EIS 1407 Appendices

AB017133

Review of environmental factors : upgrading of Pacific Highway

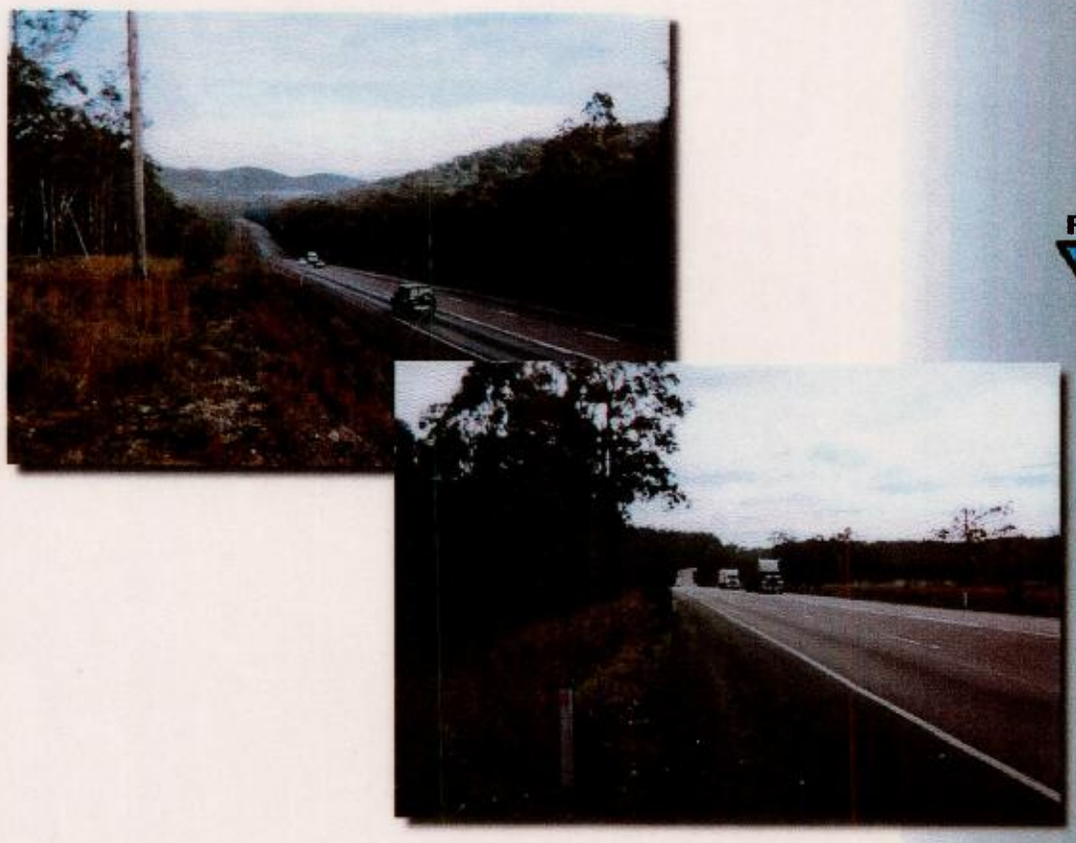
Karuah to Bulahdelah

Karuah to Bulahdelah

Pacific Highway Upgrading

Review of Environmental Factors

Upgrading the Pacific Highway



RTA

Appendices

MITCHELL ERM McCOTTER

APPENDICES

Appendix A
Community Newsletters

COMMUNITY NEWSLETTER

PACIFIC HIGHWAY UPGRADE

Karuah to Bulahdelah

August 1997 No 1

A study examining the environmental impacts of upgrading the Pacific Highway between Karuah and Bulahdelah is currently underway. This newsletter explains the background and scope of the study and how you can be involved.

Upgrading the Pacific Highway

Over the next ten years, the Pacific Highway will undergo a major reconstruction programme between Hexham and the Queensland border making it safer for all road users. This is the result of a joint State and Federal government initiative.

A 40 kilometre section of highway between Karuah and Bulahdelah is one of the areas targeted for early improvement (see map). It is currently a single carriageway with two lanes, widening to three lanes in some areas to allow for overtaking. The proposed upgrading work will provide separate carriageways with two lanes in each direction.

The Environmental Assessment

The concept design for upgrading this section of the Highway is currently being prepared by the Roads and Traffic Authority (RTA). Before the design can be finalised and upgrading works approved, an environmental assessment must be undertaken. Environmental consultants, ERM Mitchell McCotter, have been engaged to carry out this assessment.

The environmental assessment, called a Review of Environmental Factors (REF), will examine the proposal's effect on the natural, social and economic environment. This will involve examining issues such as noise, air quality, water quality, flooding, soil erosion, flora and fauna, heritage and land use.

Potential impacts of the highway upgrade during and after construction will be assessed and measures to minimise impacts will be determined.

A diagram showing the key steps in the study process is provided overleaf.

How You Can Be Involved

An important aim of the study process is to keep you informed, identify any concerns you may have about the project, and address these concerns in the REF. There are a number of ways in which you can be involved.

Community Workshops

A workshop will be held in Hawks Nest on Wednesday 10 September 1997. The aim of the workshop is to introduce members of the project team, outline the reasons for the highway upgrade, explain what is involved in the REF and seek your views. Anyone with an interest in the project is welcome to attend.

Date: Wednesday 10 September 1997
Time: 6:00pm to 8:00pm
Venue: Hawks Nest Community Hall

Meetings

Individual meetings will be held with local community groups and affected landowners to discuss the project and specific issues of concern.

Day to day Contact

Members of the project team will be available during this planning stage of the project, if you would like to ask questions, raise issues or make comments. Contact details are provided below.

Public Exhibition

The completed REF and concept design for the upgrade will be placed on public exhibition. During this time you will have an opportunity to review the documents and forward any comments to the study team. All written submissions will be assessed before a decision is made to proceed with the project.

Newsletters

Further newsletters will be prepared to keep you informed about community involvement activities, along with updates on the progress of the study.

So that we can be sure that they reach people who are interested in the project, we would like to develop a mailing list for distribution of future issues of the newsletter.

If you wish your name to be placed on that mailing list, you are invited to return the coupon included in this newsletter.

You might also let your friends know of the invitation, so that the list can be as complete as possible for the next issue.

Further Information

If you have any questions or comments about the project or wish to be placed on the mailing list for further updates, please do not hesitate to contact:

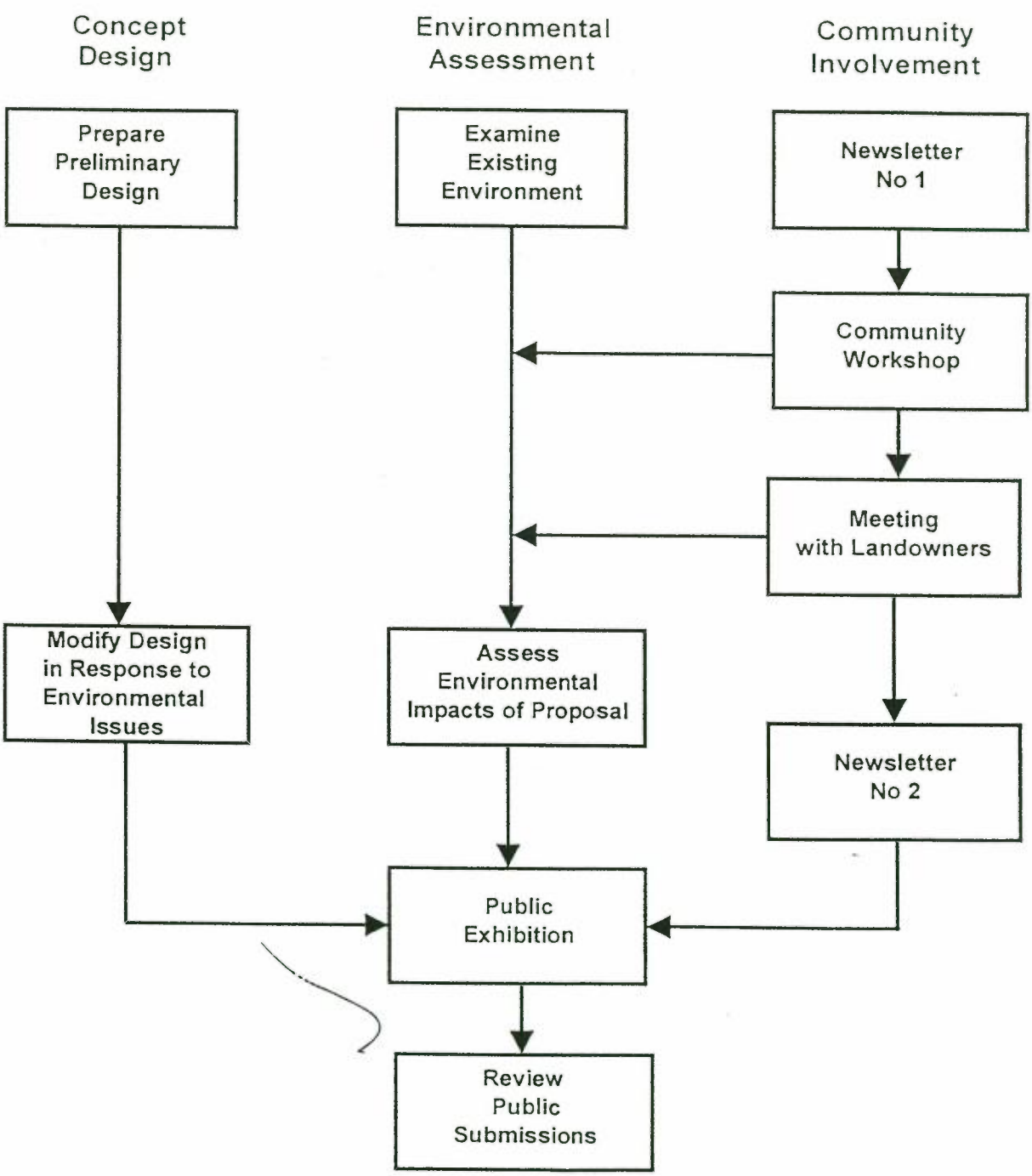
Mr K Hays
RTA
PO Box 469
Newcastle NSW 2300
Phone: (049) 240 322
Fax: (049) 295 271

or

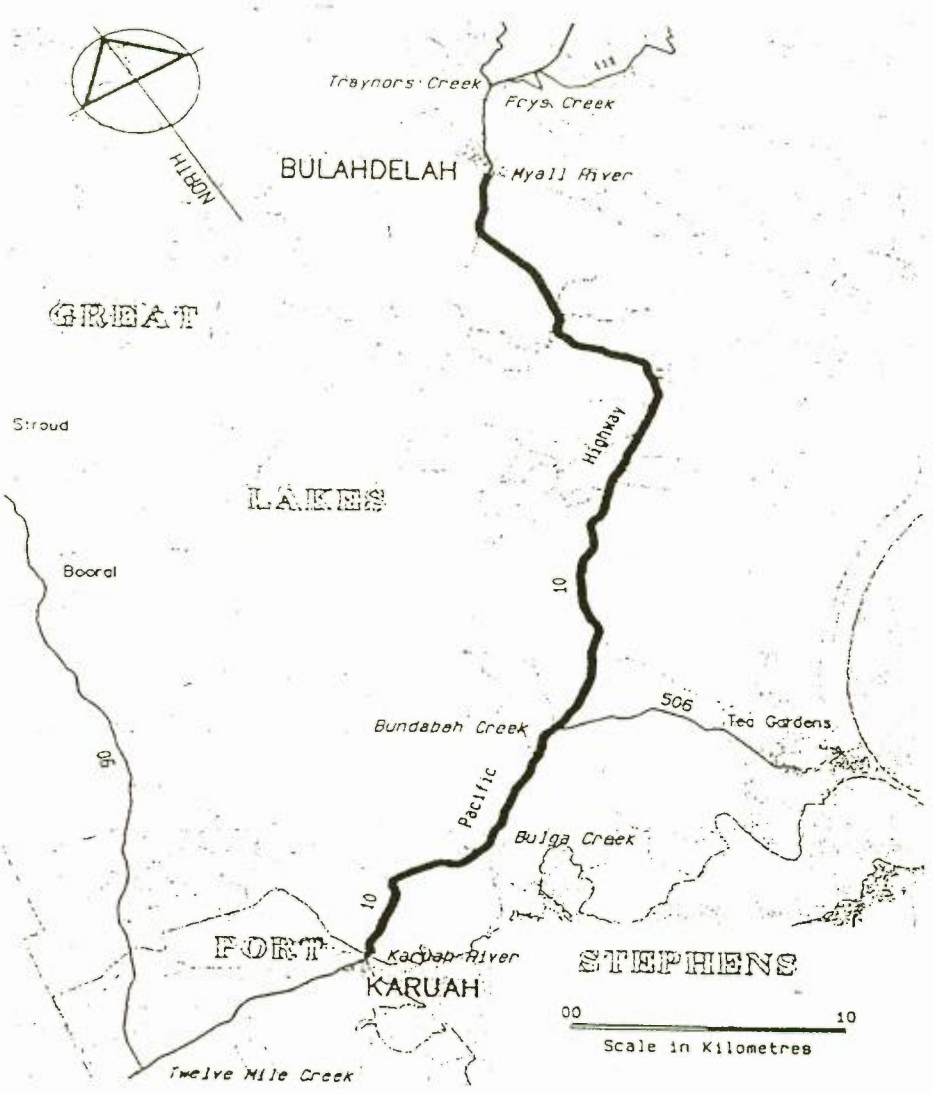
Mr Chris Power
ERM Mitchell McCotter
PO Box 487
Taree NSW 2430
Phone: (065) 512 760
Fax: (065) 510 536

PACIFIC HIGHWAY UPGRADE
KARUAH TO BULAHDELAH

The Study Process



Locality Map



R T A

Pacific Highway Upgrade
Karuah to Bulahdelah

Newsletter No 2

March 1998

Introduction

Newsletter No. 1 issued in August 1997 provided general information about plans to upgrade the Pacific Highway between Karuah and Bulahdelah.

The project is part of the 10 year Pacific Highway Reconstruction Program. Planning for the project is being funded by the NSW State Government as part of its $1.6 billion commitment to provide safer travelling conditions on the highway between Hexham and the Queensland border.

This newsletter provides an update on the progress of the study, and has been distributed broadly throughout the study area.

Importantly, this newsletter describes how you can have further input into this project.

What has happened so far?

After consultation with local residents and other key stakeholders (such as representatives from Council and environmental groups), the Roads and Traffic Authority completed a preliminary environmental assessment of the area.

A design concept was then developed for upgrading the section of highway between Karuah and Bulahdelah, which proposes dual carriageway be built within, and adjacent to, the existing highway corridor.

Consultants, ERM Mitchell McCotter, were engaged in August 1997 to prepare a Review of Environmental Factors (REF), to cover the area bounded by the project.

The REF will examine the concept design for the proposed dual carriageway, and study its effects on the natural, social and economic environment. It will also assess issues such as noise, air and water quality, flooding, soil erosion, flora and fauna, heritage and land use.

Environmental Findings to Date

The community will be invited to comment on the REF report before any final decisions are made.

The REF is presently being finalised for release. Some of its preliminary findings are summarised below:

- no aboriginal heritage items of significance were located
- ways to reduce noise have been identified
- fauna crossings and habitat corridors have been retained
- provision has been made in the concept design for issues affecting access to individual properties
- suitable concrete/asphalt batching plant sites have been identified, and
- landscaping treatments have been determined.

Community Workshop Findings

A community workshop was held at Hawks Nest on 10 September 1997.

The study team explained a number of key features of the concept design, and issues arising from the environmental assessment to those participating in the workshop.

Importantly, residents also had an opportunity to comment on the project and raise issues they felt should be studied more closely.

This workshop, as well as other meetings with individual landholders, provided a two-way flow of information between the study team and the community about the project.

The study team has greatly appreciated the interest shown by residents in this project, and welcomes that local input and the insight it has provided. This has been added to the knowledge gained from field investigations.

A number of key issues were raised during discussions with the community, including:

- local access to properties
- noise impacts during construction and operation of the new road
- visual impacts
- drainage and surface water management
- the standard of major intersections
- bus safety
- appropriate staging of the project

These issues were taken into account when developing the concept design and undertaking the environmental assessment.

Forthcoming Activities

Public Display of Concept Design- 11 March1998

A public display of the concept design for this project will be held at 'Annie's', Nerong Village on 11 March 1998, starting at 2:00pm.

All local residents and others interested in learning more about the Karuah to Bulahdelah project are encouraged to attend this important display.

The aim of the display is to provide interested parties with details of the concept design and a general update on project progress, as well as providing a further opportunity for the local community to ask questions and make comment.

Date: 11 March 1998
Time: 2:00pm to 8:00pm
Venue: 'Annie's', Nerong Village

Landholder Meetings

Affected landholders will have an opportunity to meet with members of the project team to discuss issues relating to individual properties.

The RTA will contact landholders to arrange meeting times in mid February. Alternatively, landholders can arrange meetings by contacting either Kevin Hays or Tony Fish (see *Further Information*).

What is the next step?

The REF will be finalised after careful study of feedback from the Community Focus Meeting and meetings with landowners, or other comments made direct to the study team.

The completed REF and concept design will then be placed on public display, during which time the community will be able to review the documents and forward comments to the study team.

All written submissions will be assessed before any subsequent decisions are made about the project.

Further information

If you have any questions or comments about the project, please do not hesitate to contact:

Tony Fish
ERM Mitchell McCotter
PO Box 487
Taree NSW 2430
Tel: (02) 65512760
Fax: (02) 65510536

or

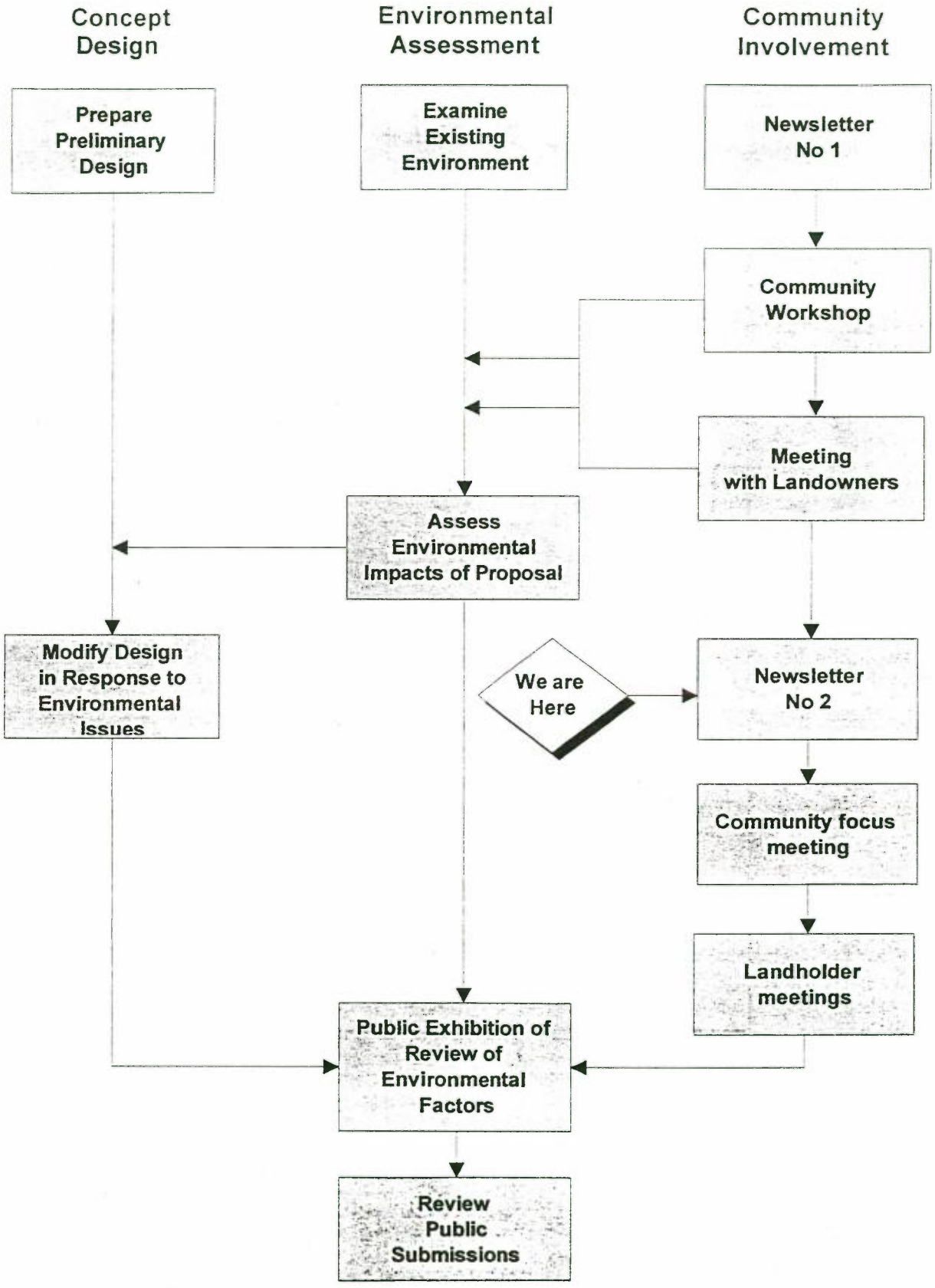
Kevin Hays
Roads and Traffic Authority
PO Box 469
Newcastle NSW 2300
Tel: (02) 49240322
Fax: (02) 49295271

Are you on the mailing list?

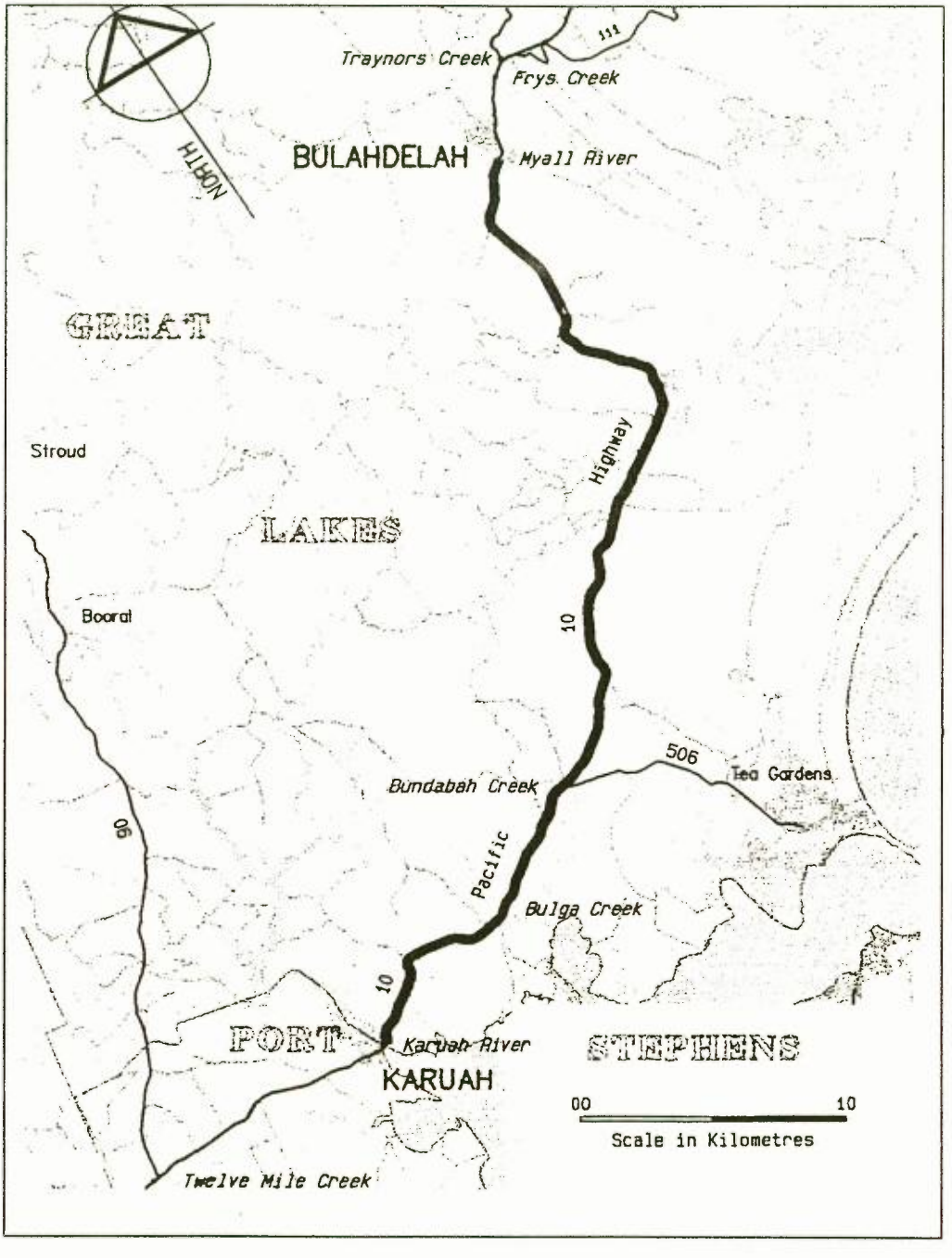
If you would like to receive information updates on the highway upgrade project and are not yet on our mailing list, either Tony Fish or Kevin Hays (see *Further Information*) can arrange for you to be included on a list for future mailouts.

PACIFIC HIGHWAY UPGRADE
KARUAH TO BULAHDELAH

The Study Process



Locality Map



Appendix B
Minutes and Feedback of Community Workshops

REF FOR PACIFIC HIGHWAY UPGRADING, KARUAH TO BULAHDELAH

Minutes of Planning Focus Meeting Held at 9.30 am on 19 August 1997 at RTA Offices Newcastle

Attendance:

Charlie Fisher	Taree Police
Sue Elks	NPWS
Shane Kempnich	DUAP
Lance Watt	DLWC
Denise Kent	SFNSW
John Moore	Telstra
Chris Ross	Telstra
Kevin Hays	RTA
Garry McPherson	RTA
Chris Power	ERM Mitchell McCotter

Apologies:

Ken McCallum	PWS
Darren Ward	NorthPower
John Taylor	Bushfire Officer, GLSC
Cathryn Ferguson	EPA
Glenn Handford	GLSC
Debra Martin	Ambulance Service
Tim Erwin	Optus
Greg Summer-Hayes	Mineral Resources
Kathryn Brookes	National Trust Heritage
Clarke Gallagher	Australian Heritage Commission

Other Invitees:

Keith Simpson	Bushfire Services
Dr John Holliday	Fisheries Research Centre
Glenda Briggs	Department of Agriculture
Ian Lewis	Fire Officer SES

ITEM 1

Kevin Hays thanked everyone for attending and outlined the RTA's project for upgrading the Pacific Highway between Karuah and Bulahdelah. The upgrade is programmed for completion in a period of five years and its main objectives are to improve safety and convenience for commuter and commercial traffic utilising the

highway. The RTA anticipates that commercial traffic will eventually divert to the New England Highway as Pacific Highway traffic volumes grow.

The value of the project is in the order of $150 million and initial construction is programmed to commence mid 1998. Wherever possible the upgrading will be confined to the existing corridor.

The project team is aiming to complete its preliminary design early in 1998.

ITEM 2

Chris Power circulated copies of a map showing the extent of the REF project together with a draft Table of Contents and program for the REF. The southern limit of the REF commences at 57.84 and consequently does not involve the SEPP 14 wetland or the quarry access issues immediately north of Karuah - these are being addressed in the Karuah Bypass EIS.

The program is currently in week 4. The project team is seeking verbal comments today from those attending regarding their departments' requirements for the REF, and written comments by next Monday 28 August, in order to meet the project program requirements.

An outline was given of the community consultation program.

The consultants are to advise the RTA by 25 August of any sections of the project which the consultants believe will require the preparation of an EIS, rather than an REF, based on preliminary investigations.

The Draft Table of Contents was discussed.

ITEM 3

Sue Elks pointed out the importance of the Aboriginal heritage issue and the need to check both Native Title and Aboriginal Land Claim applications along the route, and to liaise with all relevant Aboriginal groups.

ITEM 4

Lance Watt raised the issues of Native Title, topography and landform, SEPP 46, protected lands, groundwater and aquifers, compliance with the Rivers and Foreshores Improvement Act, tidal and flooding issues, silt, debris and water pollution.

ITEM 5

Sue Elks indicated that NPWS is considering acquisition of land around the Fame Cove area at the southern end of the route and is also investigating the Nerong State Forest. She also underlined the importance of not just looking at threatened species in the Ecological Assessment and at looking at cumulative impacts on issues such as wildlife corridors and water quality during both construction and ongoing operational phases.

ITEM 6

In response to a question from Lance Watt, Kevin Hays indicated that it was not known at this stage whether Crown Land acquisition will be required, but if so it is not likely to be extensive. Lance Watt indicated that proposals for acquisition of Crown Land would raise Native Title issues.

ITEM 7

Denise Kent indicated that SFNSW will require two southbound accesses from the Nerong State Forest. Kevin Hays indicated that access, intersections and U turning facilities were major issues and that input from the community and Government Departments will play a significant role in determining these.

ITEM 8

Kevin Hays advised that Garry McPherson is currently working on concept designs, and the Wagga office of RTA is to be engaged to assist with final design, together with possibly some external consultancy. Kevin hopes to go to detailed design on the central section of the route (13 kilometres) in mid September.

ITEM 9

Charlie Fisher indicated that the police would be seeking of provision of adequate U turn areas, safe areas for radar teams to police high speed traffic, and adequate fatigue and rest areas preferably with toilet facilities. The police would also like to see the quarry at the southern end of the project access the highway off the side road to provide better traffic management. The police would like to see a truck stop area provided between Bulahdelah and Taree, which is to the north of this particular section of the highway.

ITEM 10

Kevin Hays indicated that the RTA design and construction program will need to address the frustration of motorists who will strike extensive sections of construction work in the construction phase.

ITEM 11

Sue Elks raised the issue of cumulative impacts caused by the lack of toilets at rest areas, which caused people and their pets to intrude extensively into the bushland around those areas. Disposable nappies also cause significant impacts around rest areas with inadequate provision and regular maintenance of rubbish receptacles.

ITEM 12

John Moore and Chris Ross indicated the Sydney to Brisbane optic fibre cable crosses the highway at around 4 points, with additional break-offs to local areas. However this will be able to be managed by design and construction techniques. Telstra will also be available to undertake relocations if required.

ITEM 13

Shane Kempnich indicated the Department of Urban Affairs and Planning has an interest in the requirements of and timing for any EISs that will be required. They will also be looking to see that the requirements of the Government Departments are addressed.

ITEM 14

In response to a question Chris Power indicated that SEPP 44 will not be relevant as this REF is being dealt with under Part V of the Environmental Planning and Assessment Act, but that Koala issues will be addressed in the Ecological Assessment.

ITEM 15

In response to a question Kevin Hays indicated that no overall strategy has yet been provided for linking various sections of highway construction - the RTA's main objective is to provide dual carriageways northwards from Raymond Terrace. The issue of town bypasses at areas such as Karuah and Bulahdelah has not yet been finalised. The RTA is aiming to target road trauma areas as much as possible.

ITEM 16

Charlie Fisher indicated the police would like to see current accident areas eliminated, but pointed to the need to fix the entire highway. Past experience indicated that when one accident area is eliminated, accidents often increase elsewhere, eg the Taree four mile.

Charlie also put forward the possibility that sap from overhanging eucalypt trees may contribute to accidents by creating a slippery road surface. Kevin Hays agreed to refer this issue to the relevant RTA research team.

REF FOR PACIFIC HIGHWAY UPGRADING, KARUAH TO BULAHDELAH

Minutes of Community Consultation Meeting Held on 10 September 1997 at Hawks Nest Community Hall

Present:

RTA Representatives

Tony Thurtell
Garry McPherson
Keith Schumack
Kevin Hays
Bob McKay
Don Arasakumar

ERM Mitchell McCotter Representatives

Chris Power
Lisa Brown
Tony McNamara

28 Land Owners and Community Members

1. Doors opened 6.00. Views of photo montages, intersection designs and discussion with RTA and ERM MM representatives for 30 minutes.

2. Opening by Chris Power - presentation of agenda.

3. Presentation by Kevin Hays:
   - background to the project;
   - outline of construction and funding program over the next 10 years;
   - options for road designs; and
   - explanation of concept design and detail design.

4. Chris Power
   - outline of REF process; and
   - outline of issues
     - Natural Environment
     - Human Environment.

5. Lisa Brown
   - explanation of flora/fauna issues;
   - comments from members of the public to the effect that:
     - an injured squirrel glider had been found on the Highway near the quarry;
     - Koalas have been sighted at Mill Hill; and
     - Phascogales have been sighted in the area.

6. Chris Power
   - comments on Community Consultation Program:
     - started early August; and
     - should take 6 months to complete.

7. Presentation by Garry McPherson on an outline of the design process:
   - explanation of traffic volumes;
   - identification of problem areas; and
   - explanation of types of intersections involving signals and double crossings.

8. Comments/questions from members of the public in attendance:

- There is a need for a similar public consultation meeting for landowners/residents of Bulahdelah.

- The landowners meeting at Hawks Nest 17 September should make provision for groups as well as individual interviews.

- Some of the landowners did not receive Newsletter No 1
  - it was agreed that RTA would check landowners against RTA mailing list to ensure that all land owners have been contacted.

- Concern was voiced that this 40k section of Highway would be squeezed back into 2 lanes south of Bulahdelah and north of Karuah
  - it was explained by Bob McKay that there is a planned and funded program for the overall upgrading of the Pacific Highway. There are still issues to be resolved at both Bulahdelah and Karuah, however the process has been commenced.

- Why has the bridge at Karuah not been duplicated as yet?
  - response by RTA that there are substantial environmental impacts associated with this issue, requiring an EIS, however this process has been commenced.

- Which section will be the first to commence construction?
  - not known at this stage however the Viney Creek Road to Waterholes Gap section appears to have the least environmental constraints.

- Can you explain the meaning of seagulls, double crossings and why there is a lack of adequate shoulder width on section of the existing road?
  - these issues were dealt with in the presentation by Garry McPherson. General policy is to have a 2.5m shoulder.

  How do you propose to deal with the two existing cross streets? (Viney Creek Road and Tea Gardens Road (Hagan's Lane))?
  - stagger the intersection. An explanation was provided of the RTA policy of having a maximum 5km spacing between crossings of dual carriageways. It was noted that this presented a problem at Waterholes Gap and Burdekins Gap.

- What is the usual road reserve width for dual carriageway?
  - varies depending on design, however 60m will be adequate for most of the road.

- Will there be a visual barrier such as vegetation between separated dual carriageways?
  - yes.

- In that case how will it be possible to identify properties on the opposite side of the road?
  - this is an issue which needs to be addressed.

- From a safety view point what is a desirable separation width for dual carriageways?
  - 10m minimum. With any less separation, a barrier is desirable.

- Can a sheltered left turn be provided for safe entry into private property?
  - minor tapers plus the road shoulder width should be adequate for safe entry.

- Has any consideration been given to the needs of logging trucks?
  - the matter has been discussed with State Forests. General design is to cater for 19m long vehicles.

- How have buses eg school buses been provided for?
  - bays can be provided along the highway to suit school bus stopping points. Liaison with bus operators will be necessary to determine consent locations.

- How do you propose to deal with traffic noise at Nerong?
  - this issue will be dealt with according to government regulations. Noise loggers are being put out 11/9/97 along the highway to determine current noise levels and to assist in predicting future levels.

- Can the Tea Gardens intersection be improved having regard to the numbers of visitors at Christmas?
  - this point is noted.

- How will the issue of commercial signage along the highway be dealt with?
  - this issue will be looked at by the RTA.

- Apart from the double crossing intersection designs can specific provision be made for U turns for heavy vehicles?
  - there may be a need to provide additional facilities for trucks. This issue will be addressed in the detailed design stage.

- B-doubles enter the highway at 'Nerong Park'. Has this been taken into account?
  - the issue is noted and will be addressed.

- Can some private accesses be signposted to indicate that they are not a lay-by? (problem with rubbish and blocking private entrance)
  - it may be necessary to look at this issue on a case by case basis.

- Problem of pedestrian refuges on highway at Bulahdelah being knocked over.
  - this is a difficult issue but does not relate to this project as it is located in Bulahdelah township. Generally this problem is being resolved with town by-passes. At Bulahdelah the issue is yet to be resolved.

- What is the time factor for construction?
  - sooner rather than later. No final date for commencement. Work to proceed in 3 major contracts.

Meeting finished at 8.40 pm.

Appendix C
Precis of Community Discussions

NAME: Barry French

PROPERTY: Lot 3 DP838128, Mill Hill Karuah

DATE: 9 September 1997

MODE: Telephone

ISSUES:

- presently exit directly from 300 acre property onto highway at truck stop a little north of Karuah;
- concerned about access issues - doesn't want to travel north to head back south again;
- can't make Community Consultation Meeting on 10 September;

COMMENTS:

ERM Project Manager will discuss with Garry McPherson re access/design.

NAME: Lynette Lawry

PROPERTY: Lot 2 Pacific Hwy, Bulahdelah

DATE: 15/9/97

MODE: Exit Survey

ISSUES:

- live opposite Booral turn-off and have Koalas and Echidnas on my property which I want looked after. Lots of other fauna but those two I feel are pretty rare;

- my business of Boarding Kennels and caravan and boat storage does involve on/off highway north and south so I may have to move my driveway!

COMMENTS:

Would like a landowners meeting on site. Arrangement made for Garry McPherson to contact when appropriate.

NAME: Norm Needham

PROPERTY: Lot 9 DP321237, 6480 Pacific Hwy North Arm Cove

DATE: 16 Sept 1997

MODE: Telephone

ISSUES:

- wishes to discuss access arrangements;

COMMENTS:

Arrangements made for Garry McPherson to contact to discuss - telephone home 4997 3030 work 02 9438 4404.

NAME: Lynette Lawry

PROPERTY: Lot 2 DP230463, 9348 Pacific Hwy Bulahdelah

DATE: 16 Sept 1997

MODE: Telephone

ISSUES:

- wishes to discuss access issues when design is being considered - her property approximately opposite Stroud turnoff;
- spent $8,000 in early 1990's on access at request of Council and RTA - wants to make sure new access arrangements are satisfactory.

COMMENTS:

Arrangements made for Garry McPherson to contact her telephone 02 49974574.

NAME: Les Montgomery

PROPERTY: Blue roofed house west side of road south of Bulahdelah

DATE: 16 Sept 1997

MODE: Telephone

ISSUES:

- wants to discuss access issues

COMMENTS:

ERM Project Manager has made arrangements for Garry McPherson to contact him when appropriate on telephone 02 4997 4738.

NAME: Yvonne and Peter Kendall

PROPERTY: "Annies" Nerong Village

DATE: 12 Sept 1997

MODE: Letter to K Hays

ISSUES:

- attached sketch given to Garry McPherson proposing changes to highway intersection at Nerong - detailing reasons;
- suggest under road culvert to facilitate pedestrian access to buses;
- drawing attention to noise generated on north side of powerlines, requesting noise assessment check that area;
- reconfirming offer of use facilities for next community information meeting.

COMMENTS:

Garry McPherson to investigate intersection/design/pedestrian issues;

Noise assessment will take account of all noise generated from the highway.

NAME: Sancha Pty Ltd

PROPERTY: Lot 19 Myall River Road Bulahdelah

DATE: 15 Sept 97 (received 17 Sept 97)

MODE: Letter

ISSUES:

- Myall River Road is at the bottom of the hill north of Burdekins Gap. Northbound vehicles travel at high speed and southbound vehicles increase speed when travelling south to assist ascent over Burdekins Gap;
- wish to ensure design of access to and from Myall River Road allows for safe entry and exit of long vehicles which are frequent visitors to our property, in both northerly and southerly direction;
- please let us know when you expect to have details of the entry and exit from Myall River Road available for viewing.

COMMENTS:

Referred to Garry McPherson for attention;

Acknowledgment of letter sent 18 Sept 97.

NAME: P & Y Kendall

PROPERTY: "Annies" Nerong Village

DATE: 10 Sept 97 (received 17 Sept 97)

MODE: Exit Survey

ISSUES:

- a pleasant, well run and informative community consultation meeting;
- relieved to know people of Nerong will be catered for as an important intersection with unsafe gradients at the exit site at present;
- appreciated immediate installation of noise logger;
- attaching submission letter dated 12 September 1997.

COMMENTS:

Submission letter of Sept 97 dealt with separately.

NAME: Graham Fullerton

PROPERTY: Lot 4 DP621236

DATE: 17 Sept 97

MODE: Landowner interview

ISSUES:

- previous RTA maintenance operations fronting the adjoining Lot 3 to the south have concentrated overland flows through Lot 3 and into Lot 4;
- request that drainage be amended to reinstate sheet flow across Lot 3 (in lieu of concentrated flow) and divert additional flow to the main drain in front of Lot 4 which flows into the dam on Lot 4;
- if drainage diversion increases flow the dam wall may require further reinforcement;
- would be happy with a U turn bay located approximately on the northern boundary of Lot 4 or in the vicinity of the adjoining fish farms.

COMMENTS:

RTA will investigate drainage issues and location of U turn facility.

NAME: Col Green, General Manager Mountain Industries Pty Ltd

PROPERTY: Part Lot 222 DP573153 (Mountain Industries Quarry)

DATE: 17 Sept 97

MODE: Landowner interview

ISSUES:

- proposal for new major intersection with Pacific Highway is included in the EIS recently exhibited by Great Lakes Council and to be determined at the October Council meeting;
- in formulating their proposal Mountain Industries liaised with RTA officers;
- quarry does not own frontage to Branch Lane within approximately 1 km of the highway - this a separate, privately owned lot.

COMMENTS:

This section of the Highway is to be considered in the Karuah Bypass EIS - Kevin Hays will liaise with Graham Kinnear;

As quarry does not own land near the highway adjoining Branch Lane, does not appear realistic to require access to Branch Lane at present - may be preferable to approve DA with contribution towards Type C intersection, noting that the issue of access to Branch Lane and the quarry will need to be addressed in finalising the Karuah upgrade EIS;

Propose to discuss this issue with Great Lakes Council next week.

NAME: Jim Whitton

PROPERTY: Lot 3 DP785172

DATE: 17 Sept 97

MODE: Landowner interview

ISSUES:

- concerned re potential high hazard accident area at the southern termination of the proposed works as shown on the mosaic presented at the community meeting, as it is located in at a dangerous site, a little to the north of a major curve.

COMMENTS:

Propose to ultimately have dual carriageway all the way from Raymond Terrace to Queensland border;

RTA is aware of need to finish stages of construction which adjoin the old road at safe locations - this will be accounted for in the design and construction staging processes, and in association with consideration of the Karuah Bypass EIS.

NAME: Myall Koala and Environmental Support Group Inc

PROPERTY: N/A

DATE: 16 Sept 97 (received 18 Sept 97)

MODE: Letter

ISSUES:

- did not receive letter of 5 September inviting attendance at public meeting until 10 September, the day of meeting, insufficient time to arrange attendance;

- propose fauna underpasses under road in fauna sensitive areas. If not viable, maybe animal friendly reflectors be put on roadside posts to help prevent road deaths of animals; and

- did not receive Community Newsletter.

COMMENTS:

Community Consultation Meeting was originally advertised in Newsletter #1. The Groups newsletter should have been received in bulk mailout;

Comments re fauna referred to ecologists; and

Community Newsletter sent to Secretary.

NAME: Michael Kylie

PROPERTY: Lot 221 Pacific Hwy, adjoining quarry at southern end of project.

DATE: 22 Sept 97

MODE: Telephone

ISSUES:

- owns land 100 metres north of Mountain Industries quarry entrance and extending north 509 metres along the highway. The new quarry is proposed to be partly on Mr Kylie's land;
- wishes to discuss with project designers the potential for access to a home site on his land. Garry McPherson will arrange to contact Michael at 043 32 5852;
- has not checked his post box at Karuah - requested newsletter be sent to 31 Bay Road, Toowoon Bay, 2261 in interim.

COMMENTS:

Arrangements made for Garry McPherson to contact Mr Kylie; and

Newsletter sent to Toowoon Bay address.

NAME: Mr Bennell

PROPERTY: Northwest corner of the intersection of Booral Road and Pacific Hwy

DATE: 22 Sept 97

MODE: Telephone

ISSUES:

- concern re impact of proposed road widening.

COMMENTS:

Advised Mr Bennell that proposed road widening in vicinity of his property is most likely on the opposite side of the highway - he will contact Garry McPherson to discuss specific design/access issues.

NAME: Great Lakes Council

PROPERTY: Whole Route

DATE: 19 Sept 97 (received 25 Sept 97)

MODE: Letter

ISSUES:

- request that Council be kept informed of progress;
- Council's main concerns will be retention of satisfactory access to existing Council roads and properties with access to the highway, during both construction process and the long term; and
- minimum standards of intersection shall be according Austroads guides for AADT expected to at least the year 2007.

COMMENTS:

Meeting RTA/ERM/Council proposed to discuss project; and

Design issues referred to G McPherson.

NAME: Veronica Carey and John McIlwraith

PROPERTY: Lot 56 DP806740 - between 61.3 and 66.5 klm

DATE: 20 Sept 97 (received 25 Sept 97)

MODE: Letter

ISSUES:

- letter incomplete and consequently not fully understandable.

COMMENTS:

Telephone not listed with Telstra. Letter sent 25 Sept 97 requesting insertion of missing parts of original letter.

NAME: Mountain Industries Pty Ltd

PROPERTY: Mountain Industries Quarry

DATE: 24 Sept 97

MODE: Letter

ISSUES:

- only concern is access to the north (Taree) and access to the south (Newcastle) from Karuah Quarry;
- the company has development approval for access to the highway - DA 506/95 and anticipates approval for a new quarry, with common entry point to the highway north (Taree side) of The Branch Lane during October 1997; and
- the upgrade is timely and we support the proposal.

COMMENTS:

This property is within the area being considered by the Karuah Bypass EIS;

Referred to Kevin Hays for consideration.

NAME: Mr J.McIlwraith / Ms. V. Carey, 158 Melwood Ave Killarney Hts.

PROPERTY: Lot 56 Pacific Highway, Tea gardens.

DATE: Received 8 Oct 1997.

MODE: Letter.

ISSUES:

- Potential increased levels of noise caused by any encroachment of the new high way alignment.
- Concern with possible loss of sight distance along highway which is currently very good.
- Concern at effects on existing access which was designed to take account of the existing highway alignment.
- Concern at possible impacts on existing landscaped mound and front fence from encroaching traffic.

COMMENTS:

These issues relate mainly to specific design matters. Copy of correspondance forwarded to Kevin Hays for attention.

NAME: Mr G & Mrs D Kaster

PROPERTY: Lot 12 DP242727

DATE: 24/11/97

MODE: Letter

ISSUES:

- Will he still have access to his property during and after upgrading?

COMMENTS:

K Hays advised he would respond.

NAME: Trevor Mavey

PROPERTY:

DATE: 16/12/97

MODE: Telephone

ISSUES:

- Mr Mavey is concerned about his property access and believes RTA and ERM have not paid attention to his concerns.

COMMENTS:

He has had discussions with K Hays on 16/12/97 and was invited to next Community Focus Group Meeting and invited to submit objection.

NAME: Trevor Mavey

PROPERTY:

DATE: 3.2.98

MODE: Letter

ISSUES:

- Concern over the Viney Creek Road east will not be upgraded to a satisfactory standard.

COMMENTS:

K Hays advised and will respond. See previous record.

NAME: Brian and Ann Holden

PROPERTY: 21 Curlew Crescent Nerong

DATE: 18/2/98

MODE: Letter

ISSUES:

- concerns about noise.

COMMENTS:

Matter referred to Murray Curtis for review.

NAME: Paul Simpson - Nerong Ratepayers in Residence

PROPERTY:

DATE: 22 March 1998

MODE: Letter

ISSUES:

- efficiency of acoustic mounds;
- will the improvements remove the noise of engine brakes;
- protection from siltration and debris; and
- access to public transport in the northbound lane.

COMMENTS:

Matters referred to K Hays, G McPherson and Murray Curtis for review and action.

NAME: Andrew French

PROPERTY: Lots 1 & 2

DATE: 26 March 1998

MODE: Letter

ISSUES:

- vehicular access through the same entrance as Bundabah Stud. Can this be made safe for public transport doing U turns on the highway.

COMMENTS:

Referred to Garry McPherson for action.

NAME: R B McCormack

PROPERTY: Lot 7 Pacific Highway

DATE: 25 March 1998

MODE: Letter

ISSUES:

- would like to see the inclusion of a U turn bay adjacent to their front driveway to allow a left - left and a right - right access;
- the median strip between north and south lanes should be mown grass not native plant regeneration as they have young children using the median strip.

COMMENTS:

Referred to Garry McPherson for attention.

NAME: Yvonne & Peter Kendall

PROPERTY: Annies Nerong

DATE: 17 March 1998

MODE: Letter

ISSUES:

- how people will cross the highway to catch buses. An underpass is needed for this purpose;
- drainage

COMMENTS:

Referred to Garry McPherson for information.

NAME: Pamela and David Ransome

PROPERTY:

DATE: 5 March 1998

MODE: Letter

ISSUES:

- Highway road noise at Nerong Village and the erection of noise barriers while the highway is being upgraded;
- a north bound bus and coach section where the buses can pull off the highway safely to drop off passengers; and
- traffic control islands with refuge for the safety of pedestrians to cross the highway with pedestrian signs placed strategically on the highway to inform motorists that people may be crossing.

COMMENTS:

Referred to Garry McPherson for attention.

Appendix D
Government Authority Responses

GREAT LAKES COUNCIL

Breese Parade, Forster
PO Box 450, Forster NSW 2428
DX 7110, Forster

Telephone: (02) 6591 6222
Fax: (02) 6591 6200

ERM Mitchell McCotter
PO Box 487
TAREE NSW 2430

Our Reference: M11/11, F200
JH:JS

Contact: Mr Hulme
Telephone: 02 6591 6262

19 September 1997

Dear Sir

re: UPGRADING OF PACIFIC HIGHWAY KARUAH TO BULAHDELAH

Your letter regarding the preparation of a "Review of Environmental Factors" for upgrading of Pacific Highway, Karuah to Bulahdelah project, is acknowledged.

I ask that Council be kept informed of progress in the matter.

Council's main concerns will be the retention of satisfactory access to existing Council roads, and properties with access to the Highway, during both the construction process and the long term.

Minimum standards of intersections shall be according to Austroads guidelines for AADT expected at least to the year 2007.

Thank you for your correspondence and cooperation to date.

Yours faithfully

R HARTLEY
Director Engineering

Per: J HULME
Subdivision/Development Engineer

g:\judith\hulme\m1111809.doc

Population Change by Locality
1986 to 1991

(1986 and 1991 Census)

Note on the Population Table

The lower-end of the growth range is based on actual annual increase/decrease in the number of people from 1986-1991.
The upper-end is based on annual percentage growth from 1986-1991.
Where a village's classification changed from a rural area in 1986 to an urban area in 1991, the growth rate is unknown.

Urban	1986 Population	1991 Population	% Change 1986-91	% Growth p.a.	Growth Range p.a.
Bobhdelah	1098 5.4%	1092 4.2%	-0.5	-0.1	-1
Coomba Park	n.a.	183 0.7%	n.a.	n.a.	n.a.
Forster	7373 36.1%	9515 36.6%	29.1	5.82	428-534
Green Point	n.a.	429 1.7%	n.a.	n.a.	n.a.
Hawks Nest	1102 5.4%	1251 4.8%	13.5	2.7	30-34
Nabiac	411 2%	509 2%	23.8	4.76	20-24
Nerong	n.a.	36 0.1%	n.a.	n.a.	n.a.
North Arm Cove	n.a.	226 0.9%	n.a.	n.a.	n.a.
Pacific Palms	444 2.2%	437 1.7%	-1.6	-0.32	-1
Smith's Lake	425 2.1%	656 2.5%	54.4	10.8	46-71
Stroud	484 2.4%	558 2.1%	15.3	3.06	15-18
Tea Gardens	572 2.8%	684 2.7%	19.6	3.92	22-27
Tuncurry	3866 18.9%	5051 19.3%	29.7	5.94	230-298
TOTAL URBAN	15,775 77.2%	20,627 79.3%	30.8	6.16	970-1271

Your reference
Our reference 223

Mr Chris Powers
ERM Mitchell McCotter
PO Box 487
TAREE NSW 2430

KBC:DK

3 September, 1997

State Forests of
New South Wales

Bulahdelah District
PO Box 20
Bulahdelah NSW 2423
Phone (049) 97 4206
Fax (049) 97 4812

RE: **State Forests Issues and Requirements**
Pacific Highway Upgrade Karuah to Bulahdelah

Dear Chris,

As discussed in at the Planning Focus Meeting held on 19 August 1997, State Forests has a number of concerns in relation to the upgrading of Pacific Highway between Karuah and Bulahdelah which will affect Nerong State Forest.

1. It is assumed that the proposed dual carriageway that will replace the current highway will not infringe into State Forest estate.

2. Current access to all fire trails will be preserved, and all fences and gates will be maintained.

3. The two main roads coming out of Nerong State Forest - Nugra Rd and Nerong Rd - will require southbound access for the use of future logging traffic.

State Forests has not been contacted by ERM Mitchell McCotter in reference to the upgrading of the Karuah to Bulahdelah section of the Pacific highway. Information on Nerong State Forest's significance in terms of flora, fauna, geology, history, forest uses and resource is available, as well information on current and future management of the forest. This information is relevant to the development of the REF.

State Forests are unable to attend the Community Workshop on 10 September 1997, but would like to further discuss the project and the above

mentioned issues. It is suggested that a suitable time would be next week, 11 September 1997 meeting 10am at Bulahdelah office.

If this time is inconvenient or there is a need for further clarification of the above or any other issues of concern, please do not hesitate in contacting me.

Yours faithfully,

Denise M. Kent

Denise Kent
Planning Forester
for
K.B. CARTER
District Forester
Bulahdelah.

OPTUS

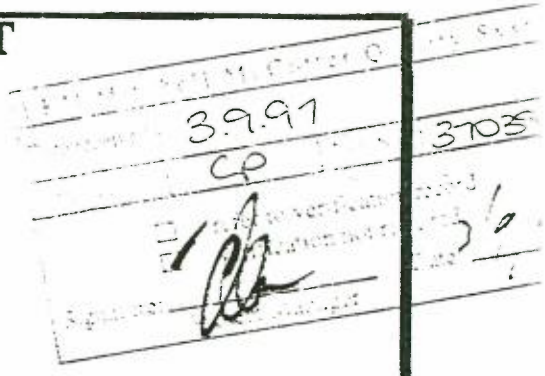
communications

LEVEL 28, OPTUS CENTRE
101 MILLER STREET
NORTH SYDNEY NSW 2060
AUSTRALIA
ACN 052 833 208

TELEPHONE (02) 9342 7320
FACSIMILE (02) 9342 7453

FAX COVER SHEET

TO	:	Kevin Hays
COMPANY	:	RTA
DATE	:	22 August 1997
FAX NUMBER	:	(049) 295 271
FROM	:	Lisa Brooker
NUMBER OF PAGES	:	1 (including Cover Sheet)



STATE HIGHWAY 10 - PACIFIC HIGHWAY
PROPOSED UPGRADE KARUAH TO BULAHDELAH

Thank you for your letter regarding the above.

Optus has no assets in this area and no future cable works are planned at this stage.

Therefore, Optus has no issues or requirements in respect to the preparation of the REF

If you have any further queries in relation to this matter, please do not hesitate to contact Ernest Green on (02) 9342 7094.

Regards.

Lisa

your ref
our ref ER 524

Quality System
3 9.97
CP | Ref No. 37039
refer to verification record
verification not required
Date: 2/9/97

MANAGER
ROADS AND TRAFFIC AUTHORITY (NEWCASTLE)
PO BOX 469
NEWCASTLE 2300

LAND & WATER CONSERVATION

ATTENTION: Mr. K. Hays

Friday, 29 August, 1997

Dear Sir

STATE HIGHWAY 10 - PACIFIC HIGHWAY - PROPOSED UPGRADE KARUAH TO BULAHDELAH.

I refer to your letter dated 6 August 97 requesting this Department's comments in regard to the above proposal.The Department has now reviewed this matter and provides the following information on the principle issues.

NATIVE TITLE

Following the introduction of the Commonwealth Native Title Act, resulting from the High Court Mabo judgement, Aboriginal people are now able to seek recognition of the native title to land. Native title is the name Australian law gives to the traditional ownership of land and waters that have always belonged to Aboriginal people according to their traditions, laws and customs. RTA must therefore be aware that should Crown land form part of any proposal that the issue of Native Title must be addressed notwithstanding any proposal to acquire Crown land.

An initial investigation within our Maitland Office, on application, will indicate if a past act has extinguished native titie. If it has not been extinguished it will be necessary to submit a non claimant application so that the matter can be determined by the National Native Title Tribunal.

Further information in regard to native title can be obtained by contacting Mr Terry St George at the Maitland Office of the Department on 02 49 342280.

SOIL CONSERVATION ISSUES

In relation to soil erosion, sedimentation and land degradation in general the Department advises that the Review of Environmental Factors should address at least, but not be limited to the following issues:-

- topography and landform
- soil type and soil erodibility
- acid sulfate and potential acid sulfate soils
- vegetation management, and SEPP 46 if applicable
- Protected Land (Soil Conservation Act 1938), if applicable
- erosion and sediment control strategy, including techniques

GROUNDWATER

The proponent must identify sensitive groundwater aquifers of the area and potential changes to groundwater regime and quality as a result of the development. All groundwater works ie. bores and excavations below groundwater must be licensed with the DLWC prior to construction.

FORESHORE STABILITY

It is noted that the proposal involves duplicating bridges or major culverts at a number of watercourses. The Department of Land and Water Conservation has a statutory responsibility under the Rivers and Foreshores Improvement Act, 1948, to ensure the stability of river and estuary systems. Development in areas requiring excavation and removal of vegetation adjacent to streams and waterbodies can destabilise banks and increase sedimentation. It is for these reasons that the Department requires consultation prior to the

464 King Street Newcastle West NSW 2302 PO Box 2213 Dangar NSW 2309 DX 4338 Newcastle West
Telephone (049) 294 346 Facsimile (049) 296 364

commencement of works with 40m of the high water mark of water bodies.

In this regard, the REF should consider the following aspects:
* A full project description, including details of all proposed clearing, draining, excavation and filling and discussion of the environmental implications of these activities.
* Any proposed changes to the existing tidal channel should be assessed with respect to changes to the hydraulic behaviour, sedimentation and pollution of the watercourse.
* The potential impacts of the construction, the proposed safeguards and the management procedures to reduce any adverse impacts on habitats should be detailed.
* Outline a management plan which minimises the amount of silt, rubbish, debris and pollutants entering the watercourses.
* Scour analysis should be undertaken to ensure that there is no significant scour around the bridge piers and abutments during a flood which would cause siltation downstream.
* A description of the design features to be incorporated into the proposed development to guard against long term actual and potential environmental disturbances, particularly in respect of maintaining the natural hydrological regime.
* A description of any proposed measures or practices to be taken to guard against actual and potential environmental disturbances to the water quality and hydrological regime during the construction of the proposal. This should include likely impacts caused during flood events.
* A description of the reinstatement plans.
* An examination of flooding impacts of the proposal on adjacent properties.
* A description of expected alteration of sediment movement patterns as a result of the proposal, (that is, what changes will occur to the natural erosion and accretion rates).
* A full description of the methods of excavation, construction and material placement.
* Details of embankment design.

I trust the above information is of assistance in regard to your consideration of this proposal. Should there be any further enquiry in this matter, please contact Mr Jeff Hunt, Catchment Planning Manager, at our Newcastle Office on 049 294346.

Yours Faithfully

Jeff Hunt, CATCHMENT PLANNING MANAGER

26 August 1997

Roads and Traffic Authority
PO Box 469
Newcastle NSW 2300

NSW
NATIONAL
PARKS AN
WILDLIFE
SERVICE

Our reference: NS:ns 97/1062; 3050-1
Your reference: MPN 10/410.1663

ATTENTION: Mr. Kevin Hays

Dear Sir

**PACIFIC HIGHWAY RECONSTRUCTION PROGRAM (PHRP)
(PROPOSED UPGRADE, KARUAH TO BULAHDELAH) -
PREPARATION OF REVIEW OF ENVIRONMENTAL FACTORS (REF)**

Thank you for your letter of 6 August 1997, inviting a National Parks and Wildlife Service (NPWS) representative to attend a Planning Focus meeting on 19 August 1997 at Newcastle, and NPWS to nominate issues or requirements for inclusion in the REF.

ERM Mitchell McCotter, the environmental consultants for this project, had previously requested that a NPWS representative attend a meeting at the consultant's office in Taree on 14 August 1997 to discuss ecological issues. Nick Sheppard, the coordinator of NPWS's PHRP environmental assessment team, attended this meeting, at which the route and its surroundings, as depicted on air photos, was discussed in detail in terms of ecological issues and NPWS's preferred approach to the preparation of the REF. Cultural heritage issues and an approach to cultural heritage assessment were also briefly discussed. Subsequently, Sue Elks, Environmental Planning Officer, attended the Newcastle meeting and provided further information on NPWS's requirements for the REF.

The following comments and information document and expand on NPWS's verbal responses at these meetings.

Northern Zone
GIO House
24 Moonee Street
Coffs Harbour NSW
Australia
PO Box 914
Coffs Harbour 2450
Fax: (066) 516 187
Tel: (066) 515 946

Head Office
43 Bridge Street
Hurstville NSW
Australia
PO Box 1967
Hurstville 2220
Fax: (02) 9585 6555
Tel: (02) 9585 6444

1. Natural Heritage issues to be addressed (identification, assessment of conservation significance at local, regional, State and national scales, etc)

1.1 Areas of natural vegetation, in particular, areas relatively unaffected by habitat degrading processes or features such as:

- weeds;
- introduced pests;
- inappropriate fire regimes;
- logging, thinning;
- tracks;
- fragmentation;

and/or containing vegetation communities, ecosystems, species or populations of particular conservation significance and/or quantity, such as:

- vegetation associations that are rare and/or of restricted extent;
- rainforest;
- old growth forest;
- wetlands (including those mapped under State Environmental Planning Policy (SEPP) No.14 Coastal Wetlands);
- watercourses and ponds;
- threatened species;
- sites (breeding, roosting ,feeding, hibernating) of significant populations of both protected and threatened species;
- high species richness (biodiversity); and
- significant wildlife corridors.

1.3 Areas of human disturbance or exotic vegetation showing significant utilisation by native species.

1.4 Lands dedicated or suitable for dedication as conservation reserves and/or for forestry:

- Nerong State Forest (northern compartments (attachment 1) identified in the Interim Forest Assessment process as forests of high conservation value that may need to be set aside from logging for inclusion in a Comprehensive, Adequate and Representative reserve system);
- land around Mt. Karuah (attachment 2) identified as possessing high conservation values, and therefore suitable for possible acquisition and dedication as a NPWS reserve.

1.5 Lands subject to SEPP No.46 (Protection and Management of Native Vegetation).

1.6 "Protected Lands" as defined by the *Soil Conservation Act 1938.*

1.7 Lands zoned for Environmental Protection in the relevant Local Environmental Plan.

1.8 Other matters outlined in attachment 3 (Environmental Issues to be Addressed).

2. Natural Heritage Assessment Process (should include):

2.1 Literature survey and database searches;

2.2 Field surveys;

2.3 Consultation with local naturalists, environmentalists and landholders and their local organisations;

2.4 Identification and assessment of impacts (both localised and route encompassing) on native flora and fauna. Off-site impacts, including but not limited to:

- human and pet activities in and adjacent to rest areas;
- sedimentation, turbidity and erosion resulting from construction activities;
- pollution (e.g. grease, fuel, rubber) from vehicles during and after construction;

should not be neglected.

2.5 Identification and evaluation of potential amelioratory measures (particular attention should be paid to ameliorating the impacts of impacts such as habitat fragmentation (and its associated demographic and genetic effects), physical or traffic barriers to wildlife movements, and the provision of (increased) access for weeds, pests, people and fire). Compensatory habitat should be considered as an option.

3. Cultural Heritage Assessment

The assessment process should be two-fold; firstly, Aboriginal consultation, secondly, archaeological assessment (desk top and field surveys).

3.1 Aboriginal Consultation

Firstly, an information exercise (providing details on the project specifications, options etc) to Aboriginal communities, seeking comment. Consultation should be with as many Aboriginal persons and representatives as possible, as no one group or person can claim to speak for all Aboriginals, and there is likely to be a wide range of views and knowledge, both amongst and within Aboriginal communities. Consultation should commence as soon as possible, as adequate time needs to be provided to allow concerns and information to be gathered and if necessary, discussed within Aboriginal communities, before being provided to the consultants.

The recent Eastern Gas Pipeline Environmental Impact Statement development process provides a good model for consultation with Aboriginal communities. Such a process provides real involvement for Aboriginal communities instead of the all too common, last minute, hurried consultation exercises related to requests for "Consent to Destroy" permits. It is essential that the consultation process does not attempt to gather information and/or views remotely (i.e. no proforma, postal surveys), or try to tell Aboriginal communities what their concerns are or should be; consultation should be face to face and through community meetings. Communities should be provided with mechanisms through which they can make effective input into the environmental assessment process in a culturally appropriate way (this may require some confidentiality provisions). Initial consultation should avoid concepts that may be alien to communities, such as "gaps in the data" and "regional models".

Overall, an effective provision of information and meaningful consultation exercise, followed by planning and data analysis to address major concerns that have been identified, should materially assist the subsequent archaeological assessment process. Adopting an appropriate approach to consultation with Aboriginal communities should result in increased Aboriginal involvement in the environmental assessment process, for example, in terms of interest, providing statements of the significance of sites to Aboriginals, and providing timely and high quality assessment of those sites which will be unavoidably impacted upon by the upgrade, and thus require "Consents to Destroy".

3.2 Archaeological Assessment

- The presence or absence of Aboriginal sites should be determined (through a search of the NPWS Aboriginal Sites Register, and field surveys), and the significance of the area to the local Aboriginal community be subsequently determined.
- Aboriginal sites and places of significance to the local Aboriginal community should be detailed on a map in a management plan. This map should be at the same scale as the map of the proposed route engineering works to assist in determining the impact of the works on the identified cultural sites.
- A description provided of the measures proposed to mitigate the impact of the development on the identified cultural sites.
- A contingency plan developed that details the measures to be undertaken if archaeological sites are discovered during route construction works.

3.3 Preferred Route Criteria

- avoids cultural sites or places of significance
- has adverse impact on the least number of sites possible, and/or sites in poor condition and/or of low significance
- crosses land which is already heavily disturbed
- crosses areas which are not known or unlikely to be rich in sites
- crosses areas where sites are known or likely to be of comparatively low significance (i.e. not able to provide much scientific information, and not of particular significance to Aboriginal communities)

Finally, NPWS has concerns with the position of the southern end of the current upgrade, given the locations of a nearby river and SEPP 14 wetland No.777 to the southeast of this point, an area of (from the aerial photographs) apparently relatively undisturbed, natural vegetation to the southwest of this location, and the possible impact on these features of potential high conservation value resulting from realigning a sharp road curvature immediately to the south of the termination of the proposed upgrade. NPWS recommends, therefore, that the location of the southern end of the upgrade be reconsidered in the light of potential constraints posed by the above features to any future upgrade to the south.

