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Roads &

Traffic

Authority

Nelson Bay Road Upgrade

Volume 1 Main Report

Review of Environmental Factors

Bobs Farm to Anna Bay

Port Stephens COUNCIL
... a community partnership

ERM

NELSON BAY ROAD UPGRADE - BOBS FARM TO ANNA BAY

Review of Environmental Factors

For:

PORT STEPHENS COUNCIL

March 2001

59042REFD1

Certification by preparing officer

" This Review of Environmental Factors provides a true and fair review of the activity in relation to its likely effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposed activity".

Name:	*Steve O'Connor*
Signed:	
Designation:	ERM Project Director
Date:	*26 March, 2001*

Countersignature by responsible regional officer

"I have examined this Review of Environmental Factors and the certification by Steve O'Connor (ERM) and accept the Review of Environmental Factors on behalf of the RTA".

Approved by:	*Terry Woodham*
Signed:	
Designation:	RTA Project Development Manager
Date:	*26 March, 2001*

Report No. 59042REF

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Chapter 1

INTRODUCTION

1.1 BACKGROUND

ERM was commissioned by Port Stephens Council on behalf of the Roads and Traffic Authority (RTA) to prepare a range of environmental studies associated with the proposed upgrade of Nelson Bay Road (Main Road 108) to an ultimate dual lane carriageway for Segment 9, identified in the 1997 RTA Route Development Strategy, between Bobs Farm and Anna Bay (as shown in *Figure 1.1*). The RTA is the proponent for this proposal. This section of road is currently a single carriageway with poor pavement condition and no passing lanes. There are limited opportunities for overtaking on the existing stretch of road.

Main Road 108 is the major arterial route connecting Newcastle and Williamtown with the Tomaree Peninsula. It carries a large volume of locally based traffic and tourist traffic visiting the Nelson Bay area and is the only route servicing the Tomaree Peninsula and the various small townships between Newcastle and Nelson Bay.

The upgrade would be 6.8 kilometres in length. It would commence approximately 1.9 kilometres south-west of the Marsh Road intersection, linking into the existing dual carriageway at the Port Stephens Drive roundabout at Anna Bay. The concept design plans of the proposed upgrade are included at the rear of this volume. The upgrade would involve duplication of the carriageway on the southern side of the existing road, changing to the northern side of the road 300 metres south of Marsh Road intersection. The duplication then changes to the southern side of the road 850 metres west of the Trotters Lane intersection. The completed road would be an 80 km/h speed zone for most of its length, with a 900 metre section of 100 km/h at the western end of the upgrade (chainage -350.00 to +740.00, see *Concept Design Plans Sheet 3*. The proposed upgrading and duplication of the existing Nelson Bay Road would improve road safety and efficiency.

Four main options were assessed in development of the most appropriate upgrade design, including:

- Option 1A: upgrade of the existing Nelson Bay Road with some upgrading of horizontal curves to 100km/h design standard;

- Option 1B: upgrading of the existing Nelson Bay Road following the existing alignment;

- Option 2(a): full deviation of the road through undeveloped land south of the existing road, following where possible an existing transmission line easement; and

- Option 3: a partial deviation of the road at Bobs Farm along the same alignment as Option 2, before rejoining the existing Nelson Bay Road at Trotter Lane.

After consideration of these options (refer *Section 2.4)*, two concept design options *(Figure 1.2)* were shortlisted being:

- Option 1B - Upgrading and duplication of the existing 6.8 kilometres of Nelson Bay Road to provide an ultimate four lane dual carriageway; and

- Option 2 – A new deviation of 6.3 kilometres of Nelson Bay Road as a four-lane dual carriageway through undeveloped land south of the existing Nelson Bay Road, generally along an existing electricity easement.

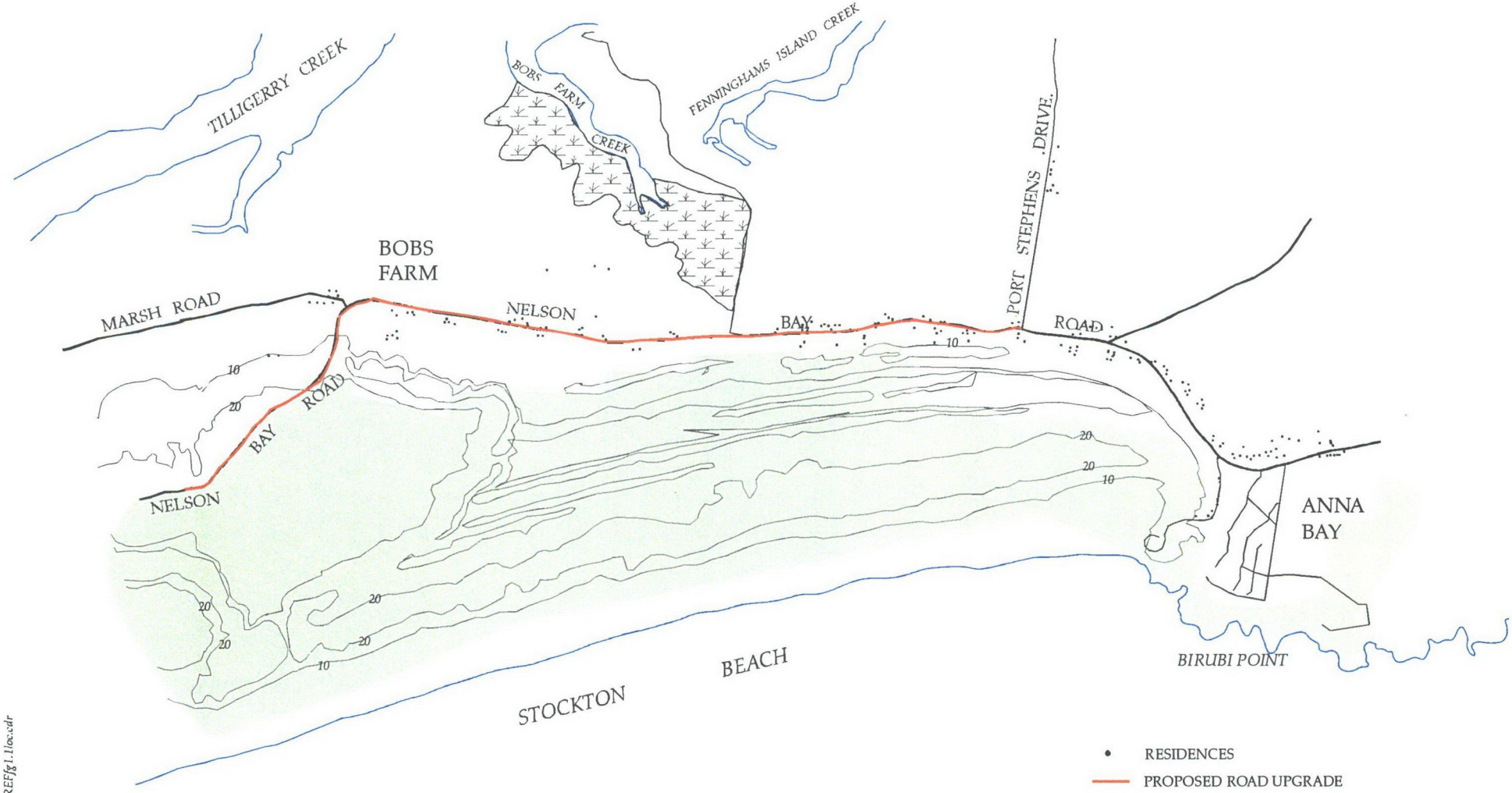
Option 1B was selected as the most appropriate option based on the results of studies conducted in the concept stage, the feedback from extensive community consultation and detailed environmental assessment of both options. Further details on the selection process are provided in *Chapter* 2.

This review of environmental factors (REF) has been prepared to consider all matters affecting or likely to affect the environment, associated with the selected option.

1.2 APPROVAL PROCESS

Under Part V of the Environmental Planning and Assessment Act 1979 (EP&A Act) a mandatory duty is imposed on the RTA as a determining authority to take into account to the fullest extent possible all matters affecting or likely to affect the environment (including critical habitat) or threatened species, populations or ecological communities, or their habitats (Section 111).

A determining authority shall not carry out an activity (i.e., the upgrade) that is likely to significantly affect the environment (including critical habitat) or threatened species, populations or ecological communities, or their habitats, unless it has obtained or been furnished with an environmental impact statement (Section 112).



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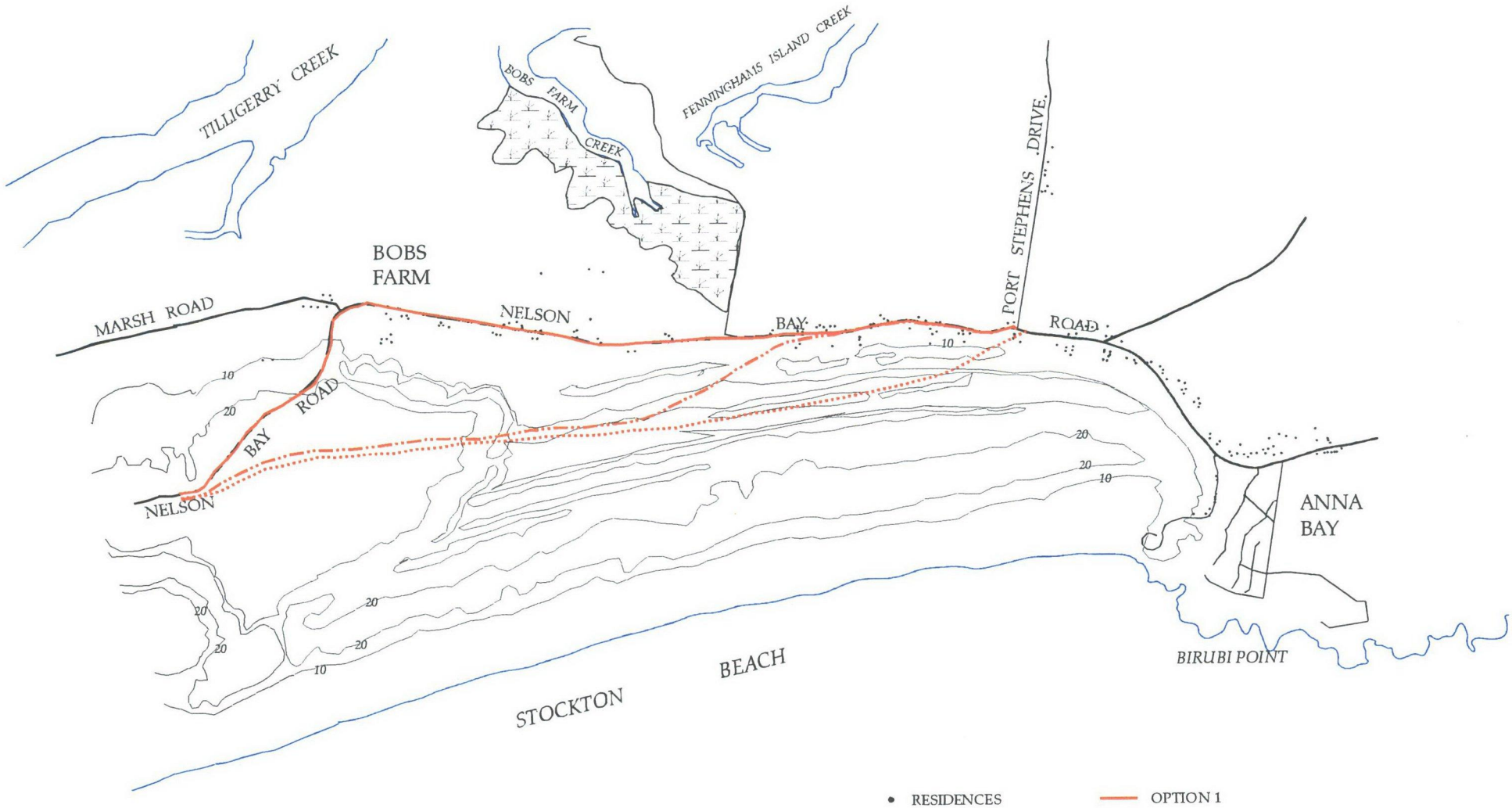
SOURCE: 1:25,000 TOPO MORNA POINT SHEET/ ENVIROSCIENCES Fig. 3.2 Project U53

ERM

Figure 1.1 LOCALITY PLAN



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SOURCE: 1:25,000 TOPO WILLIAMTOWN SHEET/ ENVIROSCIENCES Fig. 3.2 Project U53
YOUNG CONSULTING ENGINEERS (1997)

ERM

Figure 1.2 ROAD ALIGNMENT OPTIONS

A Review of Environmental Factors (REF) would be sufficient to document the environmental effects of proceeding with the development if an EIS is not required.

Chapter 2

PROJECT DESCRIPTION AND JUSTIFICATION

2.1 INTRODUCTION

The project development process involved a number of phases of assessment before a preferred upgrade route for Nelson Bay Road between Bobs Farm and Anna Bay was selected. Initially the need for the upgrade was assessed based on existing road and traffic conditions and accident history. The need for the project is detailed in *Section 2.3.*

The next phase of the process included the development of options. This involved a number of specialist studies including a route development study, value management study and environmental assessments. A summary of these studies is presented in *Section 2.4.*

Community and Authority consultation was undertaken during all phases of the project development process described above. The third phase involved ongoing community consultation. Community and Authority consultation is discussed in *Chapter 3.*

A preferred option was then selected based on the accumulated knowledge gained from all previous phases of assessment. Option 1B is the preferred option and the subject of this Review of Environmental Factors.

2.2 THE ROUTE SELECTION PROCESS

The decision to upgrade the section of Nelson Bay Road between Bobs Farm and Anna Bay was based on the poor road condition, the large volume of traffic using the road and the history of road accidents along this section of the road.

A number of possible routes for the upgrade were formulated in 1997. Four different route options were investigated (refer *Section 1.1*). As a result of workshops with key stakeholders, Option 2 was identified as the preferred route. Further investigations were undertaken to ensure that this selection was acceptable in terms of biophysical and social impacts. As a result of these investigations it was decided that Options 1B

and 2 should be the subject of more detailed environmental assessments that were undertaken by ERM in 1998.

The environmental assessment reports for both options were placed on public exhibition and public comment was invited. A number of serious concerns were raised in light of the outcomes of the environmental assessments. In particular the National Parks and Wildlife Service objected strongly (see letter in *Appendix A*) to the selection of Option 2 as it would dissect and fragment land of high natural and cultural heritage significance which has been identified by the State Government for reservation under the National Parks and Wildlife Act, 1974. It also had potential to disrupt the life cycle of the squirrel glider. Concerns were also raised regarding the impact of dune encroachment on Option 2. This would threaten the road within 30 years and completely cover most of the road by 2095 if sand drift remained unabated and continued at the present rate.

In light of these concerns and the environmental assessments it was determined that the most appropriate option was 1B. Further environmental studies into flora and fauna, archaeology and noise were then instigated to assist in further quantifying the likely environmental impact of this option.

As a result of these studies and ongoing community consultation Option 1B was progressively modified to take into account the issues raised. Modifications to the original design of the Option 1B route include the following:

- the width of central medians was substantially reduced in some areas to reduce the impact on properties and houses along the route;
- the median was reduced and a retaining wall included in the concept design, approximately one kilometre from the start of the upgrade, to reduce impact on the Go-kart Track;
- an additional retaining wall was included approximately one kilometre from the start of the upgrade to protect Aboriginal middens in the sand dune;
- the alignment was altered to preserve squirrel glider den trees;
- tree guards are to be provided around squirrel glider den trees close to the proposed upgrade; and
- a bus stop was relocated to preserve squirrel glider den trees.

The announcement of Option 1B as the preferred route was followed by strong criticism by some sections of the local community. It was argued that Option 1B was not favoured by the community. The need to further assess the social impact of the proposal was also raised. This led to the RTA's decision that additional community

consultation be undertaken to further discuss the two favoured options prior to making a final decision.

A Community Liaison Group was formed, involving five full day meetings at Port Stephen Council's Administration Office to discuss issues of community concern.

The RTA placed these two alternatives on public exhibition for 30 days between 19 April and 17 May, 2000. These options were previously placed on public display between 14 October 1998 and 11 November 1998. As a result, 375 submissions were received including short letters, detailed responses, voting forms and petitions providing a range of comments and preferences. ERM was commissioned to assess and review the submissions received. The results of this assessment are discussed in *Section 3.2.5*. In summary, two thirds of submissions supported Option 1B and one third supported Option 2.

Following the outcome of the public exhibition in favour of Option 1B, this option was confirmed as the preferred option for the upgrade of Nelson Bay Road from Bobs Farm to Anna Bay, by the Minister for Transport, on 31 October 2000. This announcement received widespread television and media coverage.

ERM were not involved in the selection of the preferred option by the RTA. The assessment process does not compare the project with other options, rather it considers the impacts and merits of the specific project under consideration.

2.3 NEED FOR THE PROJECT

2.3.1 *Existing Road And Traffic Conditions*

i. Traffic Conditions

Main Road 108 (MR 108) carries a large volume of locally based traffic and tourist traffic visiting the Nelson Bay area. The RTA published traffic volume data for MR 108 has not included any traffic surveys at the relevant section between Salt Ash and Anna Bay since 1984. The most recent (Year 1994/5) traffic volumes for various locations along Nelson Bay Road from the route development study (L.B. Dowling and Associates, 1997) are summarised in *Table 2.1*.

Table 2.1 TRAFFIC VOLUMES

Road No	Seg No	Location	AADT[1]
108	4	Williamtown - 200 m east of Cabbage Tree Road	13,364 - 1995
108	5	Williamtown - 200 m east of Medowie Road	8,445 - 1994
108	6	Salt Ash - 200 m east of Richardson Road	14,315 - 1995
108	9	Bobs Farm - 300 m west of Cromarty Lane	11,234 - 1995
108	11	Anna Bay - 200 m north of Gan Gan Road (south)	5,510 - 1994

Source: *L.B. Dowling & Associates (1997).*

Notes: *1. AADT - Annual Average Daily Traffic.*

As *Table 2.1* indicates, traffic volumes along the length of Nelson Bay Road vary considerably. The table shows traffic volumes are generally higher near Newcastle Airport at Williamtown, decrease east of Medowie Road and increase again where Richardson Road joins with Nelson Bay Road.

RTA traffic surveys at other locations on Nelson Bay Road and other main roads in the Fern Bay - Williamtown area during the period 1992 to 1988 indicate that the current peak hour proportion of daily traffic flow is approximately 9.5 per cent with a 65 to 35 per cent directional distribution.

Annual traffic growth rates for Nelson Bay Road vary between 2.9 per cent and 4.6 per cent with an overall average annual growth rate of 3.3 per cent, east of Medowie Road.

ii. Existing Road Condition

The section of Nelson Bay Road between Bobs Farm and Anna Bay is currently a single carriageway with poor pavement condition. There are no passing lanes and there are limited opportunities for overtaking on the existing 6.8 kilometre stretch of road. There are no public road alternative routes, however a maintenance track exists.

Given the large volume of traffic using Nelson Bay Road (*Table 2.1)* and the existing poor road condition, the proposed duplication and upgrade is necessary to improve safety and efficiency of this section of road.

2.3.2 *Accident History*

The accident history for the section of Nelson Bay Road between Bobs Farm and Anna Bay has been reviewed for the period 1994 to 1999 with a total of 36 accidents recorded during a 5.25 year period. The average number of accidents per year for this period was 6.86. Around 52 per cent of the accidents involved only one vehicle, 30 per cent involved two vehicles, and 18 per cent involved three or more vehicles. The proportions of accident types recorded were:

- 58% tow-away accidents;
- 27% minor injury accidents;
- 13% serious injury accidents; and
- 2% fatal accidents.

The overall average NSW accident statistics for 1996 are as follows:

- 62% tow-away accidents;
- 28% minor injury accidents;
- 9% severe injury accidents; and
- 1% fatal accidents.

Provisional accident data supplied by the RTA for 1999 indicate the following statistics for NSW:

- 61.4% non-injury accidents;
- 37.6% injury accidents; and
- 1% fatal accidents.

The accident types for this section of Nelson Bay Road have a similar range of severity to the accident statistics for NSW; however, the proportion of fatal accidents is higher for this section of Nelson Bay Road in comparison to the NSW statistics for 1996 and 1999.

The upgrade would not only improve road safety and efficiency for local road users and commuters, it would have positive implications for the growing tourism industry on the Tomaree Peninsula.

2.4 PREVIOUS STUDIES

A number of studies have been undertaken in the lead up to the selection of a preferred upgrade option. The studies at the concept stage included a route development study, a value management study, community consultation, road-user cost/benefit assessment and a preferred option report.

Following preliminary economic analysis, environmental assessment and community consultation, environmental assessment reports were completed for the two favoured options, 1B and 2 (ERM Mitchell McCotter 1998a and 1998b). Both reports investigated key issues including planning and consultation, hydrology, soils, flora and fauna, land use, noise, archaeology and socio-economic impacts. Both reports were placed on public exhibition for community and government authority comment.

Review of these assessment reports determined that the most appropriate option was 1B - upgrading and duplication of the existing Nelson Bay Road. Issues raised in these reports are summarised in *Section 2.4.1, (Part v)*.

Further studies were then undertaken for what were considered to be the key issues for option 1B.

2.4.1 *Options Development*

i. Route Development Study

A route development strategy (RDS) was prepared by LB Dowling and Associates (1997) as a management strategy for maintenance and route development of Nelson Bay Road. The report considered Nelson Bay Road in the context of the Lower Hunter Integrated Transport Study which aimed to develop a way to manage and meet transport demand in the region with a focus on public passenger transport.

The road was divided into 13 segments between Hexham and Shoal Bay and analysed in terms of speed zones within each segment. The area between Marsh Road at Bobs Farm and Port Stephens Drive at Anna Bay is known as Segment 9 (the proposed upgrade includes Segment 9 and 1.8 kilometres of road south-west of Marsh Road). Segment 9 is 5.0 kilometres long, 0.5 kilometres of which has a speed limit of 100 kilometres per hour and 4.5 kilometres with a speed limit of either 80 or 90 kilometres per hour.

A draft version of the Route Development Strategy was exhibited for public comment for two months and comments were incorporated into the final version of

the report. The report also included authority consultation with the common themes being:

- awareness of the population growth in the area; and
- popularity of the Nelson Bay area as a tourist destination increasingly accessible by road, particularly from Sydney.

ii. Concept Design

Options for the upgrading of Segment 9 of Nelson Bay Road (MR 108) were investigated.

In order to identify the most appropriate location for passing lanes, a number of options were assessed in the field. In assessing each of the options consideration was given to property acquisition requirements, earthworks, access, environmental considerations, vertical and horizontal alignment, drainage structures, rest areas, staging of construction, travel time and cost.

The concept design for the road was based on the following design criteria:

- Travel speed 100 km/hr or 80 km/hr
- Intersections at Grade (Austroads)
- Draft Environmental Criteria for Road Traffic Noise (NSW Government)
- Road Environment Safety Guidelines (RTA)
- Road Design Guide (RTA)
- Environment Manual (RTA)
- Bicycles (Austroads).

Four main options were considered for the upgrade of this section of Nelson Bay Road. These alignment options were:

- Option 1A: upgrade of the existing Nelson Bay Road with some upgrading of horizontal curves to 100km/h design standard;
- Option 1B: upgrading of the existing Nelson Bay Road following the existing alignment;

- Option 2: full deviation of the road through undeveloped land south of the existing road, following where possible an existing transmission line easement; and

- Option 3: full deviation of the road at Bobs Farm along the same alignment as Option 2, before rejoining the existing Nelson Bay Road at Trotter Lane.

iii. Value Management Study

As part of the concept design, a Value Management Workshop was undertaken over two days on 6 and 7 November 1997 by Strategic Thinking Pty Limited to assist in the recommendation for a preferred route. Key stakeholder perspectives were considered and a series of presentations were made. The objectives prior to the workshop being held were:

- to improve access to Nelson Bay (Tomaree Peninsula) including:

    1. enhanced road user safety;

    2. traffic efficiency; and

    3. by maintaining ESD principles.

The methodology adopted at the Value Management Workshop was as follows:

- to determine a series of evaluation criteria to evaluate the three given route options;

- to weight the evaluation criteria according to stakeholder perceptions;

- to recommend a preferred route option representing stakeholder needs;

- to brainstorm relevant concept design issues related to the preferred route option; and

- to undertake preliminary risk identification of the preferred route option.

Seven critical issues were identified and addressed by the workshop. These issues were:

- access issues;

- environmental issues (air, noise, water);

- indigenous/heritage items;

- sand dune impact;
- business impact;
- flora and fauna impact; and
- community impact.

Groups evaluated the options using an option evaluation matrix considering the critical issues and objectives of the workshop. Using evaluation criteria of sand dune impact, road user safety, ecological impact, business impact, community impact and travel time, the preferred route of the stakeholders at the Value Management Workshop was found to be Option 2. The results of the workshop were incorporated into a Value Management Study.

iv. The 'Do Nothing' Option

The option of not proceeding with the upgrade of Nelson Bay Road was also assessed. Without major improvements to the road there would be increased accidents, increased travel times and greater traffic congestion as traffic levels increase as a result of predicted population growth. Given the Port Stephens Council Community Profile estimates that annual population growth will continue at between four and five percent, traffic levels will continue to increase. Nelson Bay Road in its existing condition will therefore reach its capacity in five to ten years. The 'do nothing' option would result in general failure of the road to meet the transport needs of the local area, the region and the State. Future residential, industrial, commercial and tourism development in the Port Stephens area could be impeded.

v. Environmental Assessment Reports

Investigations into the concept design options resulted in the need to review the environmental impacts of two proposed options. Environmental assessment reports (EAR) were prepared for both options (ERM Mitchell McCotter 1998a and 1998b). These reports investigated and documented the biophysical impacts and social impacts, identified key issues of the project and recommended safeguards to minimise impact.

The Option 1B Environmental Assessment Report (ERM Mitchell McCotter 1998a) summarised the environmental effects of implementing option 1B alignment as follows:

Potentially Beneficial Effects:

- increased safety and less accidents;
- reduced maintenance costs;
- improved access for local and tourist traffic to the Tomaree Peninsula; and
- decreased time travel to and from the Tomaree Peninsula.

Potentially Adverse Effects:

- archaeological impacts;
- direct and indirect impacts to populations of squirrel glider;
- ecological impacts such as loss of habitat and nesting sites for various species, including squirrel glider and brush-tailed phascogale;
- increase in the ecological barrier formed by Nelson Bay Road;
- increase in noise levels during construction and operation; and
- delays in traffic movement during construction.

The Option 2 Environmental Assessment Report (ERM Mitchell McCotter 1998b) summarised the environmental effects for implementing the Option 2 alignment as follows:

Potentially Beneficial Effects:

- increased safety and less accidents;
- reduced noise from road traffic;
- improved access for local and tourist traffic to the Tomaree Peninsula; and
- decreased time travel to and from the Tomaree Peninsula.

Potentially Adverse Effects:

- archaeological impacts;
- ecological issues such as impacts to the orchid *Diurus praecox;*
- direct and indirect impacts to populations of squirrel glider;

- loss of habitat and nesting sites for various species, including koala;
- isolation of habitats by the formation of a barrier;
- sand dune encroachment;
- increase in noise during the construction period;
- slight delays in traffic movement during construction of join in sections; and
- increased maintenance costs for Port Stephens Council of a four lane, dual carriageway road.

vi. Selection of Preferred Option Report

ERM Mitchell McCotter was commissioned by Port Stephens Council to prepare a Selection of Preferred Options Report (ERM Mitchell McCotter 1998c) based on the environmental assessment, community consultation and economic analysis undertaken for the project. Multi-criteria analysis techniques were used. The criteria included:

- Sand dune impact;
- Road user safety;
- Ecological impact;
- Business impact;
- Community impact; and
- Travel time.

The report recommended that Option 2 (full deviation) be adopted as the preferred option. However, it stated that

> *'it is possible that ecological issues may be significant enough to prevent options 2 or 3 proceeding, in which case Option 1B would be the most viable alternative. Additionally, if the area through which Options 2 and 3 pass is subject to a successful Aboriginal land claim, or becomes a National Park, Option 1B is the recommended alternative.'*

It was considered outside the scope of the report to pre-empt a decision on the issue of an Aboriginal land claim or creation of a National Park, therefore the recommendation of Option 2 was given without further consideration of these issues.

2.4.2 *Preferred Option*

Option 1B involving the duplication and upgrade of the existing road, was announced by the Minister for Transport in March, 1999 as the preferred option for the upgrade of Nelson Bay Road between Bob's Farm and Anna Bay. Although the Selection of Preferred Option Report (ERM Mitchell McCotter 1998c) recommended Option 2 (full deviation) be adopted as the preferred route, there were a number of factors which rendered the viability and approval of Option 2 uncertain.

One of the key issues for consideration in the final selection process is the likelihood of the area through which Option 2 would pass, being declared as a National Park or Nature Reserve. The NSW National Parks and Wildlife Service (NPWS) expressed strong opposition to Option 2. Following a review of the environmental assessment reports for Options 1B and 2 the NPWS stated the following:

> *'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'.*

A copy of the correspondence from NPWS is included in *Appendix A*. In addition to the concerns and objections raised by NPWS, the flora and fauna investigations found that Option 2 had the potential to disrupt the life cycle of the squirrel glider. In order to determine the significance of the impact on the squirrel glider, the National Parks and Wildlife Service (NPWS) Director-General's requirements for a Species Impact Statement (SIS) would need to be sought and an SIS prepared. When completed, the SIS would be referred to NPWS for consideration and granting of concurrence by the Director-General. If concurrence were granted, then an EIS would need to be prepared in accordance with Part V of the *Environmental Planning and Assessment Act 1979*. Approval of Option 2 would be very uncertain given the likelihood of the area being declared as a National Park or Nature Reserve, the issue of an Aboriginal Land Claim over a significant part of the route, and the proximity of sand dunes.

For these reasons Option 1B was finally selected as the preferred option.

2.5 DESCRIPTION OF THE PROPOSAL

2.5.1 *Road Upgrade*

The alignment would be constructed at approximately the same grade as the existing road. Concept Design Plans showing the existing road, the proposed road upgrade

and other features of the proposal, are included at the rear of this volume. The length of the upgrade is described below in sections of chainage and commences at chainage 0.00 metres. The "tie-in" section, where the proposed road works integrate with the existing dual carriageway, is described as chainage -300.00 metres to 0.00 metres. The proposed road surface is open grade asphalt.

The total width of the road reserve would vary between 38 to 47 metres. This would comprise two 2 lane carriageways each 10 metres wide, a central median ranging between 4 and 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 (Ch-350.00 to +740.00 metres) the median would be between 24 and 7 metres wide. The rest of the road would have a median width varying between 3 and 14 metres as shown on the Concept Design Plans.

The first 350 metres of the upgrade (Ch-350 to Ch000) would involve integrating with the existing dual carriage way to the west of the proposed upgrade.

From Ch000 to Ch740 the new carriageway would be on the southern side of the existing road to avoid several squirrel glider den trees (Chainage 100), the existing road would become the eastbound carriageway, and the median would be a depressed grassed median 7 metres wide.

In the sand dune area, between Ch400 and Ch940, cut and fill batters would be constructed at a grade of 4:1 (H:V) including a 9 metre cut (Ch400-420), a 13 metre cut (Ch620-640) and a 13 metre fill (Ch880-940).

From Ch740 to Ch1100 both carriageways would be reconstructed as the carriageways cross over at this point. The median would reduce in width from 7 metres to 3 metres wide and would change to a raised concrete median.

For the next 2.6 kilometres (Ch1100 to Ch3700) the new carriageway would be on the northern side of the existing road, which is approximately the same alignment that was originally proposed in 1959. The existing road would become the westbound carriageway. For the first 300 metres of this section the median would be a 3 metre wide raised median with a safety fence separating the two carriageways. The narrow median width of 3 metres was adopted to minimise the environmental impacts on the northern side of the road. For the next two kilometres of this section the median would range between 3 and 11 metres wide, and the remaining 350 metres of this section would have a depressed grassed median ranging between 9 and 14 metres wide.

From Ch3700 to Ch4900 both carriageways would be reconstructed as the carriageways cross over again at this point. The median would generally be a 5 metre wide raised grassed median.

For the next 600 metres (Ch4900 to Ch5500) the new carriageway would be on the southern side of the existing road, which is approximately the same alignment that was originally proposed in 1959. The existing road would become the eastbound carriageway. The median would generally be a 4 metre wide depressed grassed median.

For the last kilometre (Ch5500 to Ch6500) both carriageways would be reconstructed, as the alignment would be straightened. For the first 700 metres of this section the widening would be on the southern side of the existing road, for the remaining 300 metres the widening would be on the northern side. The median would generally be a 5 metre wide raised grassed median. A squirrel glider den tree at Ch5580 would be within the new road reserve, but would be retained.

Channelisation is proposed at each intersecting side street to provide access for local residents. These intersections would comprise right turn deceleration lanes and accelerating and decelerating lanes for left turning traffic.

As a central median is part of the design for the upgrade, eight U-turn bays would be provided at intervals of between 600 and 1300 metres each way to enable access for residents. Truck-turning bays are proposed at Trotters Lane, Cromarty Lane and at Ch5700. The locations of the U-turning and truck-turning bays are shown on the Concept Design Plans.

Bus stops and dedicated pedestrian crossing points are proposed at the following locations as shown on the Concept Design Plans:

- Ch1100 (approximately) - east and westbound carriageways;
- Ch2000 – eastbound carriageway;
- CH2700 - eastbound carriageway;
- CH3100 - eastbound carriageway;
- Ch3700 – eastbound carriageway;
- Ch4700 – eastbound carriageway;
- CH5600 - east and westbound carriageways; and
- CH6450 - east and westbound carriageways.

Details of pedestrian crossings and access and provision for cyclists would be provided at the detailed design stage.

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 kilometre from the start of the upgrade in the sand hills; and
- removal of protective fencing and temporary sediment control structures.

All gravel and pavement material would be won from licensed quarries.

The construction would be carried out in stages as determined by the availability of funding for the project. Each stage would be at least one kilometre in length, but most likely not more than two kilometres, and would form part of the ultimate four lane divided carriageway. This would assist in reducing the potential impact of construction activities on local traffic and residents. Local access to adjacent residents and businesses would be provided, as required in consultation with owners. Existing powerlines would need to be progressively relocated, which may result in some interruption to power supply in the local area.

As part of the proposed road upgrade a number of residences along the route would be provided with air conditioning or suitable ventilation for noise amelioration, given the internal noise criteria would be exceeded at these residences when the windows are open (see *Section 5.10*).

2.5.2 *Ancillary Works*

Ancillary works would comprise site compounds, spoil and topsoil stockpiles and possible acid sulfate soil treatment sites.

Depending on the exact number of construction stages, at least two compound sites would be required for the contractor's plant and equipment. These would be located at Marsh Road intersection at Ch1640 on the northern side of the road within the road reserve and on Council's land at Trotters Road at Ch4500 (Port Stephens Council, DP 622229) on the northern side of the road (see the Concept Design Plans). The area at Trotters Road would need to be cleared. This area was included in the flora and fauna and archaeology studies for the proposal.

Stockpile sites for topsoil, tree mulch, concrete pipes and other construction materials would be located beside the road in existing cleared areas within the road reserve, close to where these materials would be required. No additional clearing would be required to provide stockpile sites, with the exception of a small area of Council's land at Trotter Road that would be cleared for a site compound and may also be used to stockpile construction material. Sealing aggregate would be stockpiled on the old road east of Gan Gan Road.

Preliminary geotechnical investigations indicated that acid sulphate soils are present between Ch1500 and Ch1850. The exact locations of acid sulfate soil treatment sites have not yet been determined and would be subject to further investigations as part of the detailed design phase. The type of treatment site required would be determined following further investigations and the preparation of an Acid Sulfate Soil Management Plan.

2.6 COSTING AND TIMING

It is estimated that the total cost of the proposed upgrade would be $16 million (year 2001 costs). One of the benefits of adopting the selected option is that the upgrade can be conducted in stages and therefore has advantages for funding arrangements.

The timing of the proposed upgrade is dependent on securing all necessary approvals and funding being made available. It is anticipated that the earliest that works could commence would be the 2001/2 financial year. Funding for State Roads is allocated to the RTA by the State Government, on a state wide priority system.

Chapter 3

CONSULTATION

3.1 AUTHORITY CONSULTATION

Extensive consultation with Government authorities was undertaken during the concept design stage and during the preparation of the Route Development Strategy.

The preparation of the Value Management Study (VMS) provided certain stakeholders with an opportunity for further input into the consideration of options for the upgrading of the road link between Marsh Road and Port Stephens Drive.

Following the public exhibition of the Environmental Assessment Reports for Options 1B and 2, the NSW National Parks and Wildlife Service responded with comments which are summarised in *Section 3.1.2*.

3.1.1 Responses from Authorities

Comments were sought from a number of government authorities in relation to their requirements during the concept design phase. Responses were received from the following Authorities:

- Environment Protection Authority;
- Department of Land and Water Conservation;
- Roads and Traffic Authority;
- National Parks and Wildlife Service;
- Worimi Local Aboriginal Land Council;
- NSW Fisheries;
- RAAF Base Williamtown;
- Hunter Water Corporation;
- Port Stephens Council; and
- Department of Mineral Resources.

Several authorities did not respond including the Anna Bay Precinct Committee and the Nelson Bay Precinct Committee. Comments received from the authorities that responded are summarised below while copies of their full response are included as *Appendix A*. *Table 3.1* provides a list of the issues raised by these authorities and where each issue is addressed in the document.

i. Environment Protection Authority

The Environment Protection Authority (EPA) advised that the location of the study area and the scope of works are such that the environmental issues would not be such 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.

ii. Department of Land and Water Conservation

The Department of Land and Water Conservation (DLWC) provided information on a number of issues. A summary of comments is provided below.

a. Crown Land

The Aboriginal land claims within the concept design 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. The Department in consideration of proposals affecting Crown land must take into account whether the proposal would affect any Native Title interest that may exist in the land. The issues of Native Title need to be addressed in terms of the requirements of the Commonwealth Native Title Act 1993.

b. 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 the same;

- drainage works and erosion and sediment control strategies during construction;
- revegetation strategy to include prior collection of endemic seed and vegetative material; and
- cumulative impact of habitat destruction along Stockton Bight.

c. Groundwater

The proposed route of the Nelson Bay Road runs though a sensitive groundwater environment. The groundwater resources in the area have a high value and are also highly vulnerable to pollution.

The study should include an assessment of the groundwater resource in the area and potential impacts of the groundwater resources as a result of the proposed development.

d. Flooding Impacts

Under the State Government's Flood Policy, proponents of development in floodprone areas are required to demonstrate that local flooding would 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 would encroach into a flood storage area. The impact on flooding due to loss of flood storage should be assessed. It was also noted that flow paths along the proposed road route may be partially blocked and local watercourses may be redirected. Compensatory works to reduce these flooding impacts may be necessary.

e. Coastal Processes

The area is subject to dunal movements. The concept design study must assess the impacts of dunal movement in site selection.

iii. Roads and Traffic Authority

The RTA is the proponent for the works and therefore has had an ongoing role throughout the study process.

iv. *National Parks and Wildlife Service*

The issues raised by the National Parks and Wildlife Service (NPWS) were not relevant to Option 1B, but rather expressed concern regarding Option 2 which included a long section within the area proposed for gazettal as Stockton Bight National Park.

v. *Worimi Local Aboriginal Land Council*

Worimi Local Aboriginal Land Council (LALC) attended the field survey and provided comments on the completed archaeology report (*Appendix F*). The LALC identified the area as having a high potential for Aboriginal sites and recommended sub-surface testing to provide a more accurate record of any insitu archaeological material. They recommended a LALC approved Sites Officer be engaged to monitor works until the road is in place, that low vegetation clearance be undertaken before construction commences and that if any Aboriginal material is uncovered work in the immediate area should cease and the LALC be contacted.

vi. *NSW Fisheries*

NSW Fisheries require that a description of fish and fish habitat affected by this project should be included in the concept design. There should also be a description of what the predicted impacts are and any mitigating or remedial action that would 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.

vii. *RAAF Base, Williamtown*

The RAAF Base advised they did not have any comments in relation to this project.

viii. *Hunter Water Corporation*

Hunter Water Corporation (HWC) advised that 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 a 40 kilometre long pipeline would be constructed in the roadside reserve. As such, alterations to the route or dimensions of the road would 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.

ix. *Port Stephens Council*

Port Stephens Council's Sustainable Development Department advised that the concept design should address the following:

- a cost/benefit analysis of the differing options addressing economic, social and environmental issues;
- an analysis of the impacts on flora and fauna in the area with particular emphasis on the Threatened Species Conservation Act and wildlife movements;
- an analysis of any drainage, inundation and erosion control impacts;
- consideration of the impacts of Potential Acid Sulfate Soils in the locality;
- an analysis of the impacts on residents in the locality from the proposals (eg: noise, privacy, access); and
- an assessment of the objectives of the Port Stephens LEP and those of the 1(a) zone applying to the proposal.

x. *Department of Mineral Resources*

The Department of Mineral Resources (DMR) advised that there are several mineral deposits and extractive resources that may be adversely affected by any proposal to construct a new road south of the existing Nelson Bay Road.

The north-eastern end of the proposed deviation is situated along the northern side of foundry sand extraction operations conducted by Metromix Pty Limited and ACI Industrial Minerals Division. Access is provided by an unsealed track from Nelson Bay Road and 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.

Table 3.1 GOVERNMENT AUTHORITY REQUIREMENTS

Issue	REF Section Reference
Environment Protection Authority	
Measures to control dust emissions, minimise erosion and sediment migration and control noise during construction.	5.2.5, 5.3, 5.10
Department of Land and Water Conservation	
Address the issues of Native Title needs in terms of the requirements of the Commonwealth Native Title Act 1993.	5.1
A wide range of Crown land issues need to be addressed including the proposed Stockton Bight National Park and Hunter Water Corporation Water Reserve.	5.1
Effect on habitat and endangered species.	5.6
Size and slope of road batters and implications for stabilising steep siliceous sands.	2.5
Acid sulfate soils and management strategies for handling and disposal.	5.3.2, 6.2.3
Drainage works and erosion and sediment controls during construction.	5.5, 6.2.2
Revegetation strategy.	5.12
Cumulative impact of habitat destruction along Stockton Bight.	5.6
Assessment of the groundwater resource and potential impacts.	5.1.2, 5.5
Demonstrate that local flooding would not be exacerbated by the proposed development and assess impact due to loss of flood storage where areas of land are filled.	5.5
Assess impacts of dunal movement in site selection.	5.4
National Parks and Wildlife Service	
The NPWS view is that the proposal should be located wholly outside the proposed Stockton Bight National Park.	3.1.2, 5.1.1
NSW Fisheries	
Description of the fish and fish habitat affected, predicted impacts and mitigative or remedial action.	5.7
Hunter Water Corporation	
Address issue of proposal to construct a pipeline in the road reserve and impact on the location of the pipeline and access to fittings.	5.1.2
Port Stephens Council	
Cost/benefit analysis of the differing options addressing economic, social and environmental issues.	5.13
Impacts on flora and fauna, wildlife movements and implications of the Threatened Species Act.	5.6

Table 3.1 GOVERNMENT AUTHORITY REQUIREMENTS *(Contd)*

Issue	REF Section Reference
Analysis of drainage, inundation and erosion control impacts.	5.3, 5.5
Impacts of acid sulfate soils.	5.3.2
Impacts on residents in the locality (noise, privacy, access).	5.10, 5.13
Assessment of the objectives of the Port Stephens LEP and relevant land zone.	4.1.1
Department of Mineral Resources	
The DMR raised concern regarding mineral deposits and extractive industries that would be affected by the deviation (Option 2).	5.1.1

3.1.2 Additional NPWS Consultation

The NSW National Parks and Wildlife Service (NPWS) submitted a response to the Environmental Assessments for Options 1B and 2 in January 1999. This response detailed the Service's objections to Option 2 on the basis that it would dissect and fragment land that has been identified by the State Government for a reserve because of its high natural and cultural significance.

The NPWS expressed concern regarding the impact of Option 2 on the Stockton Bight sand dune system which displays a unique geomorphological history and pattern of barrier evolution. The dune system is the most intensively studied portion of late Quaternary sequences along the coastline of NSW and significantly contributes to the wider understanding of Australian natural history.

The NPWS also notes that the dunal vegetation communities provide important habitat for the koala, powerful owl and masked owl and consider that Option 2 would diminish the conservation value and viability of the area. The NPWS consider Option 2 is likely to be more destructive on threatened species and their habitat than Option 1B. They also consider that Option 1B would involve clearing of a smaller area and more degraded vegetation than Option 2 and would not establish a secondary barrier to fauna movement in the locality.

The NPWS considers that both options are likely to result in impact on Aboriginal sites, with Option 2 posing greater impact. The Service recommended further investigation of Aboriginal sites along the routes.

