that there is no impact on fish and fish habitat from this development then the reasons for this should be clearly outlined in the concept design study.

I have included a copy of the Habitat Protection Plan Number 1 to help you identify any potential impacts this proposal may have on fish and fish habitat.

If you have any further enquiries please do not hesitate to contact Mr Peter Carter, Supervising Fisheries Office (Conservation) on (02) 49 821311.

Yours sincerely

Graeme White
A/Conservation Manager (Central Region)
18 November, 1997

Encl.

cc. Peter Carter, SFO(Conservation)

CENTRAL REGION
Port Stephens Research Centre - Taylors Beach Road - Taylors Beach NSW 2316 - Australia
Telephone: (049) 82 1232 • **Facsimile:** (049) 82 1107

your ref: 57088L01GD
our ref: ER 608

ERM Mitchell McCotter Quality System
Referred to: JA Ref No. 57088
Date received: 15 JAN 1998
refer to verification record
verification not required
Date:
Signature: Project Manager

LAND & WATER CONSERVATION

MANAGER
ERM MITCHELL MCCOTTER (MAITLAND)
PO BOX 388
EAST MAITLAND NSW 2323

ATTENTION: Mr. S. O'Connor

FAXED 13-1-98.

Tuesday, 13 January, 1998

Dear Sir

Date: 1/

NELSON BAY ROAD CONCEPT DESIGN STUDY.

I refer to your letter dated 3 October 1997 requesting this Department's comments in regard to the above proposal. I apologise for the delay, but the Department has now reviewed this matter and provides the following information addressing the principle issues:

CROWN LAND

The Nelson Bay Road proposal involves Crown land and has been subject to considerable correspondence with the Department's Maitland District Office (ref. MD95 H 182).

Preliminary investigation of the status of Crown land within the concept study area indicates the following:-

1. Parts of the Crown land are subject to Aboriginal Land Claims No. 5717 and 5750 pursuant to provisions of the Aboriginal Land Rights Act, 1983.

2. The area lies within a Bombing and Gunnery Range declared via Commonwealth Gazette 9 December, 1954;

3. All Crown land within the Parish of Tomaree is within Reserve No. 72017 for Future Public Requirements notified 30 August, 1946;

4. Includes Reserve No. 13504 from Sale of Public Buildings notified 7 March, 1991;

5. Includes Crown lands to which no Crown tenures attach, and:

6. Includes Licence No. 190904 held by ACI Industrial Minerals for extractive resources purposes and Permissive Occupancy 1984/53 Newcastle held by Metromix Pty. Limited for extractive resources purposes.

Further, it is understood that:-

(i) National Parks and Wildlife Service has earmarked Crown land in this area for inclusion in the proposed Stockton Bight National Park and raises strong objection to the proposed corridor for the new route of Nelson Bay Road;

(ii) Hunter Water Corporation has expressed an interest in including Crown land in the area in a proposed Water Reserve, and:

(iii) Affected Crown land may be subject to Mining Leases administered by the Department of Mineral Resources and details should be confirmed with the subject Department.

Advice on file also indicates that Port Stephens Council has served notice on the Department for proposed compulsory acquisition of Crown lands for public road purposes under the Land Acquisition (Just Terms Compensation) Act, 1991 within the concept study area.

The Aboriginal Land Claims within the concept study area effectively negates the Department from entering into any dealings in respect of the Crown land until such time the claims have been determined by the Minister.

464 King Street Newcastle West NSW 2302 PO Box 2213 Dangar NSW 2309 DX 4335 Newcastle West
Telephone (049) 294 346 Facsimile (049) 296 364

The Department in consideration of proposals affecting Crown land must take into account whether the proposal will affect any Native Title interest that may exist in the land. The issue of Native Title needs to be addressed in terms of the requirements of the Commonwealth Native Title Act 1993.

At this time, the Department has not conducted sufficient searches to determine whether Native Title has been extinguished to any Crown land(s) within the concept study arrea.

In summary, there is a wide range of Crown Land issues which need to be addressed by the proponent.

SOIL CONSERVATION

Key issues which should be addressed include:-

- the effect on habitat and endangered species
- likely size and slope of road batters resulting from the works realising that steep siliceous sands are very difficult to stabilise
- acid sulfate/potential acid sulfate soils encountered along the route and management strategies for the handling and disposal of same
- drainage works and erosion and sediment control strategies during construction
- revegetation strategy include prior collection of endemic seed and vegetative material
- cumulative impact of habitat destruction along Stockton Bight

GROUNDWATER

The proposed route of the Nelson Bay Road runs through a sensitive groundwater environment, The groundwater resource in the area has a high value and is also highly vulnerable for pollution.

The study should include an assessment of groundwater resource of the area and potential impacts on the groundwater resource as a result of the proposed development For additional information please refer to the DLWC Tomago - Tomaree - Stockton Draft Groundwater Management Plan.

FLOODING IMPACTS

The principal objectives of the State Government's Flood Policy are to reduce the impact of flooding and flood liability on individual owners and occupiers, and to reduce private and public losses due to flooding. Under the flood policy, proponents of development in floodprone areas are required to demonstrate that local flooding will not be exacerbated as a result of their development and that their development is designed in expectation of flooding.

The proposed roadway requires filling of land that will encroach into a flood storage area. The impact on flooding due to loss of flood storage should be assessed. It is also noted that flow paths along the proposed road route may be partially blocked or redirected watercourses during local rainfall events. Compensatory works to reduce these flooding impacts may be necessary.

Any proposed upgrade of the road or development on the subject area should have regard to Council's floodplain management strategy and the Government's "Floodplain Development Manual". As indicated in the Manual, the local council is responsible for setting the flood standard and developemnt control conditions for the area.

COASTAL PROCESSES

As discussed in the Study, the area under consideration is subject to dunal movement. The Consultants must assess the impacts of dunal movement in site selection.

I trust the above information is of assistance in regard to your consideration of this proposal. Should there be any further enquiry in this matter, please contact Mr Jeff Hunt, Catchment Planning Manager, at our Newcastle Office on 02 4929 4346.

Yours Faithfully

Jeff Hunt, CATCHMENT PLANNING MANAGER

HUNTER WATER CORPORATION ACN 053 102 837

PO Box 5171B, Newcastle West, NSW 2302 Australia
Telephone (049) 799 799 DX7858

Reference: C5/2273
Contact: Luke Finnegan
Ph: 02 – 4979 9453
Fax: 02 – 4979 9492

ERM Mitchell McCotter
PO Box 71
Thornton NSW 2323

ERM Mitchell McCotter Quality System
Routed to: SOC Ref. No. 57088
Date received 19 NOV 1997
refer to verification record
verification not required
Signature: SOC Date: 17/11/97
Project Manager

17 November 1997

ATTENTION: Steve O'Connor

Dear Steve,

Re: Nelson Bay Road Concept Design Study

I refer to your letter dated 3 October 1997 regarding your commission to undertake a concept design study for upgrading of the Nelson Bay Road near Bobs Farm (*your reference: 57088L01GD*).

Selection of an upgrade strategy has the potential to impact on the Corporation's planning functions for two reasons.

1. The Corporation plans to construct a major water supply main between its treatment facilities at Tomago and the Tomaree Peninsula within the next two years. It is anticipated that this 40km long pipeline will be constructed in the roadside reserve. As such, alterations to the route or dimensions of the road will impact on the location of the pipe and access to fittings. This issue must be resolved prior to the commencement of pipeline construction, which is presently scheduled for the next financial year.

2. The deviation illustrated in your letter coincides with land regarded by the Corporation as an essential source of groundwater, both for future supply to the Tomaree Peninsula when additional growth occurs and as an emergency supply for Newcastle in times of severe drought. The Corporation holds a Department of Land and Water Conservation licence to undertake groundwater investigations on this land and routinely collects data on water levels and chemistry from monitoring wells on the proposed route. The Corporation has concerns that a road through this area has the potential to negatively impact on the quality of the groundwater resource, either by accidental spillage through road accidents or routine operation.

If you require additional information please contact me on Ph. 02-4979 9453

Yours faithfully

Luke Finnegan

Luke Finnegan
Engineer, Assets/Planning

EPA

Environment
Protection
Authority
New South Wales

NSW Government Offices
117 Bull Street Newcastle West NSW 2302
PO Box 488G Newcastle NSW 2300
Tel .049. 26 9971 Fax .049. 29 6712

ERM Mitchell McCotter
PO Box 388
EAST MAITLAND NSW 2323.
Attention: Mr Steve O'Connor

Our Reference: 270147A32

Your Reference: 57088L01GD

24 OCT 1997

Contact: Karen Marler

Dear Sir,

NELSON BAY ROAD CONCEPT DESIGN STUDY

I refer to your letter of 3 October 1997 providing an opportunity for the Environment Protection Authority (EPA) to comment on the environmental issues to be considered in the concept design study for the upgrading of Nelson Bay Road.

I advise that the given the location of the study area and the scope of the works proposed the EPA is of the opinion that the environmental issues will not be such as to warrant the EPA's direct input into the study. Provided the measures routinely implemented to control dust emissions, minimise erosion and sediment migration and control noise emissions on road construction projects are implemented a satisfactory environmental outcome should be achievable.

Accordingly, the EPA will decline your invitation by letter dated 20 October 1997 to attend the Value Management Study Workshop (VMS) to be held on 6 and 7 November 1997. However, please do not hesitate to refer any specific issues arising from the VMS workshop that requires the EPA's consideration for comment.

If you have any further enquiries regarding this matter, please contact Karen Marler on (02) 49269985.

Yours sincerely,

GRAHAME CLARKE
Head Regional Operations Unit – Hunter
For Director-General

ERM Mitchell McCotter Quality System			
Referred to	SO'C	Ref. No.	57088

Date received 29 OCT 1997

☐ refer to verification record
☑ verification not required

Signature: _____ Date: 29/10/97
Project Manager

NSW
NATIONAL
PARKS AND
WILDLIFE
SERVICE

ERM Mitchell McCotter
PO Box 388
EAST MAITLAND NSW 2323

Attention: Steve O'Connor

Our ref: SYZ/GD/97/310
Your ref: 5788I01GD

Dear Sir,

RE: NELSON BAY CONCEPT DESIGN STUDY

Thank you for your letters dated 3 October 1997 and 20 October 1997 in which you consult with the National Parks and Wildlife Service in respect to the above matter.

The proposal to which you refer is of great concern to the NPWS as it appears to include a long section within the area proposed for gazettal as Stockton Bight National Park. The NPWS objects vehemently to the construction of a road within the proposed Stockton Bight National Park. The NPWS view is that any Nelson Bay link road should be located wholly outside the proposed Stockton Bight National Park.

The NPWS intends to address the matter of the proposed road directly with the Department of Land and Water Conservation and Port Stephens Council. It is anticipated that these discussions will be conducted prior to the Value Management Study (VMS) scheduled for 6 and 7 November 1997. The NPWS will determine whether to participate in the VMS following these discussions.

If you have any questions on this issue please contact Ms Lou Ewins, Environmental Planning Manager, on 02 9585 6675.

Yours sincerely

Gdunnett 21.10.97

Gary Dunnett
Acting Environmental Planning Manager
SYDNEY ZONE

ERM Mitchell McCotter Quality System
Referred to: SOC | Ref. No. 5708
Date received: 24 OCT 1997
☐ refer to verification record
☑ verification not required
Signature: SOC Date: 27/10/97
Project Manager

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SERVICE

The Study Manager
Nelson Bay Road Upgrade
ERM Mitchell McCotter
PO Box 943
CROWS NEST NSW 2065

ERM Mitchell McCotter Quality System
Number: TMF Ref No: 97218
1 JAN 1999
NPWS

Our ref: 97/318 (3)

Dear Sir / Madam

1/1/99

RE: Environmental Assessments for Options 1B and 2
Proposed Nelson Bay Road Upgrade

I refer to the environmental assessment reports for Options 1B and 2 which were recently placed on public exhibition. The National Parks and Wildlife Service (NPWS) understands that the proposed upgrade of the Bob's Farm to Anna Bay section of Nelson Bay Road is subject to Part 5 approval by the Roads and Traffic Authority (RTA), following the preparation of a Review of Environmental Factors or an Environmental Impact Statement, as per the requirements of the *Environmental Planning and Assessment Act, 1979*.

The National Parks and Wildlife Service (NPWS) welcomes the opportunity to comment on the two route options. The NPWS notes that unfortunately while it received a copy of the community newsletter regarding this public exhibition, it did not receive a copy of the relevant assessment reports. These were obtained in November following a request to Council, hence the delay in the NPWS's response.

In sum, the NPWS strongly objects to Option 2, on the basis that it will dissect and fragment land which has been identified by the State Government for reservation under the *National Parks and Wildlife Act, 1974* because of its high natural and cultural heritage significance. The proposed Stockton Bight conservation reserve is part of a Government commitment made prior to the last election to establish various new parks and reserves in NSW. The Government is committed to proceeding with these areas subject to resolution of Aboriginal Land Claims (ALC).

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During concept development for the new Nelson Bay Road, NPWS has consistently stated its objection to Option 2 (refer for example correspondence to Port Stephens Council dated 1/12/97 and 21/10/97). The NPWS also considers that Option 2 is likely to have a greater impact on native flora, fauna, threatened species and Aboriginal heritage and cultural significance than Option 1b.

The NPWS's preferred option for accommodating traffic along Nelson Bay Road is a widening of the current road alignment, described as Option 1b. The NPWS notes that this option would support the RTA's corporate policy of making use of the existing road network where possible, as well as fulfilling the RTA's and Council's commitment to upgrading Nelson Bay Road. The NPWS also understands that the cost of Option 1b, currently estimated to be approximately $14.3 million, could be reduced to approximately $11 million through the use of existing pavement, thus making this a more cost effective option than Option 2. The following attachment gives greater detail on the basis of NPWS' objection to Option 2.

The NPWS trusts that this information will assist in the final determination of the route option for this proposal.

Please do not hesitate to contact either Lou Ewins, Manager, Environmental Planning Unit on (02) 9585 6674 or Katharine Sale, Environmental Planning Officer on (02) 9585 6920 if you wish to discuss this further.

Yours sincerely

R. Couch

Russell Couch
Manager
Sydney Zone

22/12/98

cc. RTA; DLWC; Port Stephens Council

ATTACHMENT 1

Conservation values of Stockton Bight

Geomorphology

Thom (1977) stated that "the outer barrier at Newcastle Bight contains an existing array of dune landforms. When considered together these landforms represent a history of environmental change involving periodic transfer of large amounts of sand from free moving, mobile sand surfaces to vegetated dune ridges". The Bight represents one of the most comprehensive and accessible records of coastal environmental change on the NSW coast.

The Stockton Bight sand dune system contains the longest continuous barrier dune system in NSW and the unvegetated dunes of the outer barrier are the largest continuous mobile sand mass in south eastern Australia. The processes responsible for such changes are poorly understood, a fact that adds to the value of these landforms of our recent geological inheritance. The dunes of Stockton Bight comprise stable (inner vegetated dunes) and presently active transgressive (outer) dunes. The presently active, aeolian mobile outer dune is a long walled transgressive dune moving inland at the estimated rates of 0.8m/yr north of Stockton township, 3.2 to 5.2m/yr in the middle of the Bight and 2.7m/yr near Anna Bay (from HLA, 1995, B7:2).

The Newcastle Bight sand dune system displays a unique morphological history and pattern of barrier evolution. The features of the Bight indicate the late Quaternary sea level and climatic changes, recording the history of environmental change over 150,000 years, and longer in term of stratigraphy. The outer barrier forms part of the only example of a dual barrier system of Pleistocene and Holocene age along the central and southern coast of NSW (Chapman, 1982).

The sand dune system is a key field site and most intensively studied portion of late Quaternary sequences along the NSW coast which is important for scientific research into paleo-environmental history reconstruction. The area therefore contributes to a wider understanding of Australian natural history and provides an established reference site.

Flora and fauna

The dunal vegetation communities, its relationship to a large transgressive dunal system and relatively undisturbed nature result in it being of unique conservation significance (HLA, 1995, B3:40). The land subject to ALC's comprises seven vegetation communities (HLA, 1995, Tab 1). Whilst these are not considered unique, they do occur in an area of high coastal development and are significant and valuable as wildlife habitat. The contiguous band of largely unfragmented / undisturbed habitats acts as a corridor and reserve for many coastal (forest and littoral) fauna species, including a number of threatened species (HLA, 1995). The Koala, Tiger Quoll, Brush-tailed Phascogale, Yellow-bellied Sheath-tail Bat, Greater Broad-nosed Bat, Powerful Owl, Turquoise Parrot, Black-necked Stork, all listed as vulnerable on the Schedules of the *Threatened Species Conservation Act 1995,*

have been recorded in this area. It therefore provides important habitat for the declining Koala, Powerful Owl and Masked Owl while the beach zone is expected to provide a foraging and breeding area for the Pied Oystercatcher and Little Tern, also listed in the *TSC Act 1995.*

Aboriginal heritage

In a report to the NSW NPWS and National Estate Grants Committee, Dean-Jones (1990) identified over 110 Aboriginal sites, predominantly middens and open campsites and artefacts in the Stockton Bight area, which demonstrates intensive occupation over the last 1,000 years and utilisation of coastal resources of the Bight. Archaeological excavations at Moffats Swamp, also part of the dune system, revealed evidence of Aboriginal occupation which is thought to date to the Early Holocene period. The report recommends acquisition by the NPWS of the 'remnant beach ridge plain east of Bobs Farm and the section of the outer transgressive dune surface and deflation basin between Boyces Track and the track from Bobs Farm to the beach' on archaeological grounds. This particular area samples the Early Holocene (ie: 10,000 years to >5,000 years) and Late Holocene land surfaces, is believed to have high archaeological sensitivity and contains the highest recorded density of archaeological artefacts in the Newcastle Bight study area.

Description of the NPWS reserve proposal

Stockton Bight is one of the 24 new parks proposed in Labor's Nature Conservation Strategy (1995), and Labor's Vision for the NSW Coast (1995). The Premier has indicated that the Government is committed to proceeding with the protection of the original 24 areas promised, a position which is also reflected in the Government's *NSW Coastal Policy 1997 - A Sustainable Future for the New South Wales Coast.* Two of the key actions of this policy are to establish a comprehensive system of protected areas and reserves in the coastal zone, and to assess coastal lands and aquatic environments with conservation values and to ensure that appropriate tenures, reservations, zonings and/or regulations are put in place to protect them, conserve biodiversity and to protect and ensure the recovery of threatened species.

The boundaries of the proposed national park and state recreation area are shown on Attachment 2. The northern two thirds of the vegetated dunes (~2000 ha), which is currently under Aboriginal Land Claim (ALC), is proposed as National Park subject to the NPWS reaching agreement with the local Aboriginal community on joint management. The ALC over the area is yet to be determined.

A smaller area focusing on the 23 km of beach from Anna Bay in the north to Fern Bay in the south is proposed for State Recreation Area (SRA). This area of approx. 1600 ha includes the beach from the low water mark inland for 400-500 m, the Landcom land at Fern Bay, and some of the southern vegetated dunes (refer Attachment 2). Some of the SRA proposal is affected by ALCs.

Impacts of Option 2 on the Proposed Reserve

Option 2 would dissect and fragment the proposed Stockton Bight National Park. It would also effectively sterilise the section of land between Option 2 and the existing Nelson Bay Road (refer Attachment 2). The NPWS would not accept this land for inclusion in the proposed national park, and other options for its management would need to be explored.

The NPWS considers that the conservation values of both this section of land, and land adjoining the proposed Option 2 to the south would be diminished should this option proceed. The conservation value and viability of the site is directly related to the size and shape of the vegetation remnants which remains and the connectivity with other large bushland areas. Diminishing the size of the remnant will progressively diminish its conservation value, and in general the smaller and more linear the bushland remnant becomes the less viable it becomes, and the less able it is to buffer the impacts of surrounding development. Linear and smaller areas generally have a high edge to area ratio, and are less able to buffer edge effects such as changed light conditions, changes to wind speed, weed invasion, rubbish dumping etc. These factors can significantly reduce the habitat value of an area in the longer term.

Vegetation communities

Option 2 would require the removal of up to 31 hectares of vegetation. The route would pass through four vegetation communities: grassland, Blackbutt / Rusty Gum open forest, Blackbutt / Rusty Gum low open forest, and swamp forest. It has been estimated (ERM, 1998) that 90% of the vegetation within or adjacent to the proposed route is in a natural condition, with disturbance confined to the power transmission line easement and 4WD tracks. 75% of the vegetation along the route is described by HLA-Envirosciences (1995) as remnant, that is, containing original floristic diversity, has not been subject to substantial physical disturbance nor substantially affected by altered fire regime. This contrasts with proposed Option 1B, which would pass through only 2 vegetation communities, of which only 25% is described as remnant vegetation. The plant communities and fauna habitats within the route defined by Option 2 are described as having moderate to high conservation significance.

Threatened species

The NPWS considers that Option 2 is likely to be more destructive on threatened species and their habitat than Option 1b, given that it involves the greatest clearance of intact vegetation, and will directly impact on threatened flora species. The report indicates that Option 2 is likely to have a significant impact on *Diurus praecox,* as it would destroy all individuals within the road corridor. This population is only one of three confirmed sites in the region for this species. Squirrel Glider, Powerful Owl and Koala were recorded along this route, and Option 2 has the potential to fragment and isolate habitat for these species. Additionally, it is highly likely that a number of

threatened bat species will be affected. Option 2 will also establish a second major barrier to wildlife movement (the first barrier being the existing Nelson Bay Road), and adversely affect the capacity of remnant habitat between Option 2 and the existing Nelson Bay Road to support both threatened and protected species. The potential for road kills of a range of fauna species including the koala is likely to increase. The NPWS notes that two active koala sites have been recorded near the western end of the proposed route.

While Option 1b also has the potential to impact on threatened species and will intensify the barrier effects of the current road, the NPWS considers that it will have a lesser impact on threatened species and natural heritage values, compared to Option 2. Option 1b will involved clearing of a smaller area and more degraded vegetation, and will not establish a second barrier to faunal movement in the locality.

Aboriginal heritage

Both Option 1b and 2 are likely to result in impacts on Aboriginal sites, and the assessment has recommended further investigation of Aboriginal sites along both routes. The NPWS is of the view that Option 2 has the potential to have a greater impact on Aboriginal heritage values, as it would dissect an area which has been identified as having high cultural significance to the Aboriginal community because it contains relatively undisturbed evidence of their traditional lifestyles, which includes extant examples remnant vegetation likely to have previously existed, as well as occupation evidence. The NPWS notes that section 90 approval under the *National Parks and Wildlife Act 1974* is likely to be required for either proposal.

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Chapman, D. M., Geary M., Roy, P. S. and Thom, B. G. (1982) Coastal Evolution and Coastal Erosion in New South Wales. Coastal Council of New South Wales, Sydney.

Dean-Jones, P. (1990) *Newcastle Bight Aboriginal Sites Study.* A report to the NSW National Parks and Wildlife Service and National Estate Grants Committee.

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Thom, B. G. (1977) Correspondence (22/12/77) to Director-General, NSW National Parks and Wildlife Service.

RTA

COMMUNITY CONSULTATION

Appendix B

Port Stephens COUNCIL
... a community partnership

ERM

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Chapter 1

INTRODUCTION

This chapter provides background information about the project.

1.1 BACKGROUND

The RTA is currently considering upgrading Nelson Bay Road (Main Road 108) between Bobs Farm and Anna Bay (*Figure 1.1*). Main Road 108 is the major arterial route connecting Newcastle and Williamtown with the Tomaree Peninsula. It carries a large proportion of locally based traffic in addition to tourist traffic visiting the Nelson Bay area particularly during holiday periods and weekends. It is the only route which services the Tomaree Peninsula and the various small townships between Newcastle and Nelson Bay.

To assist in selecting a preferred option for an ultimate four lane upgrade of the road, the RTA placed two alternatives on public exhibition between 19 April and May 17, 2000 and invited public comment. Submissions were accepted by the RTA up to 2 June, 2000.

The two options are described as follows:

- Option 1b: upgrading of the existing Nelson Bay Road following the existing alignment. It involves duplication of the existing 6.7 kilometres of Nelson Bay Road to provide an ultimate four lane dual carriageway; and

- Option 2: a full deviation, 6.2 kilometres in length as an ultimate four lane dual carriageway through undeveloped land south of the existing road and generally adjacent to an existing transmission line easement.

As a result, 375 submissions were received by the RTA providing a range of comments and preferences. In response, the RTA has commissioned ERM to assess and review the submissions received.

1.2 SUBMISSIONS

Amongst the 375 submissions received were short letters, detailed responses, voting forms and four petitions. The majority of responses stated a preference for either of the two alternatives on exhibition. However, two additional options were raised and

commented on by some community members. One of the suggested alternatives involved a split four lane carriageway similar to the recently completed upgrade through the sandhills to the west of Bobs Farm. The existing road was proposed as a two lane carriageway for east bound traffic and a new two lane carriageway generally following the electricity easement would be constructed for westbound traffic.

The other alternative proposed during the exhibition period involved a new route along the eastern boundary of the sandunes. Some attention was given to this proposal by the media, including an article in a local newspaper.

1.3 REVIEW PROCESS

Initially, an overall review of each submission was undertaken in order to ascertain preference and identify key issues. To further sort and group responses, each key issue was categorised into sub sections.

A detailed analysis of each submission was then undertaken with consideration given to the stated preference, format of the response, type of respondent, geographic location of respondent, and the specific issues raised.

To assist with the analysis of information, a database was created to record the details of each submission. This permitted the sorting of data, identification of trends, and grouping of responses. The issues were based on those considered important during the value management study, issues raised during previous studies, issues raised by the community and the responses given during the latest exhibition period. This analysis aimed to identify any trends in terms of the issues raised and the opinions expressed by the type of respondent and/or their geographic location.

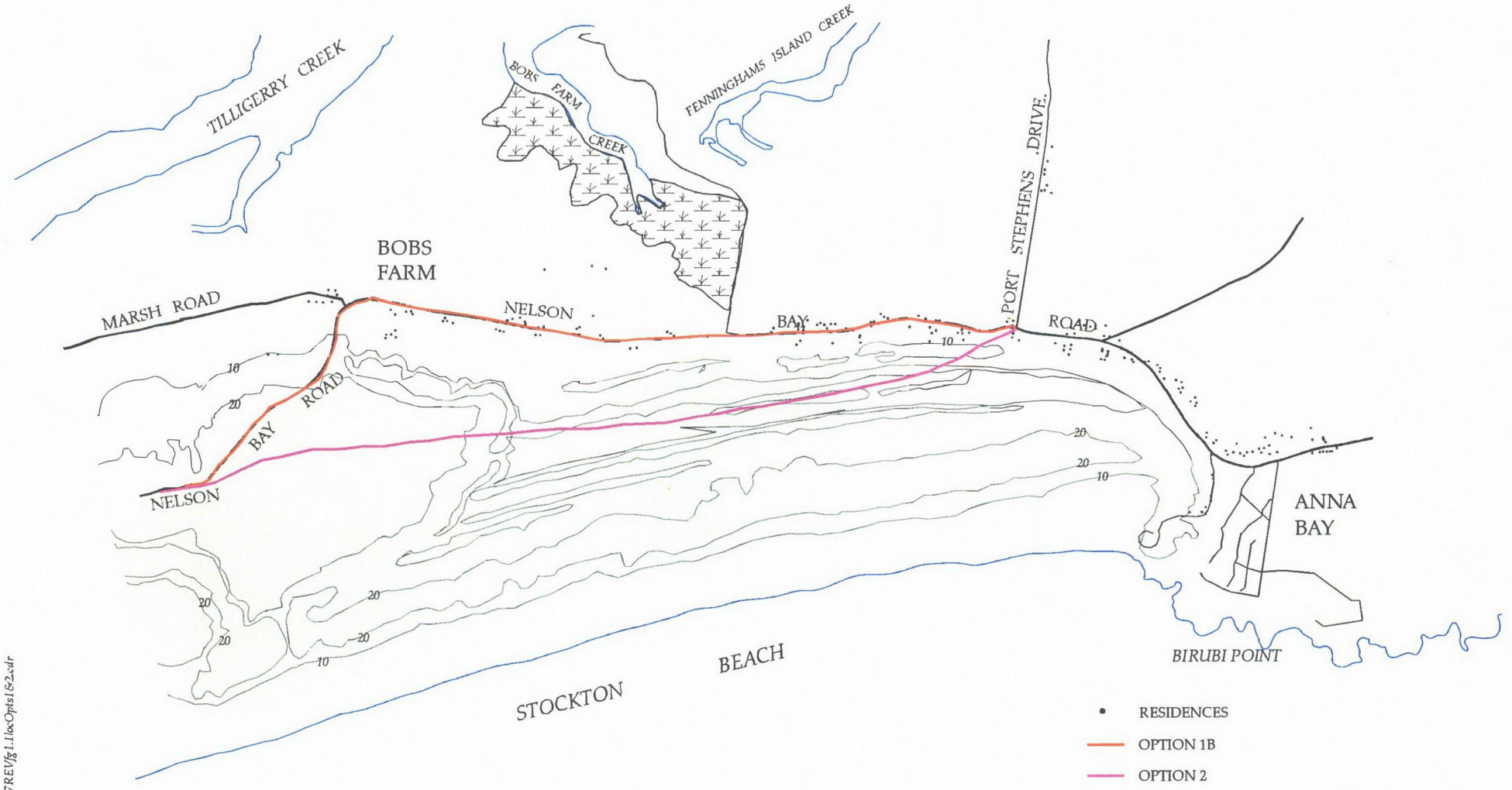

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Figure 1.1 LOCALITY PLAN

1.4 CATEGORIES

Each submission was assigned a category based on the respondent as set out in Table 1.1.

Table 1.1 RESPONDENT CATEGORY

Type
Government Authority
Bobs Farm Business
Tomaree Peninsula Business
Non-local Business
Bobs Farm Resident
Tomaree Peninsula Resident
Non-local Resident
Community Organisation/Residents Group
Other/not specified

A range of key issues were identified based on those identified in the value management study, previous community feedback, issues raised by the Community Consultation Group, and additional issues raised during the exhibition process. The key issues and sub categories are listed in Table 1.2.

Each submission was counted as one response in terms of the total number of submissions. Although some responses included more than one signature, these were treated as one submission and not as a petition.

Table 1.2 KEY ISSUES AND SUB CATEGORIES

Issues and Sub categories	Issues and Sub categories
Impact on Sand Duns	***Utilities***
Impact on sand dune	Power
Safety	Water
Road user safety	Telstra
Accidents	***Road Maintenance Costs***
Speed	Road maintenance costs
Traffic volume	Construction costs
Pedestrians	***Noise***
Timing of improvements/benefits	Impacts
Long term condition of NBR if duplicated	Mitigation
Road user safety (general)	Bunding
Heavy/commuter/tourist/light vehicle separation	Vibration
Environmental issues	***Air***
Flora & fauna	Exhaust fumes
National Park	Dust
Earthworks	***Water***
Fire risk	Drainage
Environment (general)	Flooding
Acid sulphate soils	Quality
Business impact	Ground water
Economic	***Property***
Tourism	Value
Compensation (lost business)	Loss of land
Travel time	Fragmentation
Travel time	Loss of house/buildings
Access	Compensation (property)
Resident	***Construction impacts***
Business	Noise/vibration
Incidents - fire/accident	Dust
Continued access on NBR	Traffic delays
Bus stops	Staging
Archaeological impacts	***Social impacts***
Aboriginal	Amenity
Heritage	Aesthetics/visual environment
Land claim	Policing
Vehicle running costs	Bus services
Vehicle running costs	Health
	Other
	No comment

1.5 STRUCTURE OF REPORT

Chapter 1 provides an outline of the project, review process and key issues. Chapter 2 outlines the overall results of the exhibition process. Chapter 3 summarises the key points raised in government authority submissions. General trends and observations are documented in Chapter 4.

Chapter 2

RESULTS

This chapter provides the results of the analysis and indicates the preferences shown by the various respondents.

2.1 RESPONSES

The largest number of submissions were received from Tomaree Peninsula Residents (39%) followed by Non-local Residents (21%) with Bobs Farm Residents making up 18% of all submissions received. Figure 2.1 illustrates the breakdown of the submissions received by the various respondents.

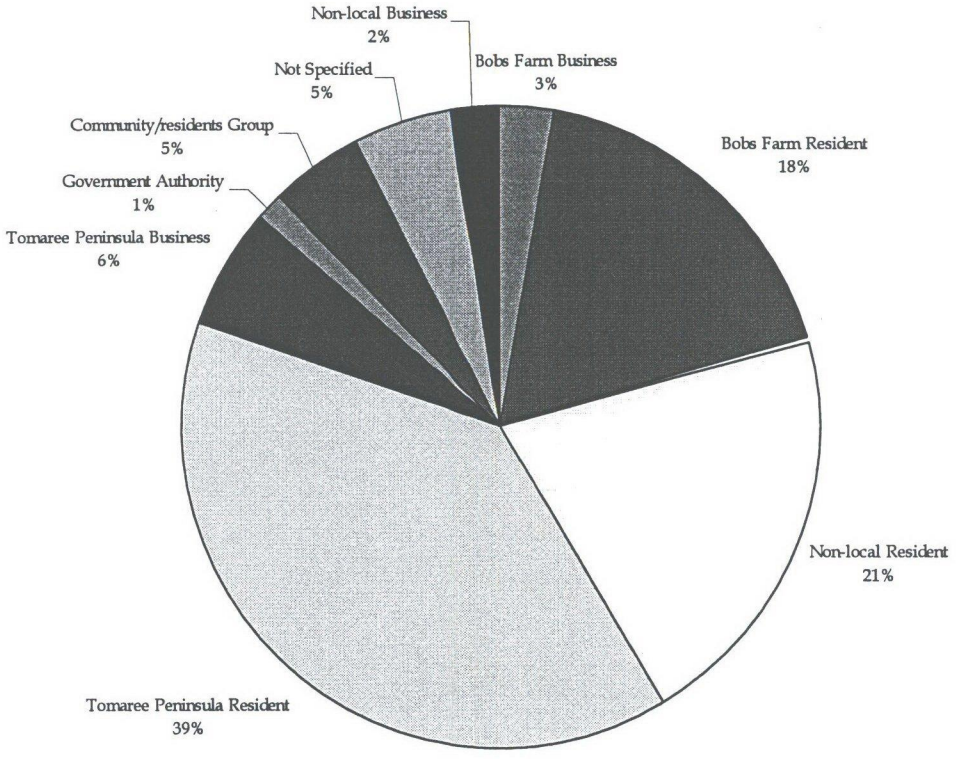

Figure 2.1 BREAKDOWN OF RESPONSES

2.2 PREFERENCES

The total preferences (including percentages) are provided in Table 2.1.

Table 2.1 TOTAL RESPONSE

Option	Count	Percentage
Option 1b	238	64
Option 2	126	34
Split	4	1
No preference	3	1
TOTAL	**371**	100

Note: Petitions are not included in the figures

The results in Table 2.1 show that there is a strong preference for Option 1b with 64 per cent of all respondents indicating their support for this option. Thirty four percent of the total submissions were in favour of Option 2. Only one percent of the respondents supported the split option and one percent did not state a preference. Figure 2.2 shows the preference for each option.

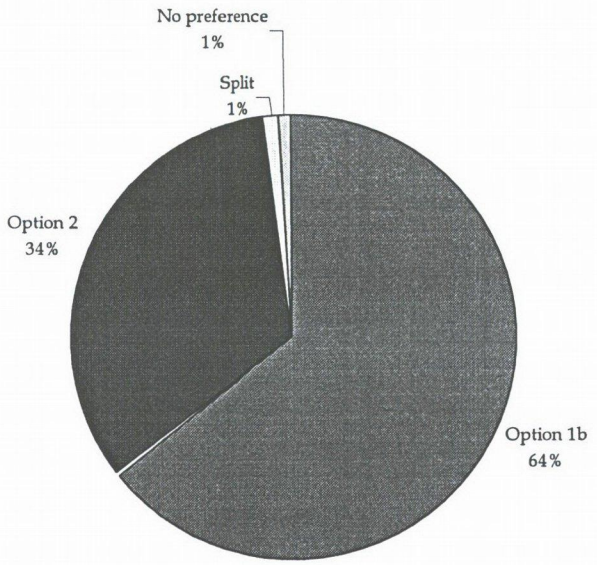

Figure 2.2 OVERALL PREFERENCES

The breakdown of preferences shown by the various respondents is provided in Table 2.2. The total number of responses are shown for each group in addition to the preference by type of respondent.

Table 2.2 PREFERENCE BY RESPONDENT TYPE

Respondent	Total count	Option 1b (%)	Option2 (%)	Split	No Preference
Government Authority	5	60	0	0	40
Bobs Farm Business	10	80	20	0	0
Tomaree Peninsula Business	23	65	26	4	4
Non-local Business	9	78	22	0	0
Bobs Farm Resident	66	50	50	0	0
Tomaree Peninsula Resident	143	58	41	1	0
Non-local Resident	79	75	24	1	0
Community/residents Group	17	76	18	6	0
Other	19	89	11	0	0

Note: Petitions are not included in the figures

The results show that the majority of respondent groups clearly favour Option 1b in preference to Option 2. The exception is the Bobs Farm Residents who are evenly distributed between both options at fifty per cent each. The Tomaree Peninsula residents provided the greatest number of responses show that 60 per cent are in favour of Option 1b. Figure 2.3 and 2.4 show the preference of each respondent type between Option 1b and 2. The results for split and no preference are not shown on either figure due to the limited number of total responses. Two of the five (40%) Government Authorities did not indicate a preference for either option.

Figure 2.4 shows the preference of each respondent type between Option 1b and 2 based on the total number of responses in each category rather than percentages as shown in Figure 2.3. The figure demonstrates that there is clear preference for Option 1b by all respondents with the majority of responses provided by Tomaree Peninsula residents and non local residents.

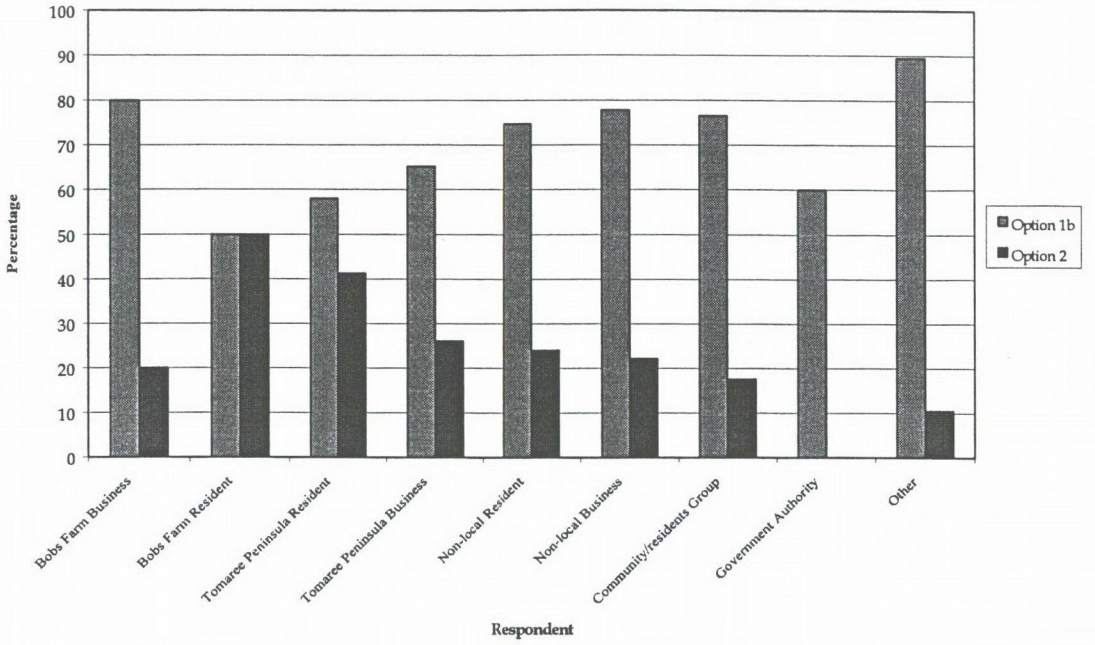

Figure 2.3 PREFERENCE BY RESPONDENT TYPE (PERCENTAGE)

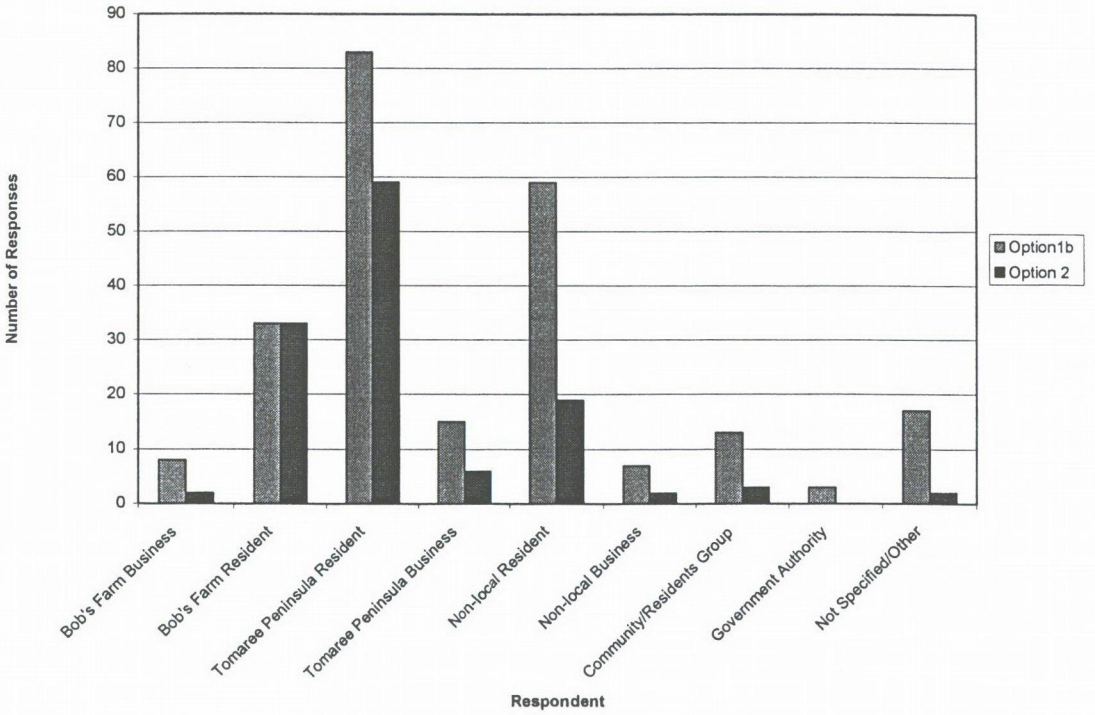

Figure 2.4 PREFERENCE BY RESPONDENT TYPE (TOTAL COUNT)

2.3 MOST FREQUENTLY RAISED KEY ISSUES

Each submission was reviewed to identify each respondent's preferences and identify key issues based on those listed in Section 1.4. Table 2.3 shows the key issues raised by all respondents in relation to Option 1b and 2. The table does not indicate a preference towards a specific option, rather the most frequently raised issues whether of concern or in support of that option. It should be noted that some respondents only raised one or two issues whilst others raised numerous issues. The counts provided in Tables 2.3 indicate the number of submissions that raised or discussed a key issue.