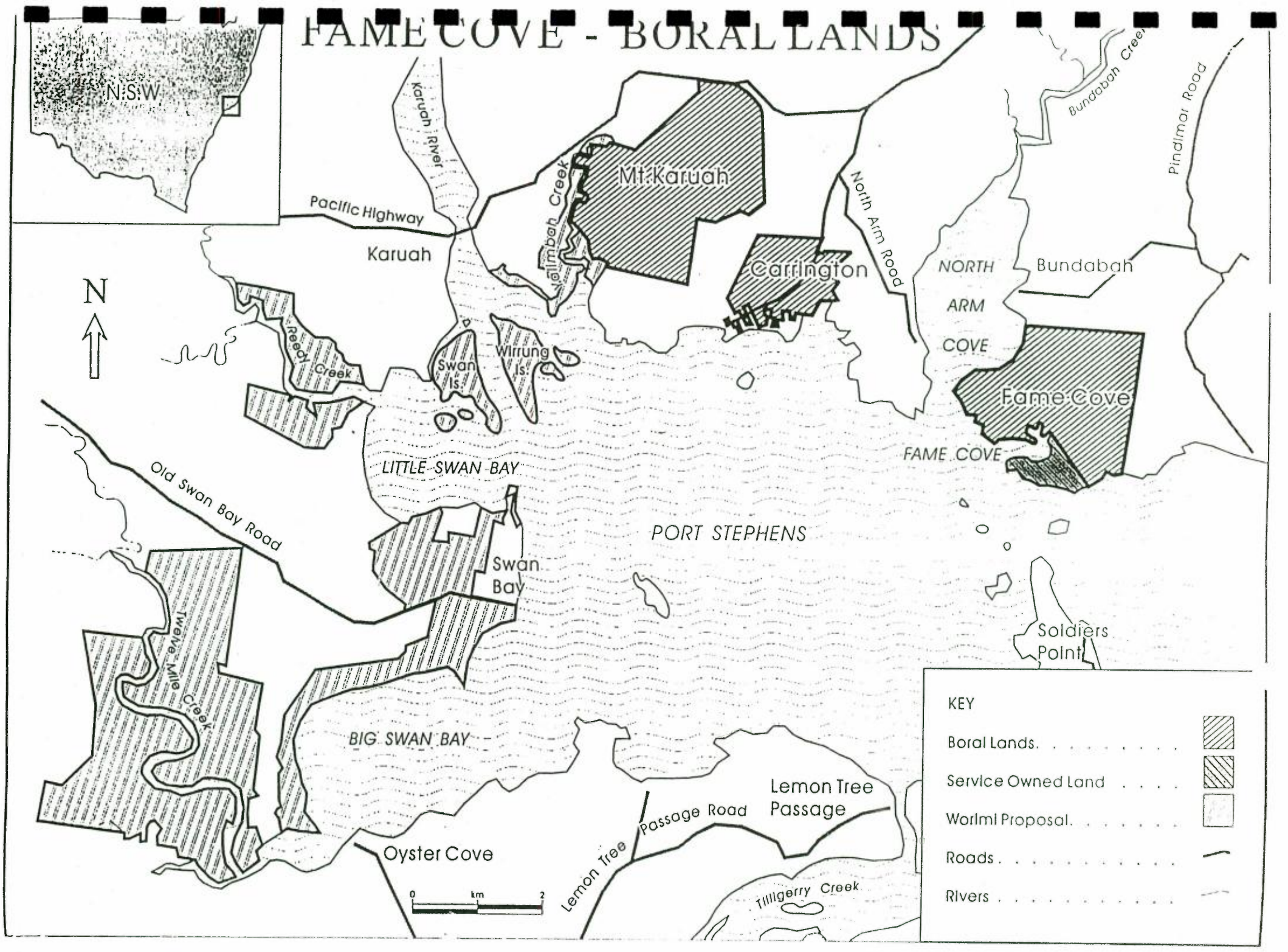
Please contact Nick Sheppard on (02) 66598231 if you wish to discuss any of the above points.

Yours faithfully

S Nally

SIMON NALLY
A/Manager, Environmental Planning Unit
Northern Zone

for DIRECTOR-GENERAL


FAME COVE - BORAL LANDS
N.S.W
Karuah River
Pacific Highway
Karuah
Mt Karuah
Jalmbah Creek
Carrington
North Arm Road
Bundabah Creek
Pindimar Road
NORTH
ARM
COVE
Bundabah
Fame Cove
FAME COVE
N
Reedy Creek
Swan Is
Wirrung Is
LITTLE SWAN BAY
Old Swan Bay Road
PORT STEPHENS
Swan Bay
Soldiers Point
Twelve Mile Creek
BIG SWAN BAY
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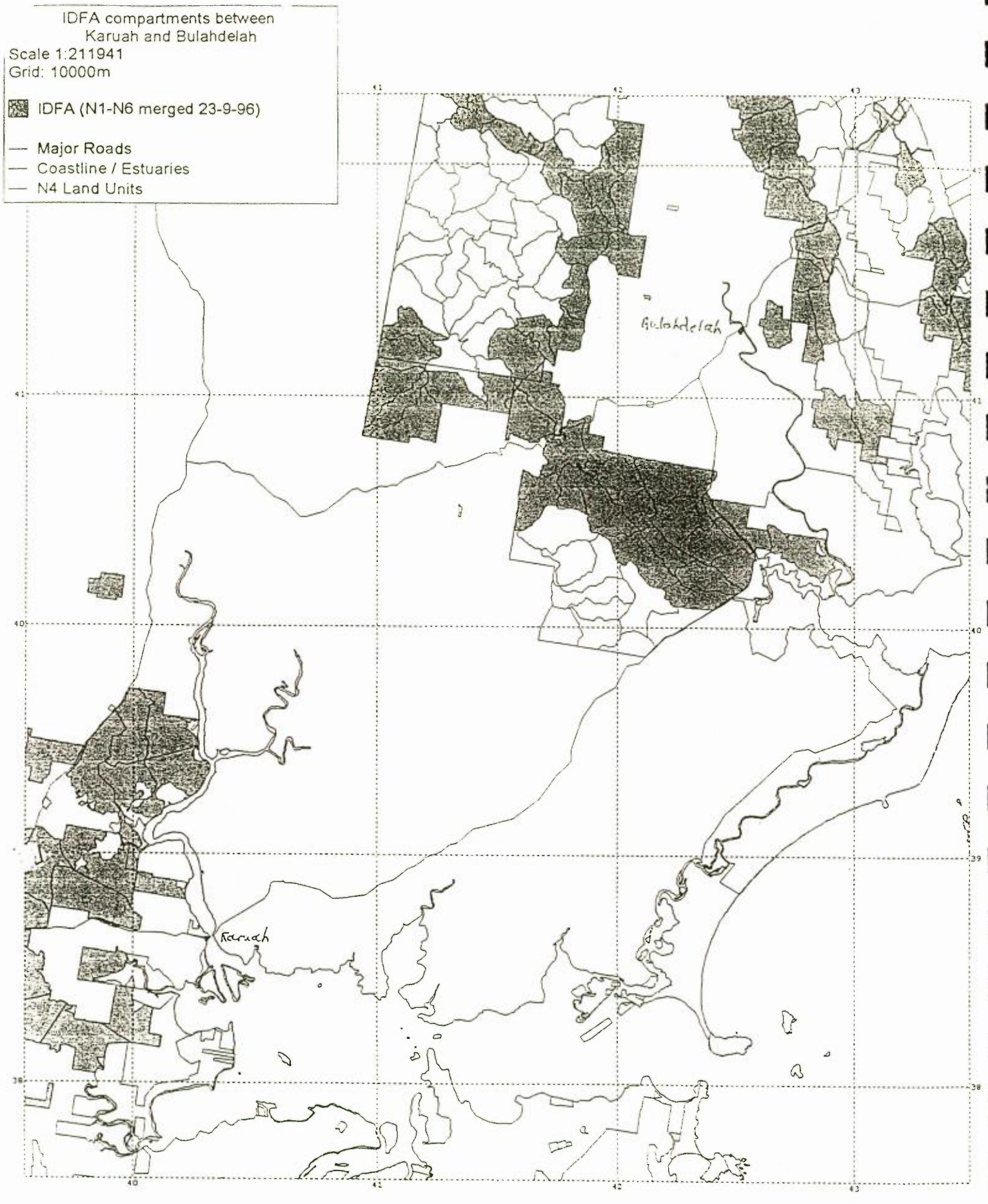
IDFA compartments between
Karuah and Bulahdelah
Scale 1:211941
Grid: 10000m
IDFA (N1-N6 merged 23-9-96)
Major Roads
Coastline / Estuaries
N4 Land Units
Bulahdelah
Karuah

NSW NATIONAL PARKS AND WILDLIFE SERVICE, NORTHERN ZONE

ENVIRONMENTAL ISSUES TO BE ADDRESSED

INTRODUCTION

The following list is provided to assist in the preparation of environmental impact assessment reports. The list details the type of information that is required by the New South Wales National Parks and Wildlife Service (NPWS) in their assessment of such applications.

Please note that the provision of information in accordance with this list does not negate the applicant's obligations under any legislative or planning instruments. NPWS suggests that the applicant contact the relevant local council and the Department of Urban Affairs and Planning to ascertain these obligations.

GENERAL

1. Map(s) showing the locality of the proposed development in a regional and local context. Local context maps should be based on 1:25 000 topographic plans. Photographs of the site's key attributes may provide useful documentation.

2. A description of the existing environment on the subject land and surrounding land, the proposed development and ancillary works, and the manner in which the environment will be modified by the proposal (particularly with regard to the clearing of native vegetation and impacts on fauna habitat).

3. The area subject to development should be clearly identified on an appropriately scaled plan. This includes all ancillary works such as buildings and other structures, parking areas, loading/processing/treatment areas, access roads, and material stockpiling areas.

4. The applicability or otherwise of Local Environment Plans (LEP), Regional Environment Plans (REP) and State Environmental Planning Policies (SEPP) to the site should be determined and detailed. In particular, your attention is drawn to SEPP No. 14 - Coastal Wetlands, SEPP No. 26 - Littoral Rainforest, SEPP No. 44 - Koala Habitat Protection, and SEPP No. 46 - Protection and Management of Native Vegetation.

FLORA

1. A comprehensive description of the vegetation on the site. This will include an assessment of the condition of the plant communities present, including the designation of conservation significance at a local, regional and State level, and the identification of the presence of any threatened species, populations or ecological communities listed under Schedules 1 or 2 of the *Threatened Species Conservation Act 1995* and any Rare or Threatened Australian Plant (ROTAP) species

2. A plan showing the distribution of the Threatened and ROTAP species and the vegetation communities on the site, and the extent of vegetation proposed to be cleared. This plan should be at the same scale as the plan of the area subject to development in order to assist in the assessment of the impact of the proposal on the existing vegetation.

3. Where the assessment concludes that threatened species, populations or ecological communities, or their habitats, exist on or in proximity to the subject land, the effect of the proposed development should be determined in accordance with the eight point test described in Section 5A of the *Environmental Planning and Assessment Act* 1979. An assessment of the impact of the development on the plant communities and/or ROTAP species should also be provided.

4. A description of the measures proposed to mitigate and/or ameliorate the impact of the development on the plant communities and/or Threatened and ROTAP species.

FAUNA

1. A fauna survey to identify the distribution and abundance of fauna species known or likely to utilise the site, including a description of available fauna habitats and an assessment of the conservation status of each of the faunal components at a local, regional and State level.

2. A plan showing the results of the above survey. This plan should be at the same scale as the plan of the area subject to development to assist in the assessment of the impact of the proposal on fauna.

3. An assessment of the impact of the development on the identified fauna.

4. An assessment of the existence or likely occurrence of threatened species, populations or ecological communities, or their habitats on the subject land. Where the assessment concludes that threatened species, populations or ecological communities, or their habitats exist on or in proximity to the subject land, the effect of the proposed development should be determined in accordance with the eight point test described in Section 5A of the *Environmental Planning and Assessment Act* 1979.

5. A description of the measures proposed to mitigate and/or ameliorate the impact of the development on fauna.

CULTURAL

1. The presence or absence of Aboriginal sites should be identified and the significance of the area to the local Aboriginal community must be determined. Accordingly, a search of the NPWS Aboriginal sites register should be made and the local Aboriginal community should also be consulted with regard to any Aboriginal heritage issues associated with the proposed development.

2. Aboriginal sites and places of significance to the Aboriginal community are to be detailed on a plan. This plan should be at the same scale as the plan of the area subject to development to assist in the assessment of the impact of the proposal on the identified cultural components.

3. An assessment of the impact of the development on the identified cultural sites.

4. A description of the measures proposed to mitigate and/or ameliorate the impact of the development on the identified cultural sites.

5. A contingency plan that details the measures to be taken in the event that archaeological sites are discovered during the course of operations must be prepared.

NATIONAL PARKS ESTATE

Where the proposal may result in impacts on NPWS estate or is on land adjacent to NPWS estate, an assessment of the impact of the development on NPWS estate should be made.

NOTES

Surveys and Assessments

1. Fauna, flora and cultural surveys and assessments should be undertaken by suitably qualified persons and the qualifications and experience of the persons undertaking the work detailed.

2. Dates, site locations, design, methodology, analysis techniques, and weather conditions at the time of the assessments and surveys must be described. The limitations of surveys should be identified and the results interpreted accordingly.

3. Conclusions drawn in surveys and assessments should be substantiated by evidence resulting from those surveys and assessments. The document being supported by the surveys and assessments should reflect these conclusions and clearly state where recommendations of the surveys and assessments have been incorporated in the proposal.

NPWS Databases

4. The NPWS can provide records of flora and fauna held in the Wildlife Atlas and / or Rare or Threatened Australian Plants (ROTAP) databases. In addition NPWS has an Aboriginal Sites Register of which searches can be made. These services generally attract a fee. Enquires should be made to NPWS Hurstville office, telephone (02) 585 6444.

5. It should be noted that the above databases are not comprehensive and should only be used as a guide. They do not negate the need for specific site investigations.

Environment Australia

Environment
Protection Group

FILE NO 96/5851

CONTACT Chris Hillbrick
PHONE: 02 6274 1652

Mr Kevin Hays
Project Manager
Roads and Traffic Authority
PO Box 469
NEWCASTLE NSW 2300

Dear Mr Hays

PACIFIC HIGHWAY: PROPOSED UPGRADE KARUAH TO BULAHDELAH

Thank you for your letter of 6 August 1997 advising me of the above project and the invitation to the Planning Focus Meeting for this project.

Following discussions with the federal Department of Transport and Regional Development, I understand that this project has not triggered the *Environment Protection (Impact of Proposals) Act 1974* (the Act) as Commonwealth funding has not yet been decided. It would be inappropriate for an officer from this Department to attend the Planning Focus Meeting at this time.

Should this project attract Commonwealth funding in the future and thus trigger the Act, I would appreciate notification as soon as possible to enable the needs of both Commonwealth and State legislation to be met with one set of documentation to avoid unnecessary duplication. I have enclosed a copy of the Administrative Procedures under the Act for your information.

Concerning the preparation of the Review of Environmental Factors (REF), I suggest the following environmental matters be included:

- any areas listed on the Register of the National Estate which may be affected by the projects, and the manner in which they may be affected and management regimes proposed for the protection of any sites;
- any species in Schedule 1 of the Commonwealth *Endangered Species Protection Act 1992*. which occur in the areas to be affected by the projects and management regimes proposed for the protection of any such species;
- any wetlands of National significance or international importance related to the Ramsar Convention;
- any potential impacts on migratory birds subject to the Japan-Australia and China-Australia Migratory Bird Agreements (JAMBA and CAMBA).

Should you wish to discuss any of the above matters the contact officers are Mr Robert Bruce in the Australian Heritage Commission on (02) 6217 2111 and Mr David Jackson in the Biodiversity Group on (02) 6250 0217.

If you require further information or have any other queries concerning the proposal the contact officer is Chris Hillbrick on (02) 6274 1652, or fax (02) 6274 1620.

Yours sincerely

Gerry Morvell
Assistant Secretary
Environment Assessment Branch
20 August 1997

TAREE POLICE

Manning Great Lakes Local Area Command
83 Albert Street, Taree. 2430
P.O. Box 630
TAREE.

Telephone: 02-6552-1044 E/N 73399
Fax: 02-6552-1396 E/N 73367

3.9.97
CR
3.9.97

FACSIMILE TRANSMISSION

TO: ROADS & TRAFFIC AUTHORITY NEWCASTLE

FROM SGT FISHER MANNING GREAT LAKES COMMAND

FOR THE ATTENTION OF: KEVIN HAYS

NUMBER OF PAGES: THREE THIS SHEET INCLUDED

TIME & DATE SENT: 11 AM 20/8/97

MESSAGE: FOLLOW UP OF MEETING 19/8/97

NSW POLICE SERVICE
MANNING GREAT LAKES COMMAND

POLICE STATION, TAREE. 2430.
35 ALBERT STREET, TAREE.

Tel: 02 65521044
E/N: 73330
Fax: 02 65521396
E/N: 73367

20 August 1997

Roads & Traffic Authority.
P.O. Box 469,
NEWCASTLE.

Attention: Kevin Hays.

State Highway 10 - Pacific Highway. Proposed upgrade Karuah to Bulahdelah.

Dear Sir,

As per our meeting on the 19 August 1997, Police request the below mentioned items be considered for inclusion in the construction :-

Sections of roadway widened to allow the safe stopping of motorists detected by1 Radar Speed Detection.

An adequate number of areas to do U turns between the dual lanes to stop offending motorists.

An adequate number of Rest Areas to replace those lost on the old Pacific Highway. The Rest Areas should include toilet and rubbish facilities as discussed and cater for articulate vehicles and vehicles towing caravans.

Construction of Pacific Highway from Bulahdelah to Coolongolook:

Police would also like consideration to be given for a Truck Stopping Station on the section of highway under construction between Bulahdelah and Coolongolook, to replace the one on the Pacific Highway at Wootton. Many operations are carried out at this location in conjunction with the Regulation Inspectors of the Roads and Traffic Authority.

We would request that the station be constructed to intercept both north and south bound heavy vehicles as intelligence has shown that when an operation is held on the Pacific Highway, heavy vehicles use the New England Highway and the reverse when held on the New England Highway.

Operations are now combined to stop this avoidance.

Many operations are carried out at Wootton location in conjunction with the Regulation Inspectors of the Roads and Traffic Authority.

Forwarded for your information.

Yours faithfully,

H C Fisher.
Traffic Service Sergeant.

NSW FISHERIES

Our Ref: CM(C) JH:JP 3859
Your Ref: MPN 10/410 1663

Mr K Hays
Project Manager
R T A
P O Box 469
NEWCASTLE
N S W 2300

14 August 1997

Dear Mr Hays

Thank you for your kind invitation to attend a focus meeting for State Highway 10 - Proposed upgrade Karuah to Bulahdelah. Unfortunately I will be unable to attend. However, an officer from our Newcastle Office may be able to attend.

To assist you in your REF, I have attached a list of guidelines for road crossing over waterways.

For further information, please do not hesitate to contact me on (049) 80 4907.

Yours sincerely

Dr John Holliday
CONSERVATION MANAGER (CENTRAL)
Enc

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

GUIDELINES FOR ROAD AND TRACK CROSSINGS OF RIVERS AND STREAMS

Where rivers and streams are intersected by roads and tracks, culvert and causeway crossings represent a potential obstruction to migrating fish.

Many species of freshwater and estuarine fish migrate within river systems to breed, to access food resources or to access more comfortable environmental conditions.

Your organisation is likely to be involved in the construction, replacement or repair of stream crossings which may have an adverse impact on fish populations.

Enclosed are copies of a newly prepared guideline document which aims to address the problem. Would you please distribute copies amongst relevant staff members to ensure that they are aware of potentials for obstruction and can take ameliorative action wherever possible.

If you have any further queries please contact your nearest Habitat Biologist as listed below.

Mr Craig Copeland, Northern NSW on (066) 26 1394
Dr John Holliday, Central NSW on (049) 82 1232
Mr Allan Lugg, Southern NSW on (044) 23 2080
Mr Adam Smith, Sydney and Far Western on (02) 9566 7844

Yours sincerely

John Glaister 18/11/96

DR JOHN GLAISTER
Director of Fisheries

HEAD OFFICE
Sydney Fish Markets, Cnr. Pyrmont Bridge Road & Bank Street, Black Wattle Bay
Locked Bag 9, Pyrmont NSW 2009 Australia.
Telephone: (02) 9566 7800 • Facsimile: (02) 9552 6627

Guidelines for ensuring fish passage past road-stream crossings

Purpose

These guidelines target local councils, road construction authorities, forestry departments, and other authorities which may be engaged in the construction of road crossings over **permanently or semi-permanently flowing streams, or tidal waterways.** The guidelines will, if followed, reduce or minimise the adverse impacts that road crossings have upon the passage of migratory fish species in these systems. They are **not** intended to apply to crossings over minor watercourses or gullies which only contain flowing water for brief periods following local rainfall.

Background

Many species of Australian native and estuarine fish undertake regular migrations or seasonal movements within river and stream systems. Fish may travel as adults or juveniles, in an upstream or downstream direction. Some move only short distances, while others can travel many hundreds or even thousands of kilometres.

For most species, migration is an essential component of their life history. They may migrate:

- for breeding purposes,
- to access food resources,
- to access more suitable environmental conditions, or
- to avoid environmental stresses (e.g. low or high temperatures).

Restricting or obstructing migration can have serious deleterious consequences for the welfare of fish populations as a whole.

Under Section 219 of the *Fisheries Management Act 1994*, it is illegal to create an obstruction across a river or creek so that the free passage of fish will or could be obstructed.

While most structures at road-stream crossings are essential components of the transport network, many could be modified or constructed in a manner that eliminates or minimises the adverse impacts on fish migration for little extra cost.

Fish passage across culvert structures is usually more of a problem for fish moving in an upstream direction than it is for those moving in a downstream direction. This is due to the need to move against the current rather than with it. Many fish species, and especially juveniles of the species, have relatively poorly developed swimming ability and lack the muscle strength to continuously swim against the current for the seven to eight metres or more which is necessary to successfully negotiate the full length of a culvert. As a result, fish often congregate on the downstream side of an obstruction where they become susceptible to high levels of predation, disease and depletion of food resources.

Culverts also represent "alien" habitat in that they have smooth sides with few if any refuges from the flow or predators. As a consequence, many fish species may simply have an instinctive reluctance to enter and swim through a culvert, even though they may be physically capable of doing so.

There is also some evidence to show that some species only migrate during daylight hours, and few, if any, individuals of those species will enter a dark pipe. As a consequence, large diameter, short length pipes are likely to pose less of a problem than small diameter long length structures, due to the greater amounts of light that can enter.

Guidelines

1. Wherever possible, use a bridge to cross a stream in preference to a culvert structure.

2. If a culvert structure is the only affordable solution, use large box culverts in preference to round pipes.

3. The cross-sectional area of the box culverts should equal, or exceed, the cross-sectional area of the stream to avoid funnelling the flow and creating a large difference in hydraulic head across the structure (i.e. use three or four sets of culverts placed side by side rather than just one).

4. Make the structure as short as possible.

5. Place the culvert as level as possible to ensure that water flow velocities through the culvert do not exceed 0.25 metres per second.

6. Set the base of the culvert **into** (rather than on) the stream bed so that natural sediments (mud, sand, gravel, etc.) can cover the bottom, providing a less alien habitat. Consider adding a few large rocks to the base of the culvert to provide additional cover and flow refuges.

7. There should be no drop, or "waterfall" at the end of the structure. The water levels above and below the crossing should be almost the same. If the water level below the crossing is too low, build it up with several rocky riffles placed across the stream bed downstream of the crossing.

Environment
Protection
Authority
New South Wales

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

Mr K Hays
Project Manager
Roads and Traffic Authority
PO Box 469
NEWCASTLE NSW 2300

Our Reference: 272598A1

Your Reference: MPN 10/410.1663

Contact: Mr Colin Halverson

Dear Sir

PACIFIC HIGHWAY PROPOSED UPGRADE - KARUAH TO BULAHDELAH

I refer to your letters of 6/7 August 1997 requesting advice on issues the Environment Protection Authority (EPA) would like to see addressed in a Review of Environmental Factors (REF) for the above project. The EPA would expect that the REF demonstrates that the short and long term activities associated with the project can be undertaken without detrimental impacts on the quality of water in local waterways and without adversely affecting local amenity (eg local air quality and noise levels).

The EPA's response is organised in terms of ***environmental issues*** associated with road construction and operation activities, the *assessment criteria* adopted by the EPA for the issues and the specific aspects (where applicable) of *road construction* and *road operation* activities that should be addressed in the REF.

Local Air Quality

Assessment Criteria

- exhaust systems of construction plant, vehicles and machinery to be maintained in accordance with manufacturer's specifications in order to meet the requirements of the *Clean Air Act*.

- EPA goal, in this instance, is to control to the maximum extent practicable, the generation of dust and particulates on-site, to contain any dust and particulates generated within the construction site area, to minimise adverse

Noise and Vibration

Assessment Criteria

- The EPA guidelines for construction noise take account of the fact that construction activities are of a transient nature and that noise from construction activities is often difficult to limit even with good control measures.

  The EPA guidelines establish target noise levels (ie. Background + 20 dB(A) for periods of less than 4 weeks and background + 10 dB(A) for periods between 4 & 26 weeks) that should be achieved through the best practicable means. In cases where it is identified that the guideline levels will not be achieved then all reasonable endeavours should be made to reduce the level of noise impacts.

- The EPA has adopted the Australian & New Zealand Environment Conservation Council guideline titled "Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure & Ground Vibration", as its guideline for limits which should not be exceeded by blasting activities.

- The EPA has recently proposed draft Road Traffic Noise Criteria in place of the previous TNL 55 descriptor. The draft criteria includes a table, which allocates appropriate road noise criteria to road project options. The road project options vary according to whether or not the option is for a new, upgraded, redeveloped or existing freeway/arterial road. RTA has been provided with a copy of the draft guidelines.

- EPA goal, in this instance, is that all practical measures be taken to ensure that the existing noise levels do not increase and where it is practicable to achieve lower levels, we consider that this should occur.

Road Construction Activities

- representative samples of the pre-construction ambient noise levels i.e. L_{A90}, L_{aeq}, L_{A10}, & L_{amax} ambient noise descriptors measured continuously at areas likely to be affected by the construction works for 15 minute intervals over proposed construction site operation hours

- proposed measures to mitigate and control noise, vibration and blasting impacts caused by construction works and associated traffic

- hours of operation of construction site

- equipment noise levels

- location of depots and other facilities emitting high noise levels such as batching plants, wood chippers, crushers etc

- access routes and times for construction and heavy delivery vehicle traffic
- assessment of noise, vibration and blasting impacts including assessment of frequency and duration of intermittent high level noise impacts on the areas affected by the road construction activities
- construction work program and associated noise, vibration and blasting impacts
- noise mitigating measures including construction work management program, noise barriers and noise attenuating treatment of equipment)eg. Piling hammers, concrete saws, tunnel ventilation systems)
- blasting and vibration mitigating measures
- time frame for and sequencing of construction of noise barriers
- monitoring of equipment noise and construction noise levels at affected areas
- maintenance of proposed control measures

Road Operation

- representative samples of existing traffic noise levels i.e. $L_{aeq(9hr\ and\ 15hr)}$, L_{A90}, L_{A10}, & L_{amax} and projected noise levels for worst case conditions for the projected design life of the road at the most effected locations.
- traffic noise mitigation measures including traffic direction, vehicle speed, road surface cover, road levels & alignment, noise barriers and building acoustical treatment.
- monitoring of performance of noise mitigation measures

Soil and Water Management

Assessment Criteria

- EPA goal, in this instance, is that all practical measures be taken to ensure that the management of water on road construction sites minimises discharges of contaminated water, and to ensure any discharge will not cause degrading of the quality of waters below that naturally occurring.
- In view of the increased number of environmentally hazardous goods being carried by road and the number of accidents that occur, the EPA considers that it is essential that additional waterway pollution control measures such as retention basins and gross pollutant traps be constructed in strategic

locations to minimise the effects of road spillages on waterways. These mitigation measures should be incorporated into the road design, particularly in areas of higher runoff.

- Guideline references:
  - Soil Landscape Maps (prep'd by Dept Land & Water Conservation)
  - "Australian Water Quality Guidelines for Fresh and Marine Waters" (ANZECC, Nov 1992)
  - "Urban Erosion & Sediment Control, Revised Edition" (DLWC, 1992)
  - "Managing Urban Stormwater - Construction Activities" (EPA, 1996)
  - "The Utilisation of Treated Effluent by Irrigation" (EPA, 1995)
  - "Wetlands for Treating Wastewater" (EPA Manual for Authorised Officers ,1995);
  - "Assessing and Managing Acid Sulphate Soils" (EPA, 1995)
  - "Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites" (ANZECC 1992)
  - "Contaminated Sites - Sampling Design Guidelines" (EPA 1995)
  - "Draft Guidelines for Consultants Reporting on Contaminated Sites" (EPA 1995).

Road Construction Activities

- waters affected by construction activities (description of classification, use, ANZECC guidelines, interim water quality objectives)
- water quality of affected waters (baseline water quality data). *Note: waters can include permanent and ephemeral watercourses, wetlands, canals and dams and ground water.*
- soil capability/suitability assessment (identification of soil hazards, erosion risks)
- soil erosion, sediment control and water quality management plan, including:
  - site vegetation clearing/disturbed area management (clearing minimisation/retention of existing trees and vegetation)

- creek management (diversion, road crossing management, bridge/culvert construction, stabilisation of creek batters/ banks)
- clean stormwater management (diversion around, under, over disturbed areas including diversion under storm conditions)
- management of stormwater runoff from disturbed areas
- design criteria and design of soil erosion and sediment controls including sedimentation basins, catch/diversion drains etc
- location of soil erosion and sediment controls
- sequencing of clearing works and installation of associated soil erosion and sediment controls
- control of access road effects on waters (eg creek crossings)
- maintenance of soil erosion and pollution controls
- revegetation and replanting
- wastewater control and management (eg from site amenities i.e. toilets and showers, cement type works, equipment washing, equipment depots)
- spillage control
- monitoring of performance of pollution control measures
- monitoring of water quality (construction site discharges & affected waters)

• identification and management of contaminated sites

• identification and management of acid sulphate soils

Road Operation

• water pollution control management plan:

- water quality objectives (ANZECC guidelines for water quality)
- potential impacts of preferred option on water quality and aquatic environments
- changes to local drainage patterns
- soil and water management plans

- stormwater management (eg diversion of clean stormwater from disturbed areas)
- the use of bridges/viaducts across watercourses
- wet detention basins
- constructed wetlands
- road spillage collection systems
- water quality monitoring (discharges and affected waters)

- flood detention and control
- litter control

Waste Management

Assessment Criteria

- EPA goal, in this instance, is based on a waste management hierarchy within which waste avoidance is a priority followed by reuse and recycling/ reprocessing with disposal as a last resort
- Guideline references:
  - "A Guide to the Waste Minimisation and Management Regulation, 1996" (EPA, Dec 1996)
  - "Environmental Guidelines: Assessment, Classification and Management of Non-Liquid Wastes (EPA, July 1997)

Road Construction Activities

- waste disposal
- hazardous waste/chemicals
- use of materials earned from building demolition
- use of recycled materials in construction
- design to balance need for excavation and filling of land
- reuse of surplus excavated material on present or other sites

- recycle/processing of green waste
- identification of hazardous materials

Environmental Management Plan

To assist in focussing on the management of environmental issues in the course of this development, the EPA suggests that a comprehensive Environmental Management Plan (EMP) be drawn up to cover development of the whole site and incorporated in the REF. This plan should include, but not necessarily be limited to:-

- Water Quality Monitoring Program (for surface and ground water)
- Pollution Incident Management Plan
- Site Rehabilitation Plan
- Sediment and Erosion Control Plan (including dust suppression initiatives)
- Noise Management Plan
- Waste Management Plan

Pollution Control Approval

Section 27(2) of the Noise Control Act 1975 requires that a pollution control approval must be obtained from the EPA by the occupier of any premises who is carrying out work that would cause the premises to become scheduled premises. Scheduled premises include any premises on which "freeway roads" are being constructed by the Minister for Roads.

It is our understanding that the road works proposed for this project, although significantly affecting traffic speed, safety and intersection management, would not cause the road to be characterised as a "freeway". In this case, a Pollution Control Approval for the project is not required for the purposes of the Noise Control Act 1975.

However, the RTA will require a pollution control approval for runoff control works associated with the project. In addition, any individual items of equipment to be used during construction which may be scheduled (eg under the Clean Air Act) will need to hold appropriate approvals and licences. These items would include mobile concrete batching plants, crushing and screening equipment and mobile bitumen plants.

Section 17J(1)(b) of the Pollution Control Act requires that an application for pollution control approval must be "accompanied by ....details of the work proposed to be undertaken, together with details of the methods intended to be adopted so as to control pollution".

As you can appreciate from the above legislation, the EPA is not legally entitled to issue approval without having the appropriate details regarding works and methods intended to be adopted for the control of pollution.

In order to satisfy the above, the EPA requires a copy of the final Environmental Management Plan and a copy of site plans showing the notional location and design parameters of all pollution control works and facilities which are the subject of an approval application.

I trust the information provided will assist your investigation and assessment of environmental interactions relating to this proposal. Inquiries regarding the above may be directed to Andrew Ling at this office on (049) 26 9969.

Yours sincerely

C Halverson

COLIN HALVERSON
Head Regional Operations Unit, Hunter
for **Director General**

Environment Protection (Impact of Proposals) Act 1974

Administrative Procedures

Showing amendments made on 5 May 1995

PLEASE NOTE: This consolidation of the administrative procedures orders made under subsection 6(1) of the *Environment Protection (Impact of Proposals) Act 1974* has been prepared for the use of officers of the Environment Protection Agency. While the Environment Protection Agency has made every endeavour to ensure the accuracy of this consolidation, no liability will be accepted for reliance on this document. Copies of the administrative procedures of 29 May 1987 and amendments of 5 May 1995 are available from Commonwealth Government Bookshops or by writing to the Environment Assessment Branch, Environment Protection Agency, 40 Blackall Street, Barton, Australian Capital Territory, 2600.

GENERAL

Interpretation

1.1. In these procedures, unless the contrary intention appears -

~~"action Minister", in relation to a proposed action, means the Minister of State for the Commonwealth responsible for the proposed action, and includes where appropriate the Minister of State for the Commonwealth for the time being administering the Act;~~

"action Minister", in relation to a Commonwealth action, means the Minister who is, or will be, responsible for the action (or a person acting on the Minister's behalf) and, if appropriate, includes the Minister for the time being administering the Act;".

"Commission" means a Commission appointed under subsection 11(2) of the Act;

"Commonwealth action" means an action of a kind referred to in any of paragraphs 5 (1) (a) to (e) of the Act that is proposed to be taken by, or on behalf of, the Commonwealth or an authority of Australia, either alone or in association with any other government, authority, body or person;

"draft environmental impact statement" means an environmental impact statement not yet revised under paragraph 8.1.;

"environmental impact statement" means an environmental impact statement under these procedures and, where the context requires or permits, includes a draft environmental impact statement and a final environmental impact statement;

"environmentally significant action" means a Commonwealth action that will, or is likely to:

(a) affect the environment to a significant extent, or to result in such an effect; or

(b) have the effect of permitting or causing an action by another person that:

  (i) would otherwise be unlikely to occur; and

  (ii) will, or is likely to, affect the environment to a significant extent, or to result in such an effect; or

(c) have the effect of promoting or facilitating an action by another person that will, or is likely to, affect the environment to a significant extent, or to result in such an effect;

"final environmental impact statement" means an environmental impact statement that has been revised under paragraph 8.1.;

"inquiry" means an inquiry under the Act;

~~"proposed action" means a matter referred to in any of the paragraphs of section 5 of the Act;~~

~~designate a person or Department, be the proponent in relation to the proposed action.~~

~~1.2.4. An authority of Australia that is responsible for a proposed action shall ensure that the Department is, as soon as possible after any initiative has been taken in relation to the proposed action, informed of the proposed action and if the authority is not the proponent in relation to the proposed action the authority shall inform the Department of the name and address of the person or Department designated as the proponent.~~

Proponent of proposed action

1.2.1 If the action Minister in respect of a Commonwealth action (or, if there is a relevant authority in relation to that action, that authority) is satisfied that:

(a) the action is an environmentally significant action; or

(b) for other reasons, it is desirable to designate a proponent in order to achieve the object of the Act;

then, except as otherwise provided by these procedures, as early as practicable before the action occurs, the action Minister (or relevant authority) must:

(c) designate an appropriate person or Department as the proponent of the proposed action; and

(d) notify the Department, in writing, of the proposed action and the name and address of the proponent.

1.2.2 Unless, under subparagraph 1.2.1 (b), it is considered desirable to designate a proponent, paragraph 1.2.1 does not apply to a Commonwealth action ('the later action') if:

(a) a proponent has been designated in relation to another Commonwealth action ('the earlier proposed action'), whether completed or not, and the action Minister (or relevant authority) considers that any relevant environmental effect of the later action:

(i) has been fully taken into account in giving effect to these procedures in relation to the earlier proposed action; or

(ii) if, under paragraph 1A.1.2, the earlier proposed action has been permitted to be taken, or commenced, before these procedures have been complied with—will be fully taken into account in giving effect to these procedures in relation to the earlier proposed action; or

(b) a proponent has been designated in relation to another Commonwealth action ('the earlier proposed action'), in relation to which these procedures have been complied with, and the action Minister (or relevant authority) considers that any relevant environmental effect of the later action:

(i) is an extension of the environmental effect of the earlier proposed action; and

(ii) is not of a nature significantly different from that of the effect of the earlier proposed action; and

(iii) does not significantly add to the effect of the earlier proposed action.

1.2.3 In paragraph 1.2.2, 'relevant environmental effect' means a consequence, or likely consequence, of the kind described in paragraph (a),

procedures, or is otherwise necessary, for the purpose of consideration, by the Minister or on the Minister's behalf, of the necessity for an environmental impact statement or a public environment report in relation to the proposed action.

Information required by procedures

2.2. For the purpose of paragraph 2.1., the information required by these procedures shall, to the extent appropriate in the circumstances of the case, be information -

(a) summarizing any preliminary planning, consideration or work undertaken in relation to the proposed action and, in particular, describing any feasible and prudent alternative to the proposed action considered by the action Minister or the proponent;

(b) describing the environment that is likely to be affected by the proposed action and by any feasible and prudent alternative to the proposed action;

(c) indicating the potential impact on the environment of the proposed action and of any feasible and prudent alternative to the proposed action, including any enhancement of the environment;

(d) describing any safeguards or standards for the protection of the environment intended to be adopted or applied in connection with the proposed action; and

(e) stating any investigations or studies intended to be made of the possible impact on the environment of the proposed action.

Requirement to provide information

2.3. For the purpose of consideration, by the Minister or on the Minister's behalf, of the necessity for an environmental impact statement or a public environment report in relation to a proposed action, the Minister, or the Department on behalf of the Minister, may require the proponent to provide, within a reasonable period, such other information as is specified and is necessary for that purpose.

REQUIREMENT FOR ENVIRONMENTAL IMPACT STATEMENTS AND PUBLIC ENVIRONMENT REPORTS

Requirement for environmental impact statement or public environment report

3.1.1. Subject to the Act and these procedures, the Department shall, as soon as possible after the information referred to in paragraph 2.1., and any further information required under paragraph 2.3., has been received in relation to a proposed action -

(a) determine, on behalf of the Minister, that the preparation or obtaining, and submission tc the Minister, of an environmental impact statement or a public environment report in relation to the proposed action is not required for the purpose of achieving the object of the Act; or

(b) refer the question whether the preparation or obtaining, and submission to the Minister, of an environmental impact statement or a public environment report in relation to the proposed action is required for the purpose of achieving the

3.1.5. The Minister shall make available to the public as soon as possible, but at the latest within 3 months after the date of receipt of a written request to do so, the reasons for an environmental impact statement or a public environment report not being directed, with the exception of such material of commercial confidence, having security implications or providing confidential advice to the Minister as would be exempt from disclosure under the *Freedom of Information Act 1982*.

Further requirement for environmental impact statement or public environment report

3.2.1. For the purposes of paragraph 3.2.2., the proponent shall keep under review the environmental aspects of a proposed action in relation to which the preparation or obtaining, and submission to the Minister, of an environmental impact statement or a public environment report is not required under paragraph 3.1.1.

3.2.2. If, at any time before a proposed action to which paragraph 3.2.1. applies is completed, the environmental significance of the proposed action appears likely to be materially different from that expected at the time of the determination under paragraph 3.1.1., the proponent shall inform the Minister or the Department specifying the respects in which the environmental aspects of the proposed action appear likely to be materially different from that so expected.

3.2.3. Subject to the Act and these procedures, the Minister shall, as soon as possible after receiving information under paragraph 3.2.2., and having regard to that information, determine whether the preparation or obtaining, and submission to the Minister, of an environmental impact statement or a public environment report in relation to the proposed action is, in the circumstances, required for the purpose of achieving the object of the Act, and shall make a direction accordingly.

3.2.4. Paragraphs 3.1.2. and 3.1.3. apply to the making of a determination under paragraph 3.2.3. in like manner as those paragraphs apply to the making of a determination under paragraph 3.1.1.

Consultation with Departments, etc.

3.3. Subject to the requirements of paragraphs 12.1.1. and 12.1.2. concerning communications with the States and the Northern Territory and with authorities of the States and the Northern Territory, for the purpose of assisting in the making of a determination under paragraph 3.1.1. or 3.2.3., the Minister, or the Department on behalf of the Minister, may consult with any
Department or authority of Australia, any State or authority of a State, the Northern Territory or an authority of the Northern Territory, any local authority or any other person or body.

Notification of directions

3.4. The Minister, or the Department on behalf of the Minister, shall, as soon as possible after the making of a direction requiring the preparation or obtaining, and submission to the Minister, of an environmental impact

Contents of public environment report

4.2. To the extent appropriate in the circumstances of the case, a public environment report shall -

(a) summarise the proposed action and any feasible and prudent alternative to the proposed action and, in particular, describe any aspects likely to have a substantial or important effect on the environment;

(b) describe the environment that is likely to be affected by the proposed action and by any feasible and prudent alternative to the proposed action;

(c) indicate the potential impact on the environment of the proposed action and any feasible and prudent alternative to the proposed action, including any enhancement of the environment;

(d) outline the reasons for the choice of the proposed action;

(e) describe and assess the effectiveness of any safeguards or standards for the protection of the environment intended to be adopted or applied in connection with the proposed action;

(f) state any investigations or studies intended to be made of the possible impact on the environment before the proposed action is undertaken; and

(g) state any monitoring or reporting intended to be made of the environmental impact of the proposed action following implementation.

Agreement on contents of environmental impact statement or public environment report

4.3. The proponent shall consult with the Department with a view to agreeing upon the matters to be dealt with, and the extent to which those matters shall be dealt with, by an environmental impact statement or a public environment report.

Determination of contents of environmental impact statement or public environment report

4.4. After consultation between the proponent and the Department under paragraph 4.3., the Minister shall, if necessary, determine the matters to be dealt with, and the extent to which those matters are to be dealt with, by an environmental impact statement or a public environment report.

Consultation by proponent

4.5. The proponent shall consult with the Department throughout the preparation of an environmental impact statement and throughout the preparation of a public environment report to ensure that the environmental impact statement or the public environment report are acceptable in terms of paragraph 4.1. or 4.2. (as the case may require).

paragraph 3.1.1. or 3.2.3., the proponent may consult with the Department with a view to agreeing that the draft environmental impact statement or the public environment report, or any part of such statement or report, should not be made available for public comment in accordance with these procedures.

6.2.3. Subject to paragraph 6.2.4., after consultations between the proponent and the Department under paragraph 6.2.2., the Minister shall, if necessary, determine whether the draft environmental impact statement or the public environment report, or any part of such statement or report, shall not be made available for public comment in accordance with these procedures, and shall make a direction accordingly.

6.2.4. The Minister shall, before making a determination under paragraph 6.2.3., consult with the action Minister or the ~~responsible authority~~ relevant authority (as the case may require) and shall take into account any views expressed by the action Minister, or the ~~responsible authority~~ relevant authority, on whether the draft environmental impact statement or the public environment report, or any part of such statement or report, should not be made available for public comment.

Public notice of public environment report or draft environmental impact statement

6.3.1. Subject to these procedures, where a draft environmental impact statement or a public environment report, or any part of such statement or report, is made available for public comment, the proponent shall give notice of -

(a) the draft environmental impact statement or the public environment report, or any part of such statement or report, having been made available for public comment;

(b) the places where copies of the draft environmental impact statement or the public environment report, or any part of such statement or report, can be purchased or otherwise obtained;

(c) the places where the draft environmental impact statement or the public environment report, or any part of such statement or report, can be examined by the public; and

(d) an address to which interested persons and bodies are invited to send written comments on the proposed action within a period being -

(i) in the case of a draft environmental impact statement, a period of not less than 28 days, or such other longer period as the Minister may determine, after the date of publication of the notice under subparagraph 6.3.2.(b), specified in the notice; and

(ii) in the case of a public environment report, a period of not less than 28 days after the date of publication of the notice under subparagraph 6.3.2.(b), specified in the notice.

6.3.2. The notice required to be given by the proponent under paragraph 6.3.1. shall be -

(a) approved by the Department;

(b) published in the Gazette; and

(c) published in such newspapers, and on such occasions, as the Department approves.

Inquiries

7.2. Subject to the Act and to the extent relevant, the Minister shall, in deciding whether to direct that an inquiry be conducted in respect of all or any of the environmental aspects of a proposed action, take into account -

(a) the significance of all or any of the environmental aspects of the proposed action;

(b) any views expressed by the action Minister or the ~~responsible authority~~ relevant authority (as the case may require); and

(c) whether all or any of the environmental aspects of the proposed action have been, are, or will be the subject of a public inquiry conducted otherwise than under the Act.

Public environment report or draft environmental impact statement, etc., to be provided to Commission

7.3. Where the Minister has directed that an inquiry be conducted in respect of all or any of the environmental aspects of a proposed action in relation to which a draft environmental impact statement or a public environment report has been prepared or obtained, the proponent shall provide a copy of the draft environmental impact statement or the public environment report, and of any written comments received under subparagraph 6.3.1.(d) or paragraph 6.4., to the Commission as soon as possible after it has been appointed to conduct the inquiry.

Reports

7.4. The Minister shall, as soon as possible after a Commission has presented its report, provide to the proponent, through the Department, a copy of the report, together with any comments made, by the Minister, or on behalf of the Minister, on the report.

REVISION OF ENVIRONMENTAL IMPACT STATEMENTS

Revision of draft environmental impact statement

8.1. If, having regard to the draft environmental impact statement, any written comments received under subparagraph 6.3.1.(d) or paragraph 6.4., any report prepared by the Department under paragraph 6.6.3., any report and any comments on the report provided to the proponent under paragraph 7.4. in relation to a proposed action, it is still intended to proceed with the proposed action, the proponent shall revise the draft environmental impact statement -

(a) to take into account -

(i) any written comments received under subparagraph 6.3.1.(d) or paragraph 6.4.;

(ii) any report prepared by the Department under paragraph 6.6.3.;

(iii) any report and any comments on the report provided to the proponent under paragraph 7.4.; and

(b) to summarize or to include in full (as appropriate) any written comments received under subparagraph 6.3.1.(d) or paragraph 6.4.

or the public environment report.

Minister's recommendations, etc., on proposed action

9.3.1. The Minister shall, within the relevant period under paragraph 9.4., make any comments, suggestions or recommendations to the action Minister and other relevant Ministers concerning the proposed action, whether or not contained in the report prepared by the Department under paragraph 9.1.1., including suggestions or recommendations concerning conditions to which the proposed action should be subject, that the Minister thinks necessary or desirable for the protection of the environment, and the Minister, or the Department on behalf of the Minister, shall inform the proponent accordingly.

9.3.2. The Minister shall make available to the public any comments, suggestions or recommendations made under paragraph 9.3.1., with the exception of such material of commercial confidence, having security implications or providing confidential advice to the Minister as would be exempt from disclosure under the *Freedom of Information Act 1982*.

Relevant period

9.4. The relevant period for the purposes of paragraph 9.1.1. and 9.3.1. shall be -

(a) 42 days after the receipt of the final environmental impact statement under subparagraph 8.2.(a);

(b) 28 days after receipt of the public environment report and written comments received in relation to the public environment report under subparagraph 6.3.1.(d) or paragraph 6.4., or, where the Minister directs the Department to hold discussions under subparagraph 6.6.1., 28 days after the completion of those discussions;

(c) in the case of an environmental impact statement, 42 days, and in the case of a public environment report, 28 days, after the receipt of any information required under paragraph 9.2.; or

(d) such longer period as is agreed to by the Department and the proponent,

whichever is the longer.

Duties of Ministers following assessment

9.5. Subject to, and in accordance with section 8 of the Act, each Minister shall give all such directions and do all such things as can be given or done by that Minister for ensuring that any final environmental impact statement or any public environment report and written comments received in relation to the public environment report under subparagraph 6.3.1.(d) or paragraph 6.4., and any suggestions or recommendations made under paragraph 9.3.1. or paragraph 3.1.4., are taken into account in matters to which they relate.

Minister may direct a public environment report following review and assessment

10.4. The Minister may, as a result of the review and assessment of all or any of the environmental aspects of the proposed action under paragraph 10.1.1., and after consultation with the action Minister, make a direction requiring the preparation or obtaining and submission to the Minister of a public environment report in relation to one or more environmental aspects of the proposed action.

EXEMPTIONS

Requests for exemptions

~~**11.1.** A Minister, Department or an authority of Australia may request the Minister to exempt a proposed action, or a class of proposed actions, from all or any of the requirements of these procedures.~~

11.1 A Minister, Department or an authority of Australia may request the Minister to exempt a Commonwealth action, or a class of Commonwealth actions:

(a) from all or any of the requirements of these procedures; or
(b) from all or any of the requirements of these procedures for a specified period; or
(c) from all or any of the requirements of these procedures until the occurrence of a specified event.

Consultation with Department, etc., concerning exemptions

11.2. Subject to the requirements of paragraphs 12.1.1. and 12.1.2. concerning communications with the States or the Northern Territory and with authorities of the States or the Northern Territory, the Minister, or the Department on behalf of the Minister, may consult with any Department or authority of Australia, any State or authority of a State, the Northern Territory or an authority of the Northern Territory, any local authority or any other person or body concerning whether a ~~proposed~~ Commonwealth action, or a class of ~~proposed~~ Commonwealth actions, should be exempted from all or any of the requirements of these procedures.

Matters to be taken into account

11.3.1. Subject to paragraph 11.3.2., the Minister shall, in determining whether to exempt a ~~proposed~~ Commonwealth action, or a class of ~~proposed~~ Commonwealth actions, from all or any of the requirements of these procedures, take into account -

(a) whether the application to the ~~proposed~~ Commonwealth action, or the class of ~~proposed~~ Commonwealth actions, of the requirements of these procedures from which exemption is sought would -
  (i) be prejudicial to national security;
  (ii) be prejudicial to the interests of Australia;
  (iii) adversely affect commercial or other confidences; or
  (iv) be otherwise contrary to the public interest; and

Northern Territory in order to facilitate the joint assessment, in appropriate circumstances, of a proposed action.

12.2.2. The Minister, or the Department on behalf of the Minister, shall make available to the public the details of any arrangement entered into under paragraph 12.2.1.

Appendix E
Flora and Fauna Assessment

FLORA AND FAUNA ASSESSMENT

Pacific Highway Upgrade
Between Karuah and
Bulahdelah

For:
NSW ROADS AND TRAFFIC AUTHORITY

July 1998
37039RP1

Report No. 37039FF

This report was prepared in accordance with the scope of services set out in the contract between ERM Mitchell McCotter Pty Ltd ACN 002 773 248 (ERMMM) and the NSW Roads and Traffic Authority (RTA). To the best of our knowledge, the proposal presented herein accurately reflects the RTA's intentions when the report was printed. However, the application of conditions of approval or impacts of unanticipated future events could modify the outcomes described in this document. In preparing the report, ERMMM used data, surveys, analyses, designs, plans and other information provided by the individuals and organisations referenced herein. While checks were undertaken to ensure that such materials were the correct and current versions of the materials provided, except as otherwise stated, ERMMM did not independently verify the accuracy or completeness of these information sources.

Approved by:	*Tony McNamara*
Position:	Project Director
Signed:	Tony McNamara
Date:	14.7.98

ERM Mitchell McCotter Quality System

TABLE OF CONTENTS

Page No.

APPENDICES

A. FLORA LIST

B. FAUNA LIST

C. EIGHT PART TEST OF SIGNIFICANCE

LIST OF TABLES

Page No.

LIST OF FIGURES

Follows Page No.

Chapter 1

INTRODUCTION

1.1 BACKGROUND

The proposed highway upgrade between the townships of Bulahdelah and Karuah will result in the removal of approximately 40 hectares of native forest (including modified forest types) and associated fauna habitats. The general topography of the locality consists of a variety of landforms, including low-lying floodplain, undulating foothills and steeply sloping hills. There are substantial areas of continuous forest abutting the existing carriageway, although the majority of vegetation along the carriageway consists of narrow woodland corridors which lie perpendicular to the road.

Ten kilometres of the proposed highway upgrade abuts the Nerong State Forest, which is approximately 8000 hectares in size. The majority of the remainder of the land is privately owned. A small section of Myall Lakes National Park abuts the eastern side of the existing highway to the north of Nerong. Only a small portion (approx. 0.2 ha) of the National Park will be disturbed by the highway upgrade. It is estimated that there is in excess of 15,000 hectares of forest vegetation adjacent to this particular section of the highway.

The Nerong State Forest has been identified during the Regional Forest Assessment as an Interim Deferred Forest Area (IDFA). This assessment was initially based on satellite (LANDSAT) imagery and aerial photographic interpretation. Further extensive studies are yet to be conducted in the area to determine the conservation significance of this area. Additionally, the Mt Karuah, Fame Cove and Carrington areas have been identified by the National Parks and Wildlife Service (NPWS) for potential acquisition into the comprehensive national reserve system.

The IDFA compartments of the Nerong State Forest are connected to Myall Lakes National Park to the east and Myall River State Forest on the western side of the existing highway. These areas are considered to jointly represent an east-west altitudinal corridor which NPWS has identified as being a significant corridor for fauna movement and important for maintenance of the flow of genetic material between the coast and the hinterland communities (pers. comm. Lynn Baker NPWS Coffs Harbour, 1998). This corridor is affected by the existing highway location. Widening of the highway may increase the current crossing difficulties encountered by fauna.

1.2 AIMS OF ASSESSMENT

The aims of the ecological assessment for the study were:

- to determine the significance of vegetation communities and fauna habitats along the proposed carriageway, particularly forested areas;
- to identify significant flora and fauna species which exist or are likely to exist in the vicinity of the proposed highway carriageway;
- to determine the potential impacts associated with the proposed development on significant flora and fauna which are known, or are likely to occur within the proposed easement;
- to identify the potential constraints on development of the proposed highway carriageway imposed by the presence of significant flora and fauna species; and
- to determine a mitigation strategy which will minimise long and short term impacts on native flora and fauna.

Chapter 2

ASSESSMENT METHODOLOGY

2.1 LITERATURE REVIEW

A literature search was undertaken to gather information for review, particularly previous ecological studies conducted in the area. Information was sought from the following sources:

- National Parks and Wildlife Service (NPWS);
- State Forests of New South Wales;
- local naturalists and wildlife societies;
- Local Councils; and
- Roads and Traffic Authority (RTA).

2.2 BACKGROUND

Ecological investigations were conducted in August, September and December 1997, and January 1998 by ERM Mitchell McCotter. The ecological investigations were undertaken within 200 metres either side of the proposed highway carriageway because this area is most likely to be impacted on (both directly and indirectly) by the proposed highway (ie through clearing and the impacts associated with edge effects). Aerial photographic interpretation and preliminary ground truthing was undertaken which indicated that the vegetation communities and fauna habitats beyond 40 metres from the existing road were relatively homogenous. Consequently, it was determined that the sampling locations were representative of the vegetation communities and fauna habitats that exist in the locality. Additional sampling was also undertaken in the narrow linear communities/habitats which ran perpendicular to the existing road and where edge effects were predominant in order to determine their value as wildlife corridors/linkages.

The intensity and type of investigations undertaken were influenced by the particular characteristics of the proposed development and existing environment including:

- the current quality of habitats within and directly adjacent to the existing and proposed carriageway;
- the location of the existing highway in relation to areas of cleared agricultural land and State Forests; and
- the likelihood of occurrence of threatened or regionally significant flora and fauna species in habitats within and directly adjacent to the areas proposed for disturbance by the construction of the proposed highway.

2.3 FLORA - FIELD SURVEY METHODOLOGY

The primary objectives of the flora survey were:

- to map and describe the vegetation communities using the classification scheme of Walker and Hopkins (1991) as a basis;
- to compile a list of flora occurring in the vegetation communities, identifying any threatened, regionally or locally significant species; and
- to assess the likely impacts of the proposed development and formulate recommendations for minimising its impacts on the flora in the proposed carriageway.

Vegetation analysis involved the examination of aerial photographs and qualitative field observations to identify vegetation communities within and abutting the existing road easement. Flora surveys of the vegetation communities surrounding the proposed highway upgrading were conducted over ten days during December 1997 and January 1998.

The flora survey involved a combination of ten 20 x 20 metre quadrats and random searches undertaken using the methodology of Cropper (1993) within each vegetation community, as illustrated in *Figures 2a - 2f*. It was ensured that at least one 20 x 20 metre quadrat was located within each vegetation community to enable adequate sampling of all strata. Selection of vegetation plots was also based on physical site characteristics such as aspect, slope and elevation. Additionally, vegetation surveys and searches for weeds and threatened flora were undertaken using the random meander technique in all habitats sampled during fauna surveys and structured SEPP 44 investigation sites.

Targeted flora surveys were conducted in habitats deemed suitable for threatened plant species. Plant identification was achieved using the nomenclature of Harden (1990, 1991, 1992 and 1993) and recent nomenclature changes listed in *Cunninghamia* and *Telopea*. The NSW NPWS Atlas of Wildlife provided additional flora records (of