Further correspondence was received from NPWS in June 1999 following selection of Option 1B as the preferred route, commending Port Stephens Council on the selection and their recognition of the proposed conservation reserve.

3.1.3 *Authority Consultation following the April/May, 2000 Exhibition*

As part of the route selection process, the RTA placed Option 1B and Option 2 on public exhibition for 30 days between 19 April and 17 May, 2000. As a result, 375 submissions were received including five responses from Government Authorities. Three out of the five responses (60 per cent) favoured Option 1B, the other two responses did not express a preference. This additional Government Authority consultation is summarised below.

i. 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.

ii. Department of Land and Water Conservation

The Department of Land and Water Conservation expressed support for Option 1b.

iii. 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.

iv. 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. The HWC also recognises that Option 1B poses less direct impact on the North Stockton Sandbeds that form a key part of HWC's drought management strategy and have been identified as a potential future water source for the Tomaree Peninsula.

v. Enerserve

Enerserve, a business unit 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 would need to relocated and will result in blackouts to customers along the route, requiring work programming to minimise impact on customers. Enerserve request that a suitable setback from the road be provided for poles, and that access for construction and maintenance be 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 indicated they were willing to cooperate wherever possible for this project and future stages of road upgrading.

3.2 COMMUNITY CONSULTATION

3.2.1 Introduction

Community consultation was undertaken throughout the development of the proposal. The community was consulted during the Route Development Study and community representatives attended the Value Management Study workshops (see *Section 2.4.1*). ERM Mitchell McCotter undertook community consultation during the early concept development stage, including a series of consultation workshops for three types of community groups, namely; residents, business owners and environmental organisations. The aim of the workshops was to provide the local community with an opportunity to ask questions, discuss issues and make comments on the route options. Following the consultation workshops, individual interviews with landholders and business operators were conducted along the affected alignments.

Public comment was invited in response to the public exhibition of the Nelson Bay Road Upgrade Option 1B and Option 2 Environmental Assessment reports. The reports were displayed at four locations for a four week period from 14 October 1998

to 11 November 1998. Community representatives at the Value Management Study in November 1997 suggested the Bobs Farm Store as a suitable location for one of the displays. A newsletter was distributed to the local community prior to exhibition informing the community of the display of options and seeking comment from them. The purpose of the exhibition was to inform the community of the various options, explain the advantages and disadvantages of each option and seek comment from the community on their preferred option.

Community consultation has been ongoing since the Minister's announcement of the preferred option, Option 1B, and was jointly managed by Port Stephens Council and the RTA. This has involved a public meeting and a series of community liaison group meetings.

Options 1B and 2 were placed on public exhibition again, between 19 April and 17 May 2000. Public submissions were invited and 375 submissions were received. These submissions were reviewed and assessed by ERM (see *Section* 3.2.3).

3.2.2 *Initial Consultation*

i. Community Workshops

Following the VMS, a series of consultation workshops were held with the local community to provide an opportunity to ask questions, discuss issues and make comments on the route options. Three workshops were held, for the following community groups:

- residents;
- business owners; and
- environmental organisations.

The results of each workshop are summarised below.

ii. Residents' Workshop

Community impact was defined in the VMS as the degree to which quality of life for residents of Bobs Farm and Anna Bay West would be disrupted. Local residents were invited to attend a community workshop to discuss the road upgrade options. The workshop was attended by 26 people. During the workshop, the following issues were raised:

- noise impacts, mitigation measures and the fact that noise was deleted as an assessment criterion during the VMS;
- the impact of sand dunes, including timing of construction of the road;
- the fact that a new road would provide additional access to the Tomaree Peninsula in a fire, flood or emergency;
- access to properties and severance;
- compensation for land loss;
- traffic speed, and road user and resident safety;
- travel time savings and economic benefits;
- the impact on businesses and tourism along the existing section of Nelson Bay Road if Option 2 was chosen;
- the role of economics in the decision making process;
- the role of the LALC and NPWS in determining a road corridor;
- the fact that the community wished to see a decision made quickly;
- the timing of the study, construction and compensation;
- the role of consultation in the study process and outcomes;
- acquisition of land and compensation details;
- the potential impact of acid sulfate soils; and
- the potential impact of options on groundwater.

There was a general feeling at this workshop that Options 1A or 1B would be the best option.

iii. Business Owners Workshop

Many of the businesses along Nelson Bay Road were established to capitalise on location and high exposure from resident and tourist traffic travelling between Nelson Bay and the Newcastle. A considerable proportion of the businesses rely heavily on passing trade, and have been established and developed with the

expectation that the existing alignment of Nelson Bay Road would be the main access road to Nelson Bay.

Business owners were invited to attend a workshop to discuss the implications of the road upgrade options. The workshop was attended by 26 people, and key issues raised during the workshop were as follows:

- the impact of sand dune encroachment;
- the impact of the upgrade on the value of businesses and properties;
- the fact that any land resumption or acquisition would be compensated, but any loss of business would not be compensated;
- the location and frequency of U-turn bays for access to businesses;
- the design speed of the upgraded road;
- the fact that NPWS may prevent Option 2 proceeding;
- the fact that a new road (Options 2 or 3) would result in two roads, a State controlled road (the new road) and a Council controlled road (existing Nelson Bay Road);
- the impact of Option 2 on noise levels, wildlife and adjoining land;
- the fact that power lines and services would need to be relocated as a result of the upgrade; and
- the timing of the upgrade and current study.

Most participants at the business operators' workshop were in favour of Option 1B, with at least one participant in favour of Option 2. Option 2 was generally perceived to have the greatest potential to reduce passing trade. Both Option 1B and Option 2 were discussed in relation to access to property and loss of land. Option 3 was not specifically discussed in detail.

iv. Environmental Groups Workshop

Eighteen people attended the workshop for environmental groups. The issues raised during this workshop are listed below:

- the fact that only six evaluation criteria were used in the VMS;

- the fact that the area through which Options 2 and 3 would travel has many bandicoots and possums;
- the fact that Port Stephens Conservation Group is opposed to Options 2 and 3;
- the impact of sand dunes on potential road alignments;
- the fact that Council would be responsible for maintaining the existing Nelson Bay Road if a new road was constructed;
- the number of plant and animal species in the proposed road corridor (Option 2);
- Options 2 and 3 were both seen to have large environmental impacts, and incremental impacts were also unwanted;
- the role and likelihood of an EIS being prepared;
- the likely relocation of services, including power lines;
- the fact that the business community would prefer Option 1, as Options 2 and 3 would impact on passing trade;
- a general feeling that Option 1 was the best option;
- the fact that the cost of Option 1 would be more than Options 2 or 3;
- the potential impact of acid sulfate soils; and
- the potential impact on water quality in aquifers.

There was general agreement between the business and environmental groups that Option 1 was the preferred option.

v. Summary of Workshop Outcomes

The three workshops indicated to independent consultants ERM Mitchell McCotter that a considerable proportion of people from the business, environmental and general communities supported Option 1 as the preferred option. Some support was given to Option 2, however, Option 1 was perceived as the best alternative because it would have fewer impacts on business and the local ecology. All options would have some impact on property access and would require the acquisition of some land.

Although a wide range of issues were raised during the workshops, most fell within the criteria established in the VMS. However, noise was raised as an issue at both the business and resident workshops, and concern was expressed at the environmental workshop that only six assessment criteria were used at the VMS. Additionally, concern was expressed at the residents' workshop that noise had been deleted as an evaluation criterion during the VMS.

Following the workshops and preliminary environmental investigations, it was considered that adding noise to the list of assessment criteria in the multi-criteria analysis may be worthwhile. However, no other changes to the assessment criteria used in the VMS were considered necessary.

vi. Interviews with Affected Landholders and Business Operators

Following the consultation workshops, individual interviews with landholders and business operators were conducted along the affected alignments in December 1997. Appointments were made by phone with people who had expressed interest at individual interviews at the workshops. Letters were sent to all property owners along the proposed upgrade route inviting them to make appointments for individual interviews. More than 20 people were individually interviewed with a follow up letter sent to advise all landholders of progress in the study in June 1998.

The interview surveys revealed different opinions to the general feeling expressed at the community workshops, despite the workshops being attended by many of the same people who were interviewed. This was possibly because many individuals did not want to disagree with some of their neighbours' comments at the workshops. Approximately half the people interviewed thought that Option 2 would be the best option, with the remainder preferring Option 1. Little comment was made about Option 3 in either positive or negative terms.

During the landholder and business interviews, noise was again raised as an issue of concern by the community. However, no additional significant issues were raised that fell outside the criteria established in the VMS.

3.2.3 *Public Exhibition of Options 1B And 2 - October/November 1998*

The Nelson Bay Road Upgrade Option 1B and Option 2 Environmental Assessment reports (ERM Mitchell McCotter, 1998a and 1998b) were placed on public exhibition at four locations for a four week period from 14 October 1998 to 11 November 1998. The display was advertised in local and regional newspapers. The locations were:

- Bob's Farm General Store, Nelson Bay Road;

- Port Stephens Council Administration Office, Raymond Terrace;
- Nelson Bay Motor Registry; and
- Raymond Terrace Motor Registry.

The display included a large plan showing the two options under consideration, a copy of each assessment report and summary sheets.

A newsletter was distributed to the local community prior to exhibition informing the community of the display of options and seeking comment from them.

The purpose of the exhibition was to inform the community of the various options for the upgrade of Nelson Bay Road upgrade, explain the various advantages and disadvantages of each option and seek comment from the community on their preferred option.

Thirty submissions were made by the Port Stephens community and government departments. These submissions were predominantly from individuals but also included non government organisations and businesses. Some submissions were simple statements of a preferred route while others provided detail on each option's perceived advantages and disadvantages. A summary table of the submissions and a brief description of issues raised is included in *Appendix B*.

Several submissions provided comments or discussed local issues without indicating a preference for the exhibited options. These have been included in the summary table. Many submissions indicated opposition for an option rather than a preference for the other.

A summary of the support for each option is provided in *Table 3.2* below. The following section describes the most repeated comments put forward by the community. Included in *Table 3.2* are those submissions where no preference was stated.

Table 3.2 OPTION SUPPORT SUMMARY

Option	Supporting Submissions
Option 1B	17
Option 2	19
No preference stated	5

Examination of *Table* 3.2 reveals that Option 2 received marginally more support than Option 1B based on the submissions received.

Several issues were commonly identified in the submissions received. These are summarised as follows.

i. Adoption of Option 1B would mean that there would be:

- little or no adverse impacts on local businesses;
- minimised additional impacts on wildlife and vegetation; and
- avoided impacts on sand dunes and no affect on the road by sand drift.

ii. Adoption of Option 2 would:

- increase safety along the existing Nelson Bay Road particularly when accessing residences and businesses;
- maintain uninterrupted access along the existing road during construction of the new road;
- provide an additional access route to Nelson Bay; and
- decrease noise impacts for residents.

iii. Numerous submissions that opposed an option did so as the option either directly affected their property or passed close by.

This list is not exhaustive, but rather provides a summary of the most common issues identified in the submissions received.

3.2.4 *Community Liaison Group*

A series of community liaison group meetings were conducted by Port Stephens Council/RTA from May 1999 to March 2000 involving selected local representatives and an independent facilitator. Minutes were taken at all meetings and a record of the minutes held by the facilitator and Port Stephens Council/RTA.

In March 1999 the Minister for Roads, Mr Carl Scully, announced that the RTA was proposing to upgrade Nelson Bay Road along the existing alignment and that the

alternative route had been rejected because of its potential impact on the proposed Stockton Bight National Park/Nature Reserve and nearby sand dunes.

In May 1999 a public meeting was called by a group of local residents. At this meeting seven local representatives were elected to consult with the RTA and Port Stephens Council during the next stage of the project development, to discuss issues of community concern.

These community consultation meetings were chaired by an independent facilitator, who did not have any previous knowledge of this project. Minutes of the meetings were taken by the facilitator, and sent in draft form to all members for comments prior to finalisation. These meetings were aimed at resolving issues between Option 1B and Option 2, discuss variations to these options and improving the community consultation process for this project and for other projects in the future. A summary of issues discussed at these meetings is provided below.

Meeting held on Thursday 1st July 1999: At this meeting Mr Nunn for the RTA presented some background information about this project to date, and he confirmed the RTA's commitment to work with the community. The advantages of both Option 1B and Option 2 were listed. Other options including variations to Option 2 were also discussed. The following main issues were identified to be discussed at the next meeting: drainage problems, sand dunes and their impact, NPWS and the proposed national park, and access to properties.

Meeting held on Wednesday 25th August 1999: Mr Johnson from PSC outlined Council's negotiations with property owners to date in regards to drainage problems at Bobs Farm, and it was agreed that the drainage problems need to be addressed irrespective of what happens to Nelson Bay Road. NPWS, Worimi LALC and Maiangal Traditional Owners each presented their views on the project. It was agreed that the RTA should send out a newsletter to the general community, which was subsequently mailed out towards the beginning of September. The purpose of the newsletter was to advise community members of the final selection of Option 1B as the preferred upgrade route and to advise them of activities such as surveying and assessments for the REF to be conducted along the route. It was also agreed that work on the review of environmental factors and concept design plans for Option 1B should be commenced, and that the draft plans should be presented at the next meeting.

Meeting held on Wednesday 8th December 1999: Council presented draft concept plans for the preferred option, and explained the proposal in more details. Comments were sought from those representatives present so that the plans could be improved where possible. The main issues were: property acquisition details, traffic noise, compensation, air pollution, landscaping, walkways, cycleways, parking and public access.

Meeting held on Wednesday 23 February 2000: The changes made to the draft concept plans since the last meeting were discussed and a number of additional issues were raised, which needed to be addressed before the plans were to be put on exhibition. John Bennis from the RTA outlined the procedures for property acquisition, once the RTA has determined the preferred route. Compensation is only applicable where there is a need for property acquisition. The "Do Nothing" option was discussed at great length, and it was generally agreed that the RTA should not consider this option seriously, because there is a need in the community to resolve this issue as soon possible. It was agreed that one more meeting was required before the public exhibition, so that all seven members of the group could attend (only six were able to attend the 23 February meeting).

Meeting held on Wednesday 8 March 2000: Three possible variations in the proposed alignment of Option 2 were discussed and it was agreed by the representatives opposing Option 1B that Option 2B was the best alignment. This was not supported by the other three representatives. Traffic noise impacts for Option 1B were discussed. The parameters for calculating future noise levels, the criteria that the RTA uses for providing noise protection, and the different type of noise protection measures that may be available were discussed. It was also stated that if Option 1B were to proceed, the RTA would have further consultation with those residents affected. The meeting then briefly discussed the preliminary geotechnical report, air pollution issues, and the streetscape design. The RTA outlined the public exhibition process that would be followed, what would be included in the display, when it would be likely to happen, how it would be advertised and where the public exhibitions would be held.

3.2.5 *Public Exhibition of Options 1B And 2 - 19 April to 17 May 2000*

RTA placed two alternatives (Options 1B and 2) on public exhibition between 19 April and May 17, 2000 inviting public comment. Submissions were accepted by the RTA up to 22 June 2000.

The public exhibition received strong community feedback including short letters, detailed responses, voting forms and petitions from individuals, businesses, organisations and community groups. A total of 371 submissions and four petitions were received by the RTA. No form letters were received. Tomaree Peninsula residents provided the largest (39%) number of submissions followed by non local residents (21%) and Bobs Farm residents (18%). Most Bobs Farm residents businesses business along this section of Nelson Bay Road commented on the project.

The submissions indicate a strong preference for Option 1B with 64 per cent of all respondents indicating a preference for Option 1B. Option 2 was favoured by 34 per cent of respondents.

The Nelson Bay Road Review of Public Submissions Report (ERM, 2000) is included in *Appendix B* and provides a detailed analysis of each submission received, with consideration given to the stated preference, format of the response, type of respondent, geographic location of respondent, and the specific issues raised.

In summary, submissions from Bobs Farm residents show that 50 per cent of respondents support Option 1B and 50 per cent support Option 2. All other respondent categories clearly favour Option 1B. The most frequently raised 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 majority (80%) of Bobs Farm businesses that responded, support Option 1B. Issues raised by businesses favouring Option 1B include economic benefits and flora and fauna. Bobs Farm Businesses supportive of Option 2 emphasised the reduction in traffic delays and are concerned about economics, accidents and amenity along the Option 1B route.

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.

The most frequently raised issues in all submissions received relate to flora and fauna, economic impact on business, road safety, and alternative access to the Tomaree Peninsula and general environmental concerns.

The level of community interest and involvement in the proposed road upgrade has risen dramatically since the public exhibition of Options 1B and 2 Environmental Assessment reports from 11 to 14 October, 1998 which only resulted in thirty submissions. Not only has the level of interest increased, a much broader range of individuals, organisations and businesses have indicated their preference and commented on the project compared to the previous public exhibition.

Chapter 4

PLANNING

4.1 STATUTORY PLANNING

4.1.1 *Port Stephens Local Environmental Plan 2000*

The Port Stephens Local Environmental Plan 2000 (LEP 2000) is the principal environmental planning instrument governing land use within the Port Stephens LGA.

The subject road would be classified as a "main road" or a "utility installation" under LEP 2000. A main road is defined in LEP 2000 as *'a main road within the meaning of the Roads Act 1993'*. A main road is defined in the *Roads Act 1993* as *'a road that is declared to be a main road by an order in force under Section 46'*. Section 46 of the *Roads Act 1993* is reproduced as follows;

'The Minister may, by order published in the Gazette, declare to be a main road:

(a) any public road, or

(b) any other road that passes through a public open space and joins a main road, State Highway, freeway, tollway, transitway or controlled access road.'

Nelson Bay Road is considered to be a main road.

A utility installation is defined in LEP 2000 as *'a building or work used for a utility undertaking'*. LEP 2000 defines utility undertaking as follows;

'Utility undertaking means any undertaking carried out on by or under the authority of any government department, or in pursuance of any Commonwealth or State Act, for the purpose of:

(a) railway, road, water or air transport, or wharf or river undertakings, or

(b) the provision of sewerage or drainage services, or

(c) the supply of water, hydraulic power, electricity or gas, or

(d) firefighting facilities, or

(e) *paramedical facilities.'*

A road can therefore also be considered to be a utility undertaking.

The majority of land traversed by the proposed options for the upgrade of Nelson Bay Road between Bobs Farm and Anna Bay is zoned Rural Agriculture 1(a). The objectives of this zone as set out in LEP 2000 are reproduced as follows;

'The objective of the Rural Agriculture "A" Zone is to maintain the rural character of the area and to promote the efficient and sustainable utilisation of rural land and resources by:

(a) *regulating the development of rural land for purposes other than agriculture by ensuring that development is compatible with rural land uses and does not adversely affect the environment or the amenity of the locality, and*

(b) *ensuring development will not have a detrimental effect on established agricultural operations or rural activities in the locality, and*

(c) *preventing the fragmentation of grazing or prime agricultural lands, protecting the agricultural potential of rural land not identified for alternative land use, and minimising the cost to the community of:*

  (i) *fragmented and isolated development of rural land, and*

  (i) *providing, extending and maintaining public amenities and services, and*

(d) *protecting or conserving (or both protecting and conserving):*

  (i) *soil stability by controlling development in accordance with land capability, and*

  (ii) *trees and other vegetation in environmentally sensitive localities where the conservation of the vegetation is likely to reduce land degradation or biodiversity, and*

  (iii) *water resources, water quality and wetland areas, and their catchments and buffer areas, and*

  (iv) *land affected by acid sulphate soils by controlling development of that land likely to affect drainage or lower the water table or cause soil disturbance, and*

  (v) *valuable deposits of minerals and extractive materials by restricting development that would compromise the efficient extraction of those deposits, and*

(e) *reducing the incidence of loss of life and damage to property and the environment in localities subject to flooding and to enable uses and developments consistent with floodplain management practices.'*

Main roads and utility installations are permissible with development consent in the Rural Agriculture 1(a) zone.

The northern end of Option 1B passes along the edge of a small portion of land zoned General Recreation 6(a). The objectives of this zone as set out in LEP 2000 are reproduced as follows;

'The objectives of the General Recreation "A" Zone are:

(a) *to identify publicly owned land and ensure that it is available for open space recreation, and*

(b) *to provide an open space network to serve the present and future recreational needs of residents and visitors, and*

(c) *to permit development associated with, or complementary to, open space, and*

(d) *to allow development on foreshores where that development is water related and enhances the recreational use or natural environment of the foreshore, and*

(e) *to preserve the aesthetics of land which is prominent and visible to the public along foreshore areas, and*

(f) *to reserve privately owned land that is essential for future public open space and to provide for its acquisition by the Council.'*

Utility installations are permissible with development consent in this zone.

While LEP 2000 requires consent from Council to be obtained for the road upgrade within the Rural Agriculture 1(a) and General Recreation 6(a) zones, this is overridden by State Environmental Planning Policy 4 - Development Without Consent (SEPP 4).

Clause 11C of this policy states:

'11C (1) In this clause:

'classified road' means a classified road within the meaning of the State Roads Act 1986;

'toll work' means a work declared to be a toll work under Section 46 of the State Roads Act 1986.

(2) *Where, in the absence of this clause, development for the purposes of a classified road or toll work, or a proposed classified road or toll work, may be carried out only with development consent being obtained, therefore, that development may be carried out without that consent.'*

As Nelson Bay Road is a "classified road" within the meaning of the *State Roads Act 1986*, SEPP 4 enables the development to be carried out without the need to obtain development consent. Therefore a development application does not have to be lodged with Port Stephens Council. However, this project must be assessed under Part V of the *Environmental Planning and Assessment Act 1979*. Part V assessments must be undertaken for all works exempt from having to obtain development consent under Part IV of the Act.

4.1.2 Hunter Regional Environmental Plan 1989

The Hunter Regional Environmental Plan 1989 (REP) is another planning instrument which needs to be considered in relation to the proposed roadwork. The REP provides a framework for the Hunter Region's development which deals with social, economic, settlement, access, natural resources and ecological issues.

The REP recognises the importance of maximising accessibility and facilitating the movement of people and goods throughout the region, having due regard to social, economic, environmental and safety considerations (Clause 32). It also refers to the need to identify a regional road hierarchy to meet the needs of the community and emphasises the need to improve access to district centres such as Nelson Bay and tourist destinations (Clause 35).

Nelson Bay Road is the only road access for residents along the Tomaree Peninsula. However, sections of the road are currently in need of upgrade in order to maintain the appropriate level of service to cater for future traffic growth. The safety of motorists and residents is a concern as there are large volumes of traffic along certain sections of Nelson Bay Road and it is largely a one lane undivided road with limited opportunities for overtaking.

The upgrading of this section of Nelson Bay Road is consistent with the objectives of the REP given the improvements in access and safety likely to occur. Having regard to the tourist potential of the Tomaree Peninsula, upgrading of the road would facilitate the safe movement of both local and tourist traffic.

4.1.3 Threatened Species Conservation Act, 1995

Developments requiring approval from a Council or statutory authority of the NSW State Government, are required to be assessed in accordance with the *Environmental*

Planning and Assessment Act 1979 (EP&A Act), as amended by the *Threatened Species Conservation Act 1995* (TSC Act).

Section 111(4) of the EP&A Act requires a determining authority to consider the effects of an activity on the following:

> *'(a) critical habitat, and*
>
> *(b) in the case of threatened species, populations and ecological communities, and their habitats, whether there is likely to be a significant effect on those species, populations or ecological communities, or those habitats, and*
>
> *(c) any other protected fauna or protected native plants within the meaning of the National Parks and Wildlife Act 1974.'*

Section 5A of the EP&A Act, outlines eight points which must be considered in order to determine the significance of the impact of a development on the habitat of threatened species, population and ecological communities, known or considered likely to occur in the study area and environs. This assessment is commonly referred to as an 'eight part test'.

Where the proposed development is likely to significantly affect critical habitat of a threatened species, population or ecological community, or is in critical habitat, as defined by Part 3 of the TSC Act, a species impact statement (SIS) must be prepared. After application of the 8 part test it is considered that the proposal is not likely to significantly affect threatened species, populations or ecological communities or their habitats. Consequently, a species impact statement is not required.

The flora and fauna characterising the development area and an assessment of the impact of the proposed upgrade on threatened species is provided in *Section 5.6*.

4.1.4 SEPP 44 - Koala Habitat Assessment

State Environmental Planning Policy 44 - Koala Habitat Protection (SEPP 44) aims to:

'...encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas, to ensure permanent free-living populations over their present range and to reverse the current trend of population decline...'

The practical effect of SEPP 44 is that in consideration of a development application (DA), the consent authority must ensure that approval is not issued without prior investigation of *potential* and *core* koala habitat. This policy applies to all local government areas within the known statewide distribution of the koala, including the Port Stephens local government area.

As a DA is not required for the proposed roadworks, SEPP 44 does not apply. However, an assessment of Koala habitat has been undertaken and is presented in *Section 5.6.9*. The assessment addresses potential and core habitat as defined in SEPP 44.

Under SEPP 44, *potential* koala habitat is defined as vegetation that incorporates a minimum of 15 percent of tree species in the 'upper or lower strata of the tree component' listed in Schedule 2 of SEPP 44. A person suitably qualified in tree identification (clause 7 (2)) must assess the identification of potential koala habitat. Identification of *potential* koala habitat requires further investigations to determine whether the site supports *core* habitat.

Core koala habitat is defined as

> *'...an area of land with a resident population of Koalas, evidenced by attributes such as breeding females.. and recent sightings of and historical records of a Koala population...'*

4.1.5 Port Stephens Comprehensive Koala Plan of Management

The draft Port Stephens Comprehensive Koala Plan of Management (CKPoM) if approved will supersede the provisions of SEPP 44 in the Port Stephens LGA. The CKPoM seeks to conserve koalas in their existing habitat by identifying and protecting koala habitat and incorporating koala conservation into local government planning processes (Lunney *et al*, 1998). The principal aim of the CKPoM is identical to that of SEPP 44 (Port Stephens Council, 2000).

The CKPoM identifies areas of preferred, supplementary and marginal koala habitat based on community consultation, historical records, vegetation mapping, field based surveys and identification of movement corridors between habitat areas.

Development standards and assessment criteria are outlined in the CKPoM for proposals either overlapping or adjacent to areas of preferred or supplementary koala habitat, habitat buffers or habitat linking areas (Port Stephens Council, 2000). The proposed upgrade of Nelson Bay Road would disturb areas of supplementary koala habitat as mapped by the CKPoM and areas identified during field investigations as preferred koala habitat. Areas of preferred koala habitat are afforded the highest level of protection.

The impact on koala habitat in accordance with Port Stephens Council CKPoM is provided in *Section 5.6.9*.

4.1.6 *SEPP 14 - Coastal Wetlands*

State Environmental Planning Policy 14 – Coastal Wetlands (SEPP 14) was gazetted on 12 December, 1985 with the aim of ensuring that coastal wetlands are preserved and protected in the environmental and economic interests of the State. The policy was designed to protect wetlands in coastal areas in New South Wales. In the local area SEPP 14 wetlands are concentrated along Tilligerry Creek (wetland 809), Bobs Farm Creek and Fenninghams Island Creek (wetland 767) to the north of the road. There are no designated SEPP 14 wetlands in the development area, with the nearest SEPP 14 wetland 200 metres to the north of Nelson Bay Road. The requirements of SEPP 14, therefore, do not apply to this proposal.

4.1.7 *Native Vegetation Conservation Act 1997*

The *Native Vegetation Conservation Act 1997* (NVC Act) aims to streamline approvals and to regulate the clearing of native vegetation in New South Wales by making it subject to development consent. The legislation requires the assessment of proposals to clear native vegetation for the purpose of ensuring that native vegetation is protected and managed in the environmental, social and economic interests of the State (DLWC, 1997).

Certain types of clearing are excluded from the NVC Act, including any clearing that involves the removal or lopping of any tree of other vegetation, as per Section 88 of the *Roads Act 1993*.

Section 88 states:

> *A roads authority may, despite any other Act or law to the contrary, remove or lop any tree or other native vegetation that is on or overhanging a public road, if in its opinion, it is necessary to do so for the purposes of carrying out road work.*

Consequently, the provisions of the NVC Act do not apply to the clearing of native vegetation required to carry out road works for the upgrade of Nelson Bay Road as long as the works are within the road reserve. Clearing for ancillary operations near the intersection of Nelson Bay Road and Trotters Road would disturb less than two hectares and is therefore exempt from assessment under the NVC Act (Schedule 4, Part 2 – exemptions listed under SEPP 46).

4.1.8 *Fisheries Management Act 1994*

The *Fisheries Management Act 1994* as amended by the *Fisheries Management Amendment Act 1997*, has as part of it's objectives the protection of threatened species and their habitats.

The section of Nelson Bay Road being upgraded does not cross any natural drainage lines, however it does cross several constructed drains.

The *Fisheries Management Act* 1994 (FM Act) as amended by the *Fisheries Management Amendment Act 1997* includes provision to declare and list threatened species of fish and marine vegetation, endangered populations and ecological communities, and key threatening processes. These provisions are similar to those in the TSC Act and must be considered when referring to Section 5A of the EP&A Act. An assessment of the aquatic habitat value in the proposed development area and an assessment of the impact of the proposal on aquatic habitats and threatened fresh species under Section 5A of the EPA Act are provided in *Section 5.7*.

None of the species listed as threatened are considered likely to occur in the study area. The area does not comprise critical habitat as listed under Division 3. Therefore the impacts associated with the road construction and operation upon threatened species would not be significant as assessed under Division 6 and no species impact statement or application for a licence to harm threatened species is required.

4.1.9 Protection Of The Environment Operations Act, 1997

The *Protection of the Environment Operations Act, 1997* (PoEO Act) provides for an integrated system of licensing whereby a single schedule of activities requiring an environmental protection licence will regulate all forms of pollution.

The EPA is the regulatory authority for activities carried out by the State or a public authority.

The PoEO Act contains a list of activities requiring environmental protection licences from the EPA. These activities are called 'scheduled activities' and are listed in Schedule 1 of the Act.

The proposed upgrade of Nelson Bay Road does not fit the definition of freeway or tollway, under Schedule 1 of the PoEO Act 1997 and subsequently is not classified as a scheduled activity. An environmental protection licence is therefore not required.

The EPA has advised the RTA that a water licence under the PoEO Act would not be required for the construction of the upgrade provided all works are conducted according to the RTA Code of Practice for Water Management (RTA, 1999). Water Management is addressed in *Section 5.5.2* of this REF document.

Under Part 5.6 of the PoEO Act, addressing land pollution and waste management, the proponent must transport and dispose of waste at a lawful waste facility. Waste minimisation and management is addressed in *Section 5.14* of this REF document.

Part 5.7 of the PoEO Act requires that relevant authorities be notified of pollution incidents. Discharges or emissions to water, air or land which cause, or are likely to cause, significant harm to the environment must be reported to the EPA or local council as soon as practicable after the spill occurs. If a spill results from an activity licensed by the EPA or an activity carried on by the Crown or a public authority, then the EPA must be notified. The legislation imposes this duty on the person who spills the substance and the occupier of the premises where the spill occurs.

4.1.10 Heritage Act, 1977

The *Heritage Act 1977* protects heritage items, sites, and relics. A relic is defined as any item relating to European settlement that is older than 50 years. It is an offence under the *Heritage Act 1977* 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 *Heritage Act 1977* and under Section 139 an excavation permit must be obtained from them for the excavation or disturbance of a relic.

If excavation works are to occur across the Anna Bay Public School site as discussed in *Section 5.8* an excavation permit from the NSW Heritage Office must be obtained.

4.1.11 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is Commonwealth legislation which came into force on 16 July, 2000.

The EPBC Act requires approval of the Commonwealth Minister for the Environment for actions that may have a significant impact on matters of national environmental significance. The EPBC Act also requires Commonwealth approval for certain actions on Commonwealth land. Matters of national environmental significance under the Act include the following:

- World Heritage properties;
- Ramsar wetlands of international importance;
- threatened species or ecological communities listed in the EPBC Act;
- migratory species listed in the EPBC Act;

- Commonwealth marine environment; and
- nuclear actions.

There are no World Heritage properties, Ramsar wetlands, Commonwealth marine areas or nuclear actions on or near the proposed road upgrade. There are no Commonwealth listed ecological communities however there are Commonwealth listed threatened species in the vicinity of the proposed road upgrade. These are described in *Appendix D-4*. No critically endangered or endangered plant species or communities were identified along the road corridor.

The only migratory bird species listed under the China-Australia Migratory Bird Agreement (CAMBA) observed along the road corridor was the white-bellied sea-eagle (see *Appendix D-1 and D-2*). A detailed assessment of the impact on the white-bellied sea-eagle was not undertaken as no nest sites were identified and no foraging habitat would be destroyed, isolated or substantially modified by the road upgrade (*Appendix D-4*).

The nearest Commonwealth land to the proposal is the former RAAF bombing range approximately five kilometres to the west and the Gan Gan Army Camp approximately 6.5 kilometres to the north of the closest sections of Nelson Bay Road between Bobs Farm and Anna Bay. This Commonwealth land is remote and would not be affected by the proposal.

4.2 STRATEGIC PLANNING - PORT STEPHENS

4.2.1 Introduction

MR 108 (Nelson Bay Road) is the only route which services the Tomaree Peninsula and the various small townships between Newcastle and Nelson Bay.

Along most of its length it is generally one carriageway in each direction with staged upgrading of sections of Nelson Bay Road to dual carriageway standard. The upgrading of this section of the route would therefore play an important role in improving the safety and efficiency of this important route.

The Tomaree Peninsula is a rapidly expanding area due to residential and tourist growth and this trend is likely to continue in the foreseeable future. The following State, Regional and local strategic documents have implications for, or are specific to the Port Stephens area and identify issues that must be taken into account when undertaking investigations in this locality.

4.2.2 *Cities For The 21st Century*

Cities for the 21st Century was prepared by the Department of Planning (1995) and *'provides a broad framework which gives direction to the activities and decisions of all spheres of government, responds to the current expectations of the community, and complements the operation of the private sector.'*

The document recognises that the Sydney region cannot be seen in isolation and economic, social and environmental decisions must also include the Newcastle, Central Coast and Wollongong areas.

Cities for the 21st Century indicates that there is an existing natural trend for the movement of people from Sydney to regional centres such as Newcastle. This document has identified general transport corridors linking the Sydney and Newcastle regions which would require consideration in future years to service the requirements of expanding populations in various areas. Given that Newcastle is seen as a growth area in the future it is assumed that the Port Stephens area would also experience increased growth to service the recreational and residential needs of an expanding Newcastle. As a result of this growth, service considerations such as roads and transport needs must be amplified to accommodate this growth.

4.2.3 *Stockton Bight Environmental Study and Management Plan*

This study was prepared by HLA Envirosciences (1995) and investigated the Stockton Bight area bounded by Stockton and Stockton Beach to the south, Anna Bay to the north and Nelson Bay Road/Fullerton Street/Marsh Road to the west. The Nelson Bay Road upgrade is at the northern end of the HLA study area.

The study identifies the various characteristics of the area including flora and fauna, climate, human impacts and coastal processes. Each characteristic is described as it related to the study area and key issues relating to these characteristics are detailed.

The management options and strategies section involved a process of community consultation to determine priority issues for local and regional users and government representatives. Management strategies were then developed from the issues raised.

Overall the study aims to identify land use activities within the Stockton Bight study area which are consistent with the capability of the environment to support those uses with minimal detrimental effects. The study has identified the current alignment of Nelson Bay Road as the most appropriate location for further upgrades and that further removal of vegetation should be avoided.

4.2.4 *30 Year Plan for Port Stephens*

The 30 year plan for the Port Stephens local government area (Port Stephens Council, 1997) aims to set a future direction and outlines actions which will assist in achieving the objectives. The plan looks at a settlement strategy, economic development and tourism, environment and infrastructure. Public opinion and land constraints were taken into account when considering these issues.

One objective of the plan is the ensure that state and regional roads within the LGA be maintained, upgraded and extended to manage traffic, ensure safety and comfort for residents and tourists. A recommended action to achieve this set objective is to ensure that Nelson Bay Road is upgraded to four lane dual carriageway.

4.2.5 *Hunter Coastal Urban Settlement Strategy*

The Hunter Coastal Urban Settlement Strategy (HCUSS, 1994) has been prepared by the Department of Planning to ensure that growth in coastal areas of the Hunter region are planned and managed in a responsible manner which is environmentally and economically acceptable to the community. The HCUSS recognises the high environmental values of the region and the need to protect and carefully manage the area while balancing the demands of a growing population.

Transport studies undertaken in the region indicate that private car travel is, and will continue to be, the dominant form of transport. The HCUSS recognises that increased residential and tourist growth in the Tomaree Peninsula will generate increased traffic growth. Given this expected traffic growth, continued improvements to Nelson Bay Road would be required.

In addition, coastal areas are recognised by HCUSS to have an ageing population, as they are popular retirement areas. Because of this, increased levels of public or community transport would be required to service this population.

4.2.6 *Lower Hunter Integrated Transport Study*

The Lower Hunter Integrated Transport Study was prepared by the NSW Department of Transport (1995a) to develop strategic actions for the Lower Hunter and Sydney regions as part of the 'Building Better Cities' Program. The study area covered Newcastle, Lake Macquarie, Maitland, Cessnock and Port Stephens Local Governments Areas and found that 75.3 per cent of personal trips in the region are made by private motor vehicle.

The aim of the study was to develop and implement an integrated transport strategy for the lower Hunter and to manage and meet transport demand in the region with a

focus of public passenger transport. The study found that two bus companies service the Port Stephens area and there is heavy reliance on private motor vehicle transport in the region. Accordingly, the area's road network needs to be of appropriate standard to provide safe and efficient road based public and private transport.

4.2.7 *Greater Metropolitan Integrated Transport Study*

The Greater Metropolitan Integrated Transport Study (GMITS) was prepared by the Department of Transport (1995b) and identifies transport implications for the greater metropolitan region. The greater metropolitan region includes Newcastle, Sydney and Wollongong metropolitan areas.

The GMITS provides background to the process and then details a strategy. The strategy involves issues relating to land use and transport integration, an integrated transport system and implementing urban management and transport investment.

The broad objectives of the GMITS can be broken down into economic efficiency, environmental protection and social equity. Performance measures and outcomes have then been developed from these objectives. The relevant performance measures of the GMITS that relate to the proposed upgrade of Nelson Bay Road are:

- reduced trip lengths and trip times for different modes;
- reduced total motor vehicle emissions;
- reduced energy consumption in the transport sector; and
- reduced noise levels.

The proposal seeks to achieve the above objectives.

Chapter 5

ENVIRONMENTAL IMPACT ASSESSMENT

5.1 LAND USE AND LAND OWNERSHIP

5.1.1 Land Use

The study area is located on Quaternary age sand deposits. The proposed road upgrade is situated on the flat, low-lying land behind the barrier dune system. Land use in the area is linked to local topography, soil characteristics and water availability.

The proposed Stockton Bight National Park/Nature Reserve is located immediately to the south of proposed road upgrade as shown in *Figure 1.1*. It is understood that the National Parks and Wildlife Service has not determined the exact location of the National Park/Nature Reserve, hence a detailed assessment cannot be undertaken at this stage.

In addition, DLWC and NPWS have advised that there are Aboriginal land claims within the study area. These claims effectively negate the Department from entering into any dealings in respect of the Crown land until such a time the claims have been determined by the Minister. The Department in consideration of proposals affecting Crown land must take into account whether the proposal would affect any Native Title interest that may exist in the land.

i. Urban

Port Stephens is a major tourist and residential growth area in the region, with significant growth expected to continue in the future. Nelson Bay Road provides the single access route from Newcastle to the numerous centres located on the Tomaree Peninsula.

ii. Rural/Residential Development

Local communities are established along Nelson Bay Road and include Williamtown, Salt Ash and Bobs Farm. Due to the popularity of the area, development activity has been occurring on rural and residential properties along the road resulting in merging of local communities and strip development.

There are a number of rural/residential properties in the Bobs Farm/Anna Bay area, most of which front Nelson Bay Road.

iii. Industrial and Commercial

Commercial land uses are located along Nelson Bay Road to service passing traffic and the local communities. Commercial uses in the Bob's Farm area include a coffee shop, service station, general store and pottery studio. A primary school and community hall is located on Marsh Road just off Nelson Bay Road. Due to the area's proximity to larger centres such as Anna Bay and Salamander Bay, commercial and community facilities are limited.

There are no industrial activities occurring in the Bobs Farm area, the closest being at Salt Ash.

iv. Rural/Agricultural

The land in the Bobs Farm area is generally in holdings of much less than 40 hectares. Holdings of these sizes restrict the productivity for agricultural activities and are generally considered hobby farms. Nelson Bay Road passes through a flat interdunal area around the intersection with Marsh Road supporting horse and cattle grazing and breeding activities. The higher dunal area of Bobs Farm has well-drained soils and groundwater access which supports commercial activities such as a vineyard, avocado farm, vegetable and wild flower production. Little impact to agricultural activities in the area would occur.

v. Mining

Mining and exploration has been carried out along the length of Stockton Bight for a range of purposes including silica sand and heavy mineral sand.

a. Sand Extraction

The dunal barrier system of Stockton Bight consists of Quaternary age sand deposits. These deposits contain grains that may be well sorted of uniform grain size or unsorted grains of varying size. The quality of the sand determines the final use. Sand that is extracted in the Stockton Bight area is of a quality that is suitable for foundry, construction or fill purposes.

ACI Industrial Minerals Division and Metromix are currently extracting silica sand from two sites within Crown reserves south of Nelson Bay Road. Both these operations are to the south of the proposed road upgrade and are not expected to

pose any constraints to construction. ACI is currently extracting sand from the landward side of the mobile dune which has reduced the rate of sand movement. Continued sand extraction in this area may have some benefits to the long term viability of the proposed road upgrade with regard to inundation of the road by the movement of sand.

b. Heavy Mineral Sand

Mineral sands are present in the Stockton and Tomago Sandbed areas in economically recoverable reserves. The heavy minerals of value include rutile, zircon, ilmenite, monazite and garnet. The heavy minerals have been concentrated into lenses within the sand deposits through past wave action.

The Department of Mineral Resources has a policy of protecting mineral resources from developments which may prevent future extraction options. Traversing these deposits of heavy minerals with a road would effectively sterilise part of the heavy mineral resource. However, the proposed road upgrade does not cross any heavy mineral lenses and would have no impact on future access to these mineral resources.

5.1.2 Utilities and Services

i. Water

Hunter Water Corporation has advised that the Tomago Sandbeds are an important area for groundwater and could become increasingly important for the supply of water to the lower Hunter. There is a proposal to construct a water pipeline from the Tomago Water Treatment Plant to the Anna Bay Water Treatment Plant along the existing alignment of Nelson Bay Road. The pipeline route has been discussed with Port Stephens Council and the Roads and Traffic Authority in light of the proposed road upgrade of Nelson Bay Road. An REF has been prepared for the pipeline route but has not as yet been determined. The location of the proposed pipeline in relation to the Nelson Bay Road upgrade is shown on the Concept Design Plans.

ii. Electricity

A high voltage electricity easement crosses the upgrade route at approximately chainage 0.00 metres and may require relocation of one pole. A site inspection shows that low voltage power lines are located in the road easement on the northern side of the existing Nelson Bay Road. Several poles near the Marsh Road intersection may require relocation. Generally, between Marsh Road and Cromarty Lane, the power poles are located at such a distance to allow the construction of the duplication adjacent to the existing carriageway and without the need to relocate

poles. With the upgrade of the Cromarty Lane intersection one pole would require relocation. East of Trotters Lane the power poles would require relocation as they are within the zone proposed for the additional carriageway. The Concept Design Plans show the location of service poles.

iii. Telecommunications

Correspondence with Telstra indicates that telecommunication cables follow the existing Nelson Bay Road easement. The cables run along the length of the northern side of Nelson Bay Road with cables running intermittently under the road and along the southern side of Nelson Bay Road to service properties and businesses on the southern side. Cables from Marsh Road to Trotters Lane may need to be relocated, in addition to the cables servicing individual properties. The development of the proposed road upgrade would require some relocation of these cables, however this is not considered a major constraint to the proposal.

5.1.3 Land Tenure

The study area is located within the Parish of Tomaree, County of Gloucester. Land tenure is shown in *Figure 5.1*. The proposed road upgrade traverses both freehold and crown land. Land tenure of properties adjacent to the existing road reserve where the duplication is proposed is as follows:

- mining lease (ML) - two MLs for silica sand near Anna Bay;
- Aboriginal land claim - south of Marsh Road, both sides of road;
- dedicated cemetery - south of Marsh Road;
- freehold land - along the length of Nelson Bay Road.

5.1.4 Property Acquisition

In order to minimise property acquisition along the route, the upgrade has been designed to duplicate the carriageway on the southern side of the existing road, changing to the northern side of the road 300 metres south of Marsh Road intersection. The duplication then changes to the southern side of the road 850 metres west of the Trotters Lane intersection. In addition, the median width would be reduced along the majority of the upgrade route to minimise the total area required for the road corridors.