Table 2.3 KEY ISSUES RAISED RELATING TO OPTION 1b AND OPTION 2

Key Issue	Option 1b Concern	Option 1b Favourable	Option 2 Concern	Option 2 Favourable
Business impact	15	77	47	24
Environmental issues	19	53	61	16
Road user safety	35	44	10	35
Access	30	17	4	23
Road maintenance costs	10	26	11	19
Impact on sand dune	5	25	30	5
Property	20	13	13	17
Construction impacts	20	7	7	26
Water	28	10	13	7
Travel time	5	11	2	37
Noise	26	4	4	8
Social Impacts	15	15	2	6
Other	-	36	-	2
Archaeological impacts	5	8	11	6
Air	13	6	4	7
Utilities	6	4	2	3
Vehicle running costs	-	-	-	5

Notes: ***The table does not indicate preference towards either option, the counts indicate the number of submissions that raised the key issue.***

Table 2.3 shows that the most frequently raised issue in all submissions is the potential impact on business. The majority of these were seen as favourable in regard to Option 1b and of concern regarding Option 2. Environmental aspects were the second most frequently raised with a large number in support of Option 1b and a

slightly higher number raising concerns regarding the potential impacts of Option 2. Road user safety, access issues, road maintenance and impact on the sand dunes were also frequently raised issues. Only a small number commented on noise issues with the majority of those expressing concerns in elation to Option 1b.

Figure 2.5 graphically illustrates the ten issues commented on most frequently. It shows that more comments were made regarding Option 1b whether of support or concern. It clearly demonstrates that business impacts and environmental issues were raised most frequently in favour of Option 1b and of concern regarding Option 2. It also shows that the travel time benefits and reduced impacts during construction are seen as more favourable issues in regard to Option 2 than 1b.

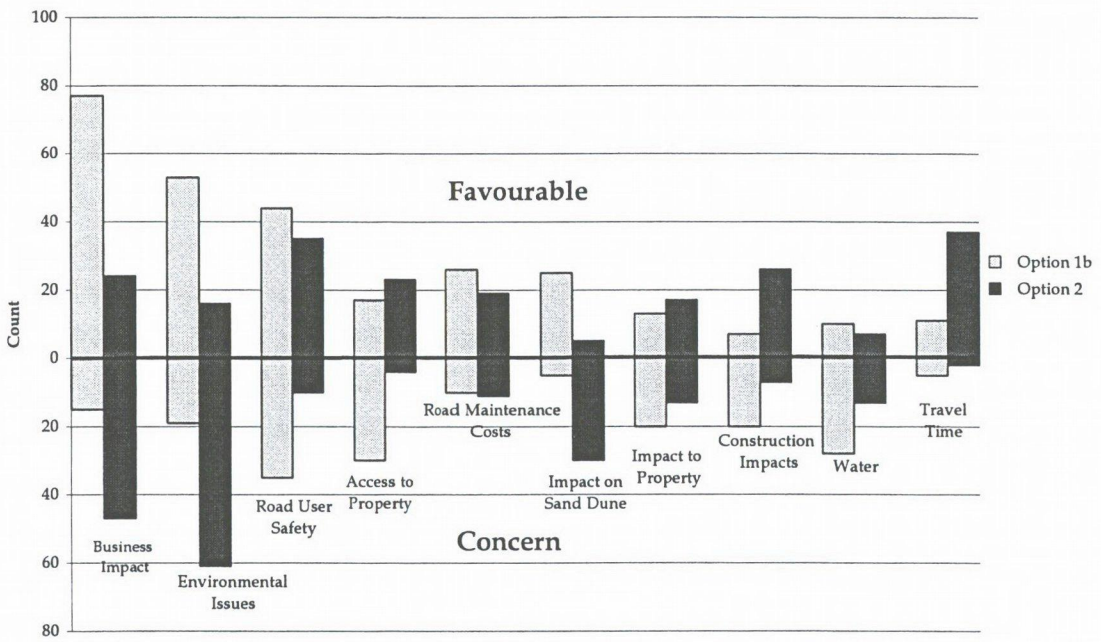

Figure 2.5 MOST FREQUENTLY RAISED KEY ISSUES RELATING TO OPTION 1b AND OPTION 2

2.4 MOST FREQUENTLY RAISED SUB - ISSUES

To gain a better understanding of the key issues of concern, detailed analysis of the sub-issues was also undertaken. For example, a large number of submissions commented on environment impacts which encompasses a wide range of issues. Accordingly, each submission was reviewed to identify sub-issues of concern based on those sub-categories listed in Section 1.4.

Tables 2.4 and 2.5 show the sub-issues raised by all respondents in relation to Option 1b and 2 respectively. The tables do not indicate a preference towards a specific option, rather the most frequently raised sub-issues whether of concern or in support of that option. It should be noted that some respondents only raised one or two issues whilst others raised numerous issues. The counts provided in Tables 2.4 and 2.5 indicate the number of submissions that raised or discussed a sub-issue.

2.4.1 *Frequently Raised Sub -Issues Regarding Option 1b*

Table 2.4 shows that the most frequently raised sub-issue in support of Option 1b was economic benefits. This was followed by flora and fauna, road user safety and general environmental benefits. Pedestrian safety was the most frequently raised sub-issue of concern relating to Option 1b followed closely by road user safety, drainage then noise impacts.

Table 2.4 FREQUENTLY RAISED SUB-ISSUES RELATING TO OPTION 1b

Favourable Issues	Count	Issues of Concern	Count
Economic	68	Pedestrian safety	26
Flora and fauna	53	Road user safety	25
Road user safety	39	Drainage	25
Environment (general)	26	Noise impact	22
Construction costs	24	Resident access	21
Timing of improvements/benefits	24		

Figure 2.6 graphically shows the most frequently raised sub-issues in support of Option 1b.

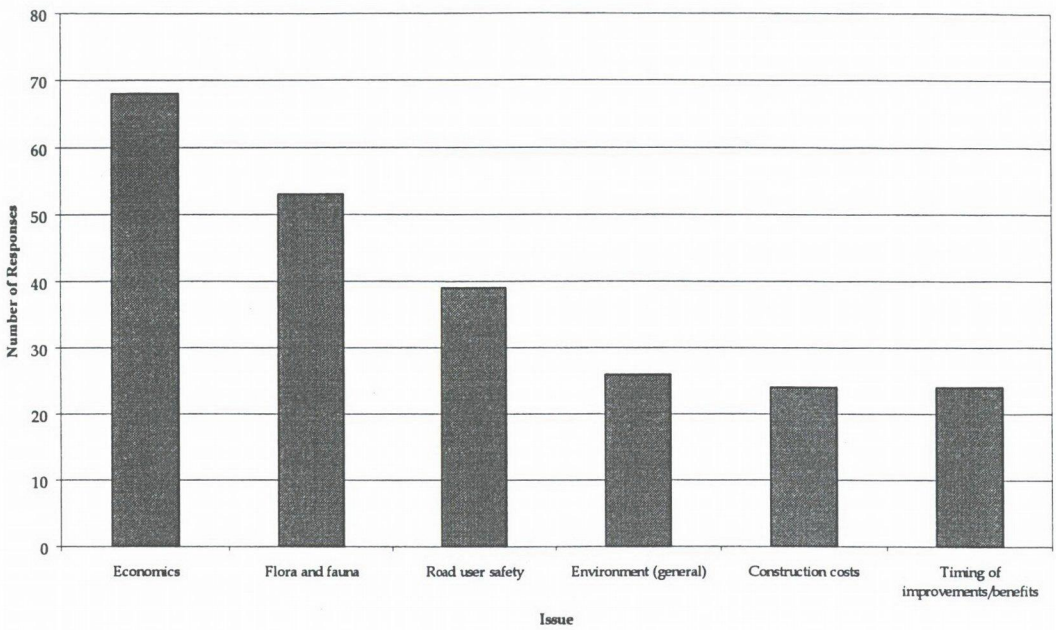

Figure 2.6 FREQUENTLY RAISED FAVOURABLE SUB-ISSUES REGARDING OPTION 1b

Figure 2.7 graphically shows the most frequently raised issues of concern regarding Option 1b.

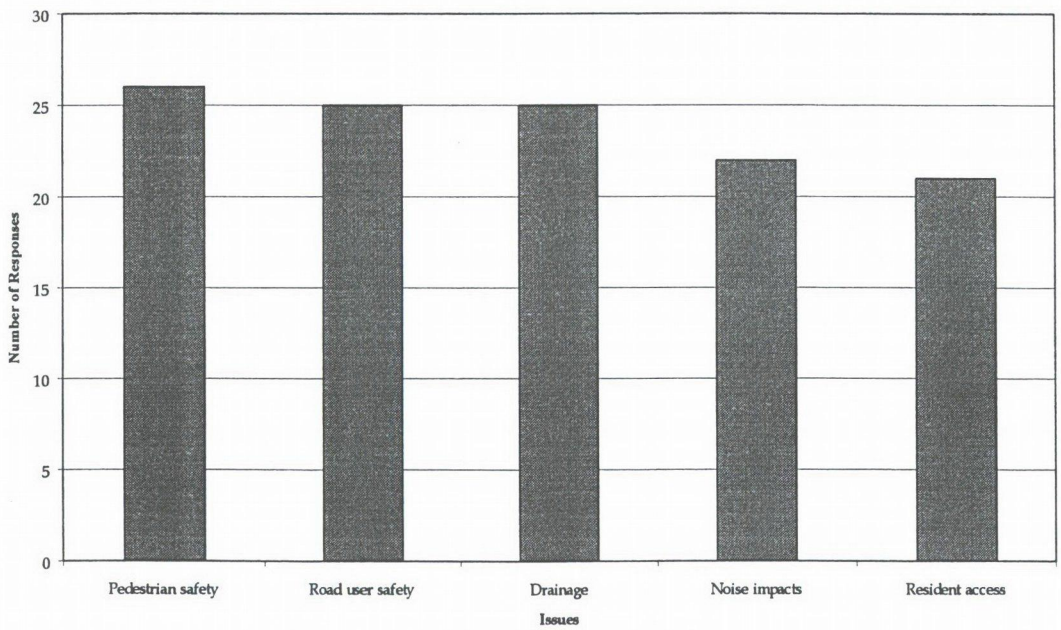

Figure 2.7 FREQUENTLY RAISED SUB-ISSUES OF CONCERN REGARDING OPTION 1b

2.4.2 *Frequently Raised Sub-Issues Regarding Option 2*

Table 2.5 shows that road user safety, travel time and alternative access during incidents of fire and accidents were the most frequently raised sub-issues in support of Option 2. Flora and fauna, economic and the potential impacts on sand dune were the most frequently raised sub-issues of concern in relation to Option 2.

Table 2.5 FREQUENTLY RAISED SUB-ISSUES RELATING TO OPTION 2

Favourable Issues	Count	Issues of Concern	Count
Road user safety	33	Flora and fauna	68
Travel time	30	Economic	40
Incidents-fire/accidents	27	Impact on sand dune	24
Traffic delays	23	Environment (general)	14
Vehicle speed	21	Road user safety	13

Figure 2.8 graphically shows the most frequently raised sub-issues in support of Option 2.

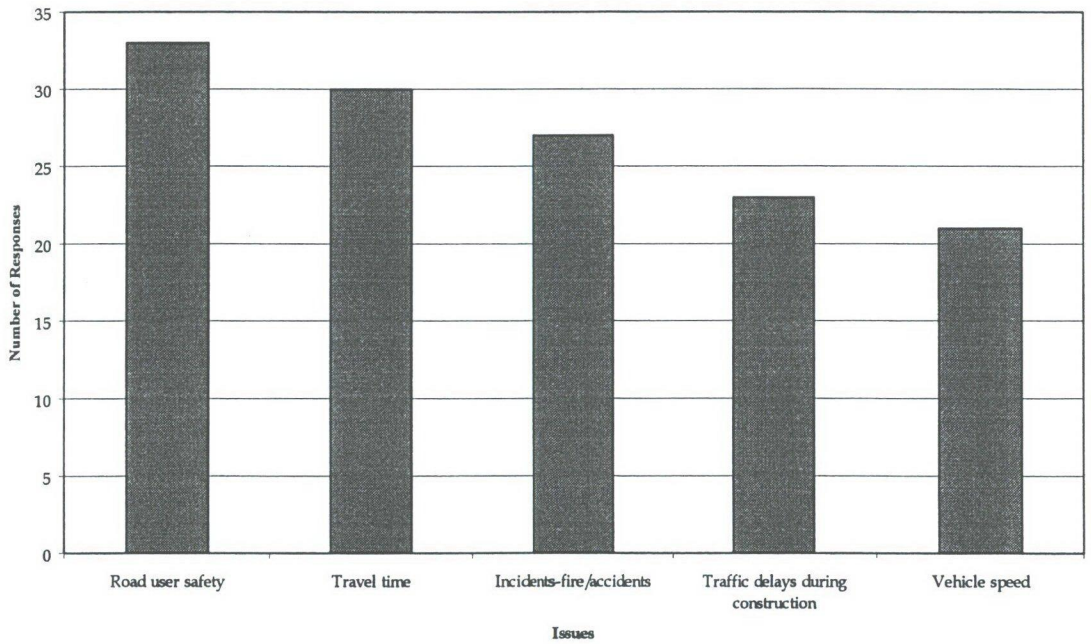

Figure 2.8 FREQUENTLY RAISED FAVOURABLE SUB-ISSUES REGARDING OPTION 2

Figure 2.9 graphically shows the most frequently raised issues of concern regarding Option 2.

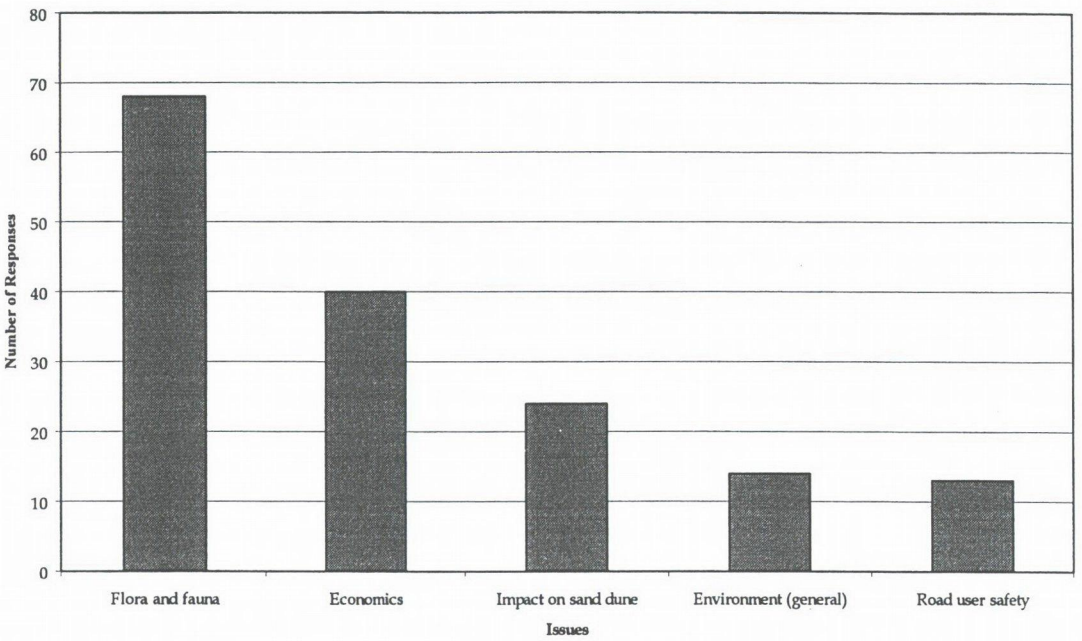

Figure 2.9 FREQUENTLY RAISED SUB-ISSUES OF CONCERN REGARDING OPTION 2

2.5 FREQUENTLY RAISED SUB-ISSUES BY RESPONDENTS

2.5.1 *Bobs Farm Businesses*

i. Support of Option 1b

The most frequently raised sub-issues by Bobs Farm Businesses who favoured Option 1b were economics, timing of improvements and the benefits to flora and fauna.

Loss of land and house was an issue of concern to some businesses who supported Option 1b. This demonstrates that whilst Option 1b is the preferred option they still have concerns relating to the impacts.

Businesses who supported Option 1b but raised concern regarding Option 2 listed as the concerns issues such as flora and fauna, economics, and impacts on the sand dunes.

ii. Support for Option 2

Traffic delays and staging were seen as favourable sub-issues for Bobs Farms Businesses who support Option 2.

Economic impacts and access to businesses associated with Option 1b were of concern to some Bobs Farm Business's who supported Option 2.

2.5.2 *Tomaree Peninsula Businesses*

i. Support of Option 1b

Economics, flora and fauna and road user safety were the most frequently raised sub-issues in support of Option 1b suggested by Tomaree Peninsula Businesses. The key sub-issues of concern regarding Option 2 by businesses who support Option 1b were economics, flora and fauna and compensation for lost business.

ii. Support of Option 2

Reduced traffic delays was identified as a key sub-issue for Tomaree Peninsula Businesses who preferred Option 2. Economics, accidents, amenity, speed, traffic volume, heavy/light vehicle separation and access were identified as issues of concern for Option 1b by respondents who preferred Option 2.

2.5.3 *Bobs Farm Residents*

i. Support of Option 1b

The most common sub-issues raised in favour of Option 1b, by Bobs Farm Residents who support Option 1b were economics, flora and fauna, construction costs, and timing of improvements/benefits. Bobs Farm Residents who preferred Option 1b were concerned with the impacts that Option 2 would have on flora and fauna, economics and the sand dune system.

ii. Support of Option 2

Almost 20 per cent of Bobs Farm Residents who preferred Option 2 suggested that access during incidents such as fire and accidents is a key benefit for this option. Reduced traffic volume on the existing road and construction costs were also benefits suggested by residents who preferred Option 2.

The key sub-issues highlighted by Bob' Farm Residents who prefer Option 2 were drainage problems and the safety of pedestrians and road users associated with Option 1. The noise impacts associated with Option 1b were also highlighted as an area of concern by 13 supporters of Option 2.

2.5.4 *Tomaree Peninsula Residents*

i. Support of Option 1b

Economics, flora and fauna and road user safety were the key sub-issues in support of Option 1b, raised by Tomaree Peninsula Residents who favour this option.

Flora and fauna, economics, road user safety, impacts on sand dunes and timing of improvements and benefits were raised by residents who supported Option 1b as adverse impacts associated with Option 2.

ii. Support of Option 2

Road user safety, improved travel time and the separation of heavy and light vehicles were raised by Tomaree Peninsula Residents as the key sub-issues in support of Option 2.

The key areas of concern to residents who favour Option 2 are adverse impacts of speed, road user safety and traffic delays during construction associated with Option 1b.

2.5.5 *Community or Resident Groups*

i. Support for Option 1b

Economics, resident and business access were frequently raised sub-issues in support of Option 1b raised by Community and Resident groups who support Option 1b.

Around 30 per cent of Community and Residents groups who preferred Option 1b were concerned with the impacts that Option 2 would have on flora and fauna, economics and the sand dune system.

ii. Support of Option 2

Travel time, construction costs, general environment, economics, and noise impacts were sub-issues raised in support of Option 2. Flora and fauna was an area of concern for Option 2 highlighted by one group who supported this option.

The noise impacts associated with Option 1b was raised as an adverse impact by two groups who preferred Option 2.

2.5.6 *Non-local Respondent*

i. Support for Option 1b

Flora and fauna, road user safety and economics were frequently raised sub-issues in support of Option 1b raised by Non-local respondents who support Option 1b.

Non-local respondents who preferred Option 1b were concerned with the impacts that Option 2 would have on flora and fauna, economics and the sand dune system.

ii. Support of Option 2

Road user safety, the separation of heavy and light vehicles and traffic delays were sub-issues raised in support of Option 2.

Traffic volume associated with Option 1b was raised as an adverse impact by two respondents who preferred Option 2.

2.5.7 *Non-local Businesses*

i. Support for Option 1b

Economics, access to businesses and construction costs were frequently raised sub-issues in support of Option 1b raised by Non-local Businesses who support Option 1b.

Flora and fauna impacts associated with Option 1b was raised as an adverse impact by one third of the respondents in this group.

ii. Support of Option 2

Speed, road user safety, the separation of heavy and light vehicles and vehicle running costs were sub-issues raised in support of Option 2 by Non-local Businesses.

Accidents, separation of heavy and light vehicles, road user safety and pedestrian safety were impacts associated with Option 1b raised by businesses who supported Option 2.

The total number of respondents for this group was nine, therefore most issues had only one response.

2.5.8 *Respondent Category Not Specified*

i. Support for Option 1b

Flora and fauna, construction costs, timing of improvements and benefits, impact on sand dune and road user safety were frequently raised sub-issues in support of Option 1b by respondents who supported this option.

The general environmental issues associated with Option 2 was raised as an adverse impact by supporters of Option 1b.

ii. Support of Option 2

Travel time, road user safety, traffic delays, speed and amenity were the key sub-issues raised in support of Option 2. Speed, road user safety, access and tourism were identified as adverse issues associated with Option 1b by supporters of Option 2.

2.6 PETITIONS

A total of four submissions were received that have been categorised as petitions. Three of the petitions support Option 1b and one submission which is not technically a petition supports Option 2 or a split system. The petitions were not independently scrutinised during their collection.

2.6.1 *Voting Form*

One submission is based on a voting form which asks the respondent to identify their preference regarding the upgrading of Nelson Bay Road between Bobs Farm and Anna Bay.

The three choices on the voting form are reproduced as follows:

1. *Make the present Nelson Bay Road a four lane highway* (Option 1a).

2. *Make a four lane highway through the sandhills along the electricity easement which does not yet exist* (Option 2).

3. *Continue the new split system - as is similar to the Salt Ash-Winery-Bobs Farm-layout.* (Split)

A total of 296 voting forms were provided. The majority include names and addresses of respondents which vary from local residents to tourists passing through the area. A breakdown of the responses is provided in Table 2.6.

Table 2.6 ANALYSIS OF VOTING SUBMISSION

Option	Number of Responses	% of total responses
1. Option 1b	Nil	Nil
2. Option 2	82	28
3. Split	211	71
Both 2 & 3	3	1
Total	**296**	**100**

It is not clear how the responses were elicited or if all responses were forwarded to the RTA. The majority of the responses (71%) provided favour a split system and just below 30 percent supporting Option 2.

2.6.2 *Petition in Support of Option 1b*

Three petitions have been provided in support of Option 1b. The same form is used for each but signatories represent different groups being local property owners, customers from Bobs Farm Store, and a wide range of respondents.

The information provided on the petitions is reproduced as follows:

Petition

For the Nelson Bay Road upgrade Option 1b... ....against Options 2A, 2B, 2C

To the Honourable the Speaker and Members of the Legislative Assembly of New South Wales in Parliament assembled.

This Petition of Citizens of New South Wales residing at Bobs Farm and Anna Bay registers with the Legislative Assembly, on the grounds of threatened species conservation and saving existing businesses, their support for the proposed Nelson Bay upgrade with Option 1b along the existing carriageway.

Your Petitioners therefore humbly pray that your Honourable House will support the conservation of threatened species and safeguard Bobs Farm and Anna Bay businesses against their isolation by ensuring the Option 1b Upgrade proceeds as originally planned and decided.

And Your Petitioners, as in duty bound, will ever pray.

The three petitions are discussed in the following section.

i. Nelson Bay Road Residents for Option 1b

Marion Reid, the coordinator of the Nelson Bay Road - Residents for Option 1b group provided a copy of a petition with 139 signatures. The original was handed to the local member Mr John Bartlett. The signatories are local property owners or business owners who rely on Nelson Bay Road for access. The full name, signature and address are provided on the petition. Some petitioners have also provided written submissions in support of Option 1b.

ii. Petition to Upgrade Option 1b

No covering letter is provided with the petition and it is not clear exactly what section of the community the petition represents (if any). It includes 296 signatures ranging from local residents to non-local residents. The full name, signature and address are provided for each. Some of the petitioners have also provided written submissions in support of Option 1b.

iii. Robert Reid -Petition to Upgrade Option 1b

Robert Reid, the operator of Bobs Farm General Store provided a written submission in addition to an attached petition. The petition includes 13 signatures ranging from local residents to non-local residents. The full name, signature and address are provided for each.

Chapter 3

GOVERNMENT AUTHORITY SUBMISSIONS

This chapter outlines the responses provided by government authorities.

3.1 PORT STEPHENS COUNCIL

Port Stephens Council is committed to the need to provide a four lane divided road from Fern Bay to Nelson Bay and indicated support for both Option 1b and Option 2. Council is aware of the disparate views held by the community regarding the proposed upgrade and has decided not to favour either option.

Council urged the RTA to make a decision regarding this project as soon as possible and requested that the RTA informs Council, all property owners and relevant public authorities when the decision is made.

3.2 HUNTER WATER CORPORATION

Hunter Water Corporation (HWC) requested that if Option 1b was selected that impact on the proposed HWC pipeline is minimised. HWC recognises that Option 2 poses less potential impact on the pipeline, however, Option 2 crosses the North Stockton Special Area containing a valuable groundwater resource and may interfere with HWC's easements for water extraction. Option 1b is outside the North Stockton Special Area and does not interfere with water extraction easements. HWC also recognises that Option 1b poses less direct impact on the North Stockton Sandbeds which form a key part of HWC's drought management strategy and have been identified as a potential future water source for the Tomaree Peninsula.

3.3 DEPARTMENT OF LAND AND WATER CONSERVATION

The Department of Land and Water Conservation expressed support for Option 1b. Reference is made to a previous submission in December 1998 by the then Regional Director and no further details are provided.

3.4 NATIONAL PARKS AND WILDLIFE SERVICE

The National Parks and Wildlife Service confirmed their support of Option 1b as it recognises the high conservation and cultural heritage values of the proposed Stockton Bight conservation area.

3.5 ENERSERVE

Enerserve, a business enterprise of Energy Australia, stated that the two corridors identified for road upgrading (Options 1b and 2) are the same for transmission line routes.

If Option 1b is selected existing powerlines will need to be relocated and work will need to be programmed to minimise impact on customers. Enerserve request that a suitable setback from the road is provided for poles and access for construction and maintenance is provided.

If Option 2 is selected, Enerserve recognise that that there are a number of options available for coexistence of the road and transmission line.

Enerserve is willing to cooperate wherever possible for this project and future stages of road upgrading.

Chapter 4

TRENDS

This chapter provides a summary of the outcomes and discusses the general trends observed.

4.1 COMMUNITY INVOLVEMENT

The public exhibition of two alternative options to upgrade the section of Nelson Bay Road between Bobs Farm and Anna Bay produced strong community feedback. A total of 371 submissions and four petitions were received by the RTA. The majority of submissions were provided by private individuals although a small number were made by businesses, community groups and government authorities.

Tomaree Peninsula residents provided the largest (39%) number of submissions followed by non local residents (21%) and Bobs Farm residents (18%). Although Tomaree Peninsula residents provided the largest number of responses, there was a good response rate from both Bobs Farm residents and businesses with a total of 66 and 10 submissions provided respectively. Given the relatively small number of residents and business along this section of Nelson Bay Road the number of submissions received indicates that most have commented on the project.

The large number of submissions shows that the level of community interest and involvement has risen in recent times. The public exhibition of the Nelson Bay Road Upgrade Option 1b and Option 2 Environmental Assessment reports from 14 October, 1998 to 11 November, 1998 only resulted in thirty submissions. Those submissions were also predominantly from individuals but included some non government organisations and businesses. Comparatively speaking, the level of community participation has increased dramatically and much broader range of individuals, organisations and businesses have indicated their preference and commented on the project.

4.2 TRENDS

The results demonstrate that there is an overall preference for Option 1b with 64 per cent of all submissions indicating their support for this option. Option 2 attracted support from 34 per cent of all responses. The split system and submissions that stated no preference attracted less than one per cent respectively of all submissions.

Four petitions with in excess of 700 signatures in total were received. This demonstrates a high level of community involvement and awareness of the project. One petition shows that a large (296) number of persons when asked about their preference for upgrading the road favour either Option 2 or the split system. Three other petitions demonstrate there is significant support for Option 1b with 448 signatures.

The most frequently raised issue in all submissions was the potential impact on business. The majority of these were seen as favourable in regard to Option 1b and of concern regarding Option 2. Environmental aspects were the second most frequently raised issues with a large number in support of Option 1b and a slightly higher number raising concerns regarding the potential impacts of Option 2. Road user safety, access issues, road maintenance and impact on the sand dunes were also frequently raised issues. Only a relatively small number of submissions commented on noise issues with the majority of those expressing concern in relation to Option 1b. Travel time benefits and reduced impacts during construction are seen as more favourable issues in regard to Option 2 than 1b.

The residents of Bobs Farm show an even distribution with 50 per cent of respondents supporting Option 1b and 50 per cent supporting Option 2. All other respondent categories clearly favour Option 1b. The most frequently raised sub-issues by Bobs Farm residents in support of Option 1b were the positive flora and fauna aspects, economic benefits for business and the cost of construction. The most frequently raised issues by Bobs Farm residents who favour Option 2 are the provision of an alternative access during incidents, lower traffic volume on the existing road and the cost of construction.

The majority (80%) of Bobs Farm Businesses support Option 1b. Sub-issues raised by businesses favouring Option 1b include economic benefits for business and less impacts on flora and fauna. Bobs Farm Businesses in favour of Option 2 support the reduction in traffic delays and staging of construction.

Tomaree residents and businesses generally favour Option 1b, although the level of support at 58 and 65 per cent respectively is not as strong as the support from local business. Non local businesses (78%), non local residents (75%) and community groups (76%) also showed a high level of support for Option 1b. The majority of government agencies (60%) support Option 1b although two agencies (40%) did not state a preference for either option.

RTA

POTENTIAL CONSTRAINTS

Appendix C

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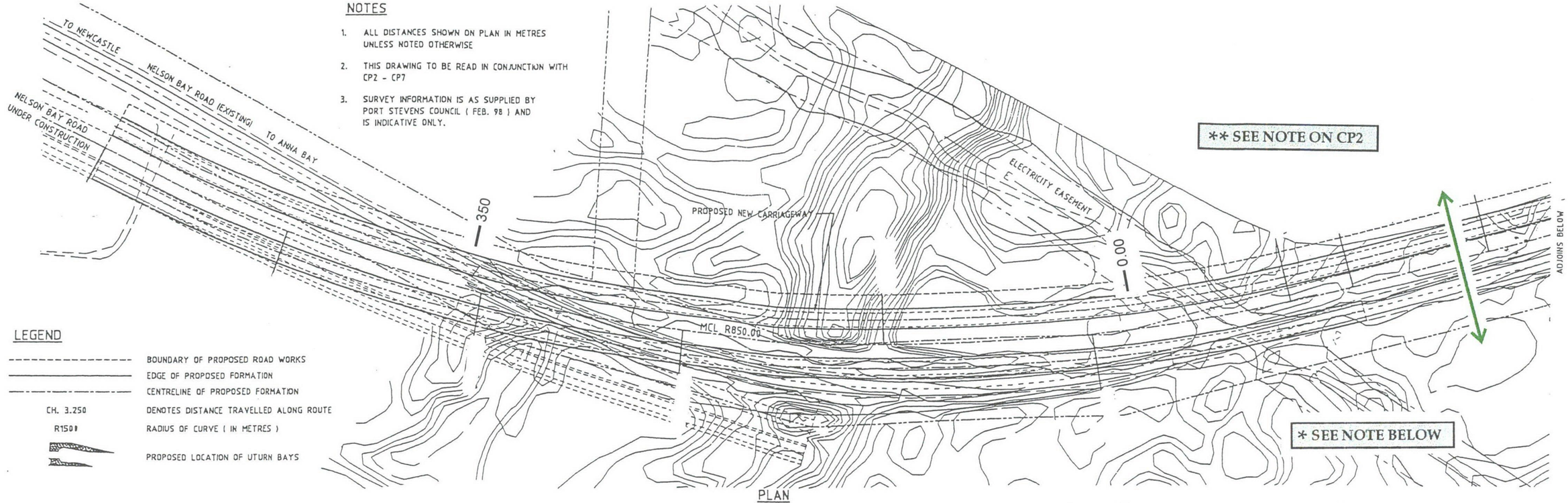
NOTES

1. ALL DISTANCES SHOWN ON PLAN IN METRES UNLESS NOTED OTHERWISE
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH CP2 - CP7
3. SURVEY INFORMATION IS AS SUPPLIED BY PORT STEVENS COUNCIL (FEB. 98) AND IS INDICATIVE ONLY.

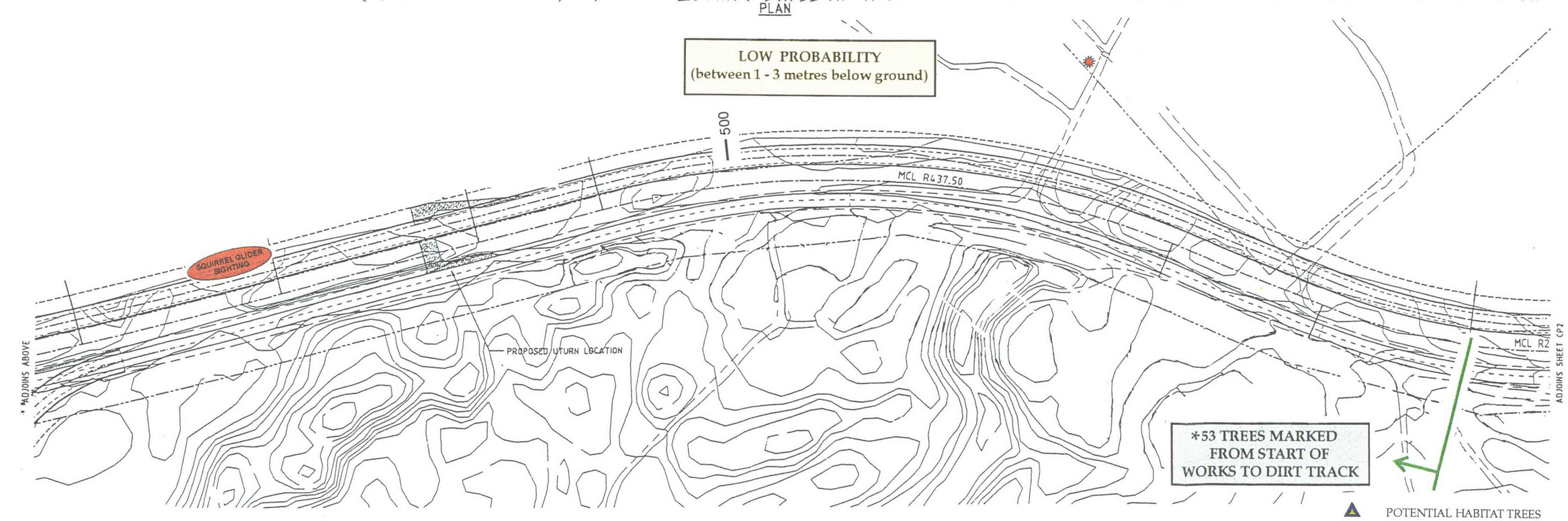


LEGEND

- BOUNDARY OF PROPOSED ROAD WORKS
- EDGE OF PROPOSED FORMATION
- CENTRELINE OF PROPOSED FORMATION
- CH. 3.250 — DENOTES DISTANCE TRAVELLED ALONG ROUTE
- R1500 — RADIUS OF CURVE (IN METRES)
- PROPOSED LOCATION OF UTURN BAYS

PLAN

LOW PROBABILITY
(between 1 - 3 metres below ground)



- POTENTIAL HABITAT TREES
- ARCHAEOLOGY MIDDEN
- ACID SULPHATE SOIL POTENTIAL

N

0 40m

SOURCE: YOUNG CONSULTING ENGINEERS - REF. CP1 REV. B

5904261

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Figure 1 POTENTIAL CONSTRAINTS

LEGEND

- BOUNDARY OF PROPOSED ROAD WORKS
- EDGE OF PROPOSED FORMATION
- CENTRELINE OF PROPOSED FORMATION
- CH. 3.250 — DENOTES DISTANCE TRAVELLED ALONG ROUTE
- R1500 — RADIUS OF CURVE (IN METRES)
- PROPOSED LOCATION OF UTURN BAYS

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HIGH PROBABILITY
(between 1 - 3 metres below ground)

LOW PROBABILITY
(between 1 - 3 metres below ground)

**165 TREES MARKED FROM START OF WORKS

FOR INTERSECTION ARRANGEMENT REFER TO DRAWING CP7

1500

MKT R260.00

HARSH ROAD (EXISTING)

GRAVEL CULVERT

LOT 126 GRAVEL CULVERT

"HALL" RMB 3700 GRAVEL CULVERT

ADJOINS SHEET CP3

1000

MCL R292.50

ADJOINS SHEET CP2

CARAVAN & BOAT STORAGE PARK

POTENTIAL HABITAT TREES

ARCHAEOLOGY MIDDEN

ACID SULPHATE SOIL POTENTIAL

N

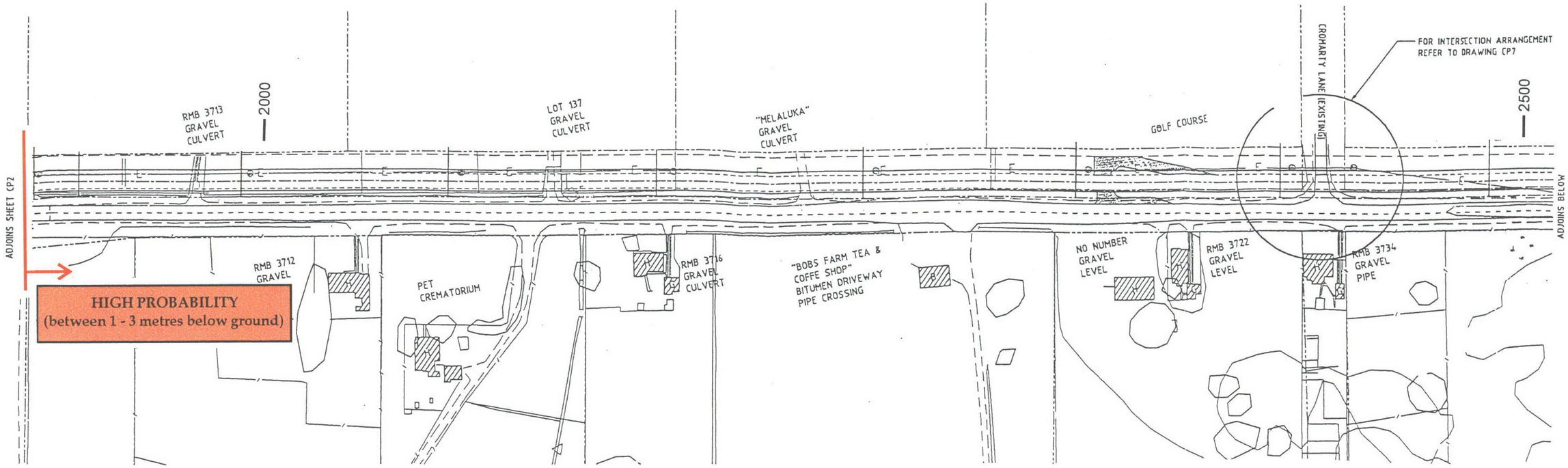
0 40m

590429g1

SOURCE: YOUNG CONSULTING ENGINEERS - REF. CP2 REV. B

ERM

Figure 2 POTENTIAL CONSTRAINTS



LEGEND

- BOUNDARY OF PROPOSED ROAD WORKS
- EDGE OF PROPOSED FORMATION
- CENTRELINE OF PROPOSED FORMATION
- CH. 3.250 DENOTES DISTANCE TRAVELLED ALONG ROUTE
- R1500 RADIUS OF CURVE (IN METRES)
- PROPOSED LOCATION OF UTURN BAYS

NOTES

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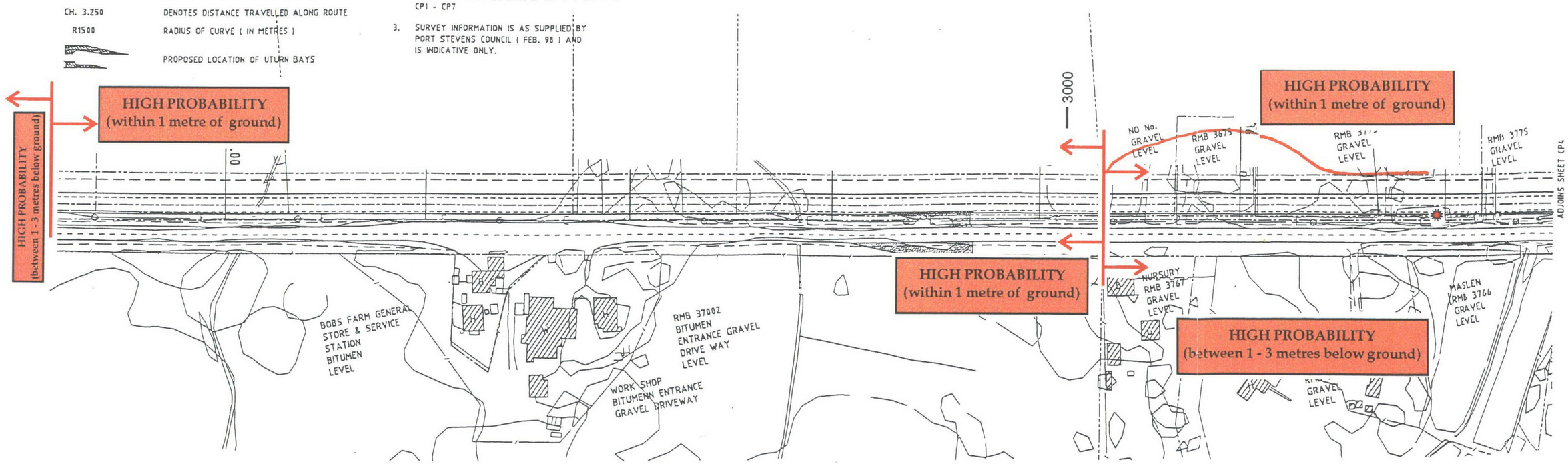

- POTENTIAL HABITAT TREES
- ARCHAEOLOGY MIDDEN
- ACID SULPHATE SOIL POTENTIAL

N

0 40m

SOURCE: YOUNG CONSULTING ENGINEERS - REF. CP3 REV. B

5904/fig1

ERM

Figure 3 POTENTIAL CONSTRAINTS

HIGH PROBABILITY
(within 1 metre of ground)

LOW PROBABILITY
(between 1 - 3 metres below ground)

HIGH PROBABILITY
(between 1 - 3 metres below ground)

PREFERRED KOALA HABITAT

PREFERRED KOALA HABITAT

PREFERRED KOALA HABITAT

RMB 3775 GRAVEL LEVEL

O ROBINSON

G A ROBINSON RMB 3783 GRAVEL LEVEL

RMB 3789 BITUMEN LEVEL

3500

ADJOINS SHEET CP3

MASLEN RMB 3766 GRAVEL

MCL R607.50

RMB 3796 GRAVEL LEVEL

RMB 3798 GRAVEL LEVEL

RMB 3802 GRAVEL LEVEL

ADJOINS BELOW

LEGEND

BOUNDARY OF PROPOSED ROAD WORKS

EDGE OF PROPOSED FORMATION

CENTRELINE OF PROPOSED FORMATION

CH. 3.250 DENOTES DISTANCE TRAVELLED ALONG ROUTE

R1500 RADIUS OF CURVE (IN METRES)

PROPOSED LOCATION OF UTURN BAYS

NOTES

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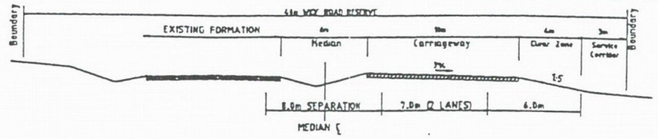

CH. 4077 - CH. 6600

TYPICAL CROSS SECTION - 40 METRE RESERVE

N.T.S.

4000

4500

RMB 3811 GRAVEL LEVEL

RMB 3815 GRAVEL LEVEL

RMB 3819 GRAVEL LEVEL

ORCHARD ?