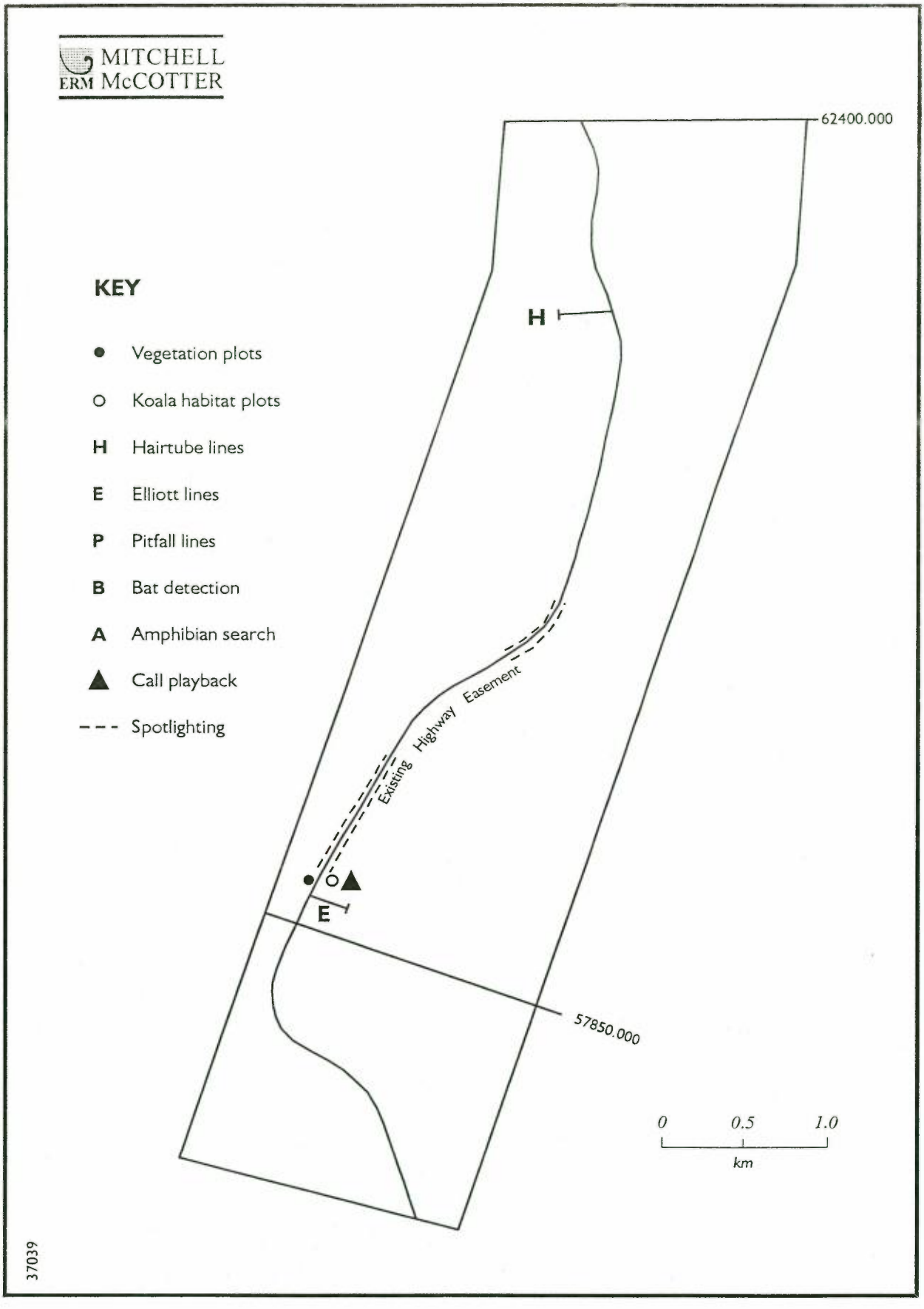

Figure 2a LOCATION OF FAUNA DETECTION TECHNIQUES, VEGETATION SAMPLING PLOTS AND KOALA HABITAT PLOTS

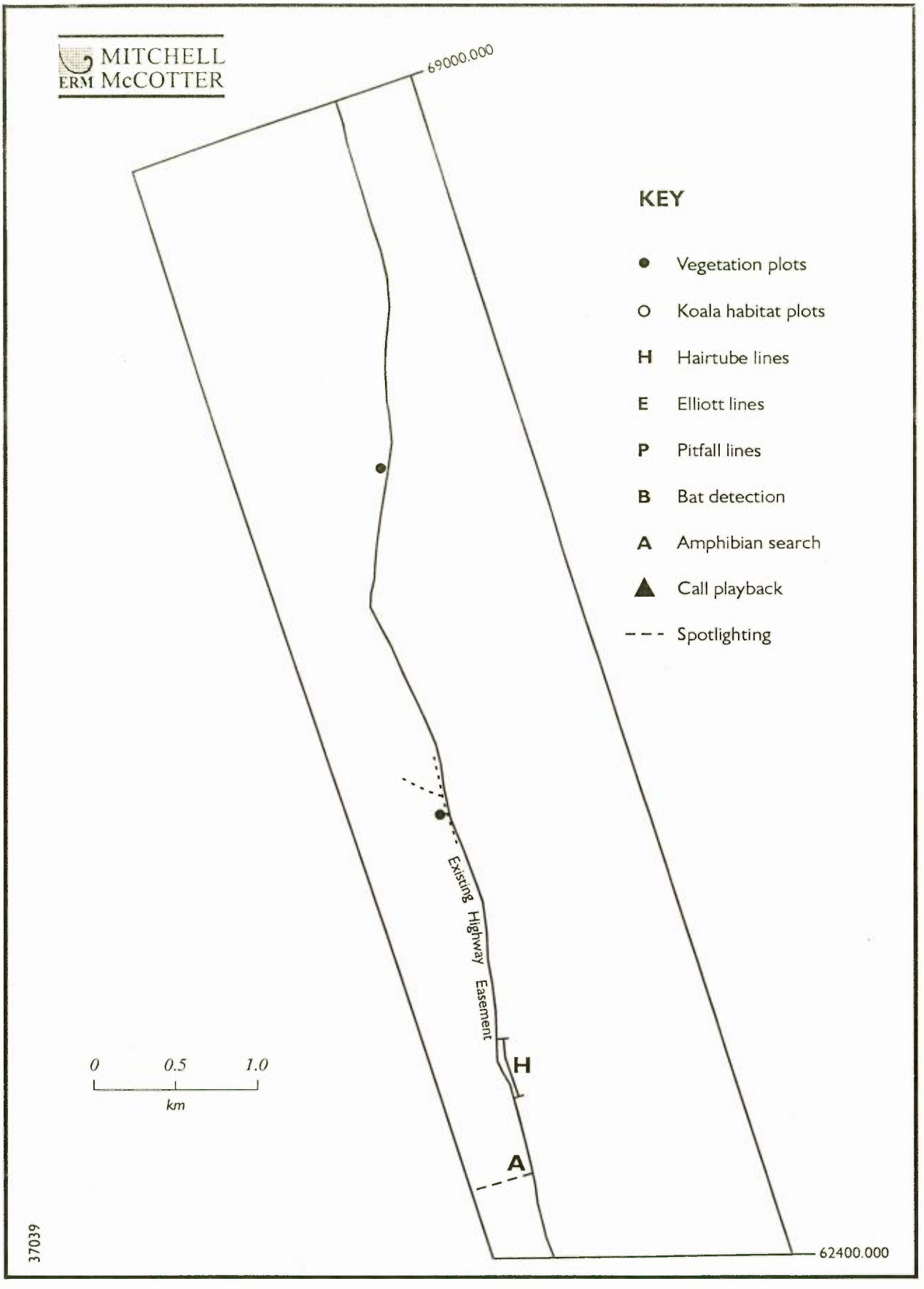

Figure 2b LOCATION OF FAUNA DETECTION TECHNIQUES, VEGETATION SAMPLING PLOTS AND KOALA HABITAT PLOTS

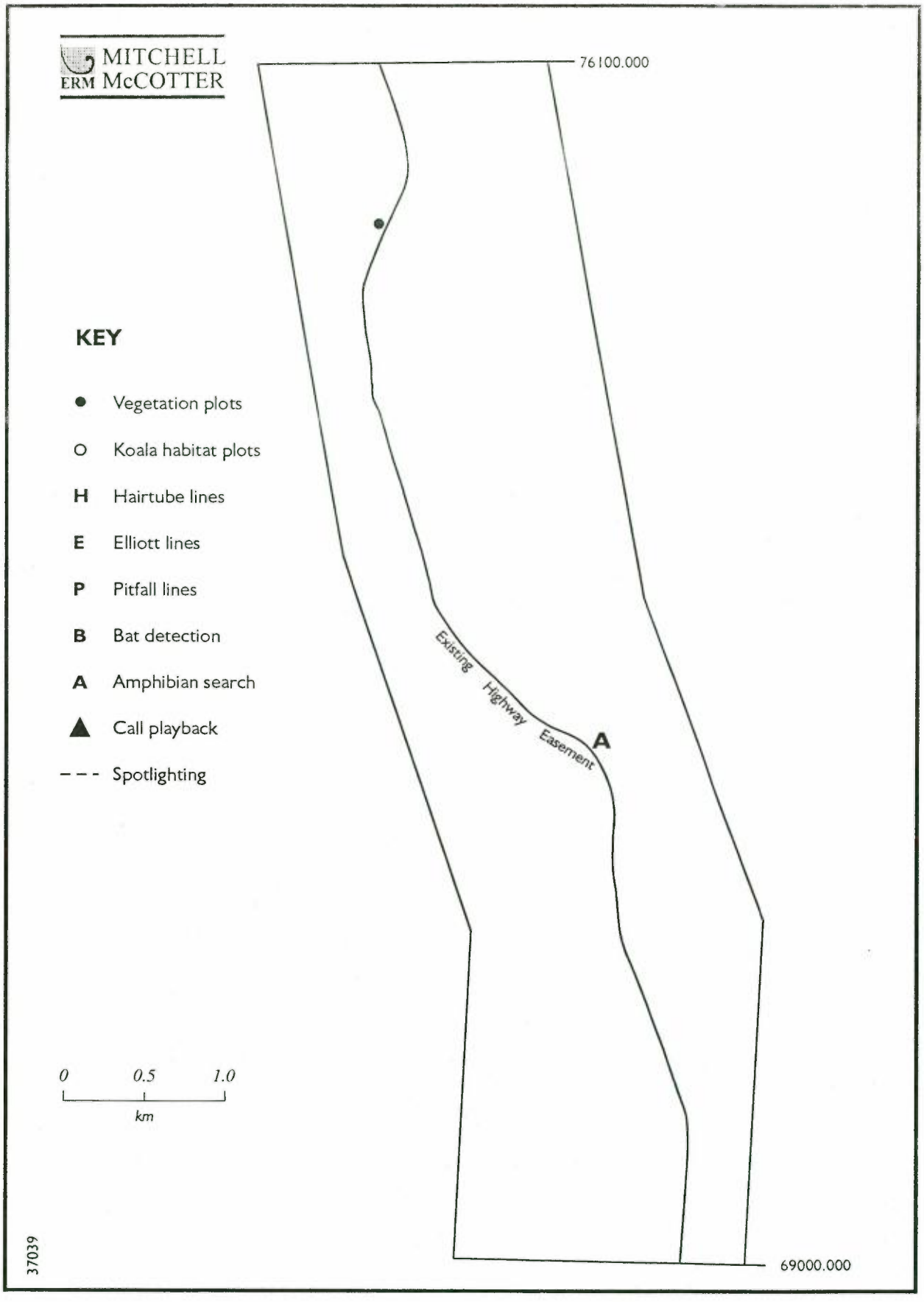

Figure 2c LOCATION OF FAUNA DETECTION TECHNIQUES, VEGETATION SAMPLING PLOTS AND KOALA HABITAT PLOTS

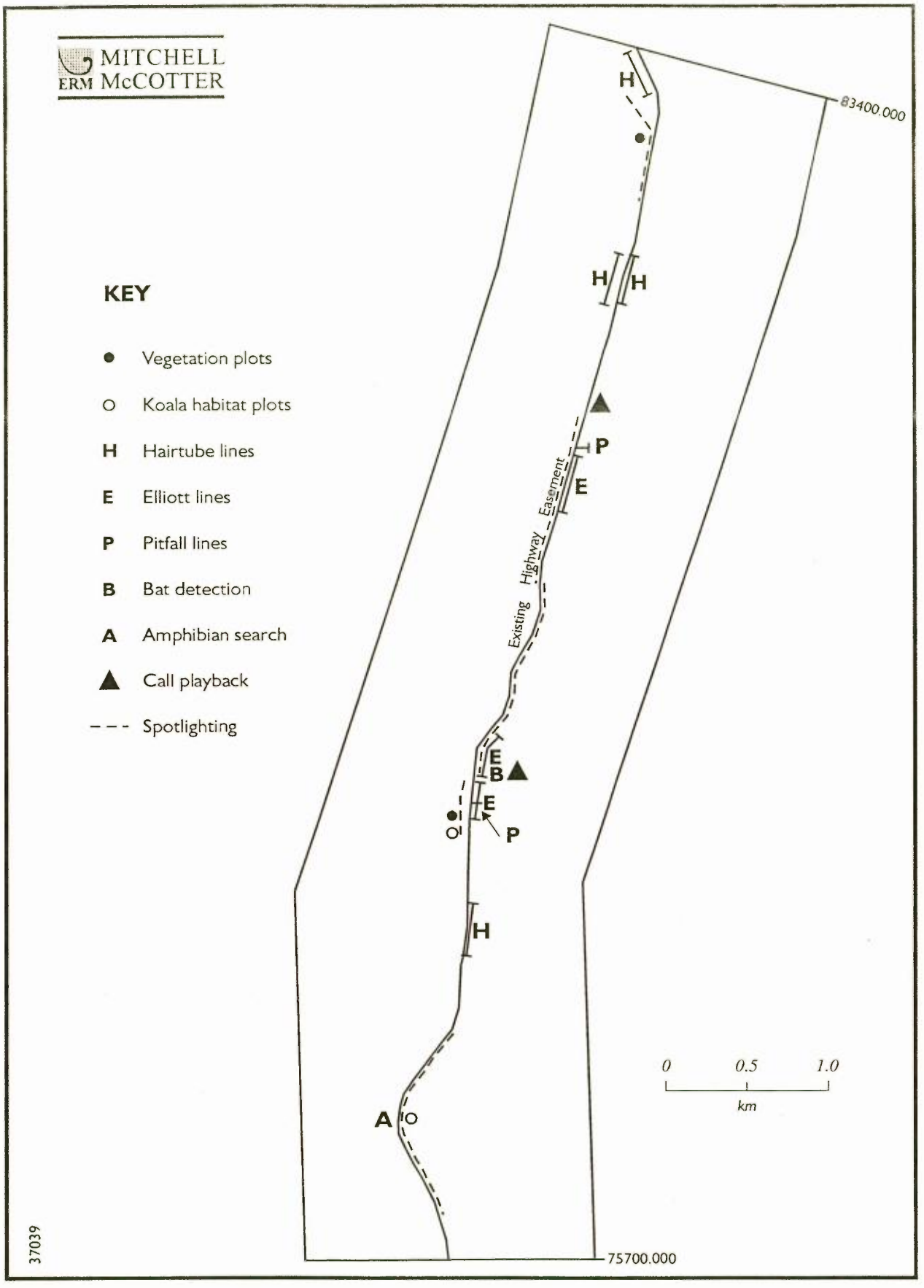

Figure 2d LOCATION OF FAUNA DETECTION TECHNIQUES, VEGETATION SAMPLING PLOTS AND KOALA HABITAT PLOTS

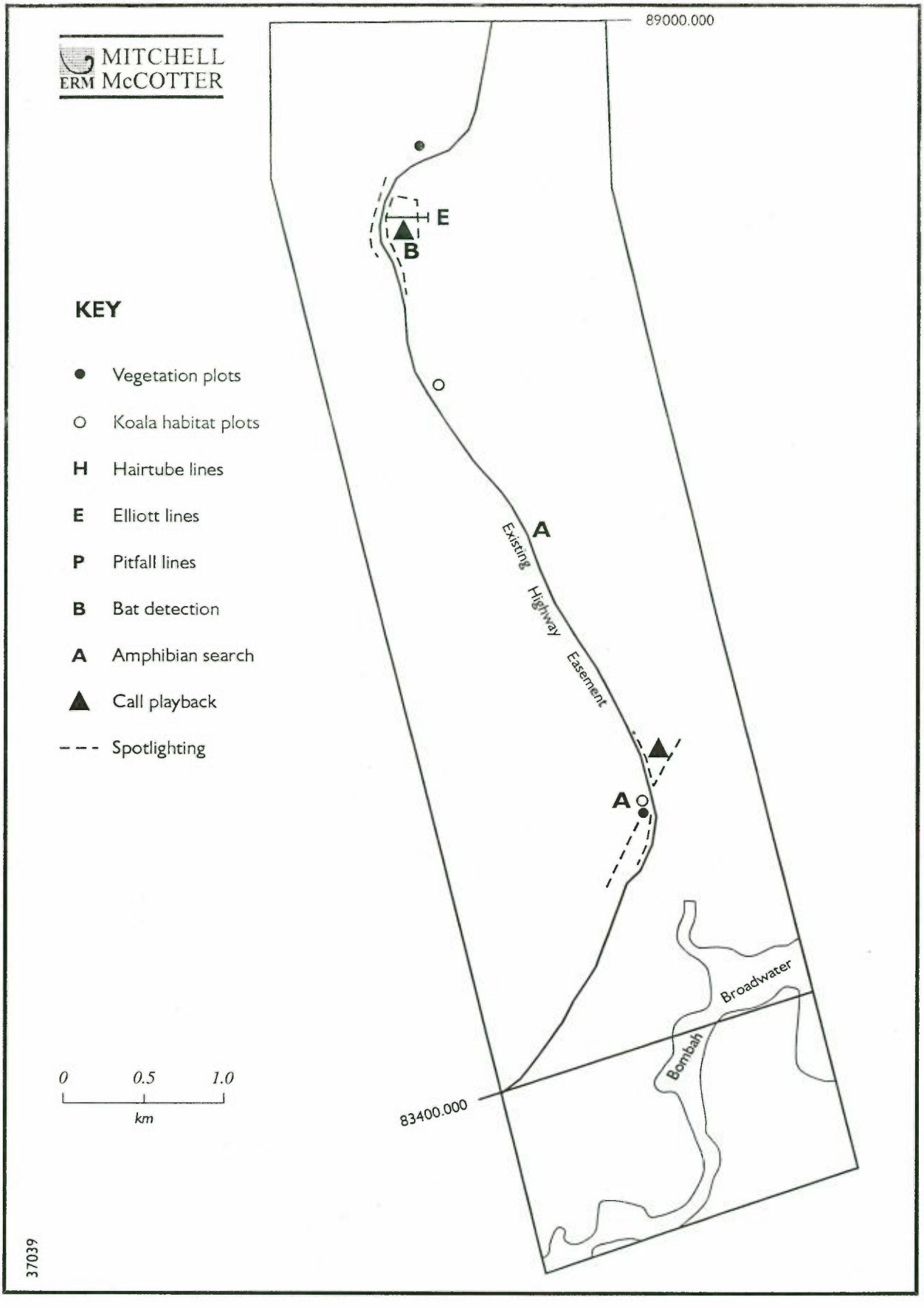

Figure 2e LOCATION OF FAUNA DETECTION TECHNIQUES, VEGETATION SAMPLING PLOTS AND KOALA HABITAT PLOTS

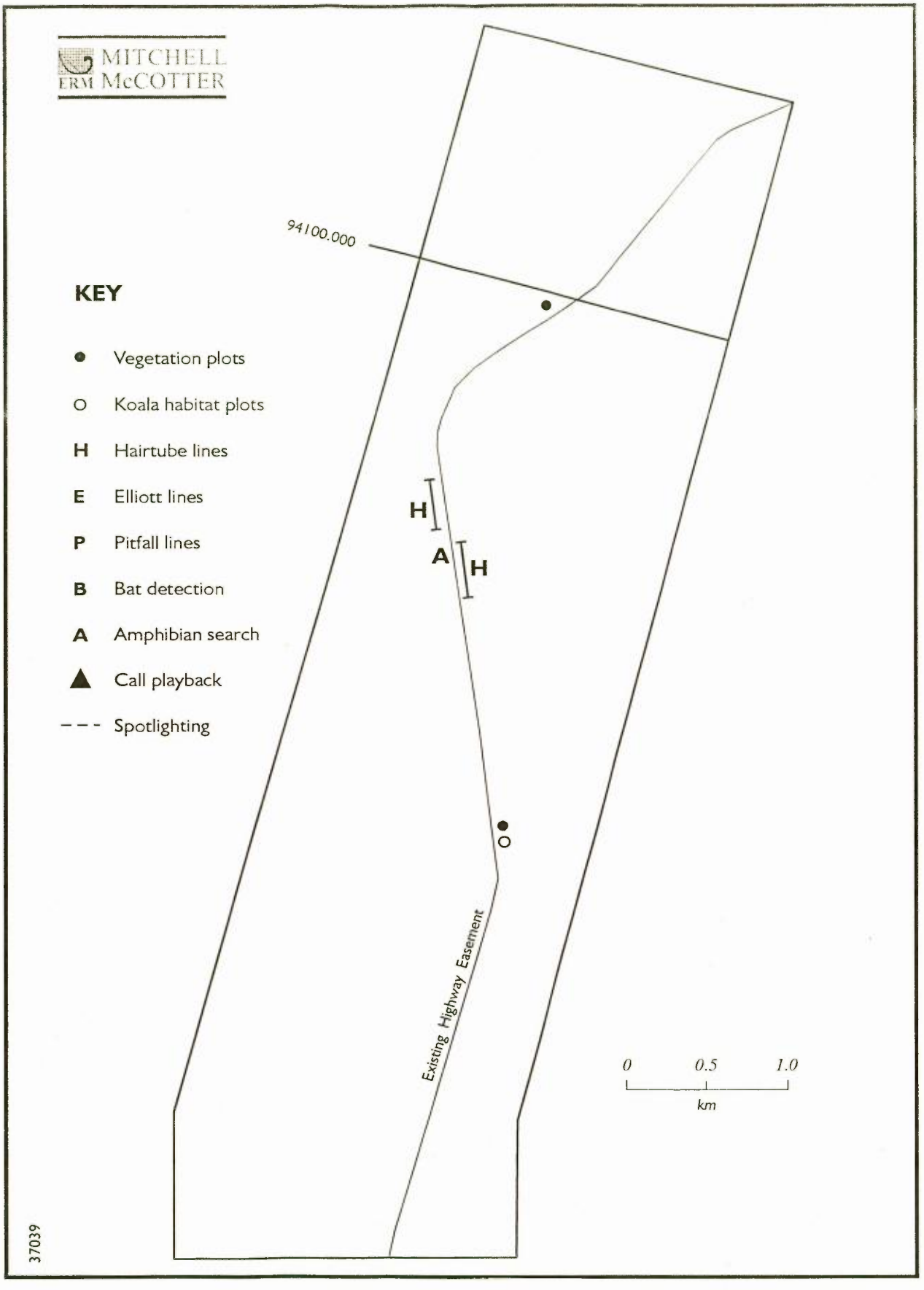

Figure 2f LOCATION OF FAUNA DETECTION TECHNIQUES, VEGETATION SAMPLING PLOTS AND KOALA HABITAT PLOTS

both ROTAP species and species listed on the Schedules of the TSC Act, 1995) for the Bulahdelah and Port Stephens 1:100 000 topographic maps. Flora records were also obtained from State Forests of NSW for the Bulahdelah Management Area.

The quality of existing vegetation communities was assessed by considering the following criteria:

- extent of weed infestation;
- information about fire history;
- evidence of logging activity and vegetation clearing/thinning; and
- fragmentation.

Vegetation community quality was determined for areas investigated up to approximately 200 metres on either side of the existing highway at all sites visited during ecological investigations (including those visited during SEPP 44 investigations and fauna sampling locations).

2.4 CONSERVATION STATUS OF PLANT COMMUNITIES

The conservation status of plant communities may be determined with reference to a number of conservation criteria. The criteria utilised for this assessment have been determined from a number of key references including Margules and Usher (1981), Usher (1986), Margules (1989) and Margules, Pressey and Nichols (1991). The criteria and their definitions are listed in *Table 2.1.*

Table 2.1 DEFINITIONS OF CONSERVATION CRITERIA FOR PLANT COMMUNITY CONSERVATION STATUS

Conservation Criteria	Definitions
1 REGIONAL REPRESENTATION	Representativeness of a community on a regional scale
2 PRESENCE OF SIGNIFICANT SPECIES	Presence of species which are rare, threatened or regionally significant
3 DIVERSITY	Diversity of species present in the community (based on the relative numbers of species supported by the community)
4 NATURALNESS	How natural is the community?
5 CONNECTIVITY	How well the community is connected to other areas of native vegetation

Table 2.1 DEFINITIONS OF CONSERVATION CRITERIA FOR PLANT COMMUNITY CONSERVATION STATUS

Conservation Criteria	Definitions
6 FRAGMENTATION	How fragmented the patch is (eg by roads, clearings etc).

2.5 FAUNA HABITAT ASSESSMENT

Vegetation communities reflect differences in community structure and plant species composition. The majority of fauna species select habitat based primarily on structural characteristics of vegetation communities rather than their composition of plant species. One notable exception is the koala (*Phascolarctos cinereus*), which selects habitat based on the presence of particular plant species. Structural characteristics of vegetation communities include the height of the dominant layer, the number of distinctive layers and the density of vegetation.

Many specialised faunal groups may also rely upon the availability of water, the presence of particular tree or shrub species, or specific micro-climatic characteristics in order to survive. Human activities, particularly those that alter the structure or cover of vegetation, have the potential to change faunal habitat characteristics, which, in turn, may result in modifications to the composition of fauna within an area.

Investigations sought to identify and assess the type and quality of fauna habitats occurring along the proposed highway carriageway. Assessment of fauna habitat types and quality was derived from a qualitative assessment of:

- dominant vegetation type;
- structural vegetation characteristics;
- presence/abundance of mature trees (rated as sparse, moderate or abundant);
- level of disturbance;
- density of ground litter (ie logs, leaf litter);
- fire history (rated as frequent or infrequent); and
- presence/absence of standing or flowing water (SWC Wetlands, 1994).

Habitat descriptions were made at all sites visited during the investigations, including fauna and flora sampling locations, hair tube SEPP 44 plots.

2.6 FAUNA - FIELD SURVEY METHODOLOGY

Information regarding fauna known or likely to occur along the carriageway was obtained by collating records from the NPWS Atlas of Wi fauna records from State Forests of NSW for the Bulahdelah Manage Local naturalists were also consulted but no information was forthcoming.

The fauna survey utilised a number of direct and indirect methods for det various vertebrate fauna species, including:

- trapping for terrestrial mammals;
- stagwatching and spotlighting for terrestrial and arboreal mam birds;
- morning and late afternoon observations for diurnal birds;
- nocturnal playback calls for significant owl and arboreal mamm followed by spotlighting;
- use of hair tubes for terrestrial and arboreal mammals; and
- searches for indirect evidence of fauna, such as scratch marks, scats and burrows.

The sampling design for fauna assessment focussed on the detection of t species likely to occur within the highway easement, with particular placed on those species potentially affected by impacts associated with the highway upgrading. Those species which are particularly mobile, are no colliding with highway traffic and have extensive home ranges were not high levels of investigation (ie bats and many avian species).

The field survey also included a search for the presence of koalas. The re of SEPP 44 - Koala Habitat Protection was used as a basis to determine th proposed carriageway by koalas (*Phascolarctos cinereus*). Hairtube samplii night of spotlighting was conducted during September 1997, while all survey activities (including additional spotlighting) were undertaken nights and five days between January 12 and 16, 1998.

Fauna trapping and sampling locations were based on the results of preliminary aerial photographic interpretation (API) which indicated that open forest was the dominant habitat type, with potential riparian and closed forest habitats existing in moist gullies and along creeklines, as well as the existence of corridors of vegetation and potentially significant wildlife corridors. Where possible, fauna survey sites were representative of the range of forest and woodland types (determined by a number of physical parameters including slope, aspect, geology and soil types) occurring along the proposed carriageway. No grasslands were thoroughly surveyed for fauna, however, incidental fauna sightings were recorded. The fauna survey focussed on assessing species diversity and did not attempt to obtain measures of species abundance. The methods used to identify fauna assemblages and to target specific species are described below.

i. Terrestrial Non-flying Mammals

Small terrestrial mammals were surveyed using two methods; Elliott trapping and hair tubes.

Five traplines were established, totalling 50 type A Elliott traps (33cm x 10cm x 9cm) placed approximately 15 to 20 metres apart in selected areas of habitat over four nights. Two type B Elliott traps were attached to suitable trees adjacent to each trapline in an effort to capture arboreal mammal species. The bait used consisted of a mixture of rolled oats, honey and peanut butter. Traplines are illustrated on *Figures 2a - 2f.* A total of 300 Elliott trap nights were achieved during the survey.

Two lines of pitfall traps (5 pit traps per line) were established across suspected fauna corridors linking retained vegetation at Nerong Waterholes with forested areas to the north and south. Pitfall trapping was also utilised to detect the presence of the common planigale (*Planigale maculata*). Drift netting was utilised in conjunction with pit fall trapping in an effort to enhance trap success.

Forty five hair tubes were placed along the carriageway in areas identified as potential movement corridors in selected areas where habitats may potentially be significant. The bait used in the tubes consisted of a mixture of rolled oats, honey and peanut butter.

Large mammals, including macropods were recorded when encountered during diurnal bird surveys, and at night during arboreal mammal and nocturnal bird spotlighting. Additionally, searches were made for indirect evidence of medium and large terrestrial mammals, including searches for scats and examination of burrows, tracks and diggings.

ii. Arboreal Non-Flying Mammals

Techniques utilised during the investigations for detecting arboreal mammals included spotlighting, playback of characteristic vocalisations and stagwatching.

Spotlighting searches were undertaken on foot at a number of sites along the proposed highway carriageway. Two 55 Watt spotlights were used, and occasionally switched off for short intervals to allow quiet listening in darkness to detect any animal movements or vocalisations. Trees with hollows were targeted, particularly at dusk due to the increased chance of animal activity around that time.

Spotlighting surveys were performed at specific sites along the length of the proposed carriageway. Surveys were conducted from a slow moving vehicle (approximately 5km/h). More intensive investigations were undertaken by walking in some areas.

Playback of pre-recorded calls of the yellow-bellied glider, squirrel glider and koala were made using a loud hailer. This was performed in an attempt to elicit a vocal response from cryptic arboreal mammals. Additional aural and sight records were obtained during the bat and owl surveys.

Stagwatching involved the quiet observation of potential nest trees to detect any animal movements. Stagwatching for approximately half an hour was undertaken at dusk on each night of the survey, and four trees with obvious hollows were selected for observation. During the survey period sunset occurred at approximately 8.00 pm.

Investigations to detect koala habitat were generally undertaken in accordance with the SEPP 44 methodology used by the Australian Koala Foundation (AKF), however, because structured SEPP 44 investigations using this method are not particularly suitable for linear habitats, surveys for koalas also utilised indirect detection methods including searches for koala scratch marks and scats, and at some locations, play-back calls. In areas where potential koala habitat was identified, further investigation was undertaken to determine whether core koala habitat existed.

Six plots of 0.1 hectares (50 x 20 metres) in size were marked out in vegetation communities suspected of containing koala habitat utilising the AKF methodology for detecting potential koala habitat. The abundance of each tree species in the upper and lower canopy was recorded to enable an approximate percentage of cover for each species to be calculated. Potential koala habitat is defined as:

'Areas of native vegetation where trees of the types listed in Schedule 2 of *the Policy constitute at least 15 per cent of the total number of trees in the upper or lower strata of the tree component.'* (refer to *Table* 2.2 for Schedule 2 species).

Table 2.2 TREE SPECIES LISTED ON SCHEDULE 2 OF SEPP44

SCIENTIFIC NAME	COMMON NAME
Eucalyptus albens	White Box
Eucalyptus camaldulensis	River Red Gum
Eucalyptus haemostoma	Broad-leaved Scribbly Gum
Eucalyptus microcorys	Tallowwood
Eucalyptus populnea	Bimble Box
Eucalyptus punctata	Grey Gum
Eucalyptus robusta	Swamp Mahogany
Eucalyptus signata	Scribbly Gum
Eucalyptus tereticornis	Forest Red Gum
Eucalyptus viminalis	Ribbon Gum

Although not listed on schedule 2 of SEPP 44, the following additional tree species are known koala feed tree species (Lynn Baker, pers comm, 1998; Gerrard Tuckerman, pers comm, 1998) hence were considered while assessing potential koala habitat:

- grey gum (*Eucalyptus propinqua*);
- Sydney blue gum (*E. saligna*);
- grey iron bark (*E. placita*); and
- cabbage gum (*E. amlifolia*).

When a plot was identified as containing potential koala habitat, each potential habitat tree within the plot was then searched for koala scratch marks. The ground beneath the canopy of each potential habitat tree was then searched for koala scats to assist in determining if such areas were 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 (that is, females with young) and recent sightings of, and historical records, of a population.'

iii. Bat Detection

Ultrasonic bat calls were detected and recorded using ANABAT II electronic bat detectors. One bat detector was deployed for 45 minute periods at three locations at fauna trapping/sampling sites. No bat traps were utilised and only a limited effort was used for bat detection due to the mobility of these species and their generally widespread nature. Due to the mobility of these species they are unlikely to be significantly impacted on by the proposed development. Detection sites are illustrated on *Figure 2a - 2f.*

iv. Diurnal Bird Survey

The diurnal census of birds involved foot traverses over sections of the proposed highway carriageway for approximately 1.5 hours each morning between 0500 and 0800 hours, and between 1730 and 1930 each afternoon. Regular stops between five and ten minutes duration were made to listen to and observe all species present. Bird surveys were undertaken at each fauna trapping site. Incidental observations were also recorded.

v. Nocturnal Bird Survey

Stagwatching of mature and dead trees with suitable hollows was undertaken at dusk for a period of half an hour to identify any owl species which may depart the hollow.

Play-back of pre-recorded owl vocalisations were made for approximately half an hour each night, based on the procedures of Kavanagh and Peake (1993) and Debus (1995). Playback of the calls of all significant owl species that may occur over the proposed highway carriageway were made with a 16 Watt portable loud hailer in suitable habitats. Calls of each species were broadcast for a period of five minutes, coupled with short periods of quiet listening for any vocal responses followed by 15 minutes spotlighting in the area.

Additionally, searches for characteristic white wash caused by owls using a regular roost or nest were made, in combination with searches for regurgitation pellets.

The location of owl broadcasting sites and stagwatching sites is illustrated on *Figures 2a - 2f.*

vi. Reptile Surveys

Reptiles and amphibians were sampled using direct and indirect observation methods. Searches were made at various sites along the proposed highway carriageway beneath ground litter, such as scrap metal and sheets of iron, fallen timber, leaf litter, decorticated bark, stones and tufts of vegetation. All amphibian

species observed or heard calling at each of the survey locations were identified and recorded. Additionally, two lines of Pitfall traps (5 traps per line) were established across potential fauna corridors.

vii. Amphibian Surveys

Nocturnal searches for amphibians were conducted at various points along the carriageway. Searches involved spotlighting along drainage lines, waterlogged areas and dams, and quiet listening to identify calls and their location. Few suitable locations for amphibians were encountered as creek and drainage lines were generally either ephemeral or saline due to salt water intrusion at times of high tide.

Chapter 3

RESULTS OF FLORA INVESTIGATIONS

3.1 VEGETATION COMMUNITIES

Six forest communities were identified in the locality surrounding the proposed road carriageway. Several types of Tall Open Forest occur along various parts of the proposed carriageway and Closed Forest is restricted to creeklines and sheltered gullies. The six vegetation communities are described further below. The extent and distribution of the various vegetation communities are illustrated in *Figures 3a - 3f.* A complete list of flora recorded during the ecological investigations is provided in *Appendix A.*

Grassland and modified forest occurs for approximately 50 percent of the proposed carriageway and only four of the native vegetation communities will be partly disturbed or cleared by the proposed highway upgrading. The approximate areas of the forested communities to be cleared by the proposed upgrading are:

- Angophora costata/Euc. globoidea Tall Open Forest 29ha
- Angophora costata/Euc. punctata Tall Open Forest 4.5ha
- Euc. punctata/Melaleuca stypheloides Tall Open Forest 0.1ha
- Corymbia gummifera/Euc. microcorys Tall Closed Forest 0.9ha
- Modified Woodland 5.5ha

i. Melaleuca nodosa Mid Open Forest

Description A moist open forest that occurs in lower lying areas occurring predominantly at the northern end of the proposed carriageway. The canopy is dominated by ball honeymyrtle (*Melaleuca nodosa*), with smooth-barked apple (*Angophora costata*) being an emergent species. The understorey is generally sparse, and consists primarily of juvenile ball honeymyrtle(*M. nodosa*), Sydney golden wattle (*Acacia longifolia*) and narrow-leaved geebung (*Persoonia linearis*). The groundcover is dense, consisting of a variety of native grasses including kangaroo grass (*Themeda australis*), wallaby grass (*Danthonia* sp.), tufted hedgehog grass (*Echinopogon caespitosus*), plume grass (*Dichelachne* sp.), pigeon grass (*Setaria* sp.) and bladey grass (*Imperata cylindrica*). Other common groundcover species include blue-flax lily

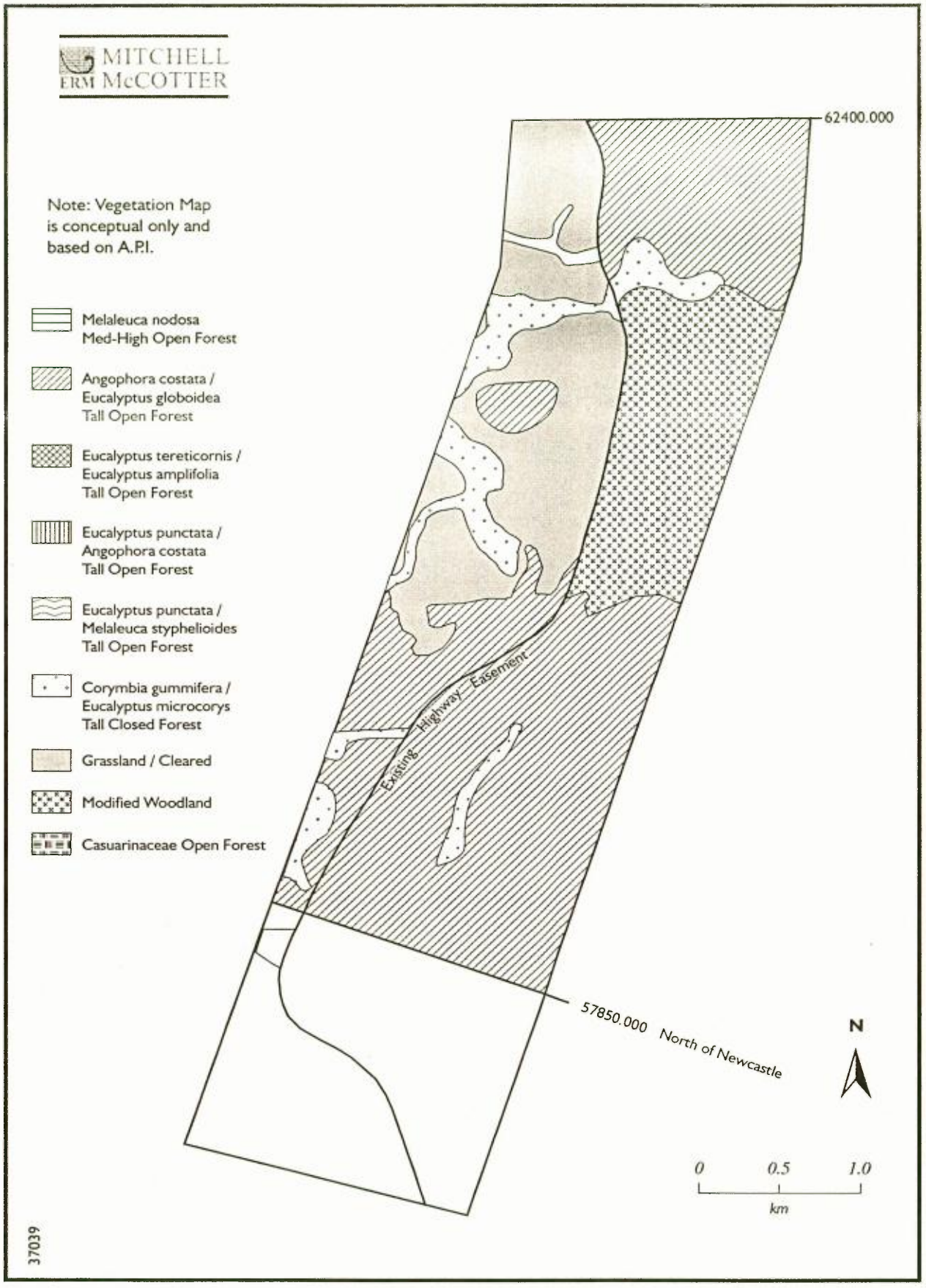

Figure 3a EXTENT AND DISTRIBUTION OF VEGETATION COMMUNITIES ALONG THE EXISTING HIGHWAY EASEMENT

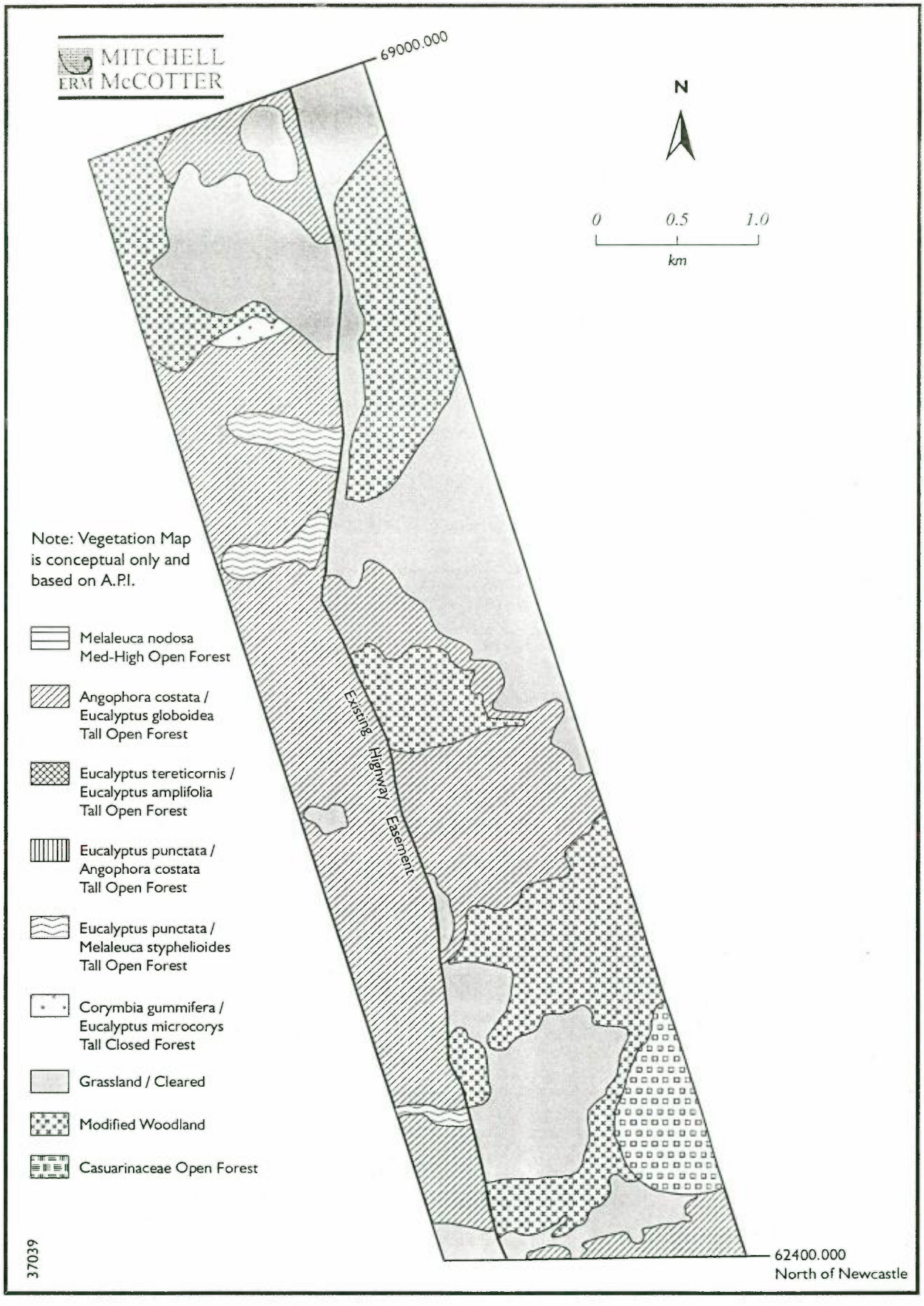

Figure 3b EXTENT AND DISTRIBUTION OF VEGETATION COMMUNITIES ALONG THE EXISTING HIGHWAY EASEMENT

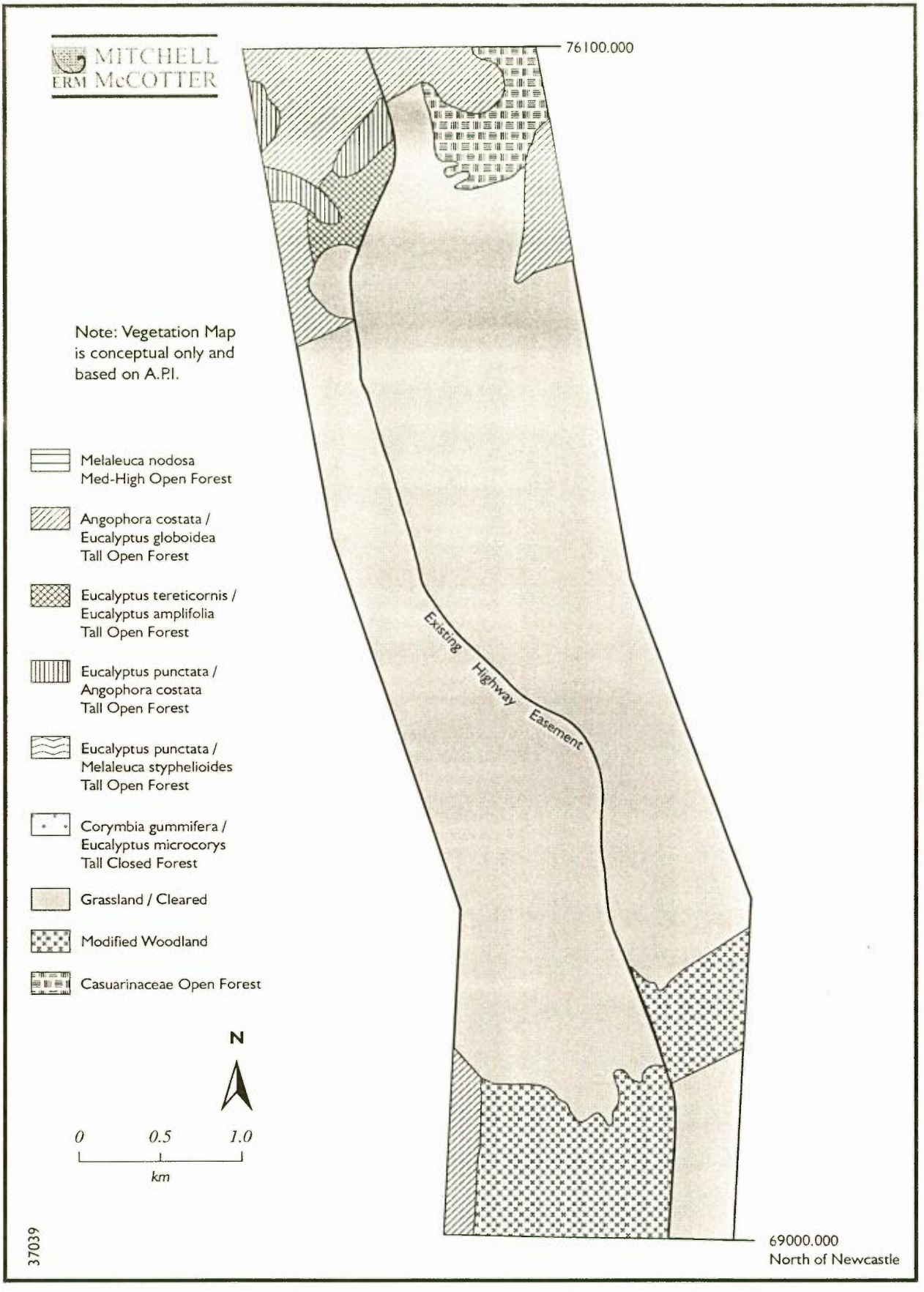

Figure 3c EXTENT AND DISTRIBUTION OF VEGETATION COMMUNITIES ALONG THE EXISTING HIGHWAY EASEMENT

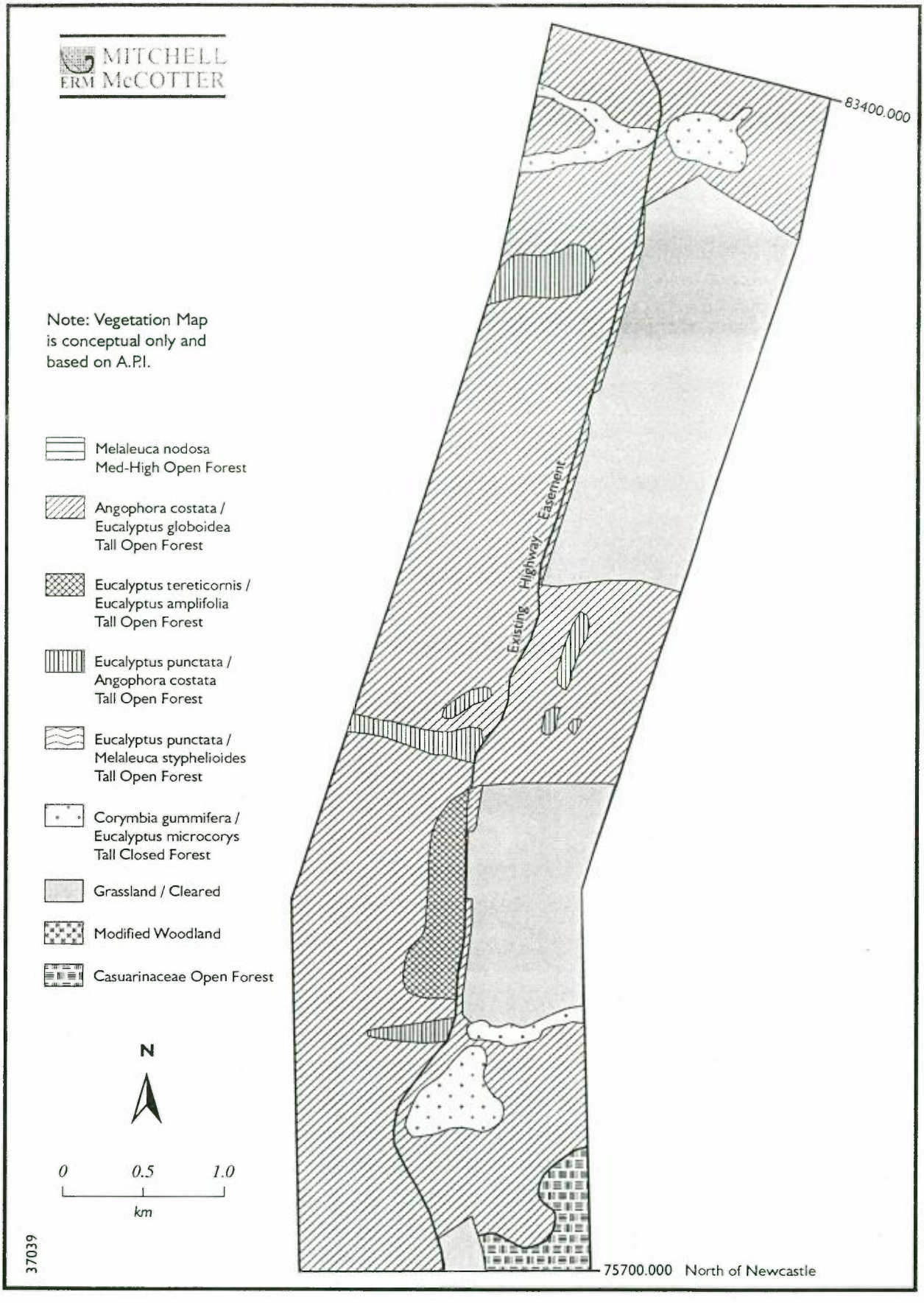

Figure 3d EXTENT AND DISTRIBUTION OF VEGETATION COMMUNITIES ALONG THE EXISTING HIGHWAY EASEMENT

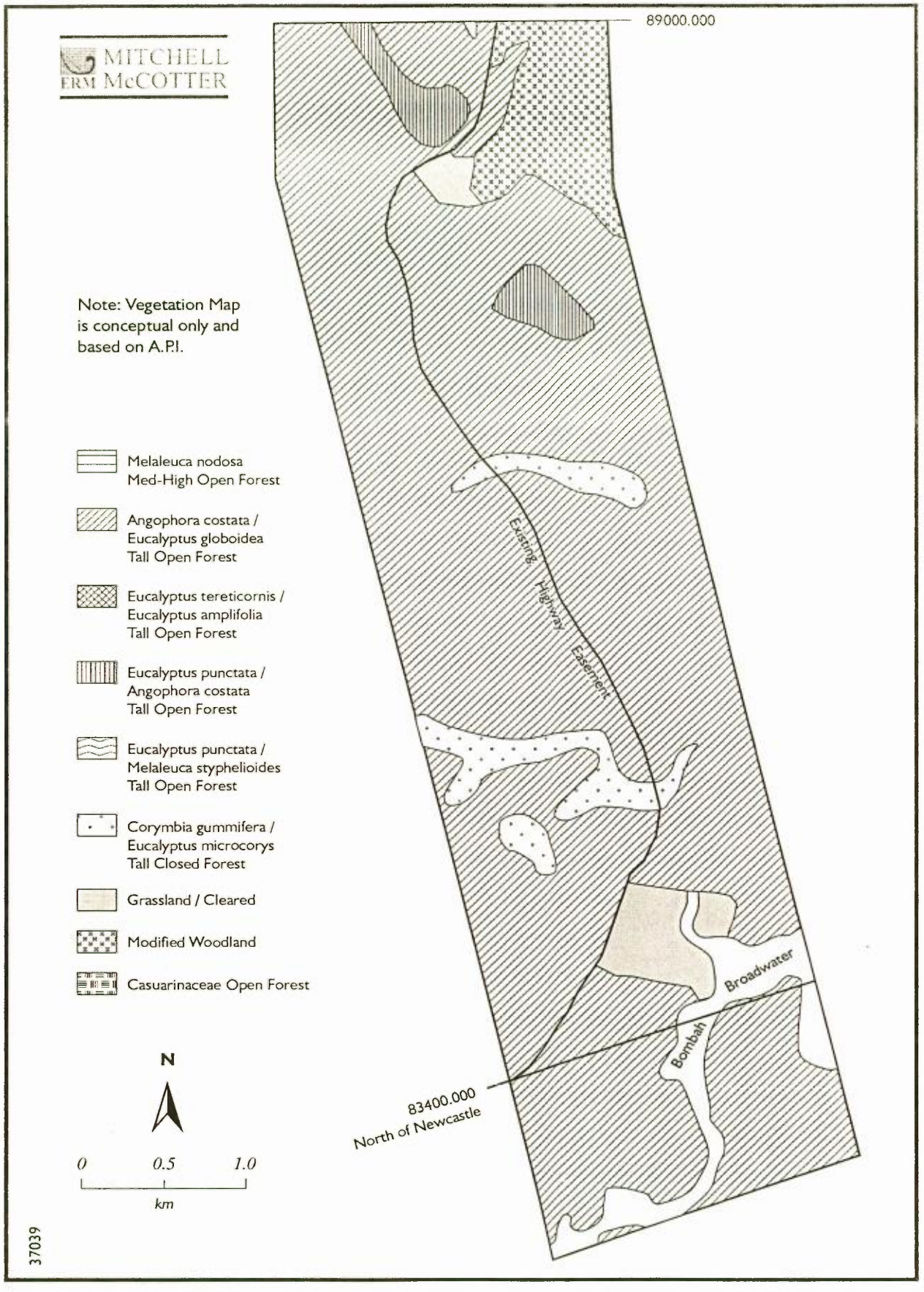

Figure 3e EXTENT AND DISTRIBUTION OF VEGETATION COMMUNITIES ALONG THE EXISTING HIGHWAY EASEMENT

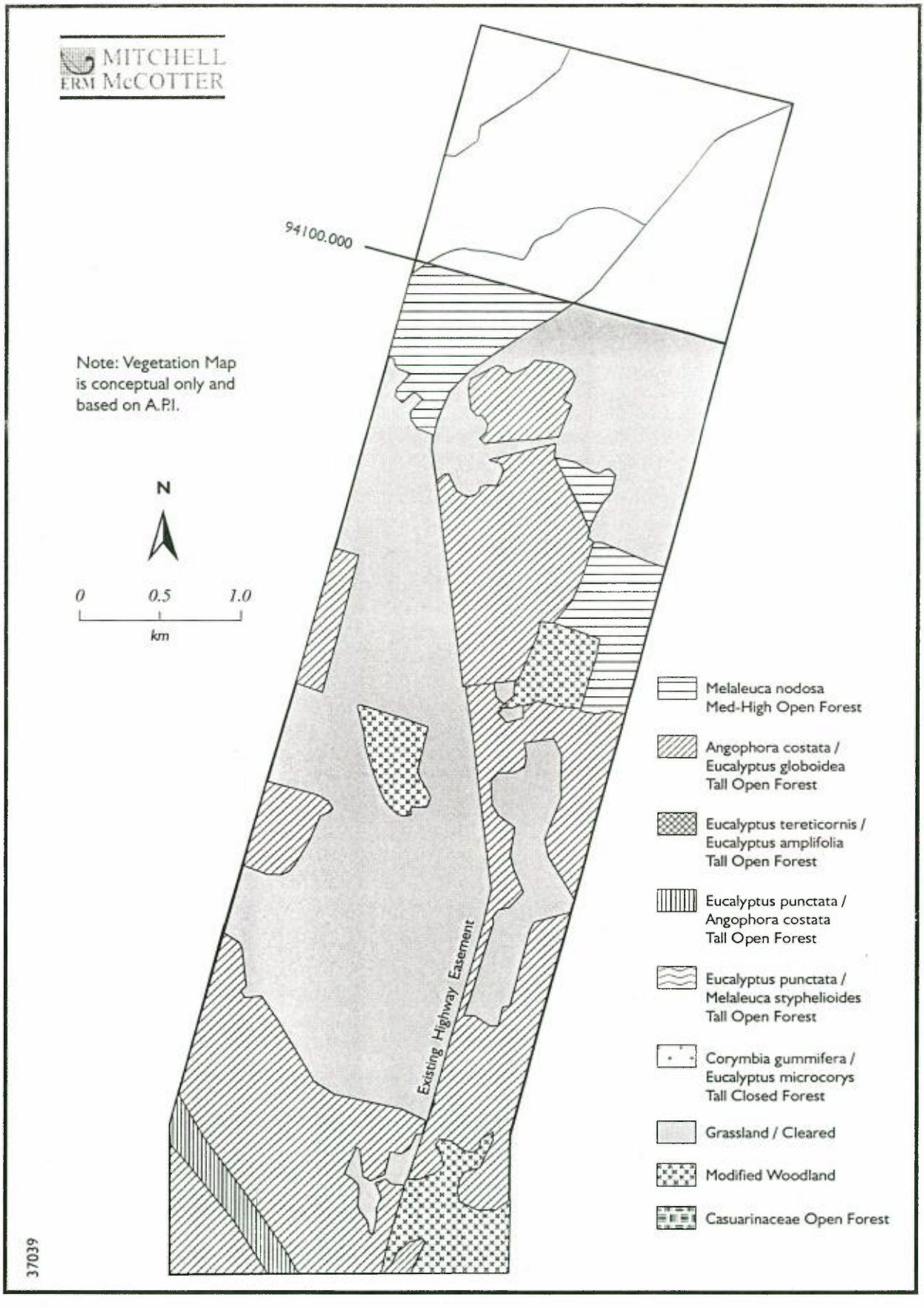

Figure 3f EXTENT AND DISTRIBUTION OF VEGETATION COMMUNITIES ALONG THE EXISTING HIGHWAY EASEMENT

(*Dianella caerulea*), hardenbergia (*Hardenbergia violacea*), bracken fern (*Pteridium esculentum*) and kurnell curse (*Hydrocotyle bonariensis*).

Vegetation Condition: Weeds are common in this community. Some areas have been and are most likely still subject to, grazing by stock and frequent low intensity fire. Although the community is fragmented in some places by some private roads, there are generally few tracks present. There are few tree hollows present and plant species diversity within this community is generally low.

ii. Angophora costata/Eucalyptus globoidea Tall Open Forest

Description: This is the most common vegetation community occurring along the proposed carriageway. The dominant canopy species are smooth-barked apple (*Angophora costata*) and white stringybark (*Eucalyptus globoidea*), followed by red bloodwood (*E. gummifera*) and blue-leaved stringybark (*E. agglomerata*). Other canopy species that occur intermittently include pink bloodwood (*Corymbia intermedia*), spotted gum (*C. maculata*), tallowwood (*E. microcorys*), grey ironbark (*E. placita*), brown stringybark (*E. capitellata*) and thin-leaved stringybark (*E. eugenioides*).

The understorey varies from sparse to dense, with common species being prickly moses (*Acacia ulicifolia*), Sydney golden wattle (*A. longifolia*), hill banksia (*Banksia spinulosa*), common hop-bush (*Dodonaea triquetra*) and matchheads (*Comesperma* spp.). Groundcover is moderate to dense, containing species such as mat-rush (*Lomandra longifolia*), fish-bones (*Lomandra obliqua*), shivery grass (*Briza maxima*), coral heath (*Epacris microphylla*) and woolly xanthosia (*Xanthosia pilosa*).

Vegetation Condition: Weeds are relatively common in this community, particularly roadside weeds along the forest fringe. *Lantana camara* and *Rubus ulmifolius* are also scattered throughout this community. Some areas of this community fringing the roadside showed signs of recent and frequent fires, as indicated by reduced species diversity and fire-tolerant species being dominant in the understorey. The understorey is dominated by immature trees, with a distinct lack of mature trees with hollows, hence indicative of past canopy thinning. The largest portion of this community occurs in Nerong State Forest. Within the Nerong State Forest fragmentation of this community by tracks is generally limited to within 150 metres of the road reserve. However, fragmentation of forest contained on privately owned property is extensive in some areas, particularly toward the southern end of the proposed carriageway. The plant species diversity within this community is generally low due to past disturbance.

iii. Eucalyptus tereticornis/Eucalyptus amplifolia Tall Open Forest

Description: A moist open forest of limited extent, that occurs on wetter, poorly drained clay soils of the proposed carriageway. The canopy is dominated by forest red gum (*Eucalyptus tereticornis*) and cabbage gum (*E. amplifolia*). Other canopy

species that occur intermittently include grey ironbark (*E. paniculata*), grey gum (*E. punctata*), and swamp mahogany (*E. robusta*).

Understorey cover varies from sparse to dense. The dominant understorey species are swamp oak (*Casuarina glauca*) and prickly-leaved paperbark (*Melaleuca stypheloides*). Other species that occur intermittently include broad-leaved paperbark (*M. quinquenervia*), swamp paperbark (*M. ericifolia*), ball honeymyrtle (*M. nodosa*), snow-in-summer (*M. linariifolia*) and sieber's paperbark (*M. sieberi*).

Groundcover is moderate to dense, and consists primarily of grasses and sedges including species such as mat-rush (*Lomandra longifolia*), nut grass (*Cyperus brevifolius*), saw sedge (*Gahnia sieberana*) and bladey grass (*Imperata cylindrica*). Other species that occur intermittently include rib-wort (*Plantago debilis*), native violet (*Viola hederacea*), einadia (*Einadia hastata*), centella (*Centella asiatica*) and blackberry (*Rubus ulmifolius*).

Vegetation Condition: Weeds are relatively sparse in this community, although roadside weeds such as paspalum (*Paspalum* sp.), cobblers pegs (*Bidens pilosa*) and purple top (*Verbena bonariensis*) are common on the forest fringe. Some areas on private property are currently subject to grazing by stock. The presence of burnt tree trunks in some areas suggests that this vegetation type is subject to occasional or frequent low intensity fire. Although the community is fragmented in some places by private roads, there are few tracks present. Previous logging activity is evident by the presence of sawn stumps, and an absence of mature and over-mature trees in the canopy. There is a notable absence of medium to large hollows, and there appears to be a low level of plant species diversity within this community.

iv. Angophora costata/Eucalyptus punctata Tall Open Forest

Description: This vegetation type is restricted to well drained southerly facing slopes at intermittent locations along the alignment. The canopy is 20 to 25 metres in height, and provides approximately 50 percent cover. The dominant canopy species are grey gum (*Eucalyptus punctata*) and smooth-barked apple (*Angophora costata).* Other canopy species that occur intermittently include spotted gum (*Corymbia maculata*), tallowwood (*E. microcorys*) and cabbage gum (*E. amplifolia*).

The midstorey is eight to 12 metres high, and provides approximately 40 percent cover. The dominant midstorey species include prickly-leaved tea-tree (*Melaleuca stypheliodes*) and forest oak (*Allocasuarina torulosa*), with juvenile canopy species occurring intermittently.

The understorey is sparse to moderate, with commonly occurring species being black wattle (*Acacia irrorata*), lemon-scented tea-tree (*Leptospermum polygalifolium*),

snow-in-summer (*Melaleuca linariifolia*), large mock olive (*Notelaea longifolia*) lantana (*Lantana camara*) and cassia (*Senna coluteoides*).

The groundcover is moderate, with bladey grass (*Imperata cylindrica*) being the dominant species. Other commonly occurring species include prickly rasp fern (*Doodia aspera*), small sickle fern (*Pellaea falcata* var. *nana*), blue flax lily (*Dianella caerulea*), dwarf trumpet (*Brunoniella pumilio*), muttonwood (*Rapanea variabilis*), blackthorn (*Bursaria spinosa*), zieria (*Zieria* sp.), common buttercup (*Ranunculus lappaceus*) and rib-wort (*Plantago debilis*).

Vegetation Condition: Weeds are relatively common in this community, including lantana (*Lantana camara*) and cassia (*Senna coluteoides*). The presence of burnt tree trunks in some areas suggests that this vegetation type is subject to occasional fires of moderate intensity. The community suffers from minor fragmentation caused by fire trails. Previous logging activity is evident by the presence of sawn stumps, and an absence of mature and dead trees in the canopy. There is a notable absence of medium to large hollows, and there appears to be a low to moderate level of biodiversity within this community.

v. Eucalyptus punctata/Melaleuca stypheloides Tall Open Forest

Description: This community occurs along creek lines in southern sections of the proposed carriageway. The canopy is 15 to 20 metres high, with an estimated cover of approximately 40 percent. The dominant canopy species are grey gum (*Eucalyptus punctata*), prickly-leaved tea-tree (*Melaleuca styphelioides*), with smooth-barked apple (*Angophora costata*) also occurring frequently. Elkhorns (*Platycerium bifurcatum*) also occur intermittently.

The midstorey is five to eight metres high, with an estimated cover of approximately 60 percent. The dominant species are prickly-leaved tea-tree (*Melaleuca styphelioides*), ball honeymyrtle (*M. nodosa*) and broad-leaved paperbark (*M. quinquenervia*).

The understorey is sparse to moderate, and consists of such species as dogwood (*Jacksonia scoparia*), snow-in-summer (*Melaleuca linariifolia*), black wattle (*Acacia irrorata*) and *Hakea* sp.

The groundcover is sparse to moderate, with an estimated cover of approximately 30 percent. The dominant species is mat-rush (*Lomandra logifolia*), with saw sedge (*Gahnia sieberana*), nut grass (*Cyperus brevifolius*), orange thorn (*Citriobatus pauciflorus*), coral heath (*Epacris microphylla*) and native violet (*Viola hederaceae*) also commonly occurring.

Vegetation Condition: Weeds are relatively sparse in this community. The presence of burnt tree trunks in some areas suggests that this vegetation type is subject to occasional fires of low intensity. The community is fragmented to some extent by vehicle tracks. Previous logging activity is evident by the presence of sawn stumps, and an absence of mature and over-mature trees in the canopy. There is a notable absence of hollows, and there appears to be a low level of plant species diversity within this community.

vi. Corymbia gummifera/Eucalyptus microcorys Tall Closed Forest

Description: This vegetation type is restricted to moist creeklines along the proposed alignment (*Figure 2*). The canopy is 25 to 30 metres in height, and provides approximately 85 percent cover. The dominant canopy species are red bloodwood (*Corymbia gummifera*) and tallowwood (*Eucalyptus microcorys*), with smooth-barked apple (*Angophora costata)*, white stringybark (*E. globoidea*), blue-leaved stringybark (*E. agglomerata*) and forest oak (*Allocasuarina torulosa*) occurring intermittently.

The midstorey is approximately six to eight metres high. The dominant species are prickly leaved tea tree (*Melaleuca stypheloides*), juvenile canopy species, particularly red bloodwood (*Eucalyptus gummifera*) and forest oak (*Allocasuarina torulosa*).

The understorey is sparse (10 percent cover), and typically consists of ball honeymyrtle (*Melaleuca nodosa*), swamp paperbark (*M. ericifolia*), black wattle (*Acacia irrorata*), prickly moses (*Acacia ulicifolia*), willow bottlebrush (*Callistemon salignus*), lemon-scented tea tree (*Leptospermum polygalifolium*) and narrow-leaved geebung (*Persoonia linearis*).

The groundcover is sparse to moderate. The dominant species is mat-rush (*Lomandra longifolia*), with intermittent species including grass trees (*Xanthorrhoea* sp.), clover (*Trifolium* spp.), common buttercup (*Ranunculus lappaceus*), kangaroo grass (*Themeda australis*), bushy starwort (*Aster subulatus*) and michaelmas daisy (*Aster novi-belgii*).

Vegetation Condition: Weeds are relatively sparse in this community, although roadside weeds such as clover (*Trifolium* spp.), bushy starwort (*Aster subulatus*) and michaelmas daisy (*Aster novi-belgii*) are common on the forest fringe. Some areas are currently subject to cattle grazing. The presence of burnt tree trunks in some areas suggests that this vegetation type is subject to occasional moderate intensity fire. The community is fragmented in some places by cattle tracks. Previous logging activity is evident by the presence of sawn stumps, and a general paucity of mature and dead trees in the canopy. Medium to large hollows exist within this vegetation community, although not in abundance. There appears to be a moderate level of plant species diversity within this community.

vii. Modified forest

Description: The overstorey retained in the areas of modified forest is dominated by smooth - barked apple (*A. costata*) and white stringybark (*E. globoidea*). This disturbed vegetation community is most likely a degraded version of the *Angophora costata/Eucalyptus globoidea* Tall Open Forest community which occurs in surrounding areas.

3.2 FLORA SPECIES OF CONSERVATION SIGNIFICANCE

No ROTAP species or plants listed on Schedules 1 or 2 of the TSC Act were identified within the vegetation communities of the proposed carriageway. However, *Eucalyptus fergusonii* may have been recorded on the western side of Burdekin's Gap toward the northern end of the proposed highway carriageway. Unfortunately, the species could not be positively identified to species level at the time of sampling due to a lack of flowering and vegetative components. A positive identification would be advantageous, however, the species is not in an area that will be cleared as a result of the highway upgrading.

Several ROTAP species have been previously recorded on the NPWS Wildlife Atlas as occurring in the vicinity of the proposed carriageway. These species are listed in *Table 3.1.*

Table 3.1 ROTAP SPECIES PREVIOUSLY RECORDED IN THE VICINITY OF THE PROPOSED CARRIAGEWAY

SCIENTIFIC NAME	CONSERVATION STATUS	HABITAT
Eucalyptus glaucina	ROTAP (3VCa)	grassy woodland; deep moderately fertile well-watered soil.
Tetratheca juncea	ROTAP (3VCi)	sandy/swampy heath; dry sclerophyll forest; coastal districts
Prostanthera densa	ROTAP (3VC)	sclerophyll forest/shrubland; coastal headlands & ranges.
Melaleuca groveana	ROTAP (3VC)	heath; exposed sites; higher areas in coastal districts.
Asperula asthenes	ROTAP (3VC)	damp sites on river banks.
Dodonaea megazyga	ROTAP (3RCa)	dry sclerophyll forest; rainforest margins.
Goodenia fordiana	ROTAP (2RC)	sclerophyll forest on lower escarpment ranges.

None of the species listed above were detected during the flora surveys conducted for this study. Although no threatened plant species were recorded as occurring along the proposed carriageway, the detection and identification of some flora species was limited due to seasonality and a consequent lack of suitable flowering or fruiting material for some species. In addition, *Syzygium paniculatum* (ROTAP species and listed on Schedule 2 of the TSC Act) has previously been recorded in the Bulahdelah area, however, this species is known to occur in subtropical littoral rainforest on sandy soils or stabilised dunes. Based on the species habitat requirements it is highly unlikely to occur within the proposed highway carriageway.

3.3 CONSERVATION STATUS OF PLANT COMMUNITIES

The conservation status of the plant communities occurring within the proposed road carriageway is low. Each community is discussed below according to the conservation criteria defined in *Table 3.1.*

i. Melaleuca nodosa Mid Open Forest

a. Regional Representation

This forest type is represented over a wide area along the mid-north coast of NSW. It is common in the moist sections of forest adjacent to the existing highway.

b. Presence of Significant Species

None recorded during the survey.

c. Diversity

Plant species diversity in this community is generally low.

d. Naturalness

Weeds are common in this community. Some areas have been and are most likely still subject to grazing by stock and frequent low intensity fires. There are few tree hollows present.

e. Connectivity

This community occurs commonly along the proposed carriageway and adjoins larger blocks of remnant vegetation to form a continuous band of forest. The vegetation communities that occur as part of Nerong State Forest form part of a substantial corridor of continuous vegetation from the coast to the hinterland (hence part of a potentially significant altitudinal corridor).

f. Fragmentation

Although this community is fragmented in some places by private roads, there are generally few tracks present.

ii. Angophora costata/Eucalyptus globoidea Tall Open Forest

a. Regional Representation

This forest type is widespread on the south coast of NSW and extends into the southern parts of the north coast, up to the Myall Lakes area (Specht *et al*, 1995). According to Hager and Benson (1994), this forest type is not or is poorly conserved throughout the north coast region, however, it is commonly scattered throughout the locality and was particularly common along the existing road easement and in Nerong State Forest.

b. Presence of Significant Species

None recorded during the survey.

c. Diversity

The plant species diversity in this community is generally low.

d. Naturalness

Weeds are relatively common in this community, particularly roadside weeds along the forest fringe. Some areas of this community fringing the roadside showed signs of recent and frequent fires, as indicated by reduced species diversity and fire-tolerant species being dominant in the understorey. The understorey is dominated by immature trees, with a distinct lack of mature trees with hollows, hence indicative of past canopy thinning.

e. Connectivity

This community occurs commonly along the proposed carriageway and adjoins larger blocks of remnant vegetation to form a continuous band of forest. The vegetation communities that occur as part of Nerong State Forest form part of a substantial corridor of continuous vegetation from the coast to the hinterland (hence part of a potentially significant altitudinal corridor).

f. Fragmentation

Within Nerong State Forest, fragmentation of this community by tracks is generally limited to within 150 metres of the road reserve. However, fragmentation of forest contained on privately owned property is extensive in some areas, particularly toward the southern end of the proposed carriageway.

iii. Eucalyptus tereticornis Tall Open Forest

a. Regional Representation

According to Forestry Commission of NSW (1989), this forest type is one of the most common occurring along the coast of NSW. It is a common forest type along the proposed carriageway and in privately owned forested remnants within the locality.

b. Presence of Significant Species

None recorded during the survey.

c. Diversity

There is low species diversity in this community.

d. Naturalness

Weeds are relatively sparse in this community, although roadside weeds are common on the forest fringe. Some areas on private land are currently subject to cattle grazing. This community is subject to occasional, low intensity fires. Previous logging activity is evident by the presence of sawn stumps, and an absence of mature and over-mature trees in the canopy. There is a noticeable absence of medium to large hollows.

e. Connectivity

This community occurs commonly along the proposed carriageway and adjoins larger blocks of remnant vegetation to form a continuous band of forest. The vegetation communities that occur as part of Nerong State Forest form part of a substantial corridor of continuous vegetation from the coast to the hinterland (hence part of a potentially significant altitudinal corridor).

f. Fragmentation

Although the community is fragmented in some places by private roads, there are few tracks present.

iv. Angophora costata/Eucalyptus punctata Tall Open Forest

a. Regional Representation

This forest type is widespread on the south coast of NSW and extends into the southern part of the north coast (Specht *et al*, 1995). In the locality, this forest type is reserved in Sugar Creek Flora Reserve which has a total area of 85 hectares (Forestry Commission of NSW, 1989). This forest type commonly occurs in privately owned forested remnants along the highway carriageway and in the locality.

b. Presence of Significant Species

None recorded during the survey.

c. Diversity

There appears to be a low to moderate level of biodiversity within this community.

d. Naturalness

Weeds are relatively common in this community and it is subject to occasional fires of moderate intensity. Previous logging activity is evident by the presence of sawn stumps and an absence of mature and dead trees in the canopy. There is a noticeable absence of medium to large hollows.

e. Connectivity

This community occurs commonly along the proposed carriageway and adjoins larger blocks of remnant vegetation to form a continuous band of forest. The vegetation communities that occur as part of Nerong State Forest form part of a substantial corridor of continuous vegetation from the coast to the hinterland (hence part of a potentially significant altitudinal corridor).

f. Fragmentation

This community suffers from minor fragmentation caused by fire trails.

v. Eucalyptus punctata/Melaleuca styphelioides Tall Open Forest

a. Regional Representation

This forest type is widespread on the south coast of NSW and extends into the southern part of the north coast (Specht *et al.*, 1995). It is reserved in Sugar Creek Flora Reserve which has a total area of 85 hectares (Forestry Commission of NSW, 1989). This forest type commonly occurs in privately owned forested remnants along the highway carriageway and in both the locality and the region.

b. Presence of Significant Species

None recorded during the survey.

c. Diversity

Diversity in this community is low.

d. Naturalness

Weeds are relatively sparse in this community and it is subject to occasional, low intensity fires. The community has been subject to logging and so, has a paucity of mature trees with hollows.

e. Connectivity

This community occurs commonly along the proposed carriageway and adjoins larger blocks of remnant vegetation to form a continuous band of forest. The vegetation communities that occur as part of Nerong State Forest form part of a substantial corridor of continuous vegetation from the coast to the hinterland (hence part of a potentially significant altitudinal corridor).

f. Fragmentation

This community is fragmented by vehicle tracks.

vi. Corymbia gummifera/Eucalyptus microcorys Tall Closed Forest

a. Regional Representation

This forest type is widespread on the south coast of NSW and extends into the southern part of the north coast (Specht *et al.*, 1995). This forest type is reserved in the locality in Bryson Flora Reserve which has a total area of 18 hectares and in O'Sullivans Gap Flora Reserve which has a total area of 320 hectares. This forest type commonly occurs in privately owned forested remnants along the highway carriageway and in the locality.

b. Presence of Significant Species

None recorded during the survey.

c. Diversity

Diversity in this community is low.

d. Naturalness

Weeds are relatively sparse in this community, although roadside weeds are common. Some areas are currently subject to cattle grazing and the community has been subject to frequent, low intensity fires. Few large hollows exist as a result of past clearing practices.

e. Connectivity

This community occurs commonly along the proposed carriageway and adjoins larger blocks of remnant vegetation to form a continuous band of forest. The vegetation communities that occur as part of Nerong State Forest form part of a

substantial corridor of continuous vegetation from the coast to the hinterland (hence part of a potentially significant altitudinal corridor).

f. Fragmentation

This community is fragmented in some places by cattle tracks.

Chapter 4

RESULTS OF FAUNA INVESTIGATIONS

4.1 FAUNA HABITATS

The habitat assessment identified three broad habitat types occurring along the proposed carriageway. The three habitats identified include closed forest, open forest and grassland.

i. Closed Forest

This habitat type consists primarily of *Corymbia gummifera/Eucalyptus microcorys* Tall Closed Forest. There are four layers of vegetation present, with a canopy layer approximately 25 to 30 metres in height. The density of the midstorey is moderate, the understorey is sparse and the groundcover is sparse to moderate.

The combination of *Corymbia* and *Eucalyptus* species in the canopy layer, and *Melaleuca* and *Acacia* species in the understorey layer would provide a mosaic of flowers throughout the year for nectivorous fauna. The SEPP 44 investigation revealed that potential koala habitat exists within this vegetation community, although no scats or other evidence of koalas inhabiting the area were found during fieldwork. The presence of *Casuarinaceae* species provides a suitable food source for glossy black cockatoos.

The abundant groundcover of litter and fallen timber would provide adequate shelter for small mammals, amphibians and reptiles. The moderate abundance of medium sized tree hollows present would provide suitable roosting resources for a variety of avifauna and flying and arboreal mammals. This habitat type contains ephemeral waterbodies that may be suitable for amphibians.