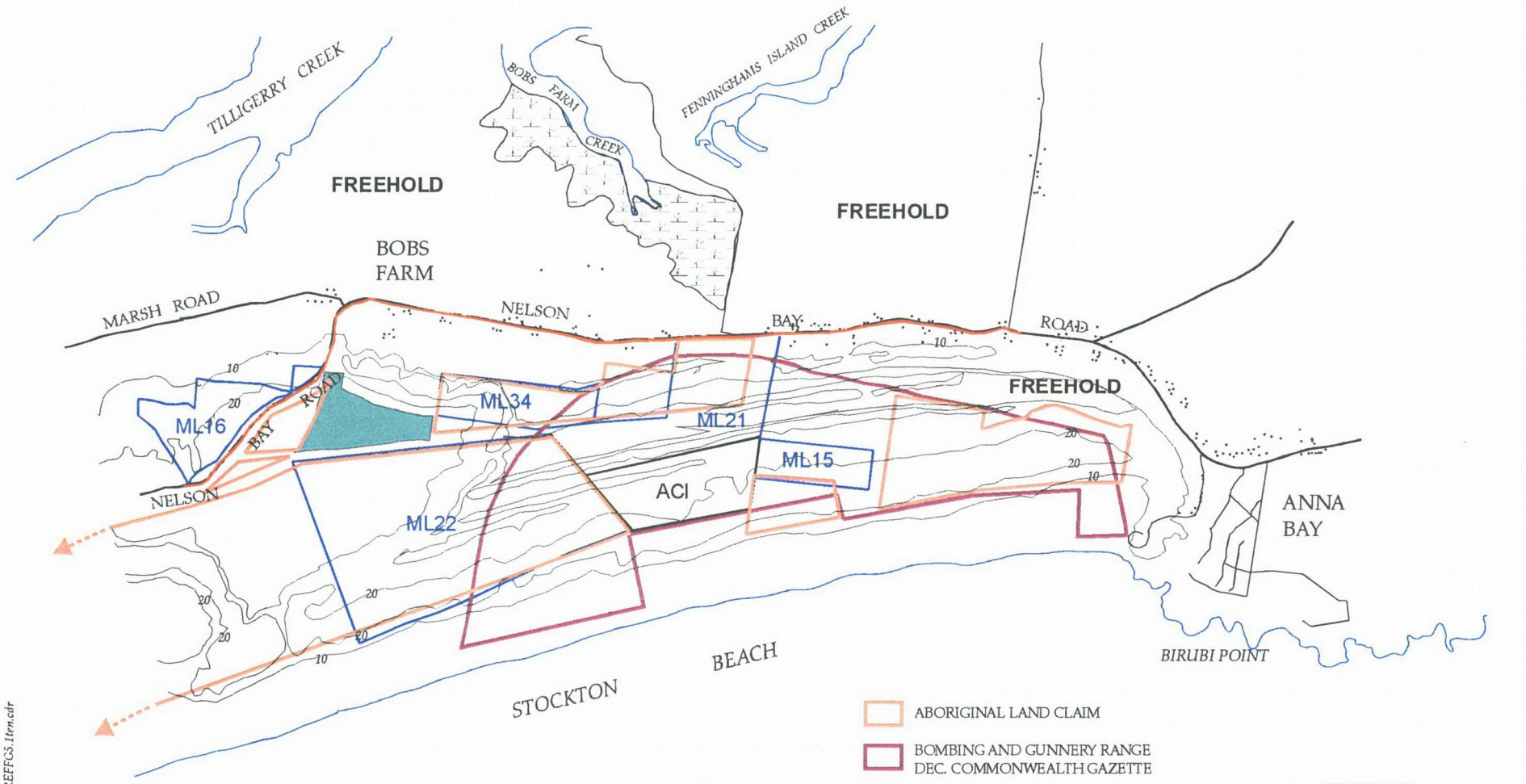

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Figure 5.1 LAND TENURE

The proposed upgrade would result in the part or full acquisition of 26 private properties and 4.1 hectares of crown land, including 0.09 hectare of Anna Bay Cemetery.

Acquisition of privately owned property would be in accordance with RTA's Land Acquisition Policy that outlines the procedures and guidelines for the transfer of land between the RTA and affected property owners.

5.2 CLIMATE AND AIR QUALITY

Climatic data has been obtained for Williamtown RAAF base and is considered to be representative of the climate at the site.

A detailed assessment of the existing air quality in the project area has not been undertaken, therefore this assessment is based on trends established in other studies and assumptions on the air quality in the area.

5.2.1 *Rainfall*

Average monthly rainfall is shown in *Table 5.2*. The average annual rainfall for the area is 1114 millimetres and the period of highest rainfall is from January to June.

Table 5.1 MONTHLY RAINFALL (mm)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
107.5	116.4	121.6	96.9	107.2	120.6	69.1	78.9	58.0	77.5	77.1	83.3

Source: Bureau of Meteorology

5.2.2 *Temperature And Humidity*

Mean minimum and maximum monthly temperatures are shown in *Table 5.2*. Mean temperatures range from a minimum of 6.3 degrees Celsius in July to a maximum of 27.7 degrees Celsius in January. The average annual maximum temperature for Williamtown is 22.9 degrees Celsius and the average annual minimum temperature is 12.3 degrees Celsius.

Table 5.2 MEAN MONTHLY TEMPERATURE (DEGREES CELSIUS)

Mean Minimum Temperature (°C)											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
18.0	17.9	16.3	13.2	10.1	7.9	6.3	6.8	8.9	12.0	14.2	16.5
Mean Maximum Temperature (°C)											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
27.7	27.2	26.1	23.6	20.2	17.5	16.9	18.4	20.9	23.3	25.3	27.1

Source: Bureau of Meteorology

5.2.3 *Wind*

Wind data for the area has been sourced from Williamtown, as detailed in the Stockton Bight Environmental Study (HLA Envirosciences, 1995). Prevailing winds for the area are generally from the west/north-west during the winter months and in the mornings for spring and summer. The afternoon winds during spring, summer and autumn are generally dominated by south or south-easterly sea breezes. These winds from the south and south-east contribute to the wind erosion and blow-outs occurring on the sand dunes along the Stockton Bight. These south-easterly winds have a large impact to the landward movement of sand dunes in the area as these winds are perpendicular to the south-west, north-east oriented dune system (HLA Envirosciences, 1995).

5.2.4 *Background Air Quality*

The proximity of the site to heavy industrial developments such as the Newcastle industrial area to the south and Tomago Aluminium to the south west has the potential to increase deposition and suspended particulate matter in the project area. Data from the Tomago area prior to development of the aluminium smelter in the early 1980s, showed low average dust deposition of around two grams per square metre per month, (Croft and Associates, 1979). These levels will have changed with the expansion of the smelter and other activities in the industrial area surrounding the site at Tomago, however the area historically does not receive high deposition of particulate matter. Total suspended particulate (TSP) matter measurements in the Stockton area in 1991 showed that the area experienced yearly averages of between 75 and 86 micrograms per square metre, (ERM Mitchell McCotter, 1997). These levels are just below current guideline values for annual average TSP and would be much higher than those experienced in the project area.

The meteorological conditions which occur in the area show a dominating pattern of south-easterly and north-westerly winds over much of the year. These wind

patterns may reduce the impact of the industrial developments to the south and south-west.

5.2.5 *Air Quality Impacts and Mitigation Measures*

Motor vehicle emissions have the potential to contribute to the photochemical smog in urban environments. The levels of carbon dioxide and hydrocarbons decrease with speed and conversely the levels of nitrogen oxides increase with speed, although more gradually (Holmes, 1995).

The extent to which traffic is restricted has a direct bearing on the levels of photochemical smog generated. The fast travel speed, the unrestricted nature of the existing road structure and the proposed development changes are unlikely to effect existing smog levels in the area.

The greatest impacts on air quality are likely to come from the construction phase of the project rather than any long term impacts, as large volumes of particulate matter would be generated by earthworks in the construction phase. The construction phase of the project has the potential to affect properties at least 600 metres away during strong dry winds and more typically up to at least 300 metres (Holmes, 1995).

The potential air quality impacts of the proposal are summarised below:

- extensive earthworks would be required, due to widening and realignment of the existing road;
- dust generated by the earthworks could be expected to effect a small number of residents and business premises along the developed section of Nelson Bay Road in the Bobs Farm/ Anna Bay area during the construction phase;
- reduced air quality during the construction phase between Marsh Road and Port Stephens Drive to the north and south of Nelson Bay Road.

Air quality impact mitigation measures would be detailed in an Air Quality Management Plan prepared for the construction phase of the upgrade. The plan would aim to minimise air quality impacts during construction and would provide dust control and air quality control measures to be implemented during construction. The mitigation measures would include the following:

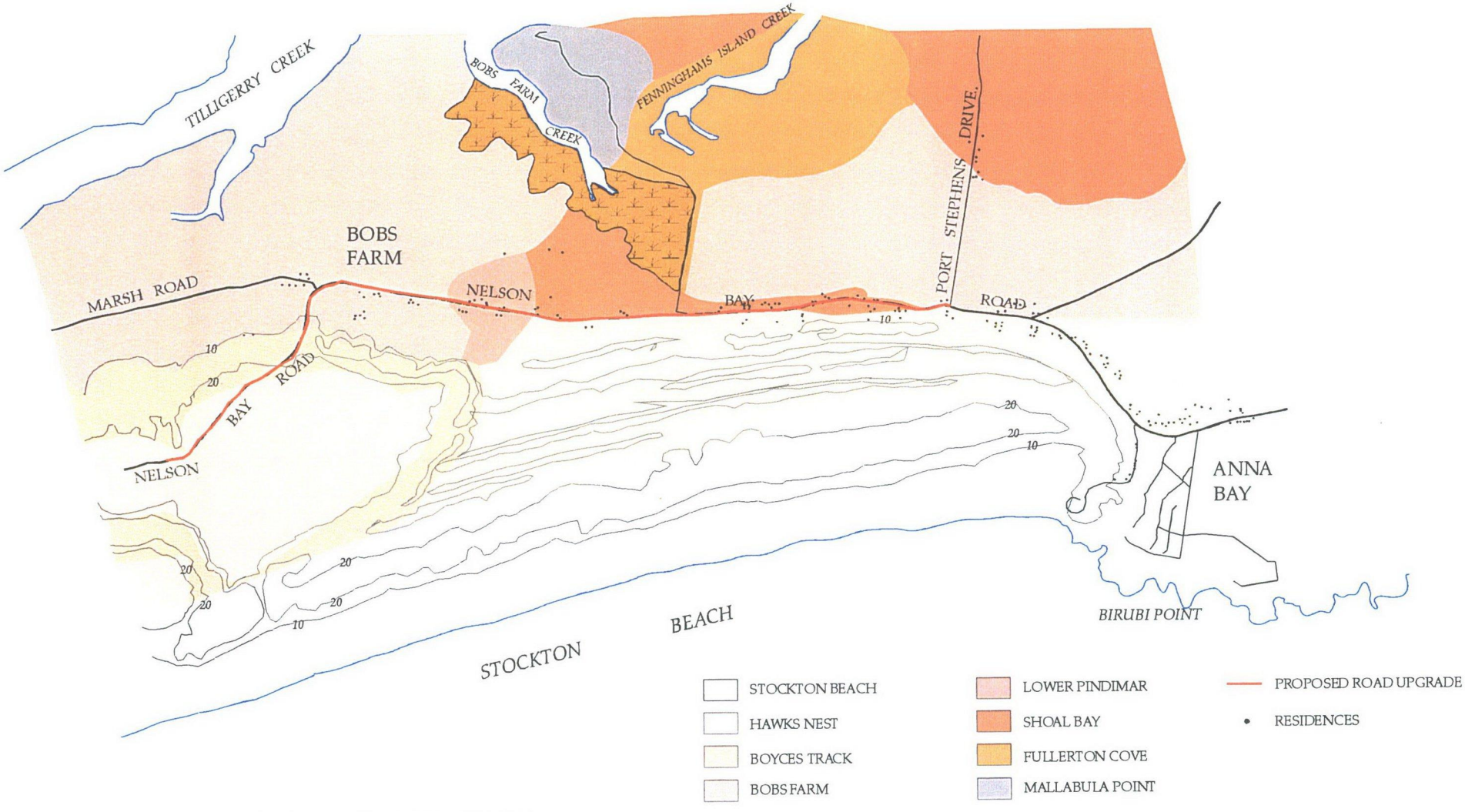
- dust suppression by water carts to dampen internal haul roads and open surfaces;
- reducing speed on unsealed sections of road during construction;

- minimising the area of disturbance;
- topsoil stripping during periods when the soil is moist;
- progressive revegetation of disturbed areas;
- covering loads of materials transported onto the site during construction;
- maintenance of all vehicles and equipment to the specifications of the relevant Australian Design Rules to minimise gaseous emissions; and
- no burning or incineration.

5.3 SOILS AND SOIL EROSION HAZARD

5.3.1 Soil Landscapes

The Soil Conservation Service of NSW soil landscape map for Port Stephens (Murphy, 1995) shows that the area of the proposed road upgrade is characterised by uniform and organic soil associations. The soil landscape map describes five landscape units along the proposed road upgrade, namely Hawks Nest, Boyces Track, Bobs Farm, Shoal Bay and Lower Pindimar as shown in *Figure 5.2*. These landscape units consists of different soil types which are positioned within the unit area according to topography. Details of the soil landscapes are provided in *Table 5.3*.



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

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Figure 5.2 SOIL LANDSCAPES

Table 5.3 SOILS

Landscape Unit	Landform	Geology	General Soil Description	Soil Erosion
Hawks Nest (hn)	stable, gentle undulating, Holocene sand sheets and beach ridges.	Holocene quartz sand sheets and beach ridges.	well-drained podzols on dunes, minor Acid Peats/Siliceous Sands in swampy swales.	moderate to extreme wind erosion.
Bobs Farm (bf)	broad, flat, swampy, Holocene estuarine plain.	Silt, clay, estuarine swamp deposits.	Poorly drained humic gleys.	
Shoal Bay (sb)	gently inclined, well-drained Pleistocene sand sheets to rolling very low dunes.	Pleistocene aeolian sand sheets and low dunes composed of quartz sands.	Well-drained podzols.	Moderate to extreme wind erosion.
Boyces Track (bt)	steep, stable, aeolian, Holocene transgressive dunes.	Holocene transgressive aeolian dunes of quartz sand.	Well-drained, weakly developed podzols.	Extreme wind erosion.
Lower Pindimar (lp)	poorly drained Holocene sand sheets.	Holocene quartz sand sheets which overlie estuarine sediments.	Imperfectly drained humus podzols on sandy rises and poorly drained siliceous sands on low-lying, poorly drained areas.	High to very high wind erosion.

Source: Murphy (1995)

Podzolic soils occur in the Hawks Nest, Shoal Bay and Boyces Track units and are generally well drained sand sheets and dunes. The podzols are uniform in nature with deep profiles ranging from loamy sand topsoil overlying sandy subsoils. The single-grained sandy structure of the soils results in a high to extreme wind erosion hazard with very low fertility. This soil type has severe limitations for urban development and cultivation and grazing activities.

Humus podzols occur in the Lower Pindimar landscape unit on sandy rises. Humus Podzols are uniform in nature and ranging from sand to loamy sand throughout the profile. As with podzols, the single-grained nature of the soils result in the potential for wind erosion to occur. Urban and rural limitations exist due to seasonal waterlogging and high watertables. Potential acid sulfate soils may occur in this soil unit at depth.

Siliceous sands occur in the Lower Pindimar unit and in minor amounts in the Hawks Nest unit in low-lying, poorly drained areas. The Siliceous sands of these units consist of single-grained loamy sand overlying Holocene estuarine sediments. Limitations with this soil type exists due to the high erodibility of the soil and seasonal waterlogging.

Acid peats occur in swampy swales of the Hawks Nest unit with up to 100 centimetres of fibrous peat and root mat overlying a mottled siliceous sand intergrade or organic mud. These areas are very poorly drained, permanently waterlogged and regularly inundated with water. Potential acid sulfate soils are an important consideration in these soil types. These characteristics have severe limitations for urban development, cultivation and grazing activities.

Humic gleys occur in the Bobs Farm soil landscape unit. The area of humic gleys along the proposed road upgrade occurs in the Bobs Farm area east of Marsh Road. Humic gleys are deep, poorly drained soils with seasonal waterlogging. The texture of these soils ranges from organic-rich sandy clays in the upper layers with light to heavy clays with a high silt content underlying this and permanently saturated sandy clay loams below this. The occurrence of acid sulfate soils are an important consideration in this soil unit. These flooding, waterlogging and acid sulfate soils characteristics have high limitations for urban and agricultural activities.

The physical and chemical characteristics of the soils located along the upgrade have the potential to cause construction difficulties and impacts, although no long term impacts are expected. The poor structure of the topsoil along the route, may lead to difficulties in stripping and topdressing operations. It is recommended that topsoil handling be restricted to times when the soil material is moist to prevent structural degradation and resulting dust generation and surface sealing.

The majority of subsoils along the route are unsuitable for rehabilitation purpose due to the single grained nature of the soil resulting in low water-holding capacity and high wind erosion hazard of the soils in the area.

5.3.2 *Acid Sulfate Soils*

Acid sulfate soils contain iron sulphides (mainly iron pyrite). They are generally found at an elevation below 10 metres above mean sea level. If these materials are exposed to air, oxidation of the pyrite occurs. If the soil does not have the capacity to neutralise the acidity, sulphuric acid is formed, and iron and aluminium are leached out of the soil. Also, the salinity of the soil is increased.

The consequences of acid sulfate generation are increases in the salinity and acidity of surface waters which is detrimental to flora and fauna. Acid sulfate materials are also highly corrosive to concrete and steel structures.

If the soils are not exposed to oxygen, the sulphides remain stable and the soil is described as *potential acid sulfate* (PASS). Soils in which oxidation has occurred are termed *actual acid sulfate* (AASS), and have pH less than 4.

Acid sulfate soil potential of the proposed road upgrade has been assessed by consulting the Department of Land and Water Conservation's (DLWC) Acid Sulfate Risk map for Morna Point. *Figure 5.3* shows the acid sulfate potential of soils surrounding the proposed road upgrade. The Potential Constraints Figures (*Figures 1 to 6, Appendix* C) prepared to assist in the concept design of the proposed road upgrade also show the acid sulfate soil potential along the route.

The proposed road upgrade passes over some areas that are considered to have a high probability of occurrence of acid sulfate soils within four metres of the surface on the western end of the option. The upgrade of Nelson Bay Road to dual carriageway would pass through three categories of landform and therefore varying probability of acid sulfate material occurrence. At the western end of the proposed route around Marsh Road and Bobs Farm there is a high probability of acid sulfate soil material occurring between 1 and 3 metres below the ground surface. The alignment then passes through an area with a high probability of acid sulfate soil material occurring within 1 metre of the ground surface. This presents a severe environmental hazard from disturbing acid sulfate materials from activities such as excavation, clearing or the construction of shallow drains.

Preliminary geotechnical investigations of the proposed road upgrade route included acid sulfate soil testing. The investigations indicated that actual and potential acid sulfate conditions are present within natural clay soils near the Marsh Road intersection between approximately chainage 1500 metres and chainage 1850 metres (see Concept Design Plan) (Douglas Partners, 2000).

The potential occurrence of acid sulfate soil material along the alignment may pose a constraint during road construction. Material would need to be excavated during the construction phase, particularly during the excavation and installation of drains

and culverts. Due to the low-lying nature of the area east of Marsh Road, the construction of drains in this area would be necessary to prevent inundation of the Nelson Bay Road upgrade.

For the eastern half of the alignment there is a low probability of encountering acid sulfate material within 3 or 4 metres of the ground surface. This area is slightly elevated and the majority of this landform is not expected to contain acid sulfate material.

Testing prior to road construction would be carried out to determine the exact location and depth of acid sulfate soil material and to further quantify the risk of disturbing ASS. This can then be related to the depth of road construction and whether acid sulfate soil material would be encountered during excavation. Regular monitoring during excavation in high-risk areas should be carried out during construction. All testing and treatment would be undertaken in accordance with the Acid Sulfate Soil Manual produced by the Acid Sulfate Soil Management Advisory Committee (ASSMAC, 1998) and also in accordance with RTA Policy and Guidelines for ASS.

A Construction Environmental Management Plan would be prepared prior to commencement of construction works and would include an Acid Sulfate Soil Management Plan. This plan would be developed in consultation with the EPA and DLWC and in accordance with the RTA's Acid Sulfate Soil policies and procedures and the RTA Code of Practice for Water Management (RTA 1999). The plan would set out steps and methods for dealing with acid sulfate soils in the event that they are encountered. Methods include adding lime to neutralise the material and excavating the acid sulfate material and replacing it with a stable material such as sand.

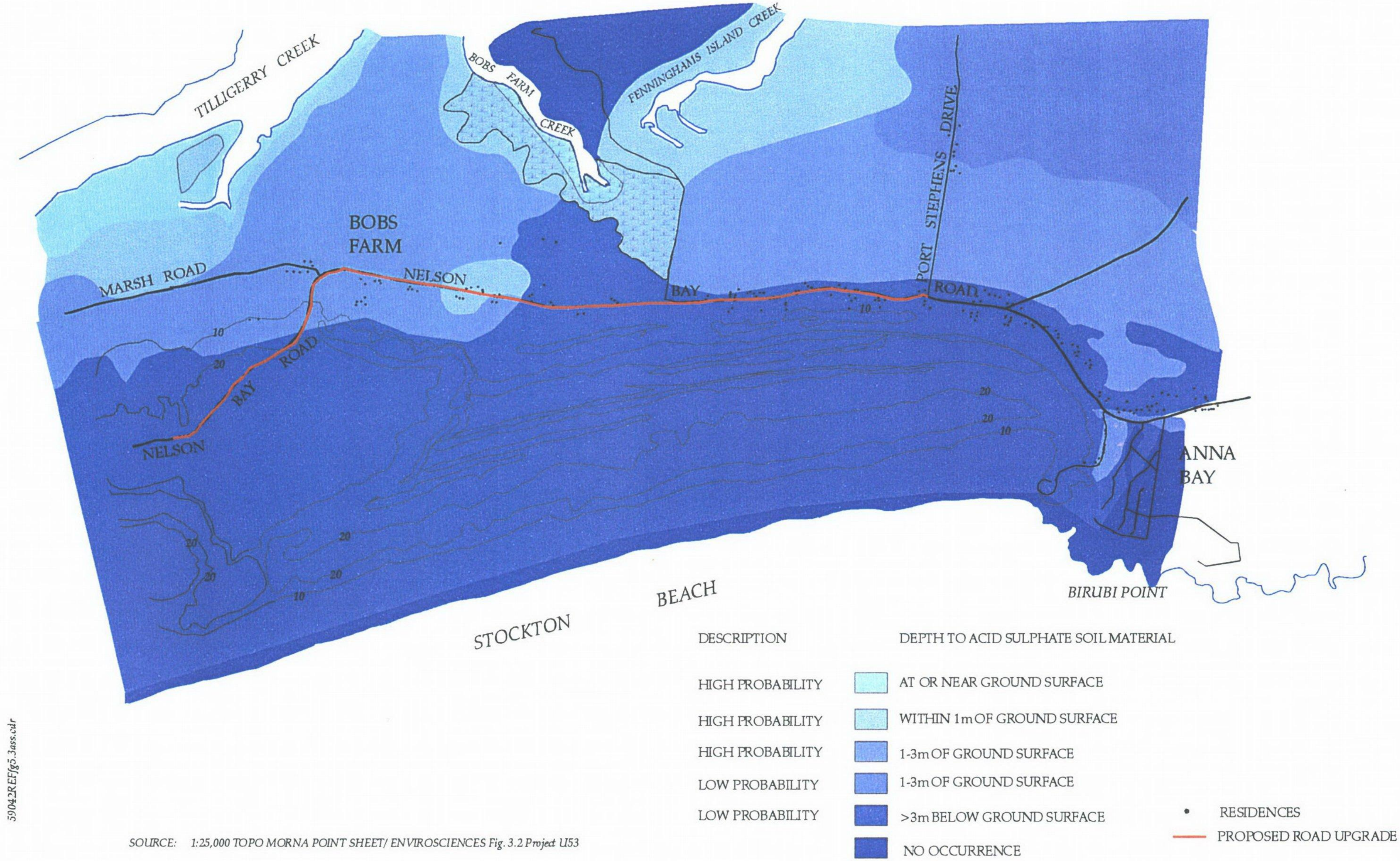
5.3.3 Soil Erosion Hazard

The proposed road upgrade would be constructed primarily on podzols (deep sands) which have a very high wind erosion hazard. Erosion hazard from concentrated flows may also be high. Erosion and the deposition of wind blown sand, sandblasting of roads and users of the road would be minimised through the implementation of erosion and sediment controls outlined in the following section.

5.3.4 Erosion and Sediment Control

The major hazard for road construction in this area is wind erosion. Measures to minimise this hazard are:

- vegetating exposed slopes;



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

Figure 5.3 ACID SULPHATE SOILS

- dune forming sand fences;
- cement modified soil;
- sealing soil with bitumen; and
- using geotextile with or without seeding mulch (Golder & Associates, 1997).

Surface disturbance and movement of equipment in the area would be minimised through good forward planning. As part of the construction program, revegetation of disturbed areas would take place as soon as possible. Disturbance to areas outside the general road construction easement would be minimised by restricting vehicle access to these areas.

Due to the ongoing high wind erosion hazard for the deep sands, monitoring and maintenance of disturbed areas would be carried out. Structures and controls would be installed with a view to long term minimisation of impacts on water quality. Appropriate erosion and sediment control measures would be installed prior to the commencement of construction works and the structures would be maintained throughout the project. Any materials to be stockpiled on site during construction would have downstream sediment protection provided.

5.4 SAND DUNES

5.4.1 Sand Dune Encroachment

Stockton Bight is characterised by a series of south-easterly oriented transgressive dunes of Holocene age. The Newcastle Bight Sand Drift Study completed by the Department of Conservation and Land Management (CaLM, 1993) identified large areas of exposed sand which are extremely susceptible to sand drift erosion. The prevailing wind conditions have allowed the transgressive dunes to remain active and to encroach on previously stable land at rates of between 4 and 10 metres per year (CaLM, 1993). There are three parallel transgressive dunes within Stockton Bight dune system.

Studies undertaken have estimated the average rate of encroachment of Barrier 3 to be 4.1 metres per year in a northerly direction (CaLM, 1993). The transgression is believed to have been initiated between 300 to 500 years ago and is the result of the process of devegetation, and prevailing south-easterly winds moving the dune inland.

5.4.2 *Impacts and Mitigation Measures*

Sand dune encroachment is a minor environmental constraint for the proposed road upgrade. At present, the sand dunes are estimated to be encroaching in a westerly direction at a rate of approximately 4.1 metres per year. *Figure 5.4* shows the predicted hind dune hazard lines in relation to the proposed route. The hind dune may reach the most easterly section of the proposed upgrade near the intersection with Port Stephens Road if the present rate of dune encroachment is not slowed.

In the preliminary geotechnical assessment undertaken as part of the Nelson Bay Road Upgrade Route Selection Study, Golders and Associates (1997) anticipated that the projected year 2095 position of dune barrier 3 would be affecting parts of the proposed road upgrade with sand. Although the proposed upgrade would not be affected by dune encroachment in the next 90 years, consideration needs to be given to measures which would reduce the rate of sand dune advance with respect to future impacts on the road.

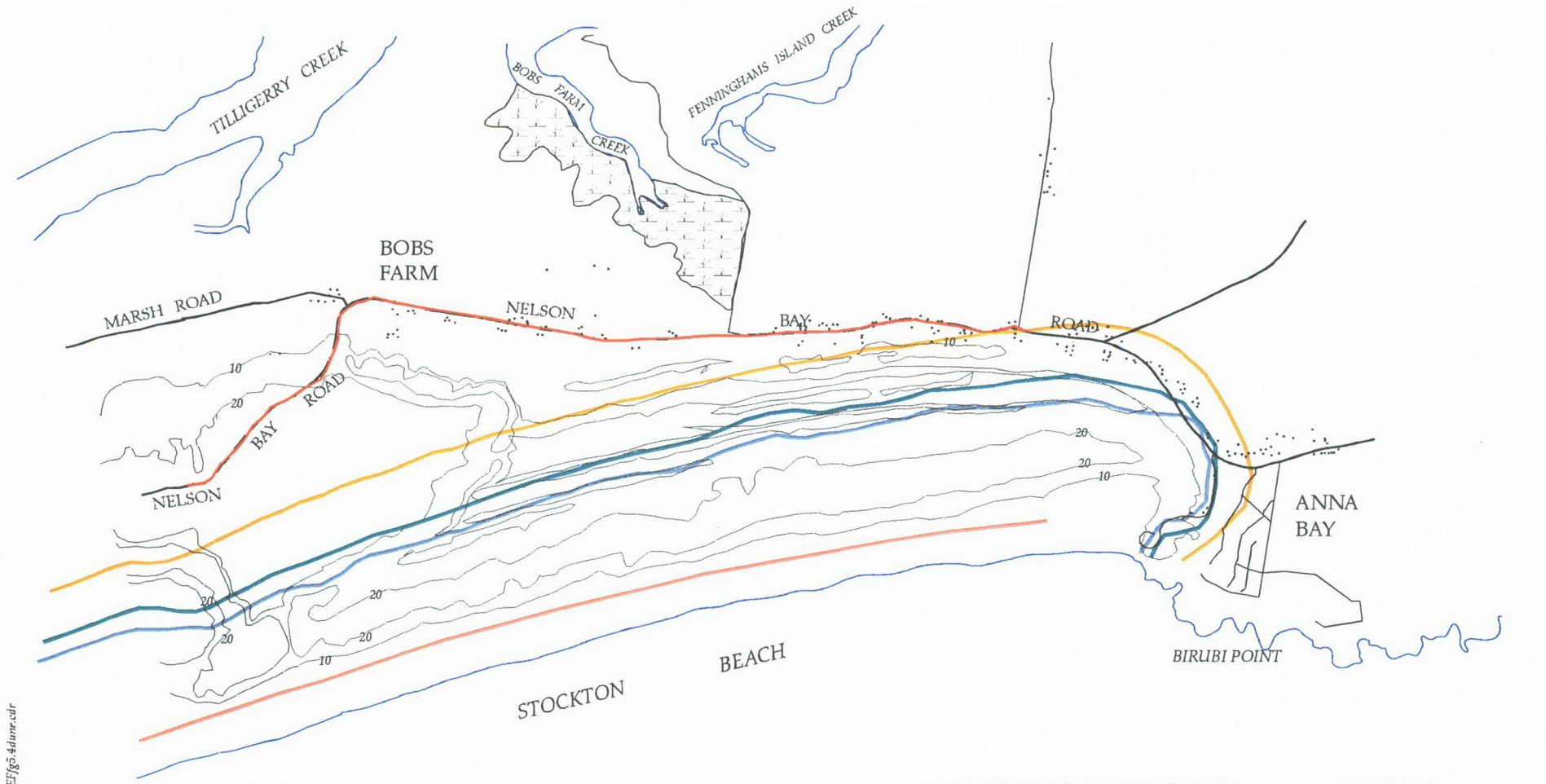
The NSW Coastline Management Manual (1990) provides management options and mitigation measures for coastal hazards such as sand dune encroachment including:

- Environmental planning;
- Development control conditions;
- Construction of protective works; and
- Dune management.

Environmental planning aims at avoiding or limiting coastal developments through land use controls.

Development control conditions can be used by planning bodies to reduce coastal hazards on a site-specific basis through development and building approvals and reducing disturbance associated with new developments. The proposed road upgrade is the most favourable of all options assessed in the concept stage as it is located furthest from the dunes and involves the least amount of disturbance.

Dune management aims to maintain the integrity of the dune system. The stability of a dune system relies primarily on maintaining the dunes protective mantle of vegetation, particularly on the foredune. Dune vegetation maintains the foredunes by retaining the sand already in the dune, trapping wind blown sand and aiding repair of dune damage. A dense ground cover would suppress sand movement and inhibit landward sand drift. Techniques of dune stabilisation and maintenance are detailed in the Soil Conservation Service Coastal Dune Management Manual (Soil Conservation Service, 1990).



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

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Figure 5.4 DUNE HAZARD LINES

Measures to reduce the rate of sand dune advance and minimise impact of future dune encroachment on the proposed upgrade are listed below. These measures were recommended in the Newcastle Bight Sand Drift Study - 1985 (Hunt, 1993) as ways to slow the rate of dune migration and reduce adverse impacts of sand inundation:

- protection of stable vegetated dunes on the western fringes of the Stockton Bight to act as a buffer to migrating dunes. This could be achieved by fencing these ares off to prevent vehicular access;
- improving bushfire control as bushfires weaken the dune vegetation;
- establishment and maintenance of a continuous frontal dune. This could be achieved by building up the frontal dune and planting it with sand spinifex grass. Although this is a difficult and long term measure it is considered a feasible method to halt sand transport from the beach to the active dune system (Hunt, 1993);
- restricting vehicle access to bare areas of sand and away from revegetating areas through signposting revegetation areas and a beach access tracks, fencing, providing defined access tracks over the frontal dune and increasing public awareness of potential damage caused by recreational vehicles; and
- controlled sand extraction within the mobile sand sheet.

In the event that future sand encroachment is close enough to threaten the viability and safety of the proposed upgrade, immediate stabilising covers could be used on the bare sand to temporarily prevent drift onto the road. Temporary stabilisers include brush matting and mulches, liquid sprays of emulsified bitumen or dispersed organic polymers, cover crops and geotextile fabrics (Soil Conservation Service, 1990).

It is recognised that effective stabilisation of the Stockton dune system would be at an enormous economic cost and that the responsibility must be shared by the various stakeholders.

5.5 HYDROLOGY AND WATER QUALITY

5.5.1 Existing Environment

The hydrology of the area between Bobs Farm and Anna Bay is dependent on the geology of the area. The eastern part of this section of Nelson Bay Road consists of

predominantly sandy soils, which promote rapid infiltration of surface water. As a result there are no defined drainage lines for surface flow in the dune area. To the north of Nelson Bay Road a number of artificial drainage lines connect to Bobs Farm Creek, Fenninghams Island Creek and Wallis Creek which are all tributaries of Tilligerry Creek.

Tilligerry Creek is a prominent drainage line running west to east in a depression between the inner and outer dunal barrier system. Whereas the soil in the barrier dunes consists of sand deposits, the interbarrier depression of Tilligerry Creek is underlain by clay. The infiltration in this area is very low and the watertable is close to the surface. Runoff can exit this system through Fullerton Cove to the west or Tilligerry Estuary to the east. A system of floodgates, drains and levees occur along the drainage network from Fullerton Cove to Tilligerry Creek. This system was installed to restrict fluctuating levels of salt water from Port Stephens and to assist the escape of surface water runoff in the area.

i. Flooding

The main risk of flooding and waterlogging in the Bobs Farm area is primarily due to poor infiltration of the soils in the Tilligerry Creek depression during localised rain, in addition to high watertable levels and the tidal levels experienced in Port Stephens.

Previous studies by Lawson and Treloar (1994) have concluded that the elevated roads in the area, including Nelson Bay Road, affect the flow of the infrequent larger floods within the Tilligerry Creek floodplain. Elevated roads tend to act as barriers and can trap flood waters for extended periods of time. Water trapped due to elevated roads provides suitable mosquito breeding habitat. A consequence of this breeding is an increase in the potential for mosquito-born diseases.

ii. Water Quality

The groundwater flow direction in the study area is in a northerly direction towards Tilligerry Creek. The aquifer beneath the road is unconfined and is therefore prone to contamination. The base of the aquifer is approximately 30 metres below sea level (Golders & Associates, 1997).

Roads and other areas of pavement concentrate rainfall and alter the direction of runoff. This has the potential to change the recharge ability of the groundwater aquifer, depending on the road design.

Groundwater quality has the potential to be adversely affected by urban and industrial activities taking place within the catchment. The upgrade of Nelson Bay

Road would contribute small amounts of oil-based contaminants and heavy metals to the groundwater system in road runoff. The potential for impact on groundwater quality already exists as a result of the road in its existing condition and urban and industrial activities occurring in the catchment. The extent of impacts on groundwater quality from the proposed road upgrade is not considered significant.

5.5.2 *Impacts And Mitigation Measures*

i. Hydrology

The upgrade of Nelson Bay Road has the potential to improve the hydrology in the Bobs Farm area by improving the drainage under and around the existing road. Currently there are a number of culverts that are blocked by sediment or are not of sufficient size to adequately drain the area. Consideration would be given to the low-lying nature of the area in the construction of the road and the functioning of culverts improved to reduce the potential for water ponding and mosquito breeding habitat.

Although the exact number, size and location of culverts and drains is yet to be determined following further investigations as part of the detailed design phase, at this stage four drainage easements are proposed at Ch1800, Ch2050, Ch3300 and Ch3600 (see the Concept Design Plans). The proposed easements at Ch1800 and Ch2050 would carry drainage north of Nelson Bay Road to Tilligerry Creek. The proposed easement at Ch3300 would also drain to the north and connect to an existing drain to Bobs Farm Creek. The proposed easement at Ch3600 would drain north along the Marslen & Lewis/Robinson property boundary for approximately 100 metres and then east to the existing drain to Bobs Farm Creek.

ii. Flooding

Some artificial drainage lines and 12 culverts would be affected by the upgrade of Nelson Bay Road. Undersized or blocked culverts may act as a barrier, which could impact on the flooding in the area and nearby properties. The extension and potential upgrading of existing drains and culverts, and construction of the proposed drainage easements in flood affected areas (at the chainages described above) would potentially reduce the flooding in the area by more effectively conveying drainage northwards to Tilligerry and Bobs Farm Creeks.

iii. Water Quality

The interbarrier deposits of the area consist of saturated estuarine clays of the Bobs Farm soil unit. These soils have a low wind erodibility and a moderate water erodibility. The erosion hazard of these soils when disturbed is negligible. The Hawks Nest, Boyce Track and Shoal Bay soil units consist of sandy soils which have high erodibility when exposed to wind or concentrated water flows. These soils have a high erosion hazard when disturbed as a result of agricultural or development activities. Sediment and erosion control issues during road construction have the potential to impact on water quality in the area.

The proposed road upgrade would initially cross an area of interbarrier deposits which have a low erodibility and erosion hazard. It would then pass over flat to gently undulating areas of sandy soils which have a high erosion hazard. Erosion and sedimentation problems on this route would be minimised by the relatively low relief of the area.

Soil erosion would have the greatest potential impact on water quality in the area during the construction period. Disturbance of the ground surface during the construction phase could lead to mobilisation of sediment, organic matter and dissolved particles which can result in pollution downstream of the works. Environmental impacts of soil erosion include turbidity of waterways and blockage of drainage lines resulting from settling of soil particles. Other environmental impacts may result downstream due to compounds that are often attached to soil particles, including nutrients, pesticides and heavy metals.

Soil erosion and sediment control measures addressed in *Section 5.3.4* would ensure that erosion and sedimentation impacts along the route are controlled. Implementation of the Acid Sulfate Soils Management Plan which would be prepared as part of the Construction EMP, would minimise the potential water quality impacts due to the disturbance of acid sulfate soils.

5.6 FLORA AND FAUNA

5.6.1 Previous Flora And Fauna Studies

A number of flora and fauna assessments have been undertaken for the proposed upgrade of the section of Nelson Bay Road between Bobs Farm and Anna Bay:

- upgrade option 1B along the existing Nelson Bay Road (ERM Mitchell McCotter 1998a); and

- upgrade option 2 being a full deviation through undeveloped land south of the existing road, following where possible, an existing transmission line easement (ERM Mitchell McCotter 1998b).

These assessments are included in *Appendix D* and a summary of the findings follows. The objectives of the previous assessments were to identify flora and fauna characterising the route, identify threatened species listed in *Threatened Species Conservation Act 1995* (TSC Act), undertake an assessment of the impacts of the proposal on threatened species in accordance with Section 5A of the *Environmental Planning and Assessment Act 1979* (EP&A Act), and identify impacts on flora and fauna and the proposed Stockton Bight National Park.

i. Option 1B

Field investigations for option 1B were undertaken over two days in July 1998 along Nelson Bay Road (see *Appendix D-1*). Investigations described the vegetation, assessed koala habitat in accordance with State Environmental Planning Policy 44 (SEPP 44), described fauna habitat and fauna assemblages. Fauna survey included diurnal bird observations, searches for frogs and reptiles, spotlighting, stagwatching, playback of nocturnal bird calls, recording and analysis of bat echolocation calls, and searches for indirect evidence.

The threatened squirrel glider (*Petaurus norfolcensis*) and little bent-wing bat (*Miniopterus australis*) were identified during investigations. Impact assessment of the proposed upgrade concluded that individual squirrel gliders may be directly or indirectly affected. It was recommended that further investigations be undertaken to determine the location of squirrel glider den sites. It was also recommended that additional surveys for bat species be undertaken in the warmer months.

ii. Option 2

Field investigations for option 2 were undertaken over six days in June 1998 along the road corridor and in adjoining habitats. Investigations described the vegetation, assessed koala habitat in accordance with SEPP 44, described fauna habitat and fauna assemblages. Fauna survey included arboreal mammal trapping, diurnal bird observations, searches for frogs and reptiles, spotlighting, stagwatching, playback of nocturnal bird calls, recording and analysis of bat echolocation calls, and searches for indirect evidence.

The threatened squirrel glider (*Petaurus norfolcensis*), powerful owl (*Ninox strenua*), koala (*Phascolarctos cinereus*) and orchid *Diuris praecox* were identified during investigations. Impact assessment of the proposed upgrade concluded that the

development would disrupt local populations of squirrel gliders, koalas and *Diuris praecox*. Option 2 would isolate a significant area of habitat within the proposed Stockton Bight National Park and would significantly impact on the population of *Diuris praecox* and other locally significant orchids. It was recommended that a species impact statement be prepared for option 2 if it were to be further investigated.

National Parks and Wildlife Service (NPWS) and other government departments reviewed the Environmental Assessment Reports for options 1B and 2. NPWS strongly objected to option 2 on the basis that it fragmented and sterilised land within the proposed national park and it was considered likely to have a higher impact on flora and fauna. Option 1B is NPWS preferred option for the road upgrade. While it would intensify the existing barrier to fauna movement provided by Nelson Bay Road, it would have a lesser impact than option 2 and would not create a second barrier.

iii. Other Studies

A review of available literature for the local area was undertaken to supplement field investigations and identify significant ecological issues. The literature review for the study included:

- vegetation survey of Tomaree National Park (Bell 1997);
- studies included in the Port Stephens Comprehensive Koala Plan of Management (Port Stephens Council 1999);
- flora, fauna and SEPP 44 assessment for a proposed school at Salamander Bay (ERM Resource Planning 1995a);
- Stockton Bight Environmental Study (HLA-Envirosciences Pty Limited 1995);
- Fauna Assessment for proposed sand extraction, Anna Bay (Mount King Ecological Surveys 1990);
- Flora and Fauna Survey for proposed Fingal Bay Road (Mount King Ecological Surveys 1992);
- 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);

- Fauna Impact Statement for residential development at Wanda Avenue, Salamander Bay (ERM Resource Planning 1995b);
- Fauna Impact Statement for residential development at Medowie (ERM Resource Planning 1995c);
- Preliminary fauna assessment for proposed residential development at Boat Harbour (Shortland Wetlands Centre 1993);
- Pre-clearance threatened fauna and flora survey at Fern Bay (ERM Mitchell McCotter 1995); and
- Broad ecological assessment Tomago sandbeds and flora and fauna studies for bore lines in Tomago sandbeds (ERM Mitchell McCotter 1998d)

5.6.2 *Objectives of the Current Flora and Fauna Assessment*

The results of the previous studies provided the basis for the scope of works for the current assessment. The main objectives of the additional flora and fauna assessment were to:

- identify squirrel glider den sites through trapping and subsequent radio-tracking;
- survey bat fauna assemblage during the warmer months to supplement winter surveys;
- assess koala habitat and activity;
- identify and map potential fauna habitat along the route to assist in the concept design of the road alignment;
- assess the impact of the road upgrade on flora and fauna; and
- 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 EP&A Act as amended by the TSC Act.

Assessment of the impact of the proposed upgrade of Nelson Bay Road on threatened species was revised from the earlier studies in light of this additional information.

5.6.3 *Survey Methodology*

Direct and indirect survey methodologies were employed to describe the flora and fauna for the proposed upgrading of Nelson Bay Road. Field observations were supplemented with searches of the NPWS databases (ROTAP and 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. Field surveys were undertaken in July 1998 (ERM Mitchell McCotter 1998a) with additional field surveys in June 1999, September 1999, December 1999 and February 2000. The location of fauna survey sites for the current and previous survey along Nelson Bay Road is shown in *Figure 5.5*.