GRAVEL LEVEL

TROTTER ROAD

ADJOINS ABOVE

ADJOINS SHEET CP5

MCL R1877.50

LOW PROBABILITY
(between 1 - 3 metres below ground)

HIGH DENSITY OF POTENTIAL HABITAT TREES

SOURCE: YOUNG CONSULTING ENGINEERS - REF. CP4 REV. B

590429g1

POTENTIAL HABITAT TREES

ARCHAEOLOGY MIDDEN

ACID SULPHATE SOIL POTENTIAL

N

0 40m

ERM

Figure 4 POTENTIAL CONSTRAINTS

HIGH PROBABILITY
(between 1 - 3 metres below ground)

LOW PROBABILITY
(between 1 - 3 metres below ground)

HIGH PROBABILITY
(between 1 - 3 metres below ground)

LOW PROBABILITY
(between 1 - 3 metres below ground)

STAN SMITH
RMB 3835
GRAVEL
PIPE

TROTTER ROAD

B 3857

5000

BED &
BREAKFAST
BITUMEN
CULVERT

R&W ROBINSON
RMB 3855
GRAVEL
PIPE

RMB 3861
GRAVEL
PIPE

RMB 3846
GRAVEL
PIPE

MCL R507.50

ADJOINS SHEET CP4

ADJOINS BELOW

SAND DUNE ACCESS

RMB 3844
GRAVEL
PIPE

GRAVEL
PIPE

GRAVEL
LEVEL

CALTEX SERVICE
STATION
BITUMEN DRIVEWAY

ANNA BAY
LAWN
CEMETERY

RMB 3876

RMB 3876

6000

5500

ANNA BAY
UNION CHURCH
PRESPERTAIAN

GRAVEL
PIPE

GRAVEL
PIPE

GRAVEL
LEVEL

GRAVEL
STEEP

CONCRETE
STEEP

RMB 3887
GRAVEL
LEVEL

HILL
RMB 3881
BITUMEN
PIPE

RMB 3883
GRAVEL
PIPE

RMB 3875
GRAVEL
PIPE

NEW BITUMEN
PIPE

SQUIRREL GLIDER
SIGHTING

MCL R457.50

MCL R507.50

ADJOINS ABOVE

ADJOINS SHEET CP6

GRAVEL
PIPE

GRAVEL
LEVEL

GRAVEL
LEVEL

RMB 3908

FOX
RMB 3910
RMB 3912

MURRAY
RMB 3866
GRAVEL
LEVEL

3876

LEGEND

- BOUNDARY OF PROPOSED ROAD WORKS
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- POTENTIAL HABITAT TREES
- ARCHAEOLOGY MIDDEN
- ACID SULPHATE SOIL POTENTIAL

N

0 40m

SOURCE: YOUNG CONSULTING ENGINEERS - REF. CP5 REV. B

590429g1

ERM

Figure 5 POTENTIAL CONSTRAINTS

LEGEND

----------	BOUNDARY OF PROPOSED ROAD WORKS
————	EDGE OF PROPOSED FORMATION
—·—·—·—	CENTRELINE OF PROPOSED FORMATION
CH. 3.250	DENOTES DISTANCE TRAVELLED ALONG ROUTE
R1500	RADIUS OF CURVE (IN METRES)
	PROPOSED LOCATION OF UTURN BAYS

NOTES

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590426g6

SOURCE: YOUNG CONSULTING ENGINEERS - REF. CP6 REV. B

POTENTIAL HABITAT TREES
ARCHAEOLOGY MIDDEN
ACID SULPHATE SOIL POTENTIAL

N

0 40m

ERM *Figure 6* POTENTIAL CONSTRAINTS

RTA

Appendix D

FLORA AND FAUNA

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Appendix D-1

FLORA AND FAUNA ASSESSMENT NELSON BAY ROAD UPGRADE ENVIRONMENTAL ASSESSMENT REPORT (1998)

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Chapter 1

INTRODUCTION

1.1 OBJECTIVES OF FLORA AND FAUNA ASSESSMENT

The primary objectives of the flora and fauna investigations were to:

- describe the vegetation in accordance with the classification system of Specht *et al* (1995), highlighting communities of particular conservation significance;
- compile a list of flora and fauna species identified along the proposed deviation, highlighting any threatened species listed in Schedules 1 and 2 of the Threatened Species Conservation Act, 1995 (TSC Act);
- assess the impacts of the proposed deviation on remnant vegetation;
- assess whether the development is likely to have a significant impact on the environment of threatened species, populations and ecological communities through consideration of section 5A of the Environmental Planning and Assessment Act, 1979 (EP&A Act) as amended by the TSC Act;
- assess the likely impacts of the proposed road upgrading on flora and fauna;
- identify impacts on the proposed Stockton Bight National Park;
- liaise with NPWS and community groups; and
- identify and discuss options for mitigation of any likely impacts.

Chapter 2

METHODOLOGY

2.1 INTRODUCTION

Flora and fauna investigations for the proposed upgrading of Nelson Bay Road from Bobs Farm to Anna Bay were based on field surveys undertaken over two days and two nights in July 1998, searches of the NSW National Parks and Wildlife Service (NPWS) ROTAP database and Atlas of NSW Wildlife, a review of existing literature on flora and fauna in the local area, and results of a survey of local residents undertaken by EcoNetwork - Port Stephens. For the purposes of this assessment, the 'study area' is defined as the proposed road corridor and immediately adjoining habitat.

2.2 FLORA SURVEY

The flora survey was designed to provide a general description of the plant communities along Option 1b and to identify any threatened plant species (or suitable habitat thereof) along the proposed route. Walking transects and sampling quadrats were used to record vascular plant species within representative plant communities and to describe the communities in accordance with the structural characteristics of Specht *et al.* (1995).

2.3 FAUNA SURVEY

The fauna survey involved preliminary field investigations identifying species present as well as known or potential habitat for threatened fauna. The fauna survey was brief yet comprehensive, and targeted areas containing suitable habitat for threatened species. The fauna survey was conducted over two days and two nights, with the proposed route surveyed during the daytime and revisited at dusk for the nocturnal survey period. The field surveys used the following methodologies:

- identification of diurnal birds by direct sightings and/or call identification;
- searches for reptile and frog species in suitable habitat areas;

- habitat assessment based on plant community descriptions and identification of important habitat components such as tree hollows, vegetation strata and nectar sources;

- spotlighting and stagwatching for nocturnally active fauna along the route, targeting hollow-bearing trees;

- playback of pre-recorded calls of masked owl (*Tyto novaehollandiae*), powerful owl (*Ninox strenua*), barking owl (*Ninox connivens*), eastern grass owl (*Tyto capensis*) and bush stone-curlew (*Burhinus grallarius*);

- recording and computer analysis of bat echolocation calls using an Anabat II detector;

- SEPP 44 (Koala Habitat Protection) assessment (as detailed below); and

- searches for evidence of the presence of fauna, including scats, diggings and tracks, whitewash and regurgitation pellets from owls, and characteristic scratch marks on tree trunks. Scats were submitted to Barbara Triggs, a recognised expert in hair and scat analysis, for identification.

2.4 SEPP 44 (KOALA HABITAT PROTECTION) ASSESSMENT

Potential koala habitat is defined as vegetation in which species listed in Schedule 2 of SEPP 44 - Koala Habitat Protection comprise a minimum of 15 per cent of the total number of trees in the "*upper or lower strata of the tree component*". The presence of *potential* koala habitat along Option 1b was assessed using a plot-based survey to record the per cent of each tree species present.

Within each 20 metre by 20 metre plot the number and type of tree species in the upper and lower strata were recorded. The upper strata is considered to be the forest canopy and emergents. The lower strata is the mid-understorey or sub-canopy of the community being trees ranging in height from approximately five to ten metres. From this assessment the percentage of each species for the plot were determined. Searches for koalas, scats and scratches on tree trunks were also undertaken within each sampling plot. In addition, trees outside each sampling plot were searched using binoculars.

2.5 LITERATURE AND DATABASE SEARCHES

The list of species recorded along Option 1b during the field surveys was supplemented with data extracted from the NPWS ROTAP and Atlas of NSW Wildlife databases, as well as recent flora and fauna studies undertaken in the Port Stephens area and a survey of local residents undertaken by EcoNetwork. Only those species considered likely to occur along the route, based on availability of suitable habitat, have been included.

The literature review undertaken for this study included:

- a flora and flora assessment for a proposed residential development at Salamander (Environsciences, 1994).
- a flora, fauna and SEPP 44 assessment for a proposed school at Salamander Bay (ERM Resource Planning, 1995a).
- Tomaree Peninsula Landscape Study (Browne *et al.*, 1986).
- Stockton Bight Environmental Study (HLA-Environsciences Pty Limited, 1995).
- Fauna Assessment for proposed sand extraction, Anna Bay (Mount King Ecological Surveys, 1990).
- Ecological Study for proposed development at Salamander Bay (Mount King Ecological Surveys, 1991).
- Flora and Fauna Survey for proposed Fingal Bay Road (Mount King Ecological Surveys, 1992a).
- Fauna Impact Statement for proposed Fingal Bay Road (Mount King Ecological Surveys, 1994).
- Fauna Impact Statement for sand extraction at Fern Bay (ERM Resource Planning Pty Limited, 1994).
- Preliminary Fauna Assessment for proposed residential development at Salamander (Shortland Wetlands Centre, 1992).
- Preliminary fauna assessment for proposed residential development at Boat Harbour (Shortland Wetlands Centre, 1993a).
- Pre-clearance threatened fauna and flora survey at Fern Bay (ERM Mitchell McCotter, 1995).

Chapter 3

SURVEY RESULTS

3.1 PLANT COMMUNITIES WITHIN STUDY AREA

Vegetation along most of Nelson Bay Road between Bobs Farm and Anna Bay has either been cleared or drastically altered. For example, in some areas where mature trees have been retained, the understorey has been removed and the groundcover is regularly mowed. Based on vegetation structural characteristics, the study area is dominated by two plant communities, namely grassland and open forest.

Weed invasion, mainly in the form of *Chrysanthemoides monilifera* subsp. *rotundata* (bitou bush) and *Lantana camara* (lantana) infestations, occurs throughout the open forest, particularly along several 4WD tracks leading from Nelson Bay Road to Stockton Beach. Weed infestations are particularly severe at the eastern end of Option 1b.

The approximate boundaries of the communities within the study area, mapped from aerial photograph interpretation (Port Stephens Shire Council, Run 3, 21.9.92, 1:16,000) and field verification, are shown in *Figure 1*. The structural characteristics and dominant species for each strata are discussed below. The vascular plant species recorded during the field surveys are included as *Appendix A*.

3.1.1 Grassland

Pasture species are established along most of the route of Option 1b, with grassland dominating the road verge. Much of the land along Option 1b is used for rural activities such as livestock grazing. Dominant grass species include *Imperata cylindrica* (blady grass), *Cynodon dactylon* (common couch), *Stenotaphrum secundatum* (buffalo grass) and *Pennisetum clandestinum* (kikuyu). Dominant herbaceous species include *Plantago major* (large plantain), *Taraxacum officinale* (dandelion) and *Anagallis arvensis* (scarlet pimpernel).

The open nature of this community has contributed to the occurrence of several orchid species including *Pterostylis* sp. (greenhood), *Acianthus* sp. (mosquito/mayfly orchid) and *Microtis* sp. (onion orchid). At the western end, native plant species diversity is higher within the grassland and includes such species as *Themeda australis* (kangaroo grass), *Gonocarpus teucrioides* (germander raspwort) and *Dianella caerulea* (blue flax lily). Vegetation within the grassland is less than one metre in

height, while percentage cover is approximately 80 to 90 per cent. This community appears to be regularly mowed or slashed as part of road and easement maintenance.

3.1.2 *Open forest*

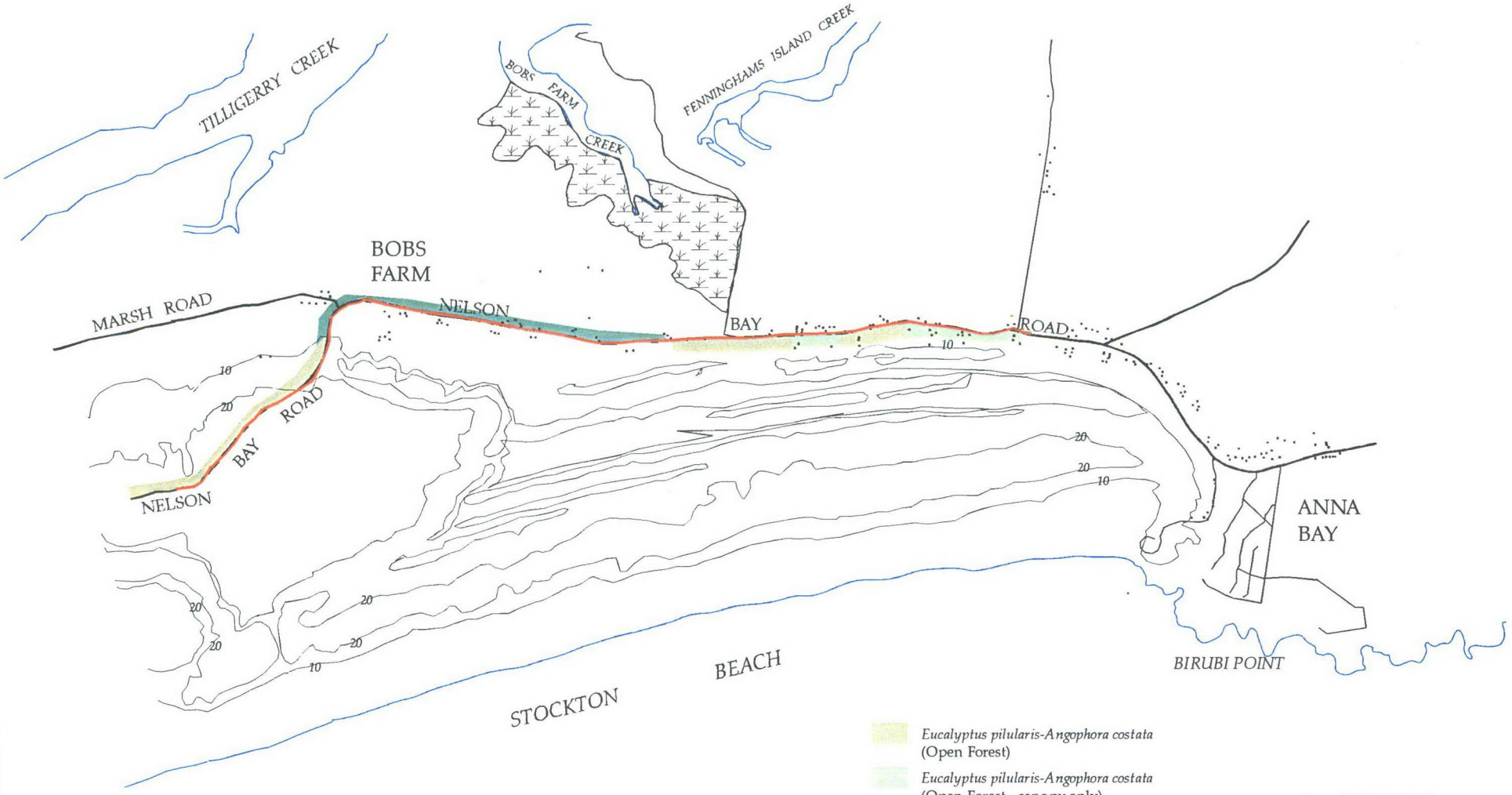
The dominant native plant community along Option 1b is open forest. This community is dominated by *Eucalyptus pilularis* (blackbutt) and *Angophora costata* (rusty gum). The canopy reaches a height of approximately 20 to 25 metres. Diameter at breast height (DBH) averages 45 centimetres, with recorded DBH ranging from 12 centimetres to 120 centimetres. The canopy provides 40 to 50 per cent projective foliage cover.

The mid-understorey, which is up to 15 metres in height, provides approximately 15 per cent projective cover and is dominated by *Banksia serrata* (old man banksia) at the western end and *B. serrata, Glochidion ferdinandi* (cheese tree) and *Dodonaea triquetra* (common hop bush) at the eastern end of Option 1b. Other species in the mid-understorey include *Monotoca elliptica* and juvenile eucalypts. The shrub understorey, which is up to two metres in height, is dense (providing approximately 80 per cent projective cover) and is dominated by *Pteridum esculentum* (bracken fern) and a range of coastal heath species including *Bossiaea rhombifolia, Monotoca scoparia* and *Leucopogon lanceolatus.*

Groundcover throughout the open forest is relatively open, providing less than 10 per cent foliage cover. Dominant species include *Acianthus* sp., *Gonocarpus teucrioides, Imperata cylindrica, Dianella caerulea* and a range of creepers such as *Pandorea pandorana* (wonga wonga vine). The margins of this community are disturbed along the length of Option 1b, with infestations of bitou bush (*Chrysanthemoides monilifera* subsp. *rotundata*) particularly prevalent at the eastern end. The dominance of bracken fern within this community indicates a high fire frequency and regular slashing along the road easement. Within the open forest, the deep, sandy soils are well drained with litter layers of 8 to 10 centimetres.

3.2 FAUNA HABITATS

No wetland habitats, including SEPP 14 wetlands as mapped by Adam *et al* (1985), occur along Option 1b. Fauna habitat types and attributes present within the study area are discussed below.



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SOURCE: 1:25,000 TOPO WILLIAMTOWN SHEET/ ENVIROSCIENCES Fig. 3.2 Project U53

ERM MITCHELL McCOTTER

Figure 3.1 PLANT COMMUNITIES - OPTION 1b

3.2.1 *Grassland*

No canopy or understorey strata are present within the grassland along Option 1b. This habitat type therefore has little value for native fauna, particularly for hollow-dependent mammals such as possums and gliders. Other important habitat components such as logs and rocks are also absent. The grass road verge provides foraging habitat for grazing animals such as the eastern grey kangaroo (*Macropus giganteus*). Groundcover varies from open to moderately dense, providing some cover for small terrestrial mammals and reptiles.

The open nature of the grassland along the road verge does provide suitable habitat for a range of orchid species, including the threatened *Diuris praecox*. However, regular slashing and/or mowing of the road verge is likely to reduce habitat suitability, particularly if such practices are undertaken during the species' flowering period.

3.2.2 *Open forest*

The open forest along Option 1b contains a high number of mature hollow-bearing trees. Small to medium sized hollows suitable for gliders and bats are particularly abundant. A range of nectar, pollen and exudate-producing species, including eucalypts, acacias and banksias, both in the canopy and the understorey, provide important food resources for a range of species, including gliders. A moderate number of fallen logs, including large hollow logs, provide suitable habitat for a range of reptiles and terrestrial mammals.

The dominance of the groundcover by bracken fern in some areas of the open forest suggests that fire frequency within this habitat type is high. Such a fire regime may affect the value of this habitat for fauna, with the potential for fauna populations to be adversely affected, either directly through mortality or injury, or indirectly through a reduction in sheltering and foraging resources.

3.3 FAUNA MOVEMENT CORRIDORS

The vegetated dunes of Newcastle Bight extend from Stockton in the south to Birubi Point at Anna Bay in the north. To the west of the dunes, vegetation has been cleared and the land is used predominantly for agricultural and industrial purposes, presenting a barrier to movement of terrestrial fauna to large areas of natural bushland in the Tomago sandbed system and Medowie area.

Nelson Bay Road currently presents a barrier to fauna movement in the Bobs Farm/Anna Bay area, particularly for terrestrial species. This barrier effect is exacerbated by cleared land adjoining the existing road, particularly to the north.

Open forest along the southern side of Nelson Bay Road is continuous with extensive natural bushland extending to Stockton in the south-west. Open forest on the north-western side of Nelson Bay Road at the western end of Option 1b is also continuous with extensive bushland. Such links form significant movement corridors in the local area.

3.4 SPECIES OBSERVED OR LIKELY TO OCCUR

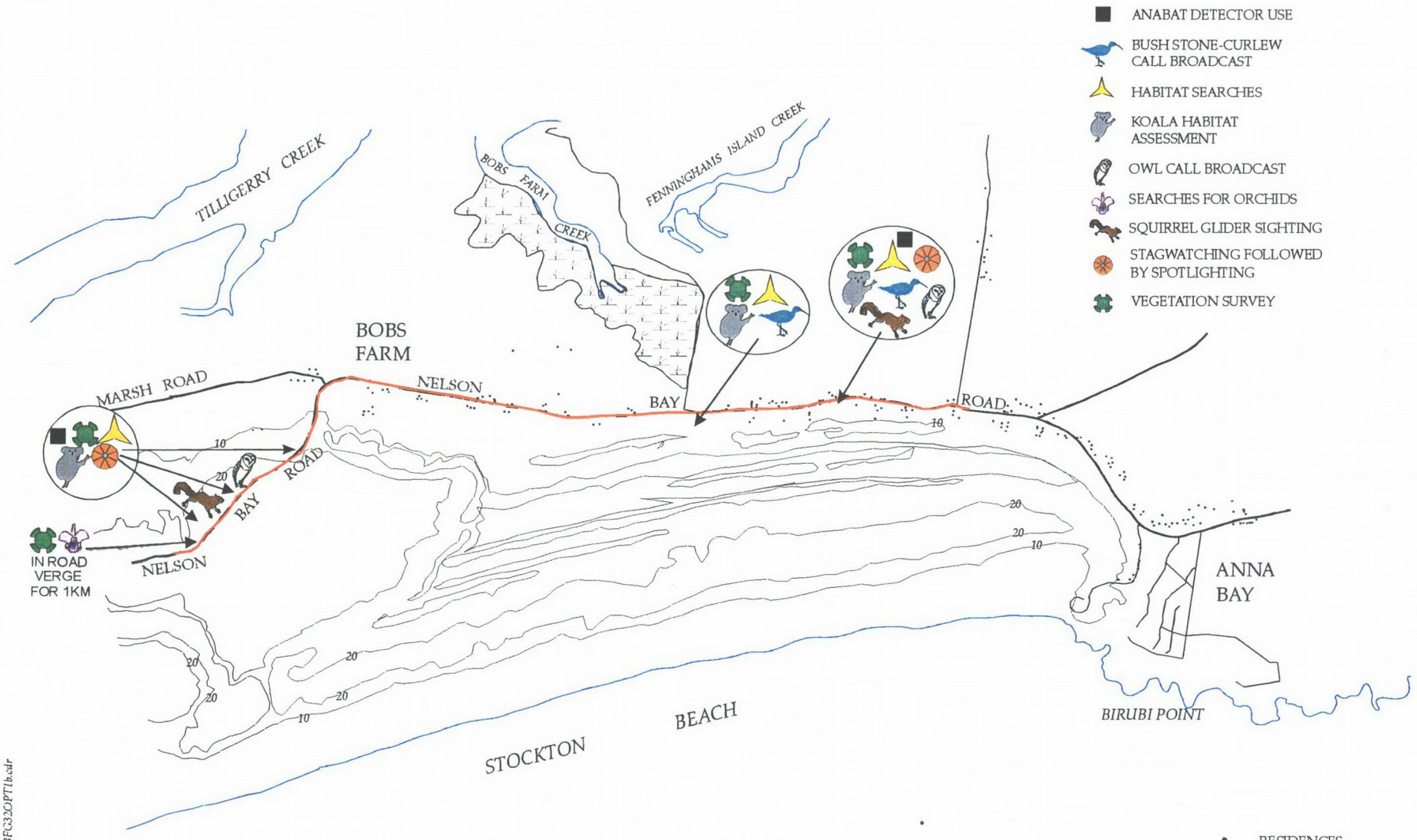
Most of the species recorded along Option 1b are typical of coastal forested habitats. The study area is expected to support a greater range of native fauna species than were recorded during the field surveys. The results have therefore been supplemented with records extracted from database searches, a review of other flora and fauna studies undertaken in the Port Stephens area and a survey of local residents (see *Appendix B* for fauna species list).

A total of 72 vascular plant species (54 native and 18 introduced species), 22 native bird species, 9 native mammal species, (including one bat species), and one frog species were recorded along Option 1b. The number of species occurring within the study area is expected to be higher than that which was recorded during fieldwork, as the field surveys were brief (though comprehensive) and sampled only one season, namely winter. During winter, many species exhibit reduced daily activity. In addition, some species (particularly microchiropteran bats) are inactive during winter. Winter is also outside the flowering season of many plant species, hence the flora list would be expected to be higher if surveying were to be undertaken during other seasons.

As the study area is expected to support a greater range of native fauna species dependent upon coastal forest habitats than were recorded during the field surveys, the results have been supplemented with records extracted from database searches, a review of other flora and fauna studies undertaken in the Port Stephens area and results of a survey of local residents.

3.4.1 Nocturnal surveys

A total of eight person hours were spent stagwatching, spotlighting, and using Anabat detection and playback of owl and bush stone-curlew (*Burhinus grallarius*) calls. Survey sites are shown on *Figure 2*. On the first night of nocturnal fieldwork, a glider (*Petaurus* sp.) was recorded gliding into a tree at the edge of the road verge at the western end of Option 1b (*Figure 3.2*). The only other nocturnal species to be recorded during the first night of nocturnal fieldwork was a common ringtail possum (*Pseudocheirus peregrinus*), which was observed at the western end of Option



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SOURCE: 1:25,000 TOPO MORNA POINT SHEET/ ENVIROSCIENCES Fig. 3.2 Project 1153

ERM MITCHELL McCOTTER

Figure 3.2 FLORA AND FAUNA SURVEY SITES - OPTION 1b

1b. There was no response to owl call playback, nor to broadcasts of the call of the bush stone-curlew.

On the second night, three gliders were observed at the eastern end of Option 1b. One of the gliders was close enough to be identified as a squirrel glider. The only other species to be recorded during nocturnal fieldwork were a common brushtail possum (*Trichosurus vulpecula*), fan-tailed cuckoo (*Cacomantis flabelliformis*) and common eastern froglet (*Crinia signifera*).

One microchiropteran bat species, the little bent-wing bat (*Miniopterus australis*), was recorded via echolocation call detection.

3.5 WEATHER CONDITIONS

Weather conditions during the field surveys were generally calm, with cool to mild temperatures (*Table 1*), and as conducive to detecting fauna as possible for the time of year in which they were conducted.

Table 1 WEATHER CONDITIONS

Date	Time	Temp.(°C)	Cloud Cover	Moon	Rain	Wind
2/7	1300	17[1]	4/8	No moon	Dry	Calm
7/7	1400	19[1]	8/8	3rd Qtr	Dry	Calm
7/7	1700	17[1]	8/8	3rd Qtr	Dry	Calm
20/7	1900	12[1]	4/8	No moon	Dry	Calm

Note: [1] = Records for Williamtown weather station

Cloud cover: 0/8 (clear) through to 8/8 (overcast)

3.6 SEPP 44 ASSESSMENT

Five plots were sampled within the forested habitats along Option 1b. *Table 2* summarises the results of this survey which indicate that *potential* koala habitat, as defined by SEPP 44, does not occur along the proposed route of Option 1b.

Table 2 SEPP 44 POTENTIAL KOALA HABITAT SURVEY

Plot No.	Habitat	Number of trees		Schedule 2 species		Potential Habitat (yes/no)
		Upper Strata	Lower Strata	Number	%	
1	OF	3	9	0	0	No
2	OF	5	2	0	0	No
3	OF	4	8	0	0	No
4	OF	8	3	0	0	No
5	OF	2	9	0	0	No

Key: *OF = Open Forest*

The study area falls within an area of habitat rated as 'potential' koala habitat by Callaghan *et al* (1994). Potential habitat areas are considered by Callaghan *et al* (1994) to be those areas that contain plant communities apparently similar to those where koalas are known to occur in other parts of Port Stephens, but where actual koala records are either very few or non-existent. Further research of these areas is considered necessary to determine the presence or absence of koalas and to assign an appropriate level of significance (Callaghan *et al*, 1994).

Phillips *et al* (1996) assessed the forested habitats along and within the vicinity of Option 1B as Secondary B habitat or 'marginal' koala habitat. According to Phillips *et al* (1996), marginal habitat is characterised by floristic alliances and/or associations wherein tree species known to be preferentially used by Koalas are largely absent or otherwise occur at very low densities (less than 10 per cent). Such habitat is considered unlikely to be capable of supporting breeding aggregations (Phillips *et al*, 1996).

During searches for evidence of the presence of fauna, several scats were located under a mature blackbutt within SEPP 44 sampling plot 4. Koala scats are similar in appearance to common brushtail possum scats. The scats were sent to Barbara Triggs who confirmed they were that of a common brushtail possum and not a koala.

3.7 FLORA SPECIES OF CONSERVATION SIGNIFICANCE IN THE STUDY AREA AND REGION

No flora species of conservation significance were identified within the study area. However *Diuris praecox*, a species listed on the TSC Act was considered likely to

occur on the basis of habitat suitability and local records (see *Chapter 5 - Threatened Species Assessment*).

Diuris praecox is recorded on the NPWS ROTAP database for the Newcastle 1:100 000 map sheet as *Diuris* sp 5. This species was recorded at Glenrock State Recreation Area in 1990 and is now described as *Diuris praecox*. While database records indicate that this species has only been recorded in this area, recent consultation with a local enthusiast indicates that he has observed specimens beside the gravel road along electricity easements in the Anna Bay area and on clay soils on hills in Nelson Bay (G. Hillman, *pers comm*). It is listed as an endangered species threatened by urban development and given a conservation criteria of 2E (Jones, 1991). Briggs and Leigh (1995) list the species as 'vulnerable' with a risk code of 2VC-. The species is also listed on Schedule 2 ('vulnerable') of the TSC Act.

In the Tomaree Peninsula Landscape Study, Browne *et al.* (1986) recorded *Rulingia hermaniifolia* and *Prostanthera densa*, which are rated as 3RCa (rare, not threatened) and 3VC- (vulnerable) respectively by Briggs and Leigh (1995). *Prostanthera densa* is listed on Schedule 2 ('vulnerable') of the TSC Act, while *R. hermaniifolia* is not listed on the TSC Act.

Dawson and Prentice (1994) list five ROTAP species for the Port Stephens area:

- *Prostanthera densa*, rated by Briggs and Leigh (1995) as 3VC- ('vulnerable') and listed on Schedule 2 ('vulnerable') of the TSC Act;
- *Melaleuca groveana*, rated as 3RC- ('rare'), and listed on Schedule 2 ('vulnerable) of the TSC Act;
- *Tetratheca juncea*, rated as 3VCa ('vulnerable'), and listed on Schedule 2 ('vulnerable') of the TSC Act; and
- *Eucalyptus paniculata ssp. matutina*, rated as 2K ('poorly known'), but not listed on the TSC Act.

Dawson and Prentice (1994) also refer to *Spartothamnella juncea* as a ROTAP species, however this species is not listed in Briggs and Leigh (1995).

The Stockton Bight Environmental Study (HLA-Envirosciences, 1995) lists several orchid species recently identified in the Newcastle Bight area, being:

- *Caladenia hillmannii*
- *Caladenia* sp. aff. *carnea*
- *Caladenia* sp. aff. *quadrifaria*

- *Diuris* sp. aff. *punctata*
- *Pterostylis* sp. aff. *longifolia*
- *Pterostylis* sp. aff. *parviflora*

All of these species have limited distributions and some may be endemic to the Newcastle Bight area (HLA-Envirosciences, 1995). None of these species or the species to which they have affinities are listed by Briggs and Leigh (1995), nor are they listed on the TSC Act.

Chapter 4

ASSESSMENT OF CONSERVATION SIGNIFICANCE

4.1 CONSERVATION SIGNIFICANCE OF PLANT COMMUNITIES AND HABITATS WITHIN STUDY AREA

An assessment of the conservation value of plant communities and fauna habitats in the study area has been made using the following criteria:

- *representativeness* – whether the vegetation communities are unique, typical or common having regard to occurrence in the region. In addition, the criteria takes into account whether or not such vegetation units are presently held in reserves;
- the existence of *rare and restricted species* adds to an area's conservation value;
- the *degree of naturalness* is used to indicate the extent of human influence and to identify the condition of vegetation;
- the *presence of special natural features* is used to indicate uniqueness in that unusual natural features might be present which may not be associated with a particular vegetation unit;
- the *size* of the area has implications for the area's ability to absorb disturbance and its carrying capacity for fauna populations;
- *links* to other natural areas provide corridors for the dispersal of plants and animals and increase an area's significance; and
- *species richness* in local and regional contexts.

These criteria are considered below:

i. Representativeness

Approximately 25 per cent of the area covered by Option 1b contains native vegetation classified by HLA-Envirosciences (1995) as 'authentic remnant vegetation', whilst the vegetation along the remainder of the route has been

classified as 'physically disturbed vegetation', with a very small section of 'regenerating native vegetation'.

Authentic remnant vegetation is defined as vegetation which essentially retains the original floristic diversity, and has not been subject to substantial physical disturbance nor substantially affected by altered fire regime (HLA-Envirosciences, 1995).

Physically disturbed vegetation has been subject to severe disturbances such as numerous vehicular tracks, rubbish dumping and erosion. Disturbance is ongoing in most areas. Whilst these areas maintain a native canopy and many native species remain in the understorey, the physical disturbance has encouraged weed invasion, particularly by bitou bush (*Chrysanthemoides monilifera*) (HLA-Envirosciences, 1995).

Remnant native vegetation along Option 1b is dominated by *Eucalyptus pilularis-Angophora costata* open forest. This community dominates the relic dunes along the Newcastle Bight and occurs throughout the dune system of the Tomaree Peninsula, and the central and north coasts of New South Wales. In the local area, this community has been disturbed by mineral sand mining and by sand extraction operations along the dune system between Fern Bay and Anna Bay.

Within New South Wales, the *Eucalyptus pilularis - Angophora costata* open forest association occurs on coastal dunes on low nutrient soils along the north coast and central coast (Benson, 1989). On a statewide basis this association, in particular the understorey, has been altered by significant changes in the fire regime and pressures from mining development.

On a statewide basis the *Eucalyptus pilularis - Angophora costata* open forest association has an overall conservation risk code of N3, that is it is not threatened in the foreseeable future and is adequately conserved (Benson, 1989). Large tracts of this community are represented in local conservation reserves, namely Tomaree National Park and Myall Lakes National Park with smaller tracts in Glenrock State Recreation Area and Awabakal Nature Reserve. It is also well represented in conservation reserves on the central and north coast of New South Wales.

ii. Rare and Restricted Species

Two threatened species, the squirrel glider and little bent-wing bat, were recorded within the study area. Nine additional threatened species were considered likely to occur based on local records and habitat suitability (*Table 4*).

Several orchid species recorded in the Newcastle Bight area are newly discovered. The species concerned are *Caladenia hillmannii, Caladenia* sp. aff. *carnea, Caladenia* sp.

aff. *quadrifaria, Diuris* sp. aff. *punctata, Pterostylis* sp. aff. *longifolia* and *Pterostylis* sp. aff. *parviflora.* All of these species have limited distributions and some may be endemic to the Newcastle Bight and Tomaree Peninsula area (George Hillman *pers comm*). None of these species were recorded within the study area, although suitable habitat does occur, particularly in the more open habitats.

iii. Degree of Naturalness

Approximately 25 per cent of the vegetation Option 1b remains in a natural or near-natural condition, with disturbance generally confined to the areas of non-native and physically disturbed vegetation and 4WD tracks leading from Nelson Bay Road to Stockton Beach.

iv. Special Natural Features

The study area falls within the largest unvegetated coastal dune system in New South Wales (HLA-Envirosciences, 1995). The sand deposits within this dune system form a dual barrier system of transgressive dunes parallel to the shoreline. The Inner Barrier, which is of Pleistocene origin, occurs inland from Stockton Bight. The Outer Barrier, which is of Holocene origin, is two to three kilometres wide, forms the current sandy shoreline of Stockton Bight (HLA-Envirosciences, 1995) and is located approximately one kilometre to the south of Option 1b.

v. Size

The area of native vegetation to the south of Option 1b, which extends for many kilometres from Anna Bay in the north to Stockton in the south, is likely to support a diverse range of fauna, particularly mammals (both terrestrial and arboreal) and birds.

vi. Links

The open forest remnants along Option 1b are continuous with similar vegetation extending for many kilometres along Stockton Bight. The study area also forms part of the proposed Stockton Bight National Park. Extensive forested habitats occur to the south and west of Option 1b. It is therefore considered that the study area forms part of a significant movement corridor for terrestrial fauna in the local area.

vii. Species Richness

Option 1b falls within the Stockton (or Newcastle) Bight area which, according to the Stockton Bight Study, has a significantly high species richness (HLA-Envirosciences, 1995). The Stockton Bight Study lists 26 native mammal species, 8 introduced mammal species, 8 native frog species, 14 native reptile species (9 lizard species and 5 snake species), 93 native bird species and 4 introduced bird species. In a comprehensive study of the flora of the Port Stephens region, McNair (1992) lists 567 plant species, including 35 orchid species.

During fieldwork undertaken for Option 1b, nine native mammal species (including one bat species), one frog species, 22 native bird species, and 54 native plant species (including at least three orchid species) were recorded. The number of native flora and fauna species recorded during field surveys undertaken for Option 1b is only moderate when compared to more extensive studies, such as the Stockton Bight Study.

The field surveys for Option 1b were brief and were undertaken during winter, when native fauna are more difficult to detect (particularly microchiropteran bats and reptiles) and a large number of plants are not flowering or fruiting. In addition, the field surveys sample only a small part of the Stockton Bight area.

When compared to flora and fauna studies of a similar scope to that undertaken for Option 1b (*Table 3*), the number of species recorded is considered to be reasonable.

Table 3 SPECIES RICHNESS RECORDED IN OTHER STUDIES

Faunal Group	Mammals	Reptiles	Frogs	Birds	Plants
FLORA AND FAUNA STUDY					
Fanning (1995)	11	4	4	46	-
Bartrim and Martin (1991a)	14	6	6	35	169
Bartrim and Martin (1991b)	7	1	1	26	80
Gunninah Environmental Consultants (1997)	16	7	3	51	185
Clements and Associates (1992)	18	3	5	37	192
Mount King Ecological Surveys (1992a)	13	3	1	41	133
ERM Resource Planning (1994)	28	7	5	47	77
ERM Resource Planning (1995a)	6	1	1	29	90
ERM Resource Planning (1995b)	22	1	2	54	-

viii. Conclusion

Open forest remnants along Option 1b form part of an extensive and significant wildlife movement corridor in the eastern Stockton Bight area. The study area also falls within an area assessed Browne *et al* (1986) as having high species richness in terms of both flora and fauna. The forested habitats along Option 1b, particularly at the western end, contain significant nesting and sheltering resources for hollow-dependent fauna, particularly gliders and bats. In addition flowering banksias, wattles and eucalypts provide abundant foraging resources for species dependent on nectar and pollen. Despite obvious disturbances, such as the proximity of the existing Nelson Bay Road and bitou bush infestations at the eastern end of Option 1b, the vegetation is considered to be in good condition and reasonably representative of the original vegetation.

Chapter 5

THREATENED SPECIES ASSESSMENT

5.1 INTRODUCTION

The proposed widening of Nelson Bay Road from Bobs Farm to Anna Bay (Option 1b) extends for a length of approximately six kilometres. Removal of native vegetation will be required over approximately 25 per cent of the length of the road corridor (*Figure 3.1*).

The field surveys, database searches and literature review were designed to satisfy the requirements of the Threatened Species Conservation Act, 1995 (TSC Act). Schedules 1 and 2 of the TSC Act list species, populations or ecological communities of native flora and fauna considered to be threatened in New South Wales. The status of threatened species, populations or ecological communities were determined by a Scientific Committee as either:

- Endangered (Schedule 1); or
- Vulnerable (Schedule 2).

Two threatened animal species, the squirrel glider (*Petaurus norfolcensis*) and little bent-wing bat (*Miniopterus australis*), were recorded during field surveys undertaken for Option 1b. These two species have been included in the eight part test, along with an additional nine species assessed in *Table 4* as having a moderate to high likelihood of occurrence, on the basis of local records and suitability of habitat within the study area. For the purposes of this assessment, local records have been defined as those occurring within a radius of five kilometres from the study area. Local records were obtained from searches of the NPWS Atlas of NSW Wildlife and ROTAP database and a review of existing literature. No threatened populations or ecological communities currently listed on the TSC Act, 1995 were recorded, or considered likely to occur, within the study area. The impacts of the proposed road widening on threatened species are addressed in the eight part test following *Table 4*.

Table 4 ASSESSMENT OF LIKELIHOOD OF THREATENED SPECIES WITHIN THE STUDY AREA

Common/Scientific Name	Status	Occurrence in Port Stephens area	Likelihood of Occurrence in Study Area
HOLLOW-DEPENDENT BIRDS			
Glossy Black Cockatoo *Calyptorhynchus lathamii*	V	Tomago Sandbeds,[1] Salt Ash and near Fern Bay.[2]	Low. Preferred foraging habitat (*Allocasuarina* spp.)[3] scarce in study area. Nesting habitat (large tree hollows) is available, however the species is rarely recorded far from its preferred food resource .[3]
Powerful Owl *Ninox strenua*	V	Recorded along powerline easement between Bobs Farm and Anna Bay.[4]	High. Local record, suitable foraging habitat.
Masked Owl *Tyto novaehollandiae*	V	Fern Bay,[5] Medowie[6] and Nelson Bay.[1]	Moderate. Suitable foraging habitat along Option 1b, however there are no confirmed records for the local area.
OTHER BIRDS			
Bush Stone-curlew *Burhinus grallarius*	E	Taylor's Beach and Lemon Tree Passage.[1]	Low. Local records, however preferred habitat (lightly timbered open forest or woodland with a ground cover of short sparse grass and few, or no shrubs[7]) absent from study area. High fire frequency further reduces habitat suitability.
Wompoo Fruit-dove *Ptilinopus magnificus*	V	Corlette and Tomago Sandbeds.[1]	Low. Few local records, preferred habitat (rainforest)[8] absent from study area.
Superb Fruit-dove *Ptilinopus superbus*	V	Corlette[8]	Low. Few local records. Lives in rainforest but will feed in adjacent mangroves or eucalypt forest[9]. Rainforest absent from study area
Osprey *Pandion haliaetus*	V	Shoal Bay,[1] nesting pair at Hawks Nest.[10]	Low. Few local records. Suitable foraging habitat (brackish or salty water body)[11], absent from study area. Tall tree, usually dead but occasionally alive, commonly used as nest site[11]. No suitable nest sites found within study area.
Sooty Oystercatcher *Haematopus fuliginosus*	V	Boat Harbour[6]	Low. Preferred habitat (rocky intertidal shorelines, coral reefs or sandy beaches near intertidal mudflats)[12] absent from study area.

Common/Scientific Name	Status	Occurrence in Port Stephens area	Likelihood of Occurrence in Study Area
CAVE-ROOSTING BATS			
Common Bent-wing Bat *Miniopterus schreibersii*	V	Medowie[14]	Moderate. Records for Port Stephens. Suitable foraging habitat.
HOLLOW-DEPENDENT MAMMALS			
Brush-tailed Phascogale *Phascogale tapoatafa*	V	Boat Harbour, Anna Bay and Salamander Bay.[1]	Moderate. Local records (including one record within 1 km[1]). Suitable habitat.
Spotted-tailed quoll *Dasyurus maculatus*	V	Anna Bay to Boat Harbour[1]	Moderate. Several local records, including two records within 1 km[1] of northern end of deviation. Suitable habitat.
Greater Broad-nosed Bat *Scoteanax rueppellii*	V	Medowie[13,14] Fern Bay[15] and Tanilba Bay.[2]	Moderate to High. Local records, suitable habitat.
Yellow-bellied sheathtail-bat *Saccolaimus flaviventris*	V	Only 1 record for Port Stephens area, at Fern Bay[15].	Moderate. Lack of local records for the species. However, suitable habitat exists along Option 1b.
OTHER MAMMALS			
Koala *Phascolarctos cinereus*	V	Numerous records for the Port Stephens area, including a high number of records for the Bobs Farm/Anna Bay area.[1]	Moderate. High number of local records, however *potential* koala habitat was not identified in study area.
Eastern Chestnut Mouse *Pseudomys gracilicaudatus*	V	No known local records.	Low. No known local records. Suitable habitat (dense wet heathland on sand with thick sedges and grasses)[16] absent.
FROGS			
Red-crowned Toadlet *Pseudophyrne australis*	V	Australian Museum records for Port Stephens area.[17]	Low. Suitable habitat (sandstone areas with non-perennial creeks or gutters)[18] absent.
Green and Golden Bell Frog *Litoria aurea*	E	Records for Kooragang Island Nature Reserve.[1]	Low. No records for Port Stephens. Suitable habitat (permanent water[18] including dams and ponds with tall emergent vegetation eg *Typha* spp. and *Eleocharis* spp.[19] absent.