This habitat type has been subject to human modification from cattle grazing, logging activity and rubbish dumping. The presence of vehicle and cattle tracks have caused minor fragmentation in some areas. Weeds are relatively sparse, although roadside weeds are common on the forest fringe. The presence of burnt tree trunks in some areas suggests that this habitat type is subject to occasional moderate intensity fire. This habitat type is considered to contain a moderate level of biodiversity.

ii. Open Forest

This habitat type consists primarily of Tall Open Forest with a canopy layer dominated by *Angophora* and *Eucalyptus* species. There are three to four layers of vegetation present, with a canopy layer varying between 15 and 35 metres in height. The density of the midstorey is sparse to moderate, the understorey varies from sparse to dense and the groundcover is moderate to dense.

The combination of *Angophora* and *Eucalyptus* species in the canopy layer, and *Acacia, Melaleuca* and *Banksia* species in the understorey layer would provide a mosaic of flowers throughout the year for nectivorous fauna. The SEPP 44 investigation revealed some areas of potential koala habitat within this habitat type, although no scats or other evidence of koalas inhabiting the area were found during fieldwork. The presence of *Casuarinaceae* species provides a suitable food source for glossy black cockatoos.

The abundant groundcover of litter and fallen timber would provide suitable shelter for small mammals, amphibians and reptiles. The dense shrub layer occurring in some areas would provide suitable habitat for a variety of small birds. Most areas contain predominantly regrowth forest, with a paucity of medium to large tree hollows. Hence there is limited roosting habitat for avifauna and flying and arboreal mammals. Ephemeral ponds suitable for amphibians are present in some areas on flat terrain with poorly drained soils.

This habitat type has been subject to human modification from cattle grazing, logging activity and rubbish dumping. The presence of vehicle tracks, particularly in the southern section of the proposed carriageway, have caused extensive fragmentation in some areas. Weeds are relatively common, particularly roadside weeds along the forest fringe. The presence of burnt tree trunks in some areas suggests that this habitat type is subject to occasional moderate intensity fire. This habitat types appears to contain a low to moderate level of biodiversity. The areas likely to contain a moderate level of biodiversity occur in the section of Nerong State Forest abutting the proposed carriageway, and the forested area referred to as Nerong Waterholes.

iii. Grassland

This habitat type consists predominantly of open pasture, with some areas containing sparsely scattered individual trees.

The abundance of grasses and herbs in this community provide a suitable foraging resource for grazing animals. The denser areas may also provide suitable shelter for small birds and mammals. The abundance of seeding grasses provide a suitable

food resource for birds. Dams constructed to provide water for livestock may also provide suitable habitat for amphibians, especially in areas where an adequate cover of macrophytes has been maintained around the dam perimeter and in drainage channels. This habitat type is generally the result of forest clearing for agricultural purposes, hence making it a disclimax community containing a low level of biodiversity.

4.2 WEATHER CONDITIONS

The Bulahdelah/Karuah area experiences a warm temperate climate. Weather conditions experienced during the survey period of August 18 -19, September 22 and December 9 - 10 1997 and between January 12 and 16 1998 are presented in *Table 4.1*. All records are those gathered in the field. Temperatures are those gathered in the field twice daily (early morning and mid-afternoon). Descriptions of wind are based on a modified Beauford scale with the scale ranging from light breeze (leaves and small branches moving) to strong wind (large branches in motion, trunks swaying). Cloud cover was assessed based on proportional cover, where 8/8 indicates total cloud cover. The prevailing weather conditions are shown in *Table 4.1*.

Table 4.1 PREVAILING WEATHER CONDITIONS

Date	Temp.°C Min to Max.	Rainfall mm^2	Cloud cover	Wind
Aug 18	15 - 23	0	0	light breeze
Aug 19	15 - 25	0	0	light breeze
Sept 22	18 - 26	0	0	nil
Dec 9	22 - 35	0	0	nil
Dec 10	21 - 35	0	0	nil
Jan 12	19 - 34	0	0	nil
Jan 13	22 - 33	0	0	light breeze
Jan 14	21 - 34	0	0	nil
Jan 15	20 - 33	3	0 - 7/8	moderate breeze
Jan 16	21 - 28	10	8/8	light to strong breeze

4.3 FAUNA RECORDINGS

A total of 67 vertebrate fauna species were recorded during the ecological investigations. This total consisted of 13 mammals, 8 reptiles, 2 amphibians and 44 birds (avifauna) were recorded. A complete list of vertebrate fauna recorded during the ecological investigations is provided in *Appendix B* and described further below.

i. Avifauna

A total of 44 bird species were recorded during the ecological investigations. The majority of birds recorded were common forest dwelling species. One threatened species was recorded, this being the osprey that was observed utilising a stick nest for roosting and also gliding over the open paddock in which the dead tree supporting the stick nest was situated. The only introduced species recorded was the house sparrow (*Passer domesticus*) which was observed within fringing forest habitat. Species frequently recorded in open forest habitat included the noisy friarbird (*Philemon corniculatus*), rainbow lorikeet (*Trichoglossus haematodus*), eastern rosella (*Platycercus elegans*), laughing kookaburra (*Dacelo novaeguineae*), jacky winter (*Microeca leucophaea*), golden whistler (*Pachycephala pectoralis*), rufous whistler (*Pachycephala rufiventris*), grey fantail (*Rhipidura fuliginosa*), superb fairy-wren (*Malurus cyaneus*) and lewin's honeyeater (*Meliphaga lewinii*).

Common species occurring in modified grassland habitat and along open forest fringes include the masked lapwing (*Vanellus miles*), common bronzewing (*Phaps chalcoptera*), crested pigeon (*Geophaps lophotes*), galah (*Cacatua roseicapilla*), black-faced cuckoo shrike (*Coracina novaehollandiae*), willie wagtail (*Rhipidura leucophrys*), house sparrow (*Passer domesticus*), magpie-lark (*Grallina cyanoleuca*), magpie (*Gymnorhina tibicen*) and Australian raven (*Corvus coronoides).*

ii. Mammals

All mammal species recorded during the ecological investigations are regarded to be commonly occurring in open forest habitat in the region. The five introduced species of mammal recorded during the survey are indicative of the degraded state of habitats along the existing highway easement.

Common small ground-dwelling mammals such as the brown antechinus (*Antichinus stuartii*) and bush rat (*Rattus fuscipes*) were recorded at all Elliott traplines and hairtube lines. The swamp rat (*Rattus lutreolus*) was recorded in open forest

habitat at Elliott traplines one and four. It is likely that this species occurred only at these sites due to a marginal increase in groundcover density at these sites.

Extensive spotlighting along the proposed carriageway revealed only one common brushtail possum (*Trichosurus vulpecula*). This species was recorded in a smooth-barked apple along the narrow strip of vegetation north of Nerong Waterholes.

Due to the possibility of rain during the fauna survey from summer storms bat detection was only conducted over two nights. In addition, bat call identification was difficult due to heavy vehicle traffic noise recorded by the sensitive ANABAT detectors. Two locations approximately 75 metres from the existing highway were selected for bat detection, and only one species was recorded (the chocolate wattled bat (*Chalinolobus morio*)) in the open forest adjacent to Elliott trapline two. No threatened bat species were recorded.

The bat detection effort was considered to be adequate for this investigation due to the lack of roosting resources for cave-dwelling bats, and the extensive area of suitable feeding and roosting habitat to be retained in surrounding areas.

iii. Reptiles

The weather was hot and sunny during four of the five survey days. The fifth day was relatively cool, with intermittent rain showers. Herpetefauna searches revealed only common species such as the red-bellied black snake (*Pseudechis porphyriacus*), jacky lizard (*Amphibolurus muricatus*), eastern blue-tongued lizard (*Tiliqua scincoides*) and common skink (*Lampropholis delicata*). A nocturnal brown tree snake (*Boiga irregularis*) and a black bellied swamp snake (*Hemiapsis signata*) were recorded during spotlighting in open forest adjacent to trapline five.

iv. Amphibians

Although moist humid weather persisted for three of the four survey nights, very few frogs were heard calling, most likely due to limited habitat for amphibian species along the proposed highway carriageway. Only two common frog species were recorded during the survey. These species were the common eastern froglet (*Crinia signifera*) heard calling from a culvert and caught in a pit fall trap, and the dwarf tree frog (*Littoria fallax*) detected in a small pond containing woolly frogmouth. Habitat suitable for threatened species was generally absent from the proposed carriageway, however, the green thighed frog (*Litoria brevipalmata*) has previously been recorded within 500 metres of the proposed alignment (pers. comm. Frank Lemckert, NSW State Forests).

4.4 THREATENED FAUNA

In NSW, threatened species of fauna are defined as those species specified in Part 1 or 4 of Schedule 1, or in Schedule 2 of the *Threatened Species Conservation Act* (1995).

The osprey (*Pandion haliaetus*) was the only threatened species to be recorded during the ecological investigations. This species is listed as Vulnerable on Schedule 2 of the *Threatened Species Conservation Act* (1995). Nevertheless, other species of threatened fauna could potentially occur along the proposed highway carriageway. A thorough discussion and a comprehensive list of species likely to occur within the proposed carriageway is provided in *Appendix 3* as part of the Section 5A assessment. The following discussion refers to threatened species that could potentially occur within the proposed carriageway. In addition, a review has been undertaken of predictive habitat modelling produced by NPWS identifies extensive areas of potentially high quality habitat for the bush-stone curlew (*Burhinus neglectus*) and the brush-tailed phascogale (*Phascogale tapoatafa*) occurring within the Nerong State Forest on both sides of the proposed highway carriageway.

i. Avifauna

The osprey is the only threatened species of avifauna identified in the vicinity of the proposed carriageway. The osprey (*Pandion haliaetus*) is usually a coastal dweller and is a specialised fish catcher. The vegetation along the carriageway may provide suitable nesting sites for the species and a current nesting site for the species was located outside the proposed carriageway in an area that will not be directly affected by the proposed development. However, care should be taken during the construction phases to ensure minimal disturbance of the nesting site on the left hand side of the existing highway heading south (approximate chainage 72300.000) and surrounding dead trees that may be utilised by the species for feeding purposes.

Other threatened species of avifauna known to inhabit the region that may be affected by the proposed carriageway include the comb-crested jacana (*Jacana gallinacea*), black bittern (*Ixobrychus flavicollis*), black-necked stork (*Ephippiorhynchus asiaticus*), wompoo fruit-dove (*Ptilinopus magnificus*), superb fruit-*dove (Ptilinopus superbus*), rose-crowned fruit-dove (*Ptilinopus regina*), glossy black cockatoo (*Calyptorhynchus lathami*), regent honeyeater (*Xanthomyza phrygia*), turquoise parrot (*Neophema pulchella*), powerful owl (*Ninox strenua*), sooty owl (*Tyto multipunctata*) and masked owl (*Tyto novaehollandiae*). Refer to *Appendix C* for a complete discussion of potential impacts of the proposed highway upgrade on threatened avifauna.

The preferred habitats of the comb-crested jacana, black bittern and black-necked stork are characterised by permanent, well vegetated wetlands and dams, with

floating vegetation. Although these species have been recorded in the region, their preferred habitats are of limited extent along the proposed carriageway.

The wompoo fruit-dove, superb fruit-dove and rose-crowned fruit-dove usually inhabit rainforest and adjacent eucalypt forest and woodlands. Although these species were not identified during the surveys, they may inhabit moist vegetation associated with creeklines along the proposed carriageway.

The glossy black cockatoo feeds predominantly on the seeds of *Allocasuarina* species in forests, woodlands and along timbered watercourses. The species has been recorded within two kilometres of the existing highway and suitable habitat does occur along the proposed carriageway.

The powerful owl, masked owl and sooty owl may potentially utilise forest habitat within the proposed carriageway. Extensive areas of suitable habitat also exist in the Nerong State Forest (approximately 8000 hectares).

ii. Mammals

No threatened mammal species were identified during the ecological investigations. Threatened non-flying mammal species previously recorded in the vicinity of the proposed carriageway include the koala, squirrel glider, yellow-bellied glider and brush-tailed phascogale. SEPP 44 investigations conducted as part of this study revealed areas of potential koala habitat, however there was no evidence of core koala habitat existing in the proposed carriageway. Although suitable habitat exists along the alignment for all of the species mentioned above, the relative quality of this habitat is poor when compared to the areas of suitable habitat that will be retained in surrounding areas.

Threatened flying mammal species previously recorded along the existing alignment include the common bent-wing bat, little bent-wing bat and eastern little mastiff bat. These species may utilise areas within the proposed carriageway for foraging, however no suitable roosting habitat exists along the proposed carriageway.

The areas sampled contained few medium to large hollows suitable for hollow dependant fauna, consequently, the loss of hollows will not represent a significant loss to hollow dependant fauna. In addition, hollow dependant fauna generally have large home ranges and a significant amount of habitat exists in the forests adjacent to the proposed carriageway and in the surrounding region. Therefore, the limited amount of clearing to be undertaken represents only a small portion of the total area available for such fauna.

iii. Reptiles

No threatened reptilian species were identified during the ecological investigation however, the stephen's banded snake (*Hoplocephalus stephensii*) is known to occur in suitable habitat within two kilometres of the proposed carriageway. The pale-headed snake has not been recorded in the vicinity of the existing highway, however it may occur in suitable habitat along creeklines within the proposed carriageway.

iv. Amphibians

No threatened amphibian species were identified during the ecological investigations. The green-thighed frog (*Litoria brevipalmata*) is known to occur within 500 metres of the proposed carriage way. The stuttering frog (*Mixophyes balbus*) and giant barred frog (*Mixophyes iteratus*) are unlikely to occur in the wet sclerophyll forests along creeklines in the proposed carriageway as creek and drainage lines are either saline or are ephemeral. Additionally, more suitable habitat of higher quality exists in surrounding areas.

Chapter 5

IMPACTS OF THE DEVELOPMENT

5.1 DIRECT IMPACTS

The clearing of existing vegetation for the proposed highway upgrading will have the greatest ecological impact. The length of the proposed carriageway is approximately 37 kilometres, of which 18 kilometres will require clearing of State Forest and forest on private properties. Although currently affected to some extent by 'edge effects' associated with the existing highway, vegetation communities contained within the Nerong State Forest are in good condition when compared to the vegetation in the proposed carriageway, and may provide suitable habitat resources for fauna in the locality.

Approximately 20 hectares of vegetation within the Nerong State Forest will be cleared for the proposed carriageway. The Nerong State Forest comprises approximately 8000 hectares. Appropriate ameliorative techniques should be implemented to reduce the impacts associated with 'edge effects' on forested areas adjacent to the new highway carriageway, as discussed in Section 1.7 below.

Approximately 19 kilometres of the proposed carriageway contains previously cleared land or supports highly modified open woodland/forest communities. These areas contain relatively low habitat value, hence the impacts associated with clearing in these areas will be minimal.

The thin strips of vegetation on the eastern side of the existing highway near Nerong Waterholes that link isolated areas of vegetation on private land do not appear to function as significant wildlife corridors. The lack of fauna presence in these strips supports this scenario. Both vegetation strips are degraded due to edge effects from the existing highway and have large gaps along their length that would significantly reduce their value as wildlife corridors.

Although of limited extent, clearing of vegetation associated with wet sclerophyll forest will result in altered microclimate conditions along the edges of the remaining vegetation. Effective methods of mitigating the impacts of such clearing are limited, and consist primarily of minimising the extent of clearing where possible.

Parts of the Nerong State Forest adjacent to the northern part of proposed carriageway has been identified during the Regional Forest Assessment as an Interim Deferred Forest Area (IDFA). The IDFA compartments of the Nerong State

Forest are connected to Myall Lakes National Park to the east and Myall River State Forest on the western side of the existing highway. These areas are considered to jointly represent an altitudinal corridor which NPWS has identified as being a significant corridor for fauna movement and important for maintenance of the flow of genetic material between the coast and the hinterland (pers. comm. Lynn Baker, NPWS Coffs Harbour, 1998). Information was sought from NPWS on the conservation values and habitat components of the IDFA areas but this was not currently available. Predictive models of habitat presence for the Brush-tailed Phascogale and Bush stone curlew were provided.

The existing highway has created a barrier to fauna movement for many years. The highway duplication will widen the distance for fauna to travel from one side to the other, however, the potential impact on fauna caused by the widening is difficult to determine due to the lack of information on the corridors' current use by fauna. Surveys undertaken for this study did not reveal a significant presence of threatened species in the area of the highway corridor.

5.2 INDIRECT IMPACTS

Removal of vegetation exposes soils to potential erosion, which may result in siltation of downstream gullies, wetlands and waterbodies. Such impacts can be minimised through the use of temporary erosion and sediment control structures during construction, combined with prompt revegetation of exposed soils after construction is complete.

The construction of additional impervious surfaces across existing drainage lines has the potential to alter the direction and volume of runoff flows. The resulting damming and draining impacts have the potential to alter the nature of existing wildlife habitats adjacent to the road. Such impacts can be minimised by directing runoff flows into retention basins and artificial wetlands. Sediment control structures used during initial road construction can be installed for such purposes.

The discharge of sediment from construction areas may result in the degradation of adjacent wetlands and waterways. Although the effects of sediment runoff are unlikely to impact on SEPP 14 wetlands downstream, potential degradation of aquatic habitats in the immediate vicinity of construction areas could occur if sediment discharges are not managed properly.

5.3 SIGNIFICANCE OF IMPACTS ON THREATENED SPECIES

An assessment was undertaken in accordance with Section 5A of the *Environmental Planning and Assessment Act (1979)*. This assessment determined the impact of the proposed upgrading of the Pacific Highway between Bulahdelah and Karuah on threatened species, populations or ecological communities, or their habitats. The results of the Section 5A assessment are provided in *Appendix C*.

The Section 5A assessment indicates that the proposed highway upgrade is unlikely to have a significant adverse effect on threatened flora or fauna species, or their habitats. Although the removal of roadside vegetation will reduce the amount of potential resources available for some threatened fauna, particularly flying, arboreal and ground dwelling mammals, it is unlikely that the loss of these potential resources will have a significant adverse effect on threatened fauna species. The likelihood of a significant effect due to lost habitat resources is also reduced by the extensive areas of suitable habitat that will be retained in surrounding areas such as the Nerong State Forest.

Chapter 6

MITIGATION STRATEGY

The proposed mitigation strategy has been prepared after consultation with the National Parks and Wildlife Service (NPWS) at Coffs Harbour and further internal consultation between the RTA and ERM Mitchell McCotter. It is also based on the recently published "RTA Policy and Guidelines - Road Development and Impacts on Habitat - Amelioration Measures" (RTA,1998).

The principal features of the strategy are:

- The provision of fauna underpasses to substantially improve the existing situation for fauna movements within the altitudinal corridor and other potential corridors;
- Culvert duplication to facilitate the movement of small fauna during dry periods;
- The provision of compensatory habitat associated with the affected area;
- Specific fauna management measures for impact mitigation;
- Monitoring procedures associated with the construction and operation; and
- Specific flora management measures.

The features of the strategy are described further below.

6.1 FAUNA UNDERPASSES (FU)

Recent research into the success of fauna underpasses indicates that they should be constructed to encourage the movement of fauna across major roads so that opportunities exist for the maintenance of genetic diversity of fauna species (Finegan, 1997).

Given that the Pacific Highway would always create a fauna barrier, the provision of fauna underpasses for this project is considered to be the most appropriate measure to facilitate the movement of fauna within the altitudinal corridor and consequently protect biological diversity and maintain ecological processes and systems. The fauna underpasses proposed would be extended to include the existing carriageway.

Consequently, there would be a major improvement in fauna movement opportunities arising from this project.

In identifying the most appropriate locations for fauna underpasses and culvert duplication, (primarily within the existing road reserve), it was necessary to examine the opportunities afforded by the topographical constraints which largely influence the design for the road upgrading. This step was essential to identify locations which met the two criteria of being both effective for fauna and being cost effective. Opportunities for the provision of overpasses was considered, however both lack of topographical opportunities and high cost resulted in no provision for such structures being made.

In section 1 of the project there are limited opportunities for the provision of fauna underpasses. To obtain improvements in this section the RTA is currently investigating the opportunities to upgrade culverts in this section to cater for the movement of fauna under the proposed carriageway. This investigation would include the potential use of stepped culverts.

The Nerong State Forest section provides greater opportunities for connection with other substantial habitat areas. In this section, it has been possible to provide a total of four fauna underpasses. In addition, two proposed creek crossings would allow an opportunity to facilitate the movement of fauna. Due to the flat topography of the majority of the proposed route, the opportunities for the provision of large structures are limited, particularly in the southern part of the proposed upgrading. The use of fauna exclusion fencing is discussed further below.

Each of the proposed fauna underpasses and two creek crossings are discussed below and the locations of the underpasses are shown in the attached *Figures 6a and 6b.*

i. Burdekin's Gap FU

The upgrading of the highway at Burdekin's Gap would involve the construction of the entire dual carriageway. It is proposed to provide a 3x3 metre fauna underpass to facilitate movement of fauna to and from Nerong State Forest to the west. The underpass would be located and designed so that it would not act as a watercourse structure. Some regeneration of vegetation would be undertaken on the western side of the new carriageway to ensure the integrity of the existing movement corridor. Exclusion fencing would be constructed for 200m to the north and 275m to the south of the crossing entrance on both sides of the road.

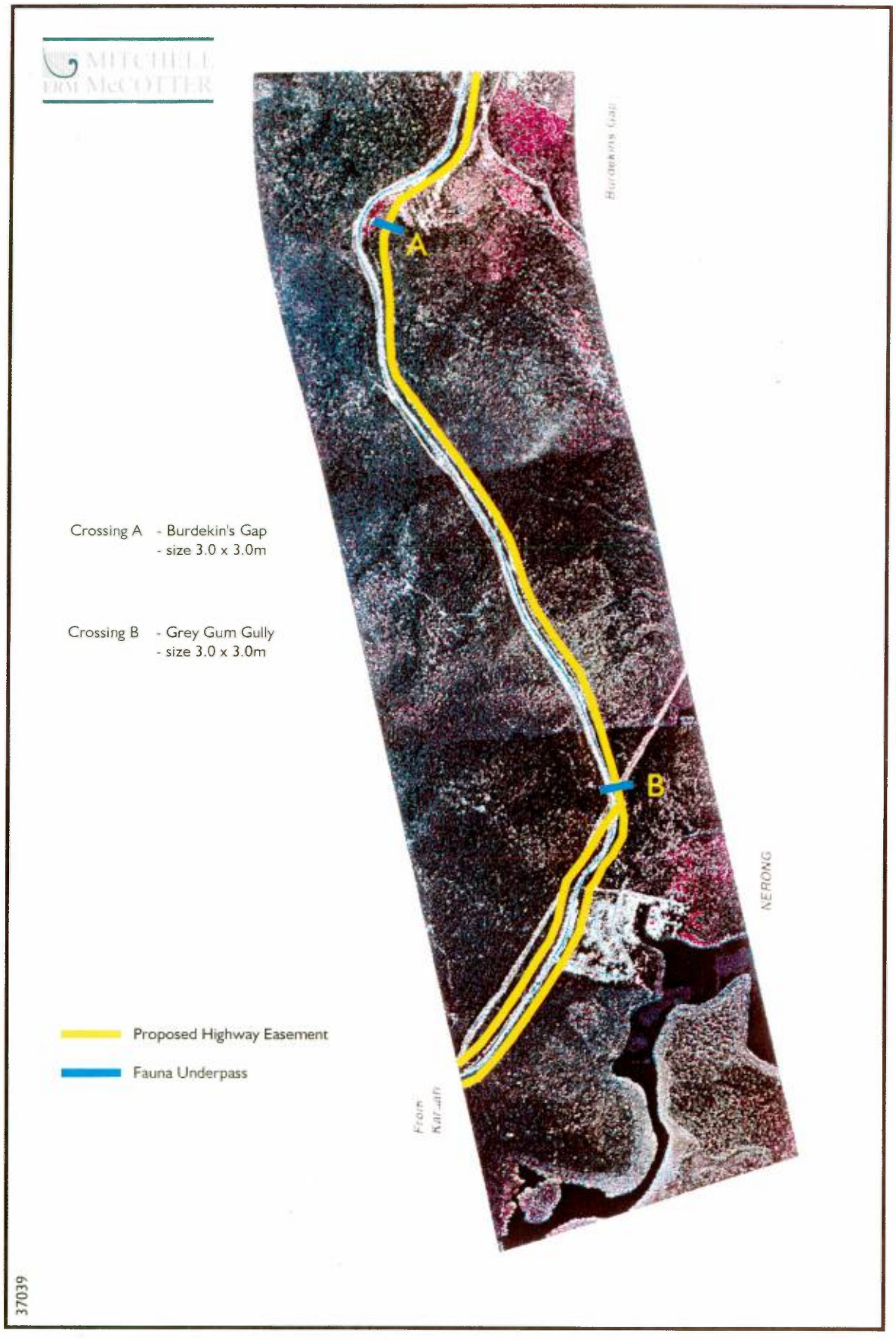

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Figure 6a LOCATION OF WILDLIFE CROSSINGS
(Chainage 89000.000 to 83400.000)

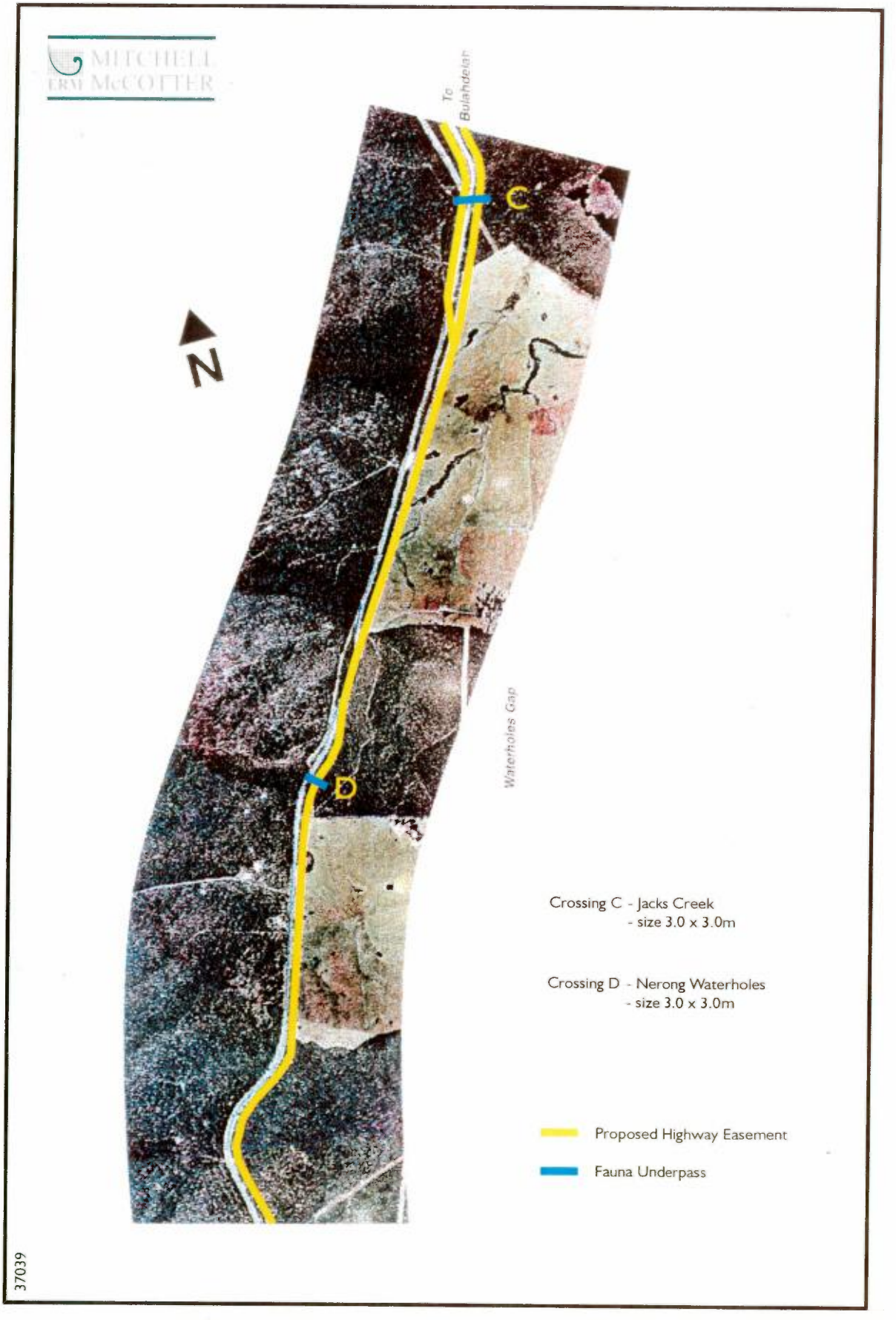

Figure 6b LOCATION OF WILDLIFE CROSSINGS
(Chainage 83400.000 to 75700.000)

ii. Grey Gum Gully FU

The upgrading of the highway at Grey Gum Gully, just to the north of Nerong, would involve the construction of the entire dual carriageway. It is proposed to provide a 3x3 metre fauna underpass, with lightwell, to link Nerong State Forest to Myall Lakes National Park. The underpass would be located and designed so that it would not act as a watercourse structure. Some regeneration of vegetation would be undertaken on the old highway to establish a vegetated linkage. Exclusion fencing would be constructed for 200m to the north and 200m to the south of the crossing entrance on both sides of the road.

iii. Jack's Creek FU

The upgrading of the highway at Jack's Creek, just to the south of Nerong, would involve the construction of the entire dual carriageway. It is proposed to provide a 3x3 metre fauna underpass, with lightwell, to link Nerong State Forest to forest vegetation on the eastern side of the carriageway. The underpass would be located and designed so that it would not act as a watercourse structure. Exclusion fencing would be constructed for 200m to the north and 200m to the south of the crossing entrance on both sides of the road.

iv. Nerong Waterholes FU

The upgrading of the highway at Nerong Waterholes would involve the construction of the south bound carriageway and conversion of the existing highway to the northbound lane. It is proposed to provide a 3x3 metre fauna underpass under both carriageways to link Nerong State Forest to an isolated parcel of forest vegetation on the eastern side of the carriageway. The underpass would be located and designed so that it would not act as a watercourse structure. Exclusion fencing would be constructed for 200m to the north and 400m to the south of the crossing entrance on both sides of the road.

v. Bundabah and Bulga Creeks

The bridges at Bundabah and Bulga Creeks would be designed so that raised flat terrain of 5-10 metres width on both sides of the creek is provided to facilitate fauna movement. This ground would be appropriately landscaped for the purpose of providing fauna with cover and dry movement from one side of the highway to the other.

6.2 CULVERT DUPLICATION

There are many culverts along the existing carriageway that would be duplicated in the new carriageway. These culverts are of varying size and include substantial structures as shown in *Figures 6a - 6b.*

The current culverts allow for the movement of smaller fauna species during drier periods, because the majority of these structures remain dry. The duplication of these structures would therefore provide the same opportunity for species to cross under the new carriageway.

6.3 COMPENSATORY HABITAT

A report would be prepared to determine the relative habitat and conservation values of potential areas of compensation in the locality. This report would then be used as a basis for further discussion with NPWS to determine an agreed approach to providing compensatory habitat.

The RTA policy and guidelines (RTA, 1998), identify that there are three policy points when considering compensatory habitat as an amelioration measure. These points are:

I. *Compensatory habitat would be employed as a measure to reduce impacts on key habitat areas where it is assessed as the most ecologically sound, cost effective and practical measure available.*

II. *Compensatory habitat would be provided only where the long-term management by an appropriate land manager is ensured and where the land tenure is secured for the purposes of conservation.*

III. *Any additional ongoing property management requirements resulting from acquisition of compensatory habitat should be dealt with at the time of acquisition by way of a present value lump sum payment and not by way of a continued Authority involvement.*

6.4 FAUNA MANAGEMENT

The following additional measures would be undertaken to mitigate the impact of the proposed upgrading on fauna.

- The construction of culverts and other drainage structures along the route would be undertaken in consultation with NSW Fisheries to ensure that the

passage of fish or other aquatic invertebrates considered part of the life cycle of any species in the region is not obstructed such that any identified populations are placed at the risk of extinction due to the construction of the road.

- Continuous vegetation with tall trees up to the road edges and between the median strips would be retained in order to provide suitable height for gliding mammal species to glide above the roadway. This is particularly important for sections of the proposed carriageway abutting Nerong State Forest and privately owned forest at the southern end of the proposed carriageway;

- Wildlife advisory signs would be placed along the northern part of the highway upgrading. State Forests of NSW, WIRES/FAWNA and local NPWS staff would be consulted to determine suitable sign locations;

- 'Floppy topped' wildlife exclusion fencing would be erected in conjunction with fauna underpasses on both sides of the highway along the proposed carriageway for a minimum distance of 200 metres, where available. The exclusion fencing would be designed to direct fauna species to the underpasses (particularly medium sized fauna);

- A 100 metre buffer zone would be maintained from the current nesting site of the Osprey and potential feeding trees during the construction phase of the proposed carriageway to minimise potential disturbance from construction activities;

- A vegetation clearing management plan would be prepared and included in the Environmental Management Plan for the project. This plan would include procedures to be undertaken prior to the clearing of any vegetation to ensure that fauna species are excluded from such areas prior to the removal of the habitat;

- A qualified wildlife carer would be present during tree clearing; and

- A list of threatened and endangered fauna sighted during construction would be reported to NPWS and recorded in a register. Records within the register would then be provided to the Director-General of the NPWS;

6.5 FLORA MANAGEMENT

The following measures will be undertaken to mitigate the impacts of the proposed upgrading on flora species.

- A revegetation plan would be formulated in conjunction with DLWC and NPWS to rehabilitate lands outside the proposed carriageway that are cleared or disturbed during highway construction; and

- A weed management program would be implemented during construction to reduce and control the infestation of introduced plant species, particularly Parramatta Grass, along the proposed carriageway.

6.6 MONITORING

The following monitoring measures will also be undertaken.

- Road mortalities would be recorded on the new project to identify additional blackspots not adequately mitigated by current mitigation measures. If blackspots are identified and species of conservation significance are likely to be impacted upon by the upgrade, additional mitigation measures would be considered; and

- Specific target surveys would be undertaken prior to construction in an effort to locate the bush stone curlew in those areas identified by NPWS to contain particularly suitable habitat for this species. If the species are sighted utilising the habitats adjacent to the proposed carriageway, appropriate mitigation measures would be incorporated into the final road design.

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APPENDICES

Appendix A

FLORA LIST

FLORA SPECIES RECORDED ON OR IN THE VICINITY OF THE PROPOSED CARRIAGEWAY.

FAMILY	COMMON NAME	SCIENTIFIC NAME
Acanthaceae	Dwarf Trumpet	*Brunoniella pumilio*
Adiantaceae	Maiden-hair Fern	*Adiantum aethiopicum*
Anthericaceae	Fringe Lily	*Thysanotus virgatus*
	Slender Wire Lily	*Laxmannia gracilis*
Apiaceae	Kurnell Curse	*Hydrocotyle bonariensis*
	Woolly Xanthosia	*Xanthosia pilosa*
	Swamp Pennywort	*Centella asiatica*
Arecaceae	Cabbage Palm	*Livistona australis*
Asclepiadaceae	Balloon Cotton Bush	*Gomphocarpus physocarpus*
Asteraceae	Cobblers Pegs	*Bidens pilosa*
	Crofton Weed	*Ageratina adenophora*
	Scotch Thistle	*Onopordum acanthium*
	Milk Thistle	*Sonchus oleraceus*
	Dandelion	*Taraxacum officinale*
Blechnaceae	Prickly Rasp-fern	*Doodia aspera*
Campanulaceae	Bluebell	*Wahlenbergia* sp.
Caesalpinioideae		*Senna coluteoides*
Casuarinaceae	Swamp Oak	*Casuarina glauca*
	Forest Oak	*Allocasuarina torulosa*
	Black She-oak	*Allocasuarina littoralis*
Chenopodiaceae	Einadia	*Einadia hastata*
Commelinaceae	Creeping Christian	*Commelina cyanea*
Convulvulaceae	Kidney Weed	*Dichondra repens*
	Swamp Bindweed	*Polymeria calycina*
Cyperaceae	Nut Grass	*Cyperus brevifolius*
	Umbrella Sedge	*Cyperus eragrostis*
		Cyperus sp.
	Variable Sword-sedge	*Schoenus laterale*
		Gahnia subaequiglumis
		Gahnia sieberana
Dennstaedtiaceae	Bracken Fern	*Pteridium esculentum*
Dicksoniaceae	False Bracken Fern	*Calochlaena dubia*
Dilleniaceae		*Hibbertia vestita*
		Hibbertia aspera
		Hibbertia obtusifolia
		Hibbertia diffusa
		Dillwynia tenuifolia
Doryanthaceae	Gymea Lily	*Doryanthes excelsa*
Epacridaceae	Coral Heath	*Epacris microphylla*
		Leucopogon microphyllus
Euphorbiaceae	Cheese Tree	*Glochidion ferdinandi*
Faboideae	Love Creeper	*Glycine clandestina*
	Dusky Coral-pea	*Kennedia rubicunda*
	Running Postman	*Kennedia prostrata*
	Dogwood	*Jacksonia scoparia*
	Pink Clover	*Trifolium* sp.
	White Clover	*Trifolium repens*
	Chain Creeper	*Desmodium brachypodum*

FLORA SPECIES RECORDED ON OR IN THE VICINITY OF THE PROPOSED CARRIAGEWAY.

FAMILY	COMMON NAME	SCIENTIFIC NAME
		Pultenaea linophylla
	Blunt Bush Pea	*Pultenaea retusa*
		Pultenaea microphylla
	Broom Bitter Pea	*Daviesia genistifolia*
Gentianaceae		*Centaurium tenuiflorum*
Goodeniaceae	Violet-leaved Goodenia	*Goodenia hederacea*
	Daisy-leaved Goodenia	*Goodenia bellidifolia*
	Variable-leaved Goodenia	*Goodenia heterophylla*
		Goodenia paniculata
Iridaceae	Leafy Purple Flag	*Patersonia glabrata*
Lindsaeaceae	Screw Fern	*Lindsaea linearis*
Lomandraceae	Fish-Bones	*Lomandra obliqua*
	Mat Rush	*Lomandra longifolia*
Luzuriagaceae	Scrambling Lily	*Geitonoplesium cymosum*
	Wombat Berry	*Eustrephus latifolius*
Menispermaceae	Snake Vine	*Stephania japonica*
Mimosoideae	Sydney Golden Wattle	*Acacia longifolia*
	Black Wattle	*Acacia irrorata*
	Prickly Moses	*Acacia ulicifolia*
	Myrtle Wattle	*Acacia myrtifolia*
Myrsinaceae	Muttonwood	*Rapanea variabilis*
Myrtaceae	Ball Honeymyrtle	*Melaleuca nodosa*
	Broad-leaved Paperbark	*Melaleuca quinquenervia*
	Prickly Leaved Tea Tree	*Melaleuca stypheloides*
	Swamp Paperbark	*Melaleuca ericifolia*
	Sieber's Paperbark	*Melaleuca sieberi*
	Snow-in-summer	*Melaleuca linariifolia*
	Spotted Gum	*Corymbia maculata*
	Pink Bloodwood	*Corymbia intermedia*
	Red Bloodwood	*Corymbia gummifera*
	Lemon-scented Tea Tree	*Leptospermum polygalifolium*
	Prickly Tea-tree	*Leptospermum juniperinum*
		Callistemon sp.
	Narrow-leaved Bottlebrush	*Callistemon linearis*
	Smooth-barked Apple	*Angophora costata*
	Brush Box	*Lophostemon confertus*
	Brown Stringybark	*Eucalyptus capitellata*
	Thin-leaved Stringybark	*Eucalyptus eugenioides*
	Grey Gum	*Eucalyptus punctata*
	Grey Gum	*Eucalyptus propinqua*
		Eucalyptus fergusonii??
	Ironbark	*Eucalyptus placita*
	Grey Ironbark	*Eucalyptus paniculata*
	Blue-leaved Stringybark	*Eucalyptus agglomerata*
	White Stringybark	*Eucalyptus globoidea*
	Tallow Wood	*Eucalyptus microcorys*
	Cabbage Gum	*Eucalyptus amplifolia*
	Sydney Blue Gum	*Eucalyptus saligna*

FLORA SPECIES RECORDED ON OR IN THE VICINITY OF THE PROPOSED CARRIAGEWAY.

FAMILY	COMMON NAME	SCIENTIFIC NAME
	Forest Red Gum	*Eucalyptus tereticornis*
	Swamp Mahogany	*Eucalyptus robusta*
	White Mahogany	*Eucalyptus acmenoides*
	Blackbutt	*Eucalyptus pilularis*
Oleaceae	Large Mock Olive	*Notelaea longifolia*
Onagraceae	Smooth Willow-herb	*Epilobium billardierianum* subs.*cinereum*
Oxalidaceae	Yellow Wood-sorrel	*Oxalis corniculata*
Philesiaceae	Scrambling Lily	*Geitonoplesium cymosum*
Philydraceae	Woolly Frogmouth	*Philydrum lanuginosum*
Phormiaceae	Blue Flax Lily	*Dianella caerulea*
Pinaceae	Radiata Pine	*Pinus radiata*
Pittosporaceae	Orange Thorn	*Citriobatus pauciflorus*
	Rough-fruit Pittosporum	*Pittosporum revolutum*
	Blackthorn	*Bursaria spinosa*
Plantaginaceae	Rib-wort	*Plantago debilis*
Poaceae	Setaria Grass	*Setaria* sp.
	Kikuyu	*Pennisetum clandestinum*
	Paspalum	*Paspalum* sp.
	Shivery Grass	*Briza minor*
	Shivery Grass	*Briza maxima*
	Rhodes Grass	*Chloris gayana*
	Windmill Grass	*Chloris truncata*
	Blady Grass	*Imperata cylindrica*
	Kangaroo Grass	*Themeda australis*
	Wallaby Grass	*Danthonia* sp.
		Danthonia linkii var. *fulva*
	Tufted Hedgehog Grass	*Echinopogon caespitosus*
	Plume Grass	*Dichelachne* sp.
		Poa sp.
	Whisky Grass	*Andropogon virginicus*
	Parramatta Grass	*Sporobolus indicus*
		Entolasia stricta
Polygalaceae	Heath Milkwort	*Comesperma ericinum*
	Matchheads	*Comesperma sylvestre*
Proteaceae		*Banksia spinulosa* var. *collina*
		Banksia oblongifolia
	Bushy Needlebush	*Hakea sericea*
		Hakea sp.
	Narrow-leaf Geebung	*Persoonia linearis*
	Smooth Geebung	*Persoonia levis*
Ranunculaceae	Common Buttercup	*Ranunculus lappaceus*
Restionaceae	Scale Rush	*Lepyrodia scariosa*
	Slender Scale Rush	*Lepyrodia gracilis*
Rosaceae	Blackberry	*Rubus ulmifolius*
	Native Rasberry	*Rubus parvifolius*
Rutaceae	Zieria	*Zieria* sp.
Sapindaceae	Common Hop-bush	*Dodonaea triquetra*

FLORA SPECIES RECORDED ON OR IN THE VICINITY OF THE PROPOSED CARRIAGEWAY.

FAMILY	COMMON NAME	SCIENTIFIC NAME
Sinopteridaceae	Small Sickle Fern	*Pellaea falcata* var. *nana*
Smilacaceae	Climbing Sarsparilla	*Smilax australis*
Solanaceae	Wild Tobacco Tree	*Solanum mauritianum*
	Forest Nightshade	*Solanum prinophyllum*
Typhaceae	Bull Rush	*Typha orientalis*
Verbenaceae	Purple Top	*Verbena bonariensis*
	Common Verbena	*Verbena officinalis*
	Lantana	*Lantana camara*
Violaceae	Native Violet	*Viola hederacea*
Xanthorrhoeaceae	Grass Tree	*Xanthorrhoea* sp.

Notes: *?? = potentially occurring within the study area, unable to be positively identified.*

Appendix B

FAUNA LIST

FAUNA SPECIES RECORDED ON OR IN THE VICINITY OF THE PROPOSED CARRIAGEWAY.

CLASS	COMMON NAME	SCIENTIFIC NAME	DETECTION METHOD
Aves			
	Maned Wood Duck	*Chenonetta jubata*	Observation
	Osprey	*Pandion haliaetus*	Observation
	Black-shouldered Kite	*Elanus notatus*	Observation
	Brown Goshawk	*Accipiter fasciatus*	Observation
	Wedge-tailed Eagle	*Aquila audax*	Observation
	Noisy Friarbird	*Philemon corniculatus*	Observation
	Painted Button Quail	*Turnix varia*	Observation
	Purple Swamphen	*Porphyrio porphyrio*	Observation
	Masked Lapwing	*Vanellus miles*	Observation
	Common Bronzewing	*Phaps chalcoptera*	Observation
	Crested Pigeon	*Geophaps lophotes*	Observation
	Yellow-tailed Black Cockatoo	*Calyptorhynchus lathami*	Observation
	Galah	*Cacatua roseicapilla*	Observation
	Rainbow Lorikeet	*Trichoglossus haematodus*	Observation
	Crimson Rosella	*Platycercus elegans*	Observation
	Eastern Rosella	*Platycercus eximius*	Observation
	Southern Boobook	*Ninox novaeseelandiae*	Observation
	Tawny Frogmouth	*Podargus strigoides*	Observation
	Laughing Kookaburra	*Dacelo novaeguineae*	Observation
	Tree Martin	*Hirundo nigricans*	Observation
	Black-faced Cuckoo Shrike	*Coracina novaehollandiae*	Observation
	Jacky Winter	*Microeca leucophaea*	Observation
	Golden Whistler	*Pachycephala pectoralis*	Observation
	Rufous Whistler	*Pachycephala rufiventris*	Observation
	Grey Shrike Thrush	*Colluricincla harmonica*	Observation
	Grey Fantail	*Rhipidura fuliginosa*	Observation
	Willie Wagtail	*Rhipidura leucophrys*	Observation
	Superb Fairy-wren	*Malurus cyaneus*	Observation

CLASS	COMMON NAME	SCIENTIFIC NAME	DETECTION METHOD
	Variegated Fairy-wren	*Malurus lamberti*	Observation
	White-browed Scrub-wren	*Sericornis frontalis*	Observation
	White-throated Treecreeper	*Cormobates leucophaea*	Observation
	Noisy Miner	*Manorina melanocephala*	Observation
	Lewins Honeyeater	*Meliphaga lewinii*	Observation
	Yellow-faced Honeyeater	*Lichenostomus chrysops*	Observation
	Brown Honeyeater	*Lichmera indistincta*	Observation
	Silvereye	*Zosterops lateralis*	Observation
	Red-browed Firetail	*Neochima temporalis*	Observation
	House Sparrow	*Passer domesticus*	Observation
	White-winged Chough	*Corcorax melanorhamphos*	Observation
	Magpie-lark	*Grallina cyanoleuca*	Observation
	Pied Butcherbird	*Cracticus nigrogularis*	Observation
	Magpie	*Gymnorhina tibicen*	Observation
	Australian Raven	*Corvus coronoides*	Observation
	Pied Currawong	*Strepera graculina*	Observation
Mammalia			
	Eastern Grey Kangaroo	*Macropus giganteus*	Inc. Obs.
	Red-necked Wallaby	*Macropus rufogriseus*	Roadkill/Inc. Obs.
	Common Brushtail Possum	*Trichosurus vulpecula*	Spotlight
	Dog	*Canis familiaris*	Roadkill
	Fox	*Vulpes vulpes*	Roadkill/Scat
	Northern Brown Bandicoot	*Isoodon macrourus*	Scratchings
	Rabbit	*Oryctolagus cuniculus*	Inc. Obs.
	Brown Antechinus	*Antechinus stuartii*	Hairtube/Elliotts
	Bush Rat	*Rattus fuscipes*	Hairtube/Elliotts
	Black Rat	*Rattus rattus*	Elliotts
	Swamp Rat	*Rattus lutreolus*	Elliotts
	House Mouse	*Mus musculus*	Hairtube
	Chocolate Wattled Bat	*Chalinolobus morio*	Anabat II
Reptilia			
	Brown Tree Snake	*Boiga irregularis*	Spotlight
	Red-bellied Black Snake	*Pseudechis porphyriacus*	Search/Roadkill

CLASS	COMMON NAME	SCIENTIFIC NAME	DETECTION METHOD
	Black-bellied Swamp Snake	*Hemiaspis signata*	Search
	Jacky Lizard	*Amphibolurus muricatus*	Search
	Bearded Dragon	*Pogona barbata*	Inc. Obs.
	Lace Monitor	*Varanus varius*	Inc. Obs.
	Eastern Blue-tongued Lizard	*Tiliqua scincoides*	Search/Roadkill
	Common Skink	*Lampropholis delicata*	Search/Inc. Obs.
Amphibia			
	Common Eastern Froglet	*Crinea signifera*	Search/Call
	Dwarf Tree Frog	*Littoria Fallax*	Search/Call

Appendix C

EIGHT PART TEST OF SIGNIFICANCE

INTRODUCTION

The NSW *Threatened Species Conservation Act* (1995) (TSC Act) made substantial amendments to the *National Parks and Wildlife Act* (1974) (NPW Act) and *the Environmental Planning and Assessment Act* (1979) (EP&A Act). Section 5A of the EP&A Act sets out eight factors to be considered in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats in order to satisfy the requirement of the TSC Act.

When undertaking the eight part test, a number of flora and fauna species have been considered. *Table 1* lists these species and their likelihood of occurrence based on habitat preference, known occurrence in the locality and NPWS Atlas of Wildlife recordings for the Bulahdelah and Port Stephens 1:100 000 topographic maps.

Table 1 POSSIBLE THREATENED FAUNA AND FLORA SPECIES.

Common Name	Scientific Name	Likelihood of Occurrence in the proposed carriageway	Likely Sensitivity to Disturbance from Proposal (if the species occurs)
Green-thighed Frog	*Litoria brevipalmata*	Moderate due to limited habitat along the carriageway, however previously recorded in the region.	High due to small home range, lack of mobility and specialised habitat requirements.
Stuttering Frog	*Mixophyes balbus*	Moderate due to limited habitat along the carriageway, however previously recorded in the region.	High due to small home range, lack of mobility and specialised habitat requirements.
Giant Barred Frog	*Mixophyes iteratus*	Moderate due to limited habitat along the carriageway, however previously recorded in the region.	High due to small home range, lack of mobility and specialised habitat requirements.
Wallum Froglet	*Crinia tinnula*	Moderate due to limited condition of habitat along the carriageway, however previously recorded in the region.	High due to small home range, lack of mobility and specialised habitat requirements.
Square-tailed Kite	*Lophoictinia isura*	High due to suitable habitat along the carriageway and previously recorded in the region.	Low due to large home range (comparatively small area of habitat to be removed) and high mobility.
Superb Fruit Dove	*Ptilinopus superbus*	High due to suitable habitat along the carriageway and previously recorded in the region.	Moderate due to relatively small area of habitat to be removed and high mobility.
Rose-crowned Fruit Dove	*Ptilinopus regina*	High due to suitable habitat along the carriageway and previously recorded in the region.	Moderate due to relatively small area of habitat to be removed and high mobility.
Wompoo Fruit Dove	*Ptilinopus magnificus*	High due to suitable habitat along the carriageway and previously recorded in the region.	Moderate due to relatively small area of habitat to be removed and high mobility.
Regent Honeyeater	*Xanthomyza phrygia*	High due to suitable habitat along the carriageway and previously recorded in the region.	Moderate due to relatively small area of habitat to be removed and high mobility.
Black Bittern	*Ixobrychus flavicollis*	Moderate due to limited habitat along the carriageway, however previously recorded in the region.	Moderate due to relatively small area of habitat to be removed and high mobility.
Bush-stone Curlew	*Burhinus grallirius*	High due to suitable habitat along the carriageway, previously recorded in the region and predictive habitat modelling identifies	Moderate due to pedestrian habit, however relatively mobile species, large home range.

Common Name	Scientific Name	Likelihood of Occurrence in the proposed carriageway	Likely Sensitivity to Disturbance from Proposal (if the species occurs)
		potential habitat for this species in the vicinity of the proposed easement.	
Black-necked Stork	*Ephippiorhynchus asiaticus*	Moderate due to limited habitat along the carriageway, however previously recorded in the region.	Moderate due to relatively small area of habitat to be removed and high mobility.
Osprey	*Pandion haliaetus*	Observed during survey	Low due to large home range (comparatively small area of habitat to be removed) and high mobility.
Turquoise Parrot	*Neophema pulchella*	High due to suitable habitat along the carriageway and previously recorded in the region.	Low due to large home range (comparatively small area of habitat to be removed) and high mobility.
Glossy Black Cockatoo	*Calyptorhynchus lathami*	High due to suitable habitat along the carriageway and previously recorded in the region.	Low due to large home range (comparatively small area of habitat to be removed) and high mobility.
Powerful Owl	*Ninox strenua*	High due to suitable habitat along the carriageway and previously recorded in the region.	Low due to large home range (comparatively small area of habitat to be removed) and high mobility.
Sooty Owl	*Tyto tenebricosa*	High due to suitable habitat along the carriageway and previously recorded in the region.	Low due to large home range (comparatively small area of habitat to be removed) and high mobility.
Masked Owl	*Tyto novaehollandiae*	High due to suitable habitat along the carriageway and previously recorded in the region.	Low due to large home range (comparatively small area of habitat to be removed) and high mobility.
Brush-tailed Phascogale	*Phascogale tapoatafa*	High due to suitable habitat along the carriageway, previously recorded in the region and predictive habitat modelling identifies potential brush-tailed phascogale habitat in the vicinity of the proposed easement.	Moderate due to relatively small area of habitat to be removed and high mobility.
Common Planigale	*Planigale maculata*	High due to suitable habitat along the carriageway and previously recorded in the region.	High due to small home range, lack of mobility and specialised habitat requirements.
Eastern Chestnut Mouse	*Pseudomys gracilicaudatus*	Moderate due to limited habitat along the carriageway, however previously recorded in the region.	High due to small home range, lack of mobility and specialised habitat requirements.
Yellow-bellied Glider	*Petaurus australis*	High due to suitable habitat along the	High due to small home range, lack of mobility

Common Name	Scientific Name	Likelihood of Occurrence in the proposed carriageway	Likely Sensitivity to Disturbance from Proposal (if the species occurs)
		carriageway and previously recorded in the region.	and specialised habitat requirements.
Tiger Quoll	*Dasyurus maculatus*	High due to suitable habitat along the carriageway and previously recorded in the region.	Moderate due to relatively small area of habitat to be removed and high mobility.
Eastern Blossom Bat	*Syconycteris australis*	Moderate due to limited habitat along the carriageway, however previously recorded in the region.	Low due to relatively small area of habitat to be removed and high mobility
Greater Broad-nosed Bat	*Scotcanax rueppellii*	High due to suitable habitat along the carriageway and previously recorded in the region.	Low due to large home range (and comparatively small area of habitat to be removed) and high mobility.
Large-footed Myotis	*Myotis adversus*	High due to suitable habitat along the carriageway and previously recorded in the region.	Low due to large home range (and comparatively small area of habitat to be removed) and high mobility.
Common Bent-wing Bat	*Miniopterus schreibersii*	High due to suitable habitat along the carriageway and previously recorded in the region.	Low due to large home range (and comparatively small area of habitat to be removed) and high mobility.
Little Bent-wing Bat	*Miniopterus australis*	High due to suitable habitat along the carriageway and previously recorded in the region.	Low due to large home range (and comparatively small area of habitat to be removed) and high mobility.
Golden-tipped Bat	*Kerivoula papuensis*	High due to suitable habitat along the carriageway and previously recorded in the region.	Low due to large home range (and comparatively small area of habitat to be removed) and high mobility.
Eastern Freetail-Bat	*Mormopterus norfolkensis*	High due to suitable habitat along the carriageway and previously recorded in the region.	Low due to large home range (and comparatively small area of habitat to be removed) and high mobility.
Squirrel Glider	*Petaurus breviceps*	High due to suitable habitat along the carriageway and previously recorded in the region.	Moderate due to relatively small area of habitat to be removed and high mobility.
Red-legged Pademelon	*Thylogale stigmatica*	Moderate due to limited habitat along the carriageway, however previously recorded in the region.	Moderate due to relatively small area of habitat to be removed and high mobility.
Long-nosed Potoroo	*Potorous tridactylus*	High due to suitable habitat along the carriageway and previously recorded in the region.	Moderate due to relatively small area of habitat to be removed and high mobility.

Common Name	Scientific Name	Likelihood of Occurrence in the proposed carriageway	Likely Sensitivity to Disturbance from Proposal (if the species occurs)
Koala	*Phascolarctos cinereus*	High due to suitable habitat along the carriageway and previously recorded in the region.	Moderate due to relatively small area of habitat to be removed and high mobility.
Stephen's Banded Snake	*Hoplocephalus stephensii*	High due to suitable habitat along the carriageway and previously recorded in the region.	High due to small home range, lack of mobility and specialised habitat requirements.
Pale-headed Snake	*Hoplocephalus bitorquatus*	Moderate due to suitable habitat along the carriageway.	High due to small home range, lack of mobility and specialised habitat requirements.
Goodenia	*Goodenia fordiana*	High due to suitable habitat along the carriageway and previously recorded in the region.	Low due to relatively small area of habitat to be removed when compared to other areas of suitable habitat in the region
Asperula	*Asperula asthenes*	Moderate due to poor condition of habitat along the carriageway, however previously recorded in the region.	Low due to relatively small area of habitat to be removed when compared to other areas of suitable habitat in the region
Tetratheca	*Tetratheca juncea*	High due to suitable habitat along the carriageway and previously recorded in the region.	Low due to relatively small area of habitat to be removed when compared to other areas of suitable habitat in the region
Hop Bush	*Dodonaea megazyga*	Moderate due to poor condition of habitat along the carriageway, however previously recorded in the region.	Low due to relatively small area of habitat to be removed when compared to other areas of suitable habitat in the region

FACTORS FOR CONSIDERATION

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

The proposed carriageway would incorporate the existing highway, which would result in only limited removal of forest habitats already affected to some extent by "edge effects". Therefore, it is considered to be sub-optimal habitat for threatened species that may occur in the carriageway vegetation. It is considered unlikely that the area proposed for clearing would comprise significant habitat for any threatened fauna or flora species. Furthermore, significant areas of higher quality habitat would be retained in the Nerong State Forest and forested private property along the proposed carriageway.

No threatened plant species were discovered along the proposed carriageway during the ecological investigations and no threatened plants have been previously recorded in the immediate locality. If any threatened plants do exist in the immediate locality it is unlikely that a "viable local population" of any plant species would be dependent on habitats contained within the proposed carriageway. This is due to the degraded nature of these habitats caused primarily by past logging activity and impacts associated with the existing highway.

Most species of threatened fauna that may occur in the vicinity of the proposed carriageway are either highly mobile, have large home ranges or have limited areas of suitable habitat within the proposed carriageway that would be directly affected by the alignment. Furthermore, other than the osprey, no threatened species of fauna were detected during the ecological investigations.

The preferred habitat of the stephen's banded snake (*Hoplocephalus stephensii*) and pale-headed snake (*Hoplocephalus bitorquatus*) is rainforest and wet sclerophyll forest. This habitat type is of very limited extent along the proposed carriageway. It is highly unlikely that a "viable local population" of either of these species would be dependent on the limited areas of suitable habitat subject to clearing by the proposed upgrading. Extensive areas of suitable habitat also exist in surrounding areas.

The preferred habitat of the green-thighed frog (*Litoria brevipalmata*), stuttering frog (*Mixophyes balbus*) and giant barred frog (*Mixophyes iteratus*) is rainforest and wet sclerophyll forest. This habitat type is of limited extent along the proposed carriageway. It is highly unlikely that a "viable local population" of any of these species would be dependent on the limited areas of suitable habitat subject to clearing by the proposed highway upgrading.

A "viable population" of the wallum froglet (*Crinia tinnula*) would not be dependent on habitat within the proposed carriageway due to a lack of acid paperbark swamp habitat. Extensive areas of suitable habitat for this species exist to the east of the proposed carriageway.

The osprey (*Pandion haliaetus*) is known to inhabit the study area, having been recorded during the ecological investigation. The species feeds predominantly on fish, particularly mullet. Nesting sites are usually located within one kilometre of suitable feeding habitat. However, the nest site located in the vicinity of the proposed carriageway is approximately four to five kilometres from suitable feeding habitat. The proposed development would not impact on either the current nesting site or waterways in which the osprey feeds, hence it would not disrupt the lifecycle of the species such that a "viable local population" of the species would be placed at risk of extinction.

Preferred habitat for the superb fruit-dove (*Ptilinopus superbus*), rose-crowned fruit-dove (*Ptilinopus regina*), wompoo fruit-dove (*Ptilinopus magnificus*), black-necked stork (*Ephippiorhynchus asiaticus*), black bittern (*Ixobrychus flavicollis*) and comb-crested jacana (*Jacana gallinacea*) is of limited extent in the proposed carriageway, being restricted mainly to creeklines. The creekline vegetation along the proposed carriageway is already degraded by previous logging activities and impacts associated with the existing highway. Extensive areas of more suitable habitat also occur in surrounding areas. Therefore, the proposed carriageway would not disrupt the lifecycle of these species such that a "viable local population" would be placed at risk of extinction.

Preferred habitat for the square-tailed kite (*Lophoictinia isura*), regent honeyeater (*Xanthomyza phrygia*) and turquoise parrot (*Neophema pulchella*) and bush stone curlew (*Burhinus grallarius*) is open forest and woodland. Although this habitat type represents a high proportion of that being cleared by the proposed highway upgrading there are extensive areas of suitable habitat in the surrounding region, particularly in the Nerong State Forest. Furthermore, these species are highly mobile. The bush-stone curlew is thought to have a pedestrian habit (Lynn Baker, NPWS pers comm, 1998). However, it is unlikely that the incidence of road kills of this species would significantly increase as a result of the proposed carriageway. Extensive areas of forest containing *Casuarinaceae* species also exist in the region, hence local populations of glossy black cockatoos (*Calyptorhynchus lathami*) would not be adversely affected by the proposed highway upgrading.

Extensive areas of open forest occur along the proposed carriageway and may provide suitable habitat for the powerful owl (*Ninox strenua*) masked owl (*Tyto novaehollandiae*) and, to a lesser extent, sooty owl (*Tyto multipunctata*). All of these species have large home ranges and are highly mobile. Therefore, it is highly unlikely that the proposed development would disrupt the lifecycle of these species

such that a "viable local population" of any of these species would be placed at risk of extinction.

The little bent-wing bat (*Miniopterus australis*) and common bent-wing bat (*Miniopterus schreibersii*) most likely utilise open forest and disturbed habitat within the study area when foraging. However, there are no roosting sites available for these species, or any other cave-dwelling microchiropteran bat species along the proposed carriageway. Although the large-footed myotis (*Myotis adversus*) has been recorded close to the northern end of the carriageway, the lifecycle of a "viable local population" of this species would not be adversely affected due to the species high mobility and cave-roosting habits. Furthermore, the use of sediment control structures during construction and implementation of a revegetation plan would ensure that the carriageway would not disturb or pollute the waterways on which this species forages.

The preferred habitat of the golden-tipped bat (*Kerivoula papuensis*) is relatively unknown. However, although the species will forage in dry open forest, it is thought to have an association with moist, dense vegetation in coastal forests. Based on this assumption the preferred habitat of this species is of limited extent along the proposed carriageway. Therefore, when also considering the species high level of mobility it is unlikely the lifecycle of a "viable local population" of this species would be adversely affected by the proposed highway upgrading.

The preferred habitat of the eastern freetail-bat (*Mormopterus norfolkensis*) is thought to include dry sclerophyll forest and woodland. Small colonies have been recorded roosting under loose bark, rock crevices and river banks. This species could potentially utilise habitat within the proposed carriageway as a foraging and roosting resource. Fortunately, extensive suitable habitat for this species occurs on private property along the proposed carriageway and in the Nerong State Forest to the west.

Suitable habitat for the common planigale (*Planigale maculata*) exists along the proposed carriageway and the species has been recorded in the region. However, the species was not recorded during the ecological investigations despite a variety of detection methods being utilised. Despite having a small home range and a relative lack of mobility, the proposed highway upgrading is unlikely to have a greater impact than that of the existing highway upon the species, hence it would not disrupt the lifecycle of these species such that a "viable local population" would be placed at risk of extinction.

Preferred habitat for the eastern chestnut mouse (*Pseudomys gracilicaudatus*) is dense wet heath and swampy areas, which are of limited extent in the proposed carriageway. Although the species has been recorded in the region there was no evidence of the species during the ecological investigations. Extensive areas of more

suitable habitat exist in areas east of the proposed carriageway. Therefore, if the species does utilise habitat along the alignment it is unlikely to be significantly affected by the proposed highway upgrading.

Although no squirrel gliders (*Petaurus breviceps*) or yellow-bellied gliders (*Petaurus australis*) were recorded along the proposed carriageway, both species have been previously recorded in the region. However, both species are highly mobile, and extensive suitable habitat exists in the Nerong State Forest. Furthermore, the proposed highway upgrading is unlikely to significantly increase the impacts associated with the existing road and the identified ameliorative techniques propose the retention of the maximum amount of native vegetation as possible, as well as a comprehensive revegetation program in disturbed areas outside the proposed carriageway after construction. Consequently, the likelihood of significant adverse impacts on possible "viable local populations" of these species is minimal.

Although no brush-tailed phascogales (*Phascogale tapoatafa*), spotted-tailed quolls (*Dasyurus maculatus*) or red-legged pademelons (*Thylogale stigmatica*) were recorded along the proposed carriageway, these species have been previously recorded in the region. These species are highly mobile and have large home ranges. Extensive suitable habitat occurs within the Nerong State Forest. Furthermore, the proposed development is unlikely to significantly increase the impacts already associated with the existing highway. Consequently, the likelihood of significant adverse impacts on possible "viable local populations" of these species is minimal.

The ecological investigations revealed several areas of potential koala habitat along the proposed carriageway. However, no koalas (*Phascolarctos cinereus*) were observed, and no other evidence of the species (ie. scratches or scats) was located during the ecological investigations. Koalas have been previously recorded in the vicinity of the proposed carriageway, particularly in forest at the far southern end of the carriageway and in forest west of the existing highway opposite Nerong Waterholes. Although some feeding resources for this species would be removed by the proposed highway easement, extensive areas of suitable feeding resources would be retained in surrounding areas. The impact amelioration measures outlined in the accompanying report recommend that wildlife exclusion fencing be constructed in areas close to previous koala sightings, and in areas containing potential koala habitat. Therefore, it is unlikely that the proposed carriageway would disrupt the lifecycle of this species such that a "viable local population" would be placed at risk of extinction.

Several ameliorative measures are outlined in this report that are aimed at minimising potential impacts associated with the proposed highway upgrading on any "viable local population" of koalas in the proposed carriageway. When considering that the majority of vegetation in the surrounding area would be

retained, the proposed highway upgrading is unlikely to disrupt the species to the extent that a "viable local population" could be placed at risk of extinction.

b ***in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised;***

No relevant endangered populations of native fauna or flora (as listed in part 2 of Schedule 1 of the TSC Act) occur in the proposed carriageway.

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

The proposed duplication of the Pacific Highway between Bulahdelah and Karuah will require the removal of approximately 40 hectares of forest vegetation. However, less than 0.25 percent of the Nerong State Forest will be affected, and a significant proportion of forested land to be affected on private property is already in a degraded state due to past timber harvesting activities and impacts associated with the existing highway.

The proposed highway upgrading is likely to remove some potential resources, particularly for threatened flying, arboreal and ground dwelling mammals (if present). Conversely, significant areas of potential resources would be retained in the Nerong State Forest (approximately 8000 hectares) and privately owned forest in surrounding areas. Ameliorative measures have also been proposed that recommend minimal removal of vegetation during construction and the formulation of a comprehensive revegetation program to rehabilitate lands disturbed during construction outside the proposed carriageway. Consequently, the area of "known habitat" for threatened species to be "modified or removed" by the proposed highway upgrading is not likely to be of significance.

In order to determine the significance of potential habitat removal in relation to its "regional distribution" an appropriate definition of "region" is provided in the *Interim Biogeographic Regionalisation of Australia* (IBRA) published by the Australian Nature Conservation Agency (ANCA). Based on the IBRA definition, the proposed carriageway for the Pacific Highway upgrading between Bulahdelah and Karuah is located within the NSW North Coast region. This region extends approximately from Nelson Bay in the south to the Queensland border, and from the coast inland to the Great Dividing Range. This area is comprised of approximately six million hectares, of which approximately 2.4 million hectares have been dedicated as State Forest and conservation areas. This figure excludes areas of forest retained on privately owned property within the region. Furthermore, the plant species that

dominate habitats within the proposed highway easement (*Eucalyptus* spp.) also dominate forested areas contained within the conservation areas (and similar protected areas).

Based on this definition, the area of potential habitat to be removed by the proposed highway upgrading is a very small proportion of the "regional distribution of the habitat" of any threatened species or population potentially occurring in the proposed carriageway.