For the purposes of this assessment, the 'study area' is defined as the existing road corridor and immediately adjoining habitat.

i. Vegetation Survey

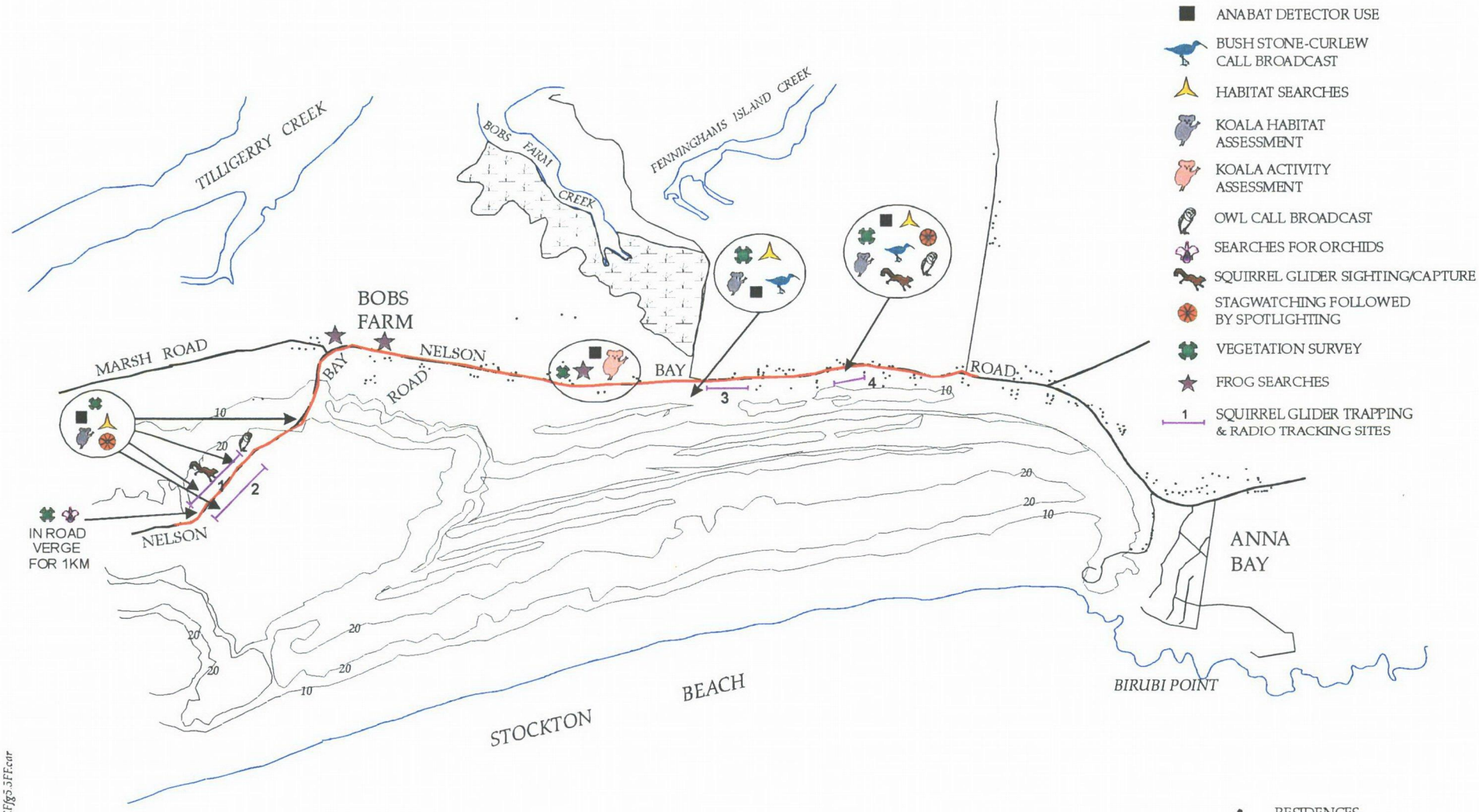
The flora survey was undertaken in July 1998 and December 1999. Vegetation analysis involved a review of existing information and a description of the communities using field observations. Vascular plant species were recorded during walking transects along the route and plot based surveys. Plot based surveys sampled the vegetation communities using 20 metre by 20 metre plots in compliance with the National Herbarium. At each plot the physical, structural and floristic attributes were recorded. The conservation status of flora species was derived from Briggs and Leigh (1996) and Schedules 1 and 2 of the TSC Act. The conservation status of vegetation communities was assessed based on their condition, occurrence of threatened flora, and assessment of the distribution of the community.

ii. Fauna Survey Methodology

a. Option 1B Environmental Assessment Report

The fauna survey in July 1998 involved preliminary field investigations identifying species present as well as known or potential habitat for threatened fauna. The fauna survey 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;



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

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Figure 5.5 FLORA AND FAUNA SURVEY SITES

- 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*) followed by quiet listening periods to detect any response to calls (follows Kavanagh and Peake 1993)

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

- SEPP 44 (Koala Habitat Protection) assessment; 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.

b. Current survey

Additional field surveys were undertaken in June 1999, September 1999, December 1999 and February 2000. Surveys targeted the squirrel glider, bats, wallum froglet and koala.

The squirrel glider (*Petaurus norfolcensis*) was identified during the preliminary assessment at two locations approximately five kilometres apart (ERM Mitchell McCotter 1998a). Further investigations were undertaken to determine the location of squirrel glider den sites through trapping and subsequent radio-tracking. The fauna trapping program was undertaken by ERM with radio-tracking undertaken by Forest Fauna Surveys (see *Appendix D-3*).

The objective of the study was to capture one individual from each site, and fit with a radio transmitter. Following release of the individual the glider was to be located on 10 separate days recording the location of den trees. The basis for the survey design is the ecology of the squirrel glider that is known to occupy up to eight dens (Forest Fauna Surveys 2000) within their territory.

The trapping program sampled four sites in early June and again in September and October 1999. The sites were located in open forest providing potential habitat for the squirrel glider and near previous sightings. Sites one and two were located in

open forest habitat either side of Nelson Bay Road near the start of the study area. Site three sampled open forest to the south of Nelson Bay Road near Trotters Lane. Site four sampled open forest south of Nelson Bay Road, near the previous squirrel glider sighting (see *Figure 5.5*).

Seven or eight tree-mounted Elliott B traps were set at each of the four sites. Traps were baited with a mixture of peanut butter, rolled oats and honey, secured to a bracket and attached to the tree at a height of approximately 2.5 metres. Traps were set along transects approximately 20 metres apart. The trap entrance and trunk were sprayed with a mixture of honey and water to act as an attractant. Traps were set for four consecutive nights for a total of 140 trap nights in June, 116 in September and 30 in October.

Additional surveys targeting bat fauna were undertaken in the warmer months to supplement the preliminary investigations undertaken during the cooler winter hibernation period. Winter investigations only detected the little bent-wing bat (*Miniopterus australis*) (ERM Mitchell McCotter 1998a). Additional bat fauna surveys were restricted to the detection of bat echolocation calls with an Anabat detector and subsequent computer analysis. Surveys were undertaken on 23 September 1999, 7 December 1999 and 9 February 2000. Calls were recorded during walking transects in open forest habitat and coastal swamp forest. Prevailing weather conditions were favourable for the detection of species being mild to warm nights with light to no breeze.

Spotlight searches for nocturnally active species were undertaken in conjunction with bat surveys for a total of six person hours sampling dry sclerophyll open forest and coastal swamp forest habitats.

Targeted searches for the wallum froglet (*Crinia tinnula*) were undertaken in the cooler winter months in grassy soaks near the intersection of Nelson Bay Road and Marsh Road and in February 2000 in coastal swamp forest north of Bobs Farm. Survey included broadcast of calls and searches amongst the emergent vegetation.

Further assessment of koala habitat and activity in preferred koala habitat was undertaken in September and December 1999. Survey methodology is outlined in *Section 5.6.9*.

iii. Habitat Assessment

An assessment of habitats along the Nelson Bay Road upgrade was undertaken to identify potential constraints to the conceptual design of the road upgrade and associated infrastructure. The assessment was based on the identification of habitat

for the squirrel glider and other arboreal species, areas of potential koala habitat and habitat for the wallum froglet (*Crinia tinnula*).

Approximately 4.2 kilometres of the affected section of Nelson Bay Road is forest habitat, with the remainder 2.3 kilometres being cleared land characterised by introduced grasses and herbs. Habitat assessment was based on the following parameters:

- aerial photograph interpretation;
- occurrence and density of potential den sites in ecologically mature trees within approximately 40 metres of the road;
- availability of fallen timber;
- availability of nectar sources;
- presence of free standing water and wetland habitats;
- presence of potential koala habitat based on the presence of the preferred koala feed tree swamp mahogany (*Eucalyptus robusta*);
- connectivity of habitat; and,
- degree of naturalness.

Where possible, potential den trees were identified in the field with 'H' marked on the tree or road verge. The results of the habitat assessment are presented in the Potential Constraints *Figures 1 to 6* in *Appendix C*. In areas with a high density of hollows, trees were not individually identified in the field and high density was indicated on the constraints maps.

5.6.4 Plant Communities

Vegetation along most of Nelson Bay Road between Bobs Farm and Anna Bay has either been cleared or drastically altered. Based on vegetation structural characteristics, the study area is dominated by three plant communities, namely grassland, open forest and forest.

The approximate boundaries of the communities within the study area were mapped from aerial photograph interpretation (Port Stephens Shire Council, Run 4, 20.9.92, 1:5,000) and field verification. Distribution of the vegetation communities along the road corridor is provided on the Concept Design Plans. The structural

characteristics and dominant species for each strata are discussed in the following pages.

i. Grassland

Pasture species are established along most of the route, with grassland dominating the road verge and characterising the adjoining rural properties. Dominant grass species include blady grass (*Imperata cylindrica*), common couch (*Cynodon dactylon*), buffalo grass (*Stenotaphrum secundatum*) and kikuyu (*Pennisetum clandestinum*). Dominant herbaceous species include large plantain (*Plantago major*), dandelion (*Taraxacum officinale*) and scarlet pimpernel (*Anagallis arvensis*).

The open nature of this community has contributed to the occurrence of several orchid species including *Pterostylis* sp., *Acianthus* sp. and *Microtis* sp. At the western end, native plant species diversity is higher within the grassland and includes such species as kangaroo grass (*Themeda australis*), *Gonocarpus teucrioides* and *Dianella caerulea*. Vegetation within the grassland is less than one metre in height, while percentage cover is approximately 80 to 90 percent. This community is regularly mowed or slashed as part of road and easement maintenance.

Cleared estuarine flats in the Bobs Farm area support grassland with isolated cabbage tree palms (*Livistonia australis*), swamp oaks (*Casuarina glauca*) and *Melaleuca quinquenervia*. Constructed drains along the road in the Bobs Farm area support sedges and wetland species with inundated grasses providing habitat for amphibians, including the threatened wallum froglet (*Crinia tinnula*).

ii. Open forest

The dominant native plant community along the route is structurally an open forest. Open forest community is further divided based on dominant species to blackbutt and rusty gum open forest, flooded gum and swamp mahogany open forest and paperbark and swamp mahogany open forest.

a. Blackbutt and rusty gum open forest

Blackbutt (*Eucalyptus pilularis*) and rusty gum (*Angophora costata*) open forest occurs on deeper well-drained sands. The canopy reaches a height of approximately 20 to 25 metres providing 40 to 50 percent projective foliage cover. Diameter at breast height (DBH) averages 45 centimetres, with recorded DBH ranging from 12 centimetres to 120 centimetres.

The mid-understorey trees are up to 15 metres in height providing approximately 15 percent projective cover. Dominant tree is *Banksia serrata* with juvenile eucalypts

and *Monotoca elliptica* with localised cheese tree (*Glochidion ferdinandi*). Low coastal heath shrubs include *Bossiaea rhombifolia, Monotoca scoparia, Leucopogon lanceolatus, Dodonaea triquetra* and *Dillwynia retorta.*

Groundcover throughout the open forest is dense and dominated by bracken fern (*Pteridum esculentum*) with blady grass (*Imperata cylindrica*), herbs (*Gonocarpus teucrioides, Dianella caerulea, Platysace ericoides*), vines (*Pandorea pandorana, Hardenbergia violacea*) and orchids (*Acianthus* sp., *Pterostylis* sp.).

The margins of this community are disturbed along Nelson Bay Road and side access roads, 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 eight to ten centimetres.

In some areas the understorey of the open forest has been cleared and the canopy layer retained. These areas are indicated in the Concept Design Plans as blackbutt and rusty gum open forest cleared understorey.

b. Flooded gum/ swamp mahogany open forest

To the north of Nelson Bay Road and south of the Bobs Farm general store are localised occurrences of coastal swamp open forest dominated by flooded gum (*Eucalyptus grandis*) and swamp mahogany (*Eucalyptus robusta*) with some swamp oak (*Casuarina glauca*). Canopy trees are 20 to 25 metres high providing 50 percent projective foliage cover. The trees are generally young with an average DBH of 25.2 centimetres, with recorded DBH ranging from 11 centimetres to 93 centimetres.

Mid-storey of cabbage tree palms (*Livistonia australis*) and swamp oaks reach 10 to 15 metres in height. Near Nelson Bay Road the mid-storey is characterised by a moderately dense band of small trees to six metres in height including cheese tree (*Glochidion ferdinandi*), *Phebalium squameum* subsp. *squameum* and *Acacia irrorata* subsp. *irrorata.* Lower strata is dominated by dense cover of *Gahnia clarkei* and bracken with clumps of lantana (*Lantana camara*).

c. Paperbark and swamp mahogany open forest

South of Nelson Bay Road is a localised coastal swamp open forest approximately 100 metres long by 40 metres wide. The open forest is dominated by *Melaleuca quinquenervia* and swamp mahogany (*Eucalyptus robusta*). Trees are 15 to 20 metres high providing 30 to 50 percent projective foliage cover. The trees have an average DBH of 36 centimetres, with recorded DBH ranging from 12 centimetres to 95

centimetres. The area is generally flooded and supports a dense understorey of *Phragmites australis, Gahnia clarkei* and *Blechnum indicum.*

iii. Forest

Coastal swamp forest occurs in low lying area near Bobs Farm. The dominant species is *Melaleuca quinquenervia* with swamp mahogany (*Eucalyptus robusta*). Canopy trees are 20 to 25 metres high providing 70 percent projective foliage cover. Trees have an average DBH of 27.9 centimetres, with recorded DBH ranging from 11.5 to 78 centimetres. The area is generally characterised by standing water and supports clumps of *Phragmites australis, Lepironia articulata* and *Blechnum indicum.* The inundated areas are fringed by cheese trees, with an understorey of *Gahnia clarkei* and bracken.

Swamp oak forest occurs to the north and south of the road corridor on the drained estuarine flats of the Bobs Farm area. The dominant species is swamp oak (*Casuarina glauca*) with *Melaleuca quinquenervia* and occasional swamp mahogany and or cabbage tree palm (*Livistonia australis*). This community was not sampled directly.

5.6.5 Conservation Significance

The blackbutt and rusty gum open forest is an example of the blackbutt-apple open forest on deeper sands occurring in the Tomaree National Park (Bell 1997) and dominating the relic dunes of the Stockton Bight system. This community is widespread in Tomaree and Myall Lakes national parks and along the NSW north coast. It is considered adequately conserved at a local, regional and national scale (Bell 1997). No threatened flora species were recorded in the blackbutt-apple open forest on deeper sands in Tomaree National Park (Bell 1997).

Paperbark and swamp mahogany forest and open forest communities are an example of the Melaleuca swamp forest occurring in the Tomaree National Park (Bell 1997). This community occurs only in poorly drained Holocene sand sheets and has localised occurrences in the Port Stephens area. It is considered adequately conserved at a local, regional and national scale (Bell 1997). Large tracts of this community are represented in Myall Lakes National Park.

The flooded gum and swamp mahogany open forest is poorly represented in the Port Stephens area covering only 18.1 hectares of the local government area (Lunney *et al* 1998). Flooded gum is at its southern limit of distribution at Newcastle and is not represented in the Tomaree National Park.

The orchids *Diuris praecox, Caladenia hillmanii* and *Diuris arenaria* have been observed in road reserves and easements on the Tomaree Peninsula. *Diuris praecox* is listed as

threatened and has been recorded in grassy easement along option 2 to the south of Nelson Bay Road (ERM Mitchell McCotter 1998b). *Caladenia hillmanii* and *Diuris arenaria* are recently described species, considered likely to be endemic to the Port Stephens area. *Diuris arenaria* (previously *Diuris* sp. aff. *punctata* (Nelson Bay)) was also observed along option 2 (ERM Mitchell McCotter 1998b). *Diuris arenaria* occurs in shrubby coastal heath forests dominated by *Corymbia gummifera* and *Angophora costata* with a grassy or bracken groundstorey (Jones 1999). No orchids were observed on the edge of the open forest in the road reserve possibly due to recent slashing for roadside maintenance. Access roads to the dunes include open grassy easements that provide habitat for these orchids.

The rare herbaceous plant *Gonocarpus salsoloides* has been recorded in coastal swamp forest during investigations for the previous section of upgrade of Nelson Bay Road (Ecotone Ecological Consultants 1997). *Gonocarpus salsoloides* has a ROTAP risk code of 3RCa being distributed over a range of greater than 100 kilometres (from north of Port Macquarie to Royal National Park), assessed as rare, represented in conservation reserves over its range and adequately conserved at Brisbane Water National Park (Briggs and Leigh 1996, Wilson 1991). It is not listed as threatened under the TSC Act. This species was not identified during the current survey. It is only known from one other site in the region on the Tilligerry Peninsula (Ecotone Ecological Consultants 1997) and has not been recorded from Tomaree National Park (Bell 1997) or Myall Lakes National Park (Briggs and Leigh 1996).

No threatened flora species or species of conservation significance were recorded along the preferred route.

The forested areas along Nelson Bay Road are continuous with vegetated barrier dunes of the Newcastle or Stockton Bight, the largest unvegetated coastal dune system in New South Wales (HLA-Envirosciences 1995). The vegetated dunes extend from Anna Bay in the north to Stockton in the south and inland towards Williamtown and Bobs Farm. Vegetation along the dune is dominated by rusty gum, blackbutt and bloodwood forest/woodland with swales supporting coastal swamp vegetation communities. The dunes have high natural value and the conservation significance of the dune system has been recognised by the proposal to gazette the dune system as a national park. The boundaries of the proposed national park have not been finalised, the approximate boundary is shown in *Figure 1.1*.

5.6.6 Fauna Habitats

Fauna habitats and micro habitat elements along Nelson Bay Road were mapped to identify potential constraints to the design of the road. Constraints maps are provided in *Appendix C*.

Grassland has little habitat value for native fauna excepting foraging habitat for birds and grazing animals such as the eastern grey kangaroo (*Macropus giganteus*). Other important habitat components such as arboreal hollows, logs and rocks are also absent. 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.

The open forest 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, wattles 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. Invasion by bitou bush at the eastern end of the road, limits the growth of native shrubs and groundcovers limiting habitat diversity and foraging resources in these areas.

Coastal swamp forest provides habitat for forest dependent fauna in particular the koala and also for amphibian species especially the wallum froglet (*Crinia tinnula*). They also provide a winter flowering nectar source from *Melaleuca quinquenervia* and *Eucalyptus robusta*. This resource is used by species such as the squirrel glider, birds and flying foxes.

Forested habitats along Nelson Bay Road are part of the extensive vegetated dunes of Stockton Bight system. The vegetated dune system provides continuity of habitat and wildlife corridor. The Bobs Farm area and to the north of Nelson Bay Road has been largely cleared of native vegetation. The cleared land is used predominantly for agricultural purposes. The cleared land and Nelson Bay Road present a barrier to the movement of fauna between the dune system forest and the coastal swamp forests and estuarine habitats along the tidal flats of Tilligerry Creek and Bobs Farm Creek.

5.6.7 *Fauna Species*

Fauna species observed along Nelson Bay Road are listed in earlier investigations undertaken in July 1998 (see *Appendix D-1*). The aim of the current investigations was to provide additional information on target species namely the squirrel glider, koala, wallum froglet and bat fauna.

i. Bat fauna

Winter investigations detected the little bent-wing bat (*Miniopterus australis*) (ERM Mitchell McCotter 1998a). Bat species identified in the warmer months were chocolate wattled bat (*Chalinolobus morio*), Gould's wattled bat (*Chalinolobus gouldii*), little bent-wing bat (*Miniopterus australis*), long-eared bat (*Nyctophilus* sp.), greater broad-nosed bat (*Scoteanax rueppellii*), eastern forest bat (*Vespadelus pumilus*) and little forest bat (*Vespadelus vulturnus*). Of these bats the little bent-wing bat and greater broad-nosed bat are both listed as threatened species under the TSC Act.

ii. Wallum Froglet

Targeted searches for the wallum froglet (*Crinia tinnula*) were undertaken in the cooler winter months in grassy soaks near the intersection of Nelson Bay Road and Marsh Road and in coastal swamp forest north of Bobs Farm in September 1999 and February 2000. Survey included broadcast of calls and searches amongst the emergent vegetation. No individuals were heard calling.

5.6.8 *Squirrel Glider Habitat*

The squirrel glider (*Petaurus norfolcensis*) was identified during the preliminary assessment at two locations approximately five kilometres apart (ERM Mitchell McCotter 1998a). Further investigations were undertaken to determine the location of squirrel glider den sites through trapping and subsequent tracking. The fauna trapping program was undertaken by ERM with radio-tracking undertaken by Forest Fauna Surveys (see *Appendix D-2*).

Trapping was undertaken at four sites along the road corridor as outlined in *Section 5.6.3*. Traps were set for four consecutive nights for a total of 140 trap nights in June, 116 in September and 30 in October. No individuals were captured in June with five individuals captured in September and October. In September, two individuals were captured, fitted with radio transmitters and tracked. Individuals were tracked at sites one and four.

At site one, a young male was tracked and a total of four den trees were identified. The locations of the den trees were identified by GPS and were accurately mapped by the Council's surveyor (see Concept Design Plans). Distance from the existing road formation to the identified den tree is approximately 28 metres (den tree one), 182 metres (den tree two), 55 metres (den tree three) and 32 metres (den tree one). Identified den trees would not be disturbed by the road upgrade which is on the opposite side of the existing road formation in this section. However gliders in this section of Nelson Bay Road are expected to utilise open forest habitat on both sides of the road and squirrel gliders have been observed gliding across the existing road in earlier site investigations (ERM Mitchell McCotter 1998a).

At site four, a young male was tracked to three den trees. The signal to the male at site four was not located after the fifth visit. Distance from the existing road formation to the identified den tree is approximately 75 metres (den tree one), 15 metres (den tree two) and 110 metres (den tree three). Den tree two would be within three metres of the new west bound carriageway. The tree would be protected by fencing to be specified at the detailed design stage. An arborist would also be consulted at detailed design stage to provide advice on fencing and protection that would not affect the health of the tree. The locations of the den trees were identified by GPS and were accurately mapped by the Council's surveyor (see Concept Design Plans).

5.6.9 Koala Habitat

i. State Environmental Planning Policy No 44 – Koala Habitat Protection

Preliminary environmental investigations assessed that the dominant tree community along Nelson Bay Road does not provide potential koala habitat as defined by State Environmental Planning Policy No 44 - Koala Habitat Protection (SEPP 44) (ERM Mitchell McCotter 1998a). Further assessment of potential koala habitat was undertaken for areas of coastal swamp forest east of Bobs Farm.

a. Potential Koala Habitat

Potential koala habitat is defined as vegetation which incorporates a minimum of 15 percent of tree species in the *'upper or lower strata of the tree component'* listed in Schedule 2 of SEPP 44. The identification of *potential* koala habitat must be assessed by a person suitably qualified in tree identification (clause 7 (2)).

Six plots were sampled in open forest habitat either side of Nelson Bay Road east of Bobs Farm general store. The results of the assessment are provided in *Table 5.4.*

Sites K1 and K6 sampled the same habitat and results are presented as an average of the two plots.

Swamp forest habitat east of Bobs Farm provides potential koala habitat as defined by SEPP 44. The areas of koala habitat are shown on *Figure 5.6*. In accordance with SEPP 44 further assessment of the presence of core koala habitat is required.

Table 5.4 POTENTIAL KOALA HABITAT ASSESSMENT

Site	Habitat	Number of trees	Number of Schedule 2 species	Potential koala habitat
K1 & K6	paperbark and swamp mahogany forest	30*	5 (17%)	Yes
K2	swamp mahogany/paperbark open forest	20	7 (35%)	Yes
K3	flooded gum and swamp mahogany open forest	20	11 (55%)	Yes
K4	blackbutt and rusty gum/flooded gum open forest ecotone	23	0 (0%)	No
K5	flooded gum and swamp mahogany disturbed	20	3 (15%)	Yes

Notes: * *Average results presented as sampling same habitat*

Schedule 2 species = swamp mahogany (Eucalyptus robusta)

b. Core Koala Habitat

Core koala habitat is defined as

'...an area of land with a resident population of koalas, evidenced by attributes such as breeding females.. and recent sightings of and historical records of a koala population...'

The koala is generally a solitary animal occupying semi-exclusive territories and the breeding biology is characterised by the occurrence of discrete core breeding groups of several dozen individuals. Territories of breeding males generally overlap with adjacent territories of females. In the overlap zones, individual trees are habitually used for interaction between individuals. These trees can be identified by scratch marks and copious scat deposits under the trees allowing for identification of core interaction habitat (Ferrier *et al* undated).

In accordance with SEPP 44, assessment of *core* koala habitat should address the following:

- extent of tree use based on observations of koalas and assessment of indirect evidence of the presence of koalas, that is scats or scratch marks;
- estimated size of koala population;
- evidence of breeding females; and
- presence of juveniles and sub-adults.

Assessment of koala usage of the study area was based on the Australian Koala Foundation (AKF) spot assessment technique (Phillips and Callaghan 1995). This technique was developed by the AKF based on observations of koala territorial behaviour.

The spot assessment technique assesses koala activity within a circle with a minimum radius of 10 metres from a central tree. The selection of spot assessment sites and central trees was based on the following criteria:

1 a tree of any species beneath which one or more koala faecal pellets have been observed; or

2. a tree in which a koala has been sighted; or

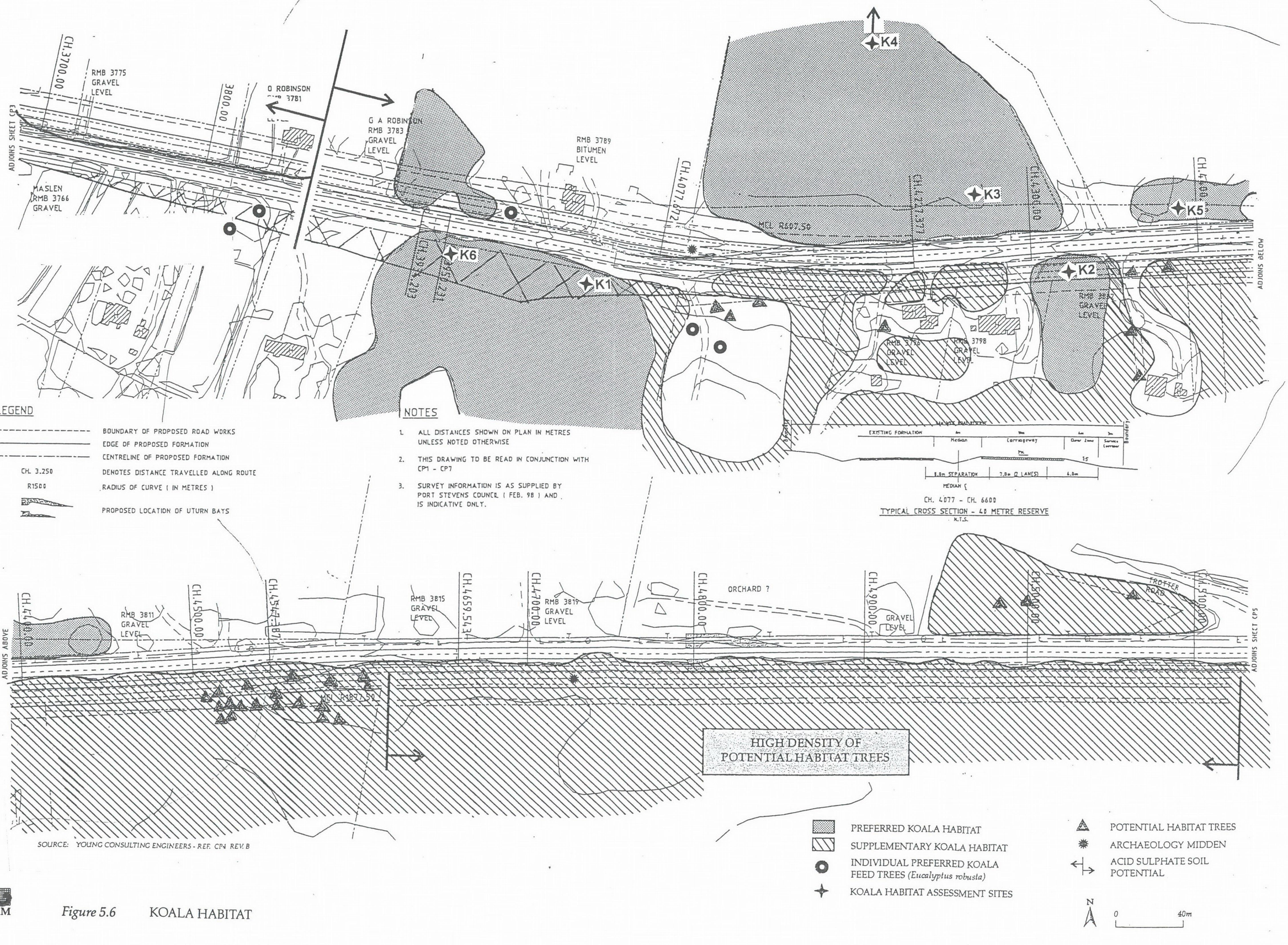
3. any other tree known or considered likely to be an important tree for koalas in a particular area.

In the 10 metre radius circle, all trees were assessed with a minimum of 20 trees per spot assessment. The radius of the circle was extended, where required, to ensure that 20 trees were assessed. Trees must have a diameter breast height over bark (DBH) of 100 millimetres or greater.

At the base of each tree a systematic search was undertaken for koala faecal pellets on the surface of and under the litter. The search was undertaken within a radius of 100 centimetres of the base of the tree for two to three person minutes.

For each tree the following parameters were recorded:

- species of tree;
- DBH;
- whether or not a koala is in the tree;



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

1. ALL DISTANCES SHOWN ON PLAN IN METRES UNLESS NOTED OTHERWISE
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH CP1 - CP7
3. SURVEY INFORMATION IS AS SUPPLIED BY PORT STEVENS COUNCIL (FEB. 98) AND IS INDICATIVE ONLY.

- PREFERRED KOALA HABITAT
- SUPPLEMENTARY KOALA HABITAT
- INDIVIDUAL PREFERRED KOALA FEED TREES *(Eucalyptus robusta)*
- KOALA HABITAT ASSESSMENT SITES
- POTENTIAL HABITAT TREES
- ARCHAEOLOGY MIDDEN
- ACID SULPHATE SOIL POTENTIAL

N

0 40m

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Figure 5.6 KOALA HABITAT

- the presence or absence of scratch marks; and
- the presence of koala faecal pellets.

Spot assessments were undertaken in the swamp forest habitat and adjoining open forest east of Bobs Farm. Central trees were selected on the basis of the tree being considered likely to be an important tree for the koala. The results are provided in *Table 5.5*.

Table 5.5 KOALA ACTIVITY LEVELS

Habitat	Site	Total no. trees	No. trees with faecal pellets	Koala activity level.
paperbark and swamp mahogany forest	K1	26	0	0%
paperbark and swamp mahogany forest	K6	34	0	0%
swamp mahogany/paperbark open forest	K2	21	0	0%
flooded gum and swamp mahogany open forest	K3	20	0	0%
flooded gum and swamp mahogany disturbed	K5	20	0	0%
blackbutt and rusty gum/flooded gum open forest ecotone	K4	23	0	0%

Notes: *1.Location of koala habitat sites shown on Figure 5.6*

2. Koala activity level = % of trees with koala faecal pellets divided by number of trees

The results of spot assessments can be used to describe koala activity and to identify primary browse trees. Koala activity is derived from the number of trees where koala faecal pellets were observed divided by the number of trees in the spot assessment area, expressed as a percentage. Koala activity greater than 30 percent is indicative of being within an area of major activity in a koala home range and the area is likely to contain a socially stable breeding aggregate. No evidence of the presence of koala was found and there was no evidence of koala activity at all sites.

No estimate of the size of the koala population or breeding status of the population in the study area is available, as there were no direct sightings of koalas. Long term residents adjoining the assessed habitats have not observed individual koalas in this area. However, there are numerous koala records on the National Parks and

Wildlife Service database for the surrounding area with records concentrated along Tilligerry Creek to the north of Nelson Bay Road.

While the swamp forest habitats in this area of the road upgrade provide potential koala habitat they are considered as not currently providing core koala habitat as defined by SEPP 44. However, the area is considered valuable as potential koala habitat and may provide wildlife corridor value linking koala population to the north of the road with the large tract of open forest habitat along the Stockton Bight dune system.

ii. Draft Port Stephens Comprehensive Koala Plan of Management

a. Habitat Assessment

The draft Port Stephens Comprehensive Koala Plan of Management (CKPoM) when approved will supersede the provisions of SEPP 44 in the Port Stephens LGA. The CKPoM seeks to conserve koalas in their existing habitat by identifying and protecting koala habitat and incorporating koala conservation into local government planning processes (Lunney *et al* 1998). The principal aim of the CKPoM is identical to that of SEPP 44 (Port Stephens Council 2000).

Important differences between the strict 'feed tree species' of Schedule 2 in SEPP 44 have been developed for the Port Stephens model to recognise the habitat attributes which are important to the koala in the Port Stephens LGA. The following tree species have been identified as preferred feed trees in the Port Stephens LGA - swamp mahogany (*Eucalyptus robusta*) and Parramatta red gum (*E. parramattensis*) on all substrates, and forest red gum (*E. tereticornis*) on Quaternary alluvials and volcanics (Port Stephens Council 2000). Vegetation associations that have been identified as important to the koala in Port Stephens LGA are described in Lunney *et al* (1998) and mapped in the CKPoM.

The draft CKPoM identifies areas of preferred, supplementary and marginal koala habitat based on community consultation, historical records, vegetation mapping, field based surveys and identification of movement corridors between habitat areas. The blackbutt and rusty gum open forest habitat that dominates the upgrade study area is mapped as supplementary koala habitat. The low lying coastal swamp forests east of Bobs Farm are mapped as supplementary and the flooded gum and swamp mahogany open forest is mapped as unknown koala habitat (Port Stephens Council 2000).

The site vegetation map differs from the vegetation map included in the CKPoM, as the small area of coastal swamp forest to the south of the road is not indicated on the CKPoM. Under the CKPoM, this area would be mapped as preferred koala habitat

as it supports greater than 10 percent density of preferred koala feed trees (*E. robusta*) (*Figure 5.6*). In accordance with the revised CKPoM, a 50 metre habitat buffer area (Port Stephens Council 2000) should be applied to all areas of preferred koala habitat to the south of Nelson Bay Road. The habitat buffer and link area would extend from approximately chainage 3350 to chainage 3620 and chainage 3740 and chainage 3870. These areas include native vegetation and cleared areas with houses. The habitat value of this area is significantly reduced as the area is already developed, restoration is difficult as it includes several private land holdings and it is dissected by Nelson Bay Road.

Isolated swamp mahogany trees occurring outside the preferred koala habitat are also indicated in *Figure 5.6*. Blackbutt and rusty gum open forest occurring along the remainder of the route (not shown in *Figure 5.6*) is mapped as supplementary koala habitat in the CKPoM. No evidence of the presence of koalas was found during fauna surveys and habitat assessments in the open forest.

b. Development Assessment

Development standards and assessment criteria are outlined in the CKPoM for proposals either overlapping or adjacent to areas of preferred or supplementary koala habitat, habitat buffers or habitat linking areas (Port Stephens Council 2000). Upgrade of Nelson Bay Road would disturb areas of supplementary koala habitat as mapped by the CKPoM and areas identified during field investigations as preferred koala habitat. Areas of preferred koala habitat are afforded the highest level of protection.

Performance criteria set out in the CKPoM recommended that developments must:

- minimise the removal or degradation of native vegetation within preferred koala habitat or habitat buffers;
- maximise retention and minimise degradation of native vegetation within supplementary koala habitat and habitat linking areas; and
- minimise the removal of any individuals of preferred koala food trees, wherever they occur on site.

These provisions may be waived by Council only if the development cannot be located in such a way to avoid removal of native vegetation and that koala habitat utilisation assessment shows the development minimises impacts on koala habitat or any koala populations (Port Stephens Council 2000).

An assessment of koala habitat utilisation was undertaken in the area of preferred koala habitat to be disturbed by the road upgrade. The results of the assessment are

provided in *Table 5.5*. No faecal pellets were observed and there was no evidence of koala activity. Location of the new carriageway minimises disturbance of preferred koala habitat to the south of Nelson Bay Road however it would disturb an area of preferred koala habitat to the north of the road (flooded gum and swamp mahogany open forest) and individual swamp mahogany trees. It would further isolate areas of preferred koala habitat that may in the long term have provided a movement corridor.

The road upgrade would compromise the future corridor value of this area increasing risk of mortality from traffic. The koala is vulnerable to being killed when crossing roads especially in urban areas and/or areas where prime habitat has been fragmented. Road mortality represents a significant problem especially for smaller remnant populations.

The annual koala road toll on New South Wales roads is estimated at 200 to 300 individuals (Fanning 1992). In the Port Stephens area, 325 koalas were hit by vehicles between December 1987 and March 1998 of which 241 were fatal (Port Stephens Council 1999). A necropsy study of free-living koalas (1980-1987) from the central and north coast of New South Wales recorded trauma, due mainly to motor vehicle collision as the most common cause of death (Canfield 1990). These koalas were typically healthy with no underlying disease (Canfield 1990).

Nelson Bay Road has been identified as a potential problem area for koalas from traffic in the CKPoM. The CKPoM recommends that potential problem areas are reviewed in conjunction with annual CKPoM monitoring program.

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. The topography of the area does not provide an opportunity to create an underpass without disturbing a greater area of preferred koala habitat.

Conservation of the preferred habitat and a buffer area would 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 program. Exclusion fencing may be warranted in the long term should there be evidence of koala activity in the area.

5.6.10 *Threatened Species*

i. Threatened Species Conservation Act 1995

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*) and the orchids, *Diuris praecox* and *Diuris arenaria.*

Threatened species considered likely to occur in the area, based on local records and preferred habitat attributes, have been tabulated in *Table 1* of *Appendix D3*. Species assessed as having a moderate to high likelihood of occurrence are powerful owl (*Ninox strenua*), masked owl (*Tyto novaehollandiae*), common bent-wing bat (*Miniopterus schreibersii*), brush-tailed phascogale (*Phascogale tapaotafa*), squirrel glider (*Petaurus norfolcensis*), spotted-tailed quoll (*Dasyurus maculatus*), koala (*Phascolarctos cinereus*) and wallum froglet (*Crinia tinnula*).

ii. Environment Protection and Biodiversity Conservation Act 1999

Nationally 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 near the road upgrade and the spotted-tailed quoll is assessed as having a moderate to high likelihood of occurrence in the study area. Both species are vulnerable under EPBC Act and an assessment of the impact of the proposed road upgrade was undertaken in accordance with the EPBC Act (see *Appendix D3*, Section 1.3.2).

Migratory bird species listed under the China-Australia Migratory Bird Agreement (CAMBA) observed along the road corridor for option 1B include the white-bellied sea-eagle (see *Appendix D-1*). A detailed assessment of the impact on the white-bellied sea-eagle was not undertaken as the bird was observed overhead in the environs of the road, no nest sites were identified and no foraging habitat would be destroyed, isolated or substantially modified by the road upgrade (see *Appendix D-3*, Section 1.2.2).

5.6.11 *Potential Impacts of the Road Upgrade on Flora and Fauna*

The proposed upgrade of Nelson Bay Road from Bobs Farm to Anna Bay would disturb forested and grassland habitats. The finished road corridor would be between 38 and 47 metres wide including the dual carriageway, cleared easements and service access. An area of blackbutt and rusty gum open forest would be disturbed at the Trotters Road intersection for ancillary operations.

Area of vegetation communities to be disturbed by the proposed upgrade is provided in *Table 5.6*.

Table 5.6 APPROXIMATE AREA OF VEGETATION DISTURBANCE

Vegetation community	Area to be disturbed (hectares)
Blackbutt and rusty gum open forest	8.05
Flooded gum and swamp mahogany open forest	0.41
Flooded gum and swamp mahogany open forest (disturbed)	0.18
Paperbark and swamp mahogany open forest	0.04
Coastal swamp forest	0.04
Swamp oak forest	0.07
Scattered trees, landscaping	0.45
Blackbutt and rusty gum open forest (understorey cleared)	0.78
Cleared land (grassland)	7.19
Total area of vegetation to be cleared	**17.21**

The flooded gum and swamp mahogany open forest is poorly represented in the Port Stephens area covering only 18.1 hectares of the local government area (Lunney *et al* 1998). Within the immediate environs there is approximately 4.19 hectares of this community (including the area of disturbed flooded gum and swamp mahogany open forest). The proposed upgrade of Nelson Bay Road would disturb approximately 0.59 hectares or 14 percent of the community in the environs. It is difficult to ensure the protection or management of the remainder of the community as it occurs on private landholdings.

The remaining communities are well represented in the immediate environs, the Port Stephens local government area and conservation reserves in the region. The area of disturbance does not represent a significant reduction in the area of the vegetation community.

The proposed road upgrade would disturb open forest, coastal swamp forest and cleared grassland habitat for native fauna. It would result in a reduction of ecologically mature habitat trees in the immediate environs, however the extent of reduction of habitat trees has been minimised through designing the road to avoid (where possible) areas of higher density habitat trees. It would remove shelter for terrestrial fauna within the road corridor and would reduce foraging habitat in the immediate environs.

The increase in the area of clearance along the road corridor barrier is not expected to impact on more mobile species such as bats and birds. The road upgrade would widen the barrier to dispersal of terrestrial and arboreal fauna. This is especially relevant for the section of road in the elevated dunes at the western end of the road where the existing road dissects a large tract of habitat through the Stockton Bight dune system. While the proposed road widening would increase the barrier to dispersal for species on either side of the road, there is a large tract of open forest habitat adjoining and on both sides of the road that provide potential habitat. 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. The remainder of the route has natural habitats only on one side of the road with large areas cleared for residences and agricultural land uses.

Conversely the road design expands an existing barrier and does not fragment habitats by the creation of an additional barrier nor does it create islands of habitat between two roads. Arboreal species vulnerable to predation and exposure following felling of habitat trees are most likely to occur to the south of Nelson Bay Road through the Bobs Farm area or at the western end of the study area. In these places the habitat is continuous with large tract of natural bushland and displaced individuals could disperse readily. Modified clearance of habitat trees and the installation of recovered tree hollows may increase the survival rate of these individuals.

On a broader scale, the proposed upgrade would not significantly impact on the regional wildlife corridor along the vegetated dunes of the Stockton Bight system, except for the most western end of the road. There would be further encroachment of edge effects into habitat to the south of the proposed road. As the boundaries of the proposed nature reserve along the Stockton Bight have not been finalised it is difficult to assess the impact on the reserve of the road upgrade. It would appear that the road upgrade would not directly disturb the proposed nature reserve and it would not fragment areas within the proposed reserve.

The impact of upgrading Nelson Bay Road on threatened species has been assessed in accordance with Section 5A of the EP&A Act as amended by the TSC Act. The assessment addresses the threatened fauna species recorded in the study area, together with the seven threatened fauna species considered to have a moderate to

high likelihood of occurrence in the area. The assessment is included in full in *Appendix D3*, Section 1.3.1 and the results are summarised as follows.

After applying the 8 part test (provided in *Appendix D3)* it is considered that the upgrade of Nelson Bay Road between Bobs Farm and Anna Bay is not likely to significantly affect 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 would be cleared. Consequently, a species impact statement is not required.

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 and ancillary operations at the intersection of Trotters Road and Nelson Bay Road;
- 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 would 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;
- presence of wildlife recovery personnel during clearing of 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, that is at the western end of the road upgrade and east of Bobs Farm general store (near chainage 3400 north bound);

- restricting the construction phase near Marsh Road intersection from summer to mid autumn (outside of the breeding season of the wallum froglet) where possible;

- construction of grassed drains with sedges to providing habitat for wallum froglet in the long term; and

- erection of protective barrier fencing during the construction period, 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 and other fauna 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 would 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 program for potential problem areas. Exclusion fencing may be warranted in the long term should there be evidence of koala activity in the area.

The impact of the road upgrade on a matter of national environmental significance was assessed in accordance with the EP&BC Act. The action is considered not to have or not likely to have a significant impact on the vulnerable species likely to occur along the road upgrade corridor. An *important population* of *Diuris praecox* occurs along the powerline easement and is not within the area of proposed works (see *Appendix D3* Section 1.3.2). It would not be affected by the upgrade.