Common/Scientific Name	Status	Occurrence in Port Stephens area	Likelihood of Occurrence in Study Area
Wallum Froglet *Crinia tinnula*	V	Wetlands near pumping station[1] in study area. Salamander Bay.[20]	Low. Local records. Suitable habitat (wet heath, swamp forest and wallum sedgeland[21] absent from study area.
PLANTS			
Diuris praecox	V	Recorded along powerline easement from Bobs Farm to Anna Bay.[22,4]	Moderate. Local records. Suitable habitat, though regular slashing and mowing of road verge reduces habitat suitability.
Prostanthera densa	V	Gan Gan Hill, approximately 7 km north-east of study area.[1]	Low. Suitable habitat (sclerophyll forest and shrubland, on coastal headlands and near-coastal ranges, chiefly on sandstone)[23] absent from study area.
Melaleuca groveana	V	Fingal Bay/Shoal Bay area.[1]	Low. Suitable habitat (heath, often in exposed sites)[24] absent from study area.
Rulingia prostrata	E	Williamtown area[6]	Low. Preferred habitat (gullies along coastal escarpments)[25] absent from study area. No local records.
Eucalyptus camfieldii	V	Salt Ash area[6]	Low. Preferred habitat (coastal shrub heath on sandy soils on sandstone, often of restricted drainage) absent from study area.[24]
Tetratheca juncea	V	14 km north of study area, near North Arm Cove.[6]	Low. No local records. Preferred habitat (pH neutral clayey soils, derived from conglomerates located in dry sclerophyll open forest on the upper part of ridges with a southerly aspect, west through to east, with the most commonly associated tree species being *Angophora costata*, *Eucalyptus globoidea* and *E. gummifera*)[26] absent from study area.

Status as per Schedules 1 and 2 of TSC Act, 1995: E = Endangered; V = Vulnerable.

1 = NPWS Atlas of NSW Wildlife ; 2 = ERM Resource Planning (1994); 3 = Clout (1989); 4 = A. Finegan, ERM Mitchell McCotter, pers. obs.; 5 = ERM Mitchell McCotter (1995) ; 6 = M. Murray, Forest Fauna Surveys, pers. comm.; 7 = Marchant & Higgins (1993); 8 = Klippel (1992); 9 = Blakers et al (1984); 10 = N. Buchlhorn, ERM Mitchell McCotter, pers obs.; 11 = Clancy (1991); 12 = Smith (1991); 13 = Antcliff (1993); 14 = Glenn Hoye, FBN Bat Surveys, pers. comm.; 15 = Clements & Associates (1992); 16 = Fox (1991); 17 = Mt King Ecological Surveys (1994); 18 = Cogger (1992); 19 = Markwell & Knight (1986); 20 = Fanning (1995); 21 = Ferrier et al (undated); 22 = G. Hillman, pers comm.; 23 = Harden (1992); 24 = Harden (1991); 25 = Harden (1990); 26 = Norton (1994)

5.2 EIGHT PART TEST

The impact of Option 1b on threatened species has been assessed in accordance with section 5A of the Environmental Planning and Assessment Act, 1979, (EP&A Act) as amended by the Threatened Species Conservation Act, 1995 (TSC Act).

The assessment addresses the threatened fauna species recorded in the study area, together with the nine threatened fauna species considered to have a moderate to high likelihood of occurrence in the area. Threatened fauna species have been assessed in groups with similar ecological requirements. The assessment also addresses the threatened flora species *Diuris praecox*. The eight part test does not address the impact on *Caladenia hillmannii, Caladenia* sp. aff. *carnea, Caladenia* sp. aff. *quadrifaria, Diuris* sp. aff. *punctata, Pterostylis* sp. aff. *longifolia* and *Pterostylis* sp. aff. *parviflora,* as these species are not listed on the TSC Act and as such do not require assessment. A separate assessment for plant species of conservation significance not listed on the TSC Act has been provided in *Section 3.7.*

i) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

For the purposes of this assessment, a 'local population' is defined as the population which occurs within the study area. A 'viable' local population is that which has the capacity to live, develop and reproduce under normal conditions.

- Hollow-dependent birds

The powerful owl and masked owl were not recorded along Option 1b during fieldwork but were considered likely to occur, based on habitat suitability and records in the Port Stephens region.

The powerful owl and masked owl are dependent on mature trees with large hollows for roost and/or nest sites (Hollands, 1991; Debus and Chafer, 1994). These species are sensitive to a reduction in prey species associated with clearance of habitat. However, both species have large foraging territories and clearance for the road widening is not expected to significantly reduce foraging habitat within the local area.

Although the study area does contain a significant number of mature hollow-bearing trees, most of the hollows were considered too small to be used by large owls such as the powerful owl and masked owl. Nesting sites for the powerful owl are provided by large tree hollows along densely vegetated gullies (Debus and Chafer, 1994). No evidence of nesting or roosting sites was found during the survey. Potential

nesting/roosting habitat resources may occur in forest adjoining Option 1b. Hence, the proposed road widening is not likely to disrupt the life cycle of either species such that a local population will be placed at risk of extinction.

- Cave-roosting bats

The little bent-wing bat was recorded in the study area via echolocation call detection. The common bent-wing bat was not recorded but was considered likely to occur based on habitat suitability and regional records. In addition, Anabat detection was undertaken in winter when the species was likely to be inactive.

Both species are insectivorous bats which forage over forested habitats. They are dependent on caves, old mines, stormwater channels or similar structures for the provision of winter hibernation and summer maternity roost sites (Dwyer, 1995a, 1995b). No roost sites occur in the study area, however it is likely that the two species roost elsewhere and use the study area as part of a large home range. Clearance of a relatively small area of forested habitat is expected to have only a marginal impact on foraging resources for the common bent-wing bat and little bent-wing bat. Hence, Option 1b is not likely to disrupt the life cycle of either species such that a local population will be placed at risk of extinction.

- Hollow-dependent mammals

The squirrel glider was recorded at two locations approximately five kilometres apart, suggesting that at least two family groups or colonies occupy forested habitats along Option 1b. This species is an arboreal mammal dependent on mature trees with hollows for den sites, foraging on plant exudates and arthropods in open forest and woodland communities. The plant communities in which the species is typically found are characterised by gum-barked and winter flowering trees and *Acacia* species (Menkhorst *et al*, 1988).

Forested areas along Option 1b contain a high number of tree hollows suitable for use by the species. In addition, the tree and shrub species within the open forest habitats provide a year round supply of nectar, with *Acacia longifolia* (Sydney golden wattle) flowering winter to spring, *Angophora costata* (rusty gum) flowering spring to summer, *Eucalyptus pilularis* (blackbutt) flowering early summer and *Banksia serrata* (old man banksia) flowering summer to autumn.

In its current form, the western end of Option 1b may not pose a barrier to dispersal for the squirrel glider, which can glide for a distance of around 50 metres. A glider has been observed gliding across the powerline easement to the south of the study area, where the canopy is more open than at the western end of Option 1b. Hence, the width of the existing road may not present a barrier to movement for the species. However, disturbance effects from traffic (such as moving vehicles, noise and lights)

may deter the species from gliding across the road. If the species were to move across the existing road, increasing the width is likely to create a permanent barrier to squirrel gliders moving from the western side of the road to the eastern side.

Underpasses have been shown by various studies (for example, AMBS (1997), Finegan (1997), Fanning (1992), Hunt *et al.* (1987), Mansergh and Scotts (1989), Paskowski (1985) and Pieters (1992, 1993)) to work for a range of terrestrial species, but are significantly less effective for arboreal fauna, particularly gliders. Structures designed to assist passage of arboreal fauna over roads (for example, gliding poles) are still relatively untested.

Sugar gliders (*Petaurus breviceps*) have been successfully introduced into re-established habitat in southern Victoria and can inhabit young forest and woodland areas if nest boxes are provided (Suckling, 1995b). The squirrel glider is less able to adapt to altered habitats than its smaller relative (Suckling, 1995a) and may not survive the trauma of relocation to new habitat. At present, there appears to be no study documenting the successful relocation of squirrel gliders. Hence, trapping and relocating the species is not considered to be an effective measure for mitigating against direct impacts upon squirrel gliders within the study area.

Field surveys undertaken for this assessment did not identify den sites for the species. Such information requires further fieldwork in the form of radio-tracking and additional stagwatching. If den sites being used by the squirrel glider are located within the corridor of Option 1b, the proposed development is likely to disrupt the life cycle of a local squirrel glider population by:

- removing den sites;
- causing direct injury or mortality to individuals during vegetation clearance;
- removing high quality foraging habitat;
- subdividing the existing population into smaller less viable sub-populations;
- limiting the movement of dispersing individuals;
- modifying and/or restricting home ranges; and
- creating a permanent barrier to movement and genetic interchange.

Further fieldwork involving radio tracking and additional stagwatching is required before it can concluded whether the proposed development will or will not have a significant impact on a local squirrel glider population. If radio tracking determines that squirrel glider den sites are located outside the area to be disturbed by Option 1b, it is unlikely that the life cycle of the species will be disrupted. If den sites are

located within the route of Option 1b, the life cycle of the species is likely to be disrupted such that a local population is likely to be placed at risk of extinction.

The brush-tailed phascogale is largely arboreal, occupying a variety of habitats, however its preferred habitat is open dry sclerophyll forest with little ground cover, on ridges up to 600 metres altitude (Cuttle, 1983). The species nests in tree hollows with narrow entrances. Their diet consists mainly of arthropods, such as spiders and centipedes, as well as small invertebrates (Cuttle, 1983). The species will also forage on the ground and eucalypt nectar is extensively utilised when trees are flowering (Traill and Coates, 1993). This species was not recorded in the study area but was considered likely to occur based on the availability of suitable habitat and local records. Atlas of Wildlife records indicate that the brush-tailed phascogale has been recorded along Option 1b near Anna Bay cemetery. On the basis of habitat suitability, the species is considered more likely to occur on the southern side of Nelson Bay Road. Option 1b may remove potential nesting sites in the form of small tree hollows, which may disrupt the life cycle of the species.

The spotted-tailed quoll typically occurs in open forest where it will spend much of its time hunting arboreally and terrestrially (Jones, 1996). The species inhabits a wide range of habitats including rainforest, open forest, woodland, coastal heath and inland riparian forest (Edgar and Belcher, 1995). The spotted-tailed quoll utilises various den sites including caves, rock crevices and hollow logs (Edgar and Belcher, 1995). No evidence of the presence of this species (including scats or sightings during spotlighting) was recorded in the study area. Potential den sites (that is, hollow logs) were checked for evidence of use by the species. The spotted-tailed quoll does not appear to be utilising potential den sites within the study area.

Atlas of Wildlife records suggest there is a local population of the spotted-tailed quoll in the Anna Bay/Boat Harbour area. These records are currently under investigation in a study involving scat analysis and confirmation of the population is yet to be established (R. Gibbs, NPWS - Hunter District). If a spotted-tailed quoll population occurs in the Anna Bay/Boat Harbour area, it is considered that the proposed development will result in only a marginal reduction in potential foraging habitat for the species, which has a large home range (Mansergh, 1983). It is therefore considered that the proposed development is unlikely to disrupt the life cycle of the species such that a viable local population of spotted-tailed quoll is likely to be placed at risk of extinction.

The yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*) and greater broad-nosed bat (*Scoteanax rueppellii*) both require tree hollows as sites for diurnal roosting, winter hibernation and summer maternity, with the latter species also utilising the roof spaces of old buildings (Richards, 1983; Hoye and Richards, 1995).

Creeks and small rivers are favoured corridors for the greater broad-nosed bat where it hawks back and forth for its prey (Hoye and Richards, 1995). This bat is a large species requiring a greater feeding range than other insectivorous bat species. Little is known of its reproductive cycle other than a single young is born in January (Hoye and Richards, 1995).

The yellow-bellied sheathtail-bat prefers woodland and dry eucalypt habitats, including mallee in the west. It forages high above the canopy which possibly limits its detectability (Richards, 1983). Lack of knowledge of habitat and breeding requirements hinders assessment of impacts on the species however, the yellow-bellied sheathtail-bat is threatened by clearance of forested habitat.

Neither the yellow-bellied sheathtail-bat nor the greater broad-nosed bat was recorded in the study area using Anabat detection, however fieldwork was undertaken during winter when both species were likely to have been inactive. It is considered likely that both of these two species may occur within the study area, either to roost in tree hollows or to forage. If roosting sites for either of these two species do occur within the study area, the life cycle of the species concerned may be disrupted such that a local viable population is likely to be placed at risk of extinction. Further investigations during the warmer months (September to March) are required before a more conclusive assessment of the impact of Option 1b on the yellow-bellied sheathtail-bat and greater broad-nosed bat can be made.

- Koala

In New South Wales, the koala (*Phascolarctos cinereus*) is associated with several forage trees, including *Eucalyptus tereticornis* (forest red gum), *E. microcorys*, (tallowwood), *E. viminalis* (ribbon gum), *E. punctata* (grey gum), *E. camaldulensis* (river red gum), *E. robusta* (swamp mahogany), *Eucalyptus saligna* (Sydney blue gum), *E. pilularis* (blackbutt), *E. grandis* (flooded gum) and *E. propinqua* (small-fruited grey gum) (Reed *et al*, 1990).

The koala is typically a solitary animal, moving infrequently and living in a small area or group of trees within the available habitat for long periods or time (Mitchell, 1990). Estimates of home ranges in Victoria are 1.7 hectares for males and 1.18 hectares for females with extensive overlap (Mitchell, 1990). They occur in low densities and a breeding population may consist of as few as 5 or 6 individuals (Callaghan *et al*, 1994).

Although not directly observed along Option 1b, the koala was considered likely to occur, based on the high number of records for the Port Stephens area and the proximity of potential koala habitat (namely swamp forest containing swamp mahogany) along the powerline easement to the south of Option 1b and the

predominance of blackbutt, which koalas are known to feed on (Reed *et al*, 1990), along Option 1b.

Potential koala habitat was not identified along Option 1b, nor was any evidence of the presence of koalas found. It is therefore considered likely that Option 1b will not disrupt a local koala population such that it is likely to be placed at risk of extinction.

- *Diuris praecox*

Diuris praecox is a terrestrial herb which occurs on hills and slopes of near-coastal districts in open forests with a grassy to fairly dense understorey, endemic to central eastern New South Wales from Port Stephens to Ourimbah (Jones, 1991). The species has been recorded at various locations along the powerline easement to the south of Option 1b, predominantly on the northern side of the easement (G. Hillman, pers comm.). The species prefers open areas where it encounters less competition for sunlight (G. Hillman, pers. comm.). *Diuris praecox* was not identified within the study area during field surveys. Suitability of habitat within the grassy road verges is likely to be reduced by various impacts including regular mowing/slashing of the road verge for road maintenance purposes. It is considered unlikely that the life cycle of *Diuris praecox* would be disrupted such that a local population may be placed at risk of extinction.

ii) *In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the population is likely to be significantly compromised.*

No endangered population currently listed on the TSC Act was recorded, or is considered likely to occur, within the study area.

iii) *In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.*

In relation to the size of bushland remnants elsewhere within the Port Stephens area, the area of habitat to be removed or modified is not considered to be significant for the threatened fauna species identified, or considered likely to occur, within the study area. On a regional basis, the area of known or potential habitat to be removed or modified is even less significant. Option 1b is unlikely to represent loss of a significant area of habitat for *Diuris praecox* as there are no records of the species along the route.

Within the Port Stephens area, similar habitat is provided in remnant open forest largely in private ownership, recreational spaces or reserves. The long term security of these areas of habitat is not assured as areas are proposed for residential

development, road construction and facilities. The most substantial conservation reserve in the Port Stephens region is Tomaree National Park.

On a broader regional scale, the Port Stephens area falls within the overlap of two biogeographic regions being the New South Wales north coast and the Sydney Basin. The New South Wales north coast biogeographic region extends from approximately Port Stephens to the Queensland border. Five to ten per cent of the region is reserved (Thackway and Cresswell, 1995). The Sydney Basin biogeographic region extends from the Hunter River to south of Sydney with greater than ten per cent of the region reserved (Thackway and Cresswell, 1995). Significant areas of habitat similar to those within the study area occur in local and regional conservation reserves including Myall Lakes NP, Tomaree NP, Limeburners Creek Nature Reserve (NR), Booti Booti NP, Lake Innes NR, Limeburners Creek NR, Yuraygir NP, Broadwater NP and Barrington Tops NP. On a regional scale, vegetation clearance for Option 1b may not represent a loss of a significant area of habitat for threatened fauna.

iv) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

Option 1b will increase the isolation of habitats on the northern side of Nelson Bay Road from those on the southern side by increasing the width of the existing road corridor. In particular, Option 1b is likely to subdivide the existing squirrel glider population within the study area into smaller sub-populations permanently isolated from currently interconnecting areas of habitat. A glider has been observed gliding across the powerline easement south of Option 1b (A. Finegan, ERM Mitchell McCotter, pers obs.). The species is able to volplane for about 50 metres (Suckling, 1995a). At present, Nelson Bay Road may be of a width which does not prevent squirrel gliders gliding from one side of the road to the other, particularly at the western end of Option 1b where the canopy separation is not as great as along the powerline easement across which the species have been observed gliding. Option 1b would present a barrier to movement of the species across the road, by increasing the width of canopy clearance.

The powerful owl has been recorded within one kilometre of the western end of Option 1b, along the powerline easement located south of Nelson Bay Road (A. Finegan, ERM Mitchell McCotter, pers obs.). Option 1b is unlikely to isolate known habitat for this species, which is highly mobile and has a large home range. Option 1b is also unlikely to isolate potential habitat for common bent-wing bat, little bent-wing bat, greater broad-nosed bat and yellow-bellied sheathtail-bat, which are also wide-ranging and highly mobile species.

The nearest records of spotted-tailed quoll are in the Anna Bay/Boat Harbour area. Brush-tailed phascogale has been recorded near the Anna Bay cemetery and is considered likely to be occupying open forest habitat on the southern side of Nelson Bay Road. Nelson Bay Road already presents a barrier to movement for the brush-tailed phascogale and spotted-tailed quoll and isolates the above known areas of habitat from proximate areas of potential habitat. Widening the existing road corridor is not expected to significantly increase isolation of habitat for either of these two species.

v) Whether critical habitat will be affected.

At present, no register of critical habitat is maintained by the Director-General of the National Parks and Wildlife Service.

vi) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.

Within the Hunter region, several conservation reserves (such as national parks and nature reserves) and other areas which offer a degree of protection (such as state forests) contain known or potential habitat for those species known from, or considered likely to occur in, the study area. These areas include Myall Lakes NP, Tomaree NP, Booti Booti NP, Wallaroo SF, Karuah SF, Medowie SF, Bulahdelah SF, Myall River SF, Bachelor SF, Wallingat SF and Nerong SF. Myall Lakes NP and Tomaree NP in particular contain significant areas of *Eucalyptus pilularis-Angophora costata* open forest.

- Hollow dependent birds

On the lower north coast, the powerful owl has been recorded from Bulahdelah SF (ERM Mitchell McCotter, 1997b; SFNSW, 1996), the Myall Lakes and Forster areas (Recher, 1975), near Hallidays Point (T. Peake, pers. obs., 1996), Wallaroo SF (NSW Atlas of Wildlife; SFNSW, 1996), Karuah SF (NSW Wildlife Atlas) Wallingat SF, Bulahdelah SF, and Myall River SF, as well as private property adjacent to Craven and Karuah SFs (SFNSW, 1996). In the Hunter Valley, the species has been recorded from Mount Royal State Forest (Shields *et al.*, 1992), the ranges west of Wybong, and Cedar Brush Nature Reserve (HBOC, 1995).

The masked owl has been recorded in Myall River SF, Wallingat SF (SFNSW, 1996) and Bulahdelah SF (ERM Mitchell McCotter, 1997b).

- Cave-roosting bats

The little bent-wing bat and common bent-wing bat have been recorded in Bulahdelah SF (ERM Mitchell McCotter, 1997a; SFNSW, 1996), as well as Bachelor SF, Wallaroo SF, Myall River SF, Nerong SF and Wallingat SF (SFNSW, 1996). Roost sites are known from Bulahdelah Mountain, compartment 121 in Wang Wauk SF, Yacaaba headland and Balickera Tunnel near Wallaroo SF (SFNSW, 1996).

- Hollow-dependent mammals

The squirrel glider has been recorded in Myall River SF, Bulahdelah SF (ERM Mitchell McCotter, 1997a), Limeburners Creek NR near Port Macquarie (Quin, 1995) and Barrington Tops NP (Adam, 1987).

The brush-tailed phascogale has been recorded in Nerong State Forest, and is expected to occur within forests throughout the Bulahdelah Management Area (SFNSW, 1996).

The spotted-tailed quoll has been recorded in Bulahdelah SF (SFNSW, 1996; NPWS Wildlife Atlas), Myall River SF, Craven SF, Nerong SF, Wang Wauk, Wallaroo SF, Medowie SF and Wallingat SF (SFNSW, 1996).

Regional records for the greater broad-nosed bat are sparse. Known localities including Barrington Tops NP (Adam, 1987), Mount Royal SF (Shields *et al*, 1992), Thornton (Parnaby, 1994), Edgeworth (SWC, 1993b), Medowie (Glenn Hoye, pers comm) Fern Bay (Clements and Associates, 1992) and Tanilba Bay (Resource Planning, 1994).

The yellow-bellied sheathtail-bat has been recorded in the central lowlands of the Hunter Valley at Mount Arthur (Resource Planning, 1993) and near Cams Wharf, south of Swansea (G. Hoye, pers. comm.). The species is known from very few records at a limited number of localities in north-eastern New South Wales including Wingham Management Area and near Lismore (Mount King Ecological Surveys, 1992b).

- Koala

Conservation reserves within the Port Stephens area which contain either potential or core koala habitat include Tomaree NP, Moffats Swamp NR and Seaham Swamp NR. However, the koala does not appear to be adequately represented in such reserves, as the area of conserved koala habitat is considered by Callaghan *et al* (1994) to be too small and too fragmented on its own to conserve the koala population of Port Stephens.

Regional conservation reserves outside of Port Stephens from which the koala has been recorded include Wallingat SF, Bachelor SF, Sugar Creek Flora Reserve (FR), and O'Sullivans Gap FR (SWC, 1994), as well as Pokolbin SF, Heaton SF, Olney SF, Corrabare SF, Wyong SF and Watagan SF (Ecotone Ecological Consultants, 1995). NPWS Atlas of Wildlife records also indicate sightings in Yengo NP and Dharug NP (SFNSW, 1995).

Whilst habitat for the powerful owl, masked owl, brush-tailed phascogale, squirrel glider, spotted-tailed quoll, greater broad-nosed bat, yellow-bellied sheathtail-bat, little bent-wing bat, common bent-wing bat and koala would appear to be adequately conserved in the region, it is not known whether or not each species itself is adequately represented in regional conservation reserves. For example, the lack of data for the yellow-bellied sheathtail-bat in regional conservation reserves suggests this particular species is not adequately represented in such areas.

- *Diuris praecox*

Habitat for *Diuris praecox* appears to be represented in regional conservation reserves, such as Glenrock SRA and Tomaree NP. How adequately the species is represented in such areas is unknown, although the species is known from Glenrock SRA and is likely to occur within suitable habitat in Tomaree NP.

Briggs and Leigh (1995) have assigned a conservation code of 2VC- to *Diurus praecox*, meaning that the species:

- has a geographic range of less than 100 kilometres;
- is vulnerable (that is, the species is not presently endangered, but is at risk over a longer period of disappearing from the wild through continued depletion, or it occurs on land whose future use is likely to change and threaten its survival);
- has at least one population in a conservation reserve, however the reserved population size is not accurately known.

vii) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

At present, the only key threatening process listed on Schedule 3 of the TSC Act is predation by the fox (*Vulpes vulpes*). Predator species such as foxes are attracted to roads to feed on the carcasses of road kills (Bennett, 1991). Besides scavenging along the freeway, predator species may also use roadside habitat as areas to hunt in (Finegan, 1997). No evidence of foxes was recorded along the route of Option 1b, however the species has been recorded along the powerline easement from Bobs

Farm to Anna Bay. Widening the existing road corridor will increase the risk of injury and/or mortality to animals crossing the road, which in turn may contribute to an increase in fox predation in the local area by producing a higher number of road kills.

In general, the clearing of fauna habitat may be seen as a threatening process, for example the removal of mature hollow-bearing trees is considered a threat to hollow-dependent fauna such as gliders and owls. The clearing of understorey such as shrub species may also pose a threat, by removing foraging habitat for gliders and sheltering habitat for small ground-dwelling mammals and reptiles, and by encouraging weed invasion.

viii) Whether any threatened species or ecological community is at the limit of its known distribution.

- Powerful Owl

The powerful owl occurs in south-eastern Australia on the coastal side of the ranges from south-west Victoria to Yeppoon, Queensland, extending west to the Pilliga scrub (Garnett, 1992).

- Masked Owl

The masked owl typically occurs in forest and woodland in a broad coastal strip around southern Australia from Cooktown to Pilbara, Western Australia (Garnett, 1992). In New South Wales, the species is generally confined to the coastal side of the Dividing Range, but is also recorded inland along rivers from the Victorian to Queensland border (Garnett, 1992).

- Squirrel Glider

The squirrel glider occurs along the eastern coast of Australia from eastern South Australia to Cairns in northern Queensland (Klippel, 1992). In New South Wales, the species is patchily distributed along the Great Dividing Range, inland to the Pilliga and Coonabarabran, and along the coastal region from south of Sydney to the Queensland border (Austeco, 1994).

- Brush-tailed Phascogale

The brush-tailed phascogale is patchily distributed around the Australian coast in areas with a rainfall exceeding 500 millimetres (Cuttle, 1982).

- Little Bent-wing Bat

The little bent-wing bat occurs in the coastal ranges of eastern Australia from the central coast of New South Wales to Cape York in Queensland (Kennedy, 1990), hence a local population would be near the southern limit of the species' known distribution.

- Common Bent-wing Bat

The common bent-wing bat occurs along the coast and ranges from Cape York to Adelaide, northern Australia and Papua New Guinea, south-east Asia, Africa and Eurasia (Klippel, 1992). Two subspecies have been recognised in Australia: *M. schreibersii orianae* from north western Australia, and *M. schreibersii blepotis* from far eastern South Australia, southern Victoria, eastern NSW and eastern Queensland (Dwyer, 1969).

The species is widely distributed and common throughout eastern Australia from Cape York Peninsula, through eastern Queensland and NSW, Victoria to far eastern South Australia. In New South Wales, it is found from coastal areas to western slopes of the Dividing Range (Dwyer, 1969).

- Greater Broad-nosed Bat

A local population of the greater broad-nosed bat would not be at the limit of its known distribution, which extends along the coast from Maryborough in Queensland to Orbost in Victoria (Klippel, 1992).

- Yellow-bellied Sheathtail-bat

The yellow-bellied sheathtail-bat is widespread throughout New South Wales, Victoria and over northern Australia (Strahan, 1992). In New South Wales, the species is patchy distributed from the east coast to the central western districts, extending further west in the northern areas of the state (Austeco, 1994).

- Koala

The koala occurs in a scattered distribution along the east coast of Australia and inland areas from Eyre Peninsula to Townsville (Klippel, 1992). In New South Wales, the species occurs principally on the central and north coast, coastal ranges and adjacent slopes with scattered records on the north-west plains and south coast (Reed *et al*, 1990).

- Spotted-tailed quoll

The spotted-tailed quoll is present in Tasmania and occurs throughout eastern Australia from Maryborough in Queensland to Portland in Victoria (Klippel, 1992). A smaller subspecies occurs in northern Queensland in the Cairns area, and the species is now largely disjunct over its present range (Edgar and Belcher, 1995). The species' range approximates areas that receive a mean annual rainfall greater than 600 millimetres, with higher densities being present in Tasmania and north-eastern New South Wales (Mansergh, 1983). In New South Wales the species is widespread along the coast and ranges from the Victorian to the Queensland border. The New England Tablelands provides a refuge area for the species, harbouring higher population densities than elsewhere in the state (Mansergh, 1983).

- *Diuris praecox*

Diuris praecox is endemic to central eastern New South Wales from Port Stephens to Ourimbah (Jones, 1991). A local population of the species is therefore at the northern limit of its known distribution.

5.2.1 *Conclusion of Eight Part Test*

There are several mitigation measures which may reduce the impact of Option 1b on flora and fauna, such as restricting vegetation removal to the road corridor, gradual clearance of the road corridor to allow fauna to move into adjoining habitats, timing of vegetation clearance to avoid periods of critical habitat usage, and the use of underpasses to assist the passage of fauna from one side of the road to the other. However, even with the incorporation of such measures, it is still likely that there will be a significant impact on local flora and fauna.

The main findings of the eight part test are summarised as follows:

- individuals of squirrel glider identified along Option 1b may be both directly and indirectly affected;

- further fieldwork involving radio tracking and additional stagwatching is required to determine the location of squirrel glider den sites;

- if squirrel glider den sites are located along the route of Option 1b, the proposed development is likely to disrupt the life cycle of the species, which in turn is likely to significantly affect a local squirrel glider population;

- Option 1b will remove potential nesting sites for the brush-tailed phascogale in the form of small tree hollows, which may disrupt the life cycle of the species;

- echolocation calls of the yellow-bellied sheath-tailed bat and greater broad-nosed bat were not recorded in the study area, however fieldwork was undertaken during winter when the species were likely to have been inactive;
- the yellow-bellied sheath-tailed bat and greater broad-nosed bat may suffer a loss of roosting habitat in the form of hollows which could significantly disrupt the life cycle of each of these two species;
- some of the threatened species addressed in the eight part test are not adequately represented in conservation reserves and/or are at their limit of distribution in the Port Stephens area;
- Option 1b will increase the barrier formed by the existing Nelson Bay Road; and
- the route may indirectly contribute to an increase in fox predation (a key threatening process listed on the TSC Act) by providing increased road kills.

On the basis of the above findings it is recommended that further fieldwork involving radio tracking of squirrel gliders, stagwatching, arboreal trapping and bat surveys (including echolocation call analysis and possibly trapping) be undertaken so that a conclusive statement regarding the requirement for a Species Impact Statement can be made.

Appendix A

FLORA SPECIES LIST

PLANT SPECIES OBSERVED ALONG OPTION 1b.

The following list includes all vascular plant species observed along Option 1b. It should be noted that as the survey design comprises sampling of vegetation across the site within sampling quadrats and along transects, it is possible that some species have been inadvertently omitted.

i. Scientific/Common Names

Scientific names do not include authorities and follow Harden (1990, 1991, 1992 & 1993) and the revision of eucalypts by Hill and Johnson (1995). Common names follow Harden.

Introduced species are indicated by an asterisk (*).

Species listed as rare or threatened by Briggs and Leigh (1995)are indicated by their risk code and/or listed in the Threatened Species Conservation Act 1995, are indicated by 'E' for endangered (schedule 1) or 'V' for vulnerable (schedule 2).

Species not accurately identified are indicated by a question mark (?). These species have been identified as accurately as possible. With some specimens identification has been constrained by a lack of suitable flowering or fruiting material.

ii. Occurrence in study area

The species listed in the following table were recorded either in open forest only or within open forest and grassland along the road verge, with the exception of species marked with '(r)' which were only recorded in grassland along the road verge.

FAMILY/Scientific Name	Common Name
FILICOPSIDA	**Ferns**
DENNSTAEDTIACEAE	
Pteridium esculentum	Bracken
MAGNOLIOPSIDA	**Flowering Plants**
Magnoliidae	**Dicotyledons**
APIACEAE	
Centella asiatica	Pennywort
Platysace lanceolata	
ASTERACEAE	
* *Aster subulatus*	Wild Aster (r)
* *Bidens pilosa*	Cobbler's Pegs (r)

FAMILY/Scientific Name	Common Name
* *Chrysanthemoides monilifera* subsp. *rotundata*	Bitou Bush
* *Conyza albida*	Tall Fleabane (r)
* *Hypochaeris radicata*	Flatweed (r)
Senecio linearifolius	
* *Senecio madagascariensis*	Fireweed (r)
* *Tagetes minuta*	Stinking Roger (r)
* *Taraxacum officinale*	Dandelion (r)
BIGNONIACEAE	
Pandorea pandorana	Wonga Wonga Vine
Pandorea sp. (?)	
CAESALPINIODEAE	
Cassia brewsteri var. *marksiana*	
DILLENIACEAE	
Hibbertia fasciculata	
EPACRIDACEAE	
Leucopogon lanceolatus var. *gracilis*	
Monotoca elliptica	Tree Broom-heath
Monotoca scoparia	Prickly Broom-heath
Lissanthe strigosa	Peach Heath
EUPHORBIACEAE	
Glochidion ferdinandi	Cheese Tree
FABACEAE	
FABOIDEAE	
Aotus ericoides	Aotus
Bossiaea rhombifolia subsp. *rhombifolia*	
Desmodium varians	
Dillwynia retorta	
Glycine clandestina	Love Creeper
Glycine microphylla	
Hardenbergia violacea	False Sarsaparilla
Kennedia rubicunda	Red Kennedy Pea
* *Trifolium repens*	White Clover (r)

FAMILY/Scientific Name	Common Name
MIMOSOIDEAE	
Acacia decurrens	Black Wattle
Acacia longifolia var *longifolia*	Sydney Golden Wattle
Acacia longifolia var *sophorae*	Coast Wattle
Acacia suaveolens	Sweet Wattle
Acacia ulicifolia	Prickly Moses
Acacia decurrens	Black Wattle
HALORAGACEAE	
Gonocarpus teucrioides	Germander Raspwort
LAURACEAE	
Cassytha sp.	Devil's Twine
MALVACEAE	
* *Sida rhombifolia*	Paddy's Lucerne
MYRTACEAE	
Angophora costata	Smooth-barked Apple
Eucalyptus pilularis	Blackbutt
Leptospermum sp.	
Melaleuca quinquenervia	Broad-leaved Paperbark
OXALIDACEAE	
* *Oxalis corniculata*	Creeping Oxalis
PITTOSPORACEAE	
Billardiera scandens	Appleberry
PLANTAGINACEAE	
* *Plantago major*	Large Plantain (r)
PRIMULACEAE	
* *Anagallis arvensis*	Scarlet Pimpernel
PROTEACEAE	
Banksia serrata	Saw-toothed Banksia
Persoonia levis	Broad-leaf Geebung

FAMILY/Scientific Name	Common Name
RANUNCULACEAE	
Clematis aristata	
RUBIACEAE	
Pomax umbellata	Pomax
SAPINDACEAE	
Dodonaea triquetra	Large-leaf Hop-bush
SMILACACEAE	
Smilax australis	Sarsaparilla
THYMELAEACEAE	
Pimelea linifolia subsp. *linifolia*	Slender Rice-flower
TREMANDRACEAE	
Tetratheca thymifolia	Black-eyed Susan
Liliidae	**Monocotyledons**
CYPERACEAE	
Cyperus sp.	
LOMANDRACEAE	
Lomandra longifolia	Spiny-headed Mat-rush
LUZURIAGACEAE	
Eustrephus latifolius	Wombat Berry
ORCHIDACEAE	
Acianthus exsertus	Mosquito Orchid
Acianthus sp.	
Microtis sp.	Onion Orchid (r)
Pterostylis sp.	Greenhood
PHORMIACEAE	
Dianella caerulea var. *producta*	Blue Flax Lily

FAMILY/Scientific Name	Common Name
POACEAE	
Cynodon dactylon	Common Couch (r)
* *Ehrharta erecta*	Panic Veldtgrass
* *Eleusine tristachya*	
Entolasia stricta	Wiry Panic
Imperata cylindrica var. *major*	Blady Grass
* *Pennisetum clandestinum*	Kikuyu Grass
* *Rhynchelytrum repens* (?)	Red Natal Grass
* *Stenotaphrum secundatum*	Buffalo Grass
Tetrarrhena juncea (?)	Wiry Ricegrass
Themeda australis	Kangaroo Grass

Appendix B

FAUNA SPECIES LIST

FAUNA SPECIES RECORDED ALONG OPTION 1B AND IN THE REGION

The following list includes all species of birds, mammals, reptiles and frogs observed in the study area and in the Port Stephens region. These records are based on field observations, literature searches and review of the NSW National Parks and Wildlife Service wildlife database search for the Newcastle and Port Stephens 1:100,000 map sheets.

i. Scientific and Common Names

Scientific names for each fauna assemblage are in accordance with the following references:

- Birds — Christidis and Boles (1994)
- Mammals — Strahan (1995)
- Reptiles — Cogger (1992)
- Amphibians — Cogger (1992)

Introduced species are indicated by an asterisk (*)

ii. Status

The status of fauna species follows:

- Birds — Hunter Birds Observers Club (1994)
- Mammals — Strahan (1992)
- Reptiles — Ehmann (1992)
- Amphibians — Tyler (1992)

Definitions used to describe the status of birds are adopted from HBOC (1994):

c	common	species that are usually located on all visits to suitable habitat.
u	usual	likely to be found on most visits in suitable habitat.
re	resident	recorded in all months.
m	migrant	species arrives in an area for a period then departs.
l	local	species recorded in only a few favoured localities.
bop	bird of passage	species present for a short period, but may be observed in any period of the year.
v	visitor	pelagic species present around coastal parts of the region on a regular basis.
r	rare	species recorded less than 10 times in one year.

a	accidental	species recorded less than once per year, on average.
b	breeding	definite evidence of the species breeding in the region.

Definitions used to describe the status of mammals, reptiles and amphibians are adopted from Strahan (1992); Ehmann (1992) and Tyler (1992) respectively:

pre	presumed extinct	no confirmation of the existence of the species in the wild for 50 years or more.
poe	possibly extinct	infrequently located that existence of species in the wild has not been confirmed for up to 50 years.
e	endangered	declining in distribution and abundance, species may become extinct with continuing threatening processes.
pe	possibly endangered	declining in distribution and abundance, but foreseeable pressures could put species at risk.
v	vulnerable	currently of satisfactory distribution and abundance, but foreseeable pressures could place the species at risk.
s	secure	no existing or foreseeable threat to continuance of the species.
ps	probably secure	probably as secure, but insufficient data to be certain.

iii. Conservation Status

Conservation status is according to the Threatened Species Conservation Act, 1995, as follows:

E Endangered (Schedule 1, Part 1);
X Presumed Extinct (Schedule 1, Part 4); and
V Vulnerable (Schedule 2).