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

The mitigation measures proposed would potentially improve interconnection between habitat areas. This is possible by constructing fauna underpasses, allowing less mobile species to cross under the proposed carriageway via constructed drainage culverts that allow fauna movement, and by retaining tall trees at the road edges and between median strips to provide gliding height for gliding mammal species. The proposed highway upgrading would not cause an area of known habitat to become further isolated from proximate areas of habitat.

e ***whether critical habitat will be affected;***

At the time of report preparation no relevant "critical habitat" has been declared by the Director-General of the NSW NPWS. Therefore, the impact associated with the proposed development on critical habitat could not be assessed.

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

Conservation reserves (and other similar protected areas) make up approximately 39 percent (2.4 million hectares) of land contained within the NSW North Coast region (six million hectares). All of the potentially occurring threatened species within the proposed highway carriageway would be represented within existing conservation reserves (and other similar protected areas). However, due to particular habitat requirements, large home ranges and/or sparse distributions a significant proportion of these species cannot be considered to be adequately represented within existing conservation reserves (and other similar protected areas). *Table 6.1* indicates the adequacy of representation within existing conservation reserves (and other similar protected areas) of all threatened species known or likely to occur within the proposed highway carriageway.

Table 6.1 ADEQUACY OF REPRESENTATION OF KNOWN AND THREATENED SPECIES CONSERVATION AREAS (OR OTHER SIMILAR PROTECTED AREAS).

Common Name	Scientific Name	Distribution	Potential Limiting Factors	Reservation Status
Green-thighed Frog	*Litoria brevipalmata*	nc NSW to se Qld	limited habitat	inadequate
Stuttering Frog	*Mixophyes balbus*	n NSW to Vic		adequate
Giant Barred Frog	*Mixophyes iteratus*	se Qld to sth - Narooma		adequate
Wallum Froglet	*Crinia tinnula*	s Qld to cc NSW	specific habitat requirements	inadequate
Square-tailed Kite	*Lophoictinia isura*	NT to Vic		adequate
Superb Fruit Dove	*Ptilinopus superbus*	C.York to s NSW		adequate
Rose-crowned Fruit Dove	*Ptilinopus regina*	C.York to s NSW		adequate
Wompoo Fruit Dove	*Ptilinopus magnificus*	C. York to Hunter R.		adequate
Regent Honeyeater	*Xanthomyza phrygia*	se Qld to Vic	specific habitat requirements	inadequate
Black Bittern	*Ixobrychus flavicollis*	WA to Vic, including NSW	limited habitat	inadequate
Black-necked Stork	*Ephippiorhynchus asiaticus*	WA to Vic, including NSW	limited habitat	inadequate
Osprey	*Pandion haliaetus*	WA to s NSW		adequate
Bush-stone Curlew	*Burhinus grallarius*	WA to Vic, including NSW		adequate

Turquoise Parrot	*Neophema pulchella*	Qld to Vic, including NSW		adequate
Glossy Black Cockatoo	*Calyptorhynchus lathami*	Qld to Vic		adequate
Powerful Owl	*Ninox strenua*	Qld to SA	habitat fragmentation	adequate
Sooty Owl	*Tyto tenebricosa*	Qld to Vic	specific habitat requirements	inadequate
Masked Owl	*Tyto novaehollandiae*	NT to Tas		inadequate
Brush-tailed Phascogale	*Phascogale tapoatafa*	NT to Vic, including NSW	large home range; spec. habitat requirements	inadequate
Common Planigale	*Planigale maculata*	NT to cc NSW		adequate
Eastern Chestnut Mouse	*Pseudomys gracilicaudatus*	n Qld to cc NSW	limited habitat	inadequate
Yellow-bellied Glider	*Petaurus australis*	Qld to Vic	large home range; spec. habitat requirements	inadequate
Tiger Quoll	*Dasyurus maculatus*	Qld to Tas		adequate
Eastern Blossom Bat	*Syconycteris australis*	C. York to cc NSW		adequate
Greater Broad-nosed Bat	*Scoteanax rueppellii*	Qld to Vic		adequate
Large-footed Myotis	*Myotis adversus*	NT to Vic, including NSW		adequate
Common Bent-wing Bat	*Miniopterus schreibersii*	NT to Vic, including NSW		adequate
Little Bent-wing Bat	*Miniopterus australis*	C York to cc NSW		adequate
Golden-tipped Bat	*Kerivoula papuensis*	C York to s NSW		adequate
Eastern Freetail-Bat	*Mormopterus norfolkensis*	se Qld to s NSW		adequate
Squirrel Glider	*Petaurus breviceps*	Qld to Vic		adequate

Red-legged Pademelon	*Thylogale stigmatica*	C York to cc NSW	limited habitat	adequate
Long-nosed Potoroo	*Potorous tridactylus*	Qld to Tas	limited habitat	inadequate
Koala	*Phascolarctos cinereus*	Qld to Vic		adequate
Stephen's Banded Snake	*Hoplocephalus stephensii*	C York to cc NSW		adequate
Pale-headed Snake	*Hoplocephalus bitorquatus*	C York to cc NSW		adequate
Goodenia	*Goodenia fordiana*	Coffs H.to Bulahdelah	limited range	inadequate
Asperula	*Asperula asthenes*	Taree to Bulahdelah	limited range	inadequate
Tetratheca	*Tetratheca juncea*	nc to cc NSW	limited range	inadequate
Hop Bush	*Dodonaea megazyga*	NT to cc NSW	limited range	inadequate

Notes: cc = central coast; nc = north coast; ne = north east; s = south; n = north.

g *whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process;*

The proposed activities are not specifically recognised as key threatening processes listed on Schedule 3 of the TSC Act. However, if the proposed activities are not conducted in accordance with the mitigation measures outlined in this report then they may be recognised by the scientific community as potentially detrimental to certain species and their habitats.

h *whether any threatened species, population or ecological community is at the limit of its known distribution.*

If present, the proposed carriageway would be at, or approaching the southern limit of the known distribution of threatened species such as the little bent-wing bat (*Miniopteris australis*) and red-legged pademelon (*Thylogale stigmatica*).

CONCLUSIONS

Based on the eight factors considered above it is unlikely that the proposed highway upgrading between Bulahdelah and Karuah would cause a significant adverse effect on any threatened flora or fauna species.

No threatened plant species were recorded during the ecological investigations. The area of vegetation to be removed is relatively small when compared to the extensive forested areas to be retained within the Nerong State Forest and on private property in surrounding areas. The majority of forested areas that would be subject to disturbance by the proposed highway upgrading have already been exposed to degrading effects associated with previous logging activity and the existing highway alignment.

The majority of threatened fauna species that potentially inhabit the proposed carriageway are either highly mobile and have large home ranges, or else their preferred habitat is of such limited extent along the proposed carriageway that habitat removal is unlikely to cause a significant effect on the species. Furthermore, the mitigation measures to be implemented, as outlined in Chapter 6 of this report, would further mitigate any potential effects that the proposed highway upgrading is likely to have on threatened species, populations or ecological communities, or their habitats.

The results of the Section 5A Assessment of Significance lead to the conclusion that a Species Impact Statement is not required for the proposed Bulahdelah to Karuah Pacific Highway upgrade.

Appendix F
Water Quality Monitoring Results

Table F1 SEPTEMBER WATER QUALITY RESULTS

	pH	DO (mg/L)	EC (mS/cm)	Susp.Solids (mg/L)	Oil/Grease (mg/L)
Criteria	6.5-8.5	>6	<1.5	< 50	< 50
Site					
1	7.93	5.84	0.353	16	5
2	8.03	7.18	6.56	13	4
3	7.56	3.89	0.334	24	5
4	8.00	8.49	42.5	25	2
5	7.69	12.6	0.598	53	< 1
6	7.81	1.75	0.651	56	1
7	7.84	4.91	0.281	17	< 1
8	8.15	4.00	0.406	9.6	3
9	8.27	7.15	1.29	6.8	< 1
10	7.79	6.9	0.279	94	< 1

September monitoring undertaken on 16/09/97 (dry catchment)

Table F2 OCTOBER WATER QUALITY RESULTS

	pH	DO (mg/L)	EC (mS/cm)	Susp.Solids (mg/L)	Oil/Grease (mg/L)
Criteria	6.5-8.5	>6	<1.5	< 50	< 50
Site					
1	6.53	8.24	0.162	14	3
2	6.91	8.55	1.12	23	1
3	6.19	5.54	0.233	7	< 1
4	7.25	6.52	34.2	29	< 1
5	8.56	10.5	0.33	83	3
6	6.94	5.75	1.39	57	< 1
7	6.42	3.85	0.172	224	5
8	6.45	6.00	0.358	18	5
9	6.75	6.94	0.259	29	2
10	6.72	8.34	0.129	31	4

October monitoring undertaken on 9/10/97 (moist catchment)

Table F3 DECEMBER WATER QUALITY RESULTS

	pH	DO (mg/L)	EC (mS/cm)	Susp.Solids (mg/L)	Oil/Grease (mg/L)
Criteria	6.5-8.5	>6	<1.5	< 50	< 50
Site					
1	Dry	Dry	Dry	Dry	Dry
2	7.57	4.72	24.2	11	<2
3	7.47	1.20	0.22	115	<2
4	7.47	5.28	39.2	8	3
5	8.25	4.69	0.34	24	<2
6	Dry	Dry	Dry	Dry	Dry
7	6.95	2.87	0.10	14	6
8	6.95	0.57	0.14	6	<2
9	7.71	5.49	0.23	20	10
10	Dry	Dry	Dry	Dry	Dry

December monitoring undertaken on 23/12/97 (very dry catchment)

Table F4 FEBRUARY WATER QUALITY RESULTS

	pH	DO (mg/L)	EC (mS/cm)	Susp.Solids (mg/L)	Oil/Grease (mg/L)
Criteria	6.5-8.5	>6	<1.5	< 50	< 50
Site					
1	6.53	6.54	0.205	15	2.6
2	7.04	6.95	23.9	8	< 1
3	7.02	6.03	0.293	18	< 1
4	7.56	8.01	44.0	22	< 1
5	7.75	10.67	0.275	22	< 1
6	8.49	8.85	0.602	90	< 1
7	6.32	4.62	0.095	13	< 1
8	7.14	5.63	0.153	30	< 1
9	7.08	6.77	0.202	14	< 1
10	6.95	10.32	0.226	4	< 1

February monitoring undertaken on 12/02/98 (moist catchment)

Table F5 APRIL WATER QUALITY RESULTS

	pH	DO (mg/L)	EC (mS/cm)	Susp.Solids (mg/L)	Oil/Grease (mg/L)
Criteria	6.5-8.5	>6	<1.5	< 50	< 50
Site					
1	6.17	7.65	0.108	21	< 1
2	6.21	7.92	0.031	180	< 1
3	6.24	8.10	0.045	72	< 1
4	5.80	8.46	0.121	61	< 1
5	5.72	7.52	0.103	74	< 1
6	6.05	6.82	0.227		
7	5.30	7.58	0.089	46	< 1
8	5.40	8.11	0.124	20	< 1
9	6.00	7.05	0.178	33	< 1
10	5.80	7.23	0.060	157	< 1

April monitoring undertaken on 24/04/98 (flooded catchment)

Table F6 JUNE WATER QUALITY RESULTS

	pH	DO (mg/L)	EC (mS/cm)	Susp.Solids (mg/L)	Oil/Grease (mg/L)
Criteria	6.5-8.5	>6	<1.5	< 50	< 50
Site					
1	6.19	> 6	0.139	31	< 1
2	6.34	> 6	0.255	5.0	< 1
3	6.00	> 6	0.145	8.0	< 1
4	5.89	> 6	0.602	12	< 1
5	6.33	8.85	0.161	29	< 1
6	6.30	> 6	0.269	27	< 1
7	5.99	> 6	0.171		
8	5.80	9.73	0.187		
9	5.81	> 6	0.213	3.0	< 1
10	6.66	> 6	0.159	200	< 1

June monitoring undertaken on 18/06/98 (moist catchment)

Appendix G
Water Pollution Control Devices

CONCEPTUAL DETAIL OF PROPOSED CONTROL OF POLLUTION AND SEDIMENT
WATER QUALITY 57 KM 850 TO 94 KM 600

Controlling Device No.	Type of Control		Trapping Efficiency		Approximate Location	Approximate Size		Existing WC		Risk to Environment		
	Perm	Non Perm	Sediment	Pollution		Volume	Area	Major	Minor	H	M	L
13	✓		✓	✓	57 km 850 R		250 m²		✓	✓		
14	✓		✓	✓	58 km 300 R		250 m²		✓		✓	
15	✓			✓	59 km 050 R	60 m³			✓			✓
16	✓		✓	✓	59 km 450 R		250 m²		✓		✓	
17	✓			✓	59 km 920 R	60 m³			✓			✓
18	✓			✓	60 km 250 R	60 m³			✓			✓
19	✓			✓	60 km 430 R	60 m³			✓			✓
20	✓			✓	60 km 650 R	60 m³			✓			✓
21	✓		✓	✓	61 km 280 L		250 m²	✓Bulga		✓		
22	✓		✓	✓	61 km 380 L		250 m²	✓Bulga		✓		
23	✓			✓	61 km 670 R	60 m³			✓	✓		
24	✓		✓	✓	61 km 450 L		250 m²		✓		✓	
25	✓			✓	62 km 550 R				✓		✓	
26	✓		✓	✓	62 km 750 R		250 m²		✓	✓		
27	✓		✓	✓	63 km 330 L		250 m²		✓	✓		
28	✓			✓	63 km 750 L	60 m³			✓Crayhaven	✓		
29	✓			✓	63 km 940 R	60 m³			✓Crayhaven	✓		
30	✓			✓	64 km 020 R	60 m³			✓Crayhaven	✓		
31	✓		✓	✓	64 km 280 L		250 m²		✓	✓		
32	✓		✓	✓	64 km 700 M		250 m²		✓	✓		
33	✓			✓	64 km 900 M	60 m³			✓	✓		
34	✓			✓	65 km 430 M	60 m³			✓	✓		
35	✓			✓	65 km 730 R	60 m³			✓	✓		
36	✓			✓	65 km 950 R	60 m³			✓	✓		
37	✓			✓	66 km 480 R	60 m³		✓Bundabah		✓		
38	✓			✓	66 km 560 M	60 m³		✓Bundabah		✓		
39	✓		✓	✓	66 km 580 R		250 m²	✓Bundabah		✓		
40	✓		✓	✓	67 km 150 R		250 m²	✓Station		✓		

Controlling Device No.	Type of Control		Trapping Efficiency		Approximate Location	Approximate Size		Existing WC		Risk to Environment		
	Perm	Non Perm	Sediment	Pollution		Volume	Area	Major	Minor	H	M	L
41	✓			✓	67 km 480 R	60 m³			✓			
42	✓			✓	67 km 850 R	60 m³			✓			
43	✓			✓	68 km 050 R	60 m³			✓		✓	
44	✓			✓	68 km 370 R	60 m³			✓		✓	
45	✓		✓	✓	68 km 520 R		250 m²		✓		✓	
46	✓		✓	✓	68 km 220 R		250 m²		✓		✓	
47	✓		✓	✓	70 km 000 R		250 m²		✓		✓	
48	✓			✓	70 km 050 R	60 m³			✓		✓	
49	✓			✓	70 km 310 R	60 m³			✓		✓	
50	✓			✓	70 km 500 R	60 m³			✓		✓	
51	✓		✓	✓	71 km 050 R		250 m²	Viney Creek			✓	
52	✓			✓	71 km 210 R	60 m³		Viney Creek			✓	
53	✓			✓	71 km 330 R	60 m³		Viney Creek			✓	
54	✓		✓	✓	71 km 700 R		250 m²		✓		✓	
55	✓			✓	72 km 050 R	60 m³			✓			✓
56	✓			✓	72 km 450 R	60 m³			✓			✓
57	✓			✓	72 km 550 R	60 m³			✓			✓
58	✓			✓	72 km 800 R	60 m³			✓			✓
59	✓			✓	73 km 050 R	60 m³			✓			✓
60	✓			✓	73 km 950 R	60 m³			✓			✓
61	✓			✓	73 km 600 R	60 m³			✓			✓
62	✓			✓	74 km 050 R	60 m³			✓			✓
63	✓			✓	74 km 150 R	60 m³			✓			✓
64	✓			✓	74 km 810 R	60 m³			✓			✓
65	✓			✓	74 km 900 R	60 m³			✓			✓
66	✓			✓	75 km 010 R	60 m³			✓			✓
67	✓			✓	75 km 050 R	60 m³			✓			✓
68	✓			✓	75 km 480 R	60 m³			✓			✓
69	✓			✓	75 km 550 R	60 m³			✓			✓
70	✓			✓	75 km 630 R	60 m³			✓			✓
71	✓			✓	76 km 380 R	60 m³			✓			✓
72	✓			✓	75 km 970 R	60 m³			✓			✓
73	✓			✓	77 km 040 R	60 m³			✓			✓

Controlling Device No.	Type of Control		Trapping Efficiency		Approximate Location	Approximate Size		Existing WC		Risk to Environment		
	Perm	Non Perm	Sediment	Pollution		Volume	Area	Major	Minor	H	M	L
74	✓			✓	77 km 160 R	60 m³			✓			✓
75	✓			✓	77 km 400 R	60 m³			✓			✓
76	✓			✓	77 km 650 R	60 m³			✓			✓
77	✓			✓	77 km 870 R	60 m³			✓			✓
78	✓			✓	78 km 140 R	60 m³			✓			✓
79	✓			✓	78 km 410 R	60 m³			✓			✓
80	✓		✓	✓	78 km 750 R		250 m²		✓			✓
81	✓			✓	78 km 890 R	60 m³			✓			✓
82	✓		✓	✓	79 km 100 R		250 m²		✓			✓
83	✓		✓	✓	79 km 400 M		250 m²		✓		✓	
84	✓	✓	✓		79 km 700 R		250 m²					
85	✓		✓	✓	80 km 000 M		250 m²		✓		✓	
86	✓			✓	80 km 430 R	60 m³		Splityard Creek		✓		
87	✓			✓	80 km 500 R	60 m³		Splityard Creek		✓		
88	✓			✓	80 km 750 R	60 m³		Splityard Creek		✓		
89	✓			✓	80 km 810 R	60 m³		Splityard Creek		✓		
90	✓			✓	81 km 410 R	60 m³			✓	✓		
91	✓			✓	81 km 740 R	60 m³		Splityard Creek		✓		
92	✓			✓	81 km 800 R	60 m³		Splityard Creek		✓		
93	✓			✓	82 km 740 R	60 m³		Jacks Creek		✓		
94	✓			✓	82 km 740 L	60 m³		Jacks Creek		✓		
95	✓			✓	82 km 850 R	60 m³		Jacks Creek		✓		
96	✓		✓	✓	82 km 850 L		250 m²	Jacks Creek		✓		
97	✓		✓	✓	83 km 250 L		250 m²			✓		
98	✓			✓	83 km 480 L	60 m³		Nerong Creek		✓		
99	✓			✓	83 km 540 L	60 m³		Nerong Creek		✓		
100	✓		✓	✓	83 km 780 L		250 m²				✓	
101	✓		✓	✓	84 km 360 L		250 m²				✓	
102	✓			✓	84 km 490 R	60 m³		Greygum Gully		✓		
103	✓			✓	84 km 550 R	60 m³		Grey Gum Gully		✓		
104	✓			✓	84 km 800 R	60 m³			✓	✓		
105	✓			✓	84 km 840 R	60 m³			✓	✓		

Controlling Device No.	Type of Control		Trapping Efficiency		Approximate Location	Approximate Size		Existing WC		Risk to Environment		
	Perm	Non Perm	Sediment	Pollution		Volume	Area	Major	Minor	H	M	L
106	✓			✓	85 km 190 R	60 m³			✓	✓		
107	✓			✓	85 km 480 R	60 m³			✓	✓		
108	✓			✓	85 km 690 R	60 m³			✓	✓		
109	✓			✓	86 km 080 R	60 m³			✓	✓		
110	✓		✓	✓	86 km 150 R		250 m²		✓	✓		
111	✓			✓	86 km 540 R	60 m³			✓			
112	✓			✓	86 km 780 R	60 m³			✓	✓		
113	✓			✓	86 km 950 R	60 m³			✓	✓		
114	✓			✓	87 km 170 R	60 m³			✓	✓		
115	✓			✓	87 km 350 R	60 m³						
116	✓			✓	87 km 500 R	60 m³			✓	✓		
117	✓		✓	✓	87 km 850 R		250 m²					✓
118	✓		✓	✓	87 km 900 L		250 m²					✓
119	✓			✓	88 km 530 R	60 m³				✓		✓
120	✓		✓	✓	89 km 040 R		250 m²			✓		✓
121	✓		✓	✓	89 km 430 R		250 m²					✓
122	✓			✓	89 km 550 R	60 m³						
123	✓			✓	89 km 850 R	60 m³						✓
124	✓	✓	✓	✓	90 km 220 R		250 m²					✓
125	✓			✓	90 km 450 R	60 m³			✓		✓	
126	✓			✓	90 km 900 R	60 m³						✓
127	✓			✓	91 km 080 R	60 m³			✓			✓
128	✓			✓	91 km 370 R	60 m³			✓			✓
129	✓		✓	✓	91 km 540 R		250 m²					✓
130	✓			✓	91 km 980 R	60 m³			✓			✓
131	✓			✓	92 km 410 R	60 m³			✓			✓
132	✓		✓	✓	92 km 730 R		250 m²					✓
133	✓			✓	92 km 090 R	60 m³			✓		✓	
134	✓			✓	93 km 090 R	60 m³					✓	
135	✓			✓	93 km 460 R	60 m³			✓		✓	
136	✓			✓	93 km 810 R	60 m³					✓	
137	✓			✓	94 km 150 R	60 m³					✓	

Appendix H
RTA Land Acquisition Policy

FOI

FREEDOM OF INFORMATION

YOUR RIGHT TO KNOW

Land Acquisitions

R T A

Roads and Traffic Authority
New South Wales

Policy Statement

Land Acquisitions

Owners of property required by the Authority in connection with roadworks are generally aware of the proposals either through enquiries made when purchasing the property or from the proposal being shown on a Local Planning Scheme. New proposals are made public as soon as possible after a final decision has been reached.

A proposal may require public consultation and the preparation of an Environmental Impact Study which enables owners of affected land, to lodge submissions.

Procedures (Authority Initiated Acquisitions)

The Authority endeavours to purchase the land by negotiation in much the same way as a private property transaction. The offer of compensation is assessed in accordance with the Land Acquisition (Just Terms Compensation) Act 1991 hereafter referred to as "The Act". When roadworks are programmed the Authority advises the owner that the land is required and when occupation of the land is required. (Occupation of the land is usually required for adjustment to public utilities prior to actual road construction).

The letter will advise the owner that a Valuer representing the Authority will make arrangements to inspect the property and discuss the acquisition for the purpose of submitting a formal offer for the owner's consideration. The letter will also state that if an owner engages a Registered Valuer and a Solicitor the Authority will reimburse reasonable fees. Valuation fees are reimbursed in accordance with the Authority's schedule included with the letter and Legal fees in accordance with Schedule 1 of the General Order of the Conveyancing Act. Every effort will then be made to negotiate an agreement.

Compensation is to be assessed by having regard to the market value of the property as if it were unaffected by the road proposals. In addition to the market value regard is also taken to special value, severance, disturbance, solatium and any increase or decrease in the value of any other land adjoining or severed by the carrying out of the work. Division 4 of The Act defines the owner's entitlement to compensation.

An advance payment (usually only for the purpose of paying a deposit on a replacement property) will be considered if requested.

If agreement cannot be reached to ensure the Authority's timely entry onto the required land for roadworks the Minister may approve the issue of a written Proposed Acquisition Notice to compulsorily acquire the land. See "Compulsory Acquisition" below.

Partial Acquisition

When only part of a property is required the Authority is responsible for the reconstruction of fencing, driveways and landscaping to a standard similar to that existing and relocation of water and gas meters. Compensation for any improvements lost as a result of the partial acquisition is added to the value of the land taken. A "Before and After" valuation will reflect most compensable items. The Authority will generally make an allowance to an owner who wishes to arrange for his/her own property adjustments.

Where all major improvements are situated outside the road corridor the Authority will generally purchase only the part of the property required for roadworks.

Compulsory Acquisition

Compulsory Acquisition is a statutory process available to the Authority to acquire land. It also provides the means for resolving disputes about the amount of compensation payable.

Compulsory acquisitions are carried out under the provisions of The Act.

The Process

- The Authority seeks the Minister's approval to compulsorily acquire land.

- If the Minister approves, the Authority issues a Proposed Acquisition Notice to each party with a known legal or equitable interest in the land, (eg a registered proprietor, mortgagee, lessee, trustee, occupant, beneficiary of an easement). The Notice advises of the Authority's intention to acquire the land after 90 days. However, a shorter period can be agreed by the owner and Authority, or can be approved by the Minister. A Proposed Acquisition Notice is accompanied by a Compensation Claim Form.

- The issue of a Proposed Acquisition Notice is recorded on the relevant Title registers at the Land Titles Office.

- During the 90 day period after the issue of the Proposed Acquisition Notice, negotiations may continue in an effort to purchase the land.

- If contracts for purchase have not been exchanged within the 90 days the Minister recommends to the Governor that the compulsory acquisition proceed.

- If the Governor approves, an Acquisition Notice is published in the Government Gazette within 120 days of the issue of the Proposed Acquisition Notice unless a longer period is agreed by the owner and the Authority. An extract of the Acquisition Notice is also published in a local newspaper.

- The Authority owns the land from the date of publication of the Acquisition Notice in the Gazette. The legal and equitable interests of each party are converted to an entitlement to compensation.

Advance Payment

Immediately following the publication of the Acquisition Notice the Authority advises affected owners of the acquisition and generally offers to pay 90% of the Authority's purchase offer, in return for vacant possession of the land.

Terms of Continued Occupation

- If possession is not given, the Authority is entitled to charge rent for the land from the date of notification in the Gazette until possession is obtained. The terms of

rental are at the discretion of the Authority. Unpaid rent may be deducted from compensation payable.

Compensation

- Each recipient of a Proposed Acquisition Notice is entitled to lodge a claim for compensation with the Authority. Also, anyone else who considers that they are entitled to compensation but did not receive a Proposed Acquisition Notice may lodge a claim. Claims must be on the prescribed form. Compensation is not paid until a properly completed claim has been lodged. If agreed, compensation may comprise land or works in whole or part settlement of a claim.

- The Valuer General determines the amount of compensation (including legal and valuation costs) to be offered by the Authority in a Compensation Notice.

- A Compensation Notice is issued within 30 days after notification of the compulsory acquisition in the Gazette. This Notice is issued whether or not a claim for compensation has been lodged. However, the Minister may approve delay in the issue of a Compensation Notice by up to an extra 60 days. However in the case of competing claims the Authority does not issue a Compensation Notice until entitlement is resolved.

- If the amount of compensation is accepted, and the necessary settlement papers and claim form are returned to the Authority properly completed, the Authority will pay the compensation within 28 days of receipt of those papers. Interest is paid on the compensation from the date of acquisition to the date of payment.

- If the amount of compensation is not accepted, the claimant may lodge an objection with the Land and Environment Court. The objection should be lodged within 90 days of the Compensation Notice issuing. This ensures that the Court will hear the objection and determine the amount of compensation to be paid. Within 28 days after lodgement of the objection, the Authority will pay the claimant 90% of the compensation offered in the Compensation Notice as an advance on account of compensation if that is acceptable to the claimant. Interest is also paid on the advance. If it is not accepted, the advance and interest will be deposited into a trust account pending the Court decision.

- If, within 90 days of a Compensation Notice issuing, the amount offered in that Notice has not been accepted and an objection has not been lodged with the Land and Environment Court the offer is deemed to have been accepted. The Authority then deposits the amount offered plus interest into the trust account where it is held until it is accepted or until an objection is lodged with the Court. Money earned by the trust account deposit becomes part of the compensation.

- If, the compensation has been in the Trust Account for six years and a claim has not been received, the compensation is paid to the State Treasurer and held in the Treasury until paid to an entitled claimant. Interest is not paid on the compensation for the time that it is held in the Treasury.

Occupation

- People in lawful occupation of land compulsorily acquired and to whom compensation is payable are entitled to remain in occupation as tenants of the Authority until:

  (a) the compensation is paid; or

  (b) an advance payment of not less than 90% of the amount offered in the Compensation Notice is paid; or

  (c) not less than 90% of the amount offered in the Compensation Notice is deposited into the trust account due to a deemed acceptance, Court action, or competing claims;

  whichever occurs first.

- Furthermore, people lawfully occupying their principal place of residence or place of business are entitled to remain in occupation as tenants of the Authority for three months after it is compulsorily acquired, regardless of whether any of the abovementioned payments have been made. However, the Minister may shorten that period.

- Once the Authority is entitled to vacant possession, it may request the Sheriff to deliver possession of the land to the Authority. The Sheriff's costs may be recovered as a debt or deducted from any compensation payable.

Hardship Acquisition

(Owner Initiated Acquisitions)

If a property is affected by a road proposal the Authority will consider acquisition under the "Hardship" provisions of the Act and acquisition clauses in Local Environmental Plans. Hardship has to be demonstrated to the satisfaction of the Authority in accordance with Division 3 of the Act. When hardship has been established to the satisfaction of the Authority the owner may negotiate the acquisition or may require the Authority to compulsorily acquire the land.

An owner who has purchased in knowledge of the Authority's proposal can usually sell on the same basis on which it was purchased and would not normally be able to demonstrate hardship.

The Authority is not obliged to acquire more land than is required for the public purpose.

The valuation will be the market value unaffected by the Authority's proposal. Disturbance items, injurious affection, severance, solatium, and the payment of legal and valuation fees need not (under the provisions of the Act) be taken into account in the assessment of compensation under the Hardship provisions.

Notes

- Solatium means compensation to a person for non-financial disadvantage resulting from the necessity of the person to relocate his or her principal place of residence as a result of the acquisition. The amount of compensation is to be assessed depending on the degree that the person is disadvantaged to a maximum of $15,000 or such increased figure as notified by the Minister in the Gazette.

- The Act does not apply to the acquisition of land by agreement where the land is available for public sale.

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RTA GRAPHIC SERVICES

Appendix I
Noise Impact Assessment

NOISE AND BLASTING ASSESSMENT

Pacific Highway Upgrade
Between Karuah and
Bulahdelah

For:
NSW ROADS AND TRAFFIC AUTHORITY

July 1998
37039NOI

Report No. 37039NOI

This report was prepared in accordance with the scope of services set out in the contract between ERM Mitchell McCotter Pty Ltd ACN 002 773 248 (ERMMM) and the NSW Roads and Traffic Authority (RTA). To the best of our knowledge, the proposal presented herein accurately reflects the RTA's intentions when the report was printed. However, the application of conditions of approval or impacts of unanticipated future events could modify the outcomes described in this document. In preparing the report, ERMMM used data, surveys, analyses, designs, plans and other information provided by the individuals and organisations referenced herein. While checks were undertaken to ensure that such materials were the correct and current versions of the materials provided, except as otherwise stated, ERMMM did not independently verify the accuracy or completeness of these information sources.

Approved by:	*Tony McNamara*
Position:	Project Director
Signed:	Tony McNamara
Date:	14-7-98

ERM Mitchell McCotter Quality System

TABLE OF CONTENTS

Page No.

LIST OF TABLES

Page No.

LIST OF TABLES

LIST OF FIGURES

Chapter 1

INTRODUCTION

This report presents an assessment of the impact of traffic noise, construction noise and vibration and batching plant noise resulting from the redevelopment of the Pacific Highway between Karuah and Bulahdelah to a four lane divided highway. The noise assessment was undertaken by ERM Mitchell McCotter using road alignment, traffic volume and construction data provided by RTA.

Noise levels at representative sites along the route were recorded to determine existing background noise levels and daytime and night-time traffic noise levels. Recorded traffic noise levels were used to verify the traffic noise prediction model developed for the redevelopment route. Traffic noise levels were predicted at potentially affected residences based on traffic volumes for two scenarios, existing (1997) and ten years following commencement of redevelopment of the highway (2009).

Traffic noise impacts on potentially affected residences were assessed according to the EPA's draft *NSW Government Environmental Criteria for Road Traffic Noise* (1998).

Impacts on potentially affected residences due to construction noise and vibration and the operation of batching plants were assessed according to EPA's *Environmental Noise Control Manual* (1994).

The assessment identified residences where noise levels due to the redevelopment exceed relevant criteria. Potential noise mitigation measures are identified and discussed.

Chapter 2

EXISTING NOISE ENVIRONMENT

Noise levels were monitored at a number of representative locations along the length of the proposed highway carriageway. Monitoring procedures were in general accordance with Australian Standard AS1055 *Acoustics - Description and Measurement of Environmental Noise* and guidelines in the Environment Protection Authority's *Environmental Noise Control Manual* (ENCM) (EPA, 1994).

Eight monitoring sites were selected to represent typical background noise levels for residences along the subject section of the Pacific Highway. The locations of the sites are shown in *Figure 2.*

Continuous noise monitoring, with results stored at 15-minute intervals, was performed using an unmanned noise data logger over the period 11 September to 18 September 1997. In each case, daytime and night-time noise levels were measured during weekday and weekend periods to ensure that minimum repeatable background noise levels could be established. ARL EL215/EL015 noise loggers, were used for the monitoring. The noise loggers were located in free field positions and calibrated before and after monitoring to check the validity of the stored data. A graphical representation of logged noise levels is provided in *Appendix A.*

A weather data logger, located approximately midway along the subject section of the highway, was used to record rainfall, temperature and wind data during the noise logging measurement period.

Due to environmental noise levels varying with time, statistical descriptors are required to adequately characterise the noise environment. The L_{10} noise level is the level exceeded for 10 per cent of the time, and is approximately equivalent to the average of maximum noise levels. The L_{90} level is the level exceeded for 90 per cent of the time, and is approximately the average of minimum noise levels. The L_{eq} level represents the average noise energy during a measurement period.

Current EPA policy is to assign the existing 'background' noise level of a site as the lowest repeatable L_{90} noise level. The EPA does not define lowest repeatable L_{90} noise level, however it has been generally accepted that this level is equivalent to the 90th percentile L_{90} noise level.

On-site observations indicate that the primary background noise sources include highway traffic, crickets, frogs and domestic animals. Variable weather conditions

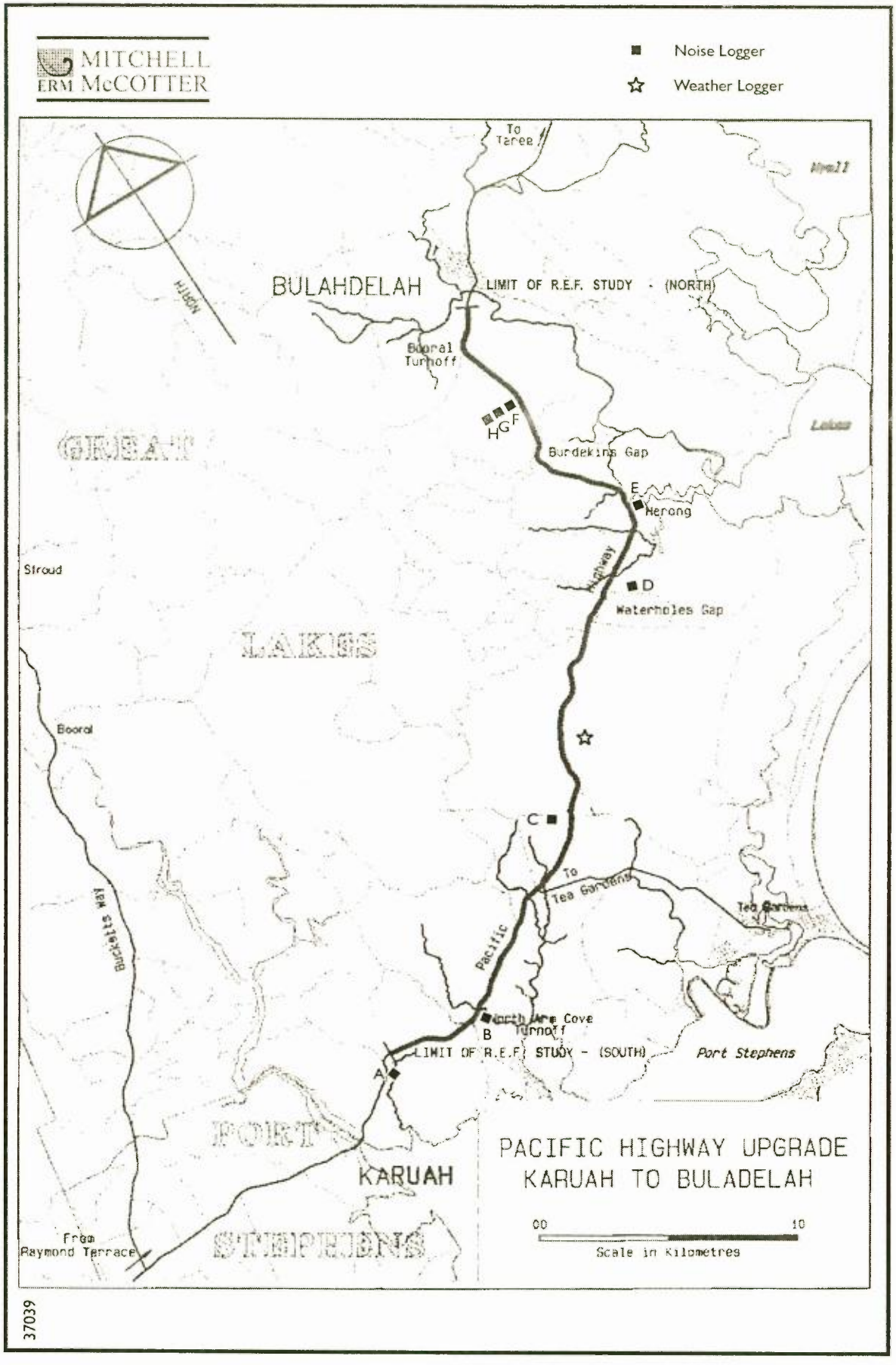

Figure 2 NOISE MONITORING SITES

were experienced during the monitoring. Data gathered during periods of rainfall or periods of wind speed greater than five metres per second have not been included in the determination of existing background noise levels. A summary of noise logger data for the 15 hour daytime (7:00 am to 10:00 pm) and 9 hour night-time (10:00 pm to 7:00 am), as defined in the ENCM for the monitoring period is provided in *Table* 2.1.

Table 2.1 SUMMARY OF LOGGED 15 HOUR AND 9 HOUR NOISE LEVELS

Location	Dist From H'way	15 Hour dB(A)				9 Hour dB(A)			
	metres	L_{Aeq}	L_{A10}	L_{A90}	L_{A90}*	L_{Aeq}	L_{A10}	L_{A90}	L_{A90}*
A. Stevens Lot 5 DP595881	80	56.5	60.3	44.3	39.5	55.1	59.1	35.7	30.0
B. Fullerton Lot 1 DP621236	150	52.6	56.2	44.2	38.5	54.3	58.4	44.0	38.5
C. Reynolds Lot 10 DP252008	330	50.6	52.3	41.0	35.1	46.0	49.2	35.4	31.5
D. Benkil P/L Lot 2 DP733104	830	44.2	46.2	37.4	33.3	44.7	48.0	37.9	30.5
E. Rose Lot 16 DP247531	120	55.6	59.2	43.2	36.8	54.5	58.7	34.3	28.5
F. Houston Lot 5 DP829939	100	54.3	58.2	43.4	37.5	54.4	58.8	36.3	28.5
G. Houston Lot 5 DP829939	460	45.7	48.4	37.2	32.0	45.3	49.4	33.4	28.0
H. Houston Lot 6 DP829939	1060	43.6	45.2	35.6	32.5	40.7	43.9	32.3	28.5

Notes: * *Lowest repeated value*

Chapter 3

OPERATIONAL NOISE IMPACTS

3.1 NOISE CRITERIA

The EPA requires that traffic noise levels at potentially-affected residences and other noise-sensitive locations should not exceed criteria set down in the draft *NSW Government Environmental Criteria for Road Traffic Noise* (1998). These criteria are applicable for the redevelopment of an existing freeway/arterial road. The criteria set out in the policy have been adopted in this report for assessment of operation noise from the proposed highway upgrading.

For residences, the EPA's criteria are defined in terms of the descriptors $L_{Aeq,15hr}$ and $L_{Aeq,9hr}$, and are shown in *Table 3.1* below. These represent the total noise energy at a receiving location, measured over the 15-hour period from 7 am to 10 pm and over the 9-hour period from 10 pm to 7 am, respectively. For the level of traffic noise to be considered acceptable, the relevant criteria in terms of $L_{Aeq,15hr}$ and $L_{Aeq,9hr}$ should both be met.

The recommended residential traffic noise criteria are also dependent on the existing ambient noise level at the assessment location. Where existing levels already exceed the criteria, the redevelopment should be designed so as not to increase existing noise levels by more than 2 dB. The policy also states that where the existing road traffic noise levels lie within 2 dB of the noise criteria, the 2 dB allowance applies to the existing noise level. For both these situations, the policy states:

'Where feasible, noise levels from existing roads should be reduced to meet the noise criteria. In many instances this may only be achievable through long term strategies such as improved planning, design and construction of adjoining land use developments, reduced vehicle emission levels through new vehicles, greater use of public transport and alternate methods of freight haulage.'

These criteria should be met at the nearest or most sensitive residential receiver. In this study, the receiver locations are taken as one metre from any residential facade at a height of 1.2 metres above ground level.

For the purpose of this assessment, the criteria should be met 10 years after opening of any proposed road project, and in this case this will be taken to be the year 2009.

Table 3.1 RECOMMENDED TRAFFIC NOISE CRITERIA FOR RESIDENCES

Noise Descriptor	Recommended Maximum Noise Level, dB(A)
Leq,15hr	60
Leq,9hr	55

3.2 NOISE PREDICTION METHODOLOGY

A total of 44 receiver locations were selected, representing premises which would be potentially worst affected by noise from the proposed highway upgrading. The location of these residences are shown in *Figure 3*. All these premises are currently affected to varying degrees by noise from traffic on the existing Pacific Highway.

Noise levels at potentially-affected premises for years 1997 and 2009 representing existing conditions and 10 years following construction were calculated using an in-house computer model which implements the CoRTN prediction model. The model involves dividing each traffic lane into sections with a maximum length of 20 metres, and calculating 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 CoRTN method was devised by the United Kingdom Department of Transport and the last update was in 1988. With suitable corrections, this method has been shown to give accurate predictions of traffic noise levels under Australian conditions.

Source heights of 0.5m, 1.5m and 3.6m were used for cars, heavy vehicles and heavy vehicle exhaust respectively. For heavy vehicles, noise levels contributed from the exhausts are approximately 8 dB lower than those from the engines.

Correction for facade effects, adjusted to Australian conditions as described in the RTA's Interim Traffic Noise Guidelines, was incorporated in the model. The actual wear surface for the upgraded highway is yet to be determined by RTA. For the assessment a correction for the effect of tined concrete and open graded asphaltic concrete was taken into account, which are approximately 5 dB above and 3 dB below the levels of standard road surfaces respectively.

The CoRTN method predicts noise levels in terms of the L_{10} level. Noise levels in terms of L_{eq} were calculated assuming that the difference between L_{10} and L_{eq} noise levels in any hour would be 3 dB. This standard correction has been shown to be accurate under typical traffic conditions.

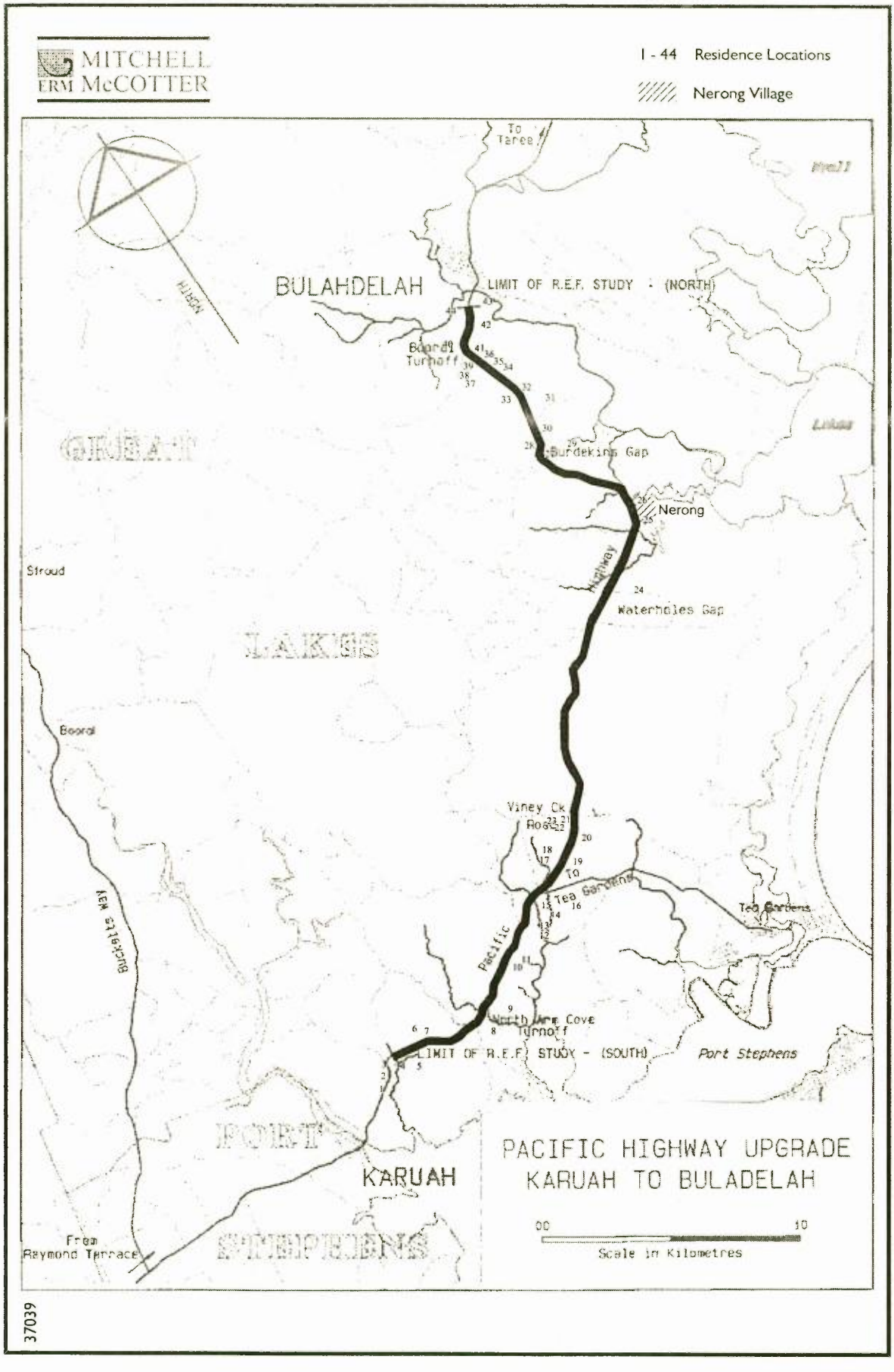

Figure 3 POTENTIALLY AFFECTED RESIDENCES

Existing traffic volumes, projected growth rates and classification data were provided by the RTA (RTA Technology, 1997). Traffic volumes used in calculations for each year were based on:

- 1996 Average Annual Daily Traffic (AADT) volume of 10,622 vehicles
- High growth (3.5%) scenario;
- 15 hour and 9 hour ratios based on hourly volume counts at Karuah River Bridge counting station;
- Vehicle classification ratios based on hourly classification data at a counting station located 1.2 kilometres north of Bulga Creek; and
- Traffic split 50 percent northbound/50 percent southbound.

Calculations included a conservative assumption for mean traffic speeds of 110 kilometres per hour (km/h) for light vehicles and 100 km/h for medium and heavy vehicles.

Hourly Traffic volumes assumed in calculations are shown in *Table* 3.2.

Table 3.2 HOURLY TRAFFIC VOLUMES ASSUMED IN CALCULATIONS

Year	15 hour		9 hour	
	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles
1997	560	92	84	48
2009	796	132	120	72

3.3 EXISTING OPERATIONAL NOISE LEVELS

Existing noise levels were measured at eight locations which are representative of residences which would be potentially affected by noise from the proposed upgrading (see Section 2.1). *Table* 3.3 provides a comparison of the $L_{eq,15hr}$ and $L_{eq,9hr}$ noise levels recorded at each location (including an adjustment for facade effect) with noise levels predicted using the computer model. In this case, traffic volumes used in the prediction model were based on actual traffic counts taken during the noise monitoring period at Karuah River Bridge counting station.

Table 3.3 COMPARISON OF MEASURED AND PREDICTED TRAFFIC NOISE LEVELS FOR 1997 TRAFFIC VOLUMES (dB(A))

Location	$L_{Aeq,15hr}$		$L_{Aeq,15hr}$	
	Measured [1]	Predicted	Measured	Predicted
A. Stevens Lot 5 DP595881	58.0	63.4	56.6	58.3
B. Fullerton Lot 1 DP621236	54.1	60.3	55.8	56.0
C. Reynolds Lot 10 DP252008	52.1	56.3	47.5	52.0
D. Benkil P/L Lot 2 DP733104	45.7	47.5	46.2	43.3
E. Rose Lot 16 DP247531	57.1	60.4	56.0	56.2
F. Houston Lot 5 DP829939	55.8	61.6	55.9	57.3
G. Houston Lot 5 DP829939	47.2	54.5	46.8	50.8
H. Houston Lot 6 DP829939	45.1	49.9	42.2	45.6

Notes: 1. Includes +1.5 dB(A) adjustment for facade effects

The measured and predicted noise levels differ from between 0.2 to 7.3 dB(A) with the larger differences during the 15 hour period. The predicted results are based on no barriers between road cutting/embankment and receiver, and hard ground assumptions (ie ground effect ignored) and are generally higher than the measured results. *Table 3.3* shows a comparison of measured and predicted levels.

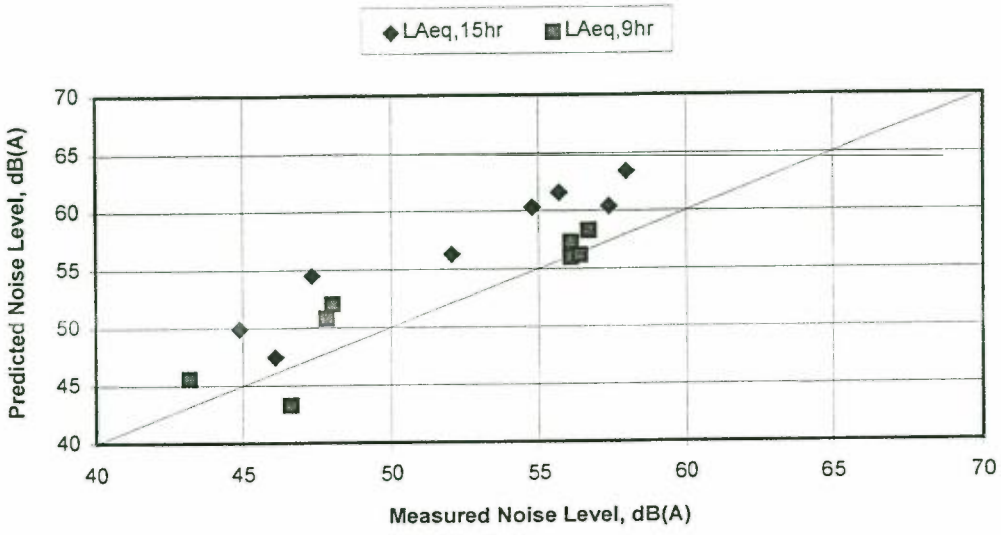

Table 3.4 COMPARISON OF MEASURED AND PREDICTED NOISE LEVELS AT MONITORING SITES

From *Table 3.4* it is clear that daytime noise levels are generally over-predicted by approximately 5 dB. On the other hand, predicted night-time levels are relatively accurate. (The average difference between predicted and measured night-time noise levels is 1.1 dB(A)). This difference between daytime and night-time predictions cannot be due to any features in the model apart from the traffic volume and percentage heavy vehicles.

Traffic volumes used in predictions were based on actual counted volumes during the measurement period - an average of 655 vph during the daytime period and 150 vph during the night-time. The proportion of heavy vehicles - 14.2% for daytime and 37.3% for night-time - was supplied by the RTA from classification counts conducted along the current road section, over a different period. From these two values, the CoRTN model predicts a difference of 4.2 dB(A) between the 15 hour and 9-hour levels, independent of terrain of other considerations, whereas the average measured difference is 0.6 dB(A). This discrepancy can be due to only two factors:

- The values for percentage heavy vehicles. If, for example, the daytime proportion of heavy vehicles during the monitoring period was 5% rather than 14.2%, the predicted difference between daytime and night-time levels reduces to 2.8 dB(A); or

- Other factors not accounted for in the model. These may include meteorological effects, which may have different impacts during the daytime and night-time periods. Such effects are more important at larger distances

from the source, and could be expected to have some influence in this case, where distances range from 100 to 1000 metres.

Table 3.5 and *Table 3.6* show daily variation in the measured values of $L_{Aeq,15hr}$ and $L_{Aeq,8hr}$, after correcting for differences in the total traffic volume on the measurement day. At any site, the range of values between days is often over 4 dB(A), indicating that noise levels are definitely influenced by factors which vary on a daily basis but cannot be predicted within the present model.

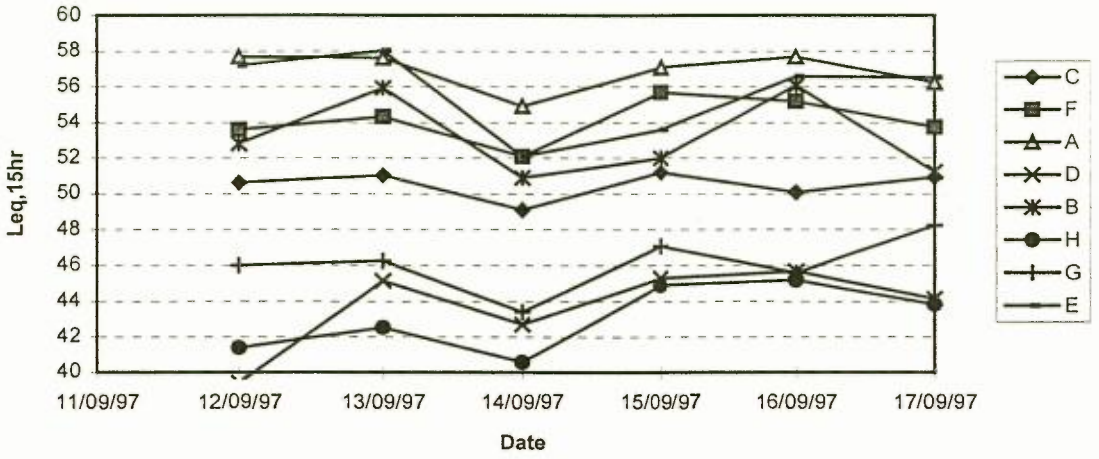

Table 3.5 MEASURED $L_{eq,15hr}$, CORRECTED FOR DIFFERENCES IN TRAFFIC VOLUME

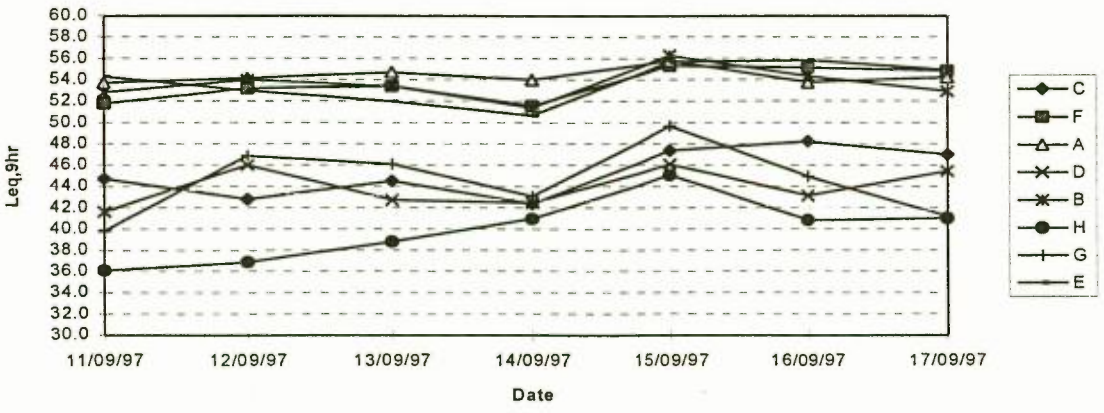

Table 3.6 MEASURED $L_{eq,9hr}$, CORRECTED FOR DIFFERENCES IN TRAFFIC VOLUME

Despite the above discussion, night-time noise levels at the measurement sites are predicted relatively well by the model, with a small average over-prediction of approximately 1 dB(A) giving a slightly conservative result. Since in this case night-time noise levels are the critical levels for determining exceedence of noise criteria, the model predictions have been adopted for noise assessment as described below, with the caution that predicted daytime noise levels may be over-estimates of the true level.

3.4 PREDICTED TRAFFIC NOISE LEVELS

In initial modelling, no barriers were included. Predicted noise levels for this case at each of the residences under existing conditions are given in *Table 3.7*. Predicted noise levels at year 10 (2009) for two types of road seal surfaces are also given in *Table 3.7*. The first option is tined concrete for all new road lanes with dense graded asphaltic concrete to remain on the existing lanes. The second option is open graded asphaltic concrete on all road surfaces. These predicted levels include only noise from the highway. However, for the selected residences, the contribution of noise from other sources would be negligible.

Table 3.7 PREDICTED NOISE LEVELS FOR YEARS 1997 AND 2009 FOR TINED CONCRETE (TC) AND OPEN GRADED ASPHALTIC CONCRETE (OGAC) AND EPA CRITERIA EXCEEDENCES - INITIAL BARRIER CONFIGURATION

Residence	Predicted $L_{Aeq,9hr}$ dB(A)						Predicted $L_{Aeq,15hr}$ dB(A)					
	1997	Criteria	2009				1997	Criteria	2009			
			TC	Exceedence	OGAC	Exceedence			TC	Exceedence	OGAC	Exceedence
1 Geany [1]	39.7	55.0	44.1	-	38.2	-	44.1	60.0	48.7	-	42.9	-
2 Geany [1]	40.1	55.0	44.5	-	38.6	-	44.6	60.0	49.1	-	43.3	-
3 O'Keefe [1]	41.3	55.0	45.6	-	39.7	-	45.9	60.0	50.4	-	44.6	-
4 Whitton [1]	48.1	55.0	52.7	-	46.7	-	52.6	60.0	57.3	-	51.4	-
5 Heeps [1]	50.2	55.0	55.6	0.6	49.3	-	54.3	60.0	60.0	-	53.7	-
6 French	50.2	55.0	53.1	-	47.8	-	54.2	60.0	57.5	-	52.3	-
7 Fitzpatrick	51.6	55.0	55.0	-	49.3	-	55.5	60.0	59.4	-	53.7	-
8 Morrow	50.6	55.0	54.6	-	48.5	-	54.9	60.0	59.1	-	52.9	-
9 Mikka	47.7	55.0	51.8	-	45.7	-	51.9	60.0	56.3	-	50.1	-
10 Fullerton	55.3	57.3	59.5	2.2	53.4	-	59.7	61.7	64.1	2.4	58.0	-
11 Carey	55.9	57.9	60.1	2.2	54.0	-	60.3	62.3	64.7	2.4	58.6	-
12 Needham	48.3	55.0	51.9	-	45.9	-	52.6	60.0	56.4	-	50.4	-
13 Grey	54.3	56.3	57.7	1.4	51.8	-	58.5	60.5	62.2	1.7	56.3	-
14 Grey	52.8	55.0	57.4	2.4	51.0	-	57.1	60.0	61.9	1.9	55.4	-
15 Grey	59.5	61.5	62.9	1.4	57.1	-	63.9	65.9	67.5	1.6	61.7	-
16 Pacific W.	50.2	55.0	56.2	1.2	49.4	-	54.5	60.0	60.7	0.7	53.9	-
17 Roberts	49.2	55.0	53.3	-	47.4	-	53.7	60.0	58.0	-	52.0	-
18 Roberts	49.1	55.0	53.0	-	47.2	-	53.5	60.0	57.6	-	51.7	-

Table 3.7 PREDICTED NOISE LEVELS FOR YEARS 1997 AND 2009 FOR TINED CONCRETE (TC) AND OPEN GRADED ASPHALTIC CONCRETE (OGAC) AND EPA CRITERIA EXCEEDENCES - INITIAL BARRIER CONFIGURATION

Residence	Predicted $L_{Aeq,9hr}$ dB(A)						Predicted $L_{Aeq,15hr}$ dB(A)					
	1997	Criteria	2009				1997	Criteria	2009			
			TC	Exceedence	OGAC	Exceedence			TC	Exceedence	OGAC	Exceedence
19 Beckett	54.2	56.2	58.3	2.1	52.4	-	58.5	60.5	62.5	2.0	56.8	-
20 Bowen	48.3	55.0	53.8	-	47.4	-	52.6	60.0	58.1	-	51.8	-
21 Ind	57.5	59.5	58.2	-	54.0	-	61.5	63.5	62.5	-	58.2	-
22 Reynolds	52.4	55.0	55.1	0.1	49.9	-	56.7	60.0	59.6	-	54.3	-
23 Offner	51.0	55.0	53.8	-	48.5	-	55.3	60.0	58.1	-	52.9	-
24 Benkil	44.7	55.0	51.5	-	44.7	-	48.9	60.0	55.9	-	49.1	-
25 Speed	58.0	60.0	58.9	-	52.3	-	62.3	64.3	63.2	-	56.8	-
26 Dunlevie	54.9	56.9	59.5	2.6	51.9	-	59.4	61.4	63.9	2.5	56.3	-
27 Silvestri	57.2	59.2	69.6	10.4	62.0	2.8	61.9	63.9	74.4	10.5	66.8	2.9
28 Guthrie	55.0	57.0	57.3	0.3	52.3	-	59.3	61.3	61.8	0.5	56.7	-
29 Rutter	47.0	55.0	55.3	0.3	48.3	-	51.2	60.0	59.4	-	52.4	-
30 Aitchison	49.9	55.0	57.5	2.5	50.6	-	54.3	60.0	61.9	1.9	55.0	-
31 Rietveld	50.0	55.0	55.7	0.7	49.3	-	54.3	60.0	60.2	0.2	53.7	-
32 Ireland	55.1	57.1	60.6	3.5	54.1	-	59.5	61.5	65.0	4.5	58.6	-
33 Montgomery	52.9	55.0	57.5	2.5	51.4	-	57.4	60.0	62.3	2.3	56.1	-
34 Woods	56.1	58.1	62.1	4.0	55.5	-	60.5	62.5	66.6	4.1	60.0	-
35 Helies	55.9	57.9	62.1	4.2	55.5	-	60.3	62.3	66.1	3.8	60.0	-
36 Lawry	56.0	58.0	62.1	4.1	55.5	-	60.5	62.5	66.6	4.1	60.1	-

Table 3.7 PREDICTED NOISE LEVELS FOR YEARS 1997 AND 2009 FOR TINED CONCRETE (TC) AND OPEN GRADED ASPHALTIC CONCRETE (OGAC) AND EPA CRITERIA EXCEEDENCES - INITIAL BARRIER CONFIGURATION

Residence	Predicted $L_{Aeq,9hr}$ dB(A)						Predicted $L_{Aeq,15hr}$ dB(A)					
	1997	Criteria	2009				1997	Criteria	2009			
			TC	Exceedence	OGAC	Exceedence			TC	Exceedence	OGAC	Exceedence
37 Sinderman	50.3	55.0	53.9	-	48.2	-	54.7	60.0	58.4	-	52.6	-
38 Pye	50.7	55.0	54.3	-	48.5	-	55.1	60.0	58.7	-	53.0	-
39 Linnegar	56.1	58.1	59.4	1.3	53.7	-	60.5	62.5	63.9	1.4	58.3	-
40 Transgrid	55.7	57.7	58.8	1.1	53.2	-	60.1	62.1	63.4	1.3	57.8	-
41 Lawry	56.6	58.6	63.2	4.6	56.5	-	61.1	63.1	67.7	4.6	61.0	-
42 Ireland [1]	45.0	55.0	50.8	-	44.2	-	49.2	60.0	55.2	-	48.6	-
43 Ireland [1]	41.6	55.0	46.7	-	40.3	-	46.1	60.0	51.4	-	45.0	-
44 Leggett [1]	44.6	55.0	48.6	-	42.6	-	49.1	60.0	53.0	-	47.1	-

Notes *1. These residences are located outside or near the end of the highway upgrade. Relatively low noise levels are a result of the model only considering noise from the upgraded highway.*

Based on modelling for 1997, existing noise levels at the majority of the residences are below the EPA's criteria. Thirteen of the residences have noise levels that exceed the EPA's criteria and a further four residences have noise levels that lie within 2 dB of the criteria. As discussed in Section 3.1 above, in these cases the redevelopment should be designed so as not to increase existing noise levels by more than 2 dB.

Should the entire highway upgrade utilise tined concrete as the road seal there would be an initial increase or decrease in operation noise at residences following completion of the upgrade works. Decreases may occur for residences located closer to the existing carriageway than the new duplicated carriageway. In the future, approximately 50 percent of the traffic volume that would have travelled on the existing carriageway would now travel on the new duplicated carriageway. Noise levels received from this traffic would be less than existing due to the additional distance to the noise source. However, due to increases in traffic volumes over time all residences would experience increases in operational noise levels by 2009.

Should the entire highway upgrade utilise open graded asphaltic concrete (OGAC) as the road seal with the exception of three residences (Silvestri, Rutter and Aitchison) all other residences would experience an initial decrease in operational noise levels. Although noise levels would increase over time due to growth in traffic volumes, operational noise levels would still be below 1997 levels in 2009 at these residences.

Residences located adjacent to the highway, at the ends of the highway upgrading (Nos. 1, 2, 3, 4, 5, 41, 42, 43) show significantly lower noise levels than other residences located similar distances from the highway. These lower levels are the result of the noise model only assessing noise levels due to traffic noise from the proposed upgrade section of the highway (ie traffic noise from the existing highway that continuing past these residences is not considered). Modelling the same section of the existing highway assuming no upgrade produced results similar to those for the upgrading. This indicates that the proposed upgrading does not impact on the acoustic amenity of these residences.

From *Table 3.7* predicted noise levels in 2009 using tined concrete exceed the relevant criteria in 23 cases of the 44 premises considered. Twenty of these cases were at private residences. Using the night-time as the critical criterion, minor exceedences (within 1.4 dB(A)) occur at eight residences and exceedences of up to 4.6 dB(A) occur at 12 residences. Exceedences of 1.1 and 1.4 dB(A) occur at two commercial/industrial premises, (electrical substation and Ayers Rock Roadhouse respectively) and 10.4 dB(A) at residence 27 (Silvestri), which is to be removed because of direct construction impact.

From *Table 3.7* predicted noise levels in 2009 using OGAC only exceed the relevant criteria in one case of the 44 residences considered. An exceedences of 2.8 dB(A) is predicted for residence 27 (Silvestri).

Noise level criteria for traffic noise at commercial premises have not been specified by the EPA. However, in general these would be expected to be at least 5 dB(A) above those applying for residential premises. Predicted noise levels at the Ayers Rock Roadhouse if tined concrete road seal is utilised would still exceed the expected criteria by 1.4 dB(A).

As indicated by the results given in *Table 3.7*, the use of open graded asphaltic concrete as the road surface along appropriate sections of the highway achieves significant noise reduction such that noise levels at the majority of residences would be within the relevant criteria. The additional cost to provide and maintain open graded asphaltic concrete should be considered.

Another practical method to reduce noise levels at residential receivers due to traffic noise is through the use of a barrier between the road and the receiver. Typically, the best location for a barrier is either close to the road or the receiver, or on top of a cutting, so that the path length for sound to travel over the barrier is at a maximum when compared to the direct line without a barrier.

Alternative mitigation measures include internal abatement or relocation of residences.

The optimum strategy to address the predicted noise criteria exceedences would be considered in terms of practicality issues and a cost-effectiveness assessment, in consultation with the affected residents and land owners.

Residences 25 and 26 represent the nearest residences in Nerong Village. A noise attenuation bund to be located along the eastern side of the highway at Nerong has been incorporated into the proposed carriageway design and hence the noise model. The extent of the bund (chainage 83120 to 84740) ensures continuous shielding of Nerong except for a gap at the intersection of Whimbrell Drive and the Pacific Highway. The bund rises three metres above the carriageway for most of its length. A small section of the bund (chainage 83940 to 84160) is constrained by the location of Telstra's fibre optic cable and only rises approximately 1.8 metres above the carriageway. Predicted noise levels at Nerong indicate a slight increase for residence 25 and a criteria exceedence of up to 4.5 dB(A) at residence 26. Modifications to the bund, addition of a screening fence or use of an alternative road seal would be incorporated into the design of the upgrade to ensure the relevant criteria are achieved for residences in Nerong.