5.7 FISHERIES HABITAT ASSESSMENT

Fisheries Management Act 1994 (FM Act) as amended by the *Fisheries Management Amendment Act 1997* includes provision to declare and list threatened species of fish and marine vegetation, endangered populations and ecological communities, and key threatening processes. These provisions are similar to those in the TSC Act and must be considered when referring to Section 5A of the EP&A Act. An assessment of the aquatic habitat value in the proposed development area and an assessment of the impact of the proposal on aquatic habitats and threatened fish species under Section 5A of the EPA Act follows.

5.7.1 *Aquatic Habitats*

There are no natural drainage lines along Nelson Bay Road between Bobs Farm and Anna Bay. The road crosses several constructed drains. Reference to each drain is based on the chainages shown in the Concept Design Plan. A desktop assessment, on site habitat description and aquatic fauna sampling was undertaken for each drain.

A constructed drain at chainage 1790 provides permanent water with no flow, supporting some aquatic vegetation. The base is composed of sandy substrate and eutrophic sediment. The banks of the drain are generally cleared and dominated by introduced grasses with scattered paperbarks (*Melaleuca quinquenervia*) and swamp oak (*Casuarina glauca*). Instream vegetation provides 30 to 60 percent coverage and includes reeds (*Typha orientalis*), sedges and aquatic plants (*Eleocharis* sp., *Bolboschoenus caldwellii, Ludwigia peploides* subsp. *montevidensis, Philydrum lanuginosum*) along the edges with a moderate cover of floating *Azolla* sp. and other duckweeds over open water. The drain is approximately two metres wide and water was approximately 500 millimetres deep at the time of inspection. The only refuge for aquatic species is the reed bed as there are no snags, rock ledges or undercut banks. The road does not appear to provide a barrier upstream. Approximately 1600 metres downstream this drain enters SEPP 14 wetland 808a along Tilligerry Creek. There are levees and floodgates at this point providing some barrier to fish movement however the levees are generally not continuous and are overtopped at high tides.

A constructed drain at chainage 2050 provides permanent water with no flow, supporting aquatic vegetation. The banks of the drain are generally cleared and dominated by introduced grasses with scattered *Melaleuca quinquenervia*. Instream vegetation provides 100 percent coverage dominated by *Persicaria* sp. and kikuyu (*Pennisetum clandestinum*). The drain is approximately 1.5 metres wide and water was approximately 100 millimetres deep at the time of inspection. The drain provides minimal aquatic habitat as it is choked with vegetation. Approximately 1850 metres downstream this drain enters SEPP 14 wetland 808a along Tilligerry Creek. The drain interlinks with other drains in the area via the road drain.

A constructed drain at chainage 2600 joins with another drain that crosses Nelson Bay Road at chainage 2850. Both drains provide permanent water with no flow supporting some aquatic vegetation. The banks of the drain at chainage 2600 are generally cleared on the northern side of the road and in flooded gum and swamp mahogany coastal swamp forest on the southern side of the road. Instream vegetation provides 70 percent coverage and is dominated by *Typha orientalis* with some *Triglochin procera*. The banks of the drain at chainage 2850 are cleared. Instream vegetation provides 30 percent coverage and is dominated by *Typha orientalis* with some *Eleocharis* sp. The road does not appear to provide a barrier

upstream. Both of the drains run through coastal swamp forest approximately 200 metres north of the road. They continue through coastal swamp forest to Bobs Farm Creek. Approximately 500 metres downstream, the drains enter SEPP 14 wetland 767 and it is approximately 1700 metres to Bobs Farm Creek. There are no levees at Bobs Farm Creek.

A constructed drain at chainage 3210 follows the north side of the road to another drain that crosses Nelson Bay Road at chainage 3300. Both drains provide permanent water with no flow supporting some aquatic vegetation. The banks of the drain are generally cleared with some *Casuarina glauca* and *Melaleuca quinquenervia* at the road. Instream vegetation is dominated by *Typha orientalis* with some sedges. The road does not appear to provide a barrier upstream. Approximately 850 metres downstream the drain enters SEPP 14 wetland 767 and it is approximately 1600 metres to Bobs Farm Creek. There are some crossings over the drain, downstream of the road within private property.

All of the above constructed drains are class 2 waterways based on the classification system of NSW Fisheries (Fairfull and Carter 1999). This is based on the drains providing clearly defined channels (that are essentially defined because they are constructed channels), permanent water (as draining a low lying area characterised by cleared coastal swamp forest) and the presence of aquatic vegetation. Nelson Bay Road is a long distance upstream from the natural creeks in the area (minimum of 1500 metres via the constructed drain). Both Tilligerry Creek and Bobs Farm Creek are characterised by mangroves and saltmarsh communities protected under SEPP 14 and are part of western Port Stephens. At the creeks, constructed drains have floodgates and/or constructed levee banks. These structures provide some barrier to fish passage however they can be overtopped at high tides.

A constructed channel drains the flooded gum and swamp mahogany open forest along Nelson Bay Road, east of Bobs Farm. The road crosses an ephemeral waterway at chainage 3775 draining the paperbark and swamp mahogany open forest to the south of the road. At the road crossing, the channel is not well defined and there was no standing water at the time of inspection. On the north side of the road the drainage area is characterised by *Blechnum indicum* and *Gahnia clarkei*. A semi-permanent depression to the south of the road supports a stand of *Phragmites australis* grading into the paperbark and swamp mahogany open forest. This area holds water following a rain event. This drain is unlikely to provide fish habitat.

5.7.2 *Aquatic Fauna Sampling*

i. Methodology

The aquatic fauna assessment was based during a field survey on 13 February 2001 and previous habitat assessments undertaken on 13 August 2000. The field survey involved water quality tests for pH, temperature, conductivity, salinity, dissolved oxygen and turbidity. Dip netting was used to sample aquatic fauna. Five samples were taken and species diversity recorded at each of the four sites. One site was located at chainage 1790, another at chainage 2050 and the remaining two at chainage 2600. It had been intended to sample at chainage 3210 to 3300 and at chainage 3775 however the drains at these points were dry at the time of survey.

Fish present and the number of macroinvertebrate species from each sample were recorded. Macroinvertebrates are defined as organisms of more than 1 millimetre long at maturity and have no backbone. They are predominantly insects but also include groups such as crustaceans, mites, snails and worms. Macroinvertebrates are responsive to changes in water quality and have been used widely as indicators of water quality.

Weather conditions on 13 February 2001 were mild and dry. Rain had not occurred in the last week so that water volume of the drains was low.

ii. Water Quality

Water quality of the sites sampled has been detailed in *Table 5.7*.

Table 5.7 WATER QUALITY DURING THE FAUNA HABITAT ASSESSMENT

Parameters	Chainage 1790	Chainage 2050	Chainage 2600A	Chainage 2600B
pH	5.91	7.08	6.34	6.11
Temperature (°C)	21.8	31.6	24.1	23.8
Conductivity (mS/cm)	0.33	0.312	0.36	3.58
Salinity (%)	0.01	0.1	0.01	0.01
Dissolved Oxygen (mg/L)	1.9	6.7	1.52	2
Turbidity	10	10	10	12

Water quality attributes were compared with those recommended for aquatic ecosystems by the Australian and New Zealand Environment and Conservation

Council (1992). Levels of dissolved oxygen were less than those recommended in all drainage lines with the exception of chainage 2050. A low level of dissolved oxygen reduces the quality of aquatic habitat. Turbidity, conductivity and salinity were also quite low but would not affect the quality of aquatic habitat. With the exception of chainage 1790 pH was consistent with the recommended levels.

iii. Results

The number of macro-invertebrate species and fish identified during sampling are detailed in *Table 5.8*.

Table 5.8 AQUATIC FAUNA IDENTIFIED ALONG NELSON BAY ROAD

Site	Macro-invertebrates	Fish
Chainage 1790	8 species	shortfinned eel (*Anguilla australis)*
		mosquito fish (*Gambusia holbooki*)
Chainage 2050	6 species	-
Chainage 2600A	2 species	mosquito fish
		empire gudgeon (*Hypseleotris compressa*)
Chainage 2600B	4 species	-

The long-necked tortoise (*Chelodina longicollis)* is also known to inhabit these drainage lines.

Chainage 1790 had a high abundance of mosquito fish. Predation by the mosquito fish of native species is now listed as a threatening process under the TSC Act, 1995. The mosquito fish tends to replace native species in more open and disturbed habitats. As this site also had a low pH and vegetation cover, it was regarded as poor habitat for native fish. Chainage 2600B also had a relatively low abundance of aquatic fauna and is regarded as poor habitat for native fish.

Chainages 2050 and 2600A had relatively low abundance of mosquito fish and habitat attributes suitable for small native fish such as empire gudgeon.

5.7.3 Threatened Fish Species

There are 15 species currently listed as threatened on the Fisheries Management Act 1994 (FM Act) and these are listed in ***Error! Reference source not found.***. An assessment of the likelihood of occurrence in the aquatic habitats of the development

area is also provided in ***Error! Reference source not found.*** based on habitat requirements of the species.

Table 5.9 THREATENED AQUATIC SPECIES

Common Name	Scientific Name	Habitat	Assessment
		Schedule 4 Part 1 - Endangered Species	
eastern freshwater cod	*Maccullochella ikei*	Freshwater, Clarence and Richmond Rivers.	Not expected, out of known distribution.
trout cod	*Maccullochella macquariensis*	Freshwater, Murray - Darling system	Not expected, out of known distribution
oxleyan pigmy perch	*Nannoperca oxleyana*	Coastal and swampy drainages, streams northern NSW to se Qld.	Not expected, out of known distribution
grey nurse shark	*Carcharias taurus*	Shallow coastal waters, deep gutters around rocky outcrops and reefs.	No habitat in drains.
green sawfish	*Pristis zijsron*	Shallow bays, estuaries and lagoons. Last records 1972 northern NSW and 1926 Sydney.	Not expected as no habitat.
river snail	*Notopala sublineata*	Free flowing rivers of the Murray-Darling system.	Not expected as out of known distribution.
Murray hardyhead	*Craterocephalus fluviatilis*	Freshwater, lower reaches of Murray system.	Not expected.
		Schedule 4 Part 4 - Species Presumed Extinct	
bennetts seaweed	*Vanvoorstia bennettiana*	Red algae known only from Port Jackson.	Not expected.
		Schedule 5 - Vulnerable	
Adams emerald dragonfly	*Archaeophya adamsi*	Small freshwater streams in Hawkesbury and Sydney region	Not expected as out of known distribution. No habitat in in drain.
great white shark	*Carcharodon carcharius*	Temperate and sub-tropical ocean. Inshore waters near islands, particularly seal colonies	No habitat in drains. Expected off Port Stephens.
black cod	*Epinephelus daemelii*	Temperate and sub-tropical waters. Rocky reefs, caves or deep ledges, 10-40 metres depth. Territorial	No habitat in drains.
Macquarie perch	*Macquaria australasica*	Cool freshwater, upper reaches of Murray-Darling system.	Not expected, out of known distribution

Table 5.9 THREATENED AQUATIC SPECIES *(Contd)*

Common Name	Scientific Name	Habitat	Assessment
		Schedule 5 - Vulnerable	
silver perch	*Bidyanus bidyanus*	Fast flowing freshwater. Natural population near Torrumbarry Weir in Murray River.	Not expected, out of known distribution
southern pygmy perch	*Nannoperca australis*	Small, slow flowing freshwater with vegetation cover. Murray and Murrumbidgee Rivers.	Not expected, out of known distribution
Buchanans fairy shrimp	*Branchinella buchananensis*	Temporary saline lakes, in north west NSW.	Not expected.

Notes: *1.Schedules 4 and 5 of the Fisheries Management Act 1994*
2.Habitat information from NSW Fisheries Scientific Committee determinations, Merrrick and Schmida (1984), McDowall (1996), Australian Museum Ichthyology web site.

Aquatic habitat in the drains along Nelson Bay Road, do not provide habitat for any of the 15 threatened species listed under the FM Act. An assessment of the impact of the development on threatened species in accordance with Section 5A of the EP&A Act follows.

i. In the case of 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.

None of the species currently listed as endangered or vulnerable in the FM Act are likely to occur in drains along Nelson Bay Road. Therefore the lifecycle of any threatened species would not be disrupted by the proposed development such that a viable local population of the species would 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.

There are currently no endangered fish populations listed on the FM Act.

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.

No known habitat for species currently listed as threatened in the FM Act exists in the drains along Nelson Bay Road. Known habitat for the two listed shark species is known to occur in waters off Port Stephens with marine reserves being located at Fly Point-Halifax Park. The proposed development would not modify or remove this habitat.

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.

Upgrading of Nelson Bay Road would require the construction of crossings over all of the identified drains. Road crossings would be constructed in accordance with NSW Fisheries guidelines for fish friendly roads and waterway crossings (Fairfull and Carter 1999). These crossings should not obstruct movement of fish species.

No area of habitat for threatened species would be isolated as a result of the proposal.

v. Whether critical habitat will be affected.

There are currently no areas of critical habitat listed in the FM Act.

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.

NSW Fisheries has declared eight Marine Protected Areas (85,803 hectares) and there are three Commonwealth marine reserves (203,870 hectares). A number of national parks and nature reserves, managed by NSW National Parks and Wildlife Service (NPWS), also contain some areas of estuarine and tidal waters (15,894 hectares) (EPA 1997). All of these reserves cover predominantly marine and estuarine habitats and are unlikely to adequately represent threatened species or their habitats.

On a regional scale, the Port Stephens area falls within the overlap of two biogeographic regions being the New South Wales north coast and the central coast Sydney Basin.

Within the north coast region, marine and estuarine protected areas cover approximately 299,871 hectares including 11,716 hectares managed by NPWS, 85,155 hectares managed by NSW Fisheries and 203,000 hectares managed by Environment

Australia (Commonwealth) (EPA 1997). NSW Fisheries reserves on the north coast are Julian Rocks off Byron Bay, Fly Point-Halifax Bay in Port Stephens and Solitary Island Marine Park between Coffs Harbour and Wooli. Commonwealth marine reserves include the reserve adjoining Solitary Island Marine Park, and the Elizabeth and Middleton Reefs Marine National Nature Reserve located 600 kilometres east of Coffs Harbour.

Area of marine and estuarine protected areas within the central coast region is approximately 3,566 hectares (NPWS) and 648 hectares, over five reserves managed by NSW Fisheries. Large NPWS reserves in the central coast region include Fullerton Cove (1536 hectares) in Kooragang Island Nature Reserve (EPA 1997).

Local reserves for threatened species occur in NSW Fisheries and NPWS managed reserves. The NSW Fisheries reserves is Fly Point–Halifax Bay in Port Stephens (75 hectares – seagrass, kelp, sand and rocky reef habitat) with NPWS managed reserves at Fullerton Cove (1536 hectares) in Kooragang Island Nature Reserve and the waterbodies of Myall Lakes National Park. The proposed road upgrade would not impact directly or indirectly on these reserves.

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

Currently no development or activity is listed as a key threatening process under schedule 6 of the FM Act.

Predation by the mosquito fish of native species is now listed as a threatening process under the TSC Act, 1995. Whilst it is not a threatening process under the FM Act it has been considered in this assessment. The mosquito fish tends to replace native species in more open and disturbed habitats. Mosquito fish were present at chainages 1790 and 2600B. Habitat at chainage 1790 is well suited for this species. Drainage lines should be rehabilitated after disturbance so that suitable habitat for this species is not created.

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

The proposed development is not within the known distribution of any of the species currently listed as threatened under the FM Act.

Conclusion

Based on the eight factors considered above, the proposed development would not have a significant effect on threatened fish species, fish populations, ecological communities or habitats. Consequently, a species impact statement is not required.

It is recommended that crossing structures be designed and constructed in accordance with NSW Fisheries guidelines for fish friendly roads and waterway crossings (Fairfull and Carter 1999). These crossings should not obstruct movement of fish species. Disturbance of instream and bank vegetation should be minimised and disturbed areas rehabilitated with endemic vegetation. Disturbed banks should be planted with *Melaleuca quinquenervia* and *Casuarina glauca*. Rehabilitation of drainage lines after disturbance would also prevent an increase of suitable habitat for the mosquito fish.

5.7.4 Conclusion

Aquatic habitat along Nelson Bay Road is artificial and highly disturbed. As no threatened fish inhabit these areas they would not be impacted by the proposed development.

Aquatic fauna sampling identified two native fish species the shortfinned eel and the empire gudgeon (Allen, 1989). The long-necked tortoise is also known from these drainage lines. These species are extremely widespread in eastern Australia. They and their habitats would be temporarily disturbed as a result of the upgrade. Long term impacts would be minimised by maintaining open channels along the road and encouraging the retention of native reeds and other vegetation for cover. The vegetation cover is particularly important for the gudeon and also in preventing habitation by the mosquito fish.

Upgrading of Nelson Bay Road would require the construction of crossings over all of the identified drains. Road crossings would be designed and constructed in accordance with NSW Fisheries guidelines for fish friendly roads and waterway crossings (Fairfull and Carter 1999). These crossings should not obstruct movement of fish species.

5.8 EUROPEAN HERITAGE

5.8.1 Methodology

The European heritage assessment included a search of pertinent heritage registers, consultation with the NSW Heritage Office and a field survey. The purpose of these investigations was to identify heritage items and landscapes in the study area. The following registers and databases were searched for heritage items in the study area:

- National Parks and Wildlife Service - Historic Sites Register;
- NSW Heritage Inventory – NSW Heritage Office;

- Australian Heritage Commission - Register of the National Estate; and
- National Trust Database.

The field study consisted of a survey along the proposed road route. The survey aimed to identify sites or areas of potential heritage significance.

One area of potential European heritage significance was identified during the community consultation process. The original Anna Bay Public School site was raised as a potential heritage landscape, particularly with reference to two historic Pine Trees growing on the site. A site inspection was carried out by an ERM archaeologist, who concluded that the school site is an area of potential heritage significance.

Consultation with the Port Stephens Council Heritage Officer and the NSW Heritage Office was carried out to determine the level of assessment that was required for the site. The Port Stephens Heritage Officer requested that an assessment of significance be carried out, including a Statement of Significance, a determination of life expectancy for the Pine Trees and a Statement of Heritage Impact. These formal assessment procedures ensure that statutory requirements of the *NSW Heritage Act* 1977 are met.

5.8.2 Results

The Stockton Bight Environmental Study and Management Plan (HLA Envirosciences, 1995) does not list any historic sites in the proposed road corridor, or within the area of impact. No sites were noted in any of the previously mentioned heritage registers.

A heritage assessment for the original Anna Bay Public School site was carried out during January 2001 (refer *Appendix E*). The assessment found that the site has local heritage significance as the site of the first public school established in Port Stephens (in 1879). The Significance Statement summarises the nature of the significance values of the site. The evaluation of lifespan for the Hoop Pine trees found that one of the trees is 80-100 years old and should live for at least another 40 years. The second tree is 30-40 years old and in danger of falling due to white ant activity. The Statement of Heritage Impact summarises the impacts of the proposed road upgrade on the site.

It is proposed to remove both Hoop Pine Trees 1 and 2 and plant 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.

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.*

Apart from the Anna Bay Public School site, no other heritage items have been identified in the study area. Therefore the only impact on the record of European heritage expected as a result of the proposed development concerns the original Anna Bay Public School site.

The Heritage Act 1977 protects relics, which are defined as objects over 50 years in age. Should any such material be uncovered during the works program works would cease and the NSW Heritage Office would be consulted.

5.9 ARCHAEOLOGY

5.9.1 Introduction

The study area lies within the boundaries of Worimi Local Aboriginal Land Council (WLALC). The executive officer Mr Len Anderson was contacted as a representative of the WLALC. Ms Carol Ridgeway-Bisset was contacted as a representative of Maiangal Aboriginal Heritage Society (MAHS), located at Nelson Bay, as a representative of traditional land owners. A full archaeological assessment was carried out for the proposed road upgrade (ERM Mitchell McCotter, 1998d).

Most archaeological surveys in the area to date have concentrated on small study areas which have also been limited by visibility and exposure, due to the vegetation cover and the mobility of the sand environment. However, an overall study was conducted by Pam Dean-Jones (1990) and a further review conducted by Sullivan and Hibbard (1994).

These studies concluded that the area of the Bight is of significance in terms of archaeology and environmental sensitivity. It has also been noted that the area is under pressure from residential development, sand based mining and encroaching dune movement and flooding particularly given predicted sea rises associated with global warming.

An archaeological survey was undertaken for the Nelson Bay Road upgrade in 1998 in accordance with recommended practices outlined by the NSW National Wildlife

Service (NPWS). It involved a site register search, literature review, discussion with the Worimi Local Aboriginal Land Council (WLALC) and Maiangal Aboriginal Heritage Society (MAHS) and a surface field survey to identify all possible exposures of the ground surface and record any archaeological material exposed. The methodology and results of this survey are included in *Sections 5.8.2* and *5.8.3*. The survey located seven midden sites along or near the route of the proposed road upgrade and concluded that the sites were significant as indicators of what may be contained within the wider sandhill environment. It was therefore proposed to undertake further sub-surface testing to confirm sites. The results of the subsequent sub-surface testing study are included in *Section 5.9.4*.

A full report detailing the archaeological investigations summarised here will be forwarded to the National Parks and Wildlife Service Aboriginal Sites Register.

5.9.2 Methodology

The National Parks and Wildlife Service Aboriginal Sites Register was used to search for data relevant to the project.

The Worimi LALC and Maiangal Aboriginal Heritage Society were contacted to obtain any information held by members, which may impact upon the approach of the study.

A review of relevant literature and data from previous archaeological investigations in the area was undertaken to assist in the prediction of most likely and potential location of sites in the vicinity of the proposed road upgrade. Relevant studies and background material, including previous archaeological survey reports, were reviewed to provide a background to the archaeological context of the study area.

i. Field Survey Units

The main aim of the survey was to identify all possible exposures of the ground surface and record any archaeological material exposed. However, the survey was not expected to reveal the full extent of the archaeological record contained within the study area.

The proposed road upgrade was divided into four survey units with a total distance of 7 kilometres. The four survey units were based upon the landforms below and are shown in *Figure 5.7*:

- Unit 1 - deflation plain - an area of elevated sandhills which have been reworked by the wind. There are two barrier ridges, barrier ridge 1 formed 6500 years ago and barrier ridge two about 2000 years ago. The study area

lies on barrier ridge 1. The deflation plain within the ridges has small undulating ridges with an elevation of about 5 metres Australian Height Datum (AHD). The deflation plain is heavily vegetated with eucalypt forest (blackbutt, rusty gum) and the dense bracken fern;

- Unit 2 - barrier ridge - is the face of barrier ridge 1 orientated to the north east and exposed by some erosion;

- Unit 3 - interbarrier - shallow depth deposits such as soft clay , peat and some sand. Low lying below about 2 metres AHD. Development of farmland in the study area has drained the soils which now support a dense cover of pasture grasses; and

- Unit 4 - backbarrier sands - are wash-over sand sheets between the strand plain and the interbarrier depression. The sand sheet is less than 6 metres AHD in elevation and the area slopes very slightly to the interbarrier depression.

Unit 1 area was surveyed on foot. The area had extremely limited visibility and access. Any exposure within the study area or within 40 metres of the study area was inspected. This survey unit was 1.2 kilometres in length.

Unit 2 had a higher level of exposure over the 100 metre area due to erosion therefore, visibility was restricted.

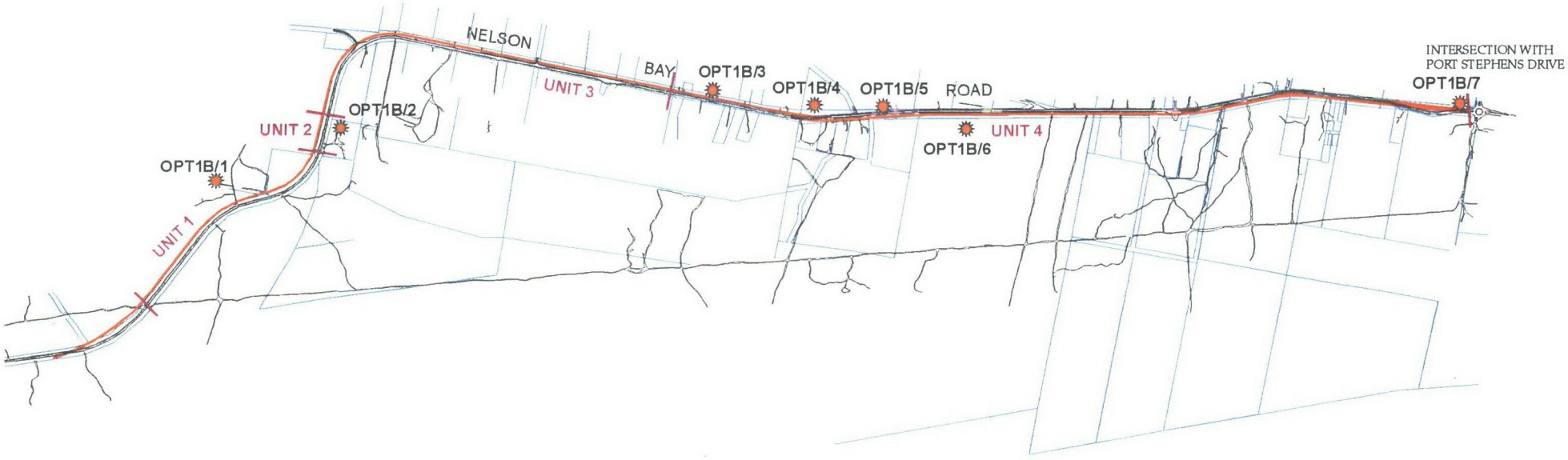
Unit 3 was densely covered in kikuyu, therefore visibility was restricted. The survey was conducted by driving slowly along the route to identify any potential exposures. Any exposures were inspected on foot. This survey unit was 2.15 kilometres in length.

Unit 4 was surveyed on foot along all intersecting tracks, the top of batters and any exposures. This survey unit was three kilometres in length.

ii. Disturbance History

The survey route (proposed road upgrade route) for Units 1 and 2 comprised elements of Eucalypt forest (especially blackbutt and rusty gum) that are relatively undisturbed. Although no scarred or carved trees were observed during the investigation, there is a potential that remnant trees in this area may be scarred or carved.

Survey Units 3 and 4 were located along the margins of Nelson Bay Road in areas that have been cleared for farming. This part of the proposed road alignment was



MIDDEN
SURVEY UNITS
EXISTING ROAD ALIGNMENT
PROPERTY BOUNDARIES
PROPOSED ROAD UPGRADE

N

0 500m

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SOURCE: YOUNG CONSULTING ENGINEERS

ERM

Figure 5.7 ARCHAEOLOGICAL SITE LOCATIONS

one of the first areas of European Settlement in the Port Stephens district and has had a long period of use and disturbance. There are also a large number of properties in this area along the existing Nelson Bay Road margins. As a result of these European disturbances, there are few remnant trees remaining, which means it is very unlikely that scarred or carved trees are present in this area.

5.9.3 Predictive Modelling

Previous survey work along the Bight (cf. Dean-Jones 1990 & 1992) and archaeological excavations at Fern Bay (ERM, 2000) provide a good indication of site types and site patterning in the Stockton Bight Holocene dune sequence. The subject land includes the inner (landward) margin of the Holocene stable transgressive dune sequence and the inter-barrier depression (or deflation basin). The interbarrier depression forms the cusp between the Holocene series of dunes and the Pleistocene series further inland (this area was the underwater coastal margin during the Pleistocene period). Predictions about site patterning for the two landforms are as follows:

i. Inner Holocene stable transgressive dunes:

There is a high potential for open artefact scatters on the inner landward margin of the Holocene dunes (Dean Jones, 1992). These dunes are stable and have the potential to contain stratified cultural deposits dating back to 4,500 years before present (Dean-Jones, 1992). Excavations at Fern Bay indicate that these occupational sequences are often at a high density and up to a metre in depth (ERM, 2000).

Sites are typically middens composed of estuarine shell species, especially Rock Oysters and Mud Whelks. Sites at Fern Bay also had stone artefacts, predominantly fabricated from Nobby's Tuff, although given the distance of the present study area from stone sources it is likely that lithic material is poorly represented in the midden complexes in this area.

There is a sparse scattering of archaeological material along the ridgelines of the stable Holocene dunes and high-density sites appear on low flat ridgelines immediately adjacent to wetland areas (ERM, 2000). It is therefore predicted that these locations have high potential archaeological sensitivity. It is further predicted that low densities of archaeological material would generally be found along ridges on the margins with the interbarrier depression (Dean-Jones, 1990). The accuracy of these predictions would be largely determined by the degree of disturbance caused by clearing and farming. Soil surface disturbance along the margins of Nelson Bay Road means that the extent and spread of surface archaeological material may not reflect sub-surface deposits (it may be more a reflection of differential disturbance and exposure).

ii. Interbarrier Depression:

The interbarrier depression was an important area for Aboriginal foraging as shown by the prevalence of sites on margins of the Holocene dune overlooking the interbarrier depression. Although these sites are in close proximity to the interbarrier depression, they are not located within the basin itself. Actual settlement patterns within the depression consist of a sparse scattering of the remnants of stratified midden, especially between Boyces Track and Uralla (Dean-Jones, 1990). It is predicted that there is a low potential for archaeological sites in the interbarrier depression area.

5.9.4 Initial Survey Results And Significance Assessment

All seven sites located during the initial field survey were middens *(Figure 5.7)*. The only variations were the quantity of shell and the presence or otherwise of stone artefacts. Only one site was revealed in the flats of the Bobs Farm area due to an unusual exposure, probably created by the congregation of horses or stock at one corner of a paddock. Given the presence of a site in such a limited exposure it would indicate that further sites probably are located underneath the dense cover of kikuyu grass.

The sites located within the study area are significant as indicators of what may be contained within the wider sandhill environment. An environment with limited visibility such as this can only be assessed on the basis of disturbed sites in exposures such as tracks, in combination with a review of the archaeological context of the wider area.

The area has been classified as archaeologically sensitive by Dean-Jones (1990) which has been supported in later reviews (Sullivan and Hibbard, 1994 and HLA Envirosciences, 1995). Unit 3 has the potential to impact upon the remnant beach ridges of the Holocene and disturb sites which have not been subject to disturbance by deflation as has been seen in the deflation plain to the west (Dean-Jones, 1990). Amongst those sites that could be disturbed are burials.

The Aboriginal community has stressed the importance of the area of the sandhills from the outset of the study. The area is considered of very high cultural significance because it contains relatively undisturbed remnants of traditional lifestyle. An important part to this significance is not only the archaeological sites, but also the remnant native vegetation, which was a resource base for the people from this environment. A summary description of each site recorded during the survey is included in *Table 5.10.*

Table 5.10 SITES RECORDED

site no. & type	survey unit & location	site environment	area	boundary criteria	site contents	condition
1 midden material	1 AMG 406900E 6373550N	west side small ridge crest on track off driveway	3m x 1m	no shell visible	pipi fragments	poor
2 midden material	2 AMG 407400E 6373750N	ridge edge of deflation plain	200 m x 40m	no shell visible	disperse pipi cockle and whelk shell flakes	good part disturbed by road
3 midden material	4 AMG 409200E 6373700N	exp.by blowout on flats	10m x 5m	no shell visible	whelk & oyster >10 individuals 1 flake tuff	poor
4 midden material	4 AMG 409500E 6373700N	very small undulation slight cut by road site both sides of road	3m x 4m	no shell visible	disperse fragmented pipi	very poor
5 midden material	4 AMG 409750E 6373700N	top of very small dune crest and on the batter south side road	10m x 1m	no shell visible	disperse fragments of pipi shell both sides of road	disturbed by road
6 midden material	4 AMG 410150E 6373680N	small ridge slope and crest	3m x 1m	no shell visible	disperse fragments of pipi both sides of road 3 flakes appear on right side batter	disturbed by road
7 midden material	4 AMG 412350E 6373700N	small ridge crest behind bus shelter	10m x 1.5m	no shell visible	very disperse pipi fragments both sides rd -3 flakes tuff	very disturbed by road

5.9.5 *Sub-Surface Testing*

Sub-surface testing works were designed in accordance with National Parks and Wildlife Service Preliminary Research Permit No. #N3/PRP/99. Stage one of the works was targeted at three dunes within the Holocene sandhills which would be disturbed at the south western end of the route. This area is known to contain Aboriginal middens and has potential to contain burials. The work was undertaken in accordance with the recommendations arising from the initial archaeological assessment. These were to:

- work in collaboration with the Aboriginal community so that Aboriginal cultural heritage is identified and conserved to the satisfaction of the community;
- liaise with National Parks and Wildlife to develop a management plan which would allow the project to proceed to the detailed design stage;
- test the effectiveness of shovel probes as a means of locating midden material underneath vegetation and soil; and
- provide a significance assessment and management plan for known sites and any sites found during the test program.

A preliminary research permit (#N3/PRP/99) has been issued for a period of eighteen months and is included in *Appendix F*. The extended period would allow the use of different testing techniques at different stages of the development. Should a site be located then appropriate mitigation measures can be determined.

Consultation with NPWS, the Worimi LALC and the Maiangal AHS indicates that the proposed road widening adjacent to the existing road would impact on fewer undisturbed sites than the alternative route. Along the proposed route, sites within the sandhills may be relatively undisturbed, while those adjacent to the road along the remainder of the route have been disturbed by rural residential and other land uses. Within this report the sandhills are referred to as the deflation plain or landform unit one. The remainder of the route is referred to as Bobs Farm to Anna Bay and incorporated landform units two and three in the initial assessment. The initial stage of testing was confined to three sample sand dunes. The crest of each dune was probed at right angles across the proposed corridor. The field work was undertaken by Angela Besant (Insite Heritage) and David Feeney (Worimi LALC).

The field work was carried out in six days intermittently over a three week period due to adverse weather conditions. Two of the dunes selected, Dunes 1 and 2, are elevated to a greater height than those immediately around them within the study

area. A third was selected as an example of smaller dunes. The location of the dunes and probes can be found in *Figure 5.8 and 5.9.*

The probes formed a grid of nine probes with two metre spacings. Three metre spacings had been proposed in the Permit application and the change was ratified by NPWS (4.11.99). The narrow width of the dune crests (6 to 9 metres) and the small surface area predicted for middens required a reduced spacing.

A grid of probes was located along the centre of the ridge crest. The line of the grids was aligned to the direction of the crest rather than a specific compass bearing. A grid of probes was placed at five metres from the top of the embankment cutting of the existing road, at twenty metres and thirty five metres respectively, and at approximately ninety degrees to the existing road.

Each probe was dug to a depth of half a metre.

5.9.6 Results Of Sub-Surface Testing

The soil at dunes one and two was a consistent black sand grading to grey which overlaid cream or white sand at a depth of about forty centimetres. Dune three had a similar profile at the third location of probes most distant from the road however the location adjacent to the road had a disturbed profile to a depth of one and a half metres. The soil was a dark to medium grey sand with road base throughout. The middle or twenty metre probes on dune three were not dug due to the low lying topography at dune three. Soil profile examples are shown in *Figure 5.10.*

At each probe location an area of seven metres square was cleared of vegetation by brush cutter and hand. The grid was laid out and the probes dug by shovel in five centimetre pits. The excavated material was sieved in a five millimetre sieve. No shell or bone was located in any of the sixty six probes excavated. The stone found in location one - dune 3 was obviously road base, comprising crushed daecite, conglomerates and volcanics. No stone was located which may relate to Aboriginal use of the area.

The dense vegetation within the study area limits the effectiveness of any surface means of detecting archaeological sites. The small surface area of the types of archaeological sites predicted to occur in the area, limits the effectiveness of traditional means such as probes. These problems limit the potential for identification of sites prior to exposure. Therefore, while the deflation plain has a high potential for the occurrence of middens, and possibly burials, their identification prior to some degree of disturbance is problematic.

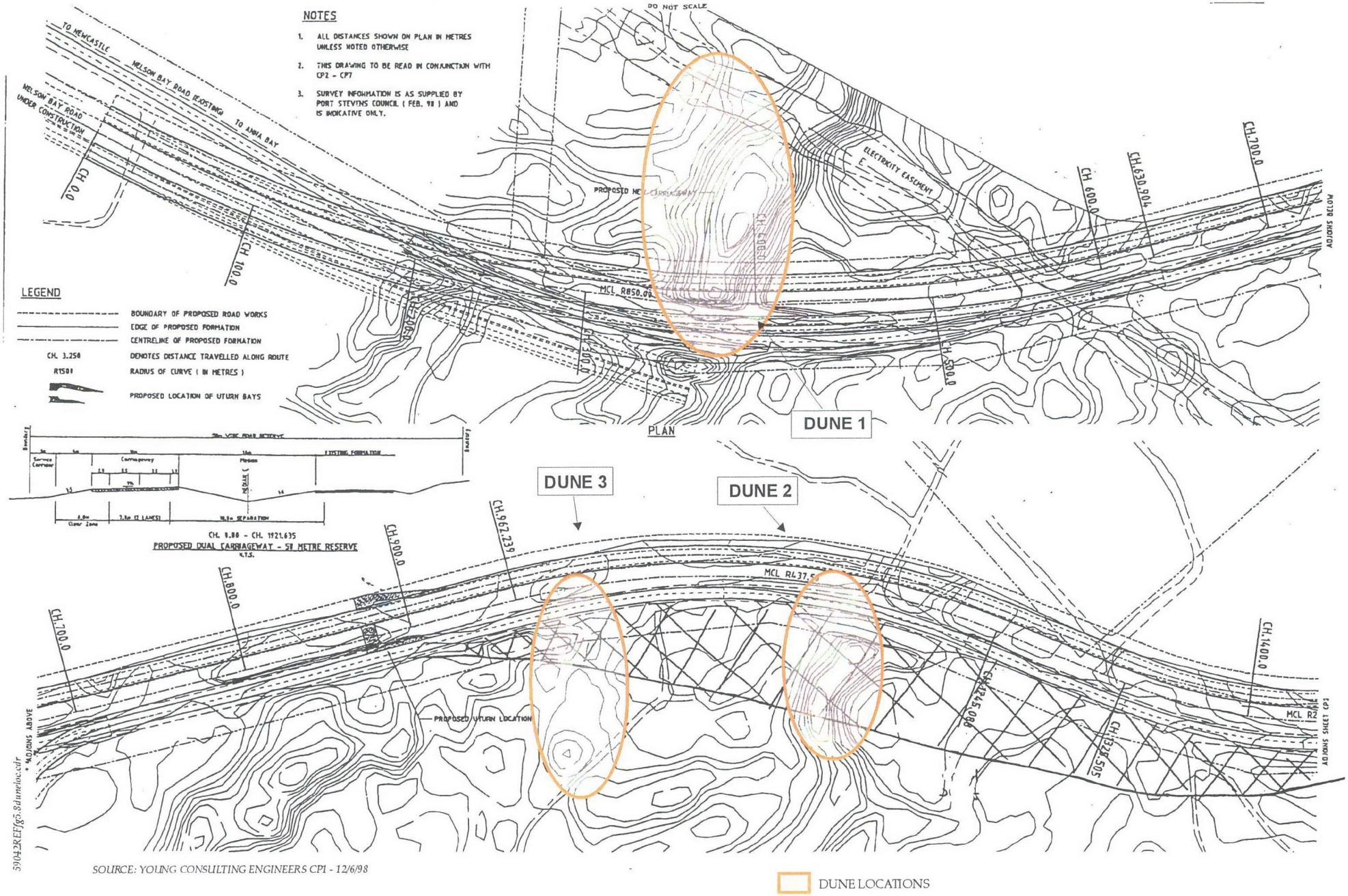
As a result of this the detailed design of the road duplication should proceed with the inclusion of further archaeological assessment. The archaeological assessment could utilise the geotechnical report to identify any older stable surfaces which have been subsequently covered by mobile sand. The depths of the probes in this testing program was not great enough to allow the identification of these buried surfaces. If any of these surfaces are located it does not ensure the presence of Aboriginal cultural material, however mitigation recommendations may be required.

In the area immediately west of the present study area, the subject of the previous Nelson Bay Road Duplication (Segment 8) it was found that middens tended to be frequent on the interdunal ridges which have lower elevations than the large dunes. The topography differs slightly within the present study area where there is less definition between interdunal ridges and swales. As stage one of the probe program has not located any previously unknown sites, it would be advisable to conduct another small excavation during the next stage of the project. One or two smaller interdunal ridges should be tested and this could be conducted over several days. The additional probes could help indicate whether the absence of material in stage one probes was a result of the positioning of the probes, the small size of the overall sample or whether some other explanation can be provided.

The study area may also be tested with a form of ground penetrating radar which can identify buried material. Generally these devices need to be passed over the ground surface at a fixed height which is likely to prove impossible in the deflation plain without the removal of vegetation. This method of detection could be considered once the vegetation is removed.

Discussions with NPWS and the Aboriginal community representatives suggests that monitoring is an appropriate method of managing the impact of construction along the remainder of the route. This would require an archaeologist and community representative to be present when clearing / initial earthworks are undertaken. Close liaison with the Aboriginal community and the archaeologist would also be undertaken during the remainder of the earthworks stage of the project.

Site two on the north eastern edge of the deflation plain requires stabilisation works to retain the slumping of the sand embankment. This site extends to each side of the existing road, however the site has been highly disturbed on the northern side of the road by construction of the existing road and excavation of sand into the dune face from privately held land adjacent to the road. The disturbed portion of the site is the preferred route for the road duplication to minimise further disturbance. Stabilisation of the remainder of the site on the southern side of the road would enhance the prospects of conservation of this portion of the site. This work would be carried out in consultation with the local Aboriginal community and a suitably qualified archaeologist when necessary.