Species listed in migratory bird treaties are also indicated as per the following key:

J JAMBA treaty
C CAMBA treaty

iv. Records

❑ Records in the Study Area

How the species was recorded is indicated using the following key:

ac	identified from audible call
o	observed directly
s	observed by spotlight search
ec	detected by echolocation call analysis
i	identified from indirect evidence (scats, scratch marks, hair sample, diggings)

l	reported in the study area by local residents ('?' indicates record under question, for example record out of species' known range and/or lack of suitable habitat within study area)
x	considered likely to occur based on habitat available and distribution.
❑	Regional records
1	NSW National Parks and Wildlife Service Atlas of Wildlife database search (Newcastle and Port Stephens 1:100,000 map sheets)
2	Shortland Wetlands Centre (1992)
3	Shortland Wetlands Centre (1993a)
4	Mount King Ecological Surveys (1992)
5	Mount King Ecological Surveys (1990)
6	Envirosciences (1994)
7	Mount King Ecological Surveys (1991)
8	ERM Resource Planning (1995a)

FAMILY Scientific Name	Common Name	Status in Hunter	Cons Status	Record in Area	Regional Record
i. Birds					
PHASIANIDAE					
Coturnix pectoralis	Stubble Quail	r		-	7
Coturnix sp.	Quail			x,l	
ANATIDAE					
Anas superciliosa	Pacific Black Duck	c,b,re		x	1,6
Chenonetta jubata	Australian Wood Duck	c,b,re		x	1,2
Cygnus atratus	Black Swan	c,b,re		-	1
PODICIPEDIDAE					
Tachybaptus novaehollandiae	Australasian Grebe	c,b.re		-	6
ANHINGIDAE					
Anhinga melanogaster	Darter	u,b,re		-	1
PHALACROCORACIDAE					
Phalacrocorax carbo	Great Cormorant	c,b,re		-	1
Phalacrocorax melanoleucos	Little Pied Cormorant	c,b,re		-	1
Phalacrocorax sulcirostris	Little Black Cormorant	c,b,re		-	1
Phalacrocorax varius	Pied Cormorant	u,re		-	1
PELECANIDAE					
Pelecanus conspicillatus	Australian Pelican	c,b,re		-	1
ARDEIDAE					
Egretta novaehollandiae	White-faced Heron	c,b,re		-	1,5
Egretta sacra	Eastern Reef Egret	r	C	-	1
THRESKIORNITHIDAE					
Platalea regia	Royal Spoonbill	u,re		-	1
ACCIPITRIDAE					
Pandion haliaetus	Osprey	l,b,re	V	-	1
Aviceda subcristata	Pacific Baza	l,b,re		-	1
Elanus axillaris	Black-shouldered Kite	u,b,re		x	1,6
Haliastur sphenurus	Whistling Kite	c,b,re		x,l	1,6,7
Haliastur indus	Brahminy Kite	l,re		-	1
Haliaeetus leucogaster	White-bellied Sea-eagle	u,b,re	C	x,l	1,2,3
FALCONIDAE					
Falco berigora	Brown Falcon	b,re		x	1
Falco cenchroides	Nankeen Kestrel	u,b,re		x	1

Key:
Status in Hunter Region: c = common; u = usual; re = resident; m = migrant; l = local; v = visitor; bop = bird of passage; r = rare; a = accidental; b = breeding
Conservation Status: E = Endangered; V = Vulnerable; X = Presumed Extinct (TSC Act, 1995 Schedules 1 and 2); J = JAMBA; C = CAMBA (Migratory bird treaties)
Record in Study Area: ac = audible call; o = observed; tt = trapped in tree trap; s = spot-light; ec = echolocation call; i = indirect evidence; l = reported in the study area by local residents; (?) = record under question; x = expected to occur; - = not expected to occur
Regional Record: 1 = NPWS Atlas of NSW Wildlife database search for Newcastle and Port Stephens 1:100 000 map sheets, 2 = SWC (1992); 3 = SWC (1993); 4 = Mount King Ecological Surveys (1992); 5= Mount King Ecological Surveys (1990); 6 = Environsciences (1994); 7 = Mount King Ecological Surveys (1991); 8 = ERM Resource Planning (1995a)

FAMILY Scientific Name	Common Name	Status in Hunter	Cons Status	Record in Area	Regional Record
RALLIDAE					
Porphyrio porphyrio	Purple Swamphen	c,b,re		-	1
SCOLOPACIDAE					
Numenius madagascariensis	Eastern Curlew	c,m	J	-	1
BURHINIDAE					
Burhinus grallarius	Bush Stone-curlew	l,b,re	E	x	1
HAEMATOPODIDAE					
Haematopus fuliginosus	Sooty Oystercatcher	l,re	V	-	1
CHARADRIIDAE					
Vanellus miles	Masked Lapwing	c,b,re		ac	1
LARIDAE					
Larus novaehollandiae	Silver Gull	c,b,re		-	1,5
Sterna bergii	Crested Tern	c,re		-	1
Chlidonias hybridus	Whiskered Tern	r,bop			1
COLUMBIDAE					
* *Streptopelia chinensis*	* Spotted Turtle-Dove	c,b,re		x	2,3,6,7,8
Ocyphaps lophotes	Crested Pigeon	c,b,re		x	1,6,7
Geopelia striata	Peaceful Dove	re		x	6
Geopelia humeralis	Bar-shouldered Dove	u,re		x	6
Leucosarcia melanoleuca	Wonga Pigeon	u,re		x	1
Ptilinopus magnificus	Wompoo Fruit-Dove	l,re	V	-	1
CACATUIDAE					
Calyptorhynchus lathami	Glossy Black-cockatoo	re	V	l(?)	1
Calyptorhynchus funereus	Yellow-tailed Black-cockatoo	u,re		x	1,2,7
Callocephalon fimbriatum	Gang-gang Cockatoo	b,re		-	1
Cacatua roseicapilla	Galah	c,b,re		ac	1,2,6,7,8
Cacatua galerita	Sulphur-crested Cockatoo	c,b,re		x	1,6,7
PSITTACIDAE					
Trichoglossus haematodus	Rainbow Lorikeet	u,re		x	2,3
Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet	u,re		x	2,6
Glossopsitta pusilla	Little Lorikeet	re		x	7
Platycercus elegans	Crimson Rosella	u,re		x	1,8
Platycercus eximius	Eastern Rosella	c,b,re		o	1,2,3,6,7

Key:
Status in Hunter Region: c = common; u = usual; re = resident; m = migrant; l = local; v = visitor; bop = bird of passage; r = rare; a = accidental; b = breeding
Conservation Status: E = Endangered; V = Vulnerable; X = Presumed Extinct (TSC Act, 1995 Schedules 1 and 2); J = JAMBA; C = CAMBA (Migratory bird treaties)
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FAMILY Scientific Name	Common Name	Status in Hunter	Cons Status	Record in Area	Regional Record
CUCULIDAE					
Cacomantis variolosus	Brush Cuckoo	m		x	1,8
Cacomantis flabelliformis	Fan-tailed Cuckoo	c,?re		ac	2,3,7
Eudynamys scolopacea	Common Koel	u,b,m		x	1,6
Scythrops novaehollandiae	Channel-billed Cuckoo	c,b,m		x	1
CENTROPODIDAE					
Centropus phasianinus	Pheasant Coucal	b,re		x,l	6
STRIGIDAE					
Ninox strenua	Powerful Owl	r	V	x	1
Ninox novaeseelandiae	Southern Boobook	re		x	1,8
TYTONIDAE					
Tyto novaehollandiae	Masked Owl	r	V	x,l	1
Tyto capensis	Grass Owl	r	V	l(?)	-
PODARGIDAE					
Podargus strigoides	Tawny Frogmouth	re		ac,l	1,3,7,8
ALCEDINIDAE					
Alcedo azurea	Azure Kingfisher	u,b,re		-	4
HALCYONIDAE					
Dacelo novaeguineae	Laughing Kookaburra	c,b,re		o,l	1,2,3,6,7,8
Todiramphus sanctus	Sacred Kingfisher	u,b,m		x	1
MEROPIDAE					
Merops ornatus	Rainbow Bee-eater	b,m	J	x	6
CORACIIDAE					
Eurystomus orientalis	Dollarbird	b,m		x	6
MENURIDAE					
Menura novaehollandiae	Superb Lyrebird	c,b,re		l(?)	1
CLIMACTERIDAE					
Cormobates leucophaeus	White-throated Treecreeper	c,b,re		x	1,2,7,8
MALURIDAE					
Malurus cyaneus	Superb Fairy-wren	c,b,re		ac	1,2,6,7,8
Malurus lamberti	Variegated Fairy-wren	u,re		x	1,3
PARDALOTIDAE					

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FAMILY Scientific Name	Common Name	Status in Hunter	Cons Status	Record in Area	Regional Record
Pardalotus punctatus	Spotted Pardalote	c,b,re		x	1,2,3,6,7, 8
Sericornis frontalis	White-browed Scrubwren	c,b,re		x	1,3,6,7
Smicrornis brevirostris	Weebill	b,re		o	1
Gerygone mouki	Brown Gerygone	u,b,re		x	1
Acanthiza pusilla	Brown Thornbill	c,b,re		o	1,2,7,8
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	u,b,re		x	2,3
Acanthiza nana	Yellow Thornbill	u,b,re		x	6,7
Acanthiza lineata	Striated Thornbill	u,b,re		x	1,3,7
MELIPHAGIDAE					
Anthochaera carunculata	Red Wattlebird	b,re		ac	1
Anthochaera chrysoptera	Little Wattlebird	c,b,re		o	3,7,8
Philemon corniculatus	Noisy Friarbird	b,re		x	1,2
Manorina melanocephala	Noisy Miner	c,b,re		o	1,6,7
Meliphaga lewinii	Lewin's Honeyeater	c,re		ac	1,2
Lichenostomus chrysops	Yellow-faced Honeyeater	c,b,m		x	1,3,6,7,8
Lichenostomus leucotis	White-eared Honeyeater	re		x	1
Lichenostomus melanops	Yellow-tufted Honeyeater	b,re		x	8
Melithreptus lunatus	White-naped Honeyeater	u,b,re		x	1
Phylidonyris novaehollandiae	New Holland Honeyeater	re		x	1,3
Phylidonyris nigra	White-cheeked Honeyeater	re		x	1,3,7
Acanthorhynchus tenuirostris	Eastern Spinebill	u,b,re		ac	2,3,6,8
Myzomela sanguinolenta	Scarlet Honeyeater	b,re		x	1
PETROICIDAE					
Microeca fascinans	Jacky Winter	u,b,re		ac	1
Eopsaltria australis	Eastern Yellow Robin	c,b,re		x	1,2
CINCLOSOMATIDAE					
Psophodes olivaceus	Eastern Whipbird	c,b,re		x	1,2,3,8
PACHYCEPHALIDAE					
Oreoica gutturalis	Crested Bellbird	a		-	1
Pachycephala pectoralis	Golden Whistler	c,re		x	1,2,7,8
Pachycephala rufiventris	Rufous Whistler	c,b,m		x	1,6
Colluricincla harmonica	Grey Shrike-thrush	c,b,re		x	1,2,3,6
DICRURIDAE					

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FAMILY Scientific Name	Common Name	Status in Hunter	Cons Status	Record in Area	Regional Record
Monarcha melanopsis	Black-faced Monarch	u,b,m		x	1
Monarcha trivirgatus	Spectacled Monarch	r		-	1
Myiagra cyanoleuca	Satin Flycatcher	r		-	1
Myiagra inquieta	Restless Flycatcher	re		-	7
Grallina cyanoleuca	Magpie-lark	c,b,re		o	1,6,7
Rhipidura rufifrons	Rufous Fantail	u,b,m		x	1
Rhipidura fuliginosa	Grey Fantail	c,b,re		x	1,2,3,6,7,8
Rhipidura leucophrys	Willie Wagtail	c,b,re		x	1,3,6,7,8
Dicrurus bracteatus	Spangled Drongo	m,bop		x	1
CAMPEPHAGIDAE					
Coracina novaehollandiae	Black-faced Cuckoo-shrike	c,b,re		o	1,2,3,6,7,8
Coracina tenuirostris	Cicadabird	b,m		x	1,3
Lalage sueurii	White-winged Triller	m		x	6
ORIOLIDAE					
Oriolus sagittatus	Olive-backed Oriole	u,b,re		x	1
ARTAMIDAE					
Artamus leucorynchus	White-breasted Woodswallow	b,re		x	1
Artamus cyanopterus	Dusky Woodswallow	b,re		x	6,7
Cracticus torquatus	Grey Butcherbird	c,b,re		ac	2,7,8
Cracticus nigrogularis	Pied Butcherbird	u,re		-	3,6,7
Gymnorhina tibicen	Australian Magpie	c,b,re		o	2,3,6,7
Strepera graculina	Pied Currawong	c,b,re		o	1,2,3,7,8
CORVIDAE					
Corvus coronoides	Australian Raven	c,b,re		o	1,2,3,5,6,7,8
CORCORACIDAE					
Corcorax melanorhamphos	White-winged Chough	u,b,re		x	1
PTILONORHYNCHIDAE					
Ptilinorhynchus violaceus	Satin Bowerbird	u,b,re		x	1
PASSERIDAE					
Neochemia temporalis	Red-browed Finch	u,b,re		o	2,3,8

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FAMILY Scientific Name	Common Name	Status in Hunter	Cons Status	Record in Area	Regional Record
Lonchura castaneothorax	Chestnut-breasted Mannikin	l,re		-	6
DICAEIDAE					
Dicaeum hirundinaceum	Mistletoebird	b,re		-	1,3
HIRUNDINIDAE					
Hirundo neoxena	Welcome Swallow	c,b,re		x	1,3,7,8
Hirundo nigricans	Tree Martin	re		x	1
Hirundo ariel	Fairy Martin	b,m		x	6
ZOSTEROPIDAE					
Zosterops lateralis	Silvereye	c,re,m		x	1,2,3,6,7

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FAMILY Scientific Name	Common Name	Status Aust	Status NSW	Record in Area	Regional Record
ii. Mammals					
ACROBATIDAE					
Acrobates pygmaeus	Feather-tail Glider	s		x	1
CANIDAE					
* *Canis familiaris*	* Dog	s		o	2,7
Canis lupus dingo	Dingo	s		x	1
* *Vulpes vulpes*	* Fox	s		x	6
DASYURIDAE					
Antechinus flavipes	Yellow-footed Antechinus	s		-	2,6
Antechinus stuartii	Brown Antechinus	s		x	1,4,6,8
Dasyurus maculatus	Spotted-tailed (Tiger) Quoll	ps	V	x	1
Phascogale tapoatafa	Brush-tailed Phascogale	ps	V	x,l(?)	1
Sminthopsis murina	Common Dunnart	s		x	1,7
EMBALLONURIDAE					
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	ps	V	x	x
LEPORIDAE					
* *Lepus capensis*	* Brown Hare	s		l	
MACROPODIDAE					
Macropus giganteus	Eastern Grey Kangaroo	s		i,l	1,4
Macropus rufogriseus	Red-necked Wallaby	s		i,l	1,4
Thylogale stigmatic	Red-legged Pademelon	s	V	l(?)	
Wallabia bicolor	Swamp Wallaby	s		i,l	1,4
MOLOSSIDAE					
Nyctinomus australis	White-striped Freetail-bat	s		x	1
MURIDAE					
Hydromys chrysogaster	Water-rat	s		-	1
* *Mus musculus*	* House Mouse	s		x	4
Pseudomys novaehollandiae	New Holland Mouse	s		x	1,4,6,8
Rattus fuscipes	Bush Rat	s		x	1,2,4,7
Rattus lutreolus	Swamp Rat	s		x	1,3,4,7
* *Rattus rattus*	* Black Rat	s		x	4,8
PERAMELIDAE					
Isoodon macrourus	Northern Brown Bandicoot	s		i,l	7
Perameles nasuta	Long-nosed Bandicoot	s		i	1,7

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FAMILY Scientific Name	Common Name	Status Aust	Status NSW	Record in Area	Regional Record
PETAURIDAE					
Petaurus australis	Yellow-bellied Glider	s	V	-	1
Petaurus breviceps	Sugar Glider	s		x,l	1,3,7,8
Petaurus norfolcensis	Squirrel Glider	s	V	s,l	1,8
Petaurus sp.				s	
Pseudocheirus peregrinus	Common Ringtail Possum	s		s,l,i	1,2,3,4,6,8
PHALANGERIDAE					
Trichosurus vulpecula	Common Brushtail Possum	s		s,l,i	1,3,4,6,7
PHASCOLARCTIDAE					
Phascolarctos cinereus	Koala	s	V	x	1,4,6,7
PTEROPODIDAE					
Pteropus poliocephalus	Grey-headed Flying-fox	s		x	1
Pteropus scapulatus	Little Red Flying-fox	s		x	1
Pteropus sp.	Flying-fox			l	1
TACHYGLOSSIDAE					
Tachyglossus aculeatus	Short-beaked Echidna	s		x,l	1
VESPERTILIONIDAE					
Chalinolobus gouldii	Gould's Wattled Bat	s		x	1
Chalinolobus morio	Chocolate Wattled Bat	s		x	1
Miniopterus australis	Little Bent-wing Bat	s	V	ec,l	1
Miniopterus schreibersii	Common Bent-wing Bat	s	V	x	1
Nyctophilus geoffroyi	Lesser Long-eared Bat				1
Nyctophilus gouldi	Gould's Long-eared Bat	s		x	1
Scoteanax rueppellii	Greater Broad-nosed Bat	s	V	x,l	1
Scotorepens orion	Eastern Broad-nosed Bat	s		x	1
Vespadelus vulturnus	Little Forest Bat	s		x	1
VOMBATIDAE					
Vombatus ursinus	Common Wombat	s		x	1
iii. Reptiles					
AGAMIDAE					
Amphibolurus muricatus	Jacky Lizard	s		x	1,3
Chlamydosaurus kingii	Frilled Lizard			l(?)	-

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FAMILY Scientific Name	Common Name	Status Aust	Status NSW	Record in Area	Regional Record
Pogona barbata	Bearded Dragon	s		x	1
BOIDAE					
Morelia spilota ssp. spilota	Diamond Python	s		x	1,4
ELAPIDAE					
Hemiaspis signata	Black-bellied Snake	s		x	1
Pseudechis porphyriacus	Red-bellied Black Snake	s		x	1
Pseudonaja textilis	Eastern Brown Snake	s		x	1
SCINCIDAE					
Ctenotus robustus	Striped Skink	s		x	1,6
Ctenotus taeniolatus	Copper-tailed Skink	s		x	1,3,6
Egernia major	Land Mullet	s		x	1
Eulamprus tenuis	Barred-side Skink			x	1
Lampropholis delicata	Grass Skink	s		x	1,3,8
Lampropholis guichenoti	Garden Skink	s		x	1
Saiphos equalis	Three-toed Skink	s		x	1
Sphenomorphus tenuis	Bar-sided Forest-skink	s		x	1,3
Tiliqua scincoides	Eastern Blue-tongued Lizard	s		x,l	1
Trachydosaurus rugosus	Shingleback Lizard	s		-	1
VARANIDAE					
Varanus varius	Lace Monitor	s		x	1,6
iv. Amphibians					
HYLIDAE					
Litoria fallax	Eastern Dwarf Tree Frog	s		-	1
Litoria jervisiensis	Jervis Bay Tree Frog	s		-	1,2
Litoria latopalmata	Broad Palmed Frog	s		-	1
Litoria peronii	Peron's Tree Frog	s		-	1
Litoria tyleri	Tyler's Tree Frog	s		-	1
MYOBATRACHIDAE					
Adelotus brevis	Tusked Frog	s		x	1
Crinia signifera	Common Eastern Froglet	s		ac	1,2,3,4
Crinia tinnula	Wallum Froglet	s	V	-	1
Limnodynastes ornatus	Ornate Burrowing Frog	s		x	6
Limnodynastes peronii	Brown-striped Frog	s		x	1,2

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FAMILY Scientific Name	Common Name	Status Aust	Status NSW	Record in Area	Regional Record
Pseudophryne bibronii	Brown Toadlet	s		x	1
Pseudophryne coriacea	Red-backed Toadlet	s		x	1,2
Uperoleia laevigata	Smooth Toadlet	s		x	1,2

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Appendix D-2

SQUIRREL GLIDER RADIO-TRACKING SURVEY

FOREST FAUNA SURVEYS

1.0 INTRODUCTION

Port Stephens Council propose to upgrade Nelson Bay Road to a dual lane carriageway over a 6.7 kilometre length of the road from Bob's Farm to Anna Bay. The upgrade commences 1.9 kilometres south-east of Marsh Road intersection, and linking into the existing dual lane carriageway at Port Stephens Drive roundabout at Anna Bay. The road corridor would be a maximum of 40 metres wide including the existing road.

Previous fauna surveys of the proposed route have recorded the presence of Squirrel Glider (*Petaurus norfolcensis*), listed as 'Vulnerable' on Schedule Two of the Threatened Species Conservation Act 1995. This study was commissioned to locate populations of Squirrel Glider along the proposed route, and also determine locations of den trees utilised by the species within, or in proximity to the road corridor.

The objective of this study was to capture one individual from four separate sites along the proposed route, and fit each individual with a collared radio transmitter for subsequent monitoring. Following release of the glider at the point of capture, each glider was to be located by radio tracking on 10 separate days, recording the location of den trees in proximity to the proposed road footprint.

2.0 METHODOLOGY

Four sites were selected along the proposed road corridor to sample for Squirrel Glider. Sites were selected in remnant forest containing habitat for the species. The locations of each sample site is presented in *Table 1.* and *Figure 1.* Survey sites can be located by reference to the 1:25,000 topographic map, Morna Point (9332-3N) (Central Mapping Authority, Land Information Centre, Panorama Avenue, Bathurst).

Table 1. Locations of Survey Sites on Nelsons Bay Road.

Site Number	AMG Zone	Easting	Northing
1	56	406500	6372800
2	56	406750	6372900
3	56	410250	6373600
4	56	411500	6373700

2.1 Arboreal Trapping

At each site, Elliott B traps (15 x 16 x 45 cm) traps were positioned on platforms and attached to trees at a height of approximately 2.5 metres. Each trap was baited with a mixture of peanut butter,

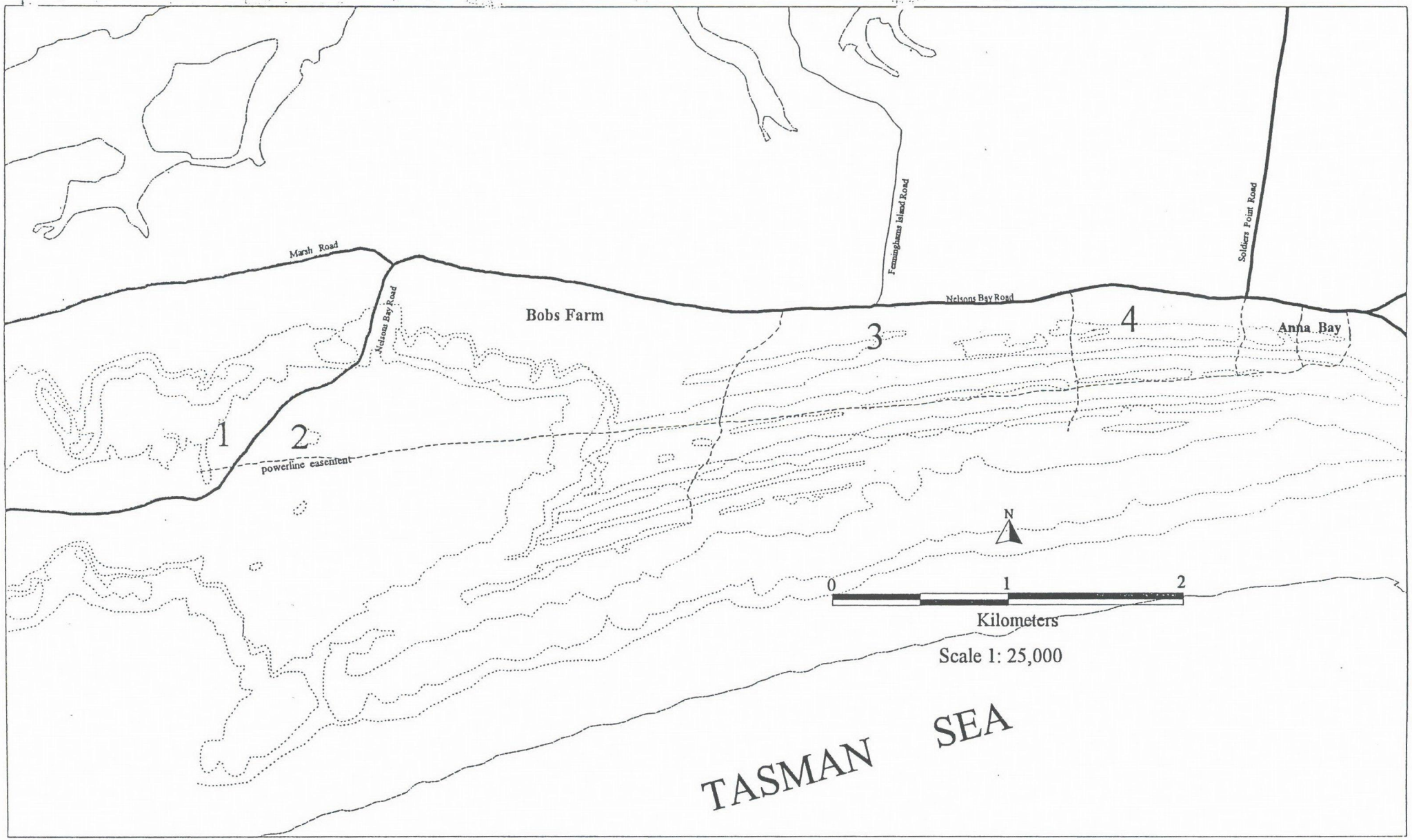

Figure One - Locations of Squirrel Glider Survey Sites

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rolled oats and honey, and the trap entrance and tree trunk was sprayed with a mixture of water and honey to act as an attractant. Traps were active for four consecutive nights for two trapping episodes (see Table 2), and two consecutive nights in October 1999. The level of survey effort was 286 trap nights.

Three trapping periods were undertaken to capture Squirrel Gliders (refer to *Table 2*). Two surveys were undertaken by ERM Mitchell McCotter in June and September 1999. Additional arboreal trapping by Forest Fauna Surveys Pty Ltd was undertaken during the period 6 - 7 October 1999. During the October survey, traps were set at sites One, Three and Four at a height of 5 metres for two consecutive nights (total of 30 traps nights).

Table 2. Trapping Periods for Squirrel Gliders, Nelsons Bay Road.

Site Number	Survey Dates	Number of Trap Nights
1, 2, 3, 4	1-4 June 1999	140
1, 2, 3, 4	13-17 September 1999	116
1, 2, 3, 4	6 - 7 October 1999	30
	TOTAL TRAP NIGHTS	286

2.2 Radio Tracking of Gliders

The objective was to capture one individual from each site and fit with a collared radio transmitter for subsequent monitoring. Following release of the glider at the point of capture, the individual glider was to be located by radio tracking on 10 separate days to record the location of den trees in proximity to the proposed road footprint. Den trees are referred to as mature trees containing hollow limbs or fissures which are utilised by Squirrel Gliders for diurnal roosts. Gliders (and other hollow dependent nocturnal fauna) emerge from den locations at dusk and forage at night, returning to the den site prior to dawn.

Any den trees recorded were to be positioned by differential GPS to provide an approximate location. However, it must be noted that more accurate positioning by surveyors is required to accurately plot den tree locations.

3.0 RESULTS

3.1 Arboreal Trapping

Two Squirrel Gliders were captured during the September trapping period, one each at sites One and Four. However, one glider at site One could not be fitted with a radio transmitter as the

transmitter failed during attachment to the glider. Overall, trapping success rate was considered low, with only two gliders captured for 256 trap nights (0.78 per cent).

Additional arboreal trapping was undertaken at a height of five metres in October 1999. A total of three gliders were captured for 30 trap nights, or trap success rate of 10.0%.

A total of five Squirrel Gliders were captured during the survey period at sites One and Four. Details of the Squirrel Gliders captured during the survey is presented in *Table 3*.

Table 3. Captured Squirrel Glider details, Nelson Bay Road.

Capture Date	Site #	Species	Sex	Age Class (yrs)	Weight (g)	Reproductive Condition
15/9/99	4	*P. norfolcensis*	M	1-2	192	n/a
16/9/99	1	*P. norfolcensis*	M	1-2	220	n/a
6/10/99	4	*P. norfolcensis*	M	1-2	215	n/a
6/10/99	1	*P. norfolcensis*	F	2-3	224	1 pouch young 40 mm
7/10/99	1	*P. norfolcensis*	M	>3 yrs	235	n/a

No gliders were captured at Sites Two and Three during the arboreal trapping survey periods.

3.2 Radio Tracking of Gliders

Squirrel Gliders fitted with a radio transmitter at sites One and Four were monitored on ten occasions during the period 16 September to 22 October 1999. The dates when den tree locations were recorded by radio tracking is presented in *Table 4*.

Table 4. Survey Dates of Squirrel Gliders fitted with Radio transmitters

	Glider 1 (Site 4)	Glider 2 (Site 1)
Survey Date	Captured and released 15/9/99	
16/9/99	+	
17/9/99	+	
19/9/99	+	
26/9/99	+	Captured and released 6/10/99
7/10/99	+	+
8/10/99	no signal	+
9/10/99	no signal	+
10/10/99	no signal	+
17/10/99	no signal	+
22/10/99	no signal	+

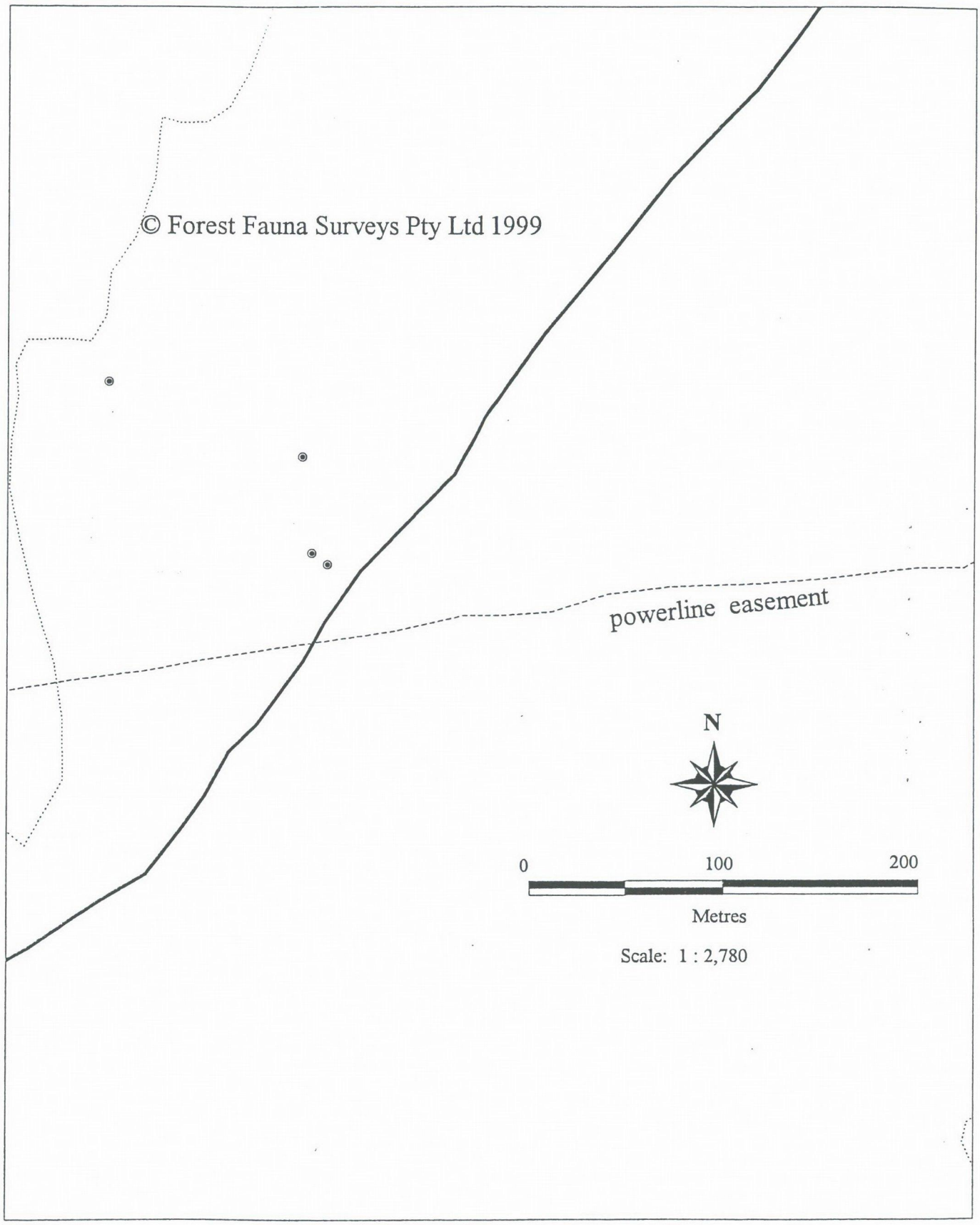

Figure Two Locations of Squirrel Glider Den Trees, Site One
Nelsons Bay Road, Bobs Farm

Two gliders were fitted with radio transmitters at sites One and Four. At site Four, a young male approximately 1 year old weighing 192 grams was fitted with a transmitter on 15 September and monitored to 7 October 1999. No further signals from the transmitter were recorded following that date. Factors considered responsible for loss of signal maybe transmitter failure, or the young male dispersed from its parental colony, and the signal no longer located. The range of the signal is about 400 to 500 metres in open country, and about 200 - 300 in dense forest. Searches of the local area failed to relocate the individual during the period 7 - 22 October 1999.

During the monitoring period of this glider, it was recorded in three den trees. The characteristics of each den tree recorded is presented in *Table 5*, and the locations of den trees presented in *Figure 3*.

Table 5 - Squirrel Glider Den Tree Characteristics (Site Four)

Date	Den Tree #	Tree Species	DBH (cm)	Number Hollows	Height	Easting	Northing
16/9/99	1	E. pilularis	71.6	5	18	411504	6373736
17/9/99	1	E. pilularis	71.6	5	18	411504	6373736
19/9/99	2	E. pilularis	135.6	> 10	20	411434	6373794
26/9/99	3	E. pilularis	61.7	1	18	411354	6373657
7/10/99	1	E. pilularis	71.6	5	18	411504	6373736
8/10/99	No further signal recorded to 22/10/99						

One female glider captured at site One on 6 October was considered unsuitable for monitoring by collared radio transmitter as she was carrying one pouch young. One young male (1-2 years) weighing 215 grams was captured at site One on 6 October, fitted with a radio transmitter, released and monitored during the period Thursday 7 October to Friday 22 October 1999. A total of four den trees were utilised by this glider during this period, and their locations are presented in *Table 6* and *Figure 2*.

Table 6 - Squirrel Glider Den Tree Characteristics (Site One)

Date	Den Tree #	Tree Species	DBH (cm)	Number Hollows	Height (m)	Easting	Northing
7/10/99	1	Dead Stag	58.0	3	15	406588	6372819
8/10/99	2	E. pilularis	79.5	7	20	406476	6372914
9/10/99	2	E. pilularis	79.5	7	20	406476	6372914
10/10/99	2	E. pilularis	79.5	7	20	406476	6372914
17/10/99	3	E. pilularis	75.7	5	20	406575	6372875
22/10/99	4	E. pilularis			20	406580	6372825

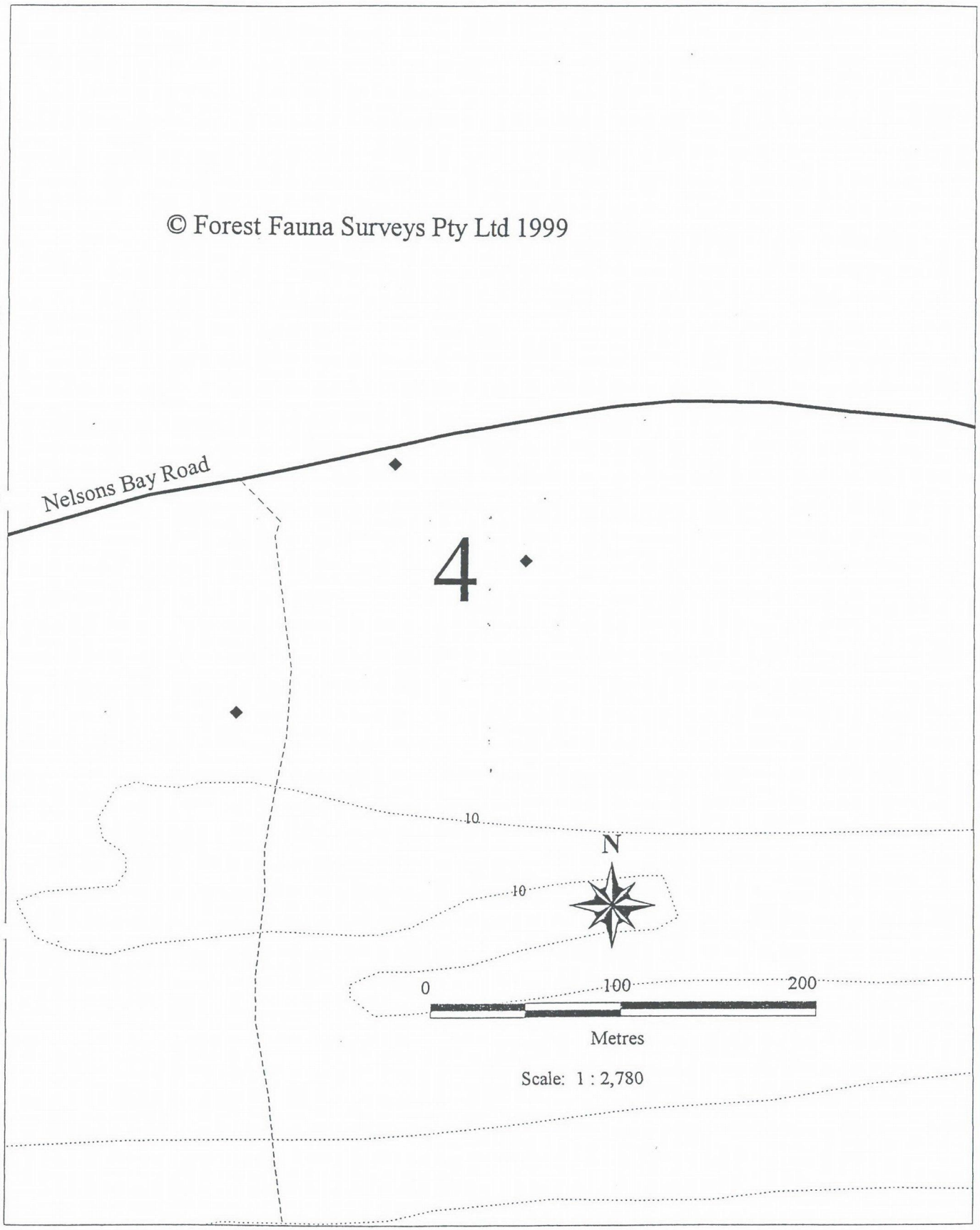

Figure Three Locations of Squirrel Glider Den Trees, Site Four
Nelsons Bay Road, Anna Bay

It must be recognised that monitoring of gliders over a 10 day period will fail to record all den trees utilised by the individual within its home range. Typically, gliders will utilise up to eight den trees on a seasonal or annual basis (M. Murray, unpublished data). Due to the relatively short monitoring period for this study, several den trees of the gliders along Nelsons Bay Road would not be located.

Hence, it is recommended that during the tree clearing phase of the road construction, ameliorative measures be adopted to minimise mortality of gliders. Strategies found successful in minimising mortality of gliders and loss of habitat trees include inspections of all felled habitat trees during the tree clearing, and adoption of a tree hollow replacement strategy. All tree limbs containing hollows should be sectioned in 600 - 800 mm lengths to inspect for resident gliders, which often become trapped when trees are felled and crush the hollow entrance. Any gliders injured should be cared for by the Native Animal Trust Fund, or released into adjoining forest if uninjured.

Suitable tree sections with hollows not damaged during the felling process should be cut into 600 - 800 mm lengths, capped at both ends, and an entrance hole of 50 - 60 mm diameter drilled through the wall of the tree limb. Any salvaged hollows should be positioned on remnant trees outside the road corridor at heights of 4 + metres to act as replacement hollows. The recommended density of hollows is 4 - 6 per hectare. Several other fauna species other than Squirrel Gliders are likely to utilise displaced hollows, including White-throated Treecreepers, Lace Monitors, Owlet-nightjars, gecko's, arboreal skinks and tree frogs. Hollows should be positioned on trees distant from the road verge to minimise fauna movements in close proximity to vehicular traffic.

Appendix D-3

THREATENED SPECIES ASSESSMENT

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Appendix D-3

THREATENED SPECIES ASSESSMENT

1.1 INTRODUCTION

The proposed upgrade of Nelson Bay Road from Bobs Farm to Anna Bay will disturb forested and grassland habitats. The road corridor will be between 38 and 47 metres wide including the dual carriageway, cleared easements and service access. Ancillary operations are proposed for an area of Council land at the Trotters Road intersection. The total length of road upgrade is 6.7 kilometres. Along the road approximately 8.8 hectares of dry open forest, 0.74 hectares of swamp forest and 7.6 hectares or cleared grassland and landscaping will be disturbed.

The results of the flora and fauna surveys and assessments are presented in *Section 5.6* of the REF. This appendix provides the threatened species assessment. A summary of the assessment is provided in *Section 5.6.11* of the REF.

1.2 THREATENED SPECIES

1.2.1 Threatened Species Conservation Act 1995

Schedules 1 and 2 of the TSC Act list species, populations or ecological communities of native flora and fauna considered to be threatened in New South Wales. No threatened populations or ecological communities currently listed on the TSC Act, 1995 were recorded within the study area. Threatened species recorded in the study area and environs include squirrel glider (*Petaurus norfolcensis*), little bent-wing bat (*Miniopterus australis*), greater broad-nosed bat (*Scoteanax rueppellii*), the orchids *Diuris praecox* and *Diuris arenaria.*

Threatened species considered likely to occur in the area, based on local records and preferred habitat attributes, are discussed in *Table 1.*

1.2.2 Environment Protection and Biodiversity Conservation Act 1999

Threatened species and ecological communities are listed by the Minister for the Environment under Part 13, Division 1, Subdivision A of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as extinct in the wild, critically

endangered, endangered or vulnerable. Nationally threatened species known from the region include spotted-tailed quoll (*Dasyurus maculatus*), green and golden bell frog (*Litoria aurea*), *Diuris praecox, Prostanthera densa, Rulingia prostrata, Eucalyptus camfieldii, Tetratheca juncea* and *Cryptostylis hunteriana.* Of these species the orchid *Diuris praecox* was recorded in the study area and the spotted-tailed quoll is assessed as having a moderate to high likelihood of occurrence in the study area (see *Table 1*) and are assessed under the TSC Act. Both species are vulnerable under EPBC Act.

An action requires consideration by the Minister of the Environment if *the action will have or is likely to have, a significant impact on a matter of national environmental significance* (being threatened species). An assessment of the significance of the impact on vulnerable species is required along with consideration of the nature and magnitude of potential impacts on site and off site, the sensitivity of the receiving environment, direct and indirect impacts, frequency and duration of the action, cumulative impacts and degree of confidence with which impacts are understood.

If the Minister decides that the action is likely to have a significant impact on threatened species then the action requires approval under the EPBC Act. If the Minister decides that the action is not likely to have a significant impact then the action does not require approval under the EPBC Act and Port Stephens Council and the Roads and Traffic Authority will not contravene the Act if the action is taken in accordance with that advice.

Migratory bird species listed under the China-Australia Migratory Bird Agreement (CAMBA) observed along the road corridor were the white-bellied sea-eagle (see *Appendix D-1*). A detailed assessment of the impact of the road upgrade on the white-bellied sea-eagle and its habitat was not undertaken. The white-bellied sea-eagle was observed overhead in the environs. The road upgrade will not impact on foraging habitat for the sea-eagle (coast, estuary, large rivers or waterbodies), it will not substantially modify, destroy or isolate an area of important habitat. No nesting sites were identified along the road corridor and the road upgrade will not seriously disrupt the lifecycle of the white-bellied sea-eagle.

Table 1 ASSESSMENT OF LIKELIHOOD OF THREATENED SPECIES WITHIN THE STUDY AREA

Common/Scientific Name	Status TSC	Status EPBC	Occurrence in Port Stephens area	Likelihood of Occurrence in Study Area
Hollow dependent birds				
glossy black cockatoo *Calyptorhynchus lathamii*	V	-	Tomago Sandbeds,[1] Salt Ash and near Fern Bay.[2]	Low to moderate. Preferred foraging resource (*Allocasuarina* spp.)[3] scarce in study area, available to the north in swamp oak coastal forest. Nesting habitat (large tree hollows) available, however rarely recorded far from preferred food resource .[3]
powerful owl *Ninox strenua*	V	-	Recorded along powerline easement between Bobs Farm and Anna Bay.[4]	High. Local record, suitable foraging habitat.
masked owl *Tyto novaehollandiae*	V	-	Fern Bay,[5] Medowie and Nelson Bay.[1]	Moderate to high. Suitable foraging habitat especially along the cleared electricity easement to the south.
Other birds				
bush stone-curlew *Burhinus grallarius*	E	-	Taylor's Beach and Lemon Tree Passage.[1]	Low. Local records however preferred habitat (lightly timbered open forest or woodland with a ground cover of short sparse grass and few, or no shrubs[6]) absent from study area. High fire frequency further reduces habitat suitability.
wompoo fruit-dove *Ptilinopus magnificus*	V	-	Corlette and Tomago Sandbeds.[1]	Low. Few local records, preferred habitat (rainforest)[7] absent from study area.
superb fruit-dove *Ptilinopus superbus*	V	-	Corlette[1]	Low. Few local records. Lives in rainforest but will feed in adjacent mangroves or eucalypt forest[8]. Rainforest absent from study area
osprey *Pandion haliaetus*	V	-	Tanilba Bay, Shoal Bay,[1] Hawks Nest.[9]	Low. Suitable foraging habitat (brackish or salt water body)[10], over Port Stephens. Nest site commonly tall tree, usually dead. No nest sites in study area, known from Tanilba Bay.

Table 1 ASSESSMENT OF LIKELIHOOD OF THREATENED SPECIES WITHIN THE STUDY AREA *Cont'd*

Common/Scientific Name	Status TSC	Status EPBC	Occurrence in Port Stephens area	Likelihood of Occurrence in Study Area
Other birds				
pied oystercatcher *Haematopus longirostris*	V	-	Tanilba Bay, Lemon Tree Passage	Low. Preferred habitat (ocean beaches, estuarine sand, mudflats and saltings)[11] not in study area, available Lemon Tree Passage and Tomaree National Park.
sooty oystercatcher *Haematopus fuliginosus*	V	-	Boat Harbour[9]	Low. Preferred habitat (rocky intertidal shorelines, coral reefs or sandy beaches near intertidal mudflats)[11] absent from study area.
Cave roosting bats				
little bent-wing bat *Miniopterus australis*	V	-	Medowie[12] Fern Bay, Salamander Bay, Tanilba Bay, Gan Gan	Recorded. No roosts identified, foraging habitat available.
common bent-wing bat *Miniopterus schreibersii*	V	-	Medowie[13]	Moderate to high. Records for Port Stephens. Suitable foraging habitat. Roost sites not identified along road.
Hollow dependent mammals				
squirrel glider *Petaurus norfolcensis*	V	-	Salamander Bay, Bagnalls Beach, Nelson Bay, Anna Bay, Bobs Farm and Lemon Tree Passage[1]	Recorded. Den sites and foraging habitat identified.
brush-tailed phascogale *Phascogale tapoatafa*	V	-	Lemon Tree Passage, Boat Harbour, Anna Bay and Salamander Bay.[1]	Moderate to high. Local records and suitable habitat available.
spotted-tailed quoll *Dasyurus maculatus*	V	V	Lemon Tree Passage, Salt Ash, Soldiers Point, Anna Bay to Boat Harbour[1]	Moderate to high. Several local records, including two records within one km[1] of eastern end of deviation. Suitable habitat.