Chapter 4

CONSTRUCTION NOISE IMPACTS

4.1 NOISE CRITERIA

Construction noise criteria are included in the EPA's Environmental Noise Control Manual. These are expressed in terms of the L_{10} level of noise from the construction site. The criteria depend on the existing background noise level at the assessment location.

The EPA's criteria for noise from construction sites are:

- 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, where noise is audible at residential premises, construction would be limited to the following times:

- Monday to Friday, 7 am to 6 pm;
- Saturday, 7 am to 1 pm if inaudible at residential premises, otherwise 8 am to 1 pm; and
- No construction work to take place on Sundays or public holidays.

At present, the duration of construction for the proposed upgrading near individual residences is unknown. Based on the existing noise monitoring results, minimum repeatable background noise levels at the nearest sensitive receptors have been determined for the proposed construction times. *Table 4.1* gives the relevant

background noise level and construction noise criteria for each of the nearest residences along the proposed carriageway.

Table 4.1 CONSTRUCTION NOISE CRITERIA AT NEAREST RESIDENCES

Residence	Dist[1] from h'way (m)	L_{A90}[2]	L_{A10} <= 4 Wks	L_{A10} 4 - 26 Wks	L_{A10} > 26 Wks	Residence	Dist[1] (m)	L_{A90}[2]	L_{A10} <= 4 Wks	L_{A10} 4 - 26 Wks	L_{A10} > 26 Wks
1	1110	40	60	50	45	23	500	32	52	42	37
2	1030	39	59	49	44	24	745	33	53	43	38
3	900	36	56	46	41	25	90	41	61	51	46
4	160	39	59	49	44	26	90	41	61	51	46
5	240	36	56	46	41	27[3]	0			N/A	
6	440	32	52	42	37	28	150	36	56	46	41
7	310	35	55	45	40	29	230	36	56	46	41
8	450	32	52	42	37	30	100	39	59	49	44
9	800	33	53	43	38	31	360	35	55	45	40
10	220	36	56	46	41	32	170	36	56	46	41
11	190	36	56	46	41	33	305	35	55	45	40
12	850	33	53	43	38	34	150	36	56	46	41
13	220	36	56	46	41	35	110	41	61	51	46
14	300	35	55	45	40	36	125	41	61	51	46
15	80	40	60	50	45	37	480	32	52	42	37
16	450	32	52	42	37	38	405	32	52	42	37
17	740	33	53	43	38	39	140	36	56	46	41
18	730	33	53	43	38	40	100	39	59	49	44
19	210	36	56	46	41	41	130	41	61	51	46
20	250	36	56	46	41	42	280	36	56	46	41
21	70	40	60	50	45	43	680	36	56	46	41
22	340	35	55	45	40	44	500	32	52	42	37

Notes *1. Approximate distance from nearest section of Pacific Highway Upgrade.*

2. Lowest repeated value.

3. Property to be acquired by RTA.

Equipment to be used during construction was divided into two stages, the earthworks stage and the pavement construction stage. These stages would typically comprise the following:

Stage 1 - Earthworks:

- Bulldozer;
- Scraper;
- Grader;
- Front-End Loader; and
- Vibratory Roller.

Stage 2 - Pavement Construction:

- Loading Haul Trucks; and
- Asphalt/Concrete Pump and Agitator.

Table 4.2 shows adopted sound power levels (SWL) for this equipment assuming all construction equipment are fitted with residential class mufflers. These mufflers would reduce noise levels by approximately 3 - 4 dB(A).

Table 4.2 ASSUMED SOUND POWER LEVELS OF CONSTRUCTION EQUIPMENT

Equipment	Sound Power Level, dB(A)
Bulldozer	114
Scraper	114
Grader	114
Front-End Loader	111
Vibratory Roller	116
Haul Truck (idling)	107
Agitator and Pumps	110

Using the Environmental Noise Model (ENM), noise levels from construction over a range of distances were calculated. ENM effectively calculates noise levels at specified receiver locations, taking into account the following:

- Local topography;
- Ground surface effects;
- Barrier attenuation; and
- Meteorological effects if required (ie: wind, temperature, temperature inversions, and humidity).

Results from the ENM model are accepted by all Australian environmental authorities. As recommended by the EPA, calculations were for still, isothermal meteorological conditions - that is, no wind or temperature gradient. *Table 4.3* shows the noise levels from construction activities at various distances from the construction equipment.

Table 4.3 CALCULATED MAXIMUM NOISE LEVELS DUE TO CONSTRUCTION ACTIVITIES

Distance[1] m	Stage 1 dB(A)	Stage 2 dB(A)	Distance[1] m	Stage 1 [2] dB(A)	Stage 2 [3] dB(A)
50	77	66	450	48	38
60	75	64	500	46	36
80	72	62	600	43	33
100	70	60	650	42	31
150	65	55	700	41	30
180	63	53	750	40	29
200	61	52	800	39	28
300	55	45	950	36	25
350	52	42	1100	34	23
400	50	40	1200	33	21

Notes *1. Distance from Source to Receiver*

2. Earthworks

3. Pavement Construction

From *Table 4.3* above, calculated levels of construction noise are in excess of the recommended criteria at most residences, depending on the construction stage and the period of construction. Pavement construction works impact on fewer residences than the earthworks. Generally, noise levels at residences greater than 750 metres from earthworks and greater than 450 metres from pavement construction are within the recommended criteria.

There appear to be few additional options available for control of noise from this form of construction. The use of moveable barriers is recommended where possible, however the nature of the local topography may limit their effectiveness. It is recommended that residents be informed in advance that construction is to take place and is likely to generate relatively high noise levels, and that the construction be completed in as short a time frame as possible, with residents being kept informed of progress at regular intervals.

Chapter 5

BATCHING PLANT IMPACTS

Six potential batching plant sites have been identified along the proposed carriageway. The nearest residence to each of the batching plant sites is shown in *Figure 5.*

As the batching plant is part of the construction process, the noise criteria derived in Section 4.1 apply for noise emissions from the batching plant sites. At present, the duration of batching plant operations near individual residences is unknown, though it is anticipated that the upgrade works will be completed over three road sections (south, central & north) with a batching plant site required for each section.

The major noise sources associated with batching operations are:

- unloading raw materials from trucks;
- two front-end loaders;
- conveyer - drive end;
- batching materials; and
- loading product to trucks.

The noise sources associated with batching operations and their assumed maximum SWLs are given in *Table 5.1.* The SWLs adopted were based on measurements taken from an existing concrete batching plant for an environmental assessment undertaken in 1996 (ERM Mitchell McCotter, 1996). On-site measurements of other noise sources were shown not to contribute to noise levels at distant receptors.

Table 5.1 MAXIMUM SOUND POWER LEVELS OF BATCHING PLANT

Equipment	SWL dB(A)
Unloading	106
Front-end Loader	112
Conveyor - Drive End	105
Batching	110
Loading	110

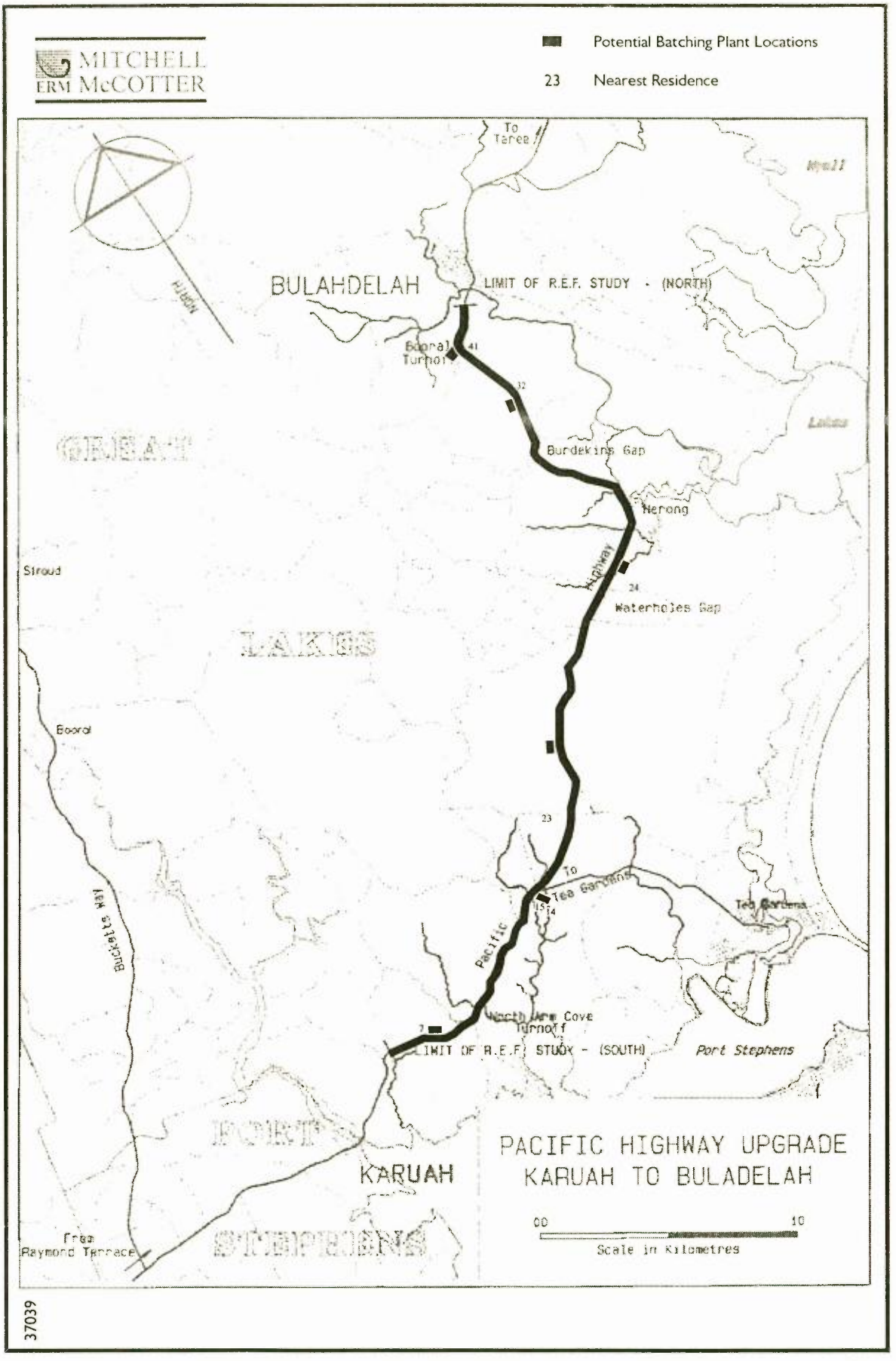

Figure 5 NEAREST RESIDENCES TO POTENTIAL BATCHING PLANT LOCATIONS

Received noise levels at the nearest residences to these sources were predicted using ENM. Received noise levels have been calculated for still, isothermal atmospheric conditions. The calculated noise level at the nearest residences are given in *Table 5.2*.

Table 5.2 CALCULATED MAXIMUM NOISE LEVELS DUE TO BATCHING PLANT

Residence	Distance From Plant m	Noise Level dB(A)
7 - Fitzpatrick	900	33
14 - Grey	250	59
15 - Ayers Rock Roadhouse	150	63
22 - Reynolds	3,000	15
24 - Benkil P/L	1,400	26
32 - Montgomery	500	44
41 - Ireland	250	59

The noise levels given in *Table 5.2*, have been calculated for operation of nearly all plant at once. This situation is likely to occur only during peak operation periods.

Note that although construction noise criteria for commercial premises (eg. Ayers Rock Roadhouse) are not specified in the EPA's Environmental Noise Control Manual, these could generally be assumed to be at least 5 dB(A) higher than those for residential premises.

The calculated levels of batching plant operation noise are in excess of the recommended criteria at residences located closer than 500 metres from the plant, depending on the period of construction. Once batching plant locations have been finalised, noise mitigation measures would be required for any residences situated within 500 metres from the plant. The amount of attenuation required would depend on the relevant noise criteria that is determined based on the proposed period of operation of the plant. The most practical method to reduce noise levels at residential receivers due to the batching plant is through the use of barriers.

Chapter 6

VIBRATION

6.1 VIBRATION CRITERIA

Vibration may be generated due to blasting and vibratory rolling for earthworks and piling for bridge works.

6.1.1 EPA Criteria

i. General Construction Activities

Chapter 174 of the EPA Noise Control Manual (EPA, 1994) provides vibration limits in buildings resulting from construction activities. Base limits relate to Z axis acceleration (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 building use.

The Z axis base acceleration levels are as shown in *Table 6.1*.

Table 6.1 BASE ACCELERATION LEVELS

Frequency (Hz)	Acceleration Level (rms) (m/s2)
1	1.00×10^{-2}
1.25	8.90×10^{-3}
1.60	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}
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 6.2*.

Table 6.2 VIBRATION MULTIPLYING FACTORS

Place	Time [2]	Continuous Vibration	Intermittent or Impulsive
Critical Areas [1]	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..

Vibration levels appropriate for buildings in proximity to construction need to be determined on an individual basis using the information provided in *Table 6.1* and *Table 6.2*.

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

- 7 am to 6 pm Monday to Friday
- 7 am to 1 pm Saturdays; and
- none on Sundays and public holidays.

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

ii. Blasting

EPA blasting criteria are specified in Chapter 154 of the Environmental Noise Control Manual (ENCM) (EPA, 1994). EPA criteria for blasting overpressure and ground vibration are given in *Table 6.3*.

Table 6.3 LIMITING CRITERIA FOR THE CONTROL OF BLASTING IMPACT AT RESIDENCES

Time of Blasting	Blast Overpressure dB(linear)	Ground Vibration Peak Particle Velocity (mm/s)
9.00 am - 3.00 pm Monday to Saturday	115	5
6.00 am -9.00 am Monday to Saturday	105	2
3.00 pm - 8.00 pm Monday to Saturday	105	2
6.00 am - 8.00 pm Sunday and Public Holidays	95	1
8.00 pm - 6.00 am Any day	95	1

6.1.2 RTA Criteria

The RTA recommend a vibration limit at property boundaries due to road construction activities of 2 mm/s. This level is very conservative compared with EPA criteria.

6.2 VIBRATION ASSESSMENT

Vibration from most construction activities is likely to occur only over short durations and, with the exception of vibratory rolling, over limited areas. It is unlikely that blasting during excavation would be required.

The vibration levels from general construction activities are unlikely to exceed the relevant criteria, however vibration may be perceptible at closer residences over short durations. In the event that construction vibration becomes an issue, it is considered that adequate control measures are available to ensure that the criterion limits provided in this report would be met.

Chapter 7

NOISE MITIGATION MEASURES

The following mitigation measures are recommended to control noise from the construction and operational phases of the Pacific Highway upgrading between Karuah and Bulahdelah and to reduce noise impacts on the local community:

- A community consultation program would be developed with the affected residents which would include identification of suitable noise control measures and provide advice on vibration impacts;
- Consideration of potential noise impacts and mitigation measures required would be taken into account when determining the final wear surface;
- To meet compliance with adopted traffic noise criteria, noise mitigation measures would be adopted for 20 residences as discussed in Section 3.4;
- Careful site selection of compound areas and rock breaking areas would occur to reduce the potential for noise impacts on residences;
- To meet compliance with adopted construction noise criteria, noise mitigation measures would be adopted for residences located within 500 metres of the concrete/asphalt batching plant;
- During construction, all equipment used would be fitted with residential class mufflers; and
- Residents would be informed in advance that construction is to take place, that relatively high noise levels and perceptible vibration could be expected during this time, and that its duration would be limited as far as possible.

Appendix J
Archaeological Assessment

ARCHAEOLOGICAL ASSESSMENT

Pacific Highway Upgrade
Between Karuah and
Bulahdelah

For:
NSW ROADS AND TRAFFIC AUTHORITY

July, 98
37039arc

Report No. 37039ARC

This report was prepared in accordance with the scope of services set out in the contract between ERM Mitchell McCotter Pty Ltd ACN 002 773 248 (ERMMM) and the Client. To the best of our knowledge, the proposal presented herein accurately reflects the Client's intentions when the report was printed. However, the application of conditions of approval or impacts of unanticipated future events could modify the outcomes described in this document. In preparing the report, ERMMM used data, surveys, analyses, designs, plans and other information provided by the individuals and organisations referenced herein. While checks were undertaken to ensure that such materials were the correct and current versions of the materials provided, except as otherwise stated, ERMMM did not independently verify the accuracy or completeness of these information sources.

Approved by:	*Tony McNamara*
Position:	Project Director
Signed:	Tony McNamara
Date:	14.7.98

ERM Mitchell McCotter Quality System

TABLE OF CONTENTS

Page No.

TABLE OF CONTENTS

LIST OF FIGURES

Chapter 1

INTRODUCTION

As part of the state wide program to improve the Pacific Highway the Road Traffic Authority (RTA) is proposing to upgrade the Pacific Highway between the towns of Karuah and Bulahdelah, NSW to a dual carriageway standard. ERM Mitchell McCotter was commissioned by the RTA to prepare a Review of Environmental Factors (REF) to assess the impact of the proposed upgrading. This archaeological investigation is part of the REF. In the following section the background to the archaeological investigation is described.

1.1 BACKGROUND

As a component of the REF study, the cultural heritage of both the regional and local areas of the Pacific Highway between Karuah and Bulahdelah was considered. Both the Indigenous cultural heritage and the Non Indigenous heritage components were assessed through deskbased and field study. The archaeological investigation was carried out by ERM Mitchell McCotter.

1.1.1 Purpose of the Investigation

The work was designed to assess the likely impacts of the proposed highway upgrading on cultural items and places. The main issues of legislative compliance by the RTA and road construction contractors and the integration of the indigenous community within the design process was addressed.

The results of this investigation would be incorporated in the final design of the highway upgrading.

The documentary research and reporting was undertaken by Adam Ford of ERM Mitchell McCotter and the fieldwork was carried out by Adam Ford and two representatives of the Karuah Local Aboriginal Land Council (Karuah LALC), Colleen Perry and Bev Manton.

1.1.2 *The Study Area*

The study covered a 38 kilometre corridor of the Pacific Highway and the associated easement between the towns of Karuah and Bulahdelah. Of particular interest were the areas where the upgrading was to deviate outside the existing road easement. The proposed highway upgrading and areas that were subject to survey are shown in *Figures 1a - 1f.*

1.1.3 *Study Personnel*

The desk top study and the field investigation were carried out by Adam Ford. Adam is a professional archaeologist with eight years qualified experience. The fieldwork was carried out on 3rd and 4th September 1997. Adam was accompanied by two representatives of the Karuah LALC.

1.1.4 *Legislative Requirements*

Indigenous cultural heritage and non indigenous cultural heritage in Australia is protected and managed under National and State legislation. A summary of relevant legislation is provided below.

i. National Legislation

- **Australian Heritage Commission Act 1975** (AHC Act 1975) establishes the Australian Heritage Commission as a Commonwealth statutory body. The Commission maintains the Register of the National Estate, an inventory of the places in Australia with 'aesthetic, historic, scientific, or social significance or other special value' for present and future generations. This includes important elements of the natural and cultural environment, including places of significance to Aboriginal, European and Asian cultures in Australia (Pearson & Sullivan 1995: 45).

- **Aboriginal and Torres Strait Islanders Heritage Protection Act 1984** (ATSIHP Act 1984) is administered by the Aboriginal and Torres Strait Islander Commission. The Act is a Federal Act, in an area where, due to the 1966 referendum, the Commonwealth has jurisdiction. This means that in certain circumstances it overrides relevant state or territory provisions, or can be implemented in circumstances where the state or territory provisions are lacking or are not enforced. The Act was passed to provide protection for the Aboriginal heritage, in circumstances when it was demonstrated that such

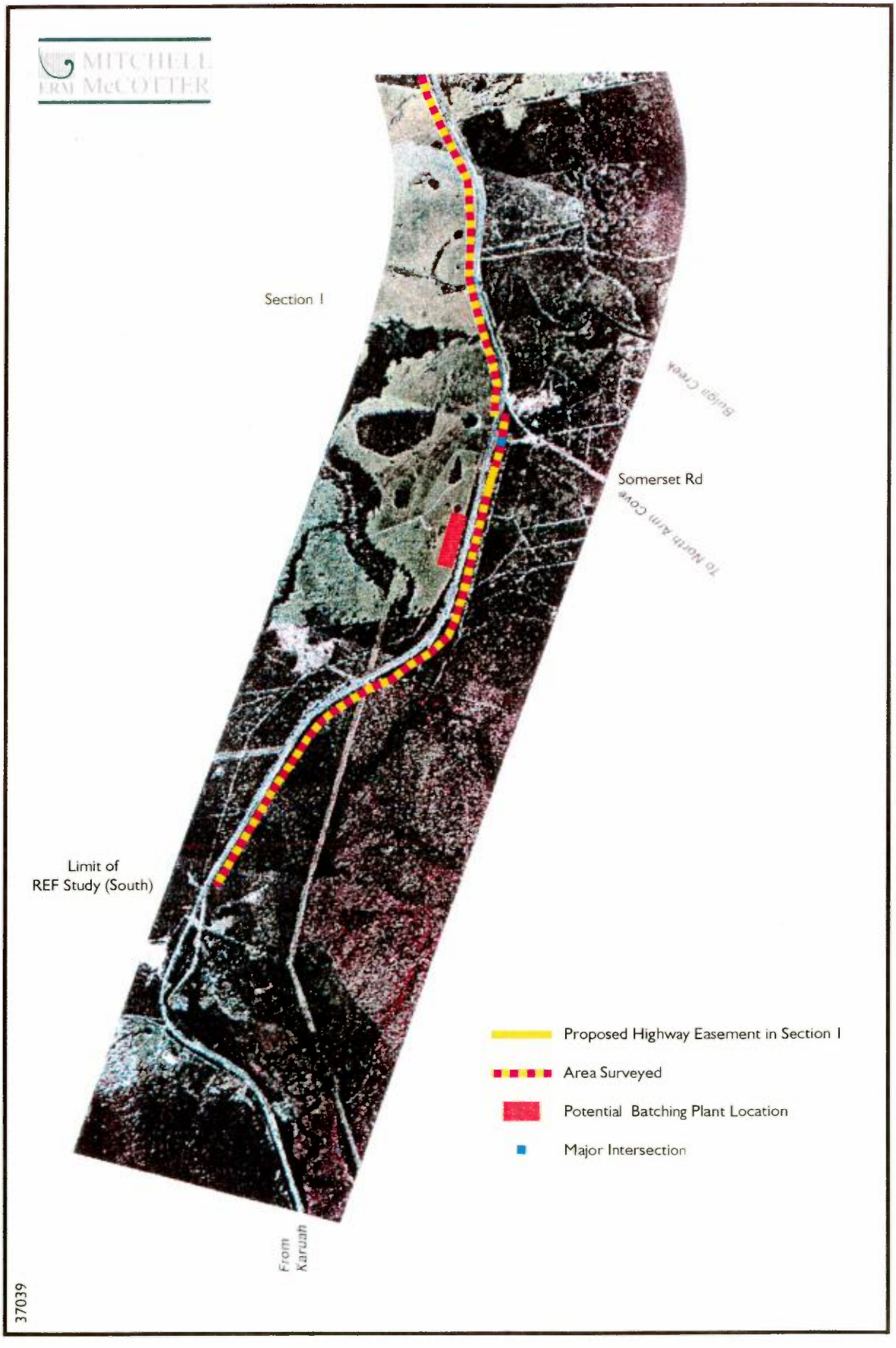

Figure 1a PROJECT COMPONENTS AND ARCHAEOLOGICAL SURVEY

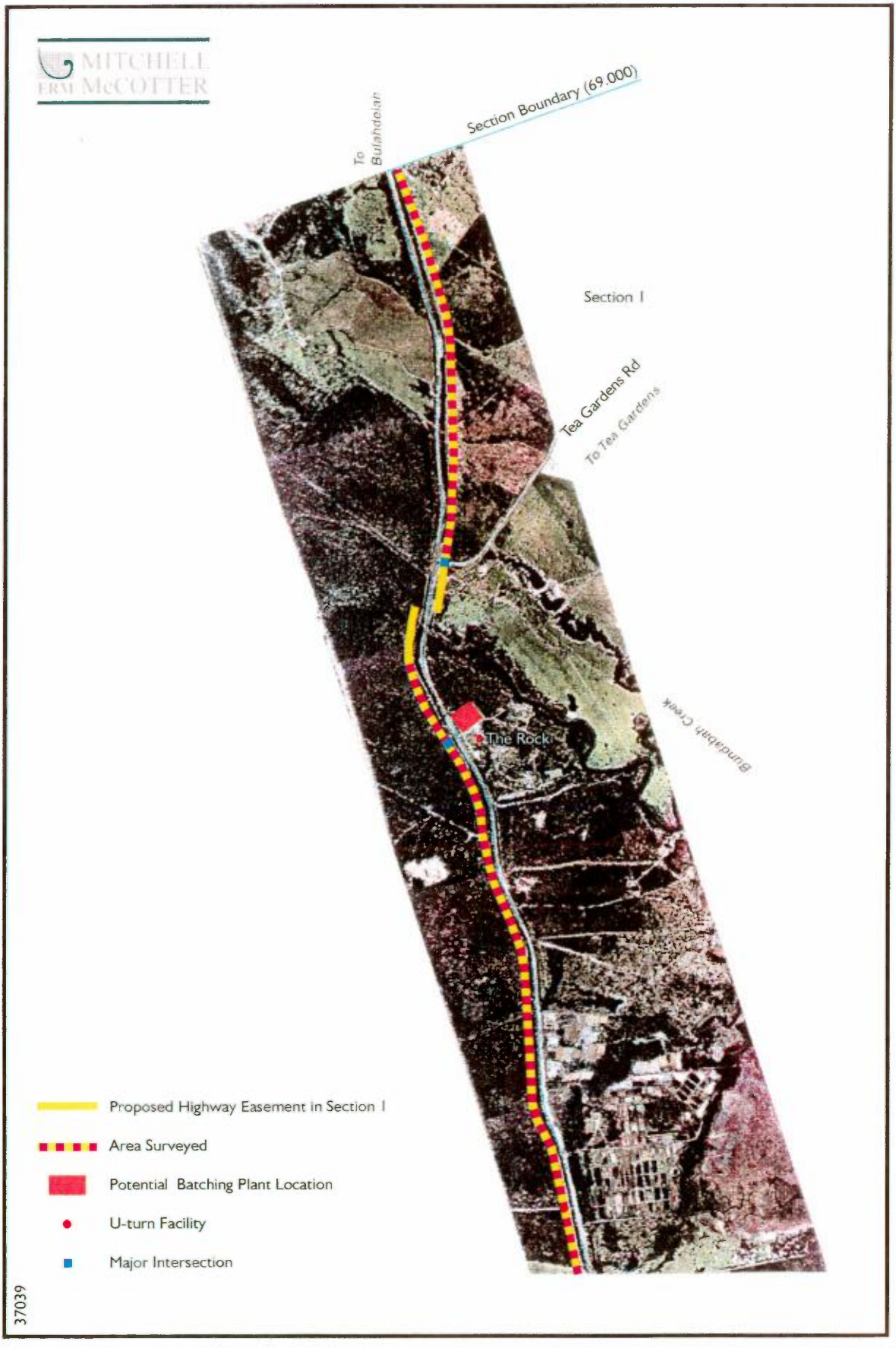

Figure 1b PROJECT COMPONENTS AND ARCHAEOLOGICAL SURVEY

Figure 1c PROJECT COMPONENTS AND ARCHAEOLOGICAL SURVEY

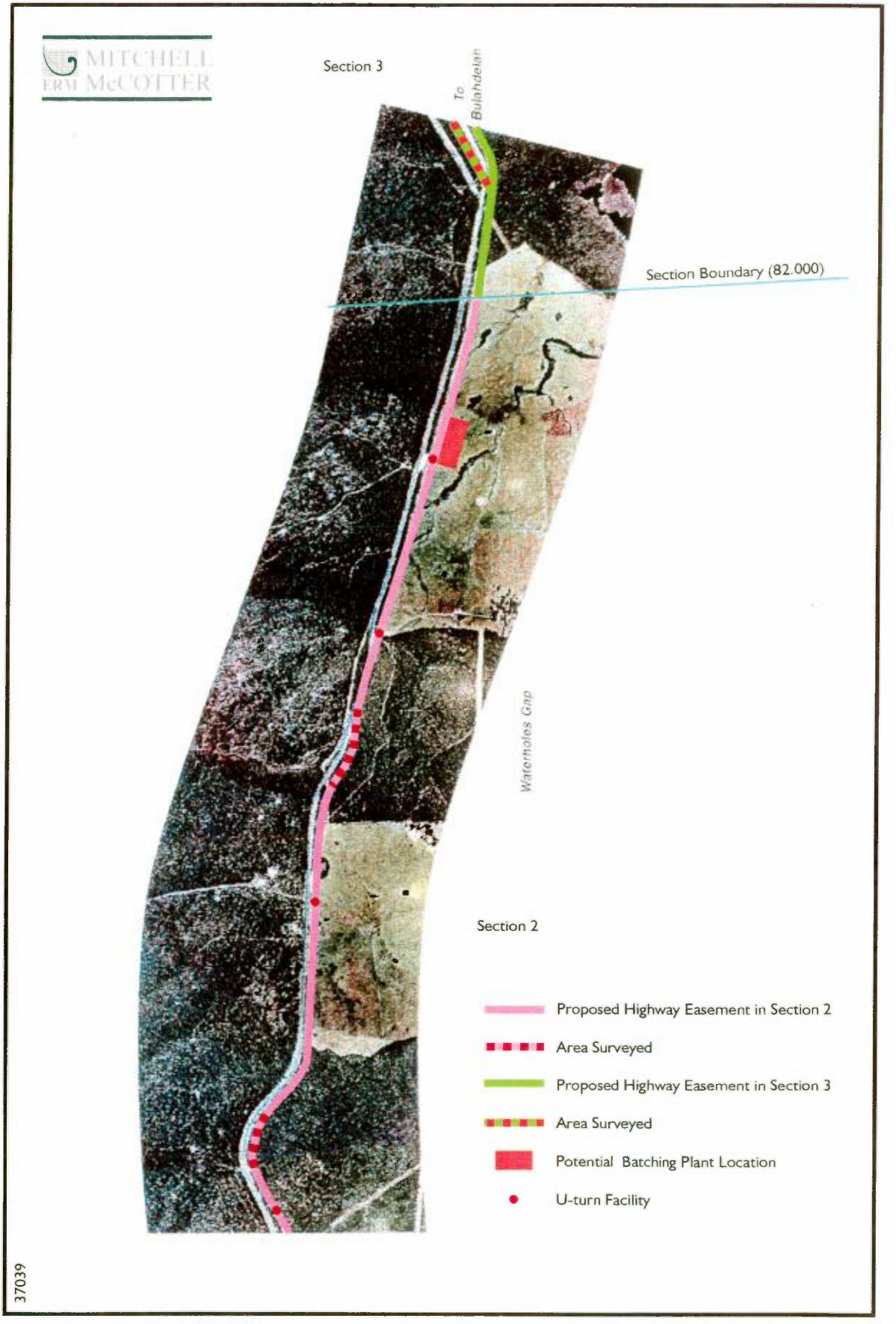

Figure 1d PROJECT COMPONENTS AND ARCHAEOLOGICAL SURVEY

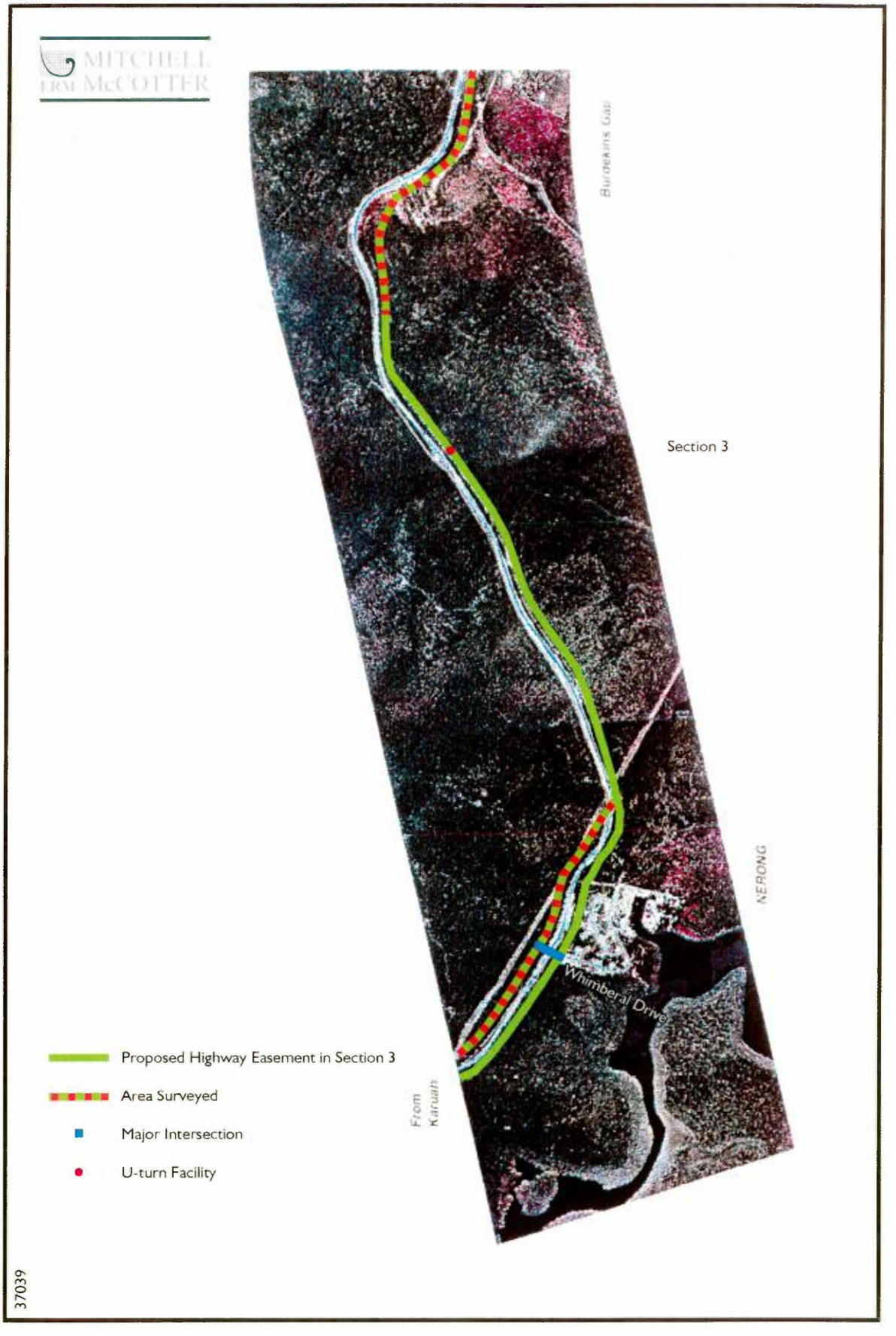

Figure 1e PROJECT COMPONENTS AND ARCHAEOLOGICAL SURVEY

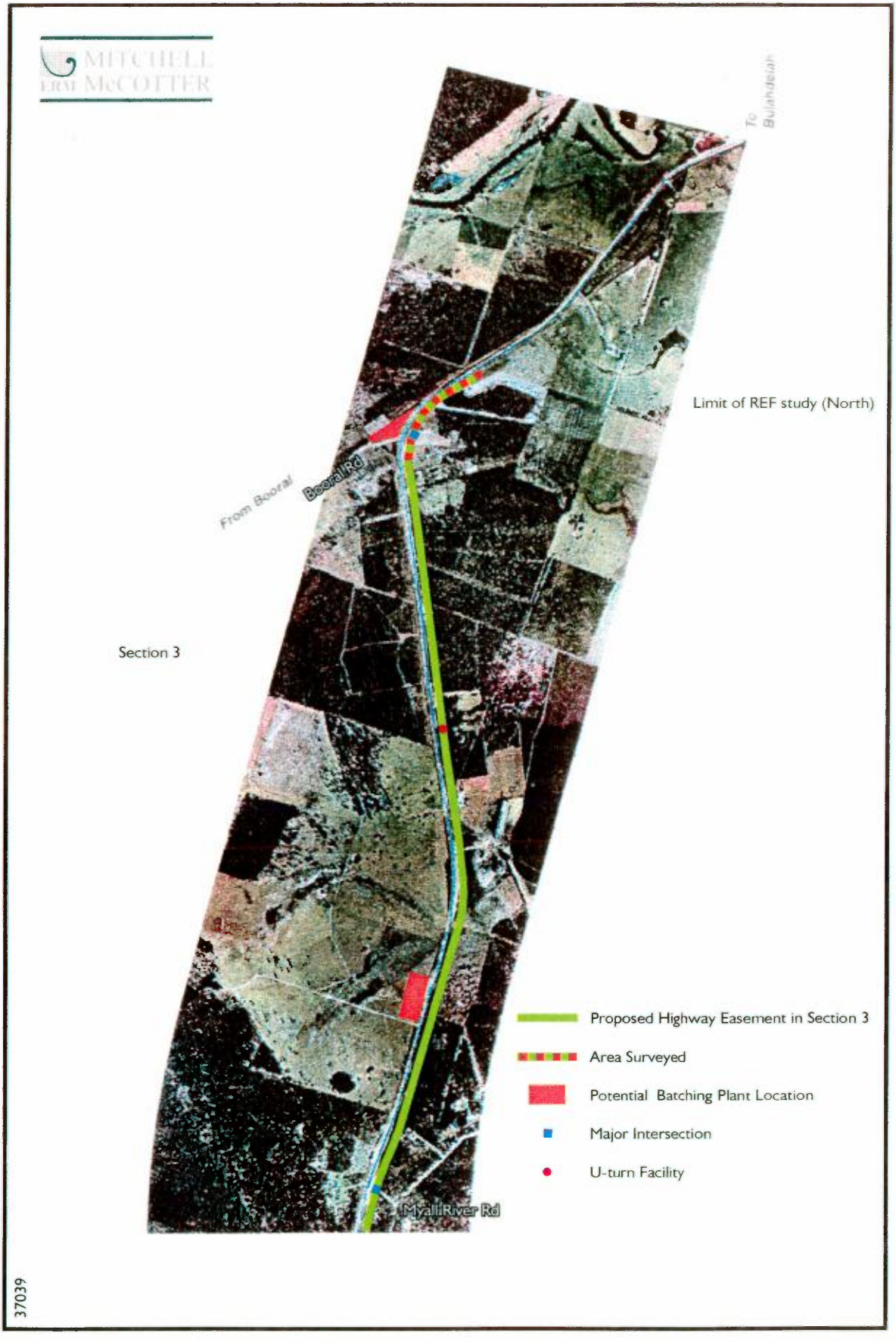

Figure 1f PROJECT COMPONENTS AND ARCHAEOLOGICAL SURVEY

protection was not available at state level. The Act must be invoked by or on behalf of an Aboriginal or Torres Strait Islander organisation.

ii. New South Wales Legislation

- **National Parks and Wildlife Act 1974** (NPW Act 1974) provides statutory protection for all Aboriginal relics under section 90 of the Act and for Aboriginal places under section 84. The protection provided to Aboriginal relics applies to all sites, irrespective of the level of significance or land tenure. Areas are only gazetted as Aboriginal places if the Minister is satisfied that sufficient evidence exists to demonstrate that the area was or is of special significance to the Aboriginal Community. Although all relics and Aboriginal places are protected, under current wording of section 90 it is only an offence to damage or destroy relics or Aboriginal places where it is done knowingly. While this may be subject to legislative revision, it needs to be noted that the NPW Act does not set up any formal mechanisms for ensuring that areas with the potential to contain Aboriginal sites or places of special significance are assessed prior to impacts on those areas. It is the EP&A Act which fulfils this role (NPWS c 1997: 1).

- **Environmental Planning and Assessment Act 1979** (EP&A Act) and its regulations, schedules and associated guidelines require that environmental impacts are considered in land use planning and decision making. 'Environmental impacts' are interpreted in NSW in the broadest sense as including impacts on cultural heritage, and specifically Aboriginal Heritage. The EP&A Act has three main parts of relevance to Aboriginal Heritage: Part 3, which governs the preparation of planning instruments; Part 4, which relates to development assessment process for local government (consent) authorities; and Part 5, which relates to activity approvals by government (determining) authorities (NPWS 1997: 1).

- **Heritage Act 1977**(with amendments in 1987) is the primary legislation protecting the historical heritage in NSW. The Act aims to conserve the 'environmental heritage' of the state, which is defined as the 'buildings, works, relics, or places of historic, scientific, cultural, social, archaeological, architectural, natural, or aesthetic significance for the state'. The Heritage Council of NSW is established to protect these items (Pearson & Sullivan 1995: 57).

1.2 ABORIGINAL COMMUNITY CONSULTATION

1.2.1 Principles

Certain heritage management principles, endorsed by NPWS's Aboriginal heritage staff and NPWS executive, are outlined in the *'Guidelines for Archaeological Survey Reporting'* (NPWS, 1997). These principles have been adopted by ERM Mitchell McCotter as a suitable and balanced set of principles for the purpose of this study. These principles are:

- it is recognised that Aboriginal culture is living and unique and recognises the right of Aboriginal People to protect, preserve and promote their culture;
- it is recognised that Aboriginal people are the rightful cultural owners of Aboriginal cultural heritage information and Aboriginal sites and objects. In the area of Aboriginal cultural heritage, the NPWS is committed to a joint and equitable management partnership with its own Aboriginal heritage staff and with Aboriginal communities;
- there is a commitment to an active partnership with Aboriginal communities in advocating constructive changes to legal and institutional arrangements governing the control of Aboriginal heritage; and,
- there is a commitment to transparency in the Aboriginal heritage decision-making processes in NPWS and the research and reporting processes with heritage consultancies.

1.2.2 Community Involvement

It has been a standard practice at ERM Mitchell McCotter to involve representatives of the Aboriginal community in all archaeological heritage assessments. In the majority of instances these representatives are members of the Local Aboriginal Land Council (LALC) for that particular area. In some areas other recognised groups, who represent significant portions of the local community, are also invited to participate in the archaeological investigation.

In this study, two representatives from the Karuah LALC attended the field survey and gave input and advice concerning the design and management of the proposed highway upgrading. The Karuah LALC has worked closely with the RTA, Council and developers throughout this part of the region and is very knowledgeable of the archaeological components and potential of the landscape and as such was invaluable member of the study team.

The recommendations of this report were discussed and agreed upon with the Karuah LALC on the last day of the fieldwork. It was also agreed that this was sufficient consultation as the recommendations would not be altered by post field analysis, as no analysis was conducted.

1.3 DESCRIPTION OF IMPACT

1.3.1 Previous Landuses

The study area comprised forested land and cleared land. The cleared land is currently used for cattle grazing on grass pastures and would have consisted of natural woodland and forest vegetation which has been cleared since European settlement in the area. There are also some areas of salty marsh, plantation pine woodland and regenerated scrub.

1.3.2 Potential Impacts of Proposed Development

i. Construction Phase

The proposed highway upgrading has been designed and surveyed. The new carriageway will follow the existing alignment and be constructed primarily within the existing road easement, wherever possible. It must be assumed that any cultural material within the construction corridor, not already disturbed by the existing road, will be destroyed or significantly disturbed by the proposed works.

ii. Post Construction Affects

Any archaeological material which survives *in situ* after the construction of the road will continue to be under threat from biotic factors, artificial revegetation, and possible increased erosion from pavement run off.

1.4 OBJECTIVES OF STUDY

The objectives of this archaeological study are to:

- identify known archaeological sites in proximity to the study area;
- locate areas previously surveyed and identify any data gaps;

- produce a predictive model for site locations, densities, types and chronologies using the results of the deskbased assessment;
- carry out a suitable field survey to locate and record previously unidentified items of indigenous cultural heritage which may be impacted by the development;
- record any new archaeological finds, and apply significance values to the known archaeological resource and likely significance values to the unknown potential archaeological resource;
- submit realistic recommendations and safeguards which will ensure compliance with statutory and non statutory obligations and the protection of significant components of the archaeological resource; and
- prepare a report to meet the National Parks and Wildlife guidelines for archaeological survey reporting.

1.5 STUDY METHOD

The archaeological investigation was carried out in three stages. Each stage and associated tasks are outlined below.

1.5.1 Desk based survey

i. Research and Investigation

The records held at the National Parks and Wildlife Service headquarters were sourced for information. All archaeological reports and Aboriginal sites cards are held in the Aboriginal sites register. In addition other relevant literature was searched and referenced. These sources included past archaeological reports, maps, geomorphic studies and EIS material.

ii. Consultation

Consultation with the Karuah LALC was undertaken prior to, and during, the field survey. The Land Council was also asked to contribute their views on this report prior to final submission. As yet no formal response has been received.

1.5.2 *Field Investigation*

i. Predictive Modelling

From the initial deskbased research the typical archaeological profile can be established. The most common site types, most frequent locations, general chronologies and the most pertinent research issues were identified from the information pulled from the above sources.

With this information, an initial predictive model can be compiled which outlines the above and aids the design of the most effective fieldwork strategy. For example, a detailed walking survey of an area, known to have been severely eroded by flooding would be an inefficient use of resources. Alternatively a vehicle survey of an area which is known to have many intact sites is inappropriate.

ii. Field Survey

A suitable field survey was designed and undertaken. The survey methodology was sufficiently flexible to allow for adjustments once in the field. The observations were recorded in detail.

1.5.3 *Analysis, Interpretation and Reporting*

i. Analysis

A thorough analysis of all recorded information from both the desk and field studies was carried out. This included analysis of Aboriginal archaeological sites with reference to the regional archaeological context.

ii. Interpretation

The information gathered was interpreted to produce a significance statement, recommendations and management safeguards. This report, detailing all of the above, was produced to comply with NPWS Guidelines for Archaeological Survey Reporting.

Chapter 2

BACKGROUND RESEARCH

Background research involving the review of available reports and literature relating to the subject area was carried out. The information obtained aids the construction of a contextual picture of the archaeological 'history' of the area. Information of the known archaeology can help to produce predictive models which in turn help the design of the fieldwork component of the study. This next section outlines the findings of the deskbased survey.

2.1 ARCHAEOLOGICAL CONTEXT

2.1.1 Methodology

The approach designed for this project conforms to the recommended study practices outlined by NSW NPWS.

i. Indigenous and Non Indigenous Heritage

a. Sites Registers

The following registers and databases were accessed and searched for data relevant to the study.

- National Parks and Wildlife Service - Aboriginal Sites Register;
- National Parks and Wildlife Service - Historic Sites Register;
- Heritage Council Register;
- Australian Heritage Commission - Register of the National Estate; and,
- National Trust Database.

Results of these searches are in *Appendix A* of this report.

b. Literature Review

A review of relevant literature and data from previous archaeological investigations in the general area was undertaken to assist in predictions of most likely and potential locations of sites and types of sites in the study area. Relevant studies and background material, including previous archaeological survey reports, were reviewed to provide a background to the archaeological context and potential of the study area. A review of archaeological literature assisted in describing expected site types and likely conditions for site location.

A review of information at a regional and local scale highlighted regional issues such as Aboriginal heritage conservation, range of types of archaeological remains, rare examples, cumulative impacts, site distribution and models of land use. A review of work previously undertaken in the vicinity of the study area assists in placing the findings of this study in a local context.

2.1.2 *Regional Archaeological Issues*

Few archaeological investigations have been carried out in this region. Only three reports specifically relate to the study region. In 1984 McKintyre surveyed a proposed quarry site to the north of Karuah. One archaeological site was located during the investigation near a creek confluence with the Karuah River. Two years later Smith surveyed another quarry site further down the Karuah River but did not find any artefacts.

Byrne in 1991 undertook a sample survey of a proposed fibre optic cable route between Karuah and Bulahdelah. The survey focused on crossings of wetlands and their margins and the Myall River. No archaeological sites were found during the survey or subsequent monitoring of the cable installation.

Paton explains the contrast between the artefactually rich coastal margins of this area and the unusually sparse distribution of materials in the hinterland. Paton suggests that this contrast is the model of occupation for the area. This model based on studies by Byrne (1982) and McFarlane (1987) in the NSW south coast, is of the coastline being a focus of activity, while the inland site densities drop off dramatically a few kilometres inland and do not increase again until 20-30 kilometres distance. People living on the coast will concentrate on the marine resources and only take day trips into the hinterland. Site densities therefore diminish and only increase again once the distances involve more than a day return.

2.1.3 *Ethnohistorical*

At the regional level few detailed surveys have been carried out, but recently a number of studies have identified evidence of large and established Aboriginal communities within the Great Lakes region. Along the coast and shores of the large salt water lakes numerous shell middens point to the major economy of the region and suggest the density of the population. Along the lowland plain there are many low density stone scatters or open camp sites which represent short duration camping stops along established trading or nomadic routes. In the highland regions similar sites can be found on the saddles, passes and ridges. Density of sites is generally higher along water courses although selective surveying has somewhat skewed the apparent distribution. According to early accounts made by the first white European settlers the Aboriginal communities were well established and numerous in this fertile area. Conflict, disease and forced relocation soon after settlement dramatically reduced the indigenous population.

In the 1820s the Australian Agricultural Company (ACC) was formed in London to raise funds to exploit the grazing possibilities of NSW. Good grazing was found in this area soon after and a large area was purchased by the AAC for the grazing of sheep. It was in this area that the fine merino stock were first introduced, considerably improving the existing stocks in the state. Since then pastoral farming has continued as the main activity and the distribution of the population reflects classic rural development.

The immediate area around the section of Pacific Highway is not exceptional to the above descriptions. Expected sites were Aboriginal open camps and European structures associated with road construction (bridge abutments, mile markers) or road side monuments such as War Memorials. Before the field survey it was judged from the results of the register searches that the potential for finding any archaeological material was moderate. Of finding significant archaeological material the potential was low.

2.2 LANDSCAPE CONTEXT

2.2.1 *Regional Landscape Context*

The study area is located to the west and north of the sandy fill of the Newcastle Bight embayment which comprises of Pleistocene and Holocene sandy deposits of marine and fluvial/estuarine origin. This is a complex coastal landform relating to eustatic sea level rises which stabilised around 6,500 years ago. The highway traverses some of the swampy areas which fringe the sandy embayment.

Bedrock traversed by the road is comprised of Carboniferous Formations, including the Nerong Volcanics or the Crawford Formation.

2.2.2 *Vegetation*

The land is comprised of a mosaic of cleared agricultural land, State Forest and forested private land. The road reserve in part supports forest and woodland communities that have generally been disturbed by clearing, logging, general access, transmission line easements and the existing highway structures.

Chapter 3

PREDICTIVE MODELLING

3.1 EXPECTED FEATURES

From the above information the following broad predictive models may be assumed. These models allow flexibility in the implementation stage of the survey.

3.1.1 Site Types in Order of Expected Frequency

The following sites are expected in the study region and are arranged in descending frequency. As outlined in the archaeological context, artefacts, if located at all, will be sparsely distributed.

- **Open Campsites** - These sites take the form of scatters of stone artefacts lying on the surface of the ground. The remains of fire hearths are occasionally associated with the artefacts.

- **Scarred Trees** - Trees bearing the scars of deliberate bark removal are, over time, becoming a dwindling resource as the trees that show these features are dying off. Most scarrings occurred a century or more ago.

- **Carved Trees** - Trees which bear ritual carvings are, as with scarred trees, becoming increasingly rare.

- **Burials** - Burial sites can occur anywhere but generally in significant landform locations and are generally inhumations. Excarnation was also a common death ritual but current evidence of this is extremely rare.

- **Quarry Sites** - Quarry sites are where stone was obtained for stone tool manufacture from natural outcrops and where ochre was gathered for art and ceremony purposes.

- **Contemporary Indigenous Sites** - These sites represent the group of site types which relate to the social interaction between the indigenous populations of Australia and the white settlers over the last two hundred years. These sites include missions, reserves, prisons, massacre sites, battle fields and resettlement sites. These are obviously extremely important sites to contemporary Koori communities.

Within the study area the open camp site and scarred trees are considered to be the most likely site types. The other site types are less likely considering the geographical location. Open camp sites are by far the most commonly occurring archaeological feature in the region. Scarred trees are also reasonably frequent in the region but, due to their organic nature, are susceptible to destruction from fire, disease, lightning strikes and land clearance. In this location grinding grooves would be less likely than quarries or burials. Post contact sites do exist in the region but are mainly identified through historic literature searches and oral histories rather than through field survey.

3.1.2 Chronology

The expected chronological framework for this area is broad due to the lack of sites which have yielded dates. Lithic assemblages are characterised by small flakes and tools comparable to the Eastern Small Tool technologies which date within the last 5,000 years. However, a number of sites in the region have markedly older timeframes up to and possibly exceeding 20,000 years. The possibility of locating Palaeolithic sites should always be borne in mind.

Chapter 4

FIELD INVESTIGATION

4.1 FIELD METHODS

A strategy for the field investigation was designed based on the following aims of the project:

- effectively survey the construction corridor;
- to relocate previously recorded sites (if any) and amend data and note changes i.e. erosion;
- identify areas of impact;
- to locate and record new archaeological sites; and
- to meet the requirements of National Parks and Wildlife Service.

4.2 ARCHAEOLOGICAL SITES

4.2.1 *Definition of a Site*

A site is defined as *" a term used to group relics or define a location where a relic or cultural item occurs"* (NPWS, 1997). The criteria commonly used for defining the boundary of a 'site' are as follows:

- exposure where archaeological evidence is revealed;
- topographic or land form unit where occupation evidence has been recorded. This may be an entire land form unit (ridge, creek valley) or a part of a landform unit (saddle no ridge, creek bank);
- sites can be defined through obvious physical boundaries. For example: mound and midden sites (if visibility is good) or a ceremonial ground;
- sites identified by the Aboriginal community on the basis of cultural significance alone, such as landscape features;

- arbitrary, or the assignation of a boundary for the convenience of recording (in cases where the site would probably be much larger if based on the criteria above). Arbitrary criteria include the use of a fence line, dirt track or gully as a boundary. In some cases the area may simply be designated as 50 x 50m, or as a smaller plot, on the basis of convenience; and,

- artefact density: in some cases a site boundary may be defined by the average number of flakes per square metre. This is a specialised type of arbitrary criterion and justification of the rules used must be made explicit.

For this project, a site was defined as two or more artefacts found within close proximity to each other, i.e. within two metres. No definite distance was set to differentiate between sites. Isolated artefacts were judged such if no other artefacts were visible within an eight metres radius.

4.2.2 *Field Survey*

The field survey was designed to sample the adjacent land on either side of the road along the 36.75 km road section The sampling sections coincided with the positions given by the RTA were it is planned to develop the road beyond the existing road easement. Eighteen points were identified (sections A to R). The digressions from the present road alignment varies from 10m up to 200m and the length of these sections vary from 250m to 2,500m. The total amount to be surveyed by field walking was estimated to be 16.7 km, around 45% of the total length of the proposed upgrading. The ground was walked with representatives of the Karuah LALC. All exposed ground surfaces were scrutinised for evidence of cultural heritage items. A copy of the letter from the Karuah LALC confirming the survey is attached at *Appendix B*.

Close to 100% of the land surveyed has been disturbed to varying levels in the past. Approximately 45% of the land surveyed was covered by immature and semi mature trees and grassy understorey vegetation. On average 35% of the sample area was exposed to afford a clear view of the ground.

4.2.3 *Survey Effectiveness*

Prior ground disturbance due to road works and associated construction limited the effectiveness of the survey. Very little of the route could be confidently assessed as undisturbed. The observed disturbance has so removed and/or reshaped the surface that archaeological material, if once present, would have been removed or destroyed.

Ground visibility was generally good with approximately 35% visibility over the whole study area, with some sections where 60% of the ground could be seen.

4.3 RESULTS AND RECOMMENDATIONS

In general terms the assessment for the REF is based on surface evidence and written records. Any subsurface investigation needed is seen as part of any future second stage of investigation.

4.3.1 Results

No artefactual evidence was uncovered from the field investigation and nowhere within the sample area did any significant area appear undisturbed. Most of the soil observed was mixed with modern refuse and detritus from the highway. In other situations the soil has been removed to bedrock by either land clearance for transmission lines, drainage or by erosion. Where the proposed upgrading deviates further afield the land is either permanent pasture or plantation forest. In both these sections the potential for significant archaeological material is very low. In no other form did the landscape indicate archaeological remains.

No non-indigenous heritage sites were identified in the study area, consequently non-indigenous sites will not be impacted by the proposed development.

4.3.2 Recommendations

It is considered that the proposed upgrading will have, at most, a negligible impact on the cultural heritage, both indigenous and non indigenous. No further archaeological investigation will be necessary before ground works, however, if archaeological remains of any kind are located during the development works must cease in that area immediately and a qualified archaeologist must be called in to assess the remains. Written permission from the Director of NPWS is required before such items can be disturbed/removed by the proposed development.

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APPENDICES

Appendix A

SITES REGISTERS AND DATABASES SEARCHES

NPWS. Register of Aboriginal sites.

Minark Report Page 1 Printed 14Aug97 14:46

Site Number	Location and Sitename	Amg E	Amg N	Date Recorded	Recorder	Assoc Report	Sitetype
x 38-5-0007	Blue Gum Creek Nerong State Fo	416700	6403700	11JUN1985	Hardman, D.C.		Scarred tree
x 38-5-0077	Dark Point Sout	426715	6390133				Midden
x 38-5-0078	Myall River Pin	424324	6390911				Midden

GREAT LAKES COUNCIL

SUMMARY OF HERITAGE LISTINGS

NORTHERN REGION as at 13-02-1997

TOWN	STREET	SUMMARY	LISTED BY	TYPE	NUMBER	AMEND	GAZETTE	FOLIO	DATE
		Baldy Island Nature Reserve	COM						21-10-1980
		Bandicoot Island Nature Reserve	COM						21-10-1980
		Cape Hawke Coastal Area	COM						21-03-1978
		Coolongolook Nature Reserve	COM						28-09-1986
		John Gould Nature Reserve	COM						21-03-1978
		Kauri & Co's Railway (S)	LGA	LEP	1996		146	8348	13-12-1996
		Little Broughton Island Nature Reserve	COM						21-03-1978
		Myall Lakes National Park	COM						21-03-1978
		Myall Lakes National Park Extensions	COM						25-08-1981
		Regatta Island Nature Reserve	COM						21-10-1980
		Seal Rocks Nature Reserve	COM						21-03-1978
		Stormpetrel Nature Reserve	COM						21-03-1978
		Tahlee House Group	COM						21-03-1978
		Wallis Is Nat Res,s-e cnr of island	COM				17	0015	15-05-1990
		Wallis Island Nature Reserve	COM				P20	37	30-06-1992
		Yahoo Is Nat Res in Wallis Lake	COM				11	37	14-05-1991
		Yahoo Is Nat Res in Wallis Lake	COM				17	0015	15-05-1990
Allworth		Allworth Wharf remains	LGA	LEP	1996		146	8347	13-12-1996
Booral		Alderly House (Aldery Creek)	REP				107	9347	03-11-1989
Booral		Booral Wharf (Karuah River)	REP				107	9347	03-11-1989
Booral		Booral Wharf Karuah River (R)	LGA	LEP	1996		146	8347	13-12-1996
Booral	Bucketts Way	Gundayn House	HC	PER	00309		084	2672	25-05-1984
Booral	Bucketts Way	St Barnabas Church & Cemetery	REP				107	9355	03-11-1989
Booral	Isaacs Lane	Booral House Por 81, Lot 1 DP 632812	LGA	LEP	1996		146	8347	13-12-1996
Booral	Lowes Lane	Booral House	COM						21-03-1978
Booral	Lowes Lane	Booral House	REP				107	9347	03-11-1989
Booral	Lowes Lane	Schoolhouse, Residence, Out Lot 1 DP 632812	LGA	LEP	1996		146	8347	13-12-1996
Booral	Millbrook Road	Gundayre House Group	REP				107	9343	03-11-1989
Booral	Millbrook Road	The Gables	REP				107	9347	03-11-1989
Booral	Millbrook Road	The Gables (R)	LGA	LEP	1996		146	8347	13-12-1996
Booral	Millbrook road	Gundayne	COM						21-03-1978
Booral	The Bucketts Way	Alderley House Por 55/154 (R)	LGA	LEP	1996		147	8347	13-12-1996
Booral	The Bucketts Way	Gundayne House Lot 1 DP 47170	LGA	LEP	1996		146	8347	13-12-1996
Booral	The Bucketts Way	St Barnabas Church & Cemetery (L)	LGA	LEP	1996		146	8347	13-12-1996
Buladelah		Former Aluminium Mine (Bulahdelah Mountain)	REP				107	9347	03-11-1989
Buladelah	Crawford Street	Former Courthouse	REP				107	9347	03-11-1989
Buladelah	Markwell Road	General Cemetery	REP				107	9347	03-11-1989
Bulahdelah		Boondelbah Nature Reserve	COM						21-03-1978
Bulahdelah		Bulahdelah Mountain former Aluminium Mine	LGA	LEP	1996		146	8347	13-12-1996
Bulahdelah		Former Court House	COM						21-03-1978
Bulahdelah		Tramline Trestle Bridge, Horses Creek (S)	LGA	LEP	1996		146	8347	13-12-1996
Bulahdelah	Crawford Street	Former Courthouse Pt Lot 1 DP 226885 (R)	LGA	LEP	1996		146	8347	13-12-1996
Bulahdelah	Markwell Road	Gen Cemetery cnr Red Gum Rd & Mahogany St	LGA	LEP	1996		146	8347	13-12-1996
Bulahdelah	Red Gum Road	General Cemetery cnr Mahogany Street	LGA	LEP	1996		146	8347	13-12-1996

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REP = Regional Environment Plans NT = National Trust

TOWN	STREET	SUMMARY	LISTED BY	TYPE	NUMBER	AMEND	GAZETTE	FOLIO	DATE
Bungwahl	The Lakes Way	Old Bungwahl Cemetery	REP						
Bungwahl	The Lakes Way	Old Bungwahl Cemetery (R)	LGA	LEP	1996		107	9347	03-11-1989
Carrington		Carrington Cemetery	COM				146	8348	13-12-1996
Carrington		Carrington Conservation Area	REP						21-03-1978
Carrington		Former St Andrews Church	REP				107	9374	03-11-1989
Carrington		Two roomed brick cottage	REP				107	9355	03-11-1989
Carrington	Church Street	Former St Andrews Church (L) Lot 1 Sec K	LGA	LEP	1996		107	9347	03-11-1989
Carrington	Cock Renoyo Point	Carrington Boat Harbour & Lime Kiln (S)	LGA	LEP	1996		146	8348	13-12-1996
Carrington	Cock Renoyo Point	Roomed Brick Cottage (2) (R)	LGA	LEP	1996		146	8348	13-12-1996
Carrington	Tahlee Road	Carrington Cemetery	REP				146	8348	13-12-1996
Carrington	Tahlee Road	Carrington Cemetery (S) Pt Por 206	LGA	LEP	1996		107	9343	03-11-1989
Carrington	Tahlee Road	Tahlee House (S) Lot 340 DP 735514	LGA	LEP	1996		146	8348	13-12-1996
Carrington	Tahlee Road	Tahlee House Group	REP				146	8348	13-12-1996
Coolongolook	Curreki Creek Road	Morris Property Graves	REP				107	9343	03-11-1989
Coolongoolook	Curreeki Creek Road	Morris Property Graves Lot 4 DP 749633 (R)	LGA	LEP	1996		107	9347	03-11-1989
Failford	Bullocky Way	House Failford cnr Failford Road	LGA	LEP	1996		146	8348	13-12-1996
Failford	Failford Road	House Failford cnr Bullocky Way	LGA	LEP	1996		146	8348	13-12-1996
Forster	Lake Street	Former Court House group cnr West St	LGA	LEP	1996		146	8348	13-12-1996
Forster	Lakely Street	General Cemetery (cnr Strand Road)	REP				146	8348	13-12-1996
Forster	Likely Street	General Cemetery cnr St Albans Place	LGA	LEP	1996		107	9347	03-11-1989
Forster	North Street	Restaurant & Bar cnr West St Lot 9 DP536200	LGA	LEP	1996		146	8348	13-12-1996
Forster	North Street	Tudor House cnr West St Lot 9 DP 536200	LGA	LEP	1996		146	8348	13-12-1996
Forster	St Albans Place	General Cemetery cnr Likely Street	LGA	LEP	1996		146	8348	13-12-1996
Forster	Strand Road	General Cemetery (cnr Lakely Street)	REP				146	8348	13-12-1996
Forster	West Street	Former Court House Group (cnr Lake Street)	REP				107	9347	03-11-1989
Forster	West Street	Former Court House group cnr Lake St	LGA	LEP	1996		107	9355	03-11-1989
Forster	West Street	Restaurant & Bar cnr North St Lot9 DP536200	LGA	LEP	1996		146	8348	13-12-1996
Forster	West Street	Tudor House cnr North St lot 9 DP 536200	LGA	LEP	1996		146	8348	13-12-1996
Hawks Nest	Bennett Street	Timber Cottage (Local)	LGA	LEP	1996		146	8348	13-12-1996
Mill Creek	Mill Creek Road	Tidal Mill Remains	HC	130			146	8348	13-12-1996
Monkerai	The Bucketts Way	Former Weismantels Inn	LGA	LEP	1996		026	0445	28-01-1983
Nabiac	Clarkson Street	House (77) opp Police Station	LGA	LEP	1996		152	8797	27-12-1996
Nabiac	Nabiac Street	Former E.S.& A. Bank & Dwelling (19)	REP				152	8797	27-12-1996
Nabiac	Nabiac Street	Former ES & A Bank & Dwelling	LGA	LEP	1996		107	9355	03-11-1989
Nabiac	Nabiac Street	Former Hancocks Store & Residence (5-9)	HC	PER	00547		152	8797	27-12-1996
Nabiac	Nabiac Street	Former Hospital (37)	LGA	LEP	1996		149	5159	30-09-1988
Nabiac	Nabiac Street	Hancocks Store (7-9) Lot 1 DP 948711	LGA	LEP	1996		152	8797	27-12-1996
Nabiac	Nabiac Street	Showground cnr Showground Lane Por 96	LGA	LEP	1996		152	8797	27-12-1996
Nabiac	Showground Lane	Showground cnr Nabiac Street Por 96	LGA	LEP	1996		152	8797	27-12-1996
Nerani Head		Nerani Head Cemetery	REP				152	8797	27-12-1996
Nerani Head		Nerani Head Cemetery	LGA	LEP	1996		107	9347	03-11-1989
Seal Rocks		Lighthouse group National Park	LGA	LEP	1996		152	8797	27-12-1996
Seal Rocks		Sugarloaf Point Lightstation	COM				152	8797	27-12-1996
Seal Rocks	Sugarloaf Point	Lighthouse Group	REP				126	0006	18-04-1985
							107	9347	03-11-1989

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GREAT LAKES COUNCIL

SUMMARY OF HERITAGE LISTINGS

NORTHERN REGION as at 13-02-1997

TOWN	STREET	SUMMARY	LISTED BY	TYPE	NUMBER	AMEND	GAZETTE	FOLIO	DATE
Stroud		Court House	COM						21-03-1978
Stroud		Public School & Headmasters Residence	COM						21-03-1978
Stroud		Stroud Conservation Area	REP				107	9374	03-11-1989
Stroud		Stroud Conservation Area	CON						01-11-1983
Stroud		Underground Grain Silos & Cannons,Silo Hill	LGA	LEP	1996		152	8798	27-12-1996
Stroud		Washpool Karuah Riv, 7.5km sth of Stroud	LGA	LEP	1996		152	8799	27-12-1996
Stroud	Berkeley Street	3 residences between Broadway & Collins St	LGA	LEP	1996		152	8798	27-12-1996
Stroud	Berkeley Street	3 single stories(bet Broadway & Collins St)	REP				107	9347	03-11-1989
Stroud	Berkeley Street	Former A.A. Co. Cottage	REP				107	9347	03-11-1989
Stroud	Berkeley Street	Former AA Co Cottages	LGA	LEP	1996		152	8798	27-12-1996
Stroud	Berkeley Street	Thornleigh	REP				107	9355	03-11-1989
Stroud	Berkeley Street	Thornleigh two story colonial home	LGA	LEP	1996		152	8798	27-12-1996
Stroud	Bridge Street	House	LGA	LEP	1996		152	8798	27-12-1996
Stroud	Broadway Street	St Columbines Church cnr Mallon Street	LGA	LEP	1996		152	8798	27-12-1996
Stroud	Cowper Street	Bank of NSW (44)	LGA	LEP	1996		152	8798	27-12-1996
Stroud	Cowper Street	Baptist Church (70)	LGA	LEP	1996		152	8798	27-12-1996
Stroud	Cowper Street	Former Council Chambers Lot 1 DP 202634	LGA	LEP	1996		152	8798	27-12-1996
Stroud	Cowper Street	Former Courthouse Lot 6b DP 709600	LGA	LEP	1996		152	8798	27-12-1996
Stroud	Cowper Street	Former Govt. House	REP				107	9347	03-11-1989
Stroud	Cowper Street	Post Office	REP				107	9347	03-11-1989
Stroud	Cowper Street	Post Office Lot 5 Sec 2	LGA	LEP	1996		152	8798	27-12-1996
Stroud	Cowper Street	Quarbi House	LGA	LEP	1996		152	8798	27-12-1996
Stroud	Cowper Street	School of Arts	REP				107	9355	03-11-1989
Stroud	Cowper Street	School of Arts Lot 4 Sec E	LGA	LEP	1996		152	8798	27-12-1996
Stroud	Cowper Street	St John the Evangelist Group	HC	PER	00330		163	5711	23-11-1984
Stroud	Cowper Street	St Johns Church Group	REP				107	9343	03-11-1989
Stroud	Cowper Street	St Johns The Evangelist Church group	LGA	LEP	1996		152	8798	27-12-1996
Stroud	Cowper Street	Stroud House	COM						21-10-1980
Stroud	Cowper Street	Stroud House	REP				107	9343	11-03-1989
Stroud	Cowper Street	Stroud House Pt Por 75	LGA	LEP	1996		152	8798	27-12-1996
Stroud	Erin Street	Public School & Residence	REP				107	9347	03-11-1989
Stroud	Erin street	Public School & Residence	LGA	LEP	1996		152	8798	27-12-1996
Stroud	Erin street	St James Church (25)	LGA	LEP	1996		152	8798	27-12-1996
Stroud	Main Street	St John the Evangelist Church Group	COM						21-03-1978
Stroud	Mallon Street	St Columbines Church cnr Broadway Street	LGA	LEP	1996		152	8798	27-12-1996
Stroud	Memorial Avenue	Central Hotel (9)	LGA	LEP	1996		152	8798	27-12-1996
Stroud	Mill Creek Road	House	LGA	LEP	1996		152	8799	27-12-1996
Stroud	Silo Hill	Cannons	REP				107	9347	03-11-1989
Stroud	Silo Hill	Underground Grain Silos	REP				107	9347	03-11-1989
Stroud	Stroud Road	Methodist Church	REP				107	9356	03-11-1989
Stroud	Stroud Road	Methodist Church Lot 1 DP 770116	LGA	LEP	1996		152	8799	27-12-1996
Tea Gardens		General Cemetery	REP				107	9347	03-11-1989
Tea Gardens	Marine Drive	Courthouse (53)	LGA	LEP	1996		152	8799	27-12-1996
Tea Gardens	Myall Street	Fisherman's Huts & Stores (215)	LGA	LEP	1996		152	8799	27-12-1996

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GREAT LAKES COUNCIL

SUMMARY OF HERITAGE LISTINGS

NORTHERN REGION as at 13-02-1997

TOWN	STREET	SUMMARY	LISTED BY	TYPE	NUMBER	AMEND	GAZETTE	FOLIO	DATE
Tuncurry	South Street	Tuncurry House	REP				107	9356	03-11-1989
Tuncurry	South Street	Tuncurry House DP 619110	LGA	LEP	1996		152	8799	27-12-1996
Tuncurry	Wharf Street	Timber Church (10)	LGA	LEP	1996		152	8799	27-12-1996
Tuncurry	Wharf Street	Tokelau (12)	LGA	LEP	1996		152	8799	27-12-1996
Waisrantels	Dingadee Road	Karuah River Road Bridge	CON				126	0006	18-04-1989

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AUSTRALIAN HERITAGE COMMISSION

Register of the National Estate Database

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Sites within or near 'gloucester'

Folk Museum , 12 , Church St , Gloucester , NSW
Gloucester Cottage , Buckett's Way , Gloucester , NSW
Vale Of Gloucester , Gloucester , NSW

The Register of the National Estate has been compiled since 1976. The Commission is in the process of developing and or upgrading official statements of significance for places listed prior to 1991.