SOURCE: YOUNG CONSULTING ENGINEERS CP1 - 12/6/98

DUNE LOCATIONS

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Figure 5.8 DUNE LOCATIONS

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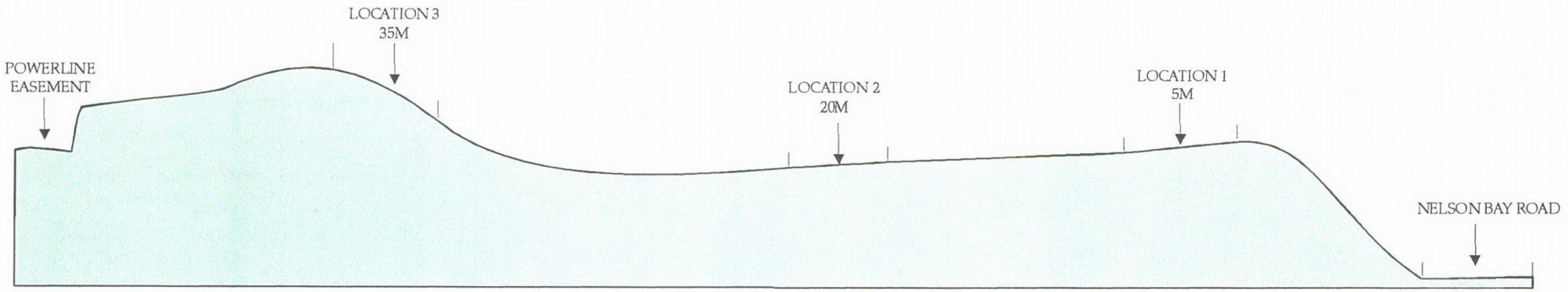
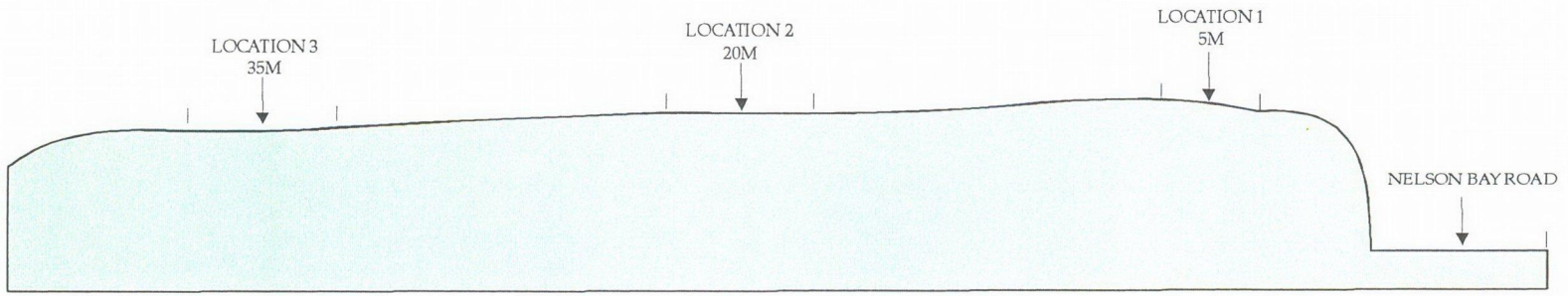
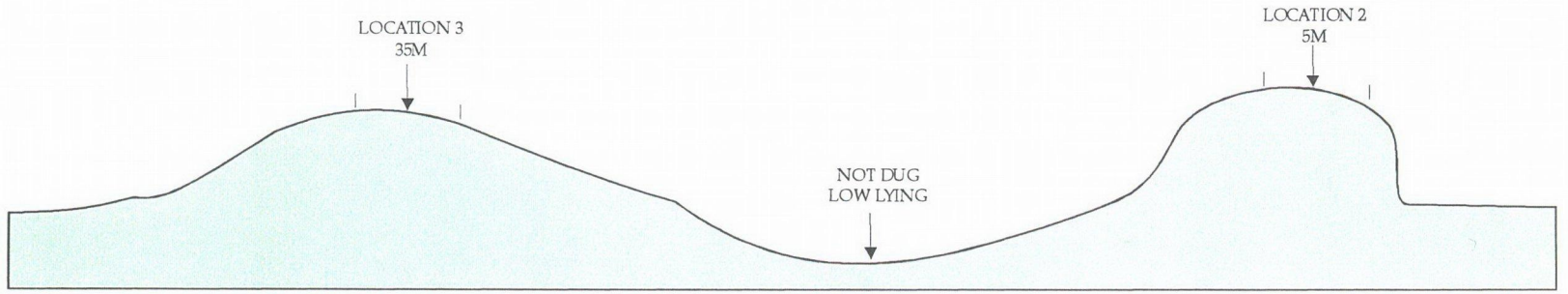


DUNE 1



DUNE 2



DUNE 3

DUNE PROFILES

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Figure 5.9 DUNE PROFILES

NOT TO SCALE

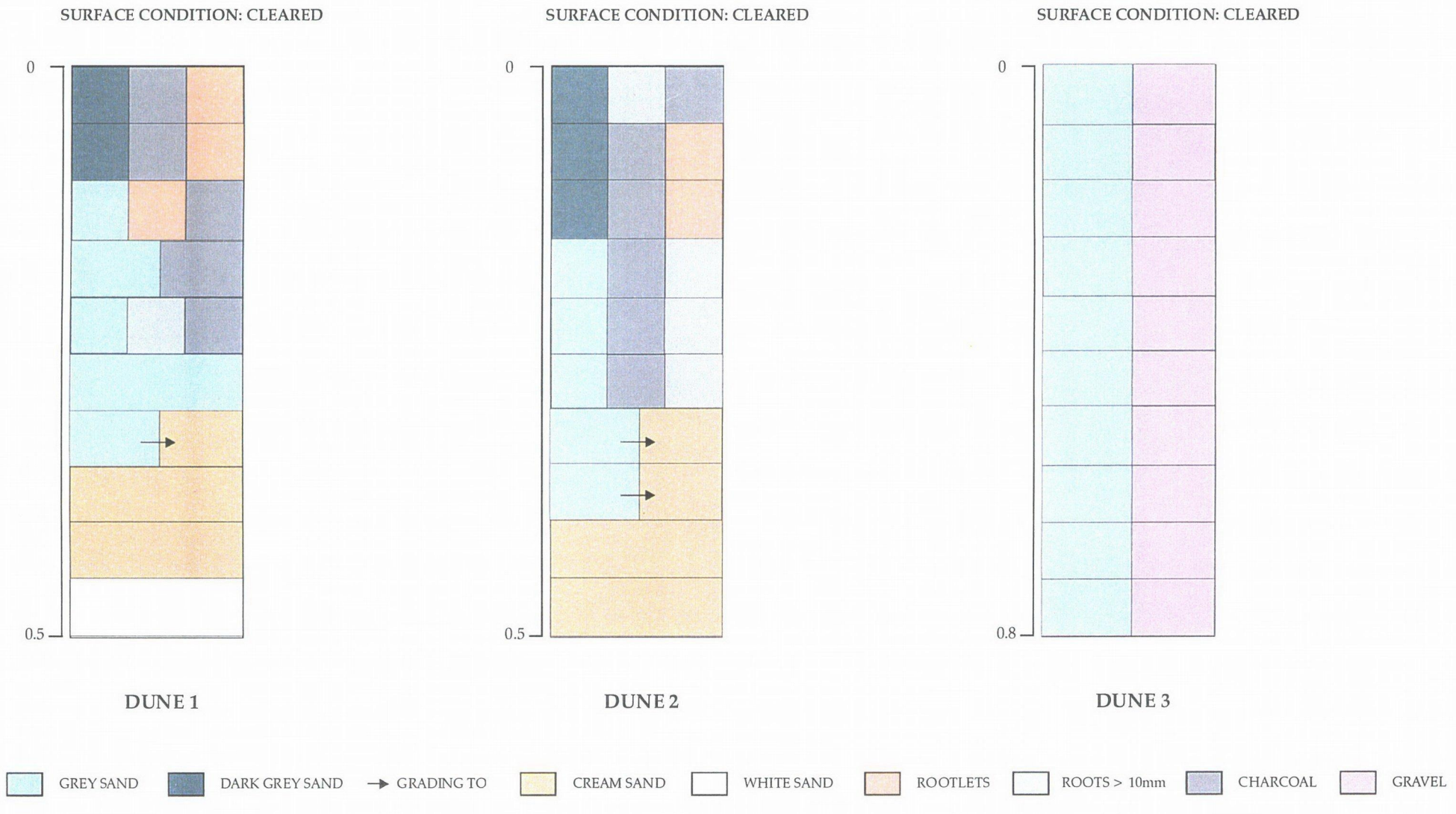

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Figure 5.10 SOIL PROFILES

NOT TO SCALE

5.9.7 *Mitigation and Management Procedures*

Management procedures have been formulated after consideration of:

- assessment of cultural heritage significance by the local Aboriginal community;
- the requirements of the Environmental Planning and Assessment Act 1979;
- results of stage one testing; and
- the requirements of the *National Parks and Wildlife Act 1974*.

The management procedures are also based on the premise that the majority of Aboriginal sites identified by field survey are disturbed. There had been no identification of sub-surface material during stage one of the testing however it is expected that intact sites are likely to be located in the sandhills area. The use of other techniques and limited further testing would therefore be carried out.

The management procedures are:

- a qualified archaeologist and a representative of the local Aboriginal community would be engaged to monitor clearing and initial earthworks for the proposed upgrade. The archaeological monitoring would specifically aim to identify archaeological material (such as middens) and scarred trees as excavation works are carried out;
- probes would be placed in a representative smaller dune within the deflation plain. This could be carried out in a few days during the detailed road design stage;
- ground penetrating radar would be considered for use after the removal of vegetation within the deflation plain;
- the results of the above would be assessed in the context of the geotechnical report; and
- dune stabilisation works would be carried out to conserve the southern portion of Site 2, on the edge the deflation plain overlooking Bobs Farm.

These actions would be carried out as part of a continuing management program and are likely to be refined as the project proceeds. All actions would be included in the project environmental management plan and the Contractor's Environmental

Management Plan. The plans would be prepared in consultation with the NPWS prior to commencement of construction.

5.9.8 Further Testing

Since the completion of the archaeological assessment, there has been a slight realignment to the section of the proposed upgrade traversing the dunes. The location of Dunes 1, 2 and 3, which were assessed in stage one of the sub-surface testing, in relation to the new alignment is shown in *Figure 5.11.*

The altered alignment does not change the results or recommendations of the archaeological assessment. It does, however, mean that Dune 1 would not be impacted on by the proposal and would not be included in further testing.

Given the management actions proposed, the upgrade would have a minor impact on the land subject to an Aboriginal land claim, opposite Trotters Lane and at the western end of the proposed upgrade (refer to *Figure 5.1*).

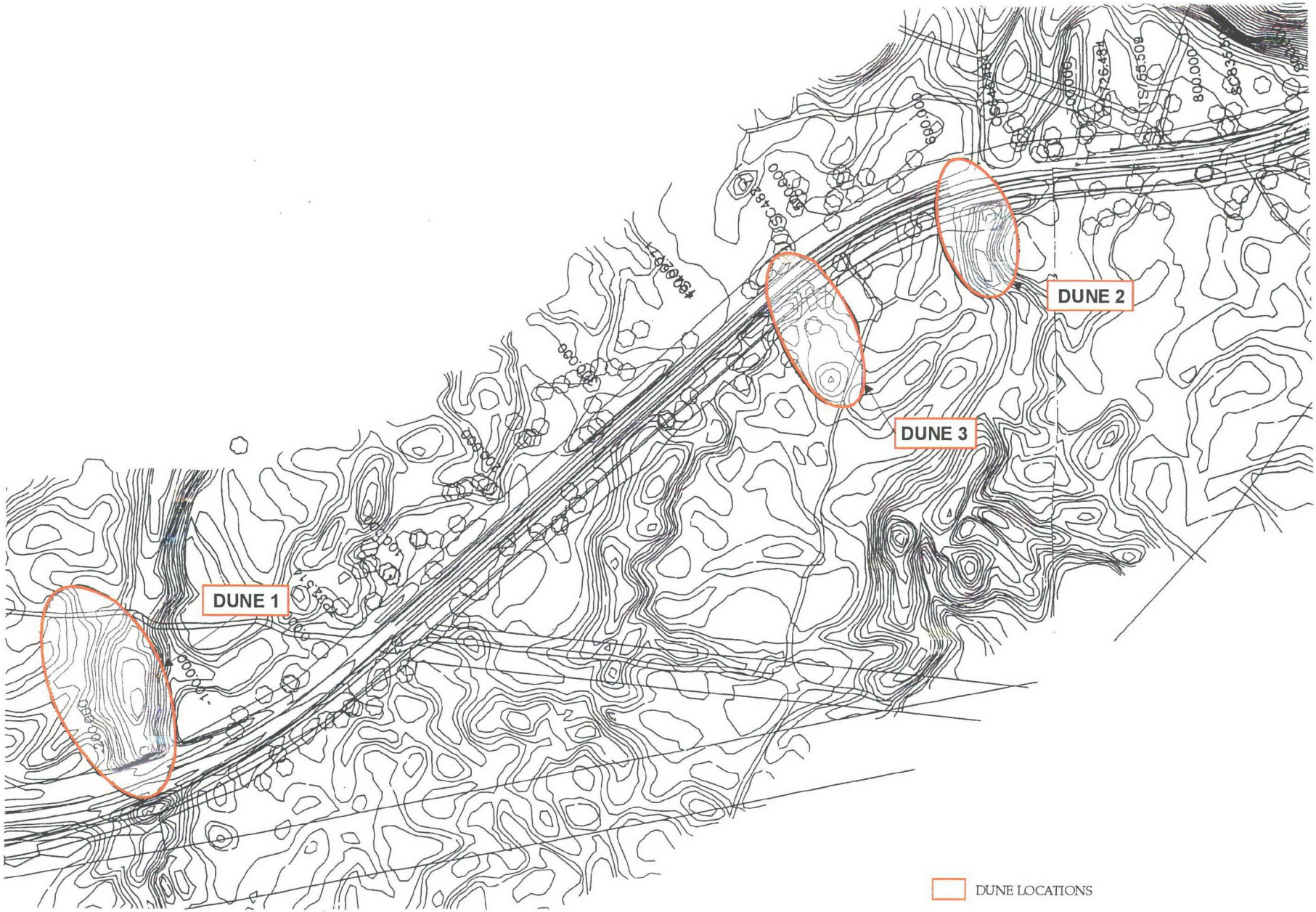
5.10 ACOUSTIC ENVIRONMENT

5.10.1 Existing Noise Levels

Existing noise levels were measured over three consecutive weekdays using noise loggers. Two ARL EL 215 noise loggers were placed at residences close to the existing road alignment in order to quantify the existing noise environment. Residences RMB 3866 and RMB 3891 were chosen due to their close proximity to the roadway and the large number of residences that they represent. RMB 3866 represents eight houses while RMB 3891 represents 14 houses similar distances from the roadway.

RMB 3866 and RMB 3891 are approximately 30 and 15 metres respectively from the nearest lane of Nelson Bay Road.

Noise levels were measured with statistical parameters calculated every 15 minutes including L_{eq}, L_1, L_{10}, L_{90}, L_{99}, L_{max} and L_{min}. Data collected during adverse weather conditions were filtered out using meteorological information supplied by Tomago Aluminium Company. Data where wind speed was in excess of 5 m/s and/or where rainfall occurred were discarded.



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SOURCE: YOUNG CONSULTING ENGINEERS CPI - 12/6/98

Figure 5.11 ALTERED ALIGNMENT & DUNE LOCATIONS

At both monitoring locations the noise environment is dominated by traffic on Nelson Bay Road. L_{90} and L_{10} noise levels are provided by distant and near traffic respectively.

i. Background Noise Levels for Construction Noise Criteria

Background noise levels, for construction criteria, are the lowest repeatable L_{90} (90th percentile) noise levels. Results from logged data are shown in *Table 5.11*.

Table 5.11 BACKGROUND NOISE LEVELS

Monitoring Location	Lowest Repeatable L90
RMB 3891	45.1
RMB 3866	46.3

Notes: *1.Excluding wind speeds in excess of 5 m/s and periods of rainfall.*

ii. Existing Traffic Noise

Measured existing daytime $L_{eq(15hr)}$ and night time $L_{eq(9hr)}$ noise levels are shown in *Table 5.12*.

Table 5.12 EXISTING DAYTIME ($L_{eq(15hr)}$) AND NIGHT-TIME ($L_{eq(9hr)}$) NOISE LEVELS

Residence	Leq(15hr)	Leq(9hr)
RMB 3891	70.3	64.4
RMB 3866	64.4	59.3

Notes: *1. Monitoring period 3/8/98 to 6/8/98.*

2. Statistical intervals where wind speed exceeds 5 m/s and/or where rainfall occurred not included.

5.10.2 Traffic Noise Criteria

In 1999 the EPA released the '*Environmental Criteria for Road Traffic Noise*' guidelines. These new criteria are applicable to this project and apply different noise limits dependent upon the development category and receptor type. *Table 5.13* shows the applicable criteria for the proposed works.

Table 5.13 NSW GOVERNMENT TRAFFIC NOISE CRITERIA

Development Type	Day Criteria $L_{eq(15hr)}$ dB(A)	Night Criteria $L_{eq(9hr)}$ dB(A)	Where Criteria is already exceeded
Redevelop existing arterial road	60	55	In all cases, the redevelopment should be designed so as not to increase existing noise levels by more than 2 dB. Where feasible and reasonable, noise levels from existing roads should be reduced to meet the noise criteria. In many instances this may be achievable only through long-term strategies such as improved planning, design and construction of adjoining land use developments; reduced vehicle emission levels through new vehicle standards and regulation of in-service vehicles; greater use of public transport; and alternative methods of freight haulage.

Notes: 1. Day Leq(15hr) from 7am to 10pm ~ Night Leq(9hr) from 10pm to 7am.

As discussed in the 1999 EPA guidelines, very small increases in noise levels from existing conditions will result in only minor changes to individual reactions. The minimum detectable change in a constant noise level under field conditions is 2 dB; hence the criteria specifying changes of less than 2 dB above existing levels.

Traffic noise criteria applicable to this project are $L_{eq,15hr}$ 60 dB(A) and $L_{eq,9hr}$ 55 dB(A) (base criteria). Where these levels are already exceeded (pre road upgrade) the criteria becomes existing level plus 2 dB (allowance criteria) in those cases where the base criterion is not exceeded by more than 2 dB, and, reasonable and feasible noise controls are not available.

Definitions of criteria compliance are:

- Traffic noise levels less than base criteria; or
- Traffic noise levels less than base criteria plus 2 dB where the increase is less than 2 dB.

Additionally, although noise levels greater than criteria as defined above may result in the design year (10 years after road opening), it is suggested this may still be considered an acceptable outcome provided:

- All reasonable and feasible noise options have been implemented; and
- The resultant traffic noise level is no more than prior to road opening (existing levels).

5.10.3 Construction Criteria

i. Noise Criteria

The recommended noise criteria for construction operations are defined in the *'Environmental Noise Control Manual'* (EPA, 1994) and are listed below:

- for construction periods of four weeks and under, the L_{10} noise level due to the construction site should not exceed the existing L_{90} background noise level by more than 20 dB;
- for construction periods of between four and 26 weeks, the L_{10} noise level due to the construction site should not exceed the existing L_{90} background noise level by more than 10 dB; and
- for construction periods greater than 26 weeks, the criteria for a continuously operating source would apply, which would generally mean that the L_{10} noise level due to the construction site should not exceed the existing L_{90} background noise level by more than 5 dB.

In addition, the manual recommends that where noise is audible at residential premises, construction should be limited to the following times:

- Monday to Friday, 7.00 am to 6.00 pm;
- Saturday, 8:00 am to 1:00 pm; and
- no construction work to take place on Sunday and public holidays.

The duration of construction activities at the site are unknown at this time, however, the RTA expect various stages of construction to generally fall into the 4 to 26 week category. *Table 5.14* provides a range of appropriate construction noise limits based on a lowest repeatable daytime L_{90} (background) noise level of 45 dB(A) as presented in *Section 5.10.1*.

Table 5.14 CONSTRUCTION NOISE LEVEL LIMITS

Duration of Construction Activity	Background Noise Level Lowest Repeated L_{90} dB(A)	Construction Noise Level Limit L_{10} dB(A)
Up to four weeks	45	65
Four to 26 weeks	45	55
Greater than 26 weeks	45	50

ii. Vibration Criteria

Chapter 174 of the EPA Environmental Noise Control Manual (1994) provides vibration limits in buildings resulting from construction activities. Base limits relate to Z axis accelerations (rms) over a range of frequencies. These base limits are adjusted via a multiplying factor relative to the time period during which vibrations are occurring, the nature of vibration (continuous, intermittent or impulsive) and the receptor buildings use.

The Z axis base acceleration levels are as shown in *Table 5.15.*

Table 5.15 BASE ACCELERATION LEVELS

Frequency (Hz)	Acceleration Level (rms) m/s2
1	1.00×10^{-2}
1.25	8.90×10^{-3}
1.6	8.00×10^{-3}
2.00	7.00×10^{-3}
2.50	6.30×10^{-3}
3.15	5.70×10^{-3}
4.00	5.00×10^{-3}
5.00	5.00×10^{-3}
6.30	5.00×10^{-3}
8.00	5.00×10^{-3}
10.00	6.25×10^{-3}
12.50	7.81×10^{-3}
16.00	1.00×10^{-2}
20.00	1.25×10^{-2}
25.00	1.56×10^{-2}
31.50	1.97×10^{-2}
40.00	2.50×10^{-2}

Table 5.15 BASE ACCELERATION LEVELS *(Contd)*

Frequency (Hz)	Acceleration Level (rms) m/s2
50.00	3.13×10^{-2}
63.00	3.94×10^{-2}
80.00	5.00×10^{-2}

Vibration multiplying factors are provided in *Table 5.16.*

Table 5.16 VIBRATION MULTIPLYING FACTORS

Place	Time	Continuous vibration	Intermittent or Impulsive
Critical areas	Day	1	1
	Night	1	1
Residential	Day	2	60
	Night	1.4	20
Office	Day	4	128
	Night	4	128
Workshops	Day	8	128
	Night	8	128

Notes: 1. *Critical working areas are hospital operating theatres, precision laboratories etc..*

2. *Daytime is between 7 am and 10 pm and night time is between 10 pm and 7 am.*

Vibrations levels appropriate for buildings in proximity to construction need to be determined on an individual basis using the information provided in *Table 5.15* and *Table 5.16.*

The EPA recommends that acceleration levels of vibrations generated on construction sites should be less than those listed under 'intermittent or impulsive' vibrations. They also recommend where measured acceleration levels exceed those permitted for 'continuous' vibration, then the following time restrictions are imposed;

- 7 am to 6 pm Monday to Friday;
- 7 am to 1 pm Saturdays; and

- none on Sundays or public holidays.

They further state that *if construction site vibration is not perceptible or within 'continuous' vibration limits, no time restriction should apply.*

The EPA vibration limits and conditions are in relation to human comfort. However, the RTA usually specifies peak particle velocity limits as a building damage criterion, typically 2 millimetres per second. Additionally British Standard 6472 provides peak particle velocity limits to ensure human comfort. It should be noted that 2 millimetres per second is a very conservative limit for prevention of damage to buildings, research suggesting that 25 millimetres per second would be more appropriate for most structures.

5.10.4 Modelling Methodology

i. Construction Noise And Vibration

It is expected that a variety of plant items will be used for construction, the number and type of which will vary throughout the project. This assessment considers noise and vibration impact from a typical construction scenario. Noise levels have been calculated for a range of distances.

Noise levels from construction activities were predicted conservatively, using loss for geometric spreading of energy (distance loss) only.

No prediction of vibration has been undertaken. It is our experience that levels of vibration due to construction activity is variable. Some detectable vibration is possible at residences within 20 metres. However, these levels are usually within criteria limits. Some examples are provided in *Section 5.10.6*.

Measurable vibration typically results from the use of vibrating rollers. Vibration monitoring is recommended for residences located close to construction activity.

ii. Road Traffic Noise

a. L_{Aeq} calculation

For impact assessment purposes existing noise levels are compared to criteria values for day and night in order to determine if they are applicable or whether alternative criteria are applicable. If calculated existing levels already exceed relevant criteria it is then necessary to use alternative criteria based on allowable increases above existing noise levels as shown in *Table 5.13*.

Existing and future noise levels at potentially affected residences were calculated using an in-house computer program, which implements the Calculation of Road Traffic Noise (CoRTN) prediction model. 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.

From previous model calibration exercises, 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 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 gave root mean square prediction errors of 0.9 dB for one project (Bulahdelah To Coolongolook Freeway (ERM, 2000)) and 1.6 dB for another (Karuah to Bulahdelah Pacific Highway Upgrading (ERM, 1999)). *Appendix G.1* provides noise model verification details.

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 was used.

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.

Corrections for facade effects, adjusted to Australian conditions as described in the EPA Road Traffic Noise Guidelines, were incorporated in the model. Results are provided for open graded asphalt. Traffic noise from an open graded asphalt surface is approximately 2 dB less than noise from standard road surfaces (dense graded asphalt).

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.

b. L_{Amax} calculation

Maximum noise levels from heavy vehicles in 80 and 100 kilometre per hour speed zones were measured at known distances. This data has been used to predict average maximum levels for residences along the proposed Nelson Bay Road alignment.

5.10.5 Modelling Parameters

All residences within one kilometres of the proposed route were assessed, the locations of these are shown in *Figures 5.12a-d*. Receiver locations shown represent individual dwellings, not clusters of houses. Resulting noise levels for individual residences are calculated based on the following parameters:

- an AADT of 14,346 in 2003;
- a predicted AADT of 18,787 in 2013;
- open graded asphalt as the road surface;
- source heights of 3.6 metres heavy vehicle exhausts, 1.5 metres heavy vehicle engines and 0.5 metres for light vehicles;
- 100 and 80 kilometres per hour car and truck speed on upgraded alignments; and
- 100 and 80 kilometres per hour car and truck speed on existing alignments (per current speed zones).

No specific noise control measures have been included in the calculations.

5.10.6 Calculated Noise Levels

i. Construction

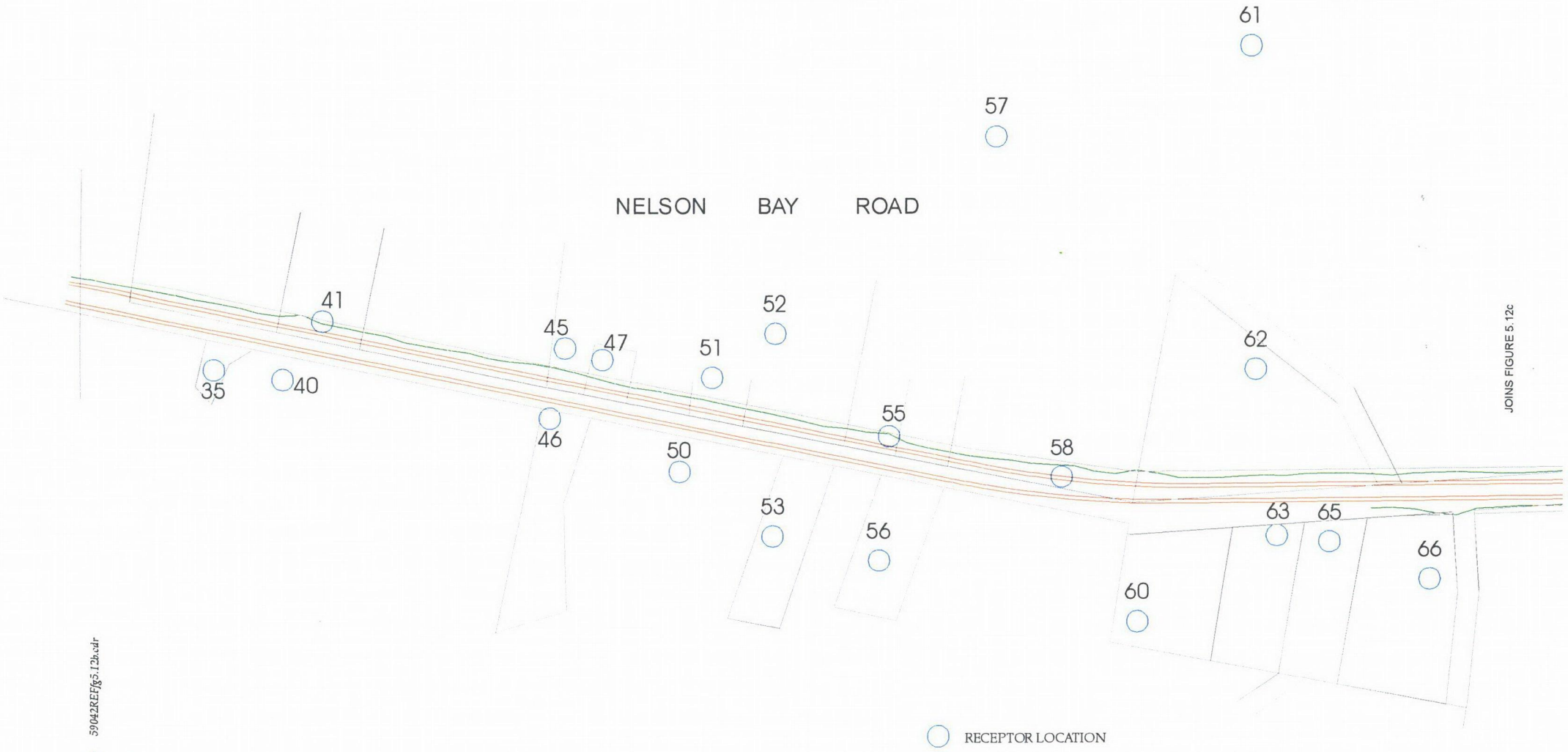
a. Noise

Road construction typically involves the use of graders, rollers, excavators and rigid tip trucks. These items have typical sound power levels as shown in *Table 5.17*.

59042REFfg5.12a.cdr

ERM

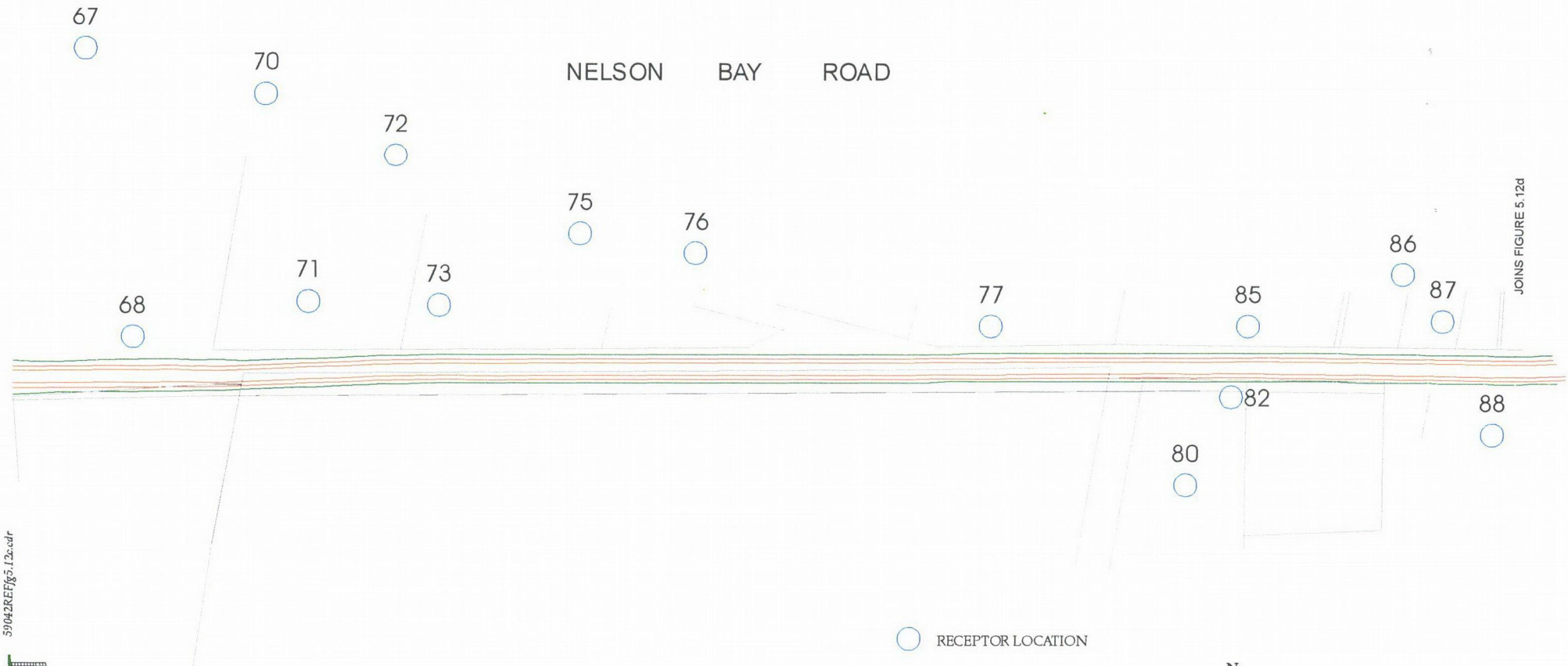
Figure 5.12a RECEPTOR LOCATIONS



59042REFfig5.12b.cdr

ERM

Figure 5.12b RECEPTOR LOCATIONS



39042REFfg5.12c.cdr

ERM

Figure 5.12c RECEPTOR LOCATIONS

59042fREFfg5.12d.cdr

ERM

Figure 5.12d RECEPTOR LOCATIONS

Table 5.17 MAXIMUM SOUND POWER LEVELS OF CONSTRUCTION PLANT

Plant Item	Sound Power Level, dB(A)
Grader	112
Roller	109
Excavator	99
Truck	107

Notes: 1. *Assumed sound powers, actual plant used may be significantly different.*

Noise levels at a range of distances, from a group of plant as listed in *Table 5.17*, are shown in *Table 5.18* while *Table 5.19* provides distances from the road where various construction criteria are met.

Table 5.18 CALCULATED CONSTRUCTION NOISE LEVELS

Distance (metres)	Construction Noise L_{10}, dB(A)
20	76
50	68
100	62

Table 5.19 DISTANCE FROM ROAD BEFORE CONSTRUCTION NOISE LEVEL LIMITS ARE SATISFIED

Duration of Construction Activity	Construction Noise Level Limit L_{10} dB(A)	Distance At Which Criterion Is Satisfied (metres)
Up to four weeks	65	70
Four to 26 weeks	55	220
Greater than 26 weeks	50	400

From *Table 5.19* it can be seen that the majority of residences along the alignment are likely to experience noise levels greater than that recommended for 4 to 26 week construction periods. It should be noted that the duration of construction noise in proximity to individual residences could be somewhat less than 26 weeks. This is because construction activity tends to progress along the road rather than be spread out over a large area (construction noise levels have been calculated for a group of machinery).

It is recommended that construction contractors understand the importance of, and implement, community liaison. They should also employ Best Available Technology Economically Achievable (BATEA) to work processes, specifically with the aim of noise minimisation.

b. Vibration

Vibration levels measured in proximity to road works in the Newcastle area are provided in *Table 5.20*. All data relates to vibratory rollers; these plant items typically provide the highest vibration levels from road construction.

Table 5.20 MEASURED PEAK PARTICLE VELOCITIES

Date/Time	Approximate Distance to Roller (m)	Peak Particle Velocity (mm/s)
8 Dec 1998/0946	50	0.521
8 Dec 1998/0949	50	0.583
12 Jan 1999/1203	25	0.794
12 Jan 1999/1205	25	0.571
12 Jan 1999/1207	25	0.571
12 Jan 1999/1217	25	1.265
12 Jan 1999/1226	25	1.029

From data in *Table 5.20* it can be seen that vibration levels from road construction are typically well below the RTA criterion of 2 millimetres per second.

ii. Road Traffic

a. Proposed road

All calculation results for both day and night time are provided in *Table 1* of *Appendix G.2*. Not included are those houses proposed to be relocated or demolished. These are residences 41, 55, 58, 96 and 120.

Table 2 of *Appendix G.2* provides calculated noise levels for road opening in 2003.

Table 5.21 list residences affected by traffic noise such that ameliorative measures are required. It should be noted that even residences experiencing undetectable increases in traffic noise (i.e. an increase of 2 dB or less) have been conservatively included in this list. Not included in *Table 5.21* are residences for which criteria

exceedances are calculated, but will experience no increase, or even a reduction, in road traffic noise levels. *Section 5.10.2* describes various criteria.

Table 5.21 LIST OF RESIDENCES WHERE CRITERIA EXCEEDANCES ARE PREDICTED, AND EXTENT OF EXCEEDANCE, PROPOSED ROAD 2013

Receiver No	Criteria exceedances dB		Change in dB	
	Day	Night	Day	Night
	15 hour	9 hour	15 hour	9 hour
45	0	2	2	3
47	2	3	3	3
51	0	2	2	3
68	3	3	1	1
82	4	5	3	3
89	0	1	3	3
113	4	5	3	3
115	2	0	3	2
122	2	3	3	3

Calculations for the proposed road show a total of 9 residences affected and requiring treatment.

The maximum predicted criterion exceedance in 2013, for the proposed road with a open graded asphalt surface, is 5 dB ($L_{Aeq,9hr}$) at residences 82 and 113.

Table 5.22 provides results regarding maximum pass-by noise levels from heavy vehicles. It shows the predicted emergence of maximum levels above the hourly traffic noise L_{eq}. *Table 5.23* shows the number of heavy vehicle movements per hour. This information is provided to assist in choosing the best noise control option for residences deemed affected in accordance with RTA policy.

Table 5.22 HOURLY EMERGENCE OF L_{Amax} OVER $L_{Aeq,1hr}$ WHERE L_{Amax} IS GREATER THAN 65 dB, PROPOSED ROAD 2013

Receiver Number	2300	0000	0001	0002	0003	0004	0005	0006	0007
1	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0
3	20	22	26	26	26	23	18	0	0
5	0	17	21	21	21	18	0	0	0
10	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0
12	17	19	22	23	23	19	0	0	0
13	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0
20	19	21	24	24	24	21	16	0	0
21	16	18	22	22	22	19	0	0	0
22	0	0	0	0	0	0	0	0	0
23	0	17	20	21	21	18	0	0	0
24	20	22	26	26	26	23	18	0	0
25	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0
31	18	20	24	24	24	21	16	0	0
32	21	23	26	26	26	23	18	0	0
33	20	22	26	26	26	23	18	0	0
34	0	0	0	0	0	0	0	0	0
35	18	20	24	24	24	21	16	0	0
40	19	21	24	25	25	21	16	0	0
45	0	17	21	21	21	18	0	0	0
46	22	24	27	27	27	24	19	0	0
47	15	17	21	21	21	18	0	0	0
50	18	20	24	24	24	21	16	0	0
51	0	17	21	21	21	18	0	0	0
52	0	0	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0	0	0

Table 5.22 HOURLY EMERGENCE OF L_{Amax} OVER $L_{Aeq,1hr}$ WHERE L_{Amax} IS GREATER THAN 65 dB, PROPOSED ROAD 2013

56	0	0	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0
63	20	22	25	26	26	22	17	0	0
65	19	21	24	24	24	21	16	0	0
66	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0
68	19	21	24	25	25	22	17	0	0
70	0	0	0	0	0	0	0	0	0
71	17	19	22	22	22	19	0	0	0
72	0	0	0	0	0	0	0	0	0
73	17	19	23	23	23	20	0	0	0
75	0	0	0	0	0	0	0	0	0
76	0	0	0	0	0	0	0	0	0
77	19	21	24	24	24	21	16	0	0
80	0	0	0	0	0	0	0	0	0
82	16	18	22	22	22	19	0	0	0
85	19	22	25	25	25	22	17	0	0
86	0	0	0	0	0	0	0	0	0
87	18	20	24	24	24	21	16	0	0
88	15	17	21	21	21	18	0	0	0
89	15	18	21	21	21	18	0	0	0
90	16	18	21	22	22	19	0	0	0
95	20	22	25	25	25	22	17	0	0
97	22	24	27	27	27	24	19	0	0
100	21	23	27	27	27	24	19	0	0
101	16	18	21	22	22	18	0	0	0
102	17	19	22	23	23	20	0	0	0
105	18	20	24	24	24	21	16	0	0
106	0	0	0	0	0	0	0	0	0
110	19	21	25	25	25	22	17	0	0

Table 5.22 HOURLY EMERGENCE OF L_{Amax} OVER $L_{Aeq,1hr}$ WHERE L_{Amax} IS GREATER THAN 65 dB, PROPOSED ROAD 2013

111	20	22	25	25	25	22	17	0	0
112	21	23	26	27	27	24	19	0	0
113	16	18	22	22	22	19	0	0	0
114	15	17	21	21	21	18	0	0	0
115	16	18	21	22	22	18	0	0	0
116	0	0	0	0	0	0	0	0	0
122	15	17	21	21	21	18	0	0	0
125	21	23	27	27	27	24	19	0	0

Table 5.23 HOURLY VOLUMES OF HEAVY VEHICLES, PROPOSED ROAD 2013

	Hour Ending								
	2300	**0000**	**0001**	**0002**	**0003**	**0004**	**0005**	**0006**	**0007**
Number of heavy vehicles	10	6	3	2	2	5	17	50	76

b. Existing Road

Traffic noise levels from the existing road in 2013 (a do nothing option) were calculated to put the acoustic impact of the proposed road into perspective. These results are presented in *Table 3* of *Appendix G.2*.

Table 5.24 lists residences affected by traffic noise such that ameliorative measures would be required.

Table 5.24 LIST OF RESIDENCES WHERE CRITERIA EXCEEDANCES ARE PREDICTED, AND EXTENT OF EXCEEDANCE, EXISTING ROAD 2013

Receiver No	Criteria exceedances	
	Day	Night
	15 hour	9 hour
20	4	5
24	5	5
31	0	3
32	5	6
33	5	5
35	0	3
40	3	3
46	6	7
63	3	4
68	3	4
77	3	3
82	0	3
85	3	3
95	4	5
97	6	7
100	6	6
105	0	3
110	3	4
111	3	3
112	6	6
113	0	3

Calculations show a total of 21 residences affected in 2013 if the road is not up graded. All residences will experience a 1 dB increase in noise due to traffic growth.

The maximum predicted criterion exceedance in 2013, for the existing road with a dense graded asphalt surface, is 7 dB at residences 46 and 97.

5.10.7 Noise Control Requirements

In cases such as this where noise levels exceed criteria for road traffic noise, the EPA Road Traffic Noise guidelines (1999) recommend:

> *'Where it is feasible and reasonable, noise levels from existing roads should be reduced to meet the criteria.'*

Noise control can be achieved by a number of methods, including:

- realignment or relocation of roads;
- road side barriers;
- lower speed limits;
- quiet road surfaces; and
- architectural treatment of affected dwellings.

i. Noise Control Feasibility

Due to the relative isolation of individual residences (i.e. there is little clustering of houses such that a barrier would reduce noise levels at multiple residences) it is not considered reasonable or feasible to construct barriers. Excepting residences 45 and 47, which are relatively close together, individual barriers would be required for various residences along the road. This would be costly and potentially unsightly.

An 80 kilometre per hour speed limit is proposed for almost the entire length of the road. This probably represents the lower speed range for a divided, four lane arterial road.

The proposed road surface is open grade asphalt. The RTA has adopted this surface on the basis of its superior noise performance in comparison to other available alternatives.

In summary, the scattering of residences means barrier control is not feasible, the speed limit is relatively low and the best performing road surface (with regard to noise emissions) is proposed. Given that the proposed road is 6.8 kilometres long, it is considered that treating individual houses would be significantly less expensive and more aesthetically appealing than erecting barriers along sections of the road.

Therefore, the logical alternative is to ensure noise levels within dwellings are no more than if the external criterion was being met.

Internal (inside a living area) noise criteria are based on the original external criteria less 10 dB. This 10 dB relationship is the level that would be expected within a dwelling if the original criterion was being met and the dwelling's windows were open approximately 20 per cent for ventilation (EPA 1999). That is, although the outside noise level target has been foregone on the basis of cost effectiveness and practicality, the interior noise level target remains unchanged.

ii. Reasonableness Regarding Noise Control

Results presented in *Section 5.10.6* show that predicted noise impacts due to the proposed road are similar to those for the existing alignment. In fact the maximum criterion exceedance is less for the proposed road than for existing. This is due to new traffic lanes being away from some sensitive receptors and use of a superior road surface.

iii. Proposed Noise Controls

Given the internal noise criteria would be exceeded at a number of residences with windows open, there is a requirement that air conditioning or suitable ventilation be provided so that windows facing the road can remain closed if so desired. This is a suitable method of treatment for criteria exceedances of up to 10 dB, the maximum predicted exceedance at any residence, from the proposed road, is 5 dB.

5.11 IMPACTS ON ROADS AND TRAFFIC

Traffic delays and reduction in travelling along Nelson Bay Road would be associated with the construction of the works for the proposed road upgrade. The construction works would be carried out in stages to minimise disruption to traffic and residents.

During construction, a speed limit of 60 kilometres per hour would be imposed within the construction zone. Disruption to traffic would be kept to a minimum. Minor delays may be experienced by local property owners requiring access to driveways and tracks affected by the works. Unsealed access ways would be provided to a number of properties adjacent to the works.

Traffic volumes and type would not significantly alter as a result of the completed work.

The new roadway, with ultimate divided carriageways would allow for either carriageway to be used for two-way traffic in an emergency. In cases of emergency

on State Roads, it is important to recognise that the RTA works closely with Police to facilitate the passage of emergency vehicles, provide for traffic management and clear any impediments to traffic flow as quickly as possible.

5.12 LANDSCAPE AND VISUAL CONSIDERATIONS

5.12.1 Visual Environment

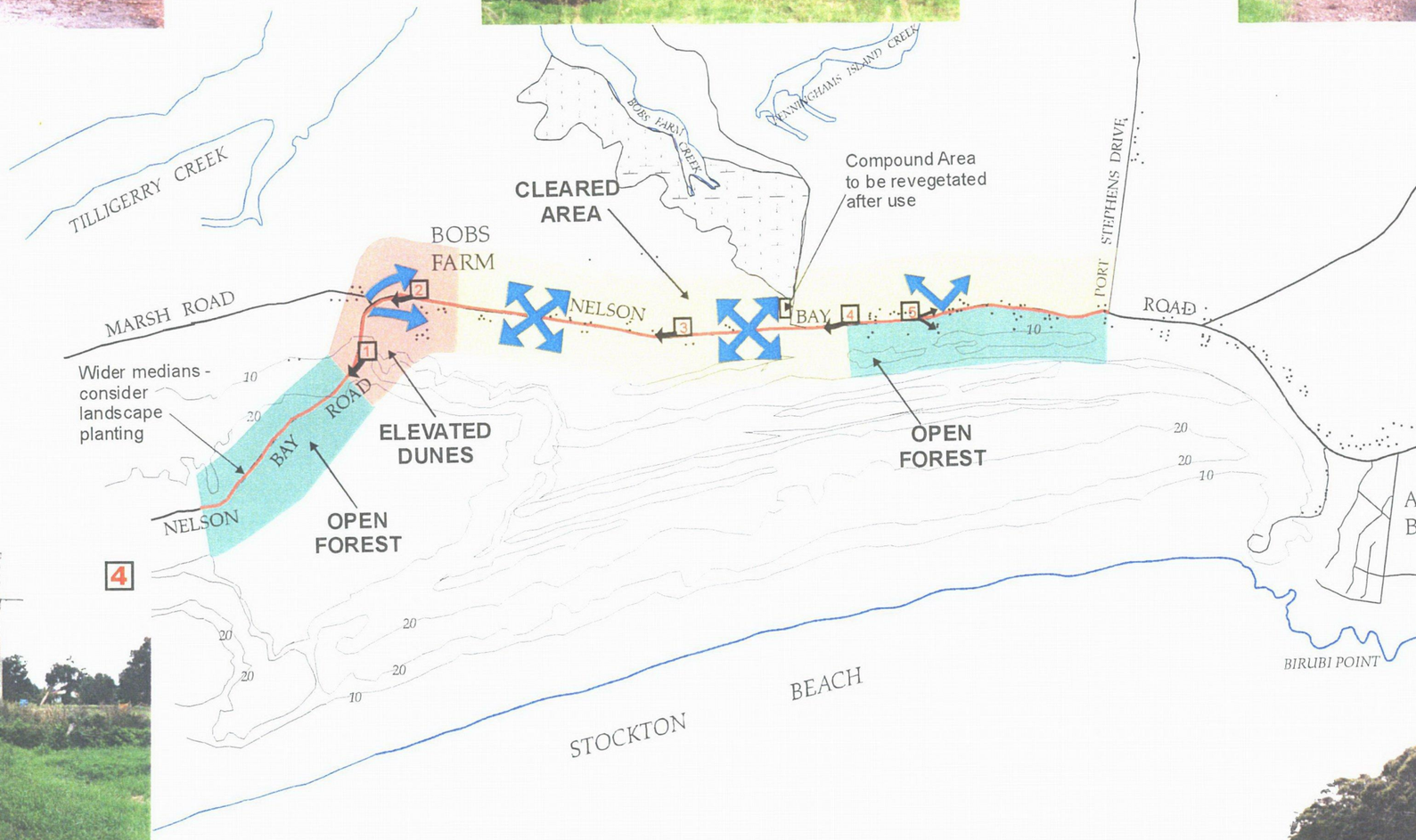
Stockton Bight Environmental Study and Management Plan (HLA Envirosciences, 1995) recognises Nelson Bay Road as a *'visual corridor - tourist gateway of Port Stephens'* (HLA Envirosciences, 1995). The section of Nelson Bay Road to be upgraded, between Bobs Farm and Anna Bay, passes through a variety of landscapes. Geomorphologically, these landscapes may be described as outerbarrier dunes (western section) and the interbarrier depression (central and eastern section).