Table 1 ASSESSMENT OF LIKELIHOOD OF THREATENED SPECIES WITHIN THE STUDY AREA *Cont'd*

Common/Scientific Name	Status TSC	Status EPBC	Occurrence in Port Stephens area	Likelihood of Occurrence in Study Area
Hollow dependent mammals				
greater broad-nosed bat *Scoteanax rueppellii*	V	-	Salamander Bay, Medowie, Fern Bay and Tilligerry Peninsula	Recorded. Arboreal roosting habitat and foraging habitat available.
yellow-bellied sheathtail-bat *Saccolaimus flaviventris*	V	-	Only one record for Port Stephens area, at Fern Bay[14].	Low to moderate. Habitat available however low number of local records.
Other mammals				
koala *Phascolarctos cinereus*	V	-	Numerous records for the Port Stephens area, including a high number of records for the Bobs Farm/Anna Bay area.[1]	Moderate to high. High number of local records. Preferred koala habitat identified in study area, no activity recorded along route.
eastern chestnut mouse *Pseudomys gracilicaudatus*	V	-	No known local records.	Low. No known local records. Suitable habitat (dense wet heathland on sand with thick sedges and grasses)[15] absent.
Frogs				
green and golden bell frog *Litoria aurea*	E	V	Records for Kooragang Island Nature Reserve.[1]	Low. No records for Port Stephens. Suitable habitat (permanent water[16] including dams and ponds with tall emergent vegetation eg *Typha* spp. and *Eleocharis* spp.)[17] absent.
wallum froglet *Crinia tinnula*	V	-	Anna Bay sandbeds[1]. Salamander Bay.[18] Oyster Cove, Tomago sandbeds.	Moderate to high. Local records. Suitable habitat (wet heath, swamp forest and wallum sedgeland)[19] occur in study area.

Table 1 ASSESSMENT OF LIKELIHOOD OF THREATENED SPECIES WITHIN THE STUDY AREA *Cont'd*

Common/Scientific Name	Status TSC	Status EPBC	Occurrence in Port Stephens area	Likelihood of Occurrence in Study Area
Plants				
Diuris arenaria	V	-	Recorded along powerline easement (option 2), near Salt Ash, Shoal Bay and Anna Bay [20, 21]	High. Preferred habitat coastal heathy forest and woodland dominated by *Corymbia gummifera* and *Angophora* sp. with a grassy or bracken understorey. [21]
Diuris praecox	V	V	Recorded powerline easement from Bobs Farm to Anna Bay.[20]	Recorded in easement perpindicular to Nelson Bay Road. Suitable habitat in road reserve is limited by regular slashing and mowing.
Prostanthera densa	V	V	Gan Gan Hill.[1]	Low. Suitable habitat absent from study area (sclerophyll forest and shrubland on coastal headlands and near-coastal ranges, chiefly on sandstone)[22].
Melaleuca groveana	V	-	Fingal Bay/Shoal Bay area.[1]	Low. Suitable habitat absent from study area (heath, often in exposed sites)[23].
Rulingia prostrata	E	E	Williamtown area[1]	Low. Preferred habitat (gullies along coastal escarpments)[24] absent from study area but also recorded from Tomago sandbeds. No local records.
Eucalyptus camfieldii	V	V	Salt Ash area[1]	Low. Preferred habitat (coastal shrub heath on sandy soils on sandstone, often of restricted drainage) absent from study area.[25]
Tetratheca juncea	V	V	14 km north of study area, near North Arm Cove.[1]	Low. No local records. Preferred habitat (pH neutral clayey soils, derived from conglomerates located in dry sclerophyll open forest on the upper part of ridges with a southerly aspect, west through to east, with the most commonly associated tree species being *Angophora costata, Eucalyptus globoidea* and *E. gummifera*)[26] absent from study area.

Table 1 ASSESSMENT OF LIKELIHOOD OF THREATENED SPECIES WITHIN THE STUDY AREA *Cont'd*

Common/Scientific Name	Status TSC	Status EPBC	Occurrence in Port Stephens area	Likelihood of Occurrence in Study Area
leafless tongue orchid *Cryptostylis hunteriana*	V	V	Gan Gan Hill and hill at Malabulla on Tilligerry Peninsula [20]	Low. Terrestrial orchid grows in coastal swamp heath on sandy soil, eucalypt woodland, swamp fringes to bare hillsides in tall forest, with *Blandfordia nobilis*, *Cryptostylis erecta* and *Cryptostylis subulata* [27]. Records in Port Stephens area restricted to volcanic hills. Habitat in Tomaree National Park.

Status in NSW as per Schedules 1 and 2 of TSC Act: E = Endangered; V = Vulnerable. Status in Australia as per EPBC Act: E = Endangered; V = Vulnerable.
1 = NPWS Atlas of NSW Wildlife ; 2 = ERM Resource Planning (1994); 3 = Clout (1989); 4 = A. Finegan, Novo Eco Consultancy, pers. obs.; 5 = ERM Mitchell McCotter (1995) ; 6 = Marchant & Higgins (1993); 7 = Klippel (1992); 8 = Blakers et al (1984); 9 = N. Buchhorn, ERM, pers obs.; 10 = Clancy (1991); 11 = Smith (1991); 12 = Antcliff (1993); 13 = Glenn Hoye, FBN Bat Surveys, pers. comm.; 14 = Clements & Associates (1992); 15 = Fox (1991); 16 = Cogger (1992); 17 = Markwell & Knight (1986); 18 = Fanning (1995); 19 = Ferrier et al (undated); 20 = G. Hillman, pers comm.; 21 = Jones (1999); 22 = Conn (1992); 23 = Wilson (1991); 24 = Harden (1990); 25 = Hill (1991); 26 = Norton (1994); 27 = Leigh et al (1984).

1.3 ASSESSMENT OF IMPACT ON THREATENED SPECIES

1.3.1 Threatened Species Conservation Act - Eight Part Test

The impact of upgrading Nelson Bay Road on threatened species has been assessed in accordance with section 5A of the *Environmental Planning and Assessment Act 1979,* (EP&A Act) as amended by the *Threatened Species Conservation Act 1995* (TSC Act).

The assessment addresses the threatened fauna species recorded in the study area, together with seven threatened fauna species considered to have a moderate to high likelihood of occurrence in the area (see *Table 1*). The assessment also addresses the threatened orchids *Diuris praecox* and *Diuris arenaria.*

Eight part tests have been undertaken for threatened species in groups rather than on an individual basis. The division into groups is based on species having similar ecological requirements, at risk from the same threats and likely to be impacted upon in similar ways by the proposed development.

For the purposes of the assessment, a 'local population' is defined as the population that occurs within the study area. A 'viable' local population is that which has the capacity to live, develop and reproduce under normal conditions.

To avoid repetition parts *b, e,* and *g* of the eight part test have been assessed for all species together.

b) *In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the population is likely to be significantly compromised.*

No endangered population currently listed on the TSC Act was recorded, or is considered likely to occur, within the study area.

e) *Whether critical habitat will be affected.*

At present, no register of critical habitat is maintained by the Director-General of the National Parks and Wildlife Service.

g) *Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.*

At present there are eight threatening processes listed on Schedule 3 of the TSC Act, these are:

- predation by the fox (*Vulpes vulpes*);
- predation by mosquito fish *Gambusia holbrooki;*
- invasion of native plant communities by bitou bush *Chrysanthemoides monilifera;*
- removal of bushrock resulting in the removal and/or disturbance of habitat for native species that may find shelter in or under rocks, use rocks for basking, or which grow in rocky areas;
- predation by the feral cat;
- high frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition;
- predation by the ship rat (*Rattus rattus*) on Lord Howe Island (not applicable); and
- anthropogenic climate change.

The upgrading of Nelson Bay Road is not in itself a scheduled threatening process. It may however provide an environment for some of the above threatening processes in particular predation by the fox and invasion of native vegetation by bitou bush.

Predator species such as foxes are attracted to roads to feed on the carcasses of road kills (Bennett 1991). Besides scavenging along the freeway, predator species may also use roadside habitat as areas to hunt in (Finegan 1997). The fox is expected to occur along the road. Widening the existing road corridor will increase the risk of injury and/or mortality to animals crossing the road, increasing road kills, which may in turn contribute to an increase in fox predation in the local area.

In general, the clearing of fauna habitat is a threatening process, for example the removal of mature hollow-bearing trees is considered a threat to hollow-dependent

fauna such as gliders. The clearing of understorey such as shrub species may also pose a threat, by removing foraging habitat for gliders and sheltering habitat for small ground-dwelling mammals and reptiles, and by encouraging weed invasion.

i. Hollow Dependent Birds

Hollow dependent birds assessed are the masked owl and powerful owl. The powerful owl and masked owl were not recorded during fieldwork but are considered likely to occur, based on availability of suitable habitat and records in the Port Stephens region.

a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

The masked owl is a sedentary species inhabiting dry eucalypt forests and woodlands with a sparse understorey, forest margins, wooded watercourses, and isolated stands of trees within cleared areas (Garnett 1992). It requires a large home range, between 500 and 1000 hectares per pair in coastal areas, with neighbouring pairs well separated (Debus and Rose 1994). The main prey species are small to medium terrestrial mammals, arboreal mammals and birds (Garnett 1992) with terrestrial prey predominating in the diet (Hollands 1991, Davey 1994).

The masked owl utilises tree hollows for diurnal roost and nest sites, and the same hollow may be used for a number of years (Hollands 1991). Nest hollows are generally located in large trees (Schodde and Mason 1980) within relatively dense forest or woodland (Beruldson 1980, Debus and Rose 1994) although observations have also been made in more open habitats and even isolated trees (Debus and Rose 1994). The masked owl is an opportunist, and may breed at any time of the year, however most eggs are laid between March and July (Hollands 1991, Debus and Rose 1994).

The powerful owl is associated with wet and dry sclerophyll forests containing ecologically mature trees. The home range of a pair of the powerful owl is estimated to extend from 770 to 1000 hectares of forest (Kavanagh 1988), dependent on the distribution and abundance of arboreal prey. Within their home range, the powerful owl possibly concentrates foraging activity in pockets until prey numbers are reduced to a level where it is difficult to catch remaining individuals before moving on to another area (Kavanagh 1988).

The powerful owl is a punctual winter breeder, with eggs laid between mid May to late June (Hollands 1991). Nesting sites are provided by large tree hollows typically emergents, often the largest within a stand and probably among the oldest in a forest

patch (Debus and Chafer 1994). It only requires hollows for nesting, with roosting sites in dense vegetation (Debus and Chafer 1994).

Both owls are sensitive to a reduction in prey species associated with clearance of habitat. They have large foraging territories and clearance of approximately 10 hectares of forested habitat for the road widening is not expected to significantly reduce foraging habitat within the local area.

The main threat to both species is reduction in the number of nest trees. Although the study area does contain a significant number of mature hollow-bearing trees, most of the hollows were considered too small to be used by large owls such as the powerful owl and masked owl. No evidence of nesting or roosting sites was found during the survey. Potential nesting/roosting habitat resources occur in forest in the immediate environs.

The proposed road widening is not likely to disrupt the life cycle of either species such that a local population will be placed at risk of extinction.

c) *In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.*

In relation to the size of bushland remnants elsewhere within the Port Stephens area, the area of habitat to be removed or modified is not considered to be significant for the masked owl or powerful owl. On a regional basis, the area of known or potential habitat to be removed or modified is not significant.

Within the Port Stephens area, similar habitat is provided in open forest largely in private ownership or water reserves. The long term security of these areas of habitat is not assured. The most substantial conservation reserve in the Port Stephens region is Tomaree National Park (NP). The nearby Tomago Sandbeds provide suitable habitat for the owls and both species have been recorded in the sandbeds.

On a broader regional scale, the Port Stephens area falls within the overlap of two biogeographic regions being the New South Wales north coast and the Sydney Basin. The New South Wales north coast biogeographic region extends from approximately Port Stephens to the Queensland border. Five to ten per cent of the region is reserved (Thackway and Cresswell 1995). The Sydney Basin biogeographic region extends from the Hunter River to south of Sydney with greater than ten per cent of the region reserved (Thackway and Cresswell 1995).

Significant areas of habitat similar to those within the study area occur in local and regional conservation reserves including Myall Lakes NP, Tomaree NP, Glenrock

State Recreation Area (SRA), Awabakal Nature Reserve (NR), Munmorrah SRA, Wallaroo NR and Barrington Tops NP.

On a broader regional scale, vegetation clearance for the upgrade of Nelson Bay Road will not represent a loss of a significant area of habitat for the powerful owl or masked owl.

d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

Upgrade of Nelson Bay Road will further isolate open forest habitat at the western end of the study area by increasing the width of the existing road corridor. For the remainder of the road upgrade, the cleared land to the north and Nelson Bay Road itself, present a barrier to the movement of fauna between the habitats of the dune system and the estuarine habitats of Port Stephens. Increasing the width of the road in this section will not isolate currently interconnecting or proximate areas of habitat.

The road upgrade is unlikely to isolate known habitat for highly mobile species and those with a large home range including the powerful owl and masked owl.

f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.

Within the Hunter region, several conservation reserves (such as national parks and nature reserves) and other areas that offer a degree of protection (such as state forests) contain known or potential habitat for the powerful owl and masked owl. These areas include Myall Lakes NP, Tomaree NP, Glenrock SRA, Awabakal NR, Munmorrah SRA, Booti Booti NP, Wallaroo NR, Karuah NR, Medowie SF, Bulahdelah SF, Myall River SF, Bachelor SF, Wallingat SF and Nerong SF

While habitat for the owls are available in conservation reserves and some individuals have been recorded in reserves, the adequacy of species representation in these conservation reserves is generally unknown.

h) Whether any threatened species or ecological community is at the limit of its known distribution.

The masked owl and powerful owl are not at their known limit of distribution in the Port Stephens area.

ii. Cave Roosting Bats

Cave roosting bats assessed are the common bent-wing bat and little bent-wing bat. The little bent-wing bat was recorded in the study area via echolocation call detection. The common bent-wing bat was not recorded but was considered likely to occur based on habitat suitability and regional records.

a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Both species are insectivorous bats that forage over forested habitats. They are dependent on caves, old mines, stormwater channels or similar structures for the provision of winter hibernation and summer maternity roost sites (Dwyer 1995a, 1995b). The main threat to both species is loss of suitable winter hibernation and maternity roost sites. In the Port Stephens area known roost sites include Balikera canal and sea caves at Yaccaba Head (Ecotone Ecological Consultants 1995).

No roost sites occur in the study area, however it is likely that the two species roost elsewhere and use the study area as part of a large foraging area. Clearance of 10 hectares of forested habitat is expected to have only a marginal impact on foraging resources for the common bent-wing bat and little bent-wing bat. The road upgrade is not likely to disrupt the life cycle of either species such that a local population will be placed at risk of extinction.

c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

In relation to the size of bushland remnants elsewhere within the Port Stephens area, the area of foraging habitat to be removed or modified is not considered to be significant for the common bent-wing bat or little bent-wing bat. On a regional basis, the area of known or potential habitat to be removed or modified is not significant.

Within the Port Stephens area, similar habitat is provided in remnant open forest largely in private ownership, recreational spaces or water reserves. The long term security of these areas of habitat is not assured. The most substantial conservation reserve in the Port Stephens region is Tomaree NP.

On a broader regional scale, significant areas of foraging habitat similar to those within the study area occur in forestry estate, local and regional conservation reserves. On a regional scale, vegetation clearance for the upgrade of Nelson Bay

Road will not represent a loss of a significant area of foraging habitat for the common bent-wing bat or little bent-wing bat.

d) *Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.*

Upgrade of Nelson Bay Road will further isolation open forest habitat at the western end of the study area by increasing the width of the existing road corridor. For the remainder of the road upgrade, the cleared land to the north and Nelson Bay Road itself, present a barrier to the movement of fauna between the habitats of the dune system and the estuarine habitats of Port Stephens. Increasing the width of the road in this section will not isolate currently interconnecting or proximate areas of habitat.

The road upgrade is unlikely to isolate known habitat for highly mobile species such as the common bent-wing bat or little bent-wing bat.

f) *Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

Within the Hunter region, several conservation reserves (such as national parks and nature reserves) and other areas which offer a degree of protection (such as state forests) contain known or potential habitat for the common bent-wing bat and little bent-wing bat. These areas include Myall Lakes NP, Tomaree NP, Glenrock SRA, Awabakal NR, Munmorrah SRA, Wallaroo NR, Karuah NR, Medowie SF, Bulahdelah SF, Myall River SF, Bachelor SF, Wallingat SF, Nerong SF and Booti Booti NP.

While foraging habitat for the bats are available in conservation reserves and some individuals have been recorded in reserves, the adequacy of species representation in these reserves is generally unknown.

h) *Whether any threatened species or ecological community is at the limit of its known distribution.*

The little bent-wing bat occurs in the coastal ranges of eastern Australia from the central coast of New South Wales to Cape York in Queensland (Kennedy 1990), hence a local population would be near the southern limit of the species known distribution. The common bent-wing bat is not at the limit of its known distribution.

iii. Hollow Dependent Mammals

Hollow dependent mammals assessed include the squirrel glider, brush-tailed phascogale, spotted-tailed quoll and greater broad-nosed bat.

a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

The squirrel glider was recorded at two locations (site 1 and site 4) approximately five kilometres apart, suggesting that at least two family groups occupy forested habitats along the road corridor. Surveys undertaken for option 2 (ERM Mitchell McCotter 1998) recorded gliders at two locations between sites 1 and 4, suggesting two additional family groups in this same tract of forest habitat. This is suggestive of squirrel gliders occurring throughout the forested habitat between Nelson Bay Road and the electricity easement to the south. Squirrel gliders are expected to occur throughout the forested habitat of the dune system extending from Anna Bay to Stockton.

This species is an arboreal mammal dependent on mature trees with hollows for den sites, foraging on plant exudates and arthropods in open forest and woodland communities. The plant communities in which the squirrel glider is typically found are characterised by gum-barked and winter flowering trees and *Acacia* species (Menkhorst *et al* 1988). Forested areas along the road contain a high number of tree hollows suitable for use by the species. In addition, the tree and shrub species within the open forest and swamp forest habitats provide a year round supply of nectar.

At the western end of the proposed upgrade (site 1), habitat and individuals have been observed on both sides of the road. The existing road may not pose a barrier to dispersal for the squirrel glider, which have been observed gliding across powerline easements. However, disturbance effects from traffic (such as moving vehicles, noise and lights) may deter the species from gliding across the road. Increasing the road width is likely to create a permanent barrier to squirrel gliders moving across the road. Structures designed to assist passage of arboreal fauna over roads (for example, gliding poles) are still relatively untested and are not recommended. However, the potential barrier to dispersal of this group is lessened by the continuity of dry forest habitat to the west of the road that provides for dispersal of individuals to other populations that are considered highly likely to occur throughout the dune forest.

Two individual gliders were tracked to den sites at the western and eastern end of the upgrade (see *Section 5.6.8*). Identified den trees will not be felled by the road upgrade. At the eastern site (site four) one of the den trees will be on the edge of the

road and the tree will be protected from vehicle impact by guard rails. As no identified den trees will be disturbed, and identified den trees at both sites are removed from the road and edge effects, the impact on both social groups is not considered to disrupt the life cycle of the local populations of this species.

The brush-tailed phascogale is largely arboreal, occupying a variety of habitats, however its preferred habitat is open dry sclerophyll forest with little ground cover, on ridges up to 600 metres altitude (Cuttle 1983). The species nests in tree hollows with narrow entrances. Their diet consists mainly of arthropods, such as spiders and centipedes, as well as small invertebrates (Cuttle 1983). The species will also forage on the ground and eucalypt nectar is extensively utilised when trees are flowering (Traill and Coates 1993). This species was not recorded in the study area but was considered likely to occur based on the availability of suitable habitat and local records. Felling of potential nesting sites in the form of small tree hollows may result in the mortality of individuals.

The spotted-tailed quoll typically occurs in open forest where it will spend much of its time hunting arboreally and terrestrially (Jones 1996). The species inhabits a wide range of habitats including rainforest, open forest, woodland, coastal heath and inland riparian forest (Edgar and Belcher 1995). The spotted-tailed quoll utilises various den sites including caves, rock crevices and hollow logs (Edgar and Belcher 1995). No evidence of the presence of this species (including scats or sightings during spotlighting) was recorded in the study area. Potential den sites (that is, hollow logs) were checked for evidence of use by the species. The spotted-tailed quoll does not appear to be utilising potential den sites within the study area. The proposed development will result in only a marginal reduction in potential foraging habitat for the species, which has a large home range (Mansergh 1983). The proposed development is unlikely to disrupt the life cycle of the species such that a viable local population of spotted-tailed quoll is likely to be placed at risk of extinction.

The greater broad-nosed bat require tree hollows for diurnal roosting, winter hibernation and summer maternity and will also utilise the roof spaces of old buildings (Richards 1983, Hoye and Richards 1995). Creeks and small rivers are favoured corridors for the greater broad-nosed bat where it hawks back and forth for its prey (Hoye and Richards 1995). This bat is large requiring a greater feeding range than other insectivorous bat species. Little is known of its reproductive cycle other than a single young is born in January (Hoye and Richards 1995).

If roosting sites for the bat do occur within the study area, individuals may be disturbed during clearance. Clearance of the forested area outside of the winter hibernation and summer maternity periods will minimise direct mortality of individuals alternatively habitat trees can be selective cleared (see *Section 5.6.11*).

c) *In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.*

In relation to the size of bushland remnants elsewhere within the Port Stephens area, the removal or modification of approximately 10 hectares of forested habitat is not considered to be significant. On a regional basis, the area of known or potential habitat to be removed or modified is not significant.

Within the Port Stephens area, similar habitat is provided in remnant open forest largely in private ownership, recreational spaces or water reserves. The long term security of these areas of habitat is not assured. The most substantial conservation reserve in the Port Stephens region is Tomaree NP. Significant area of habitat also occurs within the Tomago Sandbeds.

On a broader regional scale, significant areas of habitat similar to those within the study area occur in local and regional conservation reserves including Myall Lakes NP, Tomaree NP, Wallaroo NR, Glenrock SRA, Awabakal NR, Limeburners Creek Nature Reserve (NR), Booti Booti NP, Lake Innes NR, Limeburners Creek NR, Yuraygir NP, Broadwater NP and Barrington Tops NP. On a regional scale, vegetation clearance for upgrade of Nelson Bay Road will not represent a loss of a significant area of habitat for threatened fauna.

d) *Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.*

The upgrade of Nelson Bay Road will increase the isolation of habitats on the northern side of road from those on the southern side by increasing the width of the existing road corridor. In particular, it is likely to subdivide the existing squirrel glider population at the western end of the study area into smaller sub-populations permanently isolated from currently interconnecting areas of habitat. However connectivity with forested habitat either side of the road is likely to lessen this potential barrier impact. Road upgrade is not expected to isolate the second social group of squirrel gliders (site 4) that occur to the south of the existing road. Long term security of both populations is dependent on land uses of properties adjoining the road reserve.

The road upgrade is unlikely to isolate known habitat for highly mobile species (such as the greater broad-nosed bat) and those with a large home range (including the spotted-tailed quoll).

The nearest records of spotted-tailed quoll are in the Anna Bay/Boat Harbour area. Brush-tailed phascogale have been recorded in the environs and are considered

likely to be occupying open forest habitat on the southern side of Nelson Bay Road. Nelson Bay Road already presents a barrier to movement for the brush-tailed phascogale and spotted-tailed quoll and isolates the above known areas of habitat from proximate areas of potential habitat. Widening the existing road corridor is not expected to significantly increase isolation of habitat for either of these two species.

f) *Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

Within the Hunter region, several conservation reserves and other areas which offer a degree of protection contain known or potential habitat for those species known from, or considered likely to occur in, the study area. These areas include Myall Lakes NP, Tomaree NP, Glenrock SRA, Awabakal NR, Wallaroo NR, Karuah NR, Medowie SF, Bulahdelah SF, Myall River SF, Bachelor SF, Wallingat SF and Nerong SF.

While similar habitats are available in conservation reserves and some individuals have been recorded in reserves, the adequacy of species representation in these reserves is generally unknown.

h) *Whether any threatened species or ecological community is at the limit of its known distribution.*

None of the hollow dependent mammals are at the known limit of distribution in the Port Stephens area.

iv. *Koala*

a) *In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.*

The koala is typically a solitary animal, moving infrequently and living in a small area or group of trees within the available habitat for long periods or time (Mitchell 1990). Estimates of home ranges in Victoria are 1.7 hectares for males and 1.18 hectares for females with extensive overlap (Mitchell, 1990). They occur in low densities and a breeding population may consist of as few as five or six individuals (Callaghan *et al* 1994).

The koala is an inhabitant of forests occurring typically on high nutrient soils characterised by the presence of preferred feed trees. In Port Stephens the koalas

preferred feed trees are swamp mahogany (*Eucalyptus robusta*), Parramatta red gum (*E. parramattensis* subsp. *decadens*) and forest red gum (*E. tereticornis*).

The koala is sensitive to habitat clearance, loss of preferred feed trees, genetic isolation and is vulnerable to dog attacks and strikes from traffic. Although not directly observed, the koala is considered likely to occur in the general environs based on the high number of records for the Port Stephens area and availability of preferred koala habitat (see *Section 5.6.9*). There will be a minimal reduction in the availability of preferred feed trees. The road upgrade is more likely to increase vulnerability of koalas to traffic strikes. Implementation of traffic management recommendations included in *Section 5.6.9* may conserve habitat and limit impacts on future populations. The road upgrade will not disrupt a local koala population such that it is likely to be placed at risk of extinction.

c) *In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.*

In the Port Stephens local government area (LGA), koala habitat covers approximately 40,089.6 hectares or 48.9 percent of the LGA (Lunney *et al* 1998). Koala habitat has been further divided based on the presence of preferred koala feed trees and the area of each habitat category across the LGA calculated based on koala habitat mapping (see *Table 2*).

Table 2 AREA OF KOALA HABITAT IN PORT STEPHENS LGA

Habitat	Area (ha)	Percent of Habitat	Percent of LGA
Preferred koala habitat	7,366.8	18.4	9.0
Supplementary koala habitat	9,778	24.4	11.9
Marginal koala habitat	22,781.9	56.8	27.7
Unknown koala habitat	162.9	0.4	0.2
Other vegetation	7,752.7	0	9.5
Mainly cleared land	34,274.9	0	41.7
Total	82,117.2	100	100

Notes: *Source Lunney et al 1998*

The majority of the upgrade area is identified as supplementary koala habitat within the Fullerton Cove/Stockton Bight Koala Management Unit (Port Stephens Council 1999). Approximately 4,241 hectares or 34 percent of this unit is identified as koala habitat (Port Stephens Council 1999). Clearance of 8.8 hectares is not significant on a local basis.

The swamp forest habitats along the road upgrade are identified as preferred koala habitat. In relation to the area of koala habitat in the Port Stephens area, the removal or modification of 0.74 hectares of preferred habitat is unlikely to be significant.

On a broader regional scale, the area of known or potential habitat to be removed or modified is not significant.

d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

Upgrade of the western end of Nelson Bay Road will increase the isolation of supplementary habitats on either side of the existing road corridor. In particular it is likely to widen a potential corridor between two areas of preferred koala habitat east of Bobs Farm. However, the long term security of this corridor is not assured, as it is private property. It will not impact on habitat links identified in the comprehensive koala plan of management (Port Stephens Council 1999).

f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.

Within the Port Stephens area, koala records are numerous on the Tilligerry Peninsula and the Tomago Sandbeds in the area extending from Salt Ash to Medowie to Raymond Terrace. The Tomago Sandbeds supports some of the most significant koala habitat in the LGA and is managed as water catchment affording some degree of protection (Port Stephens Council 1999).

Within the Hunter region, several conservation reserves and other areas that offer a degree of protection, contain known or potential habitat for the koala. These areas include Tomaree NP, Tilligerry NR, Worimi NR, Moffats Swamp NR, Wallaroo NR, Myall Lakes NP, Karuah NR, Medowie SF, Bulahdelah SF, Myall River SF, Bachelor SF, Wallingat SF and Nerong SF.

While similar habitats are available in conservation reserves and some individuals have been recorded in reserves, the adequacy of species representation in these reserves is generally unknown.

h) Whether any threatened species or ecological community is at the limit of its known distribution.

The koala is not at the limit of its known distribution in the Port Stephens area. The Port Stephens population is recognised as one of the most significant southerly populations in New South Wales (Reed *et al* 1990).

v. Wallum Froglet

a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

The wallum froglet occurs in acid paperbark swamps of the wallum country (Cogger 1992). Habitat includes coastal wallum sedge land, wet heathland and swamp forest. The species breeds in late winter and calls from late winter to mid spring from the base of vegetation, especially sedges (Ferrier *et al.* undated). It is threatened by the drainage or filling of habitat.

Potential habitat for the wallum froglet occurs in paperbark swamp forest in the area. The drains along the edge of Nelson Bay Road near Marsh Road intersection may provide marginal habitat. No individuals were heard calling. A small area of swamp forest habitat will be disturbed during construction. Filling of road drains in the Bobs Farm area will reduce marginal habitat in the immediate environs. Drains along the new carriageway will be grassed and are expected to regenerate with sedges providing habitat in the long term. It is advised that the construction phase near Marsh Road intersection be undertaken from summer to mid autumn, outside of their winter breeding period. The upgrade of Nelson Bay Road is not expected to disrupt any local population of the wallum froglet such that the species is likely to be placed at risk of extinction.

c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

Approximately 0.74 hectares of swamp forest will be removed or modified by the road upgrade. This is not a significant reduction in the availability of habitat for the wallum froglet. On a regional basis, the area of known or potential habitat to be removed or modified is not significant.

Within the Port Stephens area, similar habitat is provided in swamp forest and wetland habitat largely in the Tomago sandbeds, Anna Bay sandbeds and private ownership. Wetland areas within wetlands protected under State Environmental Planning Policy No 14 - Coastal Wetlands are afforded some protection. In the region suitable habitat is conserved in Tomaree NP, Myall Lakes NP, Awabakal NR, and Munmorah NR. On a broader regional scale, clearance of 0.74 hectares of swamp forest and marginal habitat in the road drains will not represent a loss of a significant area of habitat for threatened fauna.

d) *Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.*

Suitable habitat for the wallum froglet is restricted to the low lying land in the Bobs Farm area. Large areas of swamp forest to the north of the road have been cleared and drained in the past. The main areas of swamp forest now occur along the estuarine flats of Tilligerry Creek and Bobs Farm Creek. Culverts under the road and the drain system may provide refuge for frogs and have marginal potential to provide connectivity to a 'sink' habitat south of the road. It is considered that the existing road and cleared land to the north provide a barrier to movement. Upgrade of Nelson Bay Road may increase the isolation of habitats on the northern side of road from those on the southern side. However, long term security of any population south of Nelson Bay Road is limited by the size of available habitat and existing barrier afforded by the road and cleared land.

f) *Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

Within the region, the wallum froglet is known from Moffats Swamp NR, Myall Lakes NP, Tomaree NP and Awabakal NR. It is also known from several locations in Tomago Sandbeds and Anna Bay sandbeds where it is afforded some degree of protection.

While similar paperbark and wallum habitats are available in conservation reserves in the region the adequacy of species representation in these reserves is generally unknown.

h) *Whether any threatened species or ecological community is at the limit of its known distribution.*

The distribution of the wallum froglet was until recently at its southern limit in the Newcastle area, it has now been recorded on the central coast and more recently Kurnell.

vi. Orchids

Threatened orchids recorded in the immediate environs of the road upgrade are *Diuris praecox* and *Diuris arenaria.*

a) *In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.*

Diuris praecox is a terrestrial orchid that occurs on hills and slopes of near-coastal districts in open forests with a grassy to fairly dense understorey, endemic to central eastern New South Wales from Port Stephens to Ourimbah (Jones 1991). The species prefers open areas where it encounters less competition for sunlight (G. Hillman pers. comm.). A large population of this species has been recorded along the powerline easement to the south of Nelson Bay Road, predominantly on the northern side of the easement (ERM Mitchell McCotter 1998b, G. Hillman pers comm.). A smaller population of *Diuris praecox* has been recorded in an easement east of Trotters Road (G. Hillman pers comm.). The orchids occur approximately 70 metres south of Nelson Bay Road. The grassy verges along the road itself are likely to provide marginal habitat, as they are regular mowed/slashed for road maintenance purposes.

The population of *Diuris praecox* along the powerline easement comprises a large number of individual plants as well as juvenile plants and seed capsules indicating the presence of pollinating insects (G. Hillman pers comm). This population is considered significant for survival of the orchid. Nelson Bay Road upgrade does not disturb this significant population. The smaller population near the road is outside of the upgrade area and will be protected by the erection of barrier fencing. It is considered unlikely that the life cycle of *Diuris praecox* would be disrupted such that a local population may be placed at risk of extinction.

Scattered plants of *Diuris arenaria* (previously *Diuris* sp. aff. *punctata* (Nelson Bay)) have been observed along the powerline easement (ERM Mitchell McCotter 1998b, G. Hillman pers comm). *Diuris arenaria* occurs in shrubby coastal heath forests dominated by red bloodwood (*Corymbia gummifera*) and *Angophora costata* with a grassy or bracken groundstorey (Jones 1999). It has been recorded in easements near Nelson Bay and in Tomaree NP (previously water board catchment area). It was not recorded in the electricity easement at the western end of the upgrade. The grassy verges along the road itself are likely to provide marginal habitat, as they are regular mowed/slashed for road maintenance purposes. It is considered unlikely that the life cycle of *Diuris arenaria* would be disrupted such that a local population may be placed at risk of extinction.

c) *In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.*

In relation to the size of bushland remnants elsewhere within the Port Stephens area, the area of potential habitat to be removed or modified is not considered to be

significant for the orchids. On a regional basis, the area of known or potential habitat to be removed or modified is not significant.

Within the Port Stephens area, the orchids are known from other easements and forested habitat in water reserves and conservation reserves. The most significant population of *Diuris praecox* is not in a conservation reserve and long term security of habitat is not assured due to management practices along the easements.

d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

Upgrade of Nelson Bay Road is unlikely to isolate known habitat for the two orchids. The large population of *Diuris praecox* will not be isolated from the smaller population nearer the road.

f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.

Habitat for *Diuris praecox* appears to be represented in regional conservation reserves, such as Glenrock SRA and Tomaree NP. How adequately the species is represented in such areas is unknown, although the species is known from Glenrock SRA and is likely to occur within suitable habitat in Tomaree NP.

Briggs and Leigh (1996) have assigned a conservation code of 2VC- to *Diurus praecox*, meaning that the species:

- has a geographic range of less than 100 kilometres;
- is vulnerable (that is, the species is not presently endangered, but is at risk over a longer period of disappearing from the wild through continued depletion, or it occurs on land whose future use is likely to change and threaten its survival); and
- has at least one population in a conservation reserve, however the reserved population size is not accurately known.

Jones (1999) suggests that *Diuris arenaria* be assigned a conservation code of 2VC based on the criteria of Briggs and Leigh (1996). *Diuris arenaria* is restricted to the Tomaree Peninsular and is conserved in Tomaree NP though the adequacy of conservation is not known.

h) Whether any threatened species or ecological community is at the limit of its known distribution.

Diuris praecox and *Diuris arenaria* are both at the known limit of distribution in the Port Stephens region, with the later being restricted to the region.

Diuris praecox is endemic to central eastern New South Wales from Port Stephens to Ourimbah (Jones 1991). A local population of the species is therefore at the northern limit of its known distribution.

1.3.2 *Environment Protection and Biodiversity Conservation Act 1999*

Under the EPBC Act an action requires approval from the Minister of the Environment if *the action has, will have or is likely to have, a significant impact on a matter of national environmental significance* (being threatened species). Environment Australia's guidelines on the significance of impact of actions identifies widening of an existing road as not likely to be significant under the Act where the road verge has previously been cleared or the vegetation beside the road has been heavily modified. However if road widening would require removal of native vegetation that contains critically endangered or endangered plant species or communities, it is likely to have a significant impact on a matter of national environmental significance. The vegetation along the road corridor has not been heavily modified. Critically endangered or endangered plant species or communities do not occur along the road corridor.

If the Minister decides that the action is likely to have a significant impact on threatened species then the action requires approval under the EPBC Act. If the Minister decides that the action is not likely to have a significant impact then the action does not require approval under the EPBC Act and Port Stephens Council and Roads and Traffic Authority will not contravene the Act if the action is taken in accordance with that advice.

An assessment of the significance of the impact on a vulnerable species, in particular an *important population* of a species is required. An *important population* is defined as one that is necessary for a species' long term survival and recovery including:

- key source populations either for breeding or dispersal;
- populations that are necessary for maintaining genetic diversity; and/or
- populations that are near the limit of the species range.

The spotted-tailed quoll is considered to have a moderate to high likelihood of occurring along the road corridor. The orchid *Diuris praecox* has been recorded in an easement perpendicular to the road but outside of the area of disturbance.

No individuals of spotted-tailed quoll were identified directly or indirectly in the road corridor. The existence or size of population of spotted-tailed quoll in the immediate environs is unknown. NPWS records are concentrated in the Anna Bay and Boat Harbour area suggesting that there is a local population in the area to the north of this study area. Should individuals or a population exist in the immediate environs they would be expected to be utilising the adjoining large tract of open forest along the Stockton Bight. Any population in the region are not at the limit of the known range of the spotted-tailed quoll.

The population of *Diuris praecox* occurring to the south of the road corridor, along the main electricity easement, is considered to be an important population based on the following:

- the large size of the population;
- the ecology of the orchid is poorly known;
- it is near the limit of its known range; and
- this population orchid is expected to be necessary for maintaining genetic diversity, as it constitutes adult and juvenile plants with seed capsules while other records in the region are scattered individual plants (G. Hillman pers comm).

An action has, will have or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to:

- *lead to long-term decrease in the size of an important population of a species; or*

The road upgrade along Option 1B will not impact on or decrease the size of the locally known important population of *Diuris praecox* or the smaller population closer to Nelson Bay Road.

No individuals of spotted-tailed quoll were identified along the road corridor or during current investigations or previous investigations along Option 1B or Option 2 (ERM Mitchell McCotter 1998a, 1998b). The proposed road upgrade is not anticipated to lead to long-term decrease in the size of any population of the spotted-tailed quoll.

- *reduce the area of occupancy of an important population; or*

The proposed road upgrade will disturb approximately 8.8 hectares of dry open forest, 0.74 hectares of swamp forest and 7.6 hectares or cleared grassland and landscaping. Forest habitats are continuous with a large tract of forested habitats along the Stockton Bight, which is expected to provide habitat for the spotted-tailed

quoll. The area of disturbance along the road is not a significant reduction of habitat for any population in the immediate environs.

Proposed road upgrade along Option 1B will not impact on or reduce the area of occupancy of the *important population* of *Diuris praecox*.

- *fragment an existing important population into two or more populations; or*

The proposed road upgrade is aligned along an existing road and will widen this barrier to dispersal of any population of the spotted-tailed quoll in the environs. Forest habitats are continuous with a large tract of forested habitats along the Stockton Bight, which provide habitat for the spotted-tailed quoll. The area of disturbance along the road is not a significant reduction of habitat for any population in the immediate environs.

The proposed road upgrade will not fragment the *important population* of *Diuris praecox* or the smaller population near the road.

- *adversely affect critical habitat to the survival of a species; or*

Critical habitat for the spotted-tailed quoll includes den sites, large tracts of foraging habitat and dispersal corridors. There was no evidence found of the quoll using potential den sites (hollow logs) and no 'latrine' sites defining territories along the road corridor. It is anticipated that den sites are available within the large tract of adjoining habitat along Stockton Bight and that the road upgrade will not significantly reduce available den sites. The road upgrade will minimally reduce available habitat in the immediate environs. Wildlife corridors will be affected through widening of the barrier afforded by the road especially at the western end of the road upgrade, however this is not anticipated to significantly impact on the spotted-tailed quoll. The proposed road upgrade is not expected to adversely affect critical habitat of the spotted-tailed quoll.

The population of *Diuris praecox* identified along Option 2 is likely to be significant for survival of the species in the Port Stephens area. The proposed road upgrade will not adversely affect critical habitat of the orchid.

- *disrupt the breeding cycle or an important population; or*

The spotted-tailed quoll breeds from April to July and juveniles are independent at 18 weeks. The proposed road upgrade is not expected to disrupt the breeding cycle of any individuals of spotted-tailed quoll that may occur in the environs of the study area.

Diuris praecox flowers from late July to early September, being pollinated by insects. The presence of juveniles and seed capsules indicates a breeding population. The

population of *Diuris praecox* will not be disturbed by the proposed road upgrade and the breeding cycle will not be disrupted. The smaller population near Nelson Bay Road will be protected by barrier fencing during the construction period.

- *modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline; or*

The removal of a narrow corridor of open forest over 6.7 kilometres (approximately 8.8 hectares) will not decrease the availability or quality of habitat to the extent that any population of spotted-tailed quoll is likely to decline.

The proposed road upgrade will not modify, destroy, remove or isolate or decrease the availability or quality of habitat for *Diuris praecox* to the extent that the species is likely to decline.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat (by direct competition, modification of habitat, or predation); or*

The fox and cat are recognised as invasive species that are a known or perceived threat for native species. Both are a threat to the spotted-tailed quoll through predation and competition. The fox is known to occur in the study area and is likely to scavenge along the road on road kills. Upgrading of the road may result in an increase in road kills and may contribute to and increase in fox predation in the local area.

The orchid is currently occurring in a cleared easement where there are some invasive plants. The road upgrade is not expected to alter species composition in the existing easement.

- *interferes substantially with the recovery of the species.*

The proposed road upgrade is not expected to interfere with any individuals or population of the spotted-tailed quoll. It will not interfere with the identified important population of the orchid *Diuris praecox*.

No critically endangered or endangered plant species or communities were identified along the road corridor and the action is not likely to significantly impact on matters of national significance being the vulnerable species spotted-tailed quoll or the orchid *Diuris praecox*.

1.4 CONCLUSION OF THREATENED SPECIES ASSESSMENT

The upgrade of Nelson Bay Road between Bobs Farm and Anna Bay is not expected to significantly effect threatened species, populations or ecological communities or their habitats. Identified den trees for squirrel gliders have been avoided to minimise impacts on the local populations. The road has been aligned to minimise disturbance of preferred koala habitat however some areas and individual swamp mahogany to the north of the existing road will be cleared.

The road upgrade will widen the barrier to dispersal of terrestrial and arboreal fauna provided by the existing road. This is especially relevant for the western end of the road in the elevated dunes where the existing road dissects a large tract of habitat through the Stockton Bight dune system. The only other potential corridor is where coastal swamp forest fringes both sides of the road, to the east of Bobs Farm general store. Opportunities to create underpasses in these areas are limited.

There are several mitigation measures that may reduce the impact of the road upgrade on flora and fauna:

- restricting vegetation removal to the road corridor;
- gradual clearance of the road corridor to allow fauna to move into adjoining habitats;
- timing of vegetation clearance to avoid periods of critical habitat usage, for example clearing of habitat trees outside of the winter hibernation and summer maternity periods may minimise direct mortality of tree roosting bats, alternatively habitat trees can be selective cleared;
- clearing in the vicinity of habitat trees should be modified to include initial clearance of understorey on day one, leaving the habitat tree undisturbed overnight. On day two the habitat tree will be 'nudged' by the dozer followed by 15 minutes waiting period prior to felling. This methodology allows resident fauna species the opportunity to escape reducing direct mortality of individuals;
- pre-clearance inspection of large fallen hollow logs for evidence of the spotted-tailed quoll;
- presence of wildlife recovery personnel during clearing, especially habitat trees, to recover fauna;
- establishment of nesting boxes at a density of four to six per hectare, in adjoining habitat to replace felled habitat trees (nesting boxes can be made from felled tree limbs containing hollows, sectioned into 600 to 800

millimetre lengths, capped at both ends, an entrance hole of 50 to 60 millimetre diameter drilled through the wall of the limb, and attached to a tree at a height of greater than four metre);

- use of warning signs along the road especially where corridors exist either side of the road;
- restricting the construction phase near Marsh Road intersection from summer to mid autumn (outside of the breeding season of the wallum froglet);
- construction of grassed drains with sedges to providing habitat for wallum froglet in the long term; and
- erection of protective barrier fencing during construction between the road upgrade area and the smaller population of *Diuris praecox* in the easement east of Trotters Road.