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Sites within or near 'bulahdelah'

Alum Mountain Geological Site 1 , Bulahdelah , NSW
Bulahdelah Courthouse - Former , Ann St , Bulahdelah , NSW
Myall Lakes National Park , Bulahdelah , NSW

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Sites within or near 'forster'

Baldy Island Nature Reserve , Forster , NSW
Bandicoot Island Nature Reserve , Forster , NSW
Cape Hawke-coastal Area , Forster , NSW
Regatta Island Nature Reserve , Forster , NSW
Wallis Island Nature Reserve , Forster , NSW
Wallis Lake , Forster , NSW
Yahoo Island Nature Reserve , Forster , NSW

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23 September 1997

Mr/s Chris Power
Regional Manager
North Coast New South Wales
ERM Mitchell McCotter
PO Box 487
TAREE NSW 2430

Dear Mr/s Power

REF FOR PACIFIC HIGHWAY UPGRADING KARUAH TO BULAHDELAH

I refer to your letter dated 2 September 1997 in regard to the above. The National Trust is unable to be represented at the Planning Focus Meetings to which you refer, but believes it is in your interest to request detailed information from the Trust about Classified items which may be affected by the upgrading proposals. We are unable to supply that information in detail from the map provided, but attach a photocopied extract from the National Trust Register of Classifications in the Great Lakes Council area.

More detailed information is available upon request and at a cost. Please contact Mrs Mara Barnes on 02 9258 0123 should you require further information.

Thank you for referring this matter to the National Trust.

Yours sincerely

Stephen Davies
Deputy Executive Director & Head, Conservation

LGA	STATUS	LOCALITY	ADDRESS	BUILDING/SITE/AREA
GRA	CL	CARODA		ROCKY CREEK HOMESTEAD CEMETERY CONSERVATION AREA INCLUDING ARNDELL CEMETERY & LONE GRAVE
RDI	-	CAROONA	SEE ALSO LOCALITY: QUIRINDI BELOW	
RDI	REC	CAROONA		WALHALLOW
THL	CL	CARRATHOOL	CARRATHOOL RD OVER MURRUMBIDGEE RIVER	CARRATHOOL BRIDGE
THL	REC	CARRATHOOL	MURRUMBIDGEE RIVER RD	GROONGAL ETC*
THL	REC	CARRATHOOL	MURRUMBIDGEE RIVER RD	HOWLONG HOMESTEAD
THL	REC	CARRATHOOL	MURRUMBIDGEE RIVER RD	UARDRY HOMESTEAD
BDG	REC	CARRATHOOL	STURT HWY	RUDDS PT HOMESTEAD
BE	CL	CARRATHOOL	STURT HWY	TONGANMAIN FORMERLY TOGGLEMAIN GROUP
THL	*DEM*	*CARRATHOOL*		*FORMER POLICE STATION, COURTHOUSE AND CELL BLOCK*
LWR	CL	CARRICK		LOCKYERSLEIGH ETC*
CSL	-	CARRINGTON	SEE ALSO LOCALITY: NEWCASTLE (SUBURBS) BELOW	
RPO	-	CARRINGTON	SEE ALSO LOCALITY: PORT STEPHENS BELOW	
RTL	CL	CARRINGTON	BETWEEN CARRINGTON & TAHLEE HOUSE	GENERAL CEMETERY
RTL	CL	CARRINGTON	YOUNG ST CNR HARGRAVES ST	COUNCIL CHAMBERS
RTL	REC	CARRINGTON		COTTAGE
RTL	CL	CARRINGTON	-	TAHLEE HOUSE GROUP:
RTL	CL	CARRINGTON	-	TAHLEE HOUSE ETC*
RTL	CL	CARRINGTON	-	TAHLEE HOUSE ESTATE GROUNDS ETC*
RTL	CL	CARRINGTON		AUSTRALIAN AGRICULTURAL COMPANY VILLAGE SITE
RTL	REC	CARRINGTON		YOUTH HOSTEL FORMERLY ST ANDREWS PRESBYTERIAN CHURCH
PMN	REC	CARRS CREEK		ORANGE GROVE
YLS	CL	CARWELL	CUDGEGONG RD 9km SOUTH OF RYLESTONE CARWELL CK WESTERN BANK	GENERAL CEMETERY
YL	CL	CARWELL	CUDGEGONG RD. "CARWELL" PROPERTY	NEVELL FAMILY CEMETERY
SNO	REC	CASINO	BARKER ST CNR WEST ST	ST MARKS CHURCH
SNO	CL	CASINO	-BARKER ST	POST OFFICE GROUP:
SNO	CL	CASINO	-BARKER ST	POST OFFICE
SNO	CL	CASINO	-BARKER ST 100	FORMER BANK CBC INCLUDING RESIDENCE & STABLES
SNO	REC	CASINO	CANTERBURY ST CNR CENTRE ST	ST MARYS ROMAN CATHOLIC CHURCH
SNO	REC	CASINO	CANTERBURY ST CNR WALKER ST	FORMER ES & A BANK
SNO	REC	CASINO	CANTERBURY ST REAR OF MANSE	FORMER MANSE
SNO	REC	CASINO	CENTRE ST CNR NORTH ST	ST MARYS ROMAN CATHOLIC CONVENT ETC*

Appendix B

LETTER FROM KARUAH LALC

KARUAH LOCAL ABORIGINAL
LAND COUNCIL
PO BOX 30
KARUAH NSW 2324

PHONE: 049 975 733 .... FAX: 049 975 750

Allan Ford

RE: KARUAH TO BULAHDELAH SURVEY

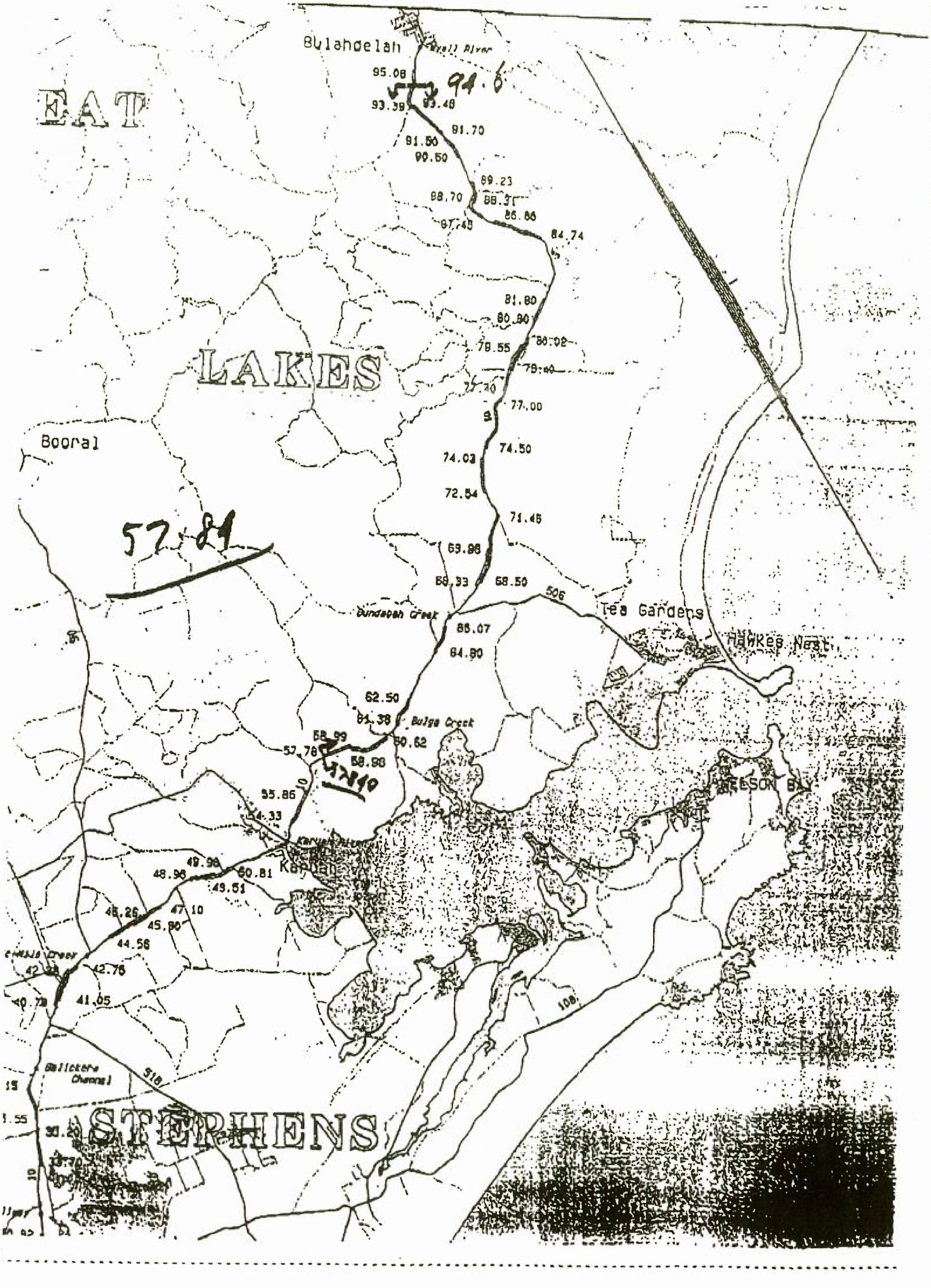
On September 3 and 4 representatives from Karuah Local Aboriginal Land Council along with Allan Ford, surveyed the roadside between Karuah and Burdikins gap near Bulahdelah.

Both sides of the road was surveyed but no Aboriginal artefacts were located over the two days, this is due to the distuirbance with previous road construction and it was impossible to find any artefacts.

Yours sincerely,

Colleen Perry

Bev Manton



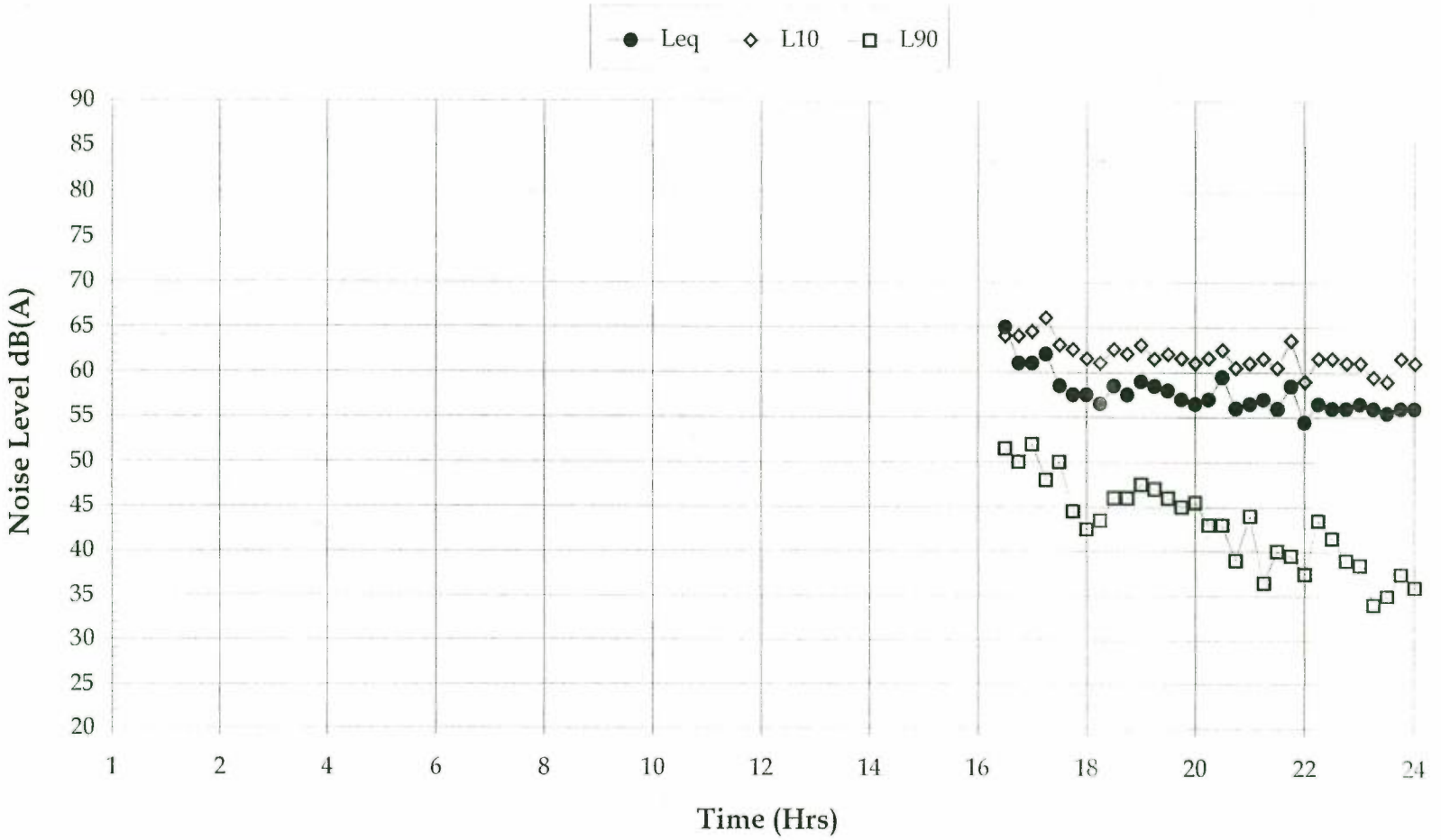
Bulahdelah
Myall River
95.06
94.6
93.39
93.48
91.70
91.50
90.50
89.23
88.70
88.31
87.45
86.86
84.74
81.80
80.80
80.02
79.55
77.00
74.50
74.03
72.54
71.46
69.86
69.33
68.50
506
Tea Gardens
Hawkes Nest
Gundabah Creek
66.07
64.80
62.50
61.38
Bulga Creek
58.99
60.62
57.78
58.98
55.86
54.33
Karuah
49.98
48.96
50.81
49.51
46.26
47.10
45.80
44.56
42.75
41.05
40.73
Ballickera Channel
518
108
EAT
LAKES
Booral
57.84
STEPHENS

APPENDICES

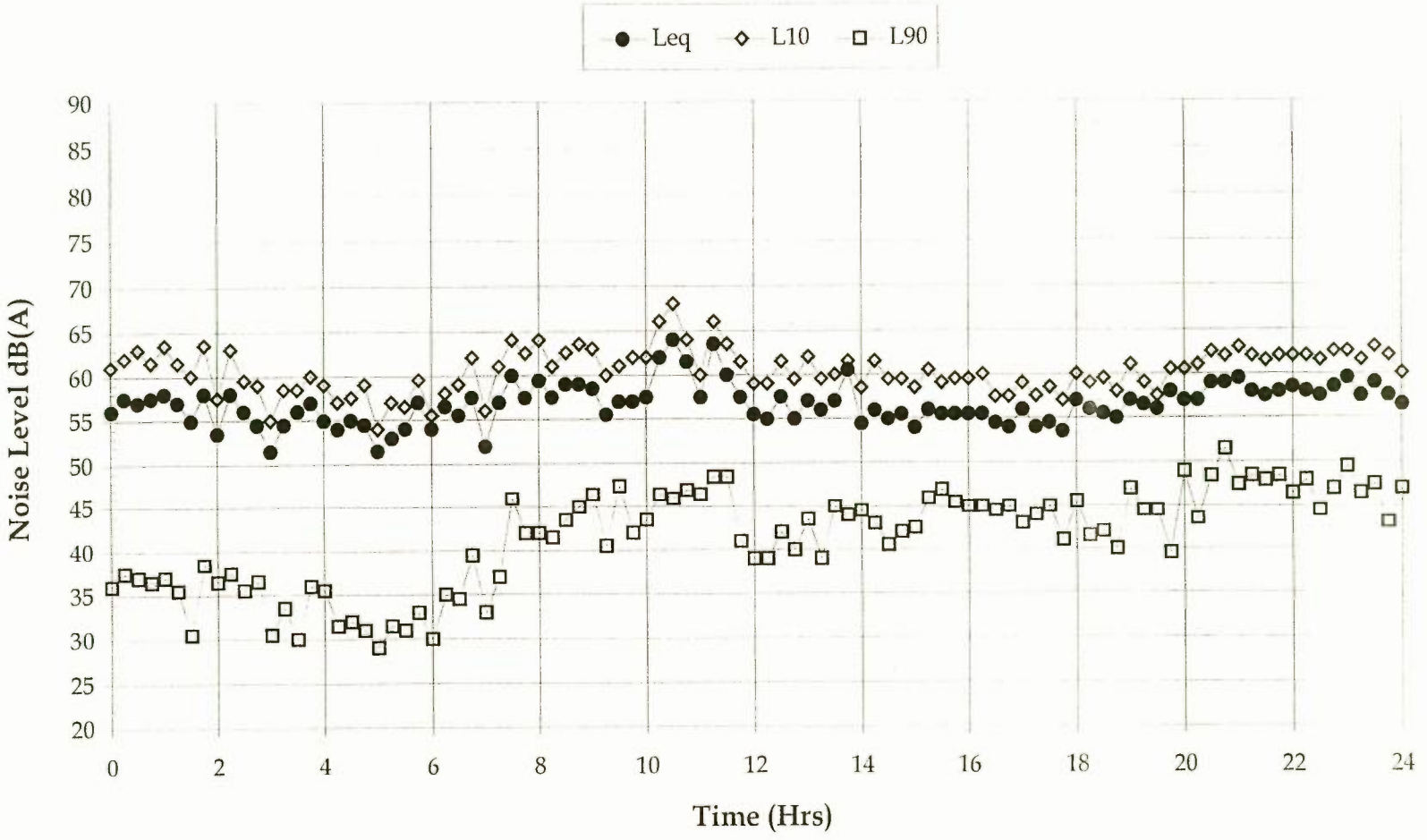
Appendix A

LOGGED NOISE DATA

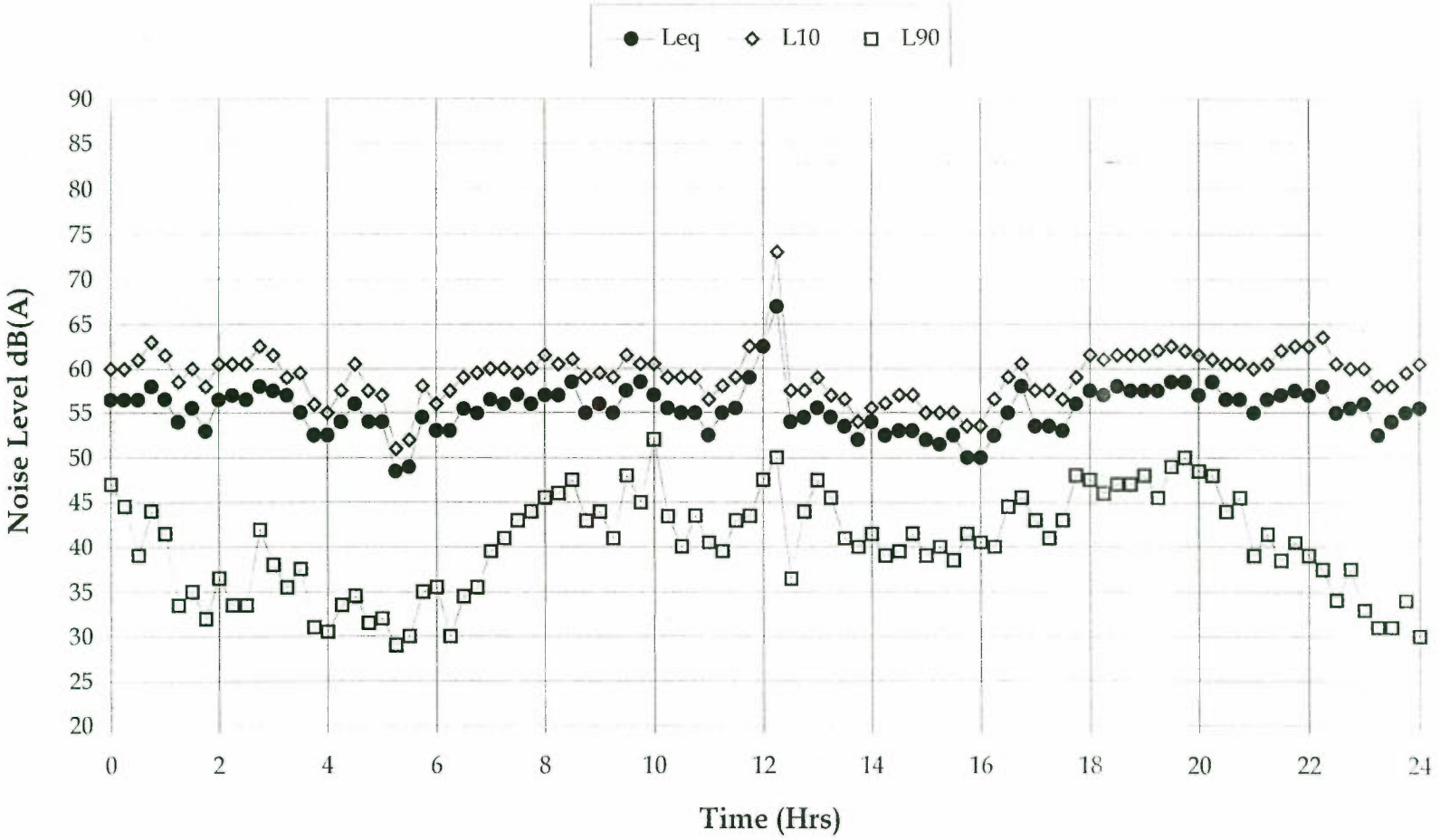
Location A (Stevens) (80m from highway)
11 September,1997



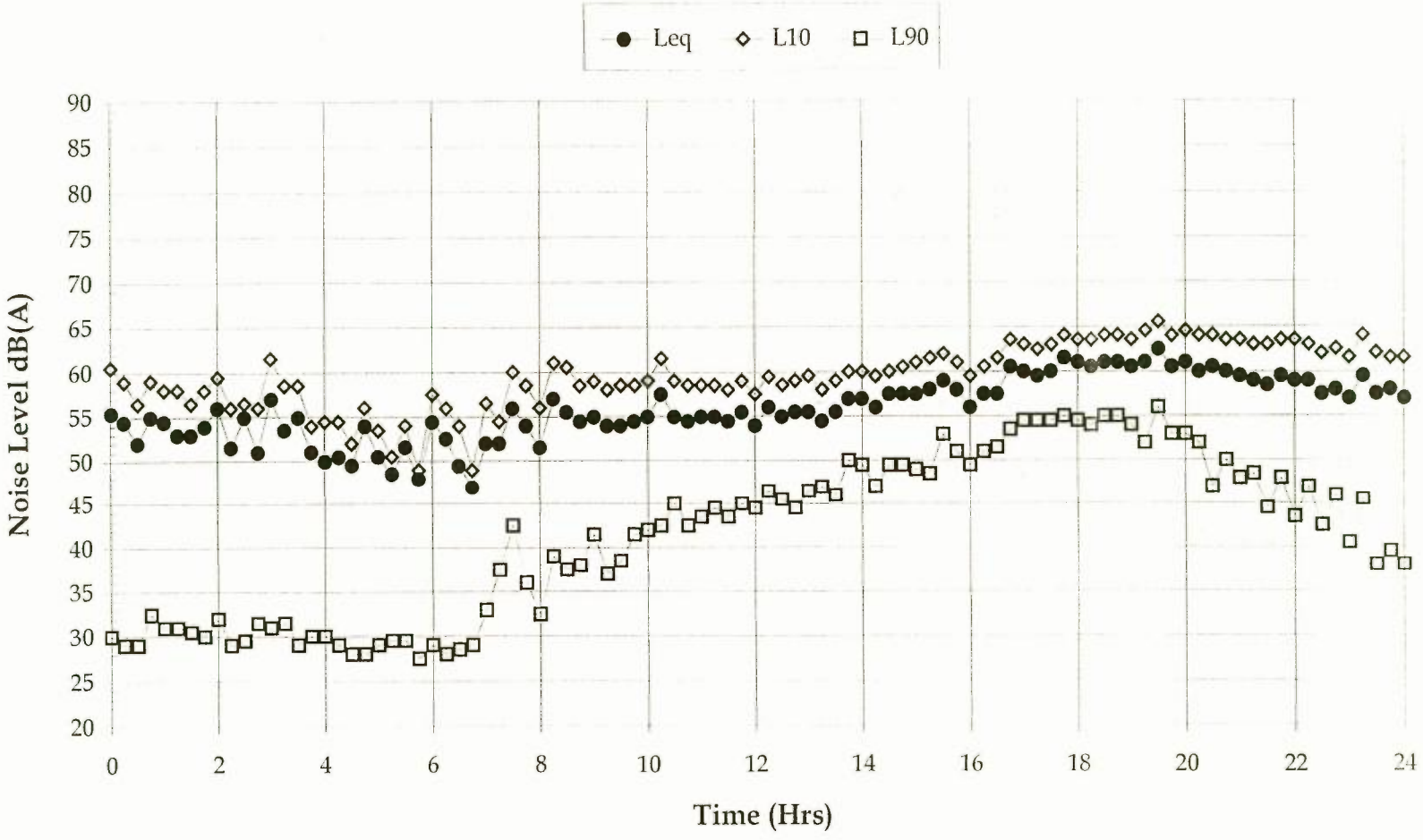
Location A (Stevens) (80m from highway)
12 September,1997



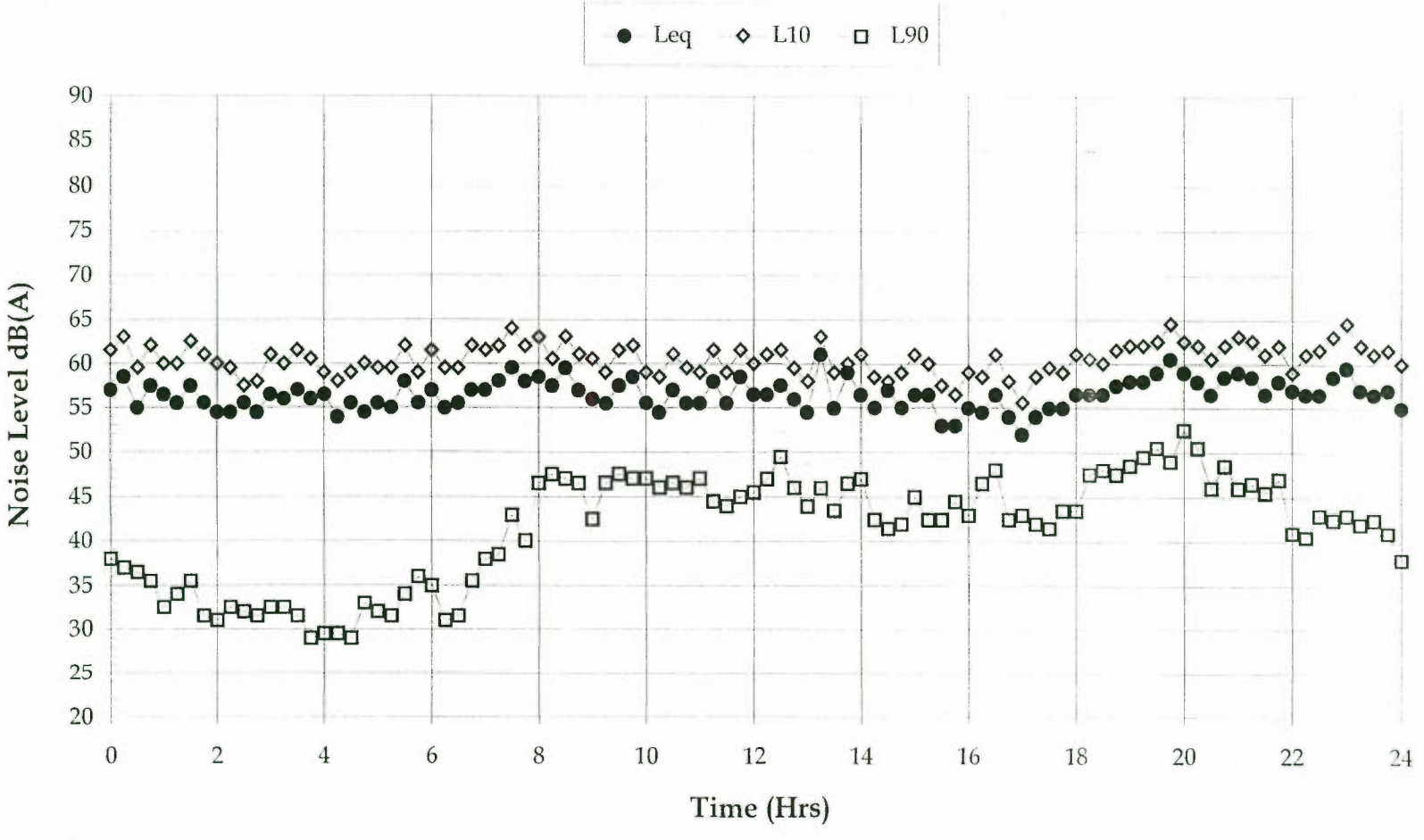
Location A (Stevens) (80m from highway)
13 September,1997



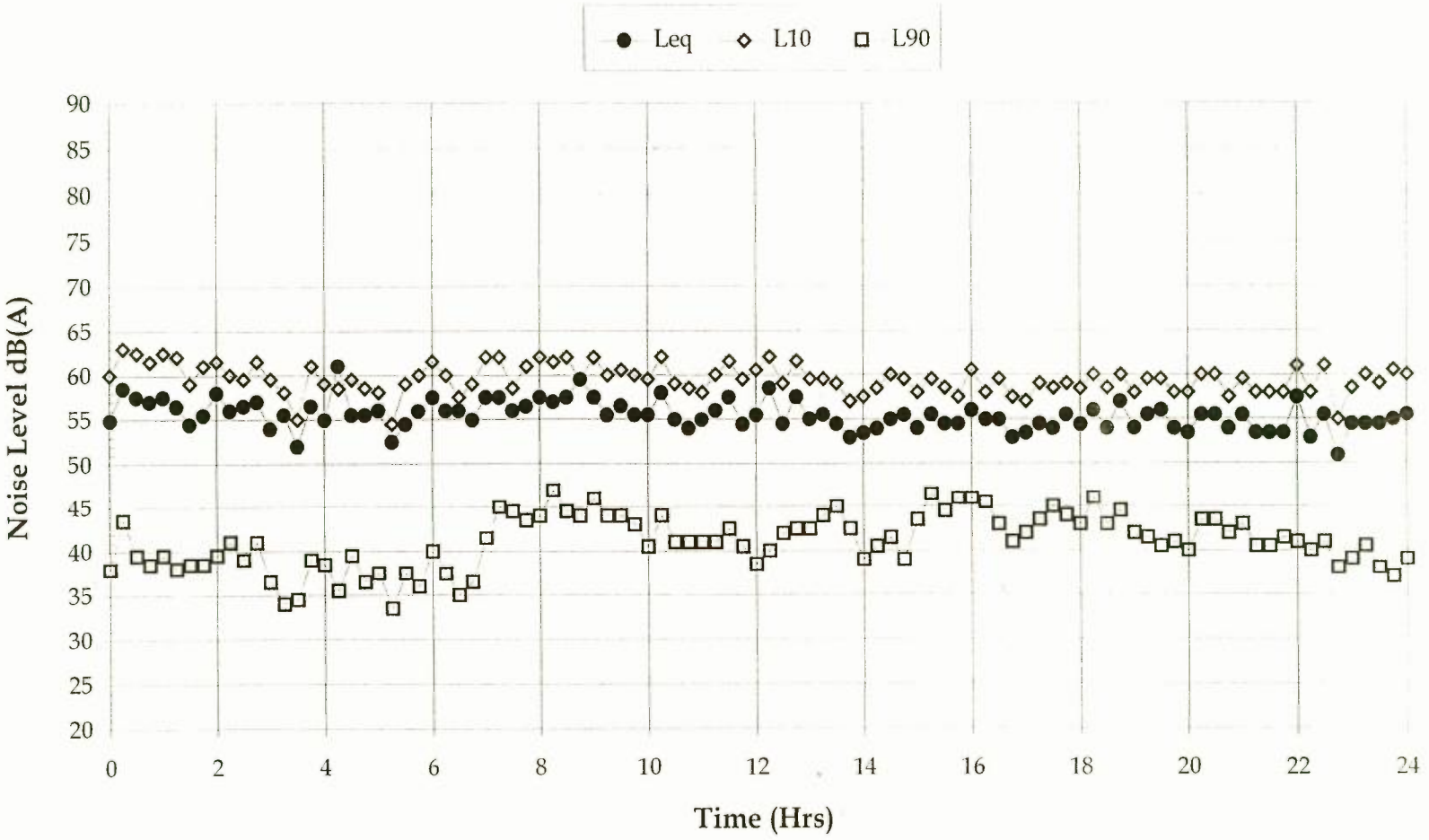
Location A (Stevens) (80m from highway)
14 September,1997



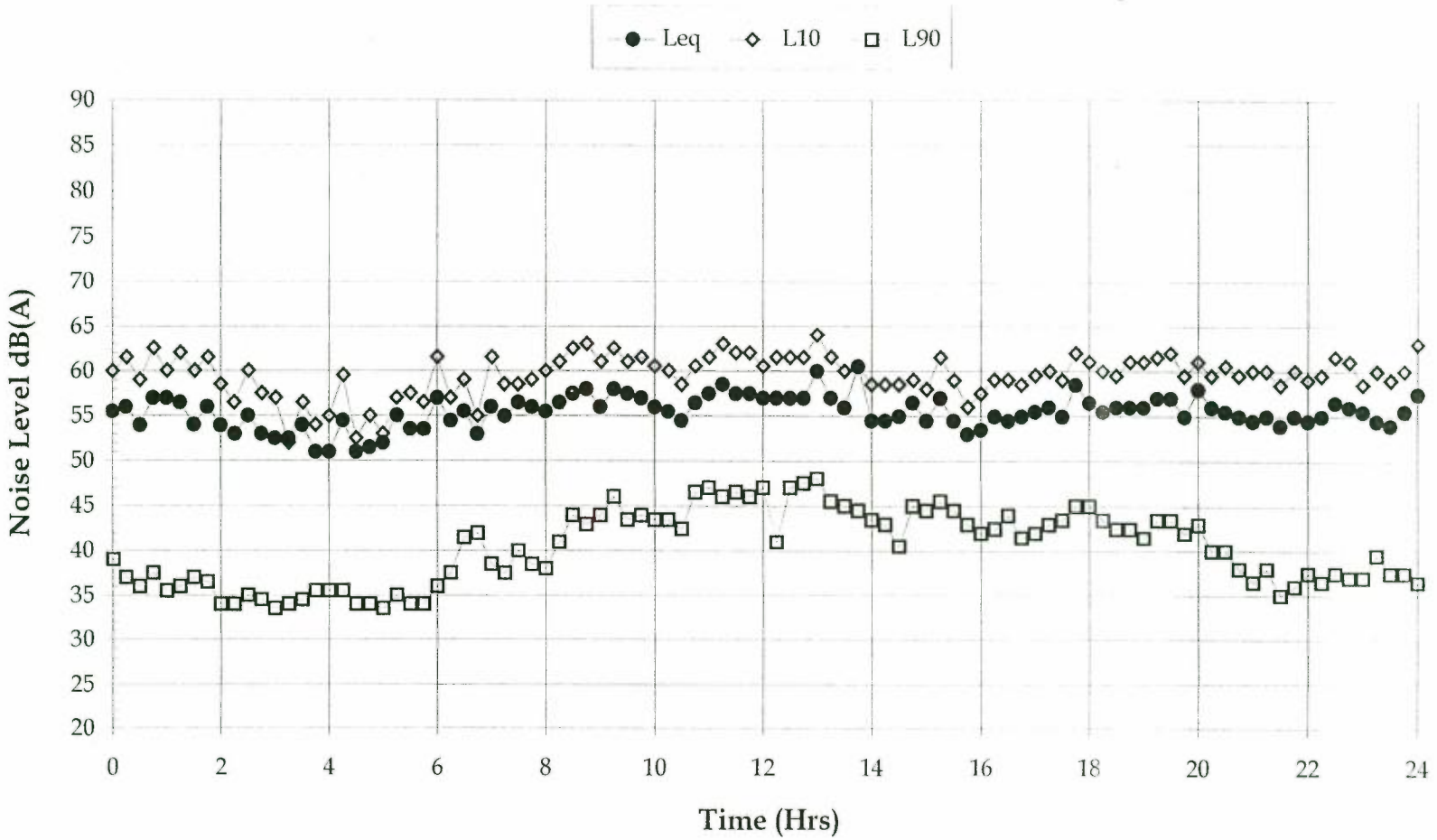
Location A (Stevens) (80m from highway)
15 September,1997



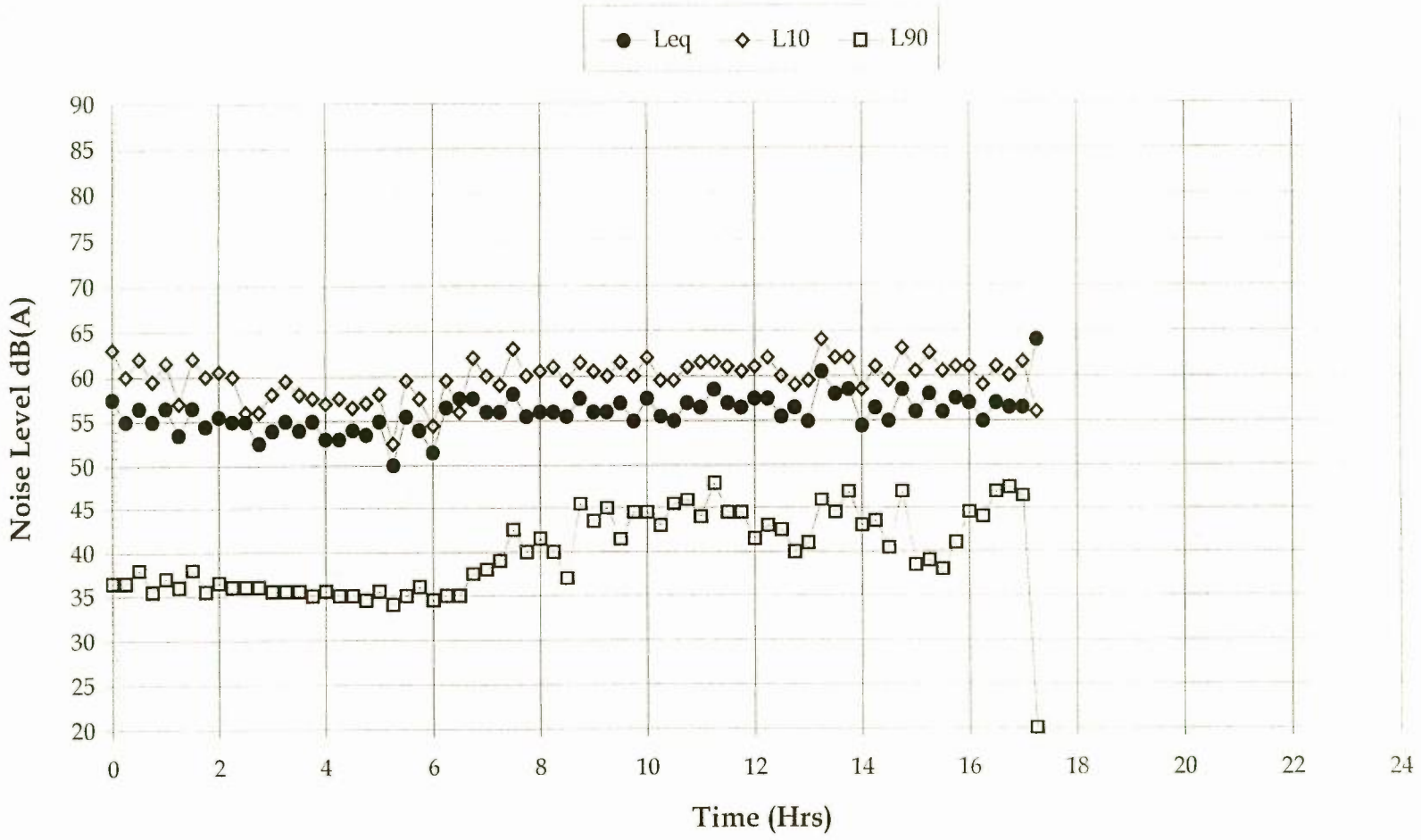
Location A (Stevens) (80m from highway)
16 September,1997



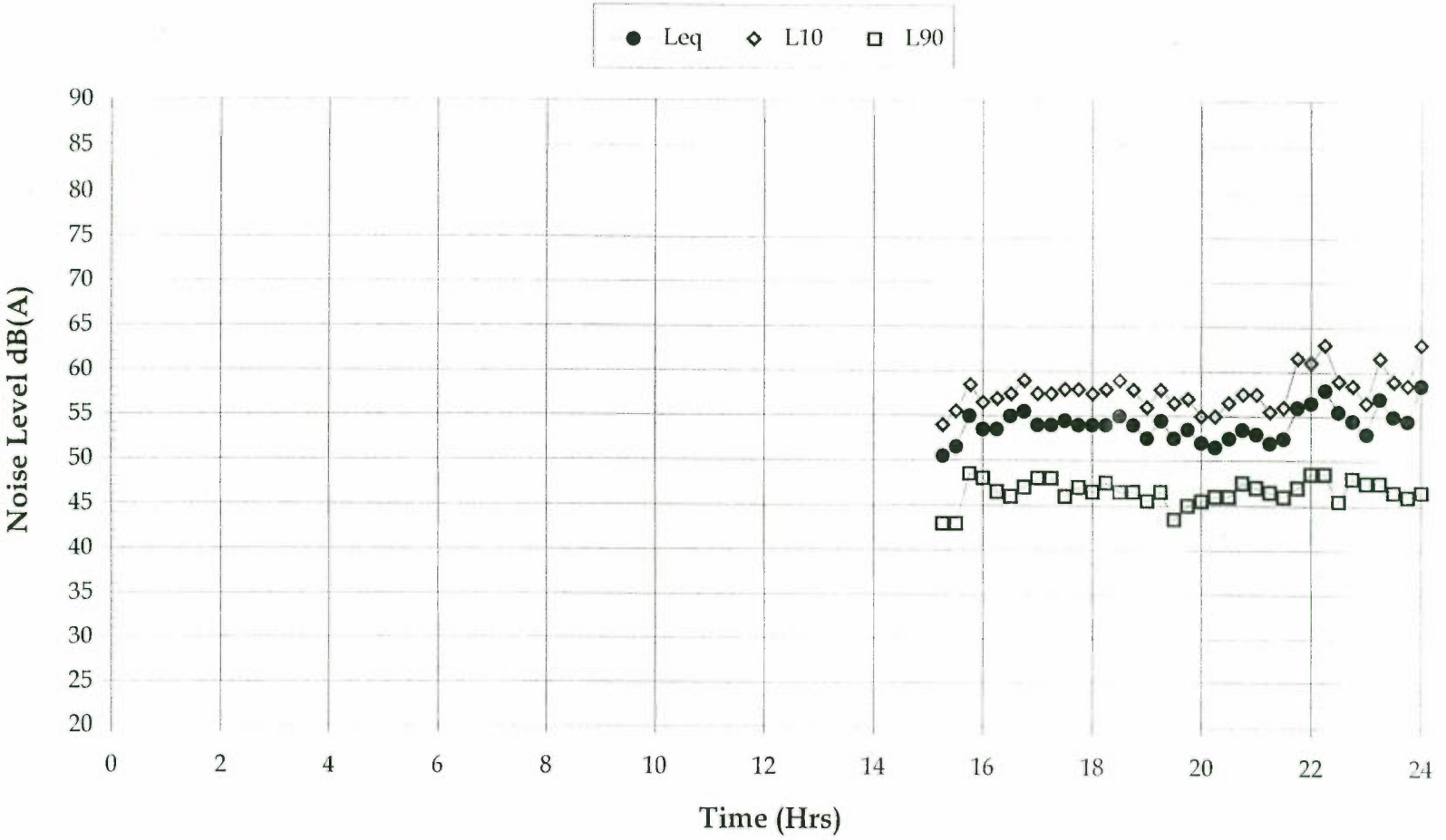
Location A (Stevens) (80m from highway)
17 September,1997



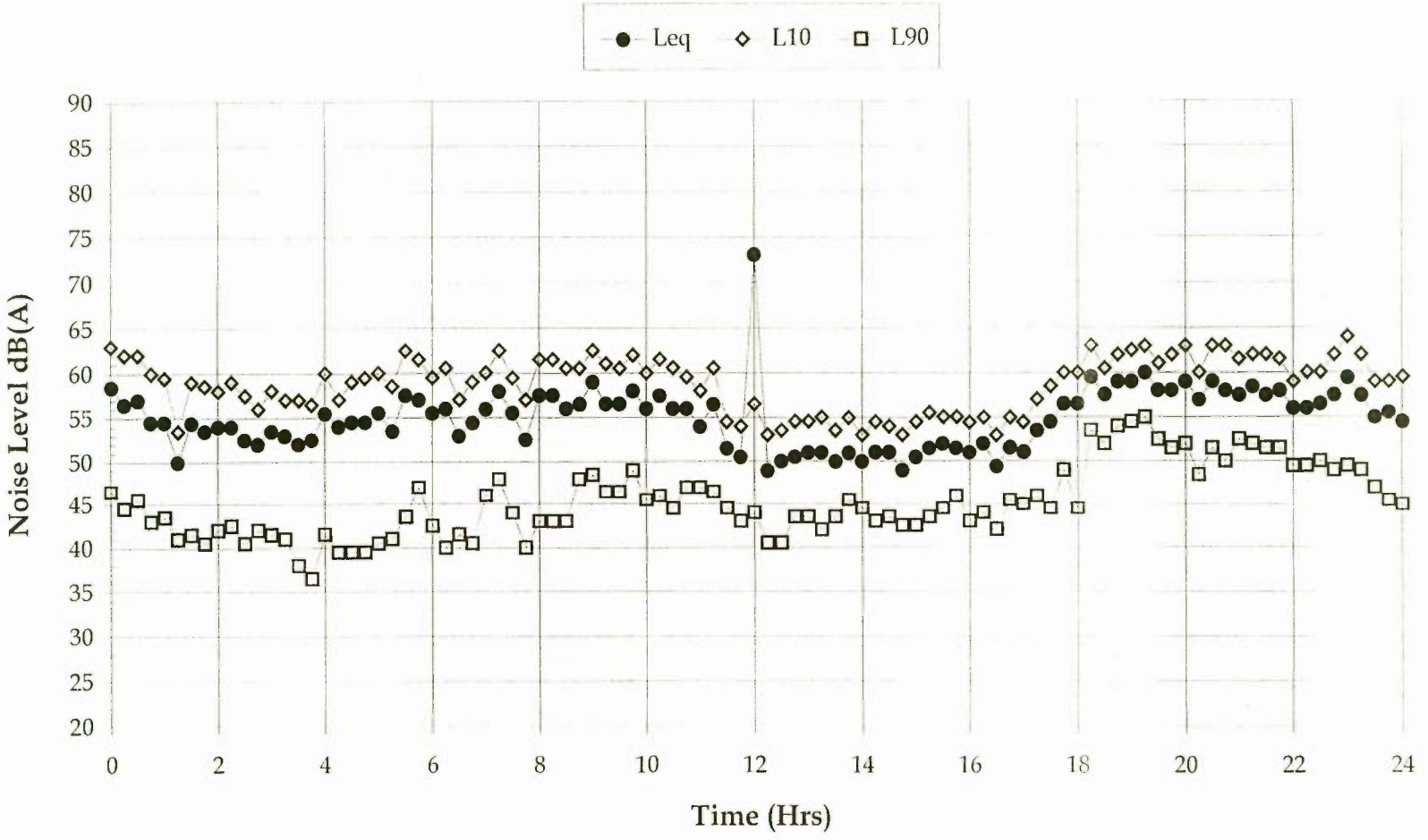
Location A (Stevens) (80m from highway)
18 September,1997



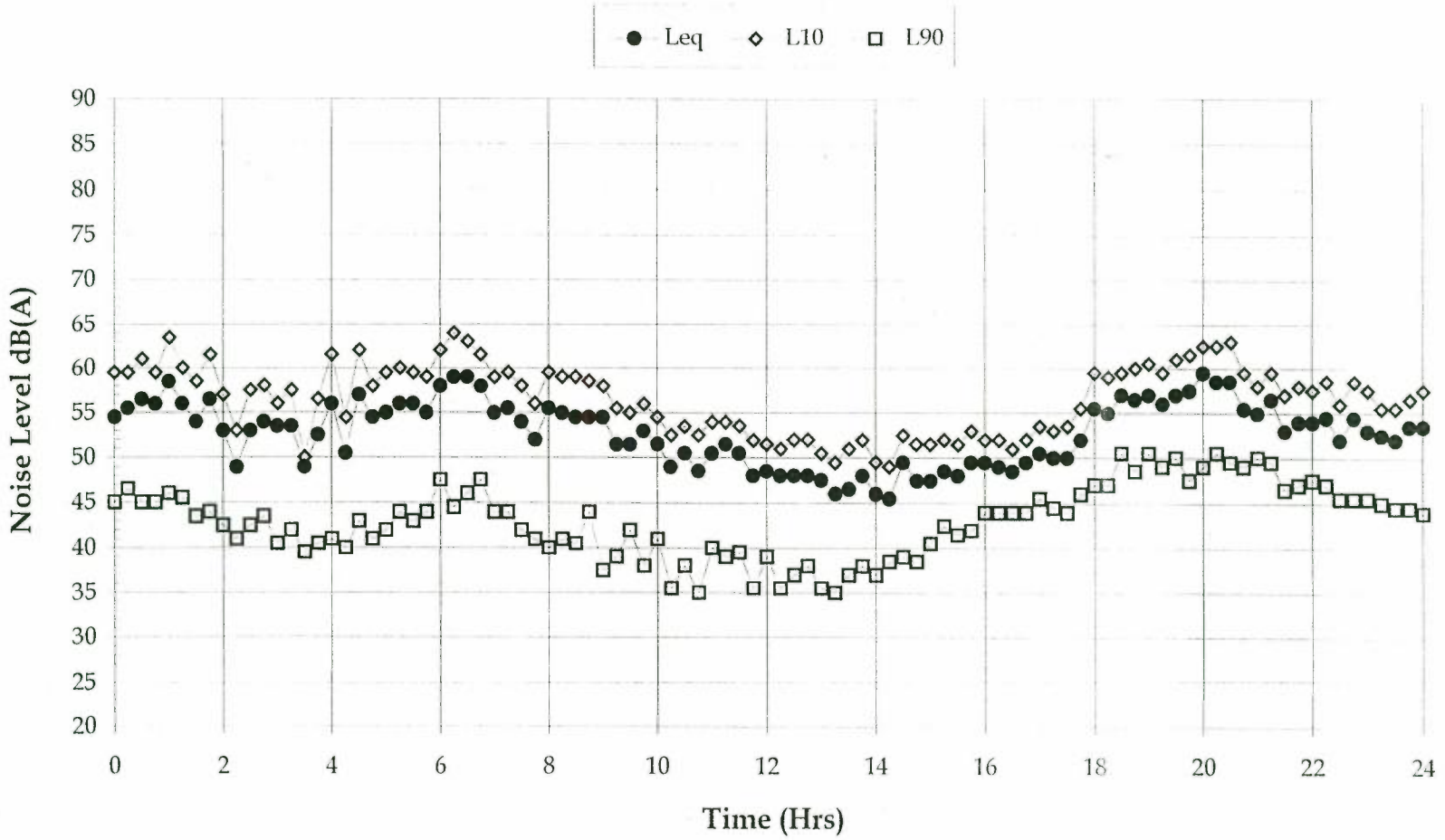
Location B (Fullerton) (150m from highway)
11 September,1997



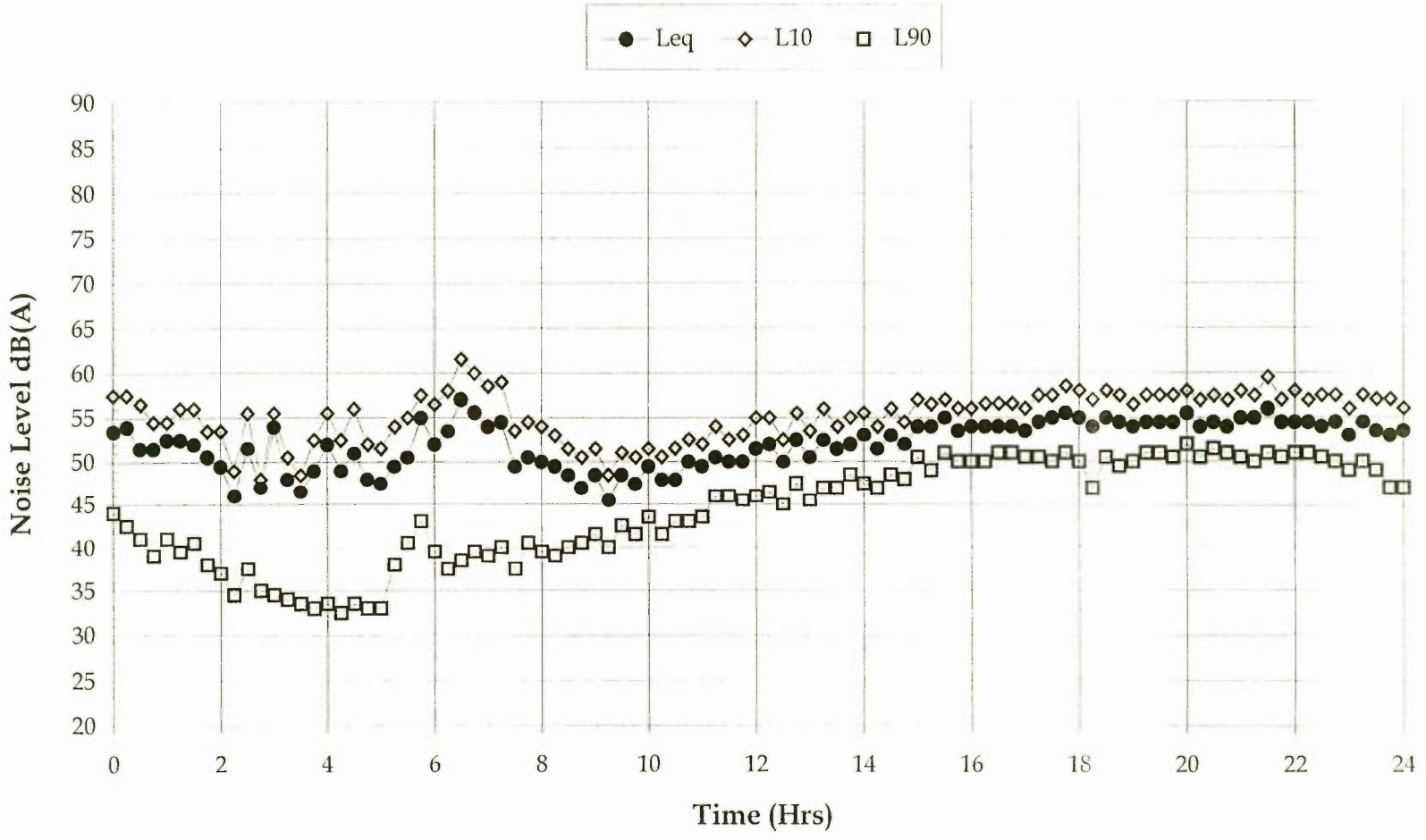
Location B (Fullerton) (150m from highway)
12 September,1997



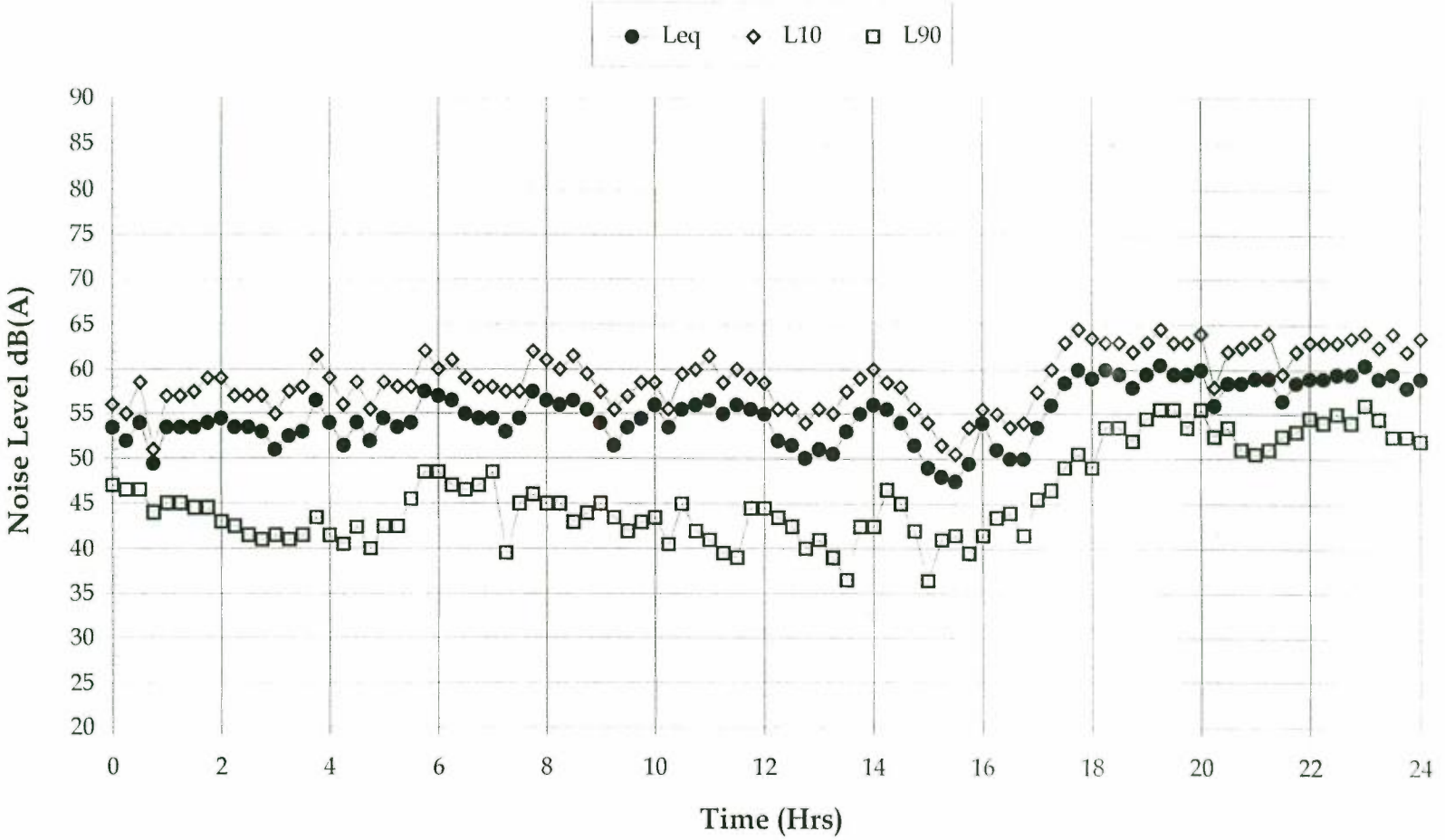
Location B (Fullerton) (150m from highway)
13 September,1997



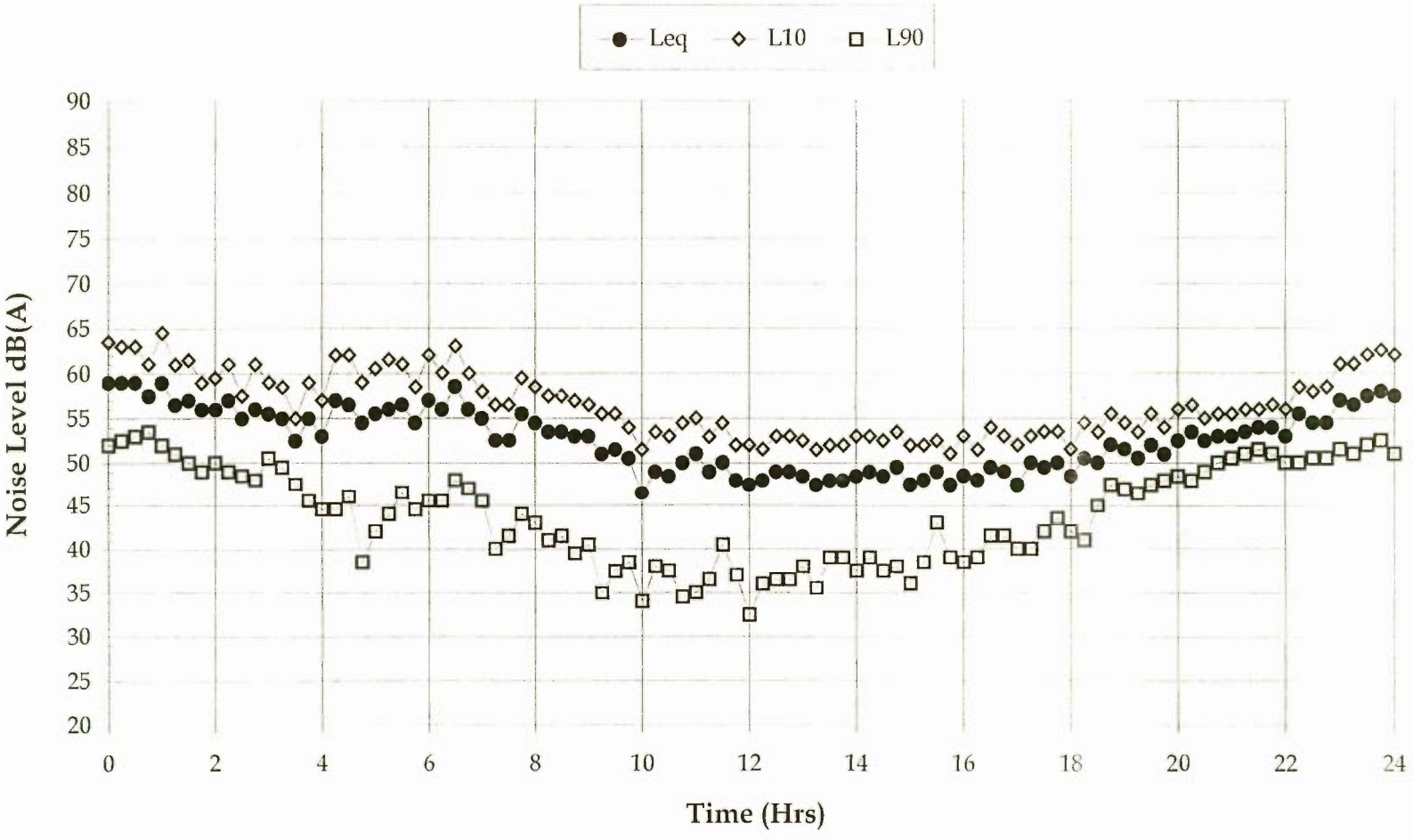
Location B (Fullerton) (150m from highway)
14 September,1997



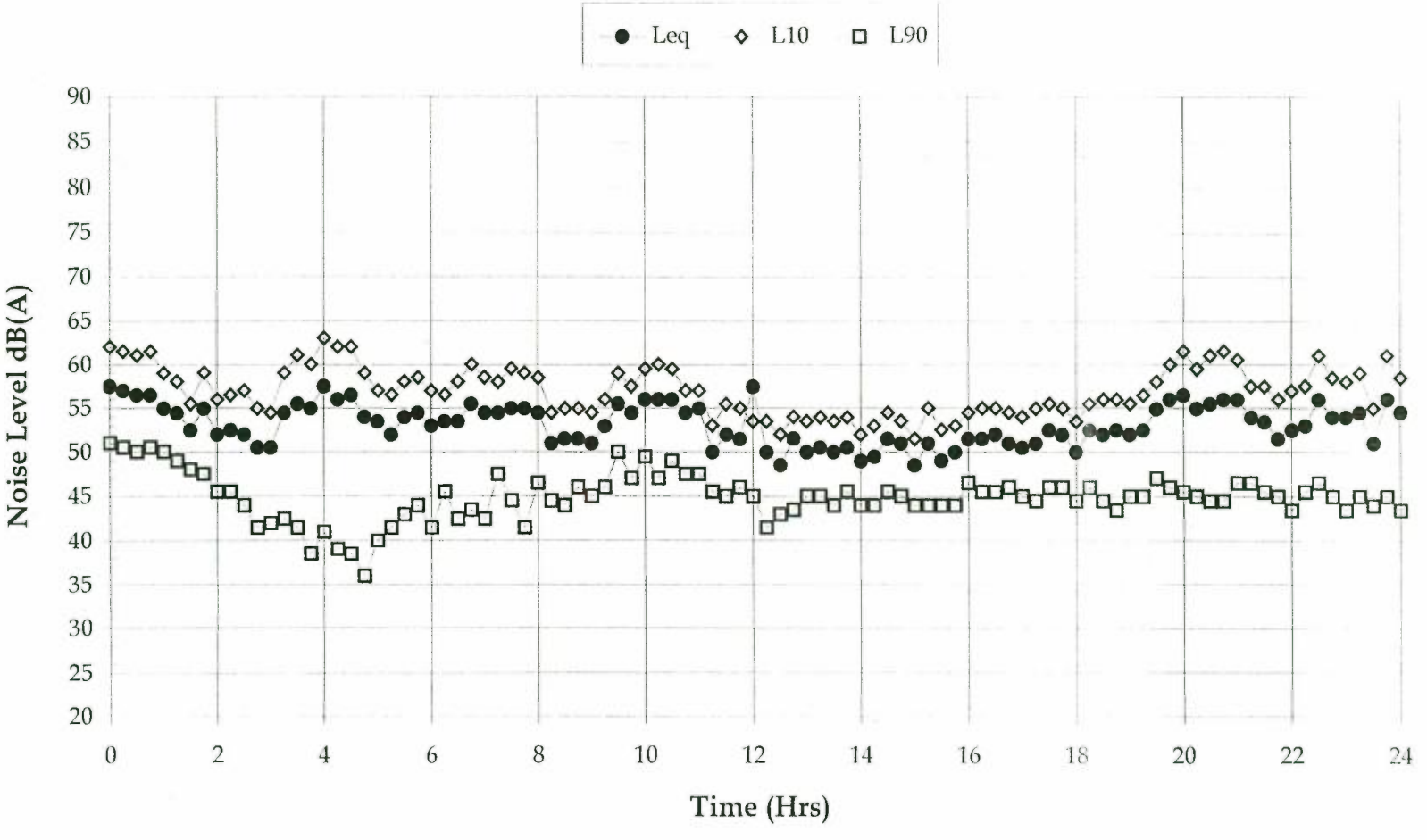
Location B (Fullerton) (150m from highway)
15 September,1997