At the western end the road passes through dunes stabilised with Blackbutt and rusty gum open forest. Views from the road are of the open forest, with glimpses through the trees to several residences situated at some distance from the road. The vista is relatively enclosed as forest trees are located on either side of the road.

From the open forest the road dips to a lower, flat area, along which the majority of the road passes. This flat area is characterised by cleared pasture areas, residences and some small businesses. Cabbage tree palms, swamp oaks and melaleucas, with areas of coastal swamp open forest, are viewed within the pasture areas, as well as landscaping associated with residences. The vista along this section of road is open, with views to the elevated vegetated dunes to the south, and across the flats towards Bobs Farm Creek to the north.

The eastern end of the subject section of Nelson Bay Road is also relatively flat, but with more dense open forest vegetation on the southern side enclosing the vista along the corridor. Residences and businesses provide change and colour contrast with the native vegetation. Several Hoop Pines along this section provide some contract with the native vegetation.

Figure 5.13 shows the above landscape units and the main viewpoints from the road corridor. Also shown are various photographs illustrating the visual characteristics of the landscape units.



59042RETfig5.13Visual.cdr

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

MAIN VIEWPOINTS

RESIDENCES

PHOTOGRAPH NUMBER AND DIRECTION OF VIEW

PROPOSED ROAD UPGRADE

N

0 500m

ERM

Figure 5.13 VISUAL ENVIRONMENT

5.12.2 *Scenic Quality*

Visual and scenic characteristics may be assessed according to the following features developed by the State Pollution Control Commission (1981) in *"Guidelines for Visual Assessment and Management of Coastal Landscapes"*. Landscape units are developed for an area according to common characteristics found in a visual catchment.

Characteristics include:

- land use;
- slope;
- vegetation;
- water-edge characteristics/features;
- water units;
- foreshore units; and
- land units.

The landscape units for Stockton Bight have been defined in the Stockton Bight Environmental Study and Management Plan (HLA Envirosciences, 1995) as consisting of eleven different units. The proposed route passes through four of these eleven landscape units, being:

- Unit 3 - vegetated stabilised dune;
- Unit 8 & 9 - elevated stabilised dune system; and
- Unit 7 - Nelson Bay Road corridor.

Unit 3 is located on the western edge of the proposed route and is assessed as having moderate scenic quality. Units 8 and 9 are of high scenic quality due to distinctive or unique variety. These units cover a small proportion of the study area to the south of Marsh Road and on the southern side of Nelson Bay Road towards the eastern end of the upgrade. Both these units consist of well vegetated dune systems with north facing steep slopes. Unit 7 is in the low scenic quality category due to the ribbon development, which is present along Nelson Bay Road in the Bobs Farm and Anna Bay area. The presence of residential and commercial development, flat landscape and reduced vegetation cover reduces the landscape quality and aesthetic appeal of the area. The subject area therefore passes through high, moderate and low scenic quality areas. The variation in land uses along the flat section of road,

whilst adding visual interest, reduces the scenic quality in this area. The unformed, rough road edge along this section of Nelson Bay Road, and the roughness of the road surface itself in some sections also contributes to a lower scenic quality.

5.12.3 Visual Aspects Of The Proposal

The proposed road upgrade would widen the road corridor by duplicating the existing carriageway. The new dual carriageway would have a sealed shoulder with a central depressed grass median. Some sections where a narrower median is required would be concreted. Barriers or retaining walls would be provided along some sections of the road, and bus stops and intersections fully formed.

To increase the width of the carriageway some vegetation would be removed, along with several residences and some pasture areas. Due to the narrowness of the median there are limited opportunities to provide landscaping within the median area, however, the detailed design stage would investigate opportunities to provide native trees and shrubs within the median where this is practical, particularly at the western end. The detailed design stage would also consider native landscaping on proposed construction compound areas, and at locations where trees, residences or front sections of yards are to be removed. Any landscaping in front of residences or businesses would be considered in consultation with the relevant land owner.

The heritage assessment (*Section 5.8*) recommends the hoop pines near the Anna Bay cemetery be replaced. As these trees are a noticeable visual element this is also recommended from a visual consideration. Their exact replanting location would be determined at detailed design stage.

During construction, road vistas would be temporarily disrupted by works associated with construction, including stockpiles, construction machinery, barriers and signs.

5.12.4 Visual Impact

The draft document *Beyond the Pavement – RTA Urban Design Practice Notes* (RTA, 1999) provides guidelines for landscaping, roadscaping and assessing 'local character' and potential 'character' impacts of roads and transitways. The document also provides a framework to ensure that RTA roads are designed to respond to their natural, built and community contexts. Landscapes are often a part of a region's culture and local character, therefore road designs should fit in with the landscape and reduce impact on scenic qualities. Landscaping solutions also need to reflect local character (RTA, 1999). Roadscape elements such as signage, guard fences and

median barriers need to 'fit' with each other, be of appropriate scale and character and integrate into the overall context and landscape of the road.

The proposed road upgrade would have a medium impact on the visual amenity of the area during the construction phase of the roadworks and in the longer term during the operation of the duplication. The impact on local character and scenic qualities of the area would be minimal given the proposal is a duplication of the existing road and roadscape elements such as signage, guard fences and medians would be sympathetic with existing elements.

Short-term visual impacts would occur due to the plant and equipment present for the construction of the road and the possibility of dust generation. These short term visual impacts would be experienced by local and tourist traffic passing along Nelson Bay Road and local residents in the Bobs Farm and Anna Bay area.

Mitigating measures to be used during construction would include water carts to suppress dust, speed restrictions for vehicles moving across unsealed areas and revegetation of exposed areas. Following construction central medians would be concreted or turfed with some tree planting on wider median sections. This would act to soften the visual impact of the proposed upgrade.

It is noteworthy that the majority of the proposed works (between Marsh Road and the roundabout) have been contained within a road-widening boundary proposed since 1959, thereby restricting the area of impact to a relatively narrow margin on either side of the existing road.

Longer-term impacts would be experienced by residences along Nelson Bay Road who would have the road located closer to their properties. Measures to reduce long-term visual impact of the proposed upgrade include minimising the area of disturbance, progressive revegetation of disturbed areas during and following the construction phase and grassing and planting of the central medians. Given these mitigation measures and that the proposal is a duplication of the existing road, there would be little change to the visual character of the landscape and minimal long-term visual impact.

Some visual improvement would be associated with the proposed works. The current road is not kerbed and the road surface and edge is rough and inconsistent along the subject section of road. The proposed consistent road surface, sealed shoulder, fencing and medians would present a more co-ordinated landscape.

5.13 SOCIO-ECONOMIC ISSUES

5.13.1 Population Characteristics

Port Stephens local government area (LGA) is divided into eight major areas or planning districts. The planning districts that are relevant to this proposal are Rural East and Tomaree Peninsula. The majority of Nelson Bay Road is located in the Rural East planning district of Port Stephens LGA and is the only road that services the Tomaree Peninsula planning district.

The Tomaree Peninsula planning district encompasses Soldiers Point, Salamander Bay, Anna Bay and the Nelson Bay/Shoal Bay areas. The Rural East planning district extends from Tomago/Hexham, along Tilligerry Creek to Bobs Farm/Anna Bay West.

Table 5.25 provides the most recent population estimates available and shows population statistics for the planning districts of the Tomaree Peninsula and the Port Stephens LGA.

Table 5.25 ESTIMATED POPULATION FOR TOMAREE PENINSULA AND PORT STEPHENS LGA

Planning District	1996 Census	Estimate to 30 June 2001
Nelson Bay	5076	-
Shoal Bay	1925	-
Fingal Bay	1392	-
Corlette	2219	-
Salamander Bay/Salamander/Taylors Beach	2622	-
Soldiers Point	1616	-
Anna Bay/ Fishermans Bay/ Boat Harbour/ One Mile Beach	3045	-
TOTAL TOMAREE	17895	21200
TOTAL PORT STEPHENS LGA	51288	60840

Source: Port Stephens Council Community Profile 1995-96

The age distribution for the Tomaree Peninsula, Rural East planning district and the Port Stephens LGA are shown in *Table 5.26.*

Table 5.26 AGE DISTRIBUTION (1996 CENSUS)

Age Group	Tomaree Peninsula	Port Stephens LGA	Hunter Region
0-4	6.4	7.9	7.1
5-9	6.2	8.2	7.4
10-14	6.2	7.7	7.3
15-19	5.2	6.3	6.8
20-24	5.1	5.7	6.9
25-29	5.5	6.6	6.7
30-34	5.7	7.3	7.2
35-39	7.3	8.0	7.7
40-44	6.2	7.2	7.2
45-49	6.3	6.4	6.8
50-54	5.8	5.2	5.5
55-59	6.0	4.9	4.5
60-64	6.3	4.7	4.2
65-69	7.1	4.8	4.5
70-74	6.6	4.1	4.0
75+	7.4	4.6	5.8

Source: Port Stephens Council (1996)

The 1996 Census data shows that 27.4 per cent of residents over the age of 60 reside in the Tomaree Peninsula area. This can be compared to 18.2 per cent for the Port Stephens LGA and 18.5 for the Hunter Region. These values reflect a high proportion of retirees in the Tomaree Peninsula area. Increased life expectancy and declining birth rates has seen significant ageing of the Australian population. The ageing population in the Port Stephens area has resulted substantially from migration of people in older age groups to the area from elsewhere.

There is also a significantly lower proportion of 15 to 34 year old residents in the Tomaree Peninsula area in comparison to the rest of the local government area and the Hunter Region. This suggests that young adults are drawn to other areas to seek employment and education opportunities.

5.13.2 Population Projections

The Port Stephens area has experienced high rates of population growth over recent years and this growth is expected to continue in the foreseeable future. The

population statistics and projections for the Tomaree Peninsula and Port Stephens LGA are shown in *Table 5.27*. The projections are from the Port Stephens Council Community Profile for 1995-96 and are based on current population trends and land availability.

Table 5.27 POPULATION STATISTICS AND PROJECTIONS

Area	1976	1981	1986	1991	1996	2001	2006	2011	2016	2021
Tomaree Peninsula	6,640	9,370	11,250	14,185	17,920	19,900	22,800	25,600	28,500	31,400
Total LGA	21,000	28,650	36,000	43,719	51,290	59,900	68,000	76,000	84,100	92,200

Source: Port Stephens Council Community Profile 1995-96

Port Stephens LGA has experienced rapid growth over the 20 year period from 1986 to 1996. It is estimated that annual population growth will continue between four and five per cent, which is four times above the National, State and Regional growth rates.

5.13.3 Employment

Individual incomes in the Port Stephens LGA are generally low. An estimated 77.7 percent of residents earn less than $30,000 and 44.8 per cent earn less than $12,000. Annual household incomes are also low for the Port Stephens LGA with 46.5 percent of families earning less than $30,000. This compares with NSW values showing that 41.1 percent of families earn less than $30,000.

This low level of individual and family income can be linked to the lack of employment opportunities and the number of retired people residing in the area. Tourism is the most significant employment industry in the LGA, particularly the Tomaree Peninsula as it caters for more than a million visitors each year. However, employment in this sector is seasonal in nature which results in limited full time employment opportunities and lower annual average income.

5.13.4 Local Businesses

A number of businesses are located along the proposed road upgrade and are listed in *Table 5.28* and shown on the Concept Design Plans. Direct access to some businesses would be restricted by the proposed median. *Table 5.28* provides distances from the closest turning facility on both the east and west bound carriageways, to the businesses along the proposed upgrade.

Table 5.28 LOCAL BUSINESSES AND DISTANCE TO U-TURN BAYS

Business Description	Location	Distance to U-Turn Bay East Bound Carriageway	Distance to U-Turn Bay West Bound Carriageway
Go -Kart Track	250A Marsh Rd	Access would continue to be off Marsh Road, a two stage intersection with u-turn bay.	Access would continue to be off Marsh Road, a two stage intersection with u-turn bay.
Newcastle and Hunter Pet Crematorium	138 Nelson Bay Rd	370 metres to u-turn bay at Cromarty Lane.	Direct access from west bound carriageway
Caravan and Boat Storage Park	138 Nelson Bay Rd	370 metres to u-turn bay at Cromarty Lane.	Direct access from west bound carriageway
Bay Turf	131 Nelson bay Rd	350 metres to u-turn bay at Cromarty Lane.	550 metres to u-turn bay at Marsh Road.
Bobs Farm Tea and Coffee House and roadstall	144 Nelson Bay Rd	180 metres to u-turn bay at Cromarty Lane.	600 metres to u-turn bay at Marsh Road.
The Palms Golf Course	145 Nelson bay Rd	Access would continue to be off Cromarty Lane with a two stage intersection with u-turn bay.	Access would continue to be off Cromarty Lane with a two stage intersection with u-turn bay.
Bobs Farm General Store and Petrol Station	156 Nelson Bay Rd	320 metres to u-turn bay at Cromarty Lane.	320 metres to u-turn bay at Cromarty Lane.
Nursery (currently closed)	160 Nelson Bay Rd	150 metres from u-turn bay.	600 metres to u-turn bay at Cromarty Lane.
W and L Robinson Haulage Contractor	187 Nelson Bay Rd	250 metres to heavy vehicle u-turn bay at Trotter Road.	380 metres to u-turn bay.
Sand Mining Access	West of 212 Nelson Bay Rd	Turning lane at intersection.	370 metres to heavy vehicle u-turn bay at Trotters Road.
Anna Bay Cemetery	East of 212 Nelson Bay Rd	U-turn bay at cemetery.	550 metres to u-turn bay at Trotters Road.
Caltex Service Station	216 Nelson Bay Rd	100 metres at cemetery.	500 metres to heavy vehicle u-turn bay.

Table 5.28 LOCAL BUSINESSES AND DISTANCE TO U-TURN BAYS *(Contd)*

Business Description	Location	Distance to U-Turn Bay East Bound Carriageway	Distance to U-Turn Bay West Bound Carriageway
Anna Bay Cafe	223 Nelson Bay Rd	200 metres to heavy vehicle u-turn bay.	370 metres to u-turn bay at cemetery.
Holiday Accommodation (not operational)	229 Nelson Bay Rd	U-turn bay opposite driveway.	550 metres to u-turn at cemetery.
Church	233 Nelson Bay Rd	750 metres to roundabout.	20 metres from u-tun bay.
Roadside stall	242 Nelson Bay Rd	In proposed road path.	In proposed road path.
Learn to Swim Centre	256 Nelson Bay Rd	300 metres from roundabout.	500 metres to u-turn bay.

5.13.5 *Residences along the Proposed Upgrade*

There are approximately 80 houses with property boundaries adjoining the proposed upgrade. These are shown on the Concept Design Plans. Distances from the proposed road upgrade to the houses range between 220 metres and 0 metres. Several residences are within the proposed road alignment. These residences require relocation or demolition. In addition, the proposed upgrade would result in the part acquisition of 26 private properties.

5.13.6 *Impacts of the Proposal*

i. Local Businesses

A considerable proportion of the businesses relies heavily on the passing trade of residents and tourists travelling between Nelson Bay and Newcastle. The proposed upgrade following the existing alignment of Nelson Bay Road would allow these businesses to continue to capitalise on the location and high exposure to residential and tourism traffic. Although some businesses may be affected by restricted access to and from the opposite carriageway, traffic safety would be improved through the use of u-turn bays, turning lanes and two stage intersections.

ii. Local Residents

Adverse social impacts of the proposed upgrade include the potential demolition and/or relocation of five residences within the proposed road alignment, and increased noise levels in a number of residences along Nelson Bay Road as the duplication would place sections of road closer to some houses. These impacts would be addressed through the provision of compensation to persons whose property is acquired and the installation of acoustic treatments in residences affected by noise. Compensation would be in accordance with RTA Acquisition Policy.

The relocation or demolition of residences along the proposed upgrade would have major implications for the particular households involved. The part acquisition of 26 properties would result in size reductions of the front yards and properties of affected freehold land.

Access to residences would be affected by the proposed upgrade with the additional carriageway and median. Eight U-turn bays would be provided at intervals of between 600 and 1300 metres each way to enable access for residents. These are shown on the Concept Design Plans. The 80 kilometre per hour speed limit along the majority of the proposed upgrade would assist in safe traffic turning.

Residents travelling along Nelson Bay Road may experience delays due to road works and during construction of the upgrade.

Positive socio-economic impacts for residents along the proposed upgrade include increased road user safety and in some cases shorter travel times. Eleven bus stops are proposed along the proposed upgrade and associated pedestrian crossing points (see *Section 2.5.1*, and the Concept Design Plans), which would benefit local residents who rely on public transport. Bus stops are indented to maintain the free flow of traffic.

iii. General Community

The proposed road upgrade would not only have benefits for local traffic to and from the Tomaree Peninsula, but for tourist traffic from the Hunter Valley, Sydney and elsewhere. Given the expected population growth and increase in tourism in the area, the demand on infrastructure and services is expected to rise.

The upgrade of Nelson Bay Road would improve road safety and the efficiency with which local and tourist traffic can enter and exit the area, which would assist the tourism industry. In addition, construction activities such as road building and maintenance would provide local employment opportunities.

Given the expected population growth in the area, the annual average daily traffic is expected to increase from approximately 13,500 (Year 2000) to 17,500 (Year 2010) and 22,000 (Year 2020). The existing two lane road would reach its practical capacity in approximately 10 to 15 years time. This would cause significant delays and frustration, particularly during peak periods and could result in a subsequent increase in the accident rate. The construction of dual carriageways with a median separating the two directions of traffic would significantly improve road safety. A detailed assessment of road user benefits is provided in *Section 5.13.7.*

Travellers along Nelson Bay Road may experience delays due to road works during construction of the proposed upgrade.

Social impact assessment must consider the overall advantages and disadvantages of the proposal to wider community. It is recognised that the proposal may negatively impact on a number of businesses and residents along Nelson Bay Road, due to proposed relocation and/or demolition of residences along the route, the increase in traffic noise received at a number of residences and changes to access.

It is noteworthy that the majority of the proposed works (between Marsh Road and the roundabout) have been contained within a road-widening boundary proposed since 1959. While this boundary has not been gazetted as an easement for road

widening, Port Stephens Council has given consideration to this when assessing developments in the subject area for a long period of time.

5.13.7 Road User Cost:Benefit Assessment

i. Methodology

Calculation of the benefit-cost ratios (BCR's) for a road project is based on the economic costs and benefits to road users. This provides a quantitative measure of the benefits associated with the road upgrade option.

The analysis compares costs and benefits associated with the project. These relate to initial construction costs, ongoing road maintenance, land purchase, travel time-savings, accident and safety.

Dollar values are assigned to each of these costs and benefits where they are able to be quantified. The analysis does not include other environmental costs and benefits that cannot be readily quantified, such as changes to local amenity, recreational opportunities and visual impact.

The recommended economic analysis procedure by both the RTA and the NSW Treasury (RTA, 1999) is based on future discounting of all relevant project costs and benefits over a 30 year period. Discounting is the reverse of adding interest, it reduces the money value of future costs and benefits for two reasons;

- income or benefits available now are preferable to income or benefits available some time in the future; and
- all capital investment has an opportunity cost where it could earn a rate of return if invested in other sectors of the economy.

The current practice for economic evaluation of NSW projects (RTA, 1999) uses a cumulative discount rate of 7% each year, with sensitivity analysis performed using the 4% and 10% discount rates. Additionally, the following economic parameters are required to be reported:

- NPV Net Present Value is the value of discounted future benefits minus discounted future costs over the life of the project. It is calculated using the specified discount rates. A positive NPV is a criterion for proceeding with a project, although risk and other factors also need to be considered. Separate reporting is also required of the NPV for both project costs and project benefits;

- BCR Benefit Cost Ratio is equal to the discounted benefits, including operating and maintenance costs, over the life of the project divided by the discounted capital cost. A value of 1.0 or greater is required for a project to be considered economically feasible. Because of the large number of road upgrading projects which are being considered at any given time in NSW, a higher value of 2.0 is frequently applied for current consideration of road upgrading projects by the NSW State Government; and

- Internal Rate of Return (IRR) is the discount rate which, when applied to the project costs and benefits, produces a net present value of zero. That is, the highest discount rate at which discounted project benefits would remain greater than or equal to discounted project costs.

ii. Project Costs

A detailed cost estimate of the proposed road upgrading (Option 1B) has been prepared including the following items.

- Investigation and Design;
- Property Acquisition;
- Utilities;
- Site Preparation /Provision for Traffic;
- Drainage;
- Earthworks;
- Pavements;
- Final Works;
- Engineering Services/Construction Management; and
- Allowances/Contingencies (30% Typically).

The total estimated project cost based on current (Year 2000) construction rates is $16.0 million. However, this expenditure would be staged over several years. Calculations have been based on progressive construction would occur over a five year period with progressive opening of the duplicated alignment in four stages.

iii. Project Benefits

The project benefits are calculated as a combination of the following types of benefit:

- travel time savings as a result of reduced traffic congestion;
- vehicle operating cost savings (fuel consumption, vehicle wear and maintenance) as a result of new smoother road pavement surface;
- accident benefits from the reduced future occurrence of accidents with fewer traffic conflicts and a divided road;
- road maintenance costs. With a newer road there are lower structural maintenance costs initially, however in the longer term the increased area of road surface to maintain/repair results in generally increased road maintenance costs.

iv. Results of Economic Evaluation

Summary details of the economic analysis are shown in *Appendix H.* The road user benefit-costs analysis results for the project are presented in *Table 5.29* and *Table 5.30.*

Table 5.29 SUMMARY OF ECONOMIC ANALYSIS RESULTS

	Option 1B		
	Discount Rate 4%	**Discount Rate 7%**	**Discount Rate 10%**
NPV Costs ($M)	14.7 (1)	13.2 (1)	12.5 (1)
NPV Benefits ($M)	112.7	68.8	44.6
NPV Net ($M)	97.9	55.6	32.1
BCR	7.64	5.20	3.57
IRR		17.0%	

Notes: *NPV = Net Present Value*

BCR = Benefit to Cost Ratio

IRR = Internal rate of return based on log-linear interpolation of 4%, 7% and 10% discount rate results

(1) = Actual construction cost ($16M) discounted years 1 to 5.

Table 5.30 BREAKDOWN OF BENEFITS (%)

Type of Benefit	Option 1B
Vehicle Operating Costs	10.6%
Travel Time Costs	89.0%
Accident Costs	1.2%
Maintenance Costs	-0.8%

Note: Proportions are based on valuations of actual project benefits in the years in which they occur

The project shows very good economic viability with a high benefit cost ratios (at the median 7 percent discount rate) of 5.20:1. and a high internal rate of return (the highest discount rate at which the project is still economically feasible) of approximately 17.0 percent.

The project economic analysis is based on a Year 1 (2001) estimated daily traffic flow of 13,458 vehicles combined with a future linear traffic growth rate of 3.3 percent annually.

Under a sensitivity analysis with a lower traffic growth rate (+2.2% per annum) the project benefit to cost ratio would reduce to 3.50:1.

v. Summary of Economic Issues

The objective of the economic evaluation is to determine the viability of the proposed road upgrading in relation to alternative development projects. In this case the construction of the recommended option (Option 1B) is considered to have viability.

The project economic evaluation has been carried out in accordance with current rural road valuations of travel time and distance savings and procedures documented in the RTA Economic Analysis Manual (RTA, 1999).

A high proportion of the project benefits, approximately 89 percent in real terms, are generated by travel time savings. This occurs because under existing conditions, typical travel speed, along the 6.8 kilometre route would gradually decline from approximately 72 km/hour in Year 2001 to 56 km/hour by the Year 2015 and to 41 km/hour by the Year 2030. In contrast, with the proposed duplication typical average travel speeds would be unaffected by traffic congestion and would remain at 82 to 83 km/hour throughout the period to the Year 2030.

Only a relatively small proportion of the project benefits (approximately 11 percent) are generated by savings in vehicle operating costs (fuel consumption, near and tear) because there is no overall shortening of the route length which remains at 6.8 kilometres for both the existing road and the proposed duplication.

5.14 WASTE MINIMISATION AND MANAGEMENT

Waste minimisation would be emphasised throughout the project with a focus on reuse and recycling of waste rather than disposal to landfill.

Plant and timber waste generated in the clearing and grubbing stage would be mulched and used as a stabilisation material on median strips and disturbed areas.

Suitable excavated materials would be reused in the construction of the road where possible. Inferior material and non-recyclable wastes would be transferred to an approved landfill for appropriate disposal.

5.15 CUMULATIVE ENVIRONMENTAL IMPACTS

The proposed upgrade of Nelson Bay Road (MR 108) between Bobs Farm and Anna Bay along the existing road alignment is not likely to have any long term cumulative adverse impacts on the environment, given the mitigation measures that would be implemented. The upgrade has been proposed by Port Stephens Council due to the poor pavement condition, lack of passing lanes and overtaking opportunities of the existing section of road. The objective of the upgrade is to improve road safety and efficiency.

Short term impacts incurred during the construction of the road upgrade would include:

- possible relocation or demolition of five residences along the route;
- increased noise levels to some residences, with slight reductions to others;
- soil erosion and sedimentation particularly due to wind erosion;
- reduced air quality;
- displacement of fauna which may be inhabiting vegetation to be cleared; and
- temporary disruptions to local traffic.

Control measures would be employed during the construction phase to minimise impacts that may result. Mitigative measures on site would include erosion and sediment control structures, regular maintenance of machinery to minimise gaseous emissions, installation of noise abatement measures at the closest receptors prior to construction and an awareness of operators of practices to reduce impacts.

The upgrade would be conducted in stages, allowing time for fauna to move out of the area. Disturbance of preferred koala habitat, habitat buffers and linking areas would be minimised during construction. The staging of construction would also reduce impacts on local and tourist traffic.

It is anticipated that the viability of surrounding landuses would not be adversely affected. The impact of partial acquisition of a number of properties along the route and the relocation or demolition of five residences would be minimised through negotiation with individual property owners and provision of compensation to those directly affected.

Chapter 6

SUMMARY

6.1 SUMMARY OF KEY ISSUES

Nelson Bay Road forms an important link between Williamtown and Nelson Bay. The upgrade of the section between Bobs Farm and Anna Bay has been proposed by Port Stephens Council due to the substandard alignment, poor surface condition and lack of overtaking opportunities of the existing section of road. The upgrade would aid the flow and safety of local and tourist traffic in the area. The following provides a summary of the key issues associated with the proposal.

i. Flora and fauna

The Nelson Bay Road upgrade would disturb blackbutt/rusty gum open forest, coastal swamp forest communities and cleared non native vegetation communities. No threatened flora species or species of conservation significance were recorded along the route. The open forest and coastal swamp forest provides habitat for squirrel gliders, bats and potential koala habitat.

Radio tracking of two individual squirrel gliders was undertaken at two sites along the proposed upgrade. Several den sites were identified at each site. None of the identified den trees would be felled for the road upgrade. At the eastern site, den tree two would be within three metres of the new west bound carriageway. Protective fencing would assist in protecting this tree.

While the swamp forest habitats in this area of the road upgrade provide potential koala habitat they are considered as not currently providing core koala habitat as defined by SEPP 44. However, the area is considered preferred koala habitat under the Port Stephens Comprehensive Koala Plan of Management. It may provide wildlife corridor value linking koala population to the north of the road with the large tract of open forest habitat along the Stockton Bight dune system. Appropriate signs would be erected warning motorists of the possibility of native fauna crossing the road.

The upgrade is not expected to significantly affect 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 would be cleared.

Continuous forested habitats to the south of Nelson Bay Road form part of an extensive and significant wildlife movement corridor in the relic dunes of the Stockton Bight. Given the proposed upgrade follows the existing alignment of Nelson Bay Road, the impact to this relic dune system would be minimised.

Long term impacts as a result of the upgrade would include the reduction of habitat and an increase in the barrier to dispersal formed by Nelson Bay Road. Given the proposed area to be cleared is relatively small and the large habitat area south of the road, the long term impacts due to loss of habitat are not considered to be significant.

ii. Acoustic Environment

Expected noise levels from future traffic flows were modelled for all residences along the proposed upgrade. Calculations for the proposed road show a total of 9 residences affected.

Definitions of criteria compliance (as discussed with the RTA) are:

- Traffic noise levels less than base criteria; or
- Traffic noise levels less than base criteria plus 2 dB where the increase is less than 2 dB.

Additionally, although noise levels greater than criteria as defined above may result in the design year (10 years after road opening), it is suggested this may still be considered an acceptable outcome provided:

- All reasonable and feasible noise options have been implemented; and
- The resultant traffic noise level is no more than prior to road opening (existing levels).

Due to the relative isolation of individual residences (i.e. there is little clustering of houses such that a barrier would reduce noise levels at multiple residences) it is not considered reasonable or feasible to construct barriers. In this case the logical alternative is to ensure noise levels within dwellings are no more than if the external criterion was being met.

Given the internal noise criteria would be exceeded at a number of residences with windows open, there is a requirement that air conditioning or suitable ventilation be provided so that windows facing the road can remain closed if so desired. This is a

suitable method of treatment for criteria exceedances of up to 10 dB, the maximum predicted exceedance at any residence, from the proposed road, is 5 dB.

iii. European Heritage

The European heritage assessment included a search of pertinent heritage registers, consultation with the NSW Heritage Office and a field survey.

One area of potential heritage significance was identified during the community consultation process. The original Anna Bay Public School site was raised as potential heritage landscape, particularly with reference to two historic Pine Trees growing on the site. A heritage assessment of the school site found that the site has local heritage significance as the site of the first public school established in Port Stephens (in 1879).

Two Hoop Pine trees would be removed at the school site, with two new Hoop Pines planted on the south side of the upgraded road. One of the existing trees has white ant damage and would be removed because of safety concerns.

If excavation works are to occur across the school site, a qualified archaeologist is to be engaged to monitor excavation works in accordance with an excavation permit from the NSW Heritage Office. If any heritage material is uncovered during the works program, works would cease and consultation with the NSW Heritage Office would be undertaken.

iv. Archaeology

Sub-surface testing concluded that while the deflation plain has a high potential for the occurrence of middens, and possibly burials, none were located. However, their identification prior to some degree of disturbance is problematic and more detailed design of the road duplication should proceed with the inclusion of further archaeological assessment. Another small excavation would be conducted during the next stage of the project. One or two smaller interdunal ridges would also be tested.

Discussions with NPWS and the Aboriginal community representatives suggests that monitoring is an appropriate method of managing the impact of construction along the remainder of the route. This would require an archaeologist and community representative to be present when clearing/initial earthworks are undertaken.

Site two on the north eastern edge of the deflation plain requires stabilisation works to retain the slumping of the sand embankment. This site extends to each side of the

existing road, however the site has been highly disturbed on the northern side of the road by construction of the existing road and excavation of sand into the dune face from privately held land adjacent to the road. The disturbed portion of the site has been selected for the road upgrade route to minimise further disturbance.

v. Social Impacts

The Port Stephens area has experienced high rates of population growth over recent years and it is projected to continue at the existing rate, which is four times above the National, State and regional growth rates. With this increase in population, there is expected to be an increased demand on infrastructure and services.

Tourism is the most significant employment industry in the Port Stephens Local Government Area, particularly the Tomaree Peninsula as it caters for more than a million visitors per annum. The upgrade would provide benefits for growing local and tourist traffic and would assist the tourism industry in the area.

As part of the socio-economic assessment a road user cost:benefit assessment was conducted. Dollar values were assigned to each of these costs and benefits where they are able to be quantified. The analysis does not include other environmental costs and benefits that cannot be readily quantified. All options were found to have high benefit:cost ratio (BCR's) (all greater than 2) and are therefore viable in an economic sense.

The proposed upgrade would result in adverse impact on a number of property owners along the route and include the potential demolition and/or relocation of five residences and one garage, partial property acquisition, and increased noise levels at a number of residences on Nelson Bay Road. These impacts would be addressed through the provision of RTA compensation to persons whose property is acquired and the installation of acoustic treatments in residences affected by noise (see *Sections 5.1.4 and 5.10.7*).

6.2 SUMMARY OF SAFEGUARD AND MITIGATIVE MEASURES

The following provides a summary of safeguard and mitigative measures that would be implemented as part of the proposed works. All these measures would be detailed in the project environmental management plant that would be prepared for the works prior to commencement of construction.

6.2.1 *Air Quality Control*

Air quality is discussed in *Section* 5.2. The mitigation measures would include the following:

- dust suppression by water carts to dampen internal haul roads and open surfaces;
- reducing speed on unsealed sections of road during construction;
- minimising the area of disturbance;
- topsoil stripping during periods when the soil is moist;
- progressive revegetation of disturbed areas;
- covering of loads of materials transported onto the site during construction;
- maintenance of all vehicles and equipment to the specifications of the relevant Australian Design Rules to minimise gaseous emissions; and
- no burning or incineration.

6.2.2 *Soil Erosion And Sediment Control*

Soil erosion and sediment controls are discussed in *Section* 5.3 and include the following:

- minimising surface disturbance and movement of equipment in the area;
- minimising disturbance to areas outside the general road construction easement by restricting vehicle access to these areas;
- revegetation of disturbed areas as soon as possible;
- monitoring and maintenance of disturbed and revegetated areas;
- installing appropriate erosion and sediment controls prior to the commencement of construction works and maintenance of the structures throughout the project; and
- installing downstream sediment protection such as sediment fencing for any material stockpiled on site during construction.

6.2.3 *Acid Sulfate Soil Management*

Acid sulfate soils management is discussed in *Section 5.3.2* and includes the following:

- testing prior to road construction to determine the exact location and depth of acid sulfate soil material and regular monitoring during excavation in high risk areas; and
- preparation of an Acid Sulfate Management Plan in consultation with the EPA and DLWC, prior to commencement of works, detailing management measures such as addition of lime, excavating the acid sulfate material and replacing it with a stable material such as sand.

6.2.4 *Water Management*

Water management is described in *Section 5.5*. The surface and groundwater management strategy includes the following:

- upgrading existing culverts and drains to improve local drainage and help reduce localised flooding; and
- implementation of the soil erosion and sediment controls and acid sulfate soil management measures would minimise impact on water quality during construction.

6.2.5 *Flora and Fauna*

Flora and fauna is addressed in *Section 5.6*. Measures to minimise impacts on flora and fauna include the following:

- restricting vegetation removal to the road corridor and ancillary operations at the intersection of Trotters Road and Nelson Bay Road;
- retaining and protecting squirrel glider den trees adjacent to the proposed road upgrade;
- gradual clearance of the road corridor to allow fauna to move into adjoining habitats;
- clearing of habitat trees outside of the winter hibernation and summer maternity periods to minimise direct mortality of tree roosting bats;
- staged clearing in the vicinity of habitat trees including clearance of

understorey on day one, leaving the habitat tree undisturbed overnight and 'nudging' the tree with a dozer prior to felling on day two. This would minimise direct mortality of resident fauna;

- presence of wildlife recovery personnel during clearing, especially habitat trees, to recover fauna;
- timing of vegetation clearance to avoid periods of critical habitat usage;
- establishment of nesting boxes at a density of four to six per hectare, in adjoining habitat to replace felled habitat trees;
- use of warning signs along the road especially where corridors exist either side of the road;
- monitoring koala activity in the area of preferred koala habitat following construction to re-evaluate the need of mitigation measures such as exclusion fencing; and
- 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 the construction period, between the road upgrade area and the smaller population of *Diuris praecox*.

6.2.6 *European Heritage*

European Heritage is addressed in *Section 5.8*.

Two Hoop Pine trees would be removed at the school site, with two new Hoop Pines planted on the south side of the upgraded road. One of the existing trees has white ant damage and would be removed because of safety concerns.

If excavation works are to occur across the school site, a qualified archaeologist is to be engaged to monitor excavation works in accordance with an excavation permit from the NSW Heritage Office. If any heritage material is uncovered during the works program, works would cease and consultation with the NSW Heritage Office would be undertaken.

6.2.7 *Archaeology*

Archaeology is addressed in *Section 5.9* and the following measures would be undertaken to minimise impact on the archaeological sites:

- testing using probes in a representative smaller dune within the deflation plain during the detailed road design stage;
- testing using ground penetrating radar after the removal of vegetation within the deflation plain;
- stabilisation of the slumping sand embankment to conserve the southern portion of Site 2, on the edge the deflation plain overlooking Bobs Farm; and
- should archaeological material be found during construction, work would cease and the National Parks and Wildlife Service and the local Aboriginal Community would be notified.

6.2.8 *Noise Impacts*

The acoustic environment and noise controls are discussed in *Section 5.10*. Proposed measures to minimise noise impacts are:

- provision of air conditioning or suitable ventilation so that windows facing the road can remain closed if so desired. This would involve up to 9 residences.

6.2.9 *Traffic Impacts*

Roads and traffic are discussed in *Section 5.11*. Proposed measures to minimise impact on local traffic during construction are as follows:

- staging of construction works to minimise disruption to traffic and residents;
- restricting speed within the construction zone to 60 km/hr during construction;
- minimising disruptions to traffic; and
- provision of unsealed access ways to a number of properties adjacent to and affected by the works would be kept to a minimum.

6.2.10 *Visual Impacts*

Visual impacts are discussed on *5.12*. Measures proposed to minimise visual impact include the following:

- progressive revegetation of areas disturbed by construction; and
- retention of trees along the sides of the road where possible, with additional planting were required.

6.2.11 *Socio-Economic Impacts*

Socio economic impacts are addressed in *5.13* and mitigation measure include the following:

- provision of u-turn bays, turning lanes and two stage intersections for access to businesses and residences along the proposed road upgrade;
- traffic safety would be improved through the construction of a dual carriageway with a central median, 80 kilometre per hour speed limit along the majority of the upgrade and provision of u-turn bays, two stage intersections and other turning treatments;
- provision of RTA compensation to persons whose property is acquired or houses relocated;
- installation of acoustic treatments in residences affected by noise;
- environmental management measures, such as soil erosion and sediment control, water management, waste management, noise, visual and air quality controls would minimise adverse impacts on the amenity of the area; and
- ongoing community consultation to inform of progress with the development.

6.3 CLAUSE 228 CHECKLIST

Clause 228(1) of the *Environmental Planning and Assessment Regulation 2000* specifies what factors must be taken into account when consideration is being given to the likely impact of an activity on the environment for the purposes of Part V of the *Environmental Planning and Assessment Act 1979*. These factors include:

'(a) for activities of a kind for which specific guidelines are in force under this clause, the factors referred to in those guidelines, or

(b) for any other kind of activity:

(i) the factors referred to in the general guidelines in force under this clause, or

(ii) if no such guidelines are in force, the factors referred to in subclause (2).'

In March 1999, the Director General of Planning issued general guidelines for environmental assessment referred to as *"Is an EIS Required – Best Practice Guidelines for Part 5 of the Environmental Planning and Assessment Act 1979"* (DUAP, 1999). These guidelines provide a list of potential environmental impacts that should be considered in the assessment of proposed developments. *Table 6.1* provides a summary of these impacts and where they are addressed in the REF.