Measures to mitigate the potential impacts on koalas of motor vehicles are limited to warning signage at this stage as there was no evidence of koala activity and the area is not identified as a 'black spot' in the CKPoM. Conservation of the preferred habitat and a buffer area will ensure the provision of a potential movement corridor in the future. It is recommended that koala activity in the area of preferred koala habitat be monitored following construction to re-evaluate the need for mitigation measures. This could be included in the annual CKPoM monitoring programme for potential problem areas. Exclusion fencing may be warranted in the long term should there be evidence of koala activity in the area.

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RTA

SCHOOL SITE HERITAGE ASSESSMENT

Appendix E

Port Stephens COUNCIL
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Chapter 1

INTRODUCTION

1.1 BACKGROUND

Environmental Resources Management Pty Ltd (ERM) has been engaged by the NSW Roads and Traffic Authority (RTA) and Port Stephens Council to prepare a cultural heritage assessment of the original Anna Bay Public School site. The assessment was carried out as part of a Review of Environmental Factors (REF) for the proposed Nelson Bay Road upgrade.

The cultural heritage study aimed to assess the heritage and archaeological significance of the site, which includes two Hoop Pine trees that are located on the boundary between the old school grounds and the Nelson Bay Road reserve.

The Port Stephens Council heritage officer has requested that the study include a Statement of Heritage Significance (SOHS) and a Statement of Heritage Impact (SOHI) in accordance with NSW Heritage Office guidelines. The SOHI and SOHS would assist the RTA, the Port Stephens Council and the NSW Heritage Office to make informed decisions about the Anna Bay Public School site.

1.2 THE PROPOSED DEVELOPMENT

The proposed Nelson Bay Road upgrade would include widening the existing road and constructing an ultimate dual-carriageway (refer to *Figure 1* for RTA plan of study area). The total width of the road reserve will vary between 38 to 47 metres. This will comprise two 2 lane carriageways between 9.5 and 10 metres wide, a central median 7 metres wide, a 6 to 9 metre clear zone on each side of the deviation and a 3 metre wide service corridor. Within the 100 km/h speed limit zone the median would be 7 metres wide. The rest of the road would have a median width varying between 3 and 4 metres.

Construction works would generally consist of the following:

- erection of temporary sediment control structures such as silt fencing and establishment of site compound;
- removal of trees and installation of protection fencing for trees that are close to the road;

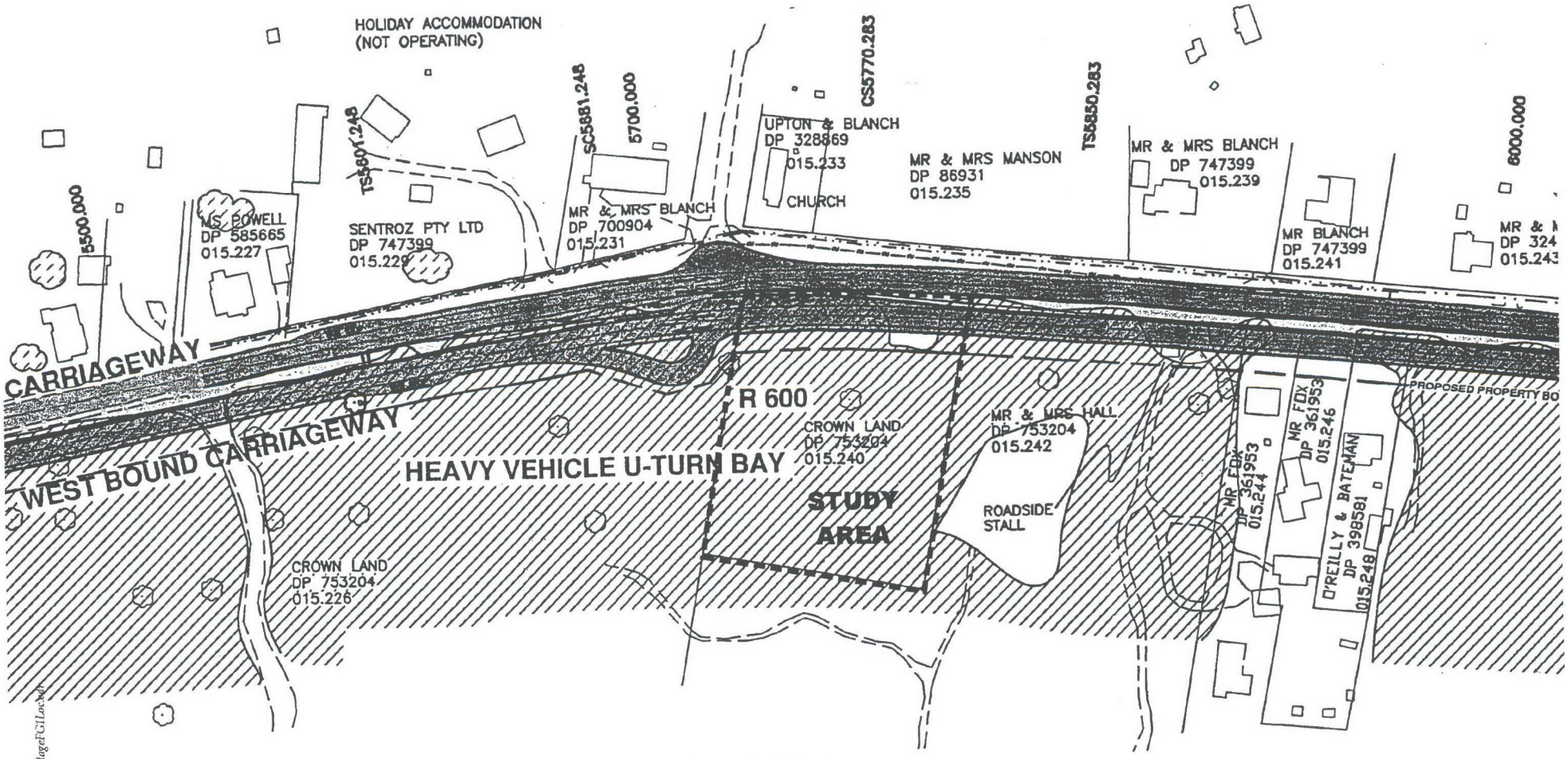
- removal of existing road surface and adjacent areas where required for realignment;
- reconstruction, removal and construction of culverts where required;
- import and placement of gravel road base;
- grading of batters and road surface (the size and slope of road batters would be determined in the detailed design phase);
- pavement laying ;
- line marking and removal of temporary protection measures;
- stabilisation/grassing of batters, open drains and other peripheral areas;
- construction of two retaining walls approximately one kilometres from the start of the upgrade in the sand hills; and
- removal of protective fencing and temporary sediment control structures.

The construction would be carried out in stages as determined by the availability of funding for the project.

1.3 OBJECTIVES

The objectives of the investigation were to:

- investigate relevant local and thematic history relating to the Anna Bay Public School;
- survey and record archaeological and cultural features at the original Anna Bay School site;
- engage a qualified Arborist to carry out a "Safe and Useful Life Expectancy" (SULE) for the historic Hoop Pine trees;
- assess the cultural heritage significance of the site and its associated features and provide a Statement of Heritage Significance;
- prepare and Statement of Heritage Impact; and
- prepare appropriate management recommendations.



SOURCE: *RTA Plan No. R1627*

BLACKBUTT & RUSTY GUM
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Figure 1 LOCALITY PLAN

1.4 METHODOLOGY

Chris Betteridge of the NSW Heritage Office was consulted in regard to Heritage Office requirements for the Heritage Assessment. Mr Betteridge, in his capacity as Port Stephens Heritage Officer and NSW Heritage Office heritage landscape specialist, advised that a Statement of Heritage Significance, a Statement of Heritage Impact and a Safe and Useful Life Expectancy (SULE) evaluation for the pine trees would be carried out. The advice provided by Chris Betteridge formed the basis of the project methodology.

Investigations consisted of a review of relevant historical information, including a search of the NSW State Heritage Inventory and the Port Stephens Council Local Environment Plan 2000(LEP 2000), consultation with the Port Stephens Historical Society, a field inspection, local oral history research and a SULE determination for the Hoop Pine trees.

A site inspection was conducted in January 2001. ERM archaeologist and heritage consultant Jim Wheeler carried out the fieldwork, which included recording cultural features relating to the site and investigating the heritage curtilage. Jim Wheeler also carried out the background research, prepared the Statement of Heritage Significance and the Statement of Heritage Impact. The report was compiled by Jim Wheeler and reviewed by project director, Steve O'Connor.

1.5 ACKNOWLEDGEMENTS

The Author would like to thank a number of people who assisted in putting together this report. Thanks are extended to Rex Coombes of the Port Stephens Historical Society for his valuable help, Thomas Blanch of Anna Bay for his fascinating first-hand recollections of school life, Newcastle City Library for their excellent local history resources, Chris Betteridge from the NSW Heritage Office for his important input and Sally Thompson for her assistance in the field.

Chapter 2

HISTORIC CONTEXT

2.1 HISTORY OF ANNA BAY PUBLIC SCHOOL AND THE ANNA BAY AREA

Anna Bay was the location for the first school at Port Stephens. The Anna Bay Provisional School was opened in November 1879 on private property facing onto the government road (now Nelson Bay Road). It is important to note that the establishment of a school at Anna Bay came 7 years before the first school was built at Nelson Bay (NSW Department of Education, 1998). This reflects the importance of Anna Bay as the focus for the earliest settlement on Port Stephens.

Prior to European settlement, the Port Stephens area was the traditional land of the Worimi people. Archaeological evidence from Moffatt's Swamp indicates that the Worimi and their ancestors have occupied the region for at least 17,000 years (Baker 1994). The earliest European mention of Port Stephens comes from Captain James Cook, who named the port as he passed along the coast in April 1770.

Port Stephens was first charted in 1795 by deputy surveyor Charles Grimes, but it was not until 1812 that European occupation of the area began. During that year, Governor Lachlan Macquarie inspected the port and set up a military post at Soldiers Point to apprehend escaped convicts (Anna Bay Centenary Committee, 1979). From 1816 cedar-getters began to intermittently visit Port Stephens in search of timber.

Actual settlement of Port Stephens did not begin until 1824, when Captain William Cromarty and his family selected 300 acres at Soldiers Point (Anna Bay Centenary Committee, 1979). Anna Bay was settled in 1855 by John and Lucy Blanch, who set up a homestead at Birubi Point and planted a variety of crops, including a vineyard (Anna Bay Centenary Committee, 1979). Settlement of the Anna Bay area continued at a slow pace, with a number of families selecting land along the margins of what is now Nelson Bay Road.

By the late 1870's the families of the Anna Bay community included 26 children of school age and there was a general perception that the children were suffering for a lack of education. This sentiment was expressed by Alfred Blanch, when he wrote in a letter to the Council of Education, dated September 1st 1879, that there had been "great want of a school experience" in Anna Bay (Anna Bay Centenary Committee, 1979). Blanch went on to explain that the community were erecting a school

building and requested that the Council of Education appoint Mr Alfred Holmes as the teacher (Anna Bay Centenary Committee, 1979).

On the 12th of September 1879, an application for the establishment of the Anna Bay Provisional School was made to the Council of Education and signed by Magnus Cromarty, Phillip Upton, Alfred Blanch and John Blanch (Anna Bay Centenary Committee, 1979). Prior to the passing of the Public Instruction Act of 1880, it was often incumbent upon the local community to take the initiative in establishing a school. The policy of the Council of Education (the fore-runner to the Dept. of Education) was that communities with an average attendance of at least 25 pupils (and at least 35-40 enrolled) received an entirely publicly-funded school (Fletcher, 1979). Unfortunately, smaller communities like Anna Bay with an average attendance of 12 - 25 students could only expect the Council to provide the teachers salary and educational materials (Fletcher, 1979). The school building, furniture and equipment had to be provided by the community themselves. Nonetheless, the Anna Bay community worked together to construct an 18 feet by 12 feet slab hut on William Blanches property (Anna Bay Centenary Committee, 1979). The school building was sited approximately 10 - 20 metres east of the Anna Bay Union Church building in an area which has since been excavated (Thomas Blanch pers. comm).

The passing of the Public Instruction Act of 1880 opened the way for Anna Bay School to be upgraded to a fully government-funded Public School. One of the most important provisions of the Act was to lower the number of pupils required for a Public School from an average attendance of 25 to 20 (Fletcher, 1979). So it followed that in 1882 when average attendance reached 20, Anna Bay Provisional School was converted to Anna Bay Public School (Anna Bay Centenary Committee, 1979). Although under the Public Instruction Act, this now meant that the Department of Education was responsible for providing and funding all aspects of the school, including buildings and furniture, the department took no action.

One of the consequences of the 1880 Act was that enrolments across NSW jumped by as much as 15 per cent in the first year. This required the Department to expand its building program four-fold, from 100,000 pounds in 1880 to 400,000 pounds in 1883 (NSW Department of Education, 1980). The huge increase in building requirements placed a strain on the department and they found it difficult to accommodate all students, in many areas resorting to temporary school tents. The implications for Anna Bay was that they were forced to lobby the Department and the Government to receive their entitlements. Thomas Bowden, the teacher at Anna Bay, led the fight to replace the school building, which he described in a letter to the Department of Education in 1883 as "not fit to house cattle much more than a human being" (Anna Bay Centenary Committee, 1979). The Department took no action regarding the building. This prompted the local community to petition their local Member of the Legislative Assembly to take up their cause. Action was finally taken in September

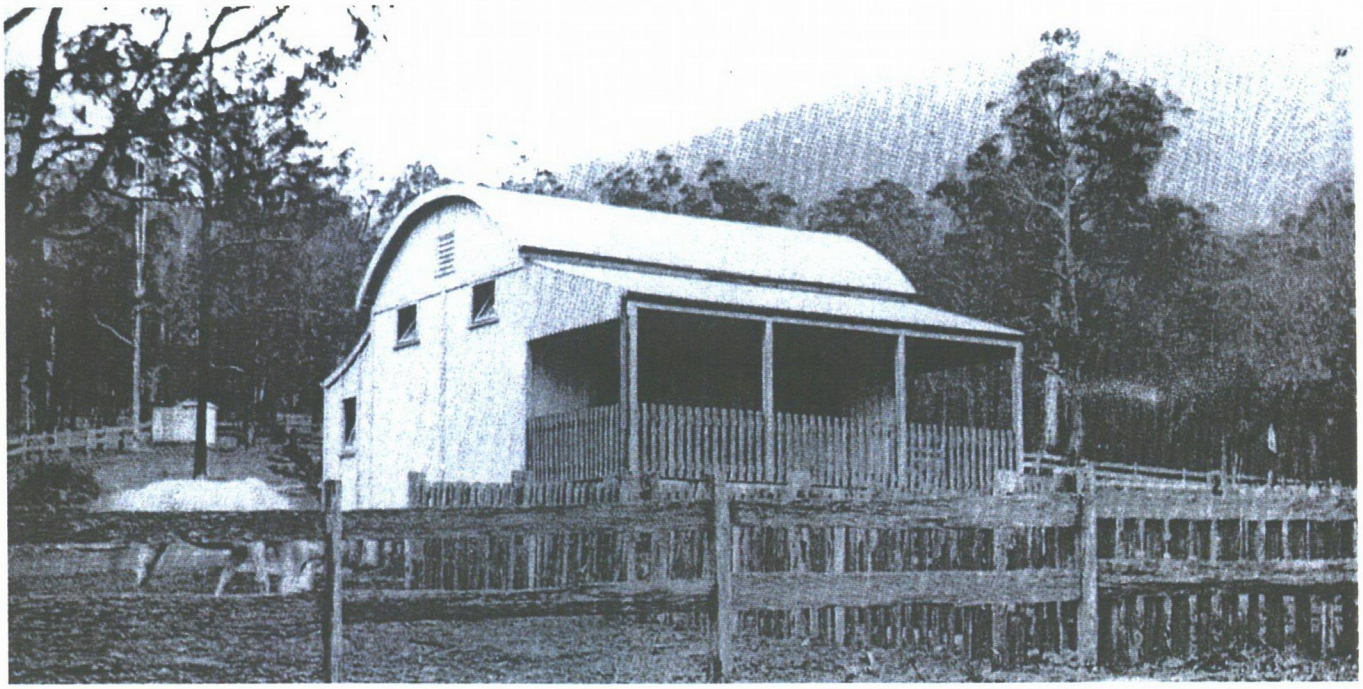
1883 when the Inspector of Schools visited Anna Bay and selected a two acre block for the new school (Anna Bay Centenary Committee, 1979). The new site was gazetted on the 7th April 1884 as crown land for Public School purposes (NSW Government Gazette 1884) (*Appendix F1* includes the portion plan for the site).

In 1884 the new Anna Bay Public School was erected on the opposite side of Nelson Bay Road from the site of the provisional school. The new classroom was a template design known as a "beehive" because of the curved shape of the roof. Beehives were designed by the Department of Education architect to be quickly and cheaply erected so that the huge demand for classrooms generated by surging enrolments could be satisfied (NSW Department of Education, 1980). The buildings consisted of one classroom only, with no storeroom and no verandah and were fabricated from tongue-in-groove timber boards and a corrugated iron roof (refer to *photograph 1*). The beehive constructed for the Anna Bay classroom was 20 feet by 16 feet in size and cost 300 pounds to build (Port Stephens Examiner, November 1979).

Immediately after the new school was established, enrolments dropped off and the Department of Education decided to operate the school on a part time basis with the newly established Nelson Bay Public School (Anna Bay Centenary Committee, 1979). In 1890 enrolments had increased sufficiently for Nelson Bay to have their own teacher appointed and Anna Bay became a full-time 1 teacher school again (Anna Bay Centenary Committee, 1979). Another sign of the increasing population in the district came in 1895 when Anna Bay received its own post office, initially taking two deliveries per week.

After the turn of the century, there was increasing unhappiness with the condition of the beehive building on account of the damage inflicted by white ants. The progress association condemned the building and after calls for its replacement, the assistant architect of schools in Newcastle carried out an evaluation, which concluded that the building was almost totally destroyed (Anna Bay Centenary Committee, 1979). A new weatherboard and hipped-roof building was erected in 1910 to replace the beehive classroom. The size of the building (21 feet square) was similar to the beehive, but it had the advantages of a verandah and much improved lighting (refer to *Photograph* 2). The remains of the beehive were used by the teacher to construct a school shed.

For forty years the school enrolments remained relatively stable and the single 25 student classroom was sufficient. This began to change in the 1920's with the advent of the automobile, the upgrading of the Government Road from Newcastle and the increasing accessibility of Port Stephens to tourists (Port Stephens Examiner, November 1979). Birubi Point was sub-divided in 1925 and this had important implications for the future of Anna Bay and Anna Bay Public School (Anna Bay Centenary Committee, 1979). As a result of the subdivision of land, population began to increase in the area and the population focus began to shift away from the



Photograph 1 Mount George Public School "Beehive", Erected 1885.

SOURCE: Sydney and the Bush, NSW Department of Education, 1980.

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Photograph 2 1910 Anna Bay Classroom in its present location at Hinton Public School.

farms and properties along Nelson Bay Road toward the modern township of Anna Bay.

In 1927 the school enrolment reached 46 and this steadily increased over the next twenty years providing the impetus to expand the school (Anna Bay Centenary Committee, 1979). By 1955 the school enrolment had reached 68 and despite the erection of a new classroom to adjoin the 1910 building a more lasting solution was required (Anna Bay Centenary Committee, 1979). A population survey was carried out and this indicated that school enrolments would continue to increase. The decision was taken by an Inspector of Schools to establish a new school in the district. After a public meeting it was decided to relocate to the modern Anna Bay Public School site (Anna Bay Centenary Committee, 1979). On the 11th of March 1961 the new Anna Bay Public School was officially opened (Anna Bay Centenary Committee, 1979).

After the closure of the original Anna Bay Public School in 1960, the facility was converted to the Teramby Special School for handicapped children. (Port Stephens Examiner, 14/1/1982). The Special School continued to operate until 1978 when declining enrolments forced its closure (Port Stephens Examiner, 14/1/1982). The site remained dormant until December 1981 when the 1910 weatherboard classroom was relocated to Hinton Public School (Port Stephens Examiner, 14/1/1982). The weatherboard classroom was refurbished in its new location at Hinton and is still in operation there.

2.2 THEMATIC HISTORY: THE DEVELOPMENT OF PUBLIC EDUCATION IN RURAL NSW

With a history dating to 1879, Anna Bay Public School is a representative example of the development of public education in rural New South Wales. Prior to the Public Instruction Act of 1880, education was not compulsory and government funding for education was limited and governed by conditions (Fletcher, 1979). Many schools were operated by churches and small schools, particularly in more isolated rural areas like Anna Bay, were only partially government funded. These "provisional schools", where average attendances were below 25 students, received educational materials and funding for a teacher from the Council of Education but everything else had to be funded by the community (Fletcher, 1979). This meant that the impetus for establishing small schools in rural NSW had to come from the local community themselves.

The Public Instruction Act of 1880 enshrined the principles of free, secular and public education and shifted the responsibility for establishing schools onto the Department of Education. One of the changes brought about by the 1880 Act was to

lower the threshold for full government-funded Public School status to all schools with a minimum average attendance of 20 (Fletcher, 1979). This enabled many schools like Anna Bay to become fully funded by the Department of Education and receive the benefits of more comfortable school buildings, equipment and furniture. Although the initial impetus to set up schools often came from a community effort, the Public Instruction Act ensured a certain degree of universality of education across New South Wales, which was and remains an important element in providing an equality of opportunity to all children, irrespective of their location.

Chapter 3

SITE SURVEY

3.1 SURVEY OF THE ORIGINAL ANNA BAY SCHOOL SITE

A field survey of the school site was carried out in January 2001 to identify landscape and archaeological features. The results of the survey are illustrated in *Figure* 2 in the form of an archaeological landscape plan. Thomas Blanch, a local Anna Bay resident, attended the original Anna Bay Public School prior to its closure in 1960 and assisted the survey team in interpreting landscape features on the school site.

The following features were identified during the survey work (refer to *figure* 2 for location of features):

- Two Hoop Pine Trees: A full physical description and evaluation of the trees is included in *Appendix F2*. There are two documentary accounts of commemorative tree-planting ceremonies being carried out in connection with Anna Bay Public School. In 1951, Alfred Diemar, the school teacher at the time organised a tree-planting as part of a "back to Anna Bay" function (Anna Bay Centenary Committee, 1979) and two centenary pines were planted at the modern Anna Bay Public School as part of centenary celebrations in 1979 (Port Stephens Examiner, November 1979). Thomas Blanch also stated that there were other pines along the boundary of the school grounds facing onto Nelson Bay Road but that they were removed (Thomas Blanch pers. comm.). These sources of evidence suggest a tradition of planting commemorative pine trees to mark school occasions and therefore it is likely that the two remaining Hoop Pine trees are examples of this.

- Footprint of the 1910 school building. A structure footprint was identified toward the western end of the school site and according to Thomas Blanch this was the site of the 1910 classroom (refer to *Photograph 3*). The weatherboard building was 21 feet square, which corresponds with the size of the area and supports Blanch's interpretation. The area in and around the classroom site has also been levelled with a gravel fill. There is a potential for sub-surface archaeological features such as footings or underfloor deposits in this area. There is also a possibility that some evidence of the original 1884 "Beehive" building may be present underneath the remains of the 1910 classroom footings.

- Remains of toilet block. Concrete remains of the toilet block are still in evidence approximately 40 meters to the rear of the 1910 classroom site. The concrete fabric was probably the back wall of the washroom and relates to a late, probably post-world war two, toilet complex (refer to *Photograph 4*). There is a potential for earlier cess-pits below the modern ground surface and to the rear of the 1910 classroom site.

- Site of Tennis Court. There is a large cleared area to the eastern end of the school site, which corresponds with a white hard-packed clay material (refer to *Photograph 5*). T homas Blanch explained that this was the site of the school tennis court (Thomas Blanch pers. comm.). Blanch stated that the clay for the court surface came from the River Rise Quarry at Nelson Bay (Thomas Blanch pers. comm.). It is unlikely that there are sub-surface deposits in this area.

- Pencil Pine. An introduced Pencil Pine was identified on the western margin of the school tennis court. There appears to be another structure footprint in this area which may have been a sport shed or player-annex to the tennis court.

- Fence Post. A single three-run wire fence post was found on the front margin of the school grounds. It is unclear whether this relates to a property fenceline or a fence around the tennis court.

The survey of the school site failed to find any evidence for a driveway or front path leading up to the school although Thomas Blanch stated that the entrance to the school was to the west of the 1910 classroom.

The 1910 Anna Bay school classroom was re-located to Hinton Public School in 1981 (Port Stephens Examiner, 14/1/1982). Following the Anna Bay School survey, Hinton Public School was visited and it was noted that the 1910 weatherboard building is still in use at the school (refer to *Photograph 2*).

3.2 CONTEXTUAL SURVEY

The 1931 Union Church is almost exactly opposite the site of the 1910 classroom, on the other side of Nelson Bay Road. Before the church was constructed, this was the site of the Anna Bay Provisional School 1879 - 1884. The slab-hut classroom was located approximately 10-20 metres east of the Union Church (Thomas Blanch pers. comm.) but due to excavation works in this area there is no potential for archaeological remains.

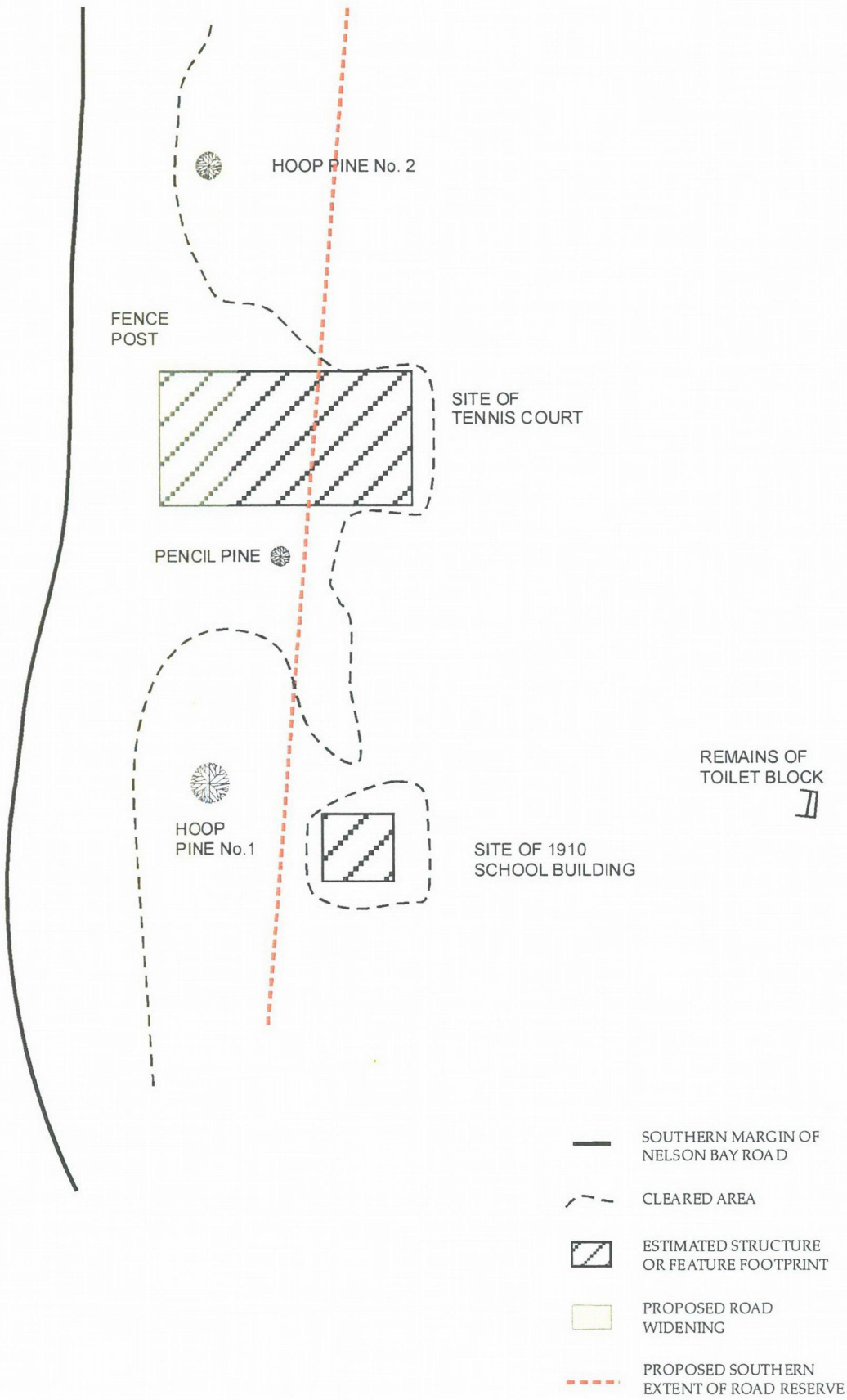

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Figure 2 ARCHAEOLOGICAL SURVEY PLAN
ANNA BAY SCHOOL 1884-1960

Photograph 3 Site of 1910 Classroom.

Photograph 4 Remains of Toilet Block

Photograph 5 Site of Tennis Court.

Photograph 6 Location shot of Study Area showing the Hoop Pine Trees.

Chapter 4

SULE ASSESSMENT OF LIFESPAN FOR THE HOOP PINE TREES

4.1 RESULTS OF THE SULE ASSESSMENT

A Safe and Useful Life Expectancy (SULE) evaluation was commissioned as part of this study to determine the life expectancy and hazard potential of the two Hoop Pine trees on the Anna Bay school site (refer to *Photograph 6*). A SULE evaluation is a formal assessment of tree life expectancy based on tree features such as basal diameter and height. A qualified consulting Arborist was engaged to carry out the SULE assessment and the full report is included in *Appendix F2*.

The findings included in the Arborist's report can be summarised as follows:

- both trees were identified as *Araucaria cunninghamii* (Hoop Pine);
- Tree 1 (located to the western side of the study area) was identified as a mature specimen, approximately 25-28 metres in height. The report estimated that the tree is 80-100 years old and has a SULE rating of 40 + years; and
- Tree 2 (located to the eastern side of the study area) was identified as a semi-mature specimen, approximately 13-15 metres in height. It is estimated that the tree is 30-40 years old although a SULE rating could not be assessed due to a basal scar and significant termite damage to the tree. The report recommended that a qualified pest controller assess the degree of termite damage to the tree and estimate the degree of structural compromise.

A qualified and licensed pest controller was engaged to assess the degree of termite damage to Tree 2 and estimate the degree of structural compromise. The results of the assessment are included in *Appendix F3* and can be summarised as follows:

- a basal scar approximately 350 mm wide and 150 mm deep has been caused by termites;
- the tree has been partially ringbarked, leaving only 40 % living tissue at the base;

- the extent of damage to Tree 2 has impaired the structural integrity of the tree and the large amount of termite activity will cause further damage to the tree; and

- Tree 2 will be at an ever increasing risk of falling on the road and may cause damage to person or property.

4.2 IMPLICATIONS OF THE SULE RESULTS

The results of the SULE assessment have a number of important implications for the Heritage Assessment of the Pine Trees. Tree 1, which is estimated to be between 80-100 years old, qualifies as a relic under the definition provided in the NSW Heritage Act 1977. Furthermore, Tree 1 is in a healthy condition and is likely to live for at least another 40 years. Tree 2 has an estimated age of 30-40 years and as such does not qualify under the minimum age of 50 years required for classification as a relic under the NSW Heritage Act 1977. The structural integrity of Tree 2 has been compromised by Termite activity and as a result has a very low life expectancy. Tree 2 should be considered a danger to the public given its potential to fall and its proximity to Nelson Bay Road.

For the purposes of the heritage significance assessment, Tree 1 will be considered as an historic feature because it qualifies as a relic under the NSW Heritage Act 1977. Tree two will not be assessed as it does not qualify as a relic under the Act. The pest assessment has also demonstrated that Tree 2 is a potential danger to the public and it is recommended that the tree be removed as soon as possible on public safety grounds.

Chapter 5

ASSESSMENT OF CULTURAL HERITAGE SIGNIFICANCE

5.1 EVALUATION CRITERIA

The concept of cultural significance helps estimate the value of places or items at the local, state, national or world level and is defined by specific criteria. New criteria came into force in April 1999 following amendments to the Heritage Act 1977. These new criteria replace those derived from the *ICOMOS Burra Charter* of aesthetic, historic, scientific/technical and social value that have formed the basis of previous assessments of cultural heritage significance.

The significance criteria and significance assessment for the Anna Bay school site are set out in *Table 5.1*. An item would be considered to have State or Local heritage significance if, in the opinion of the Heritage Council of NSW, if it meets one or more of the criteria listed in *Table 5.1*. The differentiation between State and Local significance is determined by the comparative criteria of *Representativeness* and *Rarity*, which can be summarised as follows:

- Representativeness: *Items having this value are significant because they are fine Representative examples of an important class of significant items or environments.*
- Rarity: *An item having this value is significant because it represents a rare, endangered or unusual aspect of our history or cultural environment*

5.2 SIGNIFICANCE ASSESSMENT

Table 5.1 ASSESSMENT OF THE CULTURAL HERITAGE SIGNIFICANCE OF THE ANNA BAY SCHOOL SITE AND HISTORIC HOOP PINE TREE

	Criteria	Assessment	Level
Criterion (a)	*an item is important in the course, or pattern, of NSW's cultural or natural history (or the cultural or natural history of the local area)*	Anna Bay school is a representative element in the history and development of the NSW Public Education system in the local area. The school site has rarity at the local level as the first school established on Port Stephens.	Local
Criterion (b)	*an item has strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural history (or the cultural or natural history of the local area)*	Anna Bay School has an association with pioneer families of the Anna Bay area, notably the Cromarty's and the Blanch's, who were responsible for establishing the school and founding the Anna Bay community. These associations have rarity at the local level.	Local
Criterion (c)	*an item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area)*	The pine tree at the school site has rare aesthetic appeal in the local area. The site has no ability to demonstrate technical achievement as all buildings have been removed.	Local
Criterion (d)	*an item has a strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons*	The school site has an association with the local community as a representative element in the establishment and development of Anna Bay.	Local
Criterion (e)	*an item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area)*	The school site has little potential to contribute to an understanding of NSW's cultural or natural history.	None

Table 5.1 ASSESSMENT OF THE CULTURAL HERITAGE SIGNIFICANCE OF THE ANNA BAY SCHOOL SITE AND HISTORIC HOOP PINE TREE *(Contd)*

	Criteria	Assessment	Level
Criterion (f)	*an item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area);*	The school site does not possess rare or endangered aspects of NSW's cultural or natural history.	None
Criterion (g)	*an item is important in demonstrating the principal characteristics of a class of NSW's* • *cultural or natural places; or* • *cultural or natural environments. (or a class of the local area's*	Anna Bay school represents an aspect of the history and development of the NSW Public Education system and is a rarity and representativeness as an important element in the establishment and growth of the local community.	Local

5.3 STATEMENT OF HERITAGE SIGNIFICANCE

The original Anna Bay Public School site is a heritage landscape containing an historic Hoop Pine tree and potential sub-surface archaeological features relating to school buildings and a school tennis court. The history of the site is locally representative of the development of the public education system in NSW and a rare example of the establishment and development of the Anna Bay and the broader Port Stephens community. The community effort to establish a school at Anna Bay was representative of the pioneer families struggle to establish the fundamental elements of a community in what was an isolated area. This gives the site local social significance. The Hoop Pine tree has local rarity as a commemorative planting associated with the school and as the only significant marker of the original Public School site. In addition, the Hoop Pine tree has significant local landmark qualities, standing out as an impressive and dominating feature along the roadside landscape. In summary, the original Anna Bay Public School site, including the Hoop Pine Tree and the potential archaeological features, have local heritage significance.

Chapter 6

STATEMENT OF HERITAGE IMPACT

6.1 METHODOLOGY FOR STATEMENT OF HERITAGE IMPACT

The methodology used for preparing the Statement of Heritage Impact (SOHI) follows the model set out for SOHI's in the NSW Heritage Manual (NSW Heritage Office, 1996). The SOHI is designed to convey information about the effects of proposed impacts on heritage so that informed decisions about development can be made. A SOHI, together with the Statement of Heritage Significance and other relevant information addresses:

- Why the item is of heritage significance;
- What impact the proposed works would have on that significance;
- What measures are proposed to mitigate negative impacts; and
- Why more sympathetic solutions are not viable (NSW Heritage Office, 1996).

6.2 STATEMENT OF HERITAGE IMPACT

The following aspects of the proposal respect or enhance the heritage significance of the item for the following reasons:

- No aspects of the proposed Nelson Bay Road upgrade would enhance the heritage significance of the Anna Bay School Site;
- The only sense in which the proposed road upgrade would respect the heritage significance of the landscape is that the road route would follow the same line as the original "Government Road".

The following aspects of the proposal could detrimentally impact on heritage significance:

- The proposed Nelson Bay Road upgrade would include widening the existing easement by approximately 20 metres to the south. This current plan would necessitate removing the historic Hoop Pine tree on the school site and possibly disturbing potential sub-surface archaeological features;

- The Hoop Pine has been assessed as having local significance because of its landmark qualities, and its social/historic significance as the only remaining marker of the first Public School on Port Stephens (refer to Statement of Heritage Significance). These heritage values would be completely destroyed by the proposed removal.

- There is some local historic and possibly technical significance of potential sub-surface archaeological features. The proposed road widening would excavate and could destroy potential features unless the features can be salvaged and recorded.

The following sympathetic options should be considered:

i. Shifting the line of the proposed new carriageway 10 - 15 metres to the north in the area around the school site. This option would avoid removal of the Pine Tree and avoid disturbing potential archaeological features. From a heritage perspective this is the preferred option although it may not be practical given the limited easement width for the proposed road;

ii. Altering the line of the west-bound carriageway so that it skirts to the south of the Pine Tree and incorporates the tree into a traffic island. This option would disturb potential archaeological features but would retain the historic Pine Tree. This would not be a very sympathetic option because the context of the Pine Tree would be completely lost and placing the Pine Tree in the middle of a traffic island may harm the health of the tree. This option is also potentially more expensive than option 1 and it is possibly dangerous to have such a large tree in between the two carriageways;

iii. Removing the Pine Tree and planting two new Hoop Pines on the south side of the upgraded road. Although this option would destroy the heritage value of the trees it would provide some landscape continuity. In addition, signage could be erected on the south side of the road that provides information about the history and development of the school site. A photographic record of the tree could also be made prior to removal of the trees. This option should be considered as a last resort if options 1 and 2 are not considered feasible.

iv. If excavation works are to occur across the school site a qualified archaeologist should be engaged to monitor the excavation for potential archaeological features. This work would require an excavation permit from the NSW Heritage Office in accordance with section 139 of the *NSW Heritage Act 1977*.

Chapter 7

RECOMMENDATIONS

7.1 LEGISLATIVE REQUIREMENTS

7.1.1 Hunter Regional Environmental Plan 1989 (heritage)

Schedule 2 of the Hunter Regional Environmental Plan 1989 (Heritage) lists items of Regional, Local and State heritage significance in the Hunter region, which includes the Port Stephens LGA.

Clause 7 of Hunter REP (Heritage) states:

(1) A person shall not, in respect of a building, work, relic, tree or place that is a heritage item:

(a) demolish or alter the building or work;

(b) damage or move the relic, including excavation for the purpose of exposing the relic;

(c) damage or despoil land on which the building, work or relic is situated or land which comprises the place; ...

except with consent of the Council.

(2) The Council shall not grant consent to a development application made under subclause (1) unless it has made an assessment of:

(a) the significance of the item as a heritage item;

(b) the extent to which the carrying out of the development in accordance with the consent would affect the heritage significance of the item and its site;

(c) whether the setting of the item, and in particular, whether any stylistic, horticultural or archaeological features of the setting should be retained;

(d) whether the item constitutes a danger to the users or occupiers of that item or to the public; and

(e) measures to be taken to conserve heritage items including any conservation plan prepared by the applicant.

The original Anna Bay School Site and associated pine trees are not listed on the Hunter REP (Heritage) and therefore the provisions outlined above do not apply.

7.1.2 Port Stephens Local Environmental Plan 2000

The original Anna Bay Public School Site and pine trees are not identified in the Port Stephens Local Environmental Plan 2000 (LEP 2000) heritage schedule. Therefore the provisions of the LEP 2000, which require approval for demolition of LEP listed heritage items, do not apply.

7.1.3 The Heritage Act 1977

The *Heritage Act 1977 (Amended)* protects heritage items, sites, and relics. A relic is defined as any item relating to European settlement, or which is older than 50 years. It is an offence to *disturb or excavate any land knowing or having reasonable cause to suspect that the disturbance or excavation will result in a relic being discovered, exposed, moved, damaged or destroyed, unless the disturbance is carried out in accordance with an excavation permit issued by the Heritage Council of New South Wales.* An excavation permit is required if relics are likely to be discovered, exposed, moved, damaged or destroyed.

The NSW Heritage Office is responsible for administering the *NSW Heritage Act 1977* and under Section 139 an excavation permit must be obtained from them for the excavation or disturbance of a relic. This section of the Heritage Act would apply to the Nelson Bay Road upgrade if excavation works are to occur across the school site.

7.2 MANAGEMENT RECOMMENDATIONS

The following recommendations are based on:

- the NSW Heritage Act (1977);
- the results of the heritage assessment;
- the assessment of significance carried out in accordance with NSW Heritage Office guidelines.
- the Safe and Useful Life Expectancy assessment for the Hoop Pine trees; and

- the Statement of Heritage Impact;

The following management recommendations have been reached in consultation with Chris Betteridge, who is Port Stephens Heritage Officer with the NSW Heritage Office and Natalie Vinton, archaeologist with the NSW Heritage Office:

- The Hoop Pine tree referred to as "Tree 2" in this report (ie. the eastern tree) is a potential danger to the public and it should be removed as soon as possible on public safety grounds;

- The RTA and the Port Stephens Council have considered the sympathetic management options detailed in *Section 6.2* of this report. The favoured options are number 1 and 2, however if they are considered not feasible, option 3 should be implemented. In addition, option 4 should be implemented if any excavation work or ground disturbance is to be carried out on the old Anna Bay School site; and

- The RTA and the Port Stephens Council should consult with the Port Stephens Heritage Officer in assessing the feasibility of options set out in *Section 6.2* of the report. Consultation should be carried out prior to approval to ensure that the NSW Heritage Office have an opportunity to consider and provide advice or assistance in relation to the option(s) proposed.

REFERENCES

Secondary Sources

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The Illustrated Burra Charter, by Peter Marquis-Kyle and Meredith Walker (eds). Australia ICOMOS, Sydney.

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Department of Education NSW (1980)
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Department of Education NSW (1998)
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NSW Heritage Office (1996)
NSW Heritage Manual. NSW Department of Urban Affairs and Planning, Sydney.

Fletcher, J (1979)
Anna Bay Public School: A History Written by J.Fletcher, Directorate of Planning Services. Unpublished, NSW Dept. of Education, Sydney.

Primary Sources

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"Hinton New Home for Old School"

The Port Stephens Examiner (November 1979)
"Bark Hunt First School"

APPENDICES

Appendix A

PORTION PLAN FOR ANNA BAY PUBLIC SCHOOL SITE

Lab Book 627.10610

L.D. Raymond Terrace
L.D. Newcastle

PLAN OF PORTION Nos 1 & 3

County of Gloucester Parish of Tomaree

~~Proposed to be set apart for Public School Purposes~~
Applied for under the 4th & 5th clauses of the C.L.O. Act of 1861 by
The Depart ent of Public Instruction

1569

"Hannah Bay"

Approved 26th Feby: 84 Vide papers Misc: 84/1569
Dedicated 19th Sept. 84
Vide Misc 84-8167, land set apart as site for Public School. Nos.....Noted

Por. 3. Within R. 72017 for future Public Requirements. Not'd. 30th August 1948.