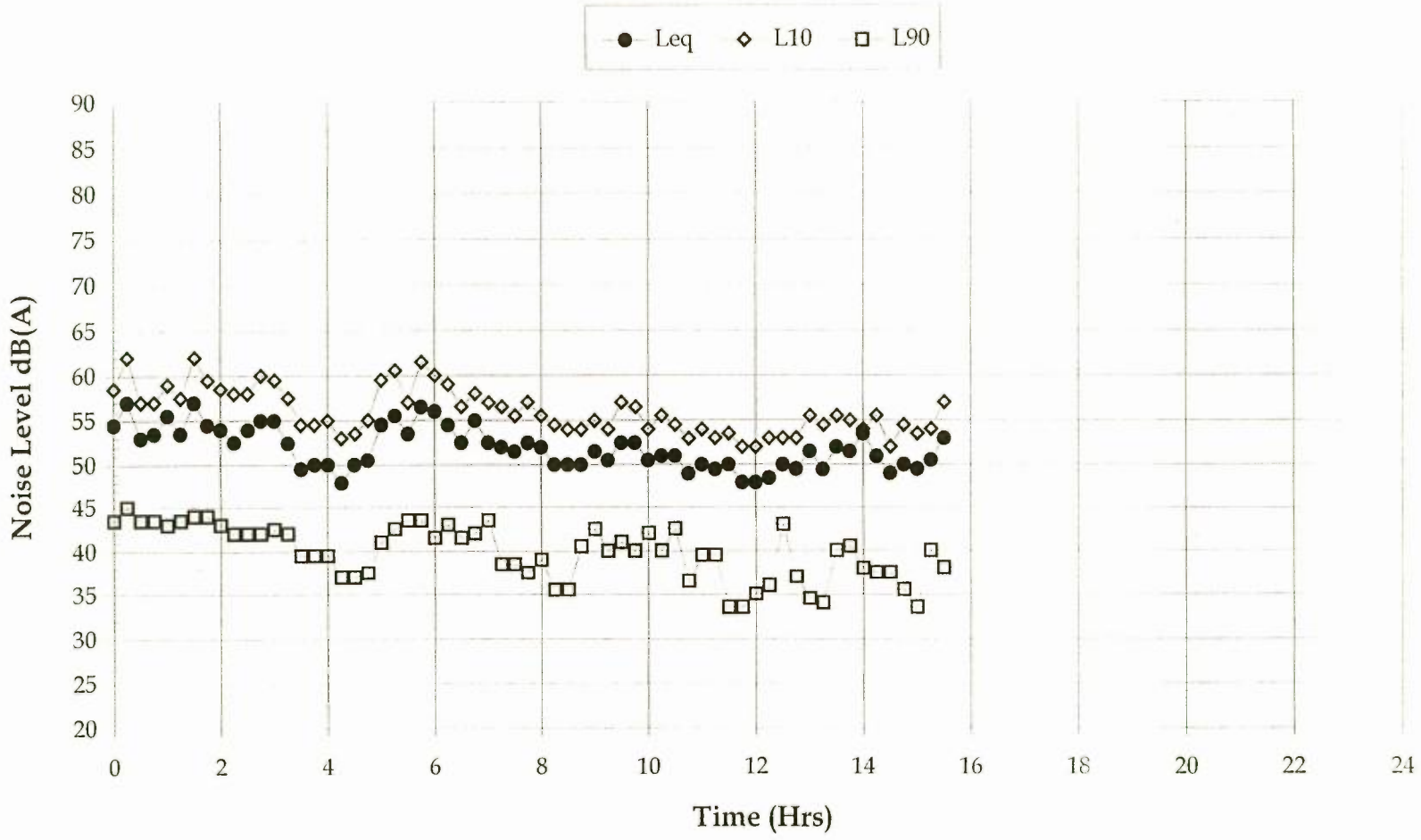
Location B (Fullerton) (150m from highway)
16 September,1997



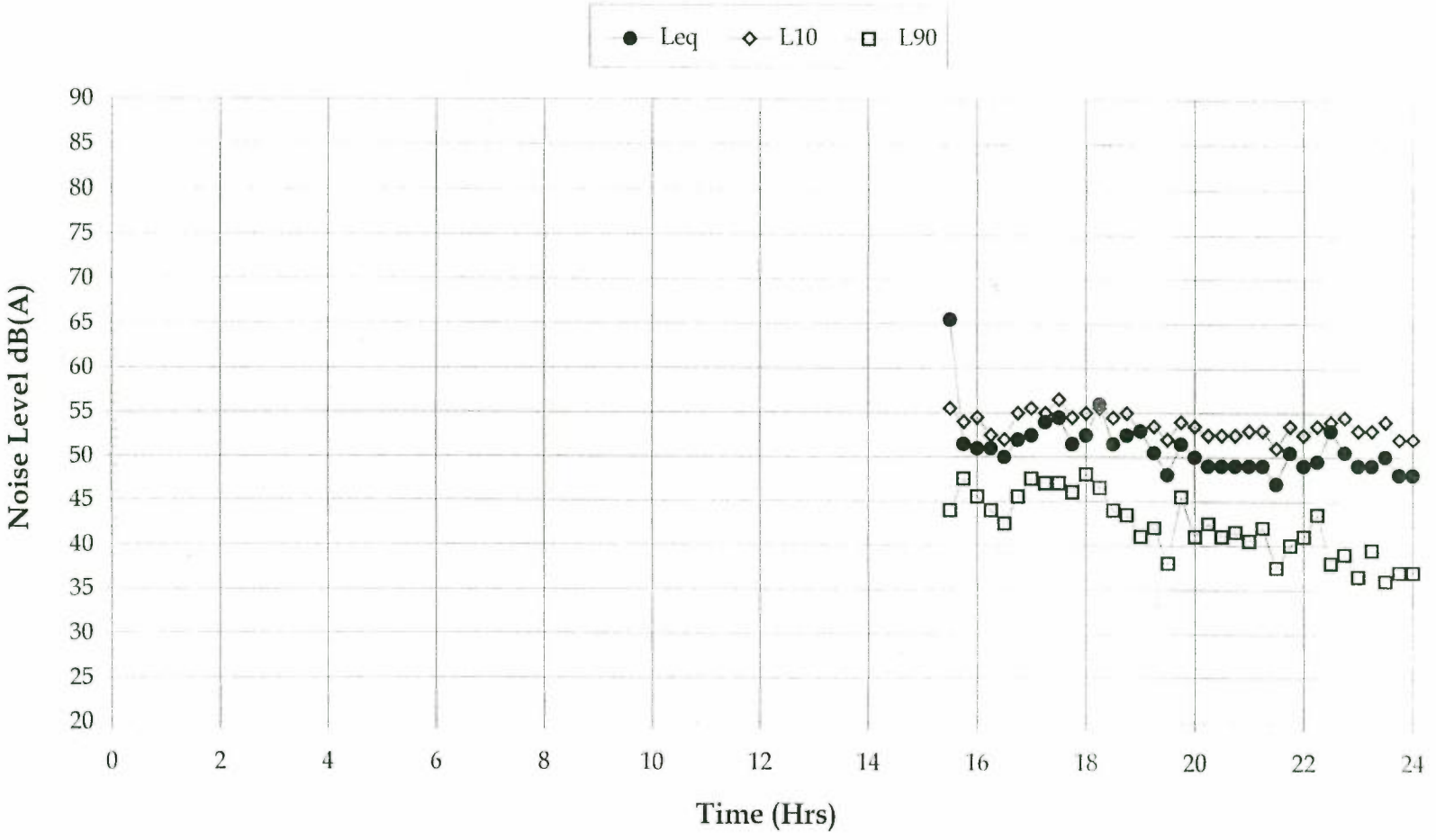
Location B (Fullerton) (150m from highway)
17 September,1997



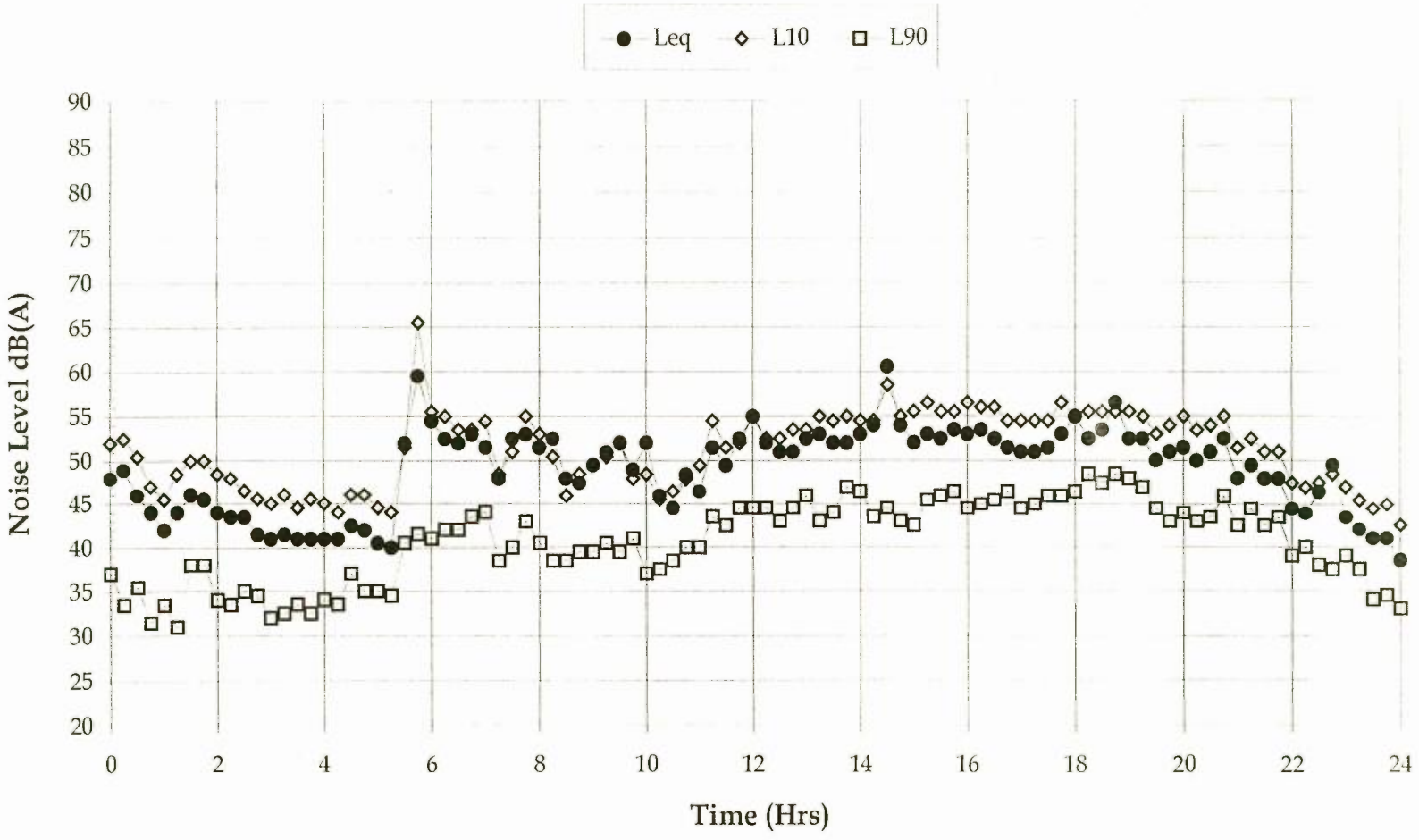
Location B (Fullerton) (150m from highway)
18 September,1997



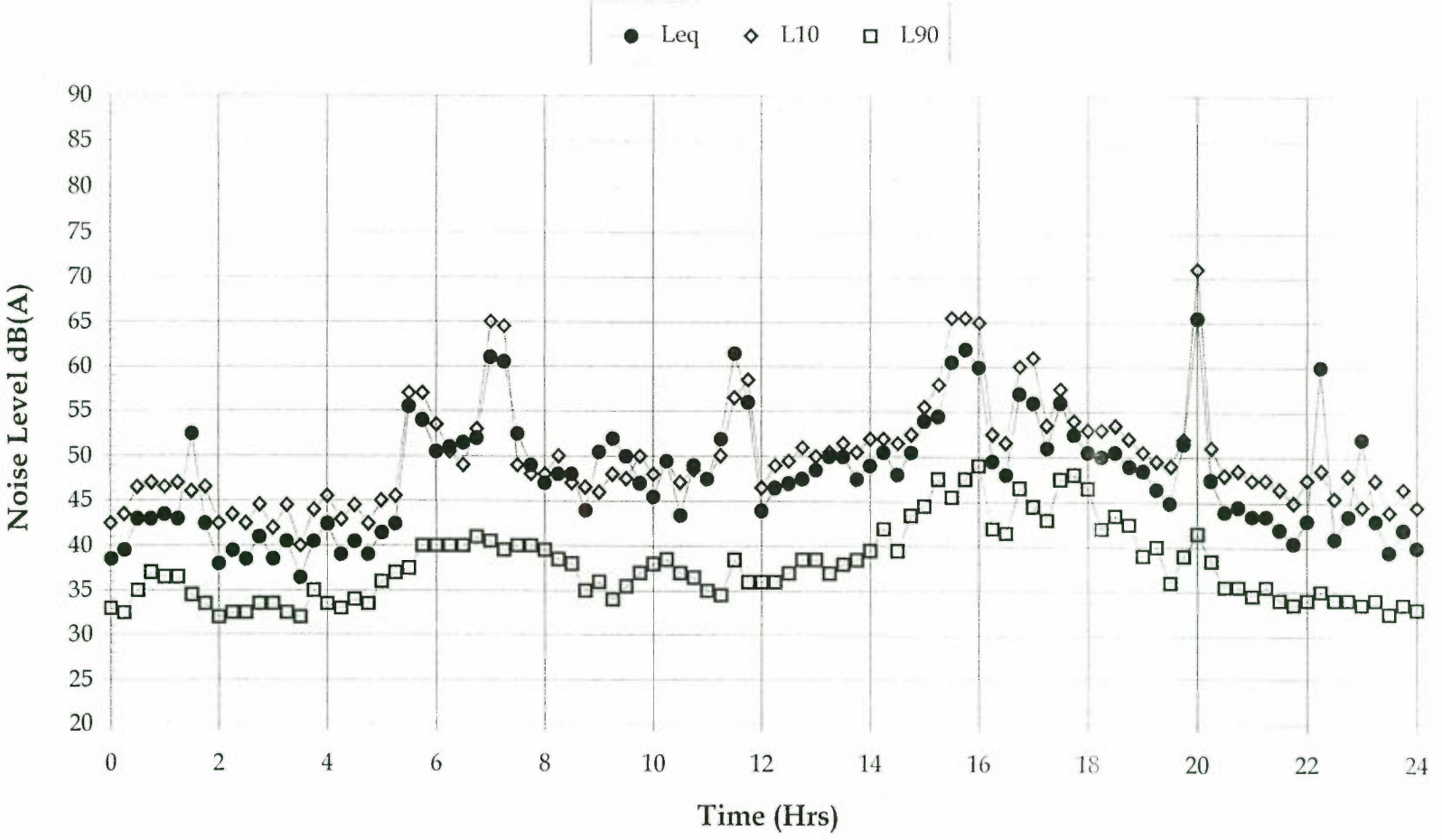
Location C (Reynolds) (330m from highway)
11 September,1997



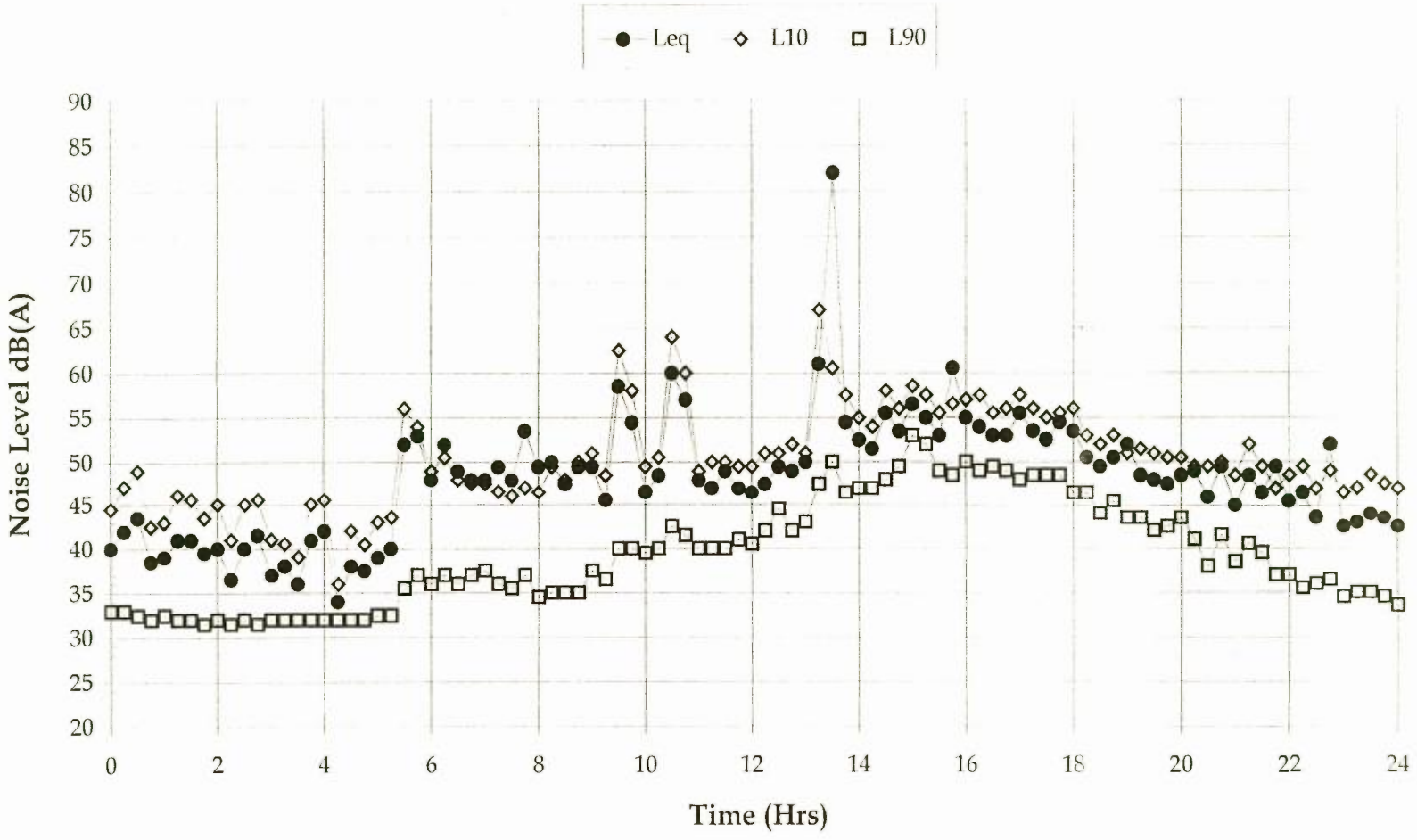
Location C (Reynolds) (330m from highway)
12 September,1997



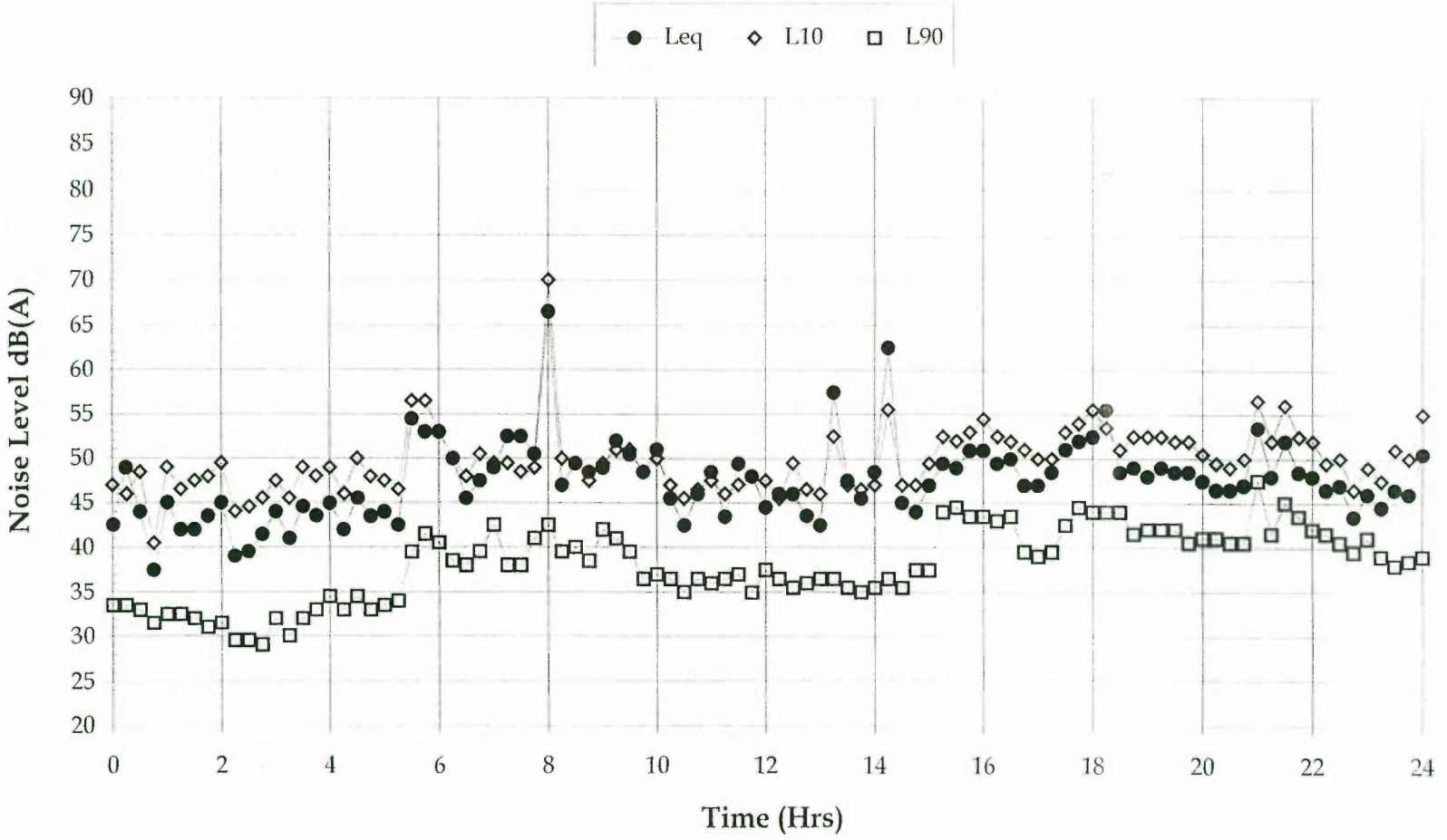
Location C (Reynolds) (330m from highway)
13 September,1997



Location C (Reynolds) (330m from highway)
14 September,1997



Location C (Reynolds) (330m from highway)
15 September,1997



Location C (Reynolds) (330m from highway)
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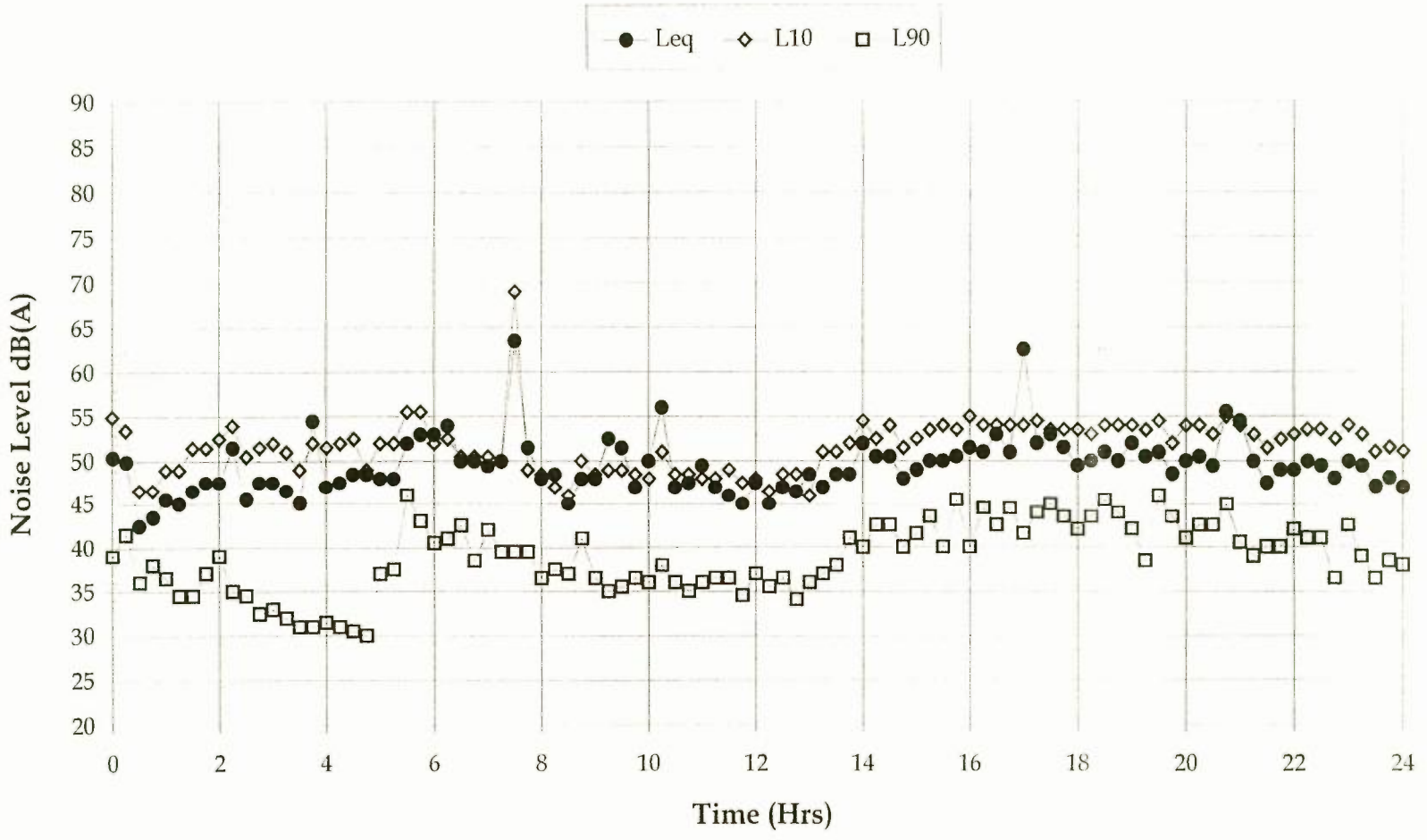

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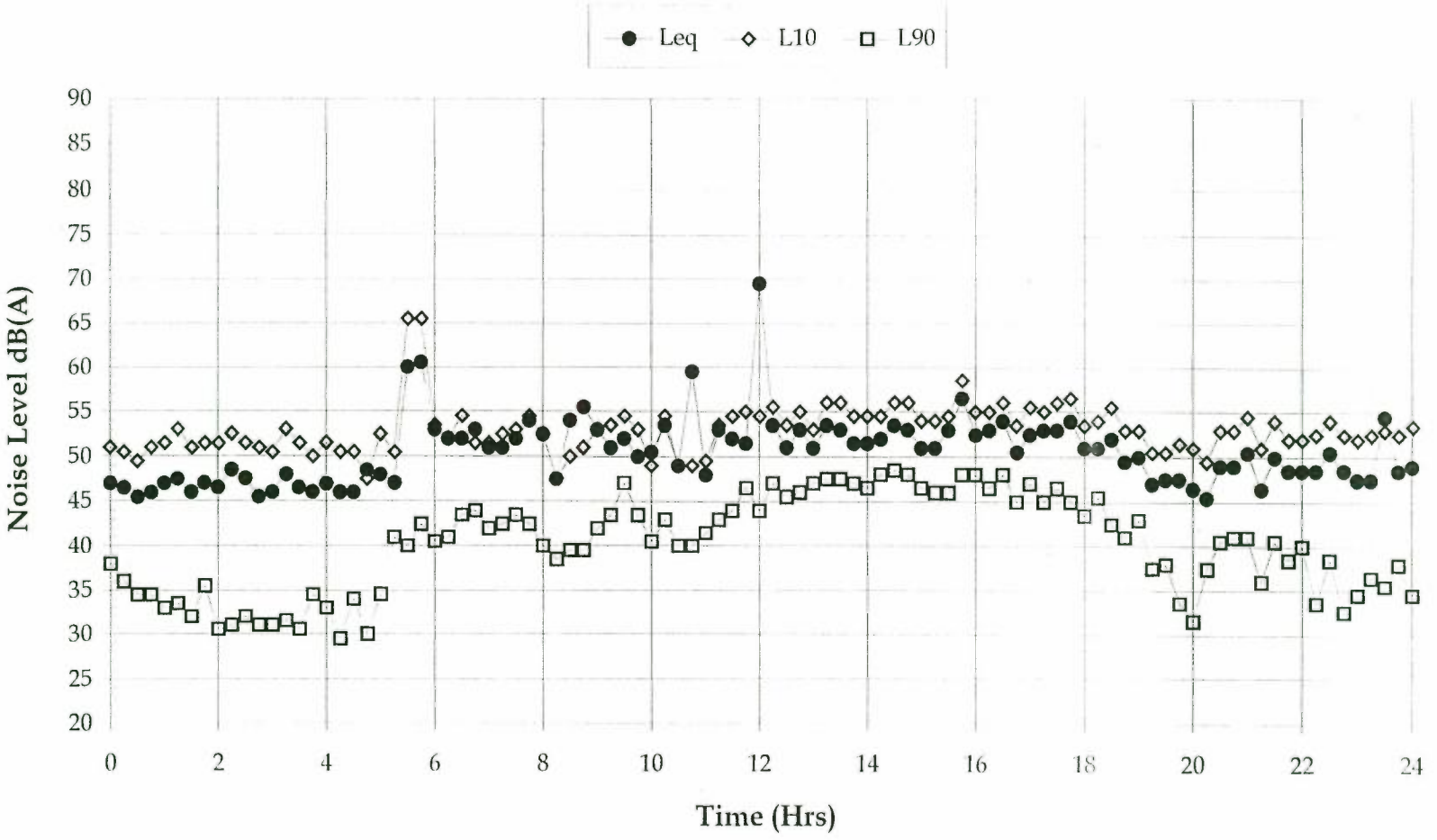
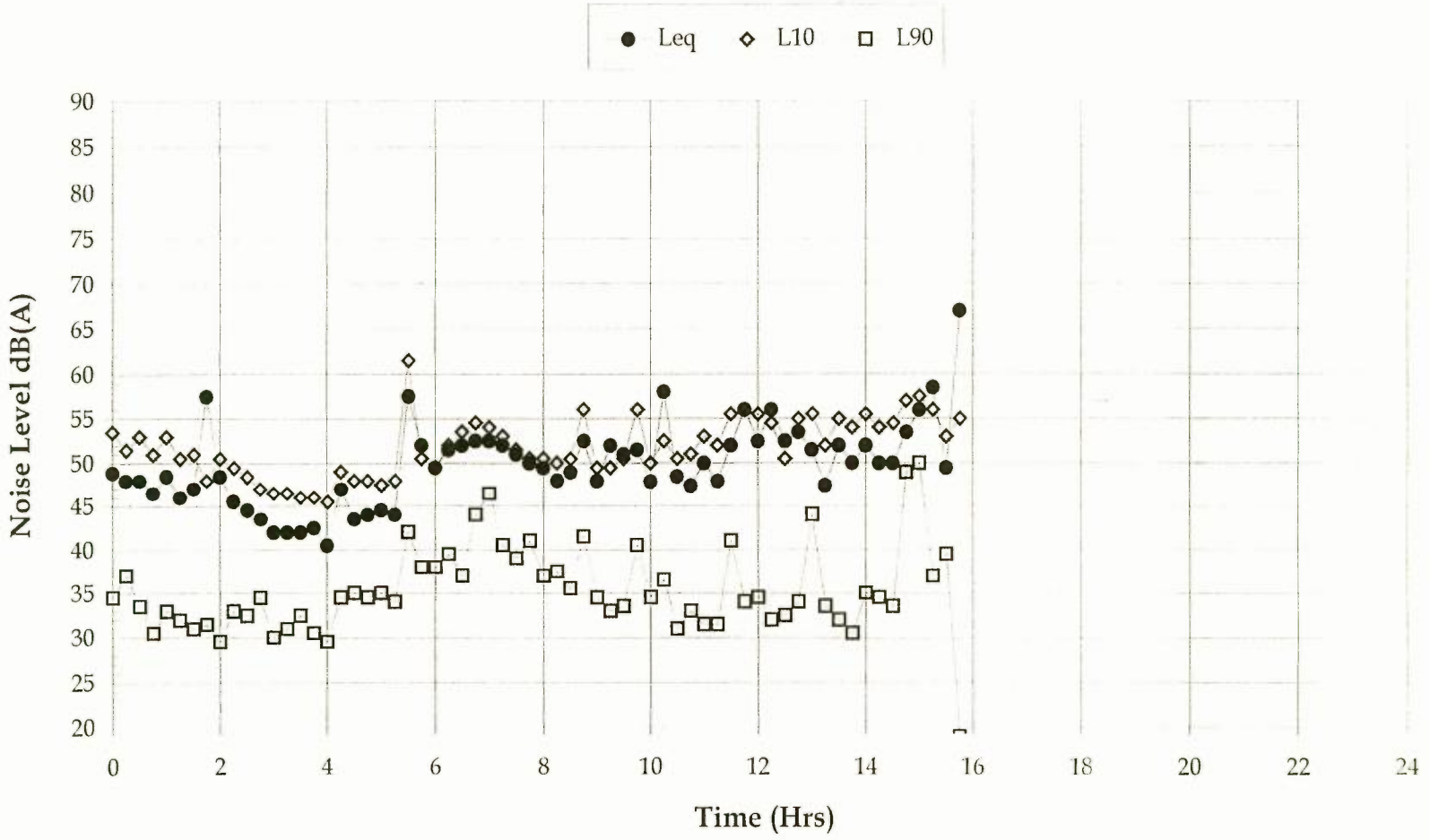
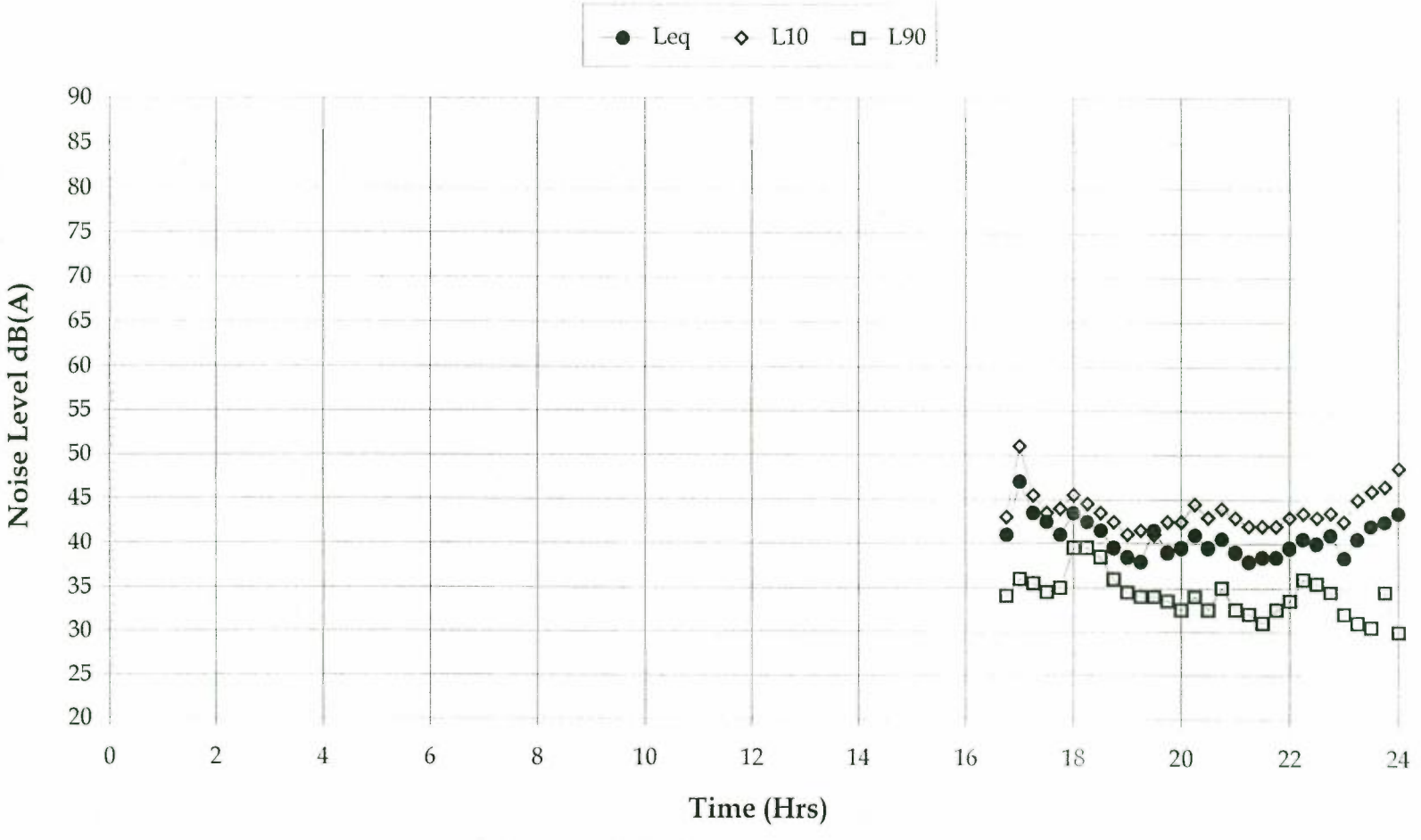


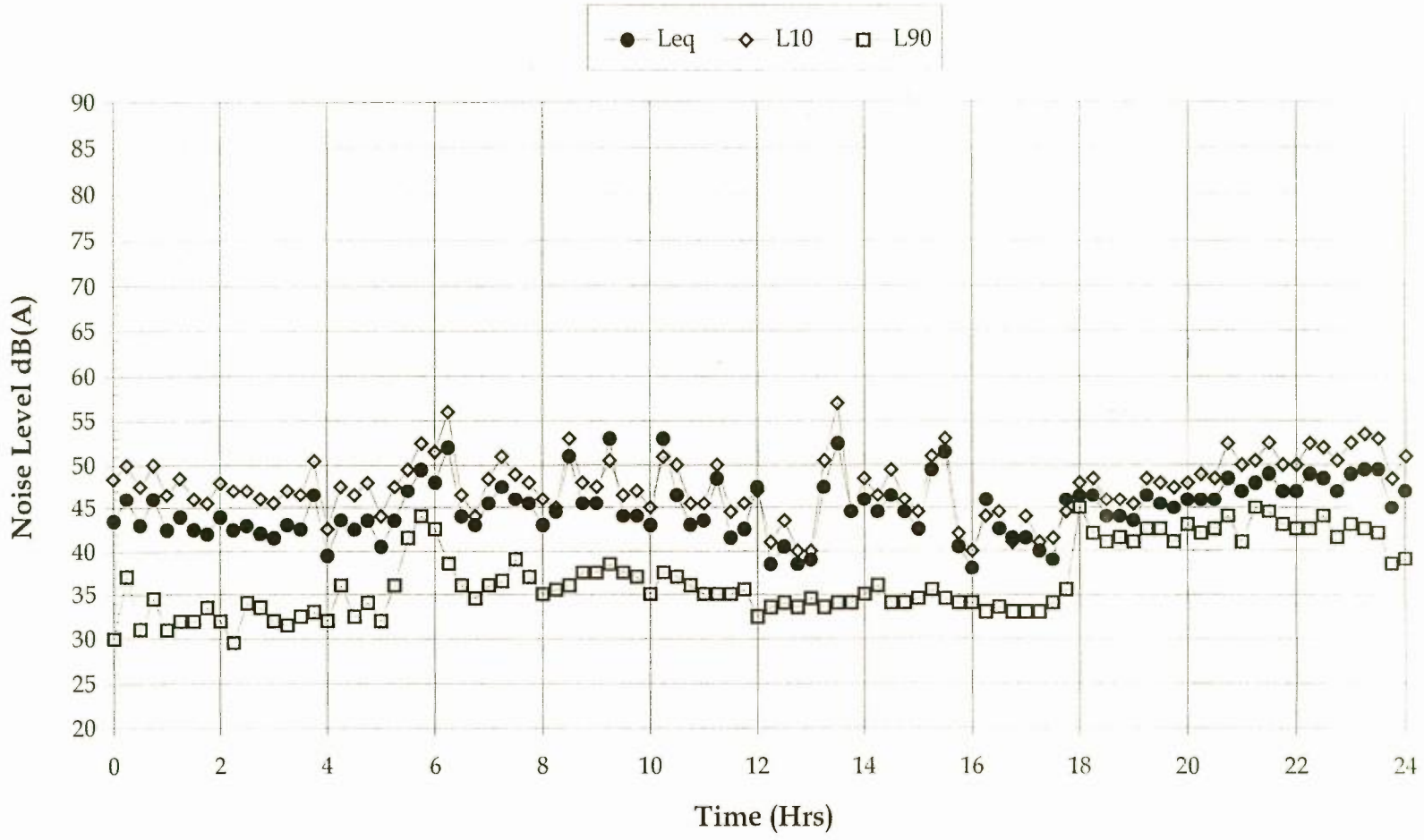
Location C (Reynolds) (330m from highway)
18 September,1997



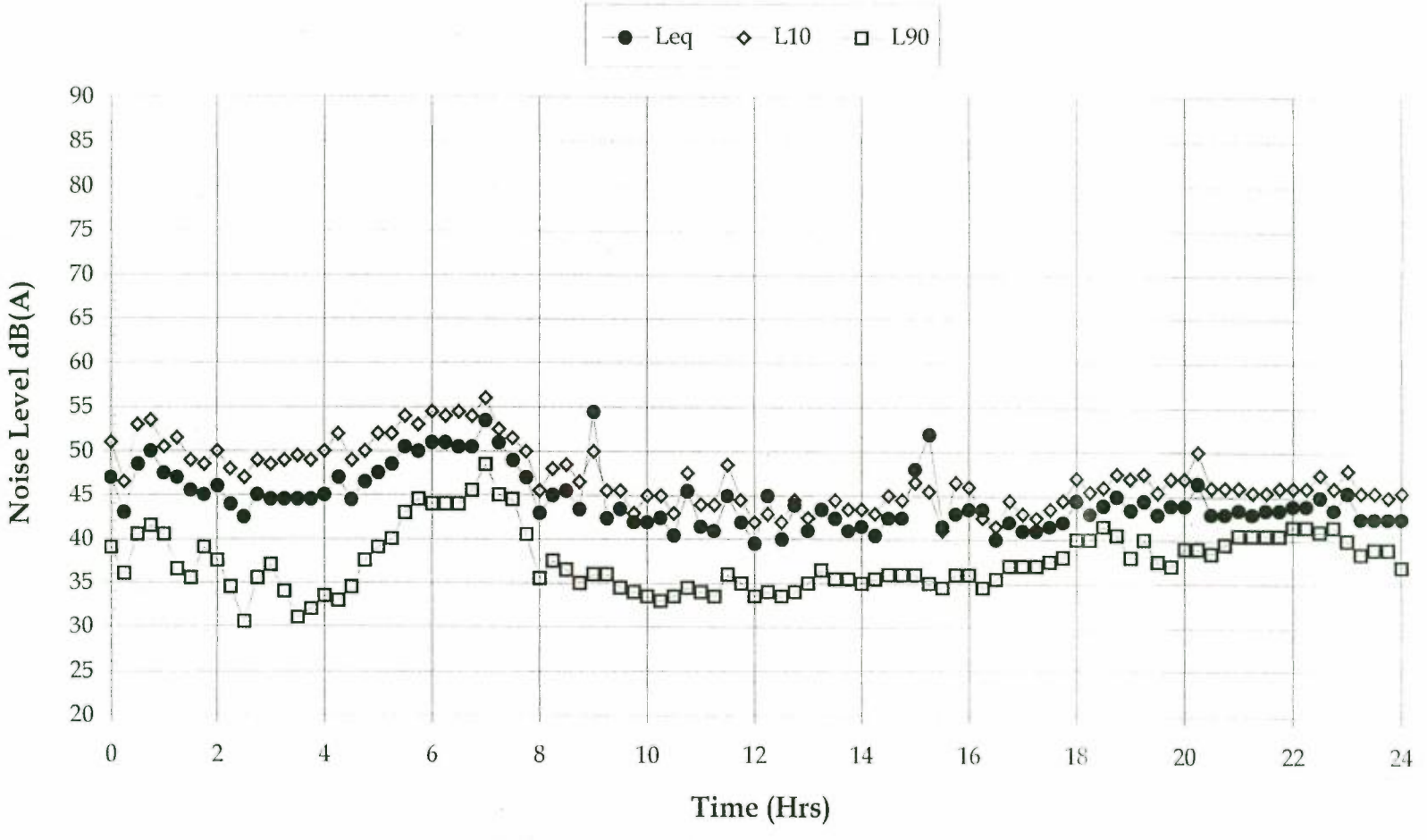
Location D (Benkil P/L) (820m from highway)
11 September,1997



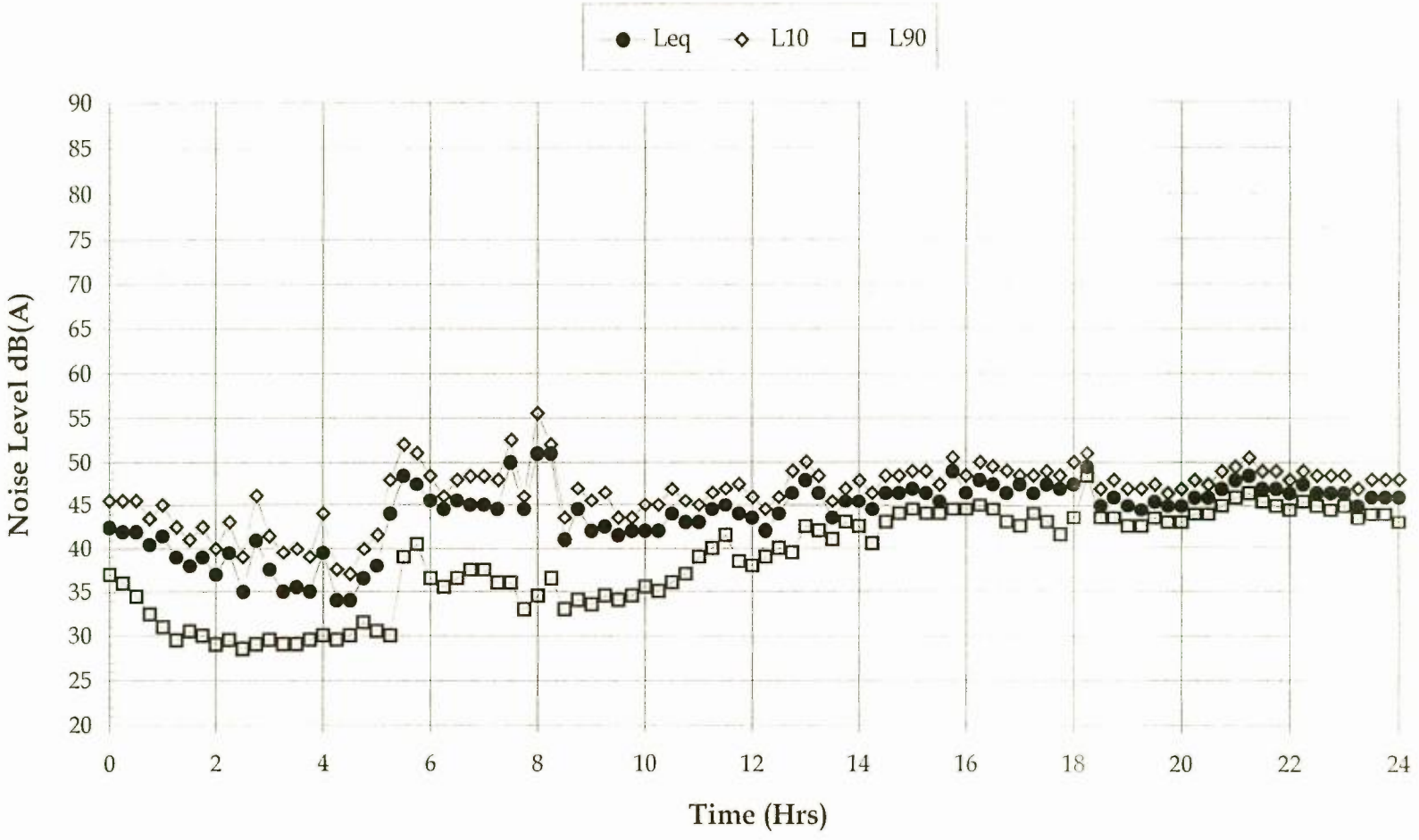
Location D (Benkil P/L) (820m from highway)
12 September,1997



Location D (Benkil P/L) (820m from highway)
13 September,1997



Location D (Benkil P/L) (820m from highway)
14 September,1997



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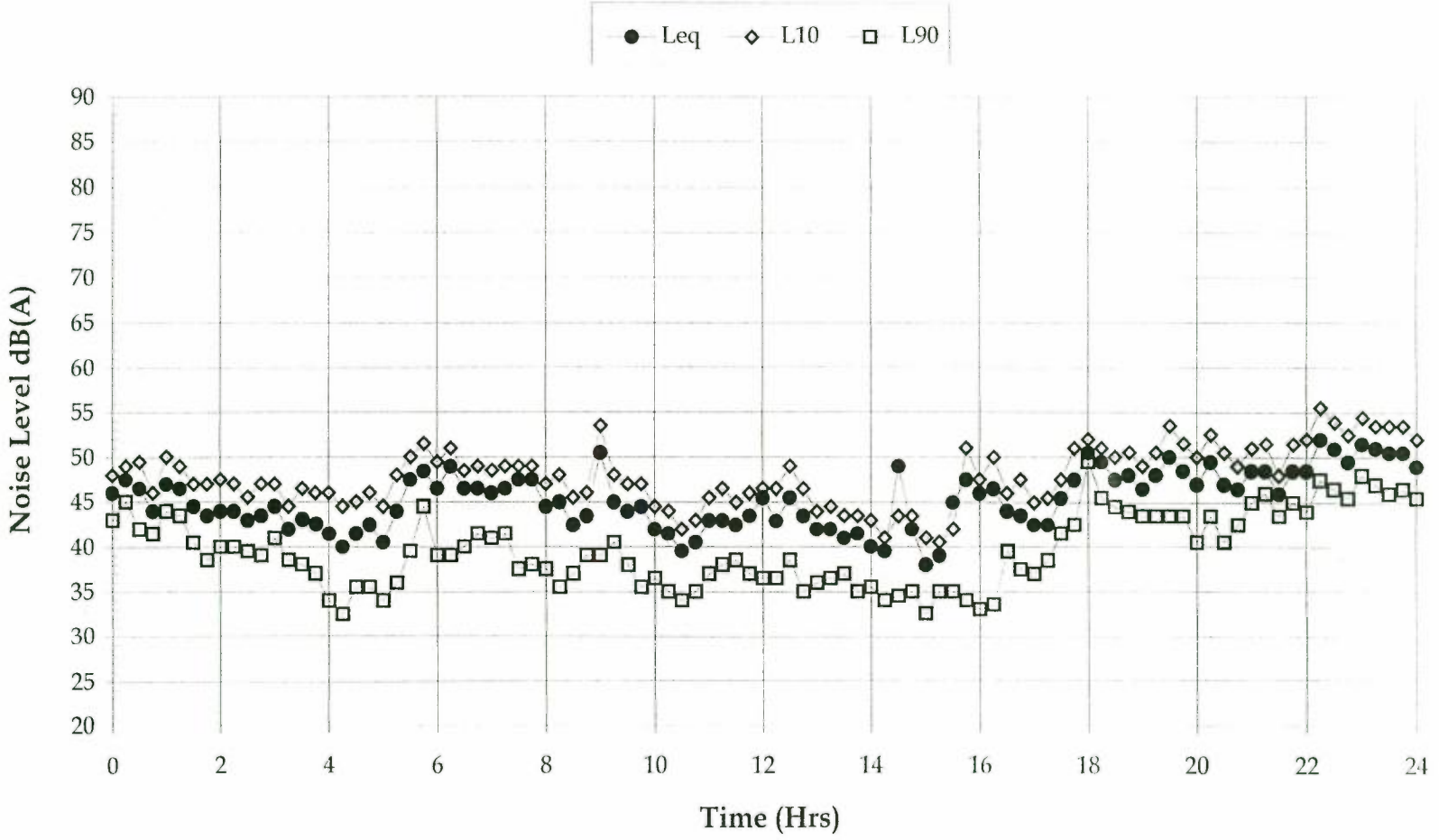
15 September,1997



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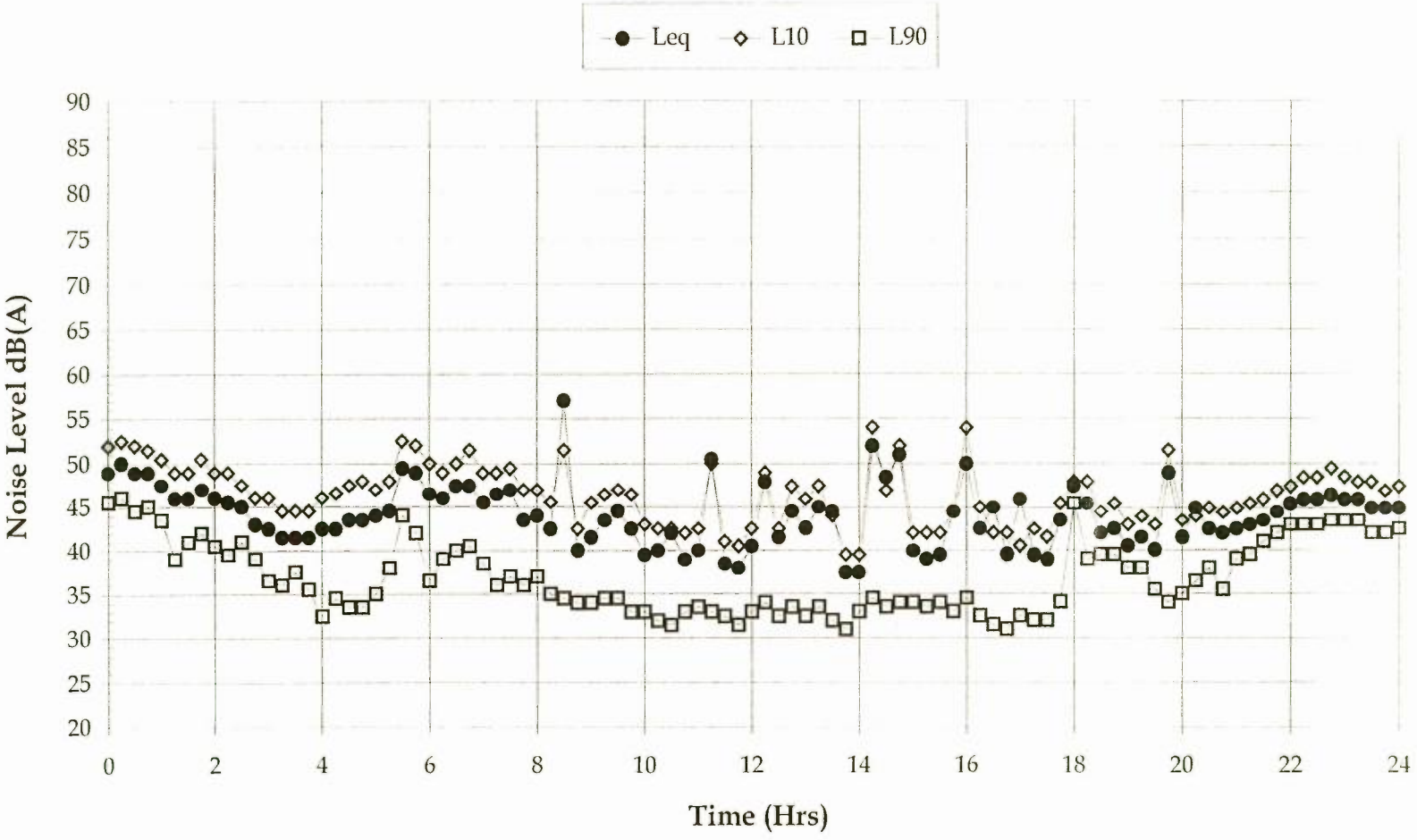
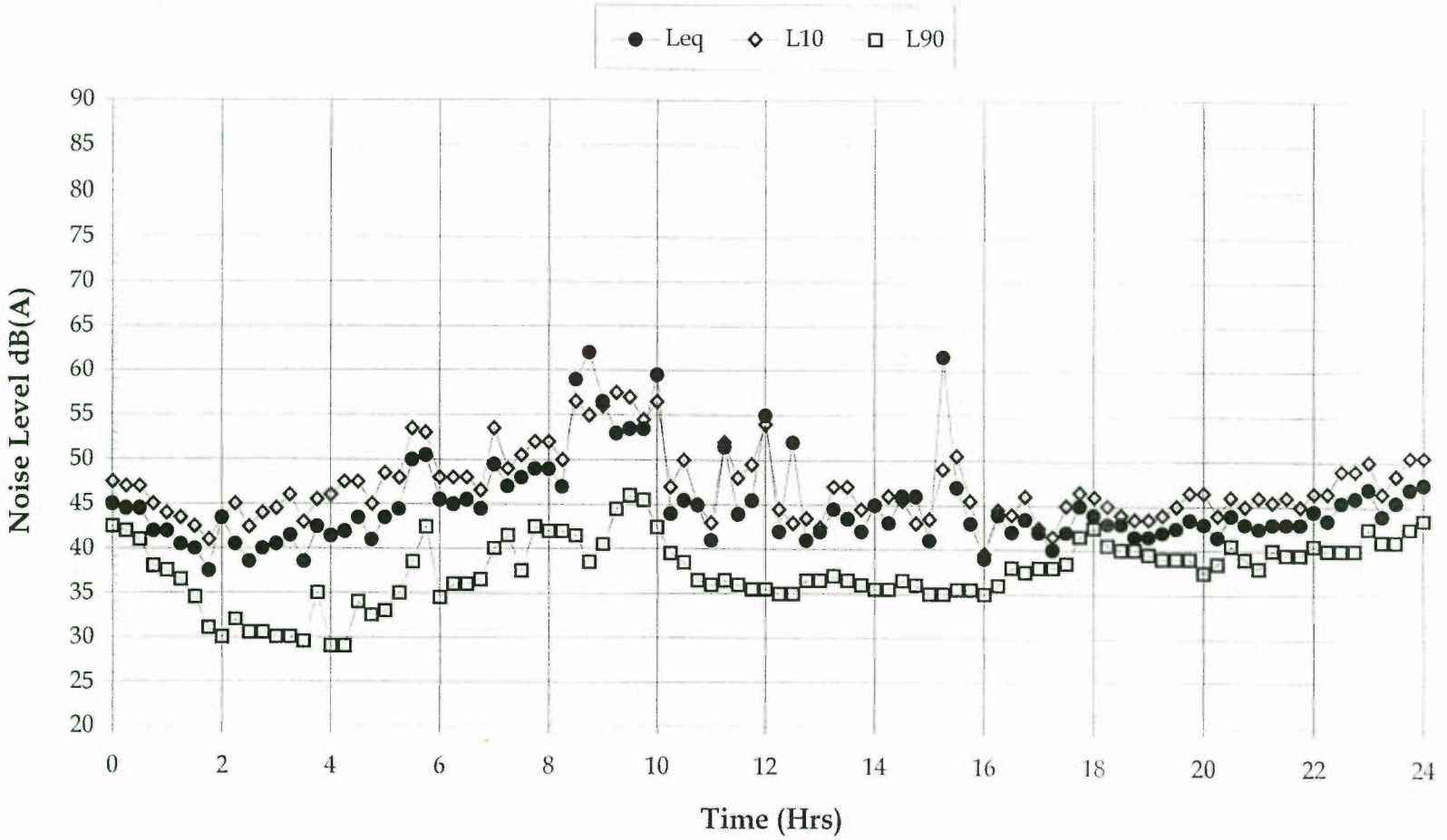


Location D (Benkil P/L) (820m from highway)
17 September,1997



Location D (Benkil P/L) (820m from highway)
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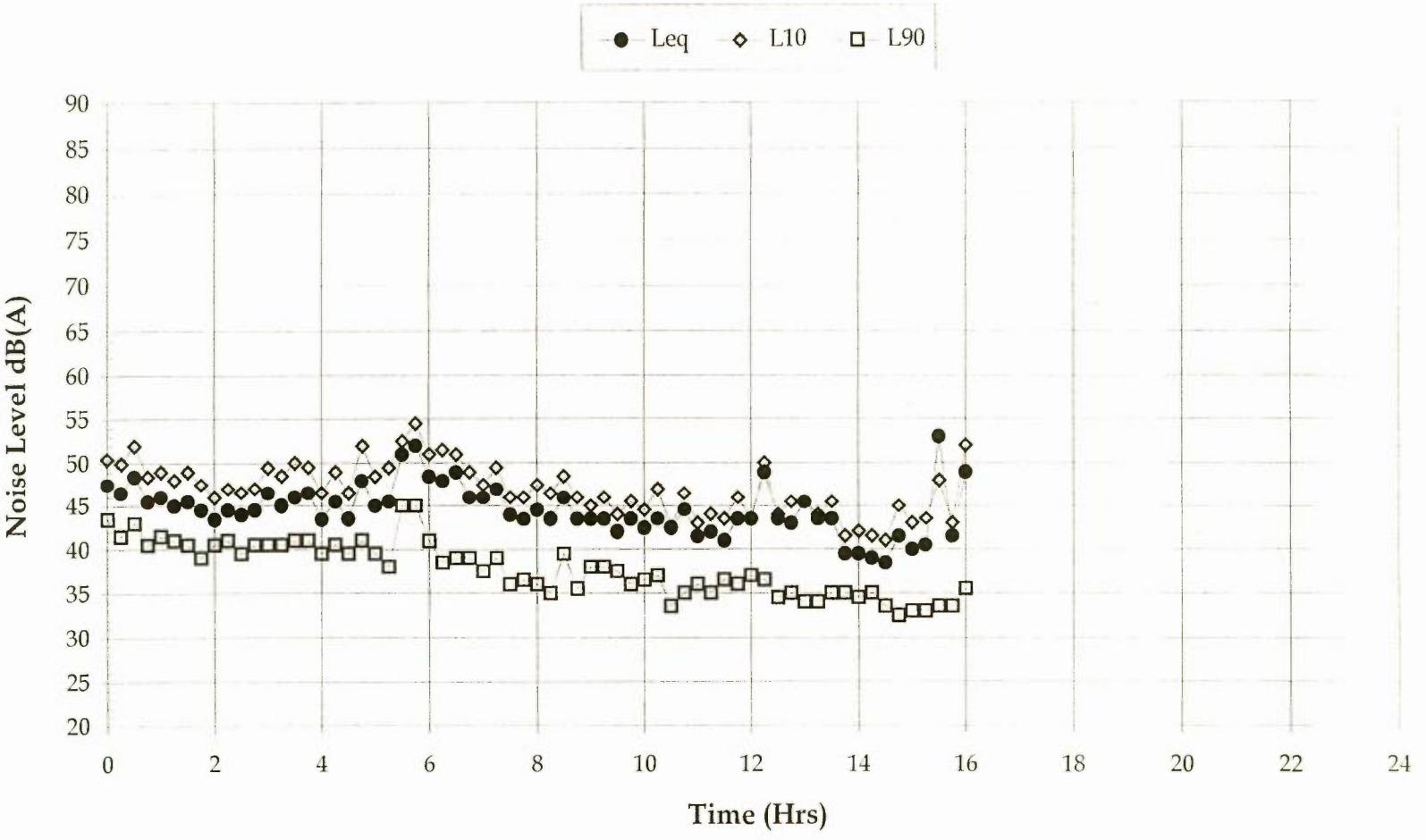
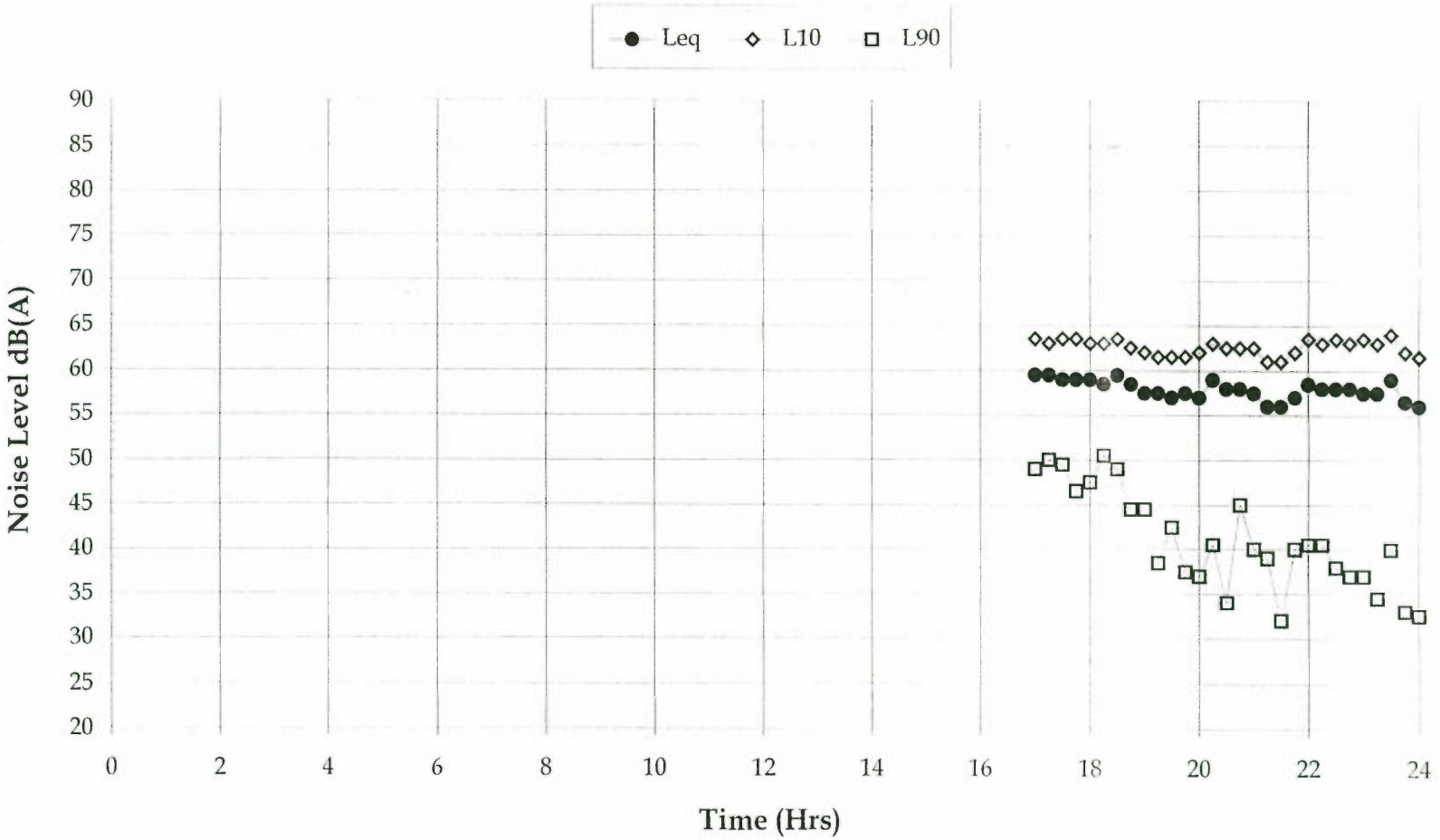