Table 6.1 POTENTIAL IMPACTS OF DEVELOPMENT

Potential Impact	Addressed in Section(s)
Air impacts	5.2.4, 5.2.5
Water impacts	5.5
Soil and stability impacts	5.3
Noise and vibration impacts	5.10
Any other physical or pollution impacts	Chapter 5
Fauna impacts	5.6, 5.7
Flora impacts	5.6, 5.7
Ecological impacts	5.6, 5.7
Community resource impacts	Chapter 2, 5.1
Natural resource impacts	Chapter 5
Social factors	5.13
Economic factors	Chapter 2, 5.13
Heritage, aesthetic, cultural impacts	5.8, 5.9, 5.12
Land use impacts	5.1
Transportation impacts	5.11
Impacts in sensitive locations	Chapter 5

Source: *Is an EIS Required – Best Practice Guidelines for Part 5 of the Environmental Planning and Assessment Act 1979* (DUAP 1999)

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CONCEPT DESIGN PLANS

Port Stephens COUNCIL
... a community partnership

ERM

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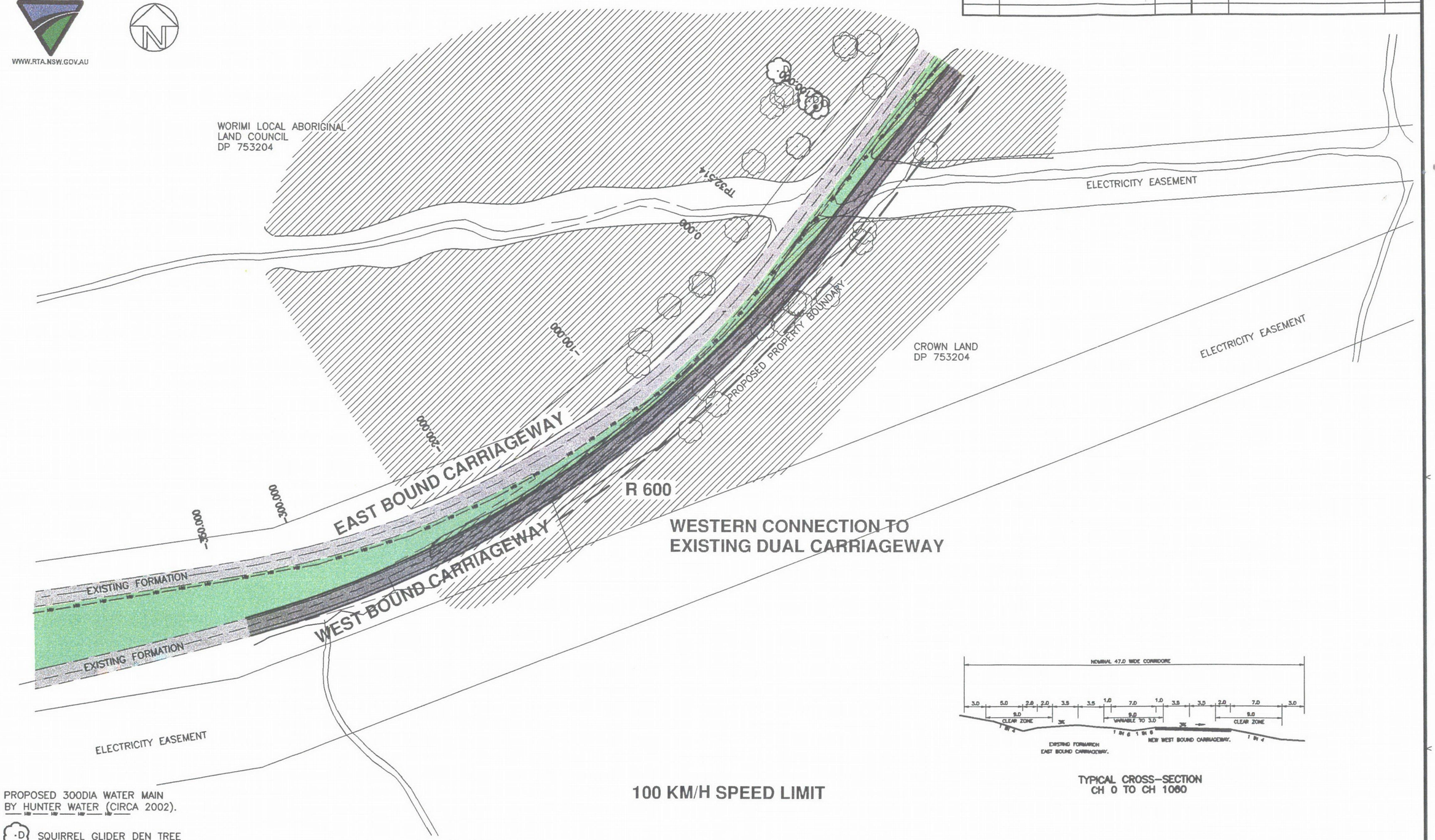

TYPICAL CROSS-SECTION
CH 0 TO CH 1060

100 KM/H SPEED LIMIT

PLAN
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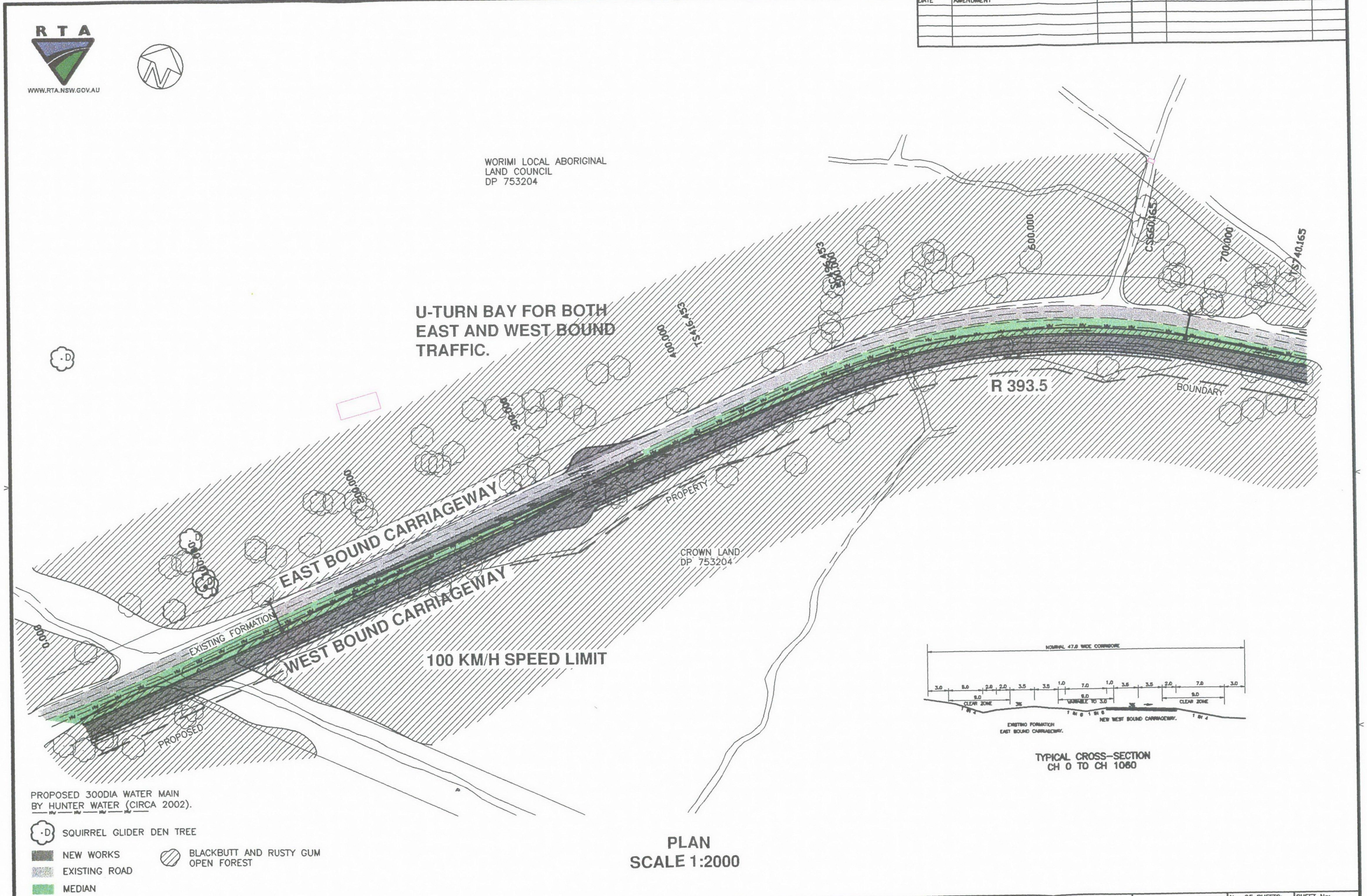
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WORIMI LOCAL ABORIGINAL LAND COUNCIL DP 753204
U-TURN BAY FOR BOTH EAST AND WEST BOUND TRAFFIC.
EAST BOUND CARRIAGEWAY
WEST BOUND CARRIAGEWAY
EXISTING FORMATION
PROPOSED
PROPERTY
BOUNDARY
CROWN LAND DP 753204
100 KM/H SPEED LIMIT
R 393.5
0.000
100.000
200.000
300.000
400.000
TS416.453
600.000
CS560.165
700.000
TS740.165
TYPICAL CROSS-SECTION CH 0 TO CH 1060
CLEAR ZONE
EXISTING FORMATION EAST BOUND CARRIAGEWAY
NEW WEST BOUND CARRIAGEWAY
PROPOSED 300DIA WATER MAIN BY HUNTER WATER (CIRCA 2002).
SQUIRREL GLIDER DEN TREE
NEW WORKS
EXISTING ROAD
MEDIAN
BLACKBUTT AND RUSTY GUM OPEN FOREST
PLAN
SCALE 1:2000

DATUM AHD

PM XXXXXX

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SCALES: PLAN, LONG SECTION

SURVEY & DESIGN TEAM

SURVEY BY:- GEOSPECTRUM APRIL '92

DESIGNED BY:- R. CRAWFORD OCT '99

THESE PLANS HAVE BEEN CHECKED ON SITE AND ARE RECOMMENDED

ENGINEER

DATE:

Port Stephens COUNCIL ... a community partnership

MR 108 NELSON BAY RD OPTION 1B BOBS FARM, PROPOSED ULTIMATE DUAL CARRIAGEWAY.

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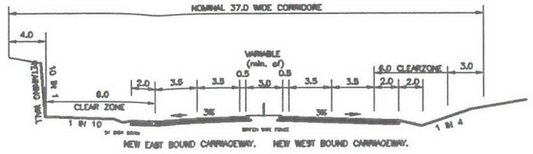

TYPICAL CROSS-SECTION
CH 1060 TO CH 1320

100 KM/H SPEED LIMIT
UP TO CH900

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563.230

MR & MRS HAY
DP832882
576.250

MR BOUGHTON & MS NORBURN
DP 599716
111.576

GO KART TRACK

MR & MRS HOGAN
DP 881147
576.250/A

WORIMI LOCAL ABORIGINAL LAND COUNCIL
DP 753204

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SC849.190
900.000
R260
1000.000
CS1046.937
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1200.000
1300.000
TS1386.500
1400.000
SC1466.500

EAST BOUND CARRIAGEWAY
EXISTING FORMATION
PROPOSED PROPERTY BOUNDARY
WEST BOUND CARRIAGEWAY
PROPOSED PROPERTY BOUNDARY

MR HAWORTH & MRS JONES
DP 841156
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FROM CH740

MR & MRS BLISS
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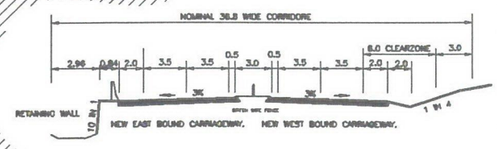
CROWN LAND
DP 753204
373.576



TYPICAL CROSS-SECTION
CH 1320 TO CH 1460

PROPOSED 300DIA WATER MAIN
BY HUNTER WATER (CIRCA 2002).

SQUIRREL GLIDER DEN TREE

NEW WORKS

EXISTING ROAD

MEDIAN

BLACKBUTT AND RUSTY GUM OPEN FOREST

SCATTERED TREES / LANDSCAPING

PLAN
SCALE 1:2000

DATUM AHD PM XXXXXX R.L. XXXXXX	SCALES PLAN, LONG SECTION -10-5 0 10 20 30 40 50	SURVEY & DESIGN TEAM SURVEY BY:– GEOSPECTRUM APRIL '92 DESIGNED BY:– R. CRAWFORD OCT '99	THESE PLANS HAVE BEEN CHECKED ON SITE AND ARE RECOMMENDED ..... ENGINEER DATE:	Port Stephens COUNCIL ... a community partnership	MR 108 NELSON BAY RD OPTION 1B BOBS FARM, PROPOSED ULTIMATE DUAL CARRIAGEWAY.

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TWO STAGE INTERSECTION WITH U-TURN BAYS FOR BOTH EAST AND WEST BOUND TRAFFIC

MARSH RD

MAXWELL PTY LTD
DP 507872
563.239

SWANAB PTY LTD
DP 841156
576.131

MR & MRS KANDLBINDER
DP 250679
576.133

MR SWAN
DP 250679
576.137

SWANAB PTY LTD
DP 250679
576.141

MR & MRS RUSSO
DP 732457
563.252

MR & MRS HOGAN
DP 881147
576.250A

HALL & HALL
576.130

MRS UPTON
DP 250679
576.134

MR HAWORTH & MRS JONES
DP 841156
576.126

SMITH
DP 841156
576.138

NEWCASTLE & HUNTER PET CREMATORIUM

MR & MRS UPTON
DP 213466

MR & MRS MITCHELL
DP 859965
576.144

CARAVAN & BOAT STORAGE PARK

PROPOSED COMPOUND SITE

PROPOSED PROPERTY BOUNDARY

TELSTRA

EAST BOUND CARRIAGEWAY

WEST BOUND CARRIAGEWAY

DRAINAGE EASEMENT PROPOSED

R240

1700.000

1800.000

1900.000

2000.000

2100.000

CS1753.929

TS1833.929

1500.000

SC1466.500

1400.000

TS1386.500

PROPOSED PROPERTY BOUNDARY

PROPOSED 300DIA WATER MAIN BY HUNTER WATER (CIRCA 2002).

SQUIRREL GLIDER DEN TREE

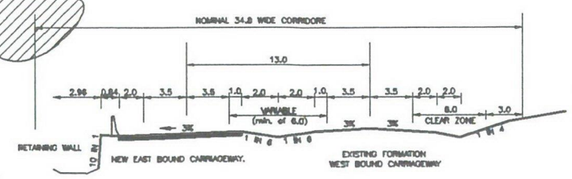
NEW WORKS

EXISTING ROAD

MEDIAN

BLACKBUTT AND RUSTY GUM OPEN FOREST

SCATTERED TREES / LANDSCAPING



TYPICAL CROSS SECTION FROM CH1480

SPEED LIMIT 80 KM/H

PLAN
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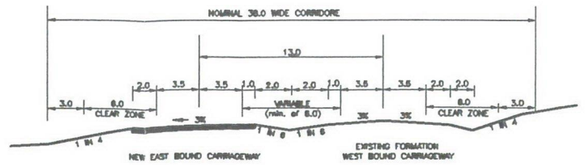

TYPICAL CROSS SECTION FROM CH1600

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R.L. XXXXXX		DESIGNED BY:-	R. CRAWFORD	OCT '99	DATE:	SHEET DESCRIPTION: PLAN		PLAN No: R 1627
					Port Stephens COUNCIL ... a community partnership	MR 108 NELSON BAY RD OPTION 1B BOBS FARM, PROPOSED ULTIMATE DUAL CARRIAGEWAY.	DIRECTORY: M:\jobs\bobs\09\R1627-4.dwg	

DATE	AMENDMENT	OFFICER	DATE	AMENDMENT	OFFICER

RTA
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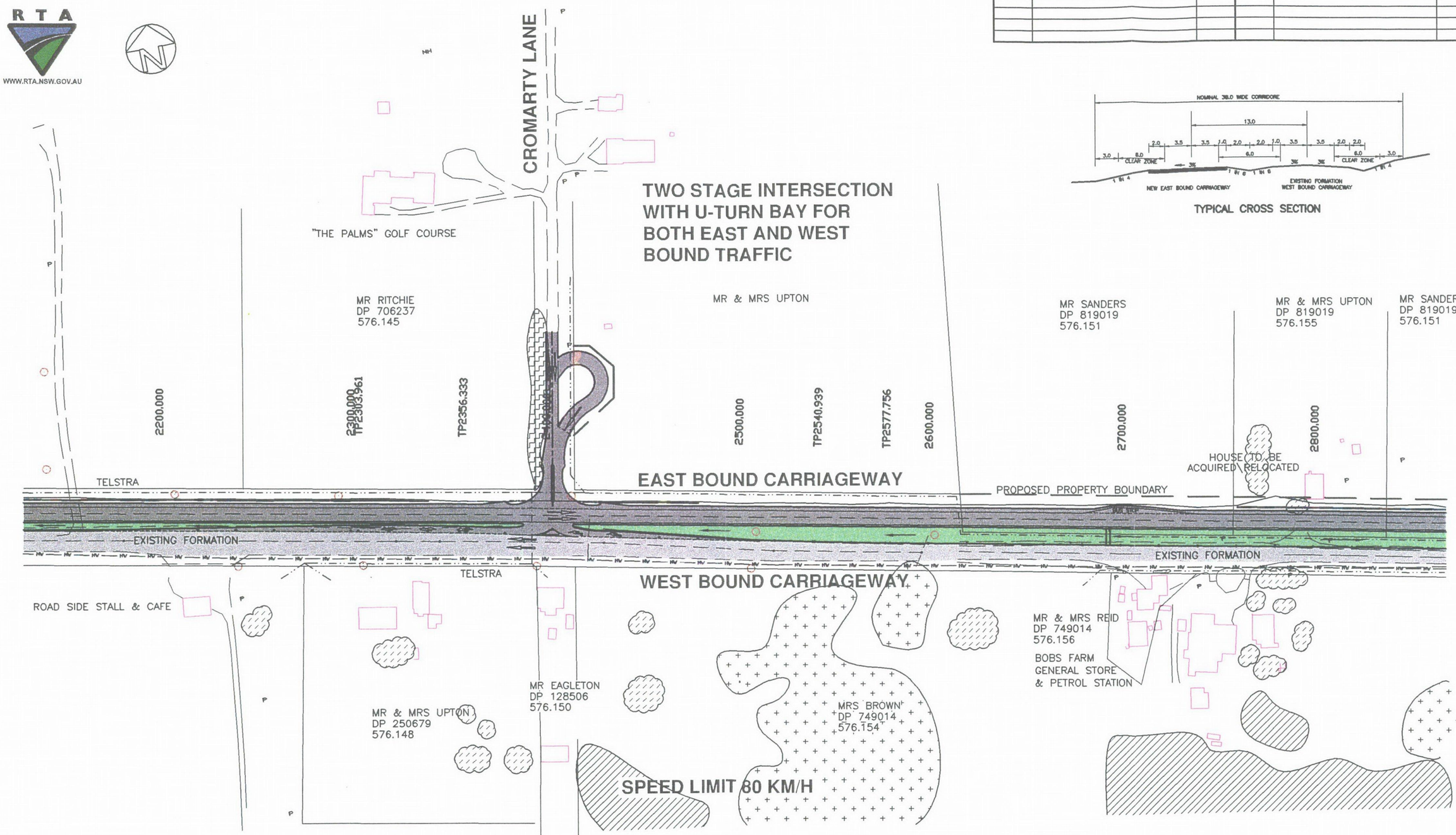
TWO STAGE INTERSECTION WITH U-TURN BAY FOR BOTH EAST AND WEST BOUND TRAFFIC

TYPICAL CROSS SECTION



PROPOSED 300DIA WATER MAIN BY HUNTER WATER (CIRCA 2002).

- SQUIRREL GLIDER DEN TREE
- NEW WORKS
- EXISTING ROAD
- MEDIAN
- BLACKBUTT AND RUSTY GUM OPEN FOREST
- SCATTERED TREES / LANDSCAPING
- FLOODED GUM AND SWAMP MAHOGANY OPEN FOREST
- SWAMP OAK FOREST

PLAN
SCALE 1:2000

DATUM AHD PM XXXXXX R.L. XXXXXX	SCALES PLAN, LONG SECTION -10-5 0 10 20 30 40 50	SURVEY & DESIGN TEAM SURVEY BY:- GEOSPECTRUM APRIL '92 DESIGNED BY:- R. CRAWFORD OCT '99	THESE PLANS HAVE BEEN CHECKED ON SITE AND ARE RECOMMENDED ENGINEER DATE:	Port Stephens COUNCIL ... a community partnership	MR 108 NELSON BAY RD OPTION 1B BOBS FARM, PROPOSED ULTIMATE DUAL CARRIAGEWAY.

FILE No:	No. OF SHEETS:	SHEET No:
E XXXXXX	11	5
SHEET DESCRIPTION: PLAN		PLAN No: R 1627
DIRECTORY: M:\jobs\bobs\09\R1627-5.dwg		

RTA

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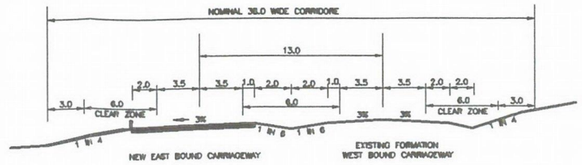
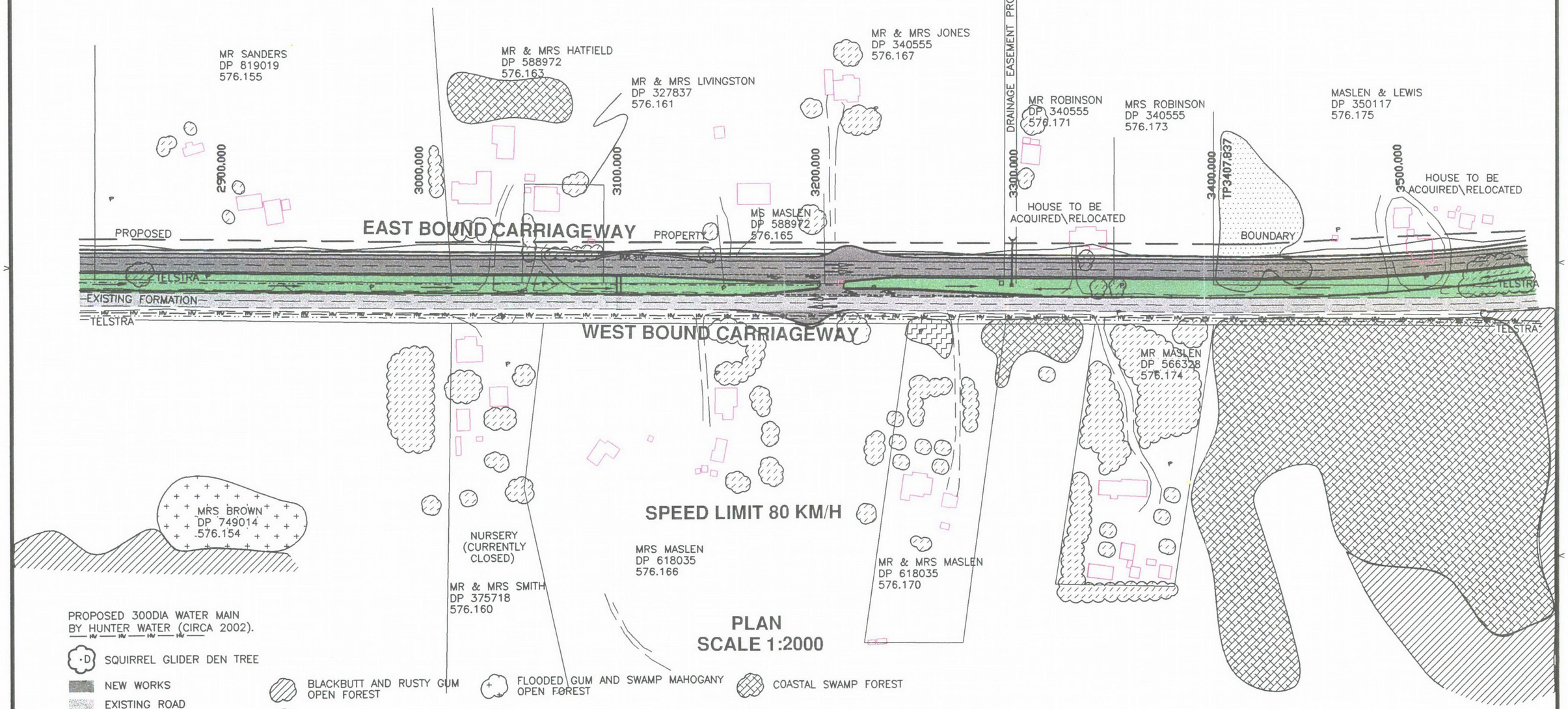
DATE	AMENDMENT	OFFICER	DATE	AMENDMENT	OFFICER



TYPICAL CROSS SECTION
CH 1600 TO CH 3760

U-TURN BAY FOR BOTH EAST AND WEST BOUND TRAFFIC.



PLAN
SCALE 1:2000

PROPOSED 300DIA WATER MAIN BY HUNTER WATER (CIRCA 2002).

SQUIRREL GLIDER DEN TREE

NEW WORKS

EXISTING ROAD

MEDIAN

BLACKBUTT AND RUSTY GUM OPEN FOREST

SCATTERED TREES / LANDSCAPING

FLOODED GUM AND SWAMP MAHOGANY OPEN FOREST

SWAMP OAK FOREST

COASTAL SWAMP FOREST

FLOODED GUM AND SWAMP MAHOGANY OPEN FOREST (DISTURBED)

DATUM AHD PM XXXXXX R.L. XXXXXX	SCALES PLAN, LONG SECTION -10-5 0 10 20 30 40 50	SURVEY & DESIGN TEAM SURVEY BY:– GEOSPECTRUM APRIL '92 DESIGNED BY:– R. CRAWFORD OCT '99	THESE PLANS HAVE BEEN CHECKED ON SITE AND ARE RECOMMENDED ENGINEER DATE:	Port Stephens COUNCIL ... a community partnership	MR 108 NELSON BAY RD OPTION 1B BOBS FARM, PROPOSED ULTIMATE DUAL CARRIAGEWAY.

FILE No:	No. OF SHEETS:	SHEET No:
E XXXXXX	11	6
SHEET DESCRIPTION: PLAN		PLAN No: R 1627
DIRECTORY: M:\jobs\bobs\09\R1627–6.dwg		

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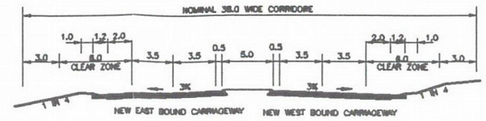
DATE	AMENDMENT	OFFICER	DATE	AMENDMENT	OFFICER



TYPICAL CROSS-SECTION
CH3760 TO CH4930

U-TURN BAY FOR BOTH EAST AND WEST BOUND TRAFFIC

MASLEN & LEWIS
DP 350117
576.175

MR & MRS ROBINSON
DP 809679
576.181

PROPOSED DRAINAGE EASEMENT

HOUSE TO BE ACQUIRED \ RELOCATED

3500.000

3600.000

TP3614.585

3700.000

3800.000

3900.000

R1000

TELSTRA

EAST BOUND CARRIAGEWAY

EXISTING FORMATION

WEST BOUND CARRIAGEWAY

TELSTRA

PROPOSED PROPERTY BOUNDARY

MRS MASLEN
DP 618035
576.166

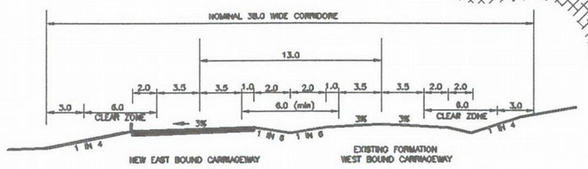
MR & MRS MICHEL
DP 529513
576.186

MR SADLER
DP 529513
576.190

MR & MRS CHALKER
DP 529513
576.194

MESSERS DYMOCK
DP 529513
576.198

SPEED LIMIT 80 KM\H



TYPICAL CROSS SECTION
CH 1600 TO CH 3760

PLAN
SCALE 1:2000

PROPOSED 300DIA WATER MAIN
BY HUNTER WATER (CIRCA 2002).

SQUIRREL GLIDER DEN TREE

NEW WORKS

EXISTING ROAD

MEDIAN

BLACKBUTT AND RUSTY GUM OPEN FOREST

SCATTERED TREES / LANDSCAPING

FLOODED GUM AND SWAMP MAHOGANY OPEN FOREST

SWAMP OAK FOREST

COASTAL SWAMP FOREST

FLOODED GUM AND SWAMP MAHOGANY OPEN FOREST (DISTURBED)

PAPERBARK AND SWAMP MAHOGANY OPEN FOREST

DATUM AHD	SCALES	SURVEY & DESIGN TEAM			THESE PLANS HAVE BEEN CHECKED ON SITE AND ARE RECOMMENDED		MR 108 NELSON BAY RD OPTION 1B BOBS FARM, PROPOSED ULTIMATE DUAL CARRIAGEWAY.	FILE No: E XXXXXX	No. OF SHEETS: 11	SHEET No: 7
PM XXXXXX	PLAN, LONG SECTION -10-5 0 10 20 30 40 50	SURVEY BY:-	GEOSPECTRUM	APRIL '92	ENGINEER	Port Stephens COUNCIL ... a community partnership		SHEET DESCRIPTION: PLAN		PLAN No: R 1627
R.L. XXXXXX		DESIGNED BY:-	R. CRAWFORD	OCT '99	DATE:			DIRECTORY: M:\jobs\bobs\09\R1627-7.dwg		

RTA
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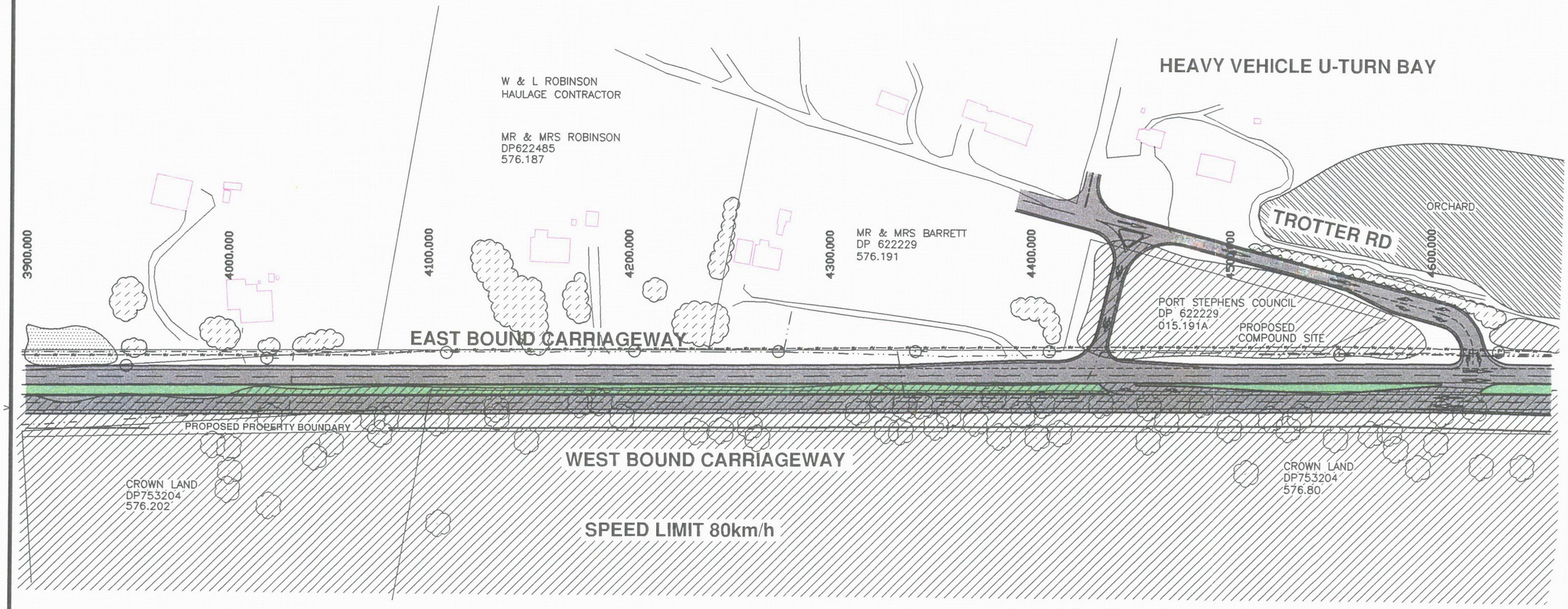
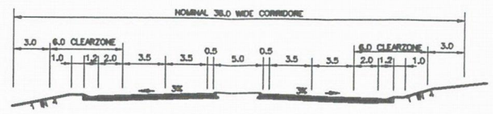
DATE	AMENDMENT	OFFICER	DATE	AMENDMENT	OFFICER





TYPICAL CROSS-SECTION
CH3760 TO CH4930

PLAN
SCALE 1:2000

PROPOSED 300DIA WATER MAIN
BY HUNTER WATER (CIRCA 2002).

SQUIRREL GLIDER DEN TREE

NEW WORKS

EXISTING ROAD

MEDIAN

BLACKBUTT AND RUSTY GUM OPEN FOREST

SCATTERED TREES / LANDSCAPING

FLOODED GUM AND SWAMP MAHOGANY DISTURBED OPEN FOREST

DATUM AHD	SCALES	SURVEY & DESIGN TEAM			THESE PLANS HAVE BEEN CHECKED ON SITE AND ARE RECOMMENDED			
PM XXXXXX	PLAN, LONG SECTION -10-5 0 10 20 30 40 50	SURVEY BY:-	GEOSPECTRUM	APRIL '92	ENGINEER	MR 108 NELSON BAY RD OPTION 1B BOBS FARM, PROPOSED ULTIMATE DUAL CARRIAGEWAY.	FILE No: E XXXXXX	No. OF SHEETS: 11	SHEET No: 8
R.L. XXXXXX		DESIGNED BY:-	R. CRAWFORD C. SMITH	OCT '99	DATE:		SHEET DESCRIPTION: PLAN		PLAN No: R 1627
							DIRECTORY: M:\jobs\bobs\07\R1627-8.dwg		

Port Stephens COUNCIL ... a community partnership

DATE	AMENDMENT	OFFICER	DATE	AMENDMENT	OFFICER

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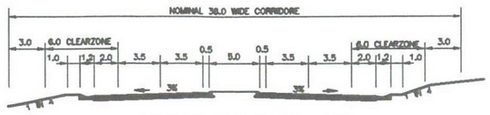
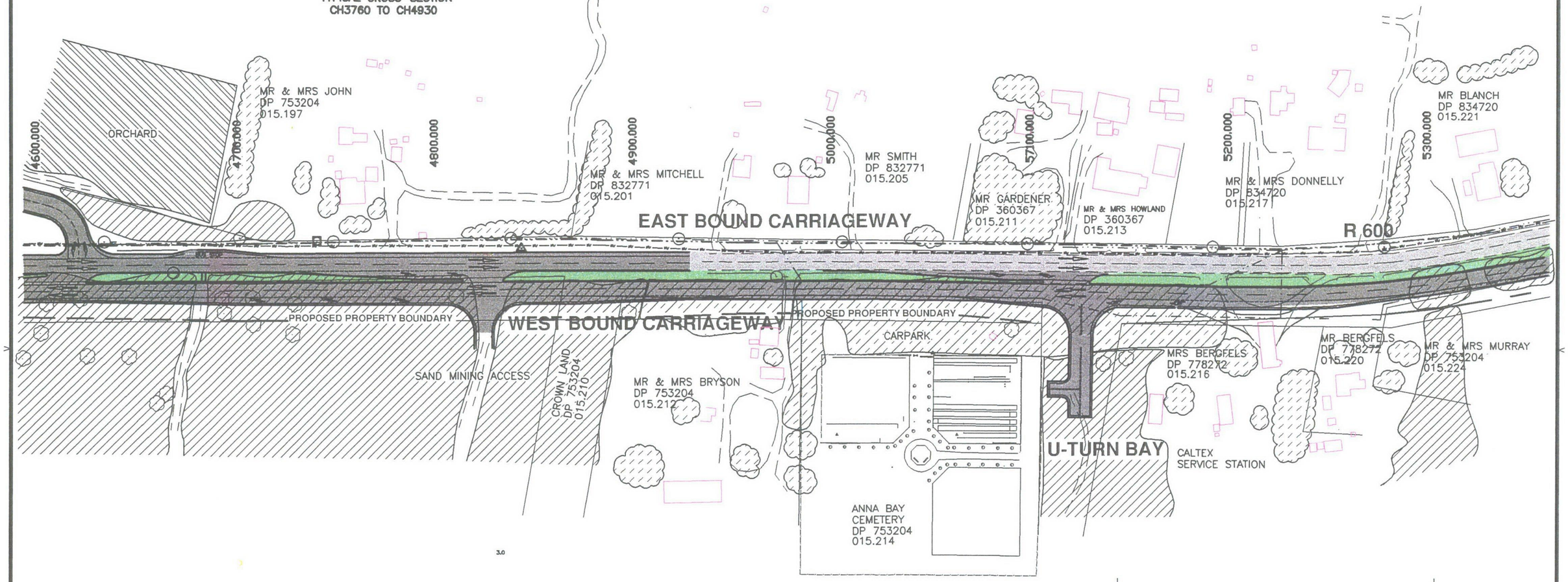
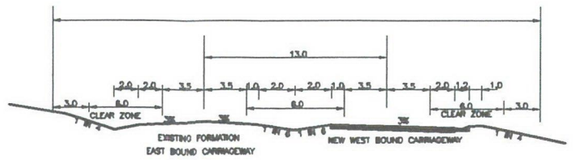


TYPICAL CROSS-SECTION
CH3760 TO CH4930





TYPICAL CROSS-SECTION
CH4930 TO CH5520

80 KM/H SPEED LIMIT

PLAN
SCALE 1:2000

PROPOSED 300DIA WATER MAIN
BY HUNTER WATER (CIRCA 2002).

SQUIRREL GLIDER DEN TREE

NEW WORKS

EXISTING ROAD

MEDIAN

BLACKBUTT AND RUSTY GUM OPEN FOREST

SCATTERED TREES / LANDSCAPING

BLACKBUTT AND RUSTY GUM OPEN FOREST– CLEARED UNDERSTOREY

DATUM AHD PM XXXXXX R.L. XXXXXX	SCALES PLAN, LONG SECTION -10-5 0 10 20 30 40 50	SURVEY & DESIGN TEAM SURVEY BY:– GEOSPECTRUM APRIL '92 DESIGNED BY:– R. CRAWFORD OCT '99 C. SMITH	THESE PLANS HAVE BEEN CHECKED ON SITE AND ARE RECOMMENDED ..... ENGINEER DATE:	Port Stephens COUNCIL ... a community partnership	MR 108 NELSON BAY RD OPTION 1B BOBS FARM, PROPOSED ULTIMATE DUAL CARRIAGEWAY.

FILE No:	No. OF SHEETS:	SHEET No:
E XXXXXX	11	9
SHEET DESCRIPTION: PLAN		PLAN No: R 1627
DIRECTORY: M:\jobs\bobs\07\R1627-9.dwg		

DATE	AMENDMENT	OFFICER	DATE	AMENDMENT	OFFICER

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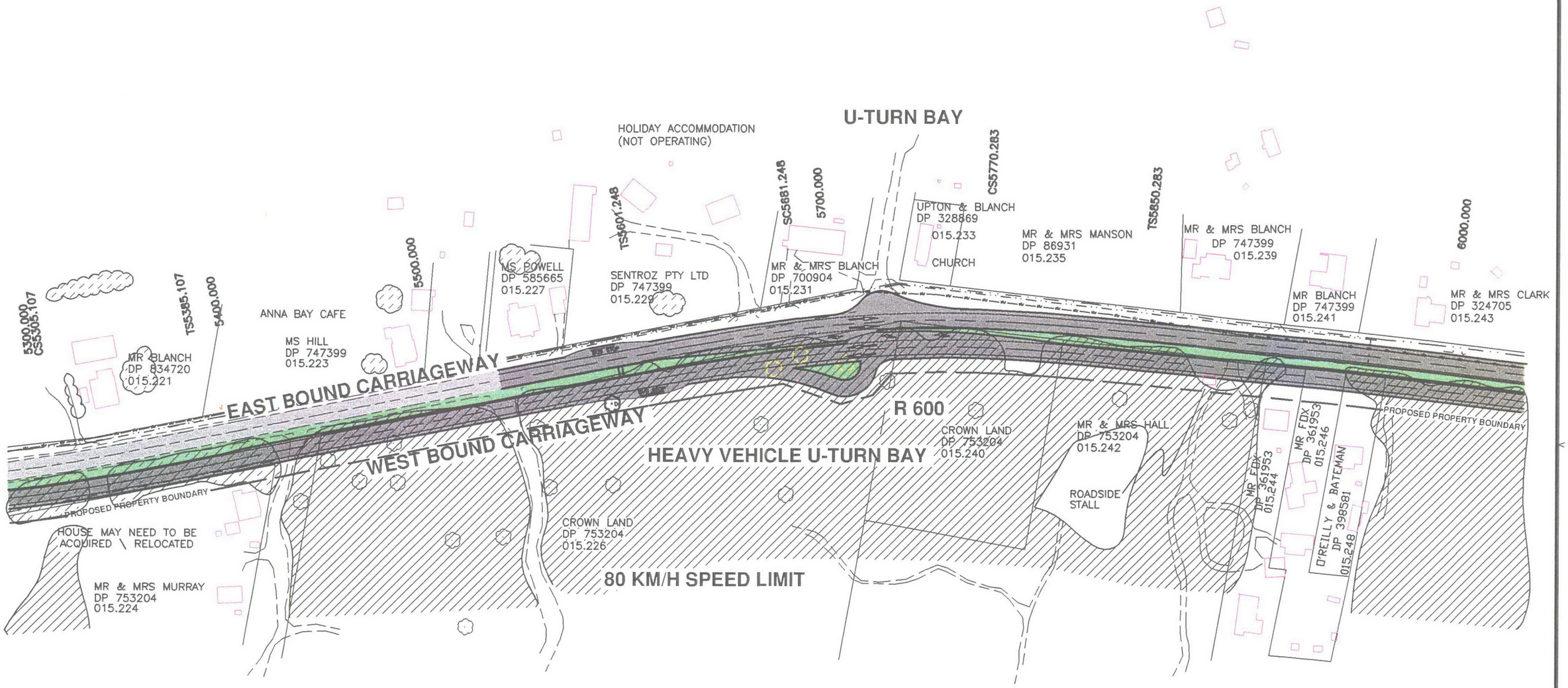
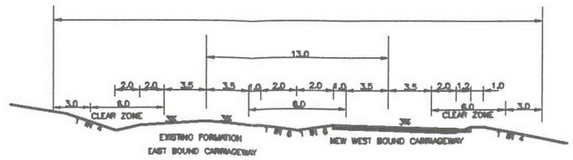


PROPOSED 300DIA WATER MAIN
BY HUNTER WATER (CIRCA 2002).

- SQUIRREL GLIDER DEN TREE
- NEW WORKS
- EXISTING ROAD
- MEDIAN
- BLACKBUTT AND RUSTY GUM OPEN FOREST
- SCATTERED TREES / LANDSCAPING
- BLACKBUTT AND RUSTY GUM OPEN FOREST– CLEARED UNDERSTOREY

PLAN
SCALE 1:2000



TYPICAL CROSS–SECTION
CH4930 TO CH5520

DATUM AHD	SCALES	SURVEY & DESIGN TEAM			THESE PLANS HAVE BEEN CHECKED ON SITE AND ARE RECOMMENDED		MR 108 NELSON BAY RD OPTION 1B BOBS FARM, PROPOSED ULTIMATE DUAL CARRIAGEWAY.	FILE No: E XXXXXX	No. OF SHEETS: 11	SHEET No: 10
PM XXXXXX	PLAN, LONG SECTION -10-5 0 10 20 30 40 50	SURVEY BY:–	GEOSPECTRUM	APRIL '92	ENGINEER	Port Stephens COUNCIL ... a community partnership		SHEET DESCRIPTION: PLAN		PLAN No: R 1627
R.L. XXXXXX		DESIGNED BY:–	R. CRAWFORD C. SMITH	OCT '99	DATE:			DIRECTORY: M:\jobs\bobs\07\R1627–10.dwg		

DATE	AMENDMENT	OFFICER	DATE	AMENDMENT	OFFICER

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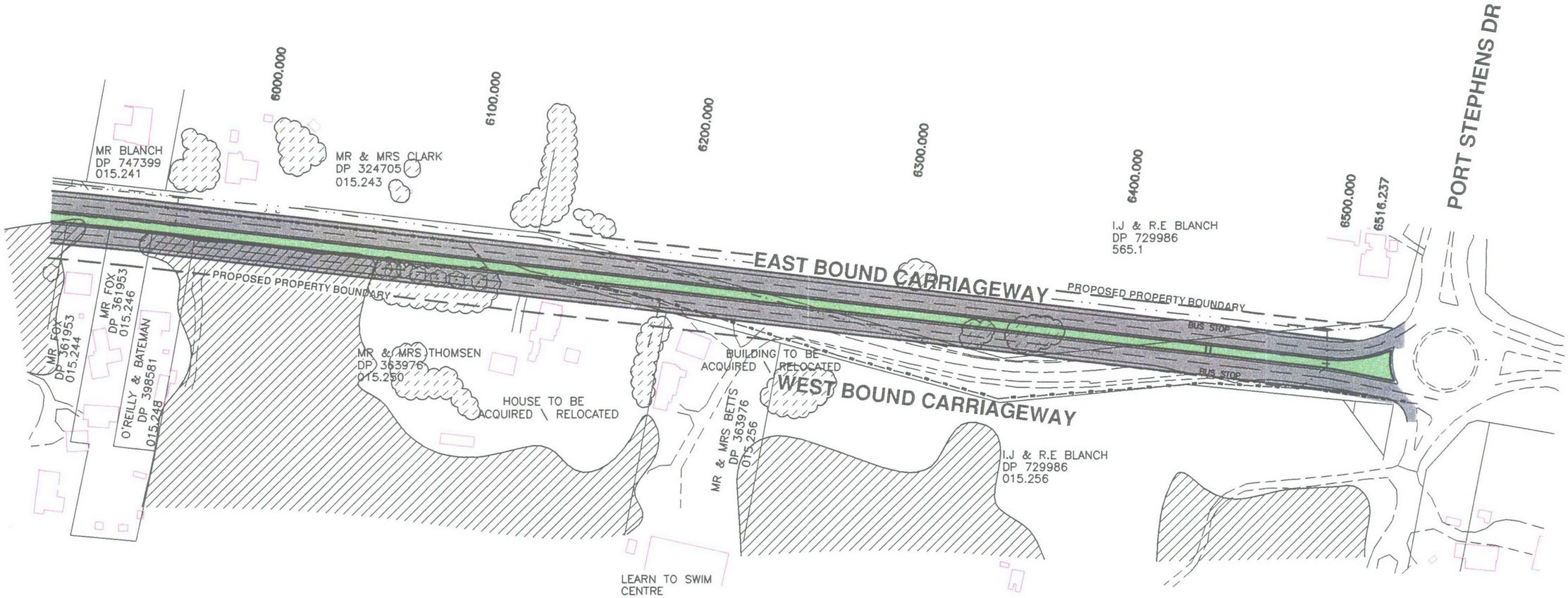


80 KM/H SPEED LIMIT

PLAN
SCALE 1:2000

PROPOSED 300DIA WATER MAIN
BY HUNTER WATER (CIRCA 2002).

·D SQUIRREL GLIDER DEN TREE

NEW WORKS

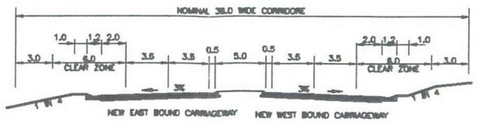
EXISTING ROAD

MEDIAN

BLACKBUTT AND RUSTY GUM OPEN FOREST

SCATTERED TREES / LANDSCAPING

BLACKBUTT AND RUSTY GUM OPEN FOREST – CLEARED UNDERSTOREY



TYPICAL CROSS-SECTION
CH5520 TO CH6516.237

DATUM AHD	SCALES	SURVEY & DESIGN TEAM			THESE PLANS HAVE BEEN CHECKED ON SITE AND ARE RECOMMENDED			
PM XXXXXX	PLAN, LONG SECTION -10-5 0 10 20 30 40 50	SURVEY BY:-	GEOSPECTRUM	APRIL '92	ENGINEER	MR 108 NELSON BAY RD OPTION 1B BOBS FARM, PROPOSED ULTIMATE DUAL CARRIAGEWAY.	FILE No: E XXXXXX	No. OF SHEETS: 11	SHEET No: 11
R.L. XXXXXX		DESIGNED BY:-	R. CRAWFORD C. SMITH	OCT '99	DATE:		SHEET DESCRIPTION: PLAN		PLAN No: R 1627
					Port Stephens COUNCIL ... a community partnership		DIRECTORY: M:\jobs\bobs\07\R1627-11.dwg		

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SOUTH MELBOURNE VIC 3005

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TAREE NSW 2430

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DX 9507 CROWS NEST

ERM