Por 3. Within R. 52244 from Sls. of Lse. other than Spl. Lse. or Annl. Lac. Not'd. 1st [illegible] 1917. Plans Rs. 2237 and 2238 Md. Rolls

62
C.P.78.17
W. Blanch 42a. 2r. 14p.

School

G1039.1427

Corner found

B note scale

ROAD 1 Chain wide to Hannah Bay & Nelson's Bay

from Raymond Terrace

68°30'

A Corner found

H 200.8 86°10' 80' C

137

1

2ac.

R. 168

488.5

513.5

G 400 F
90°0'

3

for Public School Purposes
10ac.

1368.5

covered with scrub and stunted timber

Sandy country

816.8

90°0'

Notified 7th April 84

E 90°0' 900 D

Examined & Charted W.J. Banks 9.2.84

Azimuth taken from AB

Reference to Corners

Corner	Bearing	From	Links	Vs on Tree
A	3°50'	Apple	6	A.R. 62.
B	312°45'	Honeysuckle	20	A.R. 62 63.
C	72°55'	Stringyb[illegible]	45.5	A.3.
D	61°30'	" "	26	A.3.
E	251°15'	" "	19.3	A.3. by G.2.79 Blackbutt
F	Stake			" " " "
G	90°0'	Gum	1.7	A.1.3.
H	11°40'	Stringyb[illegible]	41.3	A.1. by G.2.79 Blackbutt
I	233°20'	Apple	11.5	A.1.3. Tree referred to in instructions

Value of Improvements ——

Situated in the ——

Reference to Traverse

Line	Bearing	Distance
1	167°29'	101.3

I hereby certify that I in person made and on the 16th January 1884 completed the survey represented on this plan on which are written the bearings and lengths of the lines measured by me, and I declare that the survey has been executed in accordance with the regulations published for the guidance of Licensed Surveyors and the practice of the Surveyor Generals Department.

1236-1978

H. M. Graeme Licensed Surveyor

Scale 4 Chains to an Inch. Transmitted to the Surveyor General with my letter of the 18th January 1884 S. 84/10

P1236.1978

Appendix B

SULE ASSESSMENT REPORT

John Sheely
Tree Management and Consultancy

7Darley R
UMINA NSW 2

mobile: 0418 446
fax: 02 4344 6
email: jsheely@acay.com.a

ARBORIST REPORT
240 NELSON BAY ROAD
ANNA BAY

1.0 Background

1.1 At the request of Environmental Resources Management Australia Pty Limited, a site inspection was undertaken on 16 December 2000.

1.2 The purpose of this report is to provide comment on the safe useful life expectancy and hazard potential of two Hoop Pines located within Crown land at 240 Nelson Bay Road.

1.3 For the purposes of this report a visual assessment was undertaken.

2.0 The Trees

2.1 Tree 1: *Araucaria cunninghamii* (Hoop Pine)

This mature specimen is approximately 25-28 metres in height with a crown spread of approximately 10 metres. The basal diameter of this tree is 900mm.

This tree is supporting a well-foliated conical crown, which is dominant within the surrounding landscape.

At the time of inspection new apical growth was noted.

2.2 Tree 2: *Araucaria cunninghamii* (Hoop Pine)

This semi-mature specimen is approximately 13-15 metres in height with a crown spread of approximately 7 metres. The basal diameter of this tree is 460mm.

This tree is supporting an adequately foliated crown.

At the time of inspection new apical growth was noted.

This tree is supporting a basal wound on the southwestern side of the main trunk.

At the time of inspection active termites were noted in and around the basal wound.

3.0 Observations

3.1 Tree 1: *Araucaria cunninghamii* (Hoop Pine)

This tree appears to be a good specimen with no external structural faults noted at the time of inspection.

A build up of leaf litter and dead branches beneath the canopy of the tree indicates that minimal site disturbance has occurred immediately around the tree.

3.2 Tree 2: *Araucaria cunninghamii* (Hoop Pine)

Due to the semi-mature status of this tree it is not as prominent within the surrounding landscape as tree 1.

Due to the basal damage on the main trunk and the degree of foliation within the crown, this tree is considered to be an average specimen.

In my opinion, the basal wound and termite activity has potentially impacted upon the structural integrity of this tree.

4.0 Safe Useful Life Expectancy and Hazard Potential

4.1 Tree 1: *Araucaria cunninghamii* (Hoop Pine)

In my opinion, the safe useful life expectancy of this tree under current site conditions is estimated to be 40 + years.

In calculating this estimation the basal diameter and height of the tree were determining factors.

The hazard potential of this tree is considered to be low given that no targets exist immediately below the crown and no external faults were noted at the time of inspection.

4.2 Tree 2: *Araucaria cunninghamii* (Hoop Pine)

Unfortunately, due to the presence of active termites a safe useful life expectancy and hazard potential cannot be estimated.

5.0 Recommendations

5.1 Prior to the estimation of a safe useful life expectancy and hazard potential for tree 2, a thorough pest inspection of the subject tree is required.

5.2 Test drilling and probing of the tree is required to estimate the degree of structural compromise from the termite activity.

5.3 It is recommended that a qualified and licenced pest controller undertake this work.

John Sheely
Consulting Arborist
Member National Arborist Association of Australia
Member Australian Institute of Horticulture

Appendix C

PEST CONTROL REPORT

AMALGAMATED PEST CONTROL
A.B.N. 24 003 577 259
(Incorporating Pied Piper Pest Control)
Unit 4 / 34 Metro Court, Gateshead N.S.W. 2290
Phone 02 4943 9999 Fax 02 4943 1136
EMAIL: newcastle@amalpest.com.au

Environmental Resource Management Australia
P.O Box 71
THORNTON NSW 2322

Attention: Cleta

RE: Termite damage to a pine tree @ 240 Nelson Bay Road, Anna Bay.

An initial inspection of the tree found that a basal scar of approximately 350mm wide at the base and 280mm wide near the top, 2.15 meters high and 150mm deep exists which has been caused by termites.
The tree is about 600mm in diameter.

Upon drilling the tree it was found that the remainder seemed intact with no further hollows found.

It was noted that the tree had been partially ring barked leaving only about 40% of living tissue at the base.

The extent of current damage to the tree has, in my opinion, already impaired the structural integrity of the tree.
In addition there is a large amount of termite activity in the surrounding area indicating that further damage will be progressively done.

This tree will be at an ever-increasing risk of falling into the road and may cause damage to person or property.

If you require any further information on this matter please contact the undersigned.

Yours sincerely,

Tony Gavin
Termite Manager.

ERM Mitchell McCotter Quality System
Referred to CMN Ref. No. 59042
Date Received 12 JAN 2001
Source: Amalgamated Pest
Data suitability check received Yes ☑ No ☐
Data is:
Current ☑ ☐
Applicable to project ☑ ☐
Checked by
Explanation for 'no' answers or data
JW 12/1

RTA

PRELIMINARY RESEARCH PERMIT

Appendix F

Port Stephens COUNCIL
... a community partnership

ERM

PERMIT #:N3/PRP/99

NATIONAL PARKS AND WILDLIFE ACT 1974
SECTION 87(1)

PERMIT

PERMIT TO CARRY OUT PRELIMINARY RESEARCH

PERMIT ISSUED TO: Ms Angela Besant and Mr Adam Ford

OF: Insite Heritage
295 Dobell Drive
WANGI NSW 2267

AUTHORITY is hereby given for the person named above to conduct small test excavations for Aboriginal relics described in Schedule "A", on land described in Schedule "B", as specified under Section 86 of the National Parks and Wildlife Act 1974.

TERM OF PERMIT: Commences date of permit issue

Expires 18 months from date of permit issue

REPORTS DUE: Reports due 2 months from date of permit expiration

TERMS AND CONDITIONS OF THIS PERMIT

This permit is issued subject to General Terms and Conditions covering all archaeological Permits and Consents, as well as those Specific Terms and Conditions pertaining to each type of Permit. This Permit is also issued subject to any Special Conditions determined by the Director-General, which are detailed in the attached pages.

Excavation and/or collection is to be conducted using the methods set out in Section 3.2.1 of the Research Design that accompanied the application form (dated 1 July 1999).

DATED at Sydney this 5th day of NOVEMBER , 1999

for. Issued by the Director-General
National Parks and Wildlife

SCHEDULE A:

All Aboriginal relics, within the meaning of Section 90 of the National Parks and Wildlife Act 1974, but excluding human skeletal remains.

SCHEDULE B:

All land which, on gazettal, will be designated as road reserve accommodating Segment 9 of Nelson Bay Road, Parish of Tomaree, Port Stephens Shire, County Gloucester.

SPECIAL CONDITIONS APPLYING TO PRELIMINARY RESEARCH PERMITS

1. The permit holder shall ensure that no subsurface investigations are carried out until each of the specific areas nominated for small test excavations, and the specific methodology to be used, are ratified by the Worimi Local Aboriginal Land Council, the National Parks and Wildlife Service and Port Stephens Shire Council.

2. The permit holder shall ensure that any alterations to methodology or nominated areas must firstly be discussed, and have the concurrence of, the Worimi Local Aboriginal Land Council, the National Parks and Wildlife Service and Port Stephens Shire Council.

3. The permit holder shall ensure that all landholders, on whose property the sub surface investigations are proposed to be conducted, have been adequately consulted and have given consent to the sub surface investigations, prior to their commencement.

4. The permit holder shall ensure that representative(s) of the Worimi Local Aboriginal Land Council, and/or appropriately experienced representative(s) of the Aboriginal community, assist throughout the subsurface investigations.

5. The permit holder shall ensure that the Worimi Local Aboriginal Land Council is given the opportunity to apply for custodianship of any recovered cultural material from the subsurface investigations, through the lodgement of a completed Care and Control Permit to the National Parks and Wildlife Service.

SPECIFIC CONDITIONS APPLYING TO PRELIMINARY RESEARCH PERMITS

1 Any Aboriginal sites or locations or relics identified on the area covered by this permit must be clearly flagged and fenced temporarily as well as being identified to the proponent in the field.

2 All areas recorded or test-excavated are to be left in a condition satisfactory to the National Parks and Wildlife Service, immediately after the completion of the recording and test excavation.

3 A report on the result of the preliminary research shall be furnished to the National Parks and Wildlife Service within three months of the expiry of the Permit, or any renewal thereof.

4 This report shall include:

- outline of the aims of the research;
- a detailed description of the method of excavation/collection/ recording and analysis;
- a complete list of all material recovered;
- a detailed plan of sites excavated/collected, including the location of all trenches, auger holes and spoil heaps;
- National Parks and Wildlife Service site forms for all sites found. These must include 1:25,000 scale map references;
- the report must include a summary of consultation undertaken with relevant Aboriginal community groups;
- the permit holder shall also furnish the National Parks and Wildlife Service with a report written without archaeological terminology, which would be available to relevant Aboriginal Land Councils or relevant Aboriginal community groups.

5 All areas excavated are to be backfilled during the same field season, unless reasons acceptable to the Director-General are presented for a variance to this procedure.

6 Should any 'relic', defined under the Heritage Act of NSW be uncovered, then excavation or disturbance of that area is to stop immediately and the Heritage Council of NSW is to be informed in accordance with S.146 of the Heritage Act, 1977 (as amended).

Historic Archaeologists of the Heritage Council can be contacted on 02 9635 6155

A 'relic' under the Heritage Act is defined as any deposit, object or material evidence-

(a) which relates to the settlement of the area that comprises NSW, not being Aboriginal settlement; and

(b) which is 50 or more years old.

GENERAL TERMS AND CONDITIONS

1. Permits and Consents are not transferable.

2. A Permit covers only that area stated in the Permit.

3. A Consent covers only that area stated in the instrument of Consent and in any Schedules thereto.

4. Permits may be revoked at any time at the discretion of the Director-General.

5. Terms and conditions of Permits may be varied at any time at the discretion of the Director-General.

6. The Person to whom the Permit is issued or the Consent granted shall be responsible for the manner in which the work covered by the Permit or Consent is performed.

7. An officer of the National Parks and Wildlife Service, acting on the authority of the Director-General, may at any time examine work done or any objects recovered under any Permit or Consent.

8. Permits and Consents are necessary for all activities for which they are issued or granted, but do not in themselves give authority to enter or work on freehold land or leased Crown Land. Permission must be sought from the owner or occupier and arrangements made with him/her.

9. The holder of the Permit or Consent shall furnish, when required to do so, an undertaking to indemnify the National Parks and Wildlife Service against all actions, suits, claims and demands of whatsoever nature and all costs, charges and expenses in respect of any accident or injury to any person or property which may arise solely out of the existence of any works associated with the Permit or Consent.

10. All reports received in connection with work carried out under a Permit or Consent shall be treated as confidential but the National Parks and Wildlife Service shall have the right to copy all such reports, to allow consideration thereof by qualified referees.

11. For a period of five years from the date of issue of the Permit or Consent, the holder of the Permit or Consent may refuse to allow the National Parks and Wildlife Service and The Australian Museum, if such information is held by those institutions, to make public any information contained in any report referred to in Condition 10 above, except where it is deemed necessary for management, protection or research reasons. After this period of five years from the date of issue of the Permit or Consent, the Service and The Australian Museum shall have the right to use and authorise the use of information contained in all reports submitted under the Permit or Consent, except where specifically requested by the holder of the Permit or Consent.

12. Upon publication of any information relating to work done under a Permit or Consent, a copy of such publication(s) shall be forwarded to the National Parks and Wildlife Service, The Australian Museum, Sydney, and the Australian Institute of Aboriginal and Torres Strait Islander Studies, Canberra, unless permission to do otherwise has been obtained from the Service.

13. The holder of the Permit or Consent shall consult with the local Aboriginal community regarding the work covered by the Permit or Consent and shall respond to any reasonable request to involve the Aboriginal community in the work.

14. The National Parks and Wildlife Service and The Australian Museum may supply copies of relevant reports as furnished by the holder of the permit or Consent to local Aboriginal communities. Upon request by the Service, the holder of the Permit or Consent shall supply a summary of his/her findings with photographs, diagrams, etc., as required, to local Aboriginal communities or other interest local groups.

15. The holder of the Permit or Consent shall keep field records and a copy of all such records shall be lodged with the National Parks and Wildlife Service at the termination of each field work period. A copy of all field records shall be lodged with The Australian Museum at the time the archaeological materials are deposited with the Museum.

16. The holder of the Permit or Consent shall notify the local District office of the National Parks and Wildlife Service at the commencement and completion of fieldwork, and shall supply to District officers details of field work programs and results if requested.

17. In the event of a Permit being revoked -

a) The Person to whom that Permit was issued shall

(i) Furnish an undertaking to indemnify the National Parks and Wildlife Service against all actions, suits, claims and demands of whatsoever nature, and all costs, charges and expenses in respect of any accident or injury to any person or property which may arise solely out of the existence of any works associated with the Permit;

(ii) leave the areas, the subject of that Permit, in a condition satisfactory to the National Parks and Wildlife Service within two weeks from the date of revocation of that Permit;

(iii) furnish the National Parks and Wildlife Service within six months from the date of revocation of the Permit, a full report on the work completed at the date of revocation. Such a report shall include a complete list of any material recovered;

(iv) deposit any Aboriginal relics removed during work associated with the Permit, together with a copy of all field records, at The Australian Museum or at another place designated by the Museum, after these relics have been fully examined, or within six months from the date of revocation of that Permit whichever occurs sooner.

(b) The National Parks and Wildlife Service and The Australian Museum shall have the right to use and authorise the use of information collected under the Permit.

Wednesday, 3 November 1999
END

WORIMI LOCAL ABORIGINAL LAND COUNCIL

LOT 355/181 Lemon Tree Passage Rd
TANILBA BAY NSW 2319

Phone: (02) 49823405
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NELSON BAY ROAD SEGMENT 9 OPTION 1B

INTRODUCTION

Owing to our attendance being requested (onsite) to carry out a field survey on option 1B, to assess the potential impact on Aboriginal ideologies on Cultural and Heritge issues prevelant within the area. Our representative along with Archaeologist Angela Besant carried out field surveys by both foot and vehicle.

METHODS

The survey was conducted in four areas (segmented) in response to the terrain and the the nature of occupation (open paddocks, existing roads and residential areas) and permissive entry.
As access to several areas were limited due to the density of the undergrowth and the use of existing secondary roads was utilised and foot surveys carried out on all areas where applicable.

SURVEY COVERAGE

Once again the survey was carried out in areas were the vegetation (grass and bracken fern) was of a very dense and restrictive nature. In areas were the land was low various roadways and residential entries had been constructed above existing land level, therefore providing no clear views of the ground surfaces.

This area is identified as of having a high potential for Sites other than the seven discovered , as the land form is condusive also for burial areas (sand) the significance of the land is of paramount importance.

DISCUSSION

The existing carriageway is to be widened (approx 20 m) and does already exist on Aboriginal Sites (midden adjacent to Enlainey pottery) therefore eventhough the roadway has had to be built above existing ground levels the road base material would and possibly could cover many more undiscovered Sites.

TEST EXCAVATIONS

Subsurface testing (bores) should be carried out where applicable so as to provide a more accurate record of any insitu material and or articles as yet undiscovered.

SITE/ MANAGEMENT RECOMMENDATIONS

(A) That if at all possible the RL lines of the proposed carriageway be raised to a suitable level and what Sites possible be covered.

(B) A suitably experienced Sites Officer be engaged (local Aboriginal) who is approved by the local Aboriginal Community to monitor the initial and ongoing work schedules until actual infrastructure is in place.

(C) That a form of low vegetation clearance be undertaken BEFORE any heavy machinery or mechanised implements are engaged.

(D) If and when, at any time any Aboriginal Heritage articles/ material is uncovered that work in the immediate area CEASES and OUR OFFICES CONTACTED IMMEDIATELY.

ACKNOWLEDGMENT

I have in this matter, the permission to speak / act on behalf of the WORIMI LALC Cultural and Heritage Committee and their Council of Traditional Elders.

Yours Sincerely

Lennie Anderson
Co-ordinator/ Sites Officer
Dated ; 27 Aug 1998.

RTA

CALCULATED TRAFFIC NOISE LEVELS

Appendix G

Port Stephens COUNCIL
... a community partnership

ERM

Appendix G.1

NOISE MODEL VERIFICATION

Appendix G.1

NOISE MODEL VERIFICATION

1.1 INTRODUCTION

The model employed for calculating road traffic noise levels was extensively verified when used for the Bulahdelah to Coolongolook deviation of the Pacific Highway. The following text details this verification.

1.2 VERIFICATION METHODOLOGY

Traffic noise levels were calculated using ERM's in-house computer program that implements the Calculation of Road Traffic Noise (CoRTN) prediction model. These results were compared with logged traffic noise levels to allow model calibration.

The program divides each traffic lane into sections with a maximum length of 20 metres and calculates noise levels from each road section to each receiver. Barrier locations and heights are included in the model and barrier heights may be adjusted to achieve relevant criterion levels at each receiver.

The UK Department of Transport devised the CoRTN method and the last update was in 1988. With suitable corrections, this method has been shown to give accurate predictions of traffic noise levels under Australian conditions.

Source heights of 0.5 metres, 1.5 metres and 3.6 metres were used for cars, heavy vehicles and heavy vehicle exhausts respectively. Noise levels contributed by heavy vehicle exhausts are approximately 8 dB lower than engine noise when measured using the Leq noise descriptor.

Corrections for facade effects, adjusted to Australian conditions as described in the RTA's Interim Traffic Noise Guidelines, were incorporated in the model. A correction for the effect of tined concrete was also taken into account. Traffic noise from a tined concrete surface is approximately 2 dB higher than noise levels from standard road surfaces.

The CoRTN method predicts noise levels in terms of the L_{10} level. L_{eq} was then calculated by subtracting 3 dB from the L_{10} level. This is a standard correction that is accurate under typical traffic conditions.

For verification of this model the following parameters were used:

- actual average traffic volumes;
- actual average per cent heavy vehicles;
- 110 kilometres per hour car speed; and
- 100 kilometres per hour truck speed.

Traffic lanes, road shoulders and cut/fills were as per MOSS model data provided by Thiess. The model includes natural barriers, i.e. existing topography, where Central Mapping Authority (CMA) 1:25000 topographical maps indicated such landforms were likely to provide significant attenuation. Further, Thiess undertook detailed site surveys which enabled identification of topography not identifiable from CMA maps but may provide attenuation of traffic noise. This data is also included in the model.

Traffic noise levels were generally calculated to points representing the location of noise sensitive receptors. For some residences (where detailed assessment was required for pre-road opening studies) the building was entered into the model as a barrier, receptor points now being located one metre from its facades. Thiess surveyors provided co-ordinates of the building corners and receptor points. $L_{Aeq,8hr}$ noise levels were calculated for these facade locations (or receptor points where detailed analysis was not necessary).

Calculated and measured noise levels are compared for those receptors where there was good correlation of traffic flow and logged noise. A relationship between the two can then be determined and applied for all model results.

1.3 VERIFICATION RESULTS

The $L_{Aeq,8hr}$ noise levels due to average traffic volumes counted during the period 2200-0600 hours for the days 29 March to 5 April were calculated. Noise levels were logged at the residences Egon (residence), Goldsmith (van), Hacene, Johnson, Malcolm, Popy and Ross during the same period which allows comparison of measured and calculated levels. Of these, levels logged at Popy and Ross showed relatively strong correlation with traffic flow variations.

Two calculation methodologies were adopted; the first based on traffic volumes averaged over a week and then for traffic volumes averaged over all weekdays. Traffic data used for calculations are as per *Table 1*.

Table 1 TRAFFIC DATA USED FOR VERIFICATION CALCULATIONS

	Weekly Average		Weekday Average	
Hour Ending	**Hourly volume**	**No. heavy vehicles**	**Hourly volume**	**No. heavy vehicles**
23:00	161	47	177	61
0:00	128	46	147	61
1:00	94	36	111	48
2:00	79	27	90	35
3:00	78	30	92	39
4:00	79	27	93	36
5:00	85	28	95	38
6:00	113	25	117	32

The traffic volumes as used for model verification are equivalent to an annual average daily traffic (AADT) of 7623 comprising 11.4 percent heavy vehicles. The night time proportion of heavy vehicles is 32.6 and 38.2 percent for weekly and weekday averages respectively.

The daily average traffic of 7623 does not tally with the Pacific Highways current AADT of around 12,000. An AADT includes the influence of holiday period traffic which is considerable (a daily average of 16,340 for the period 29 December 1999 to 4 January 2000). It is likely that the annual average percent heavy vehicles would be lower than 11.4 percent given the high proportion of cars during holiday periods (3.2 percent for the period 29 December 1999 to 4 January 2000). It is therefore conservative to extrapolate this model to higher daily flows (AADT) as the proportion of heavy vehicles used would be too high. However, this model represents the typical weekday effect of the Pacific Highway.

Calculation results are shown in *Tables* 2 and 3.

Table 2 CALCULATED $L_{Aeq,8hr}$ TRAFFIC NOISE BASED ON WEEKLY AVERAGE TRAFFIC VOLUMES

Residence	Distance metres	Measured Level dB(A)	Calculated Level dB(A)	Error dB
Egon (Merriwonga)	893	44	40	-4
Goldsmith (van)	193	49	51	2
Hacene	742	45	43	-2
Johnson	85	55	55	0
Malcolm	124	55	53	-2
Popy	301	48	48	0
Ross	239	53	49	-4

Table 3 CALCULATED $L_{Aeq,8hr}$ TRAFFIC NOISE BASED ON WEEKDAY AVERAGE TRAFFIC VOLUMES

Residence	Distance metres	Measured Level dB(A)	Calculated Level dB(A)	Error dB
Egon (Merriwonga)	893	45	41	-4
Goldsmith (van)	193	49	51	2
Hacene	742	45	44	-1
Johnson	85	56	56	0
Malcolm	124	55	54	-1
Popy	301	49	49	0
Ross	239	53	50	-3

Calculation results show a high error for the residences Egon (Merriwonga) and Ross.

The likely explanation for the discrepancy in the data for the Egon residence is that calculated traffic noise levels are rather low and therefore other noise sources (e.g. insects) can easily influence the local acoustic environment (i.e. may have strongly contributed to monitored levels). Graphs of noise levels at this residence show the

night time L_{eq} sometimes follows traffic flows but is typically well above that expected from road traffic in the hours leading up to midnight.

Examination of the data for Ross shows that although L_{90} noise levels correlate with traffic flows, the L_{eq} values do not and are particularly elevated at night. It is interesting to note that night time L_{eq} values do, however, follow the weekly traffic flow pattern. This residence is located near a significant grade down which most trucks use exhaust brakes. A significant number of trucks were noted changing down gears immediately adjacent this residence as they began to ascend the grade. The proximity of this residence to a significant grade is the likely reason for the model under prediction. There are no other residences located in proximity to similar grades. As such, a plus 3 dB correction is applied to calculated results for Ross.

By excluding the data at Egon (Merriwonga) and Ross, a model calibration factor was determined.

For this calibration exercise the measured noise levels were found to lie approximately mid-way between the predicted levels under hard-ground and soft ground conditions. Analysis indicated that the best fit to the weekday data was achieved using a predictive equation of the form:

$$\text{Measured Noise Level} = S + 0.4\,(H - S)$$

where H and S are respectively the predicted noise levels under hard and soft ground conditions. This gives a root mean square prediction error of 0.9 dB.

As recommended in the CoRTN procedure, the effect of shielding by cuttings or other features was calculated using an acoustically hard ground. Where the calculated noise level with shielding is lower than the level calculated as above for partially soft ground, the level with shielding is to be used.

Interestingly, a previous calibration of this model (for the Karuah to Bulahdelah Pacific Highway Upgrading (ERM, 1999)) provided the same calibration equation, the root mean square prediction error on that occasion being 1.6 dB.

Appendix G.2

CALCULATED TRAFFIC NOISE LEVELS

Table 1 CALCULATED TRAFFIC NOISE LEVELS, PROPOSED ROAD 2013, L_{eq} dB(A)

Receiver No	2003 (existing)		2013 (proposed)		Applicable criteria		Criteria exceedance		Change	
	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour
1	53	49	53	48	60	55	0	0	0	0
2	56	51	55	51	60	55	0	0	-1	-1
3	57	53	57	53	60	55	0	0	0	0
5	58	54	58	54	60	55	0	0	0	0
10	54	49	54	49	60	55	0	0	0	0
11	56	52	56	52	60	55	0	0	0	0
12	60	55	59	54	60	55	0	0	-1	-1
13	56	52	56	52	60	55	0	0	0	0
14	52	48	52	48	60	55	0	0	0	0
15	52	47	52	48	60	55	0	0	0	0
20	63	59	62	57	60	55	2	2	-1	-1
21	59	54	58	54	60	55	0	0	-1	0
22	53	49	53	49	60	55	0	0	0	0
23	58	54	59	55	60	57	0	0	1	1
24	63	59	63	59	60	55	3	4	0	0
25	51	47	52	47	60	55	0	0	1	1
30	52	47	53	49	60	55	0	0	1	1
31	61	56	61	57	60	57	1	0	0	0

Table 1 CALCULATED TRAFFIC NOISE LEVELS, PROPOSED ROAD 2013, L_{eq} dB(A)

Receiver No	2003 (existing)		2013 (proposed)		Applicable criteria		Criteria exceedance		Change	
	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour
32	64	60	64	59	60	55	4	4	0	0
33	63	59	63	59	60	55	3	4	0	0
34	51	47	52	48	60	55	0	0	1	1
35	61	56	61	57	60	57	1	0	0	0
40	61	57	62	57	62	57	0	0	1	0
45	59	54	61	57	62	55	0	2	2	3
46	65	61	65	60	60	55	5	5	0	0
47	59	55	62	58	60	55	2	3	3	3
50	60	55	60	56	60	57	0	0	0	0
51	59	54	61	57	62	55	0	2	2	3
52	55	50	56	52	60	55	0	0	1	2
53	56	52	57	52	60	55	0	0	1	0
56	56	51	56	52	60	55	0	0	0	1
57	48	43	49	45	60	55	0	0	1	1
60	54	50	55	50	60	55	0	0	1	0
61	46	42	47	43	60	55	0	0	1	1
62	53	49	55	51	60	55	0	0	2	2
63	62	58	62	57	60	55	2	2	0	-1

Table 1 CALCULATED TRAFFIC NOISE LEVELS, PROPOSED ROAD 2013, L_{eq} dB(A)

Receiver No	2003 (existing)		2013 (proposed)		Applicable criteria		Criteria exceedance		Change	
	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour
65	61	56	61	56	60	57	1	0	0	0
66	57	52	57	53	60	55	0	0	0	1
67	48	44	50	45	60	55	0	0	2	1
68	62	57	63	58	60	55	3	3	1	1
70	50	45	51	46	60	55	0	0	1	1
71	58	54	59	54	60	55	0	0	1	1
72	51	47	52	48	60	55	0	0	1	1
73	59	54	59	55	60	55	0	0	0	1
75	54	50	55	51	60	55	0	0	1	1
76	55	51	56	51	60	55	0	0	1	1
77	62	57	62	57	60	57	2	0	0	0
80	54	50	56	51	60	55	0	0	2	2
82	61	57	64	60	60	55	4	5	3	3
85	62	57	62	58	60	55	2	3	0	0
86	56	52	57	53	60	55	0	0	1	1
87	61	56	61	57	60	57	1	0	0	0
88	57	53	59	55	60	55	0	0	2	2
89	57	52	60	56	60	55	0	1	3	3

Table 1 CALCULATED TRAFFIC NOISE LEVELS, PROPOSED ROAD 2013, L_{eq} dB(A)

Receiver No	2003 (existing)		2013 (proposed)		Applicable criteria		Criteria exceedance		Change	
	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour
90	58	54	59	54	60	55	0	0	1	1
95	63	58	63	58	60	55	3	3	0	0
97	65	61	65	61	60	55	5	6	0	0
100	64	60	64	60	60	55	4	5	0	0
101	57	53	58	53	60	55	0	0	1	1
102	58	54	59	54	60	55	0	0	1	1
105	61	56	61	57	60	57	1	0	0	0
106	52	48	53	49	60	55	0	0	1	1
110	62	57	62	58	60	55	2	3	0	0
111	62	57	62	58	60	55	2	3	0	0
112	65	60	64	60	60	55	4	5	-1	0
113	61	57	64	60	60	55	4	5	3	3
114	58	54	60	56	60	57	0	0	2	2
115	59	55	62	57	60	57	2	0	3	2
116	53	49	55	51	60	55	0	0	2	2
122	59	55	62	58	60	55	2	3	3	3
125	57	53	58	54	60	55	0	0	1	1

Note: 1. Daytime: 7:00 am to 10:00 pm, night time: 10:00 pm to 7:00 am;

Table 2 CALCULATED TRAFFIC NOISE LEVELS, PROPOSED ROAD 2003, L_{eq} dB(A)

Receiver No	2003 (existing)		2013 (proposed)		Applicable criteria		Criteria exceedance		Change	
	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour
1	53	49	52	47	60	55	0	0	-1	-1
2	56	51	54	50	60	55	0	0	-2	-2
3	57	53	56	52	60	55	0	0	-1	-1
5	58	54	57	53	60	55	0	0	-1	-1
10	54	49	53	48	60	55	0	0	-1	-1
11	56	52	55	51	60	55	0	0	-1	-1
12	60	55	57	53	60	55	0	0	-3	-2
13	56	52	55	51	60	55	0	0	-1	-1
14	52	48	51	47	60	55	0	0	-1	-1
15	52	47	51	46	60	55	0	0	-1	-1
20	63	59	61	56	60	55	1	1	-2	-2
21	59	54	57	53	60	55	0	0	-2	-2
22	53	49	52	47	60	55	0	0	-1	-1
23	58	54	58	54	60	55	0	0	0	0
24	63	59	62	58	60	55	2	3	-1	-1
25	51	47	51	46	60	55	0	0	0	0
30	52	47	52	48	60	55	0	0	0	0
31	61	56	60	56	60	55	0	1	-1	-1

Table 2 CALCULATED TRAFFIC NOISE LEVELS, PROPOSED ROAD 2003, L_{eq} dB(A)

Receiver No	2003 (existing)		2013 (proposed)		Applicable criteria		Criteria exceedance		Change	
	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour
32	64	60	63	58	60	55	3	3	-1	-1
33	63	59	62	58	60	55	2	3	-1	-1
34	51	47	51	47	60	55	0	0	0	0
35	61	56	60	55	60	55	0	0	-1	-1
40	61	57	60	56	60	55	0	1	-1	-1
45	59	54	60	56	62	57	0	0	1	2
46	65	61	63	59	60	55	3	4	-2	-2
47	59	55	61	57	62	57	0	0	2	2
50	60	55	59	55	60	55	0	0	-1	-1
51	59	54	60	56	62	57	0	0	1	2
52	55	50	55	51	60	55	0	0	0	1
53	56	52	55	51	60	55	0	0	-1	-1
56	56	51	55	51	60	55	0	0	-1	-1
57	48	43	48	44	60	55	0	0	0	0
60	54	50	54	49	60	55	0	0	0	-1
61	46	42	46	42	60	55	0	0	0	0
62	53	49	54	50	60	55	0	0	1	1
63	62	58	60	56	60	55	0	1	-2	-2

Table 2 CALCULATED TRAFFIC NOISE LEVELS, PROPOSED ROAD 2003, L_{eq} dB(A)

Receiver No	2003 (existing)		2013 (proposed)		Applicable criteria		Criteria exceedance		Change	
	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour
65	61	56	60	55	60	55	0	0	-1	-1
66	57	52	56	52	60	55	0	0	-1	0
67	48	44	49	44	60	55	0	0	1	0
68	62	57	61	57	60	55	1	2	-1	0
70	50	45	50	45	60	55	0	0	0	0
71	58	54	58	53	60	55	0	0	0	0
72	51	47	51	47	60	55	0	0	0	0
73	59	54	58	54	60	55	0	0	-1	-1
75	54	50	54	49	60	55	0	0	0	0
76	55	51	55	50	60	55	0	0	0	0
77	62	57	61	56	60	55	1	1	-1	-1
80	54	50	55	50	60	55	0	0	1	1
82	61	57	63	59	60	55	3	4	2	2
85	62	57	61	56	60	55	1	1	-1	-1
86	56	52	56	51	60	55	0	0	0	0
87	61	56	60	55	60	55	0	0	-1	-1
88	57	53	58	54	60	55	0	0	1	1
89	57	52	59	54	60	55	0	0	2	2

Table 2 CALCULATED TRAFFIC NOISE LEVELS, PROPOSED ROAD 2003, L_{eq} dB(A)

Receiver No	2003 (existing)		2013 (proposed)		Applicable criteria		Criteria exceedance		Change	
	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour
90	58	54	57	53	60	55	0	0	-1	0
95	63	58	62	57	60	55	2	2	-1	-1
97	65	61	64	59	60	55	4	4	-1	-1
100	64	60	63	59	60	55	3	4	-1	-1
101	57	53	56	52	60	55	0	0	-1	0
102	58	54	57	53	60	55	0	0	-1	-1
105	61	56	60	56	60	55	0	1	-1	-1
106	52	48	52	47	60	55	0	0	0	0
110	62	57	61	57	60	55	1	2	-1	-1
111	62	57	61	56	60	55	1	1	-1	-1
112	65	60	63	59	60	55	3	4	-2	-1
113	61	57	63	59	60	55	3	4	2	2
114	58	54	59	55	60	55	0	0	1	1
115	59	55	60	56	62	57	0	0	1	1
116	53	49	54	49	60	55	0	0	1	0
122	59	55	61	57	62	57	0	0	2	2
125	57	53	57	53	60	55	0	0	0	0

Note: 1. Daytime: 7:00 am to 10:00 pm, night time: 10:00 pm to 7:00 am;

Table 3 CALCULATED TRAFFIC NOISE LEVELS, EXISTING ROAD 2013, L_{eq} dB(A)

Receiver No	2003 (existing)		2013 (proposed)		Applicable criteria		Criteria exceedance		Change	
	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour
1	53	49	54	50	60	55	0	0	1	1
2	56	51	57	53	60	55	0	0	1	1
3	57	53	58	54	60	55	0	0	1	1
5	58	54	59	55	60	55	0	0	1	1
10	54	49	55	51	60	55	0	0	1	1
11	56	52	57	53	60	55	0	0	1	1
12	60	55	61	57	62	57	0	0	1	1
13	56	52	57	53	60	55	0	0	1	1
14	52	48	53	49	60	55	0	0	1	1
15	52	47	53	49	60	55	0	0	1	1
20	63	59	64	60	60	55	4	5	1	1
21	59	54	60	55	60	57	0	0	1	1
22	53	49	54	50	60	55	0	0	1	1
23	58	54	59	55	60	57	0	0	1	1
24	63	59	65	60	60	55	5	5	1	1
25	51	47	52	48	60	55	0	0	1	1
30	52	47	53	49	60	55	0	0	1	1
31	61	56	62	58	62	55	0	3	1	1

Table 3 CALCULATED TRAFFIC NOISE LEVELS, EXISTING ROAD 2013, L_{eq} dB(A)

Receiver No	2003 (existing)		2013 (proposed)		Applicable criteria		Criteria exceedance		Change	
	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour
32	64	60	65	61	60	55	5	6	1	1
33	63	59	65	60	60	55	5	5	1	1
34	51	47	52	48	60	55	0	0	1	1
35	61	56	62	58	62	55	0	3	1	1
40	61	57	63	58	60	55	3	3	1	1
45	59	54	60	55	60	57	0	0	1	1
46	65	61	66	62	60	55	6	7	1	1
47	59	55	60	56	60	57	0	0	1	1
50	60	55	61	57	62	57	0	0	1	1
51	59	54	60	55	60	57	0	0	1	1
52	55	50	56	51	60	55	0	0	1	1
53	56	52	57	53	60	55	0	0	1	1
56	56	51	57	53	60	55	0	0	1	1
57	48	43	49	45	60	55	0	0	1	1
60	54	50	56	51	60	55	0	0	1	1
61	46	42	47	43	60	55	0	0	1	1
62	53	49	54	50	60	55	0	0	1	1
63	62	58	63	59	60	55	3	4	1	1

Table 3 CALCULATED TRAFFIC NOISE LEVELS, EXISTING ROAD 2013, L_{eq} dB(A)

Receiver No	2003 (existing)		2013 (proposed)		Applicable criteria		Criteria exceedance		Change	
	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour
65	61	56	62	57	62	57	0	0	1	1
66	57	52	58	53	60	55	0	0	1	1
67	48	44	50	45	60	55	0	0	1	1
68	62	57	63	59	60	55	3	4	1	1
70	50	45	51	46	60	55	0	0	1	1
71	58	54	59	55	60	55	0	0	1	1
72	51	47	52	48	60	55	0	0	1	1
73	59	54	60	56	60	57	0	0	1	1
75	54	50	55	51	60	55	0	0	1	1
76	55	51	56	52	60	55	0	0	1	1
77	62	57	63	58	60	55	3	3	1	1
80	54	50	55	51	60	55	0	0	1	1
82	61	57	62	58	62	55	0	3	1	1
85	62	57	63	58	60	55	3	3	1	1
86	56	52	57	53	60	55	0	0	1	1
87	61	56	62	57	62	57	0	0	1	1
88	57	53	58	54	60	55	0	0	1	1
89	57	52	58	54	60	55	0	0	1	1

Table 3 CALCULATED TRAFFIC NOISE LEVELS, EXISTING ROAD 2013, L_{eq} dB(A)

Receiver No	2003 (existing)		2013 (proposed)		Applicable criteria		Criteria exceedance		Change	
	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour	Day 15 hour	Night 9 hour
90	58	54	59	55	60	55	0	0	1	1
95	63	58	64	60	60	55	4	5	1	1
97	65	61	66	62	60	55	6	7	1	1
100	64	60	66	61	60	55	6	6	1	1
101	57	53	58	54	60	55	0	0	1	1
102	58	54	59	55	60	55	0	0	1	1
105	61	56	62	58	62	55	0	3	1	1
106	52	48	53	49	60	55	0	0	1	1
110	62	57	63	59	60	55	3	4	1	1
111	62	57	63	58	60	55	3	3	1	1
112	65	60	66	61	60	55	6	6	1	1
113	61	57	62	58	62	55	0	3	1	1
114	58	54	59	55	60	55	0	0	1	1
115	59	55	60	56	60	57	0	0	1	1
116	53	49	54	50	60	55	0	0	1	1
122	59	55	61	56	62	57	0	0	1	1
125	57	53	59	54	60	55	0	0	1	1

Note: 1. Daytime: 7:00 am to 10:00 pm, night time: 10:00 pm to 7:00 am;

RTA

ECONOMIC ANALYSIS

Appendix H

Port Stephens COUNCIL
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Appendix H

ECONOMIC ANALYSIS

Table 1 NELSON BAY ROAD – BASE CASE

Segment type	Existing 1	Existing 2	Existing 3	Existing 4
length km	1.6	0.2	4.5	0.5
Chainage	1.6	1.8	6.3	6.8
vertical	0-2%	5-8%	0-2%	0-2%
	Flat,100k	Hilly,80k	Flat,80k	Flat,70k
horizontal	Straight	Winding	Straight	Winding
No lanes	2	2	2	2
condition	s3	s3	s3	s3
Basic Accident Rate	0.23	0.23	0.23	0.23

Option 1b : Stages 1, 2 , 3 & 4

segment type	Dup 1	Dup 2 & 4	Dup 3	Dup 5	Dup 6	Dup 7	Dup 8
length km	1.1	1	0.2	1.7	1.4	0.9	0.5
Chainage	1.1	1.6 & 2.3	1.8	4	5.4	6.3	6.8
vertical	0-2%	0-2%	5-8%	0-2%	0-2%	0-2%	0-2%
	Flat,100k	Flat,80k	Hilly,80k	Flat,80k	Flat,80k	Flat,80k	Flat,70k
horizontal	Straight	Straight	Winding	Straight	Straight	Straight	Winding
No lanes	4	4	4	4	4	4	4
condition	s3,s5	s3,s5	s3,s5	s3,s5	s3,s5	s3,s5	s3,s5
Basic Accident Rate	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Table 2 NET PRESENT VALUE OF COSTINGS (DISCOUNTING OF COSTS TO YEAR 2001)

Year 0 = 2001

Year	Option 1b			
	Actual Cost	4%	7%	10%
2001	2700000	2700000	2000000	2000000
2002	2700000	2596154	2523364	2454545
2003	4000000	3698225	3493755	3305785
2004	3300000	2933688	2693783	2479339
2005	3300000	2820854	2517554	2253944
2006	0	0	0	0
2007	0	0	0	0
2008	0	0	0	0
Total	16000000	14748921	13228457	12493614

Table 3 BENEFIT SUMMARY

	4%	7%	10%
NPVC	14748921	13228457	12493614
NPVB	112685281	68823816	44585301
NPV	97936361	55595359	32091687
BCR	7.64	5.20	3.57
FYRR	20.6%	18.3%	15.5%

Table 4 YEARLY BCR'S AT 7%

Year	Option 1b
2001	0.00
2002	0.00
2003	0.07
2004	0.17
2005	0.30
2006	0.47
2007	0.64
2008	0.82
2009	1.01
2010	1.19
2011	1.38
2012	1.57
2013	1.77
2014	1.96
2015	2.16
2016	2.36
2017	2.56
2018	2.76
2019	2.96
2020	3.17
2021	3.37
2022	3.57
2023	3.78
2024	3.98
2025	4.18
2026	4.39
2027	4.59
2028	4.80
2029	5.00
2030	5.20

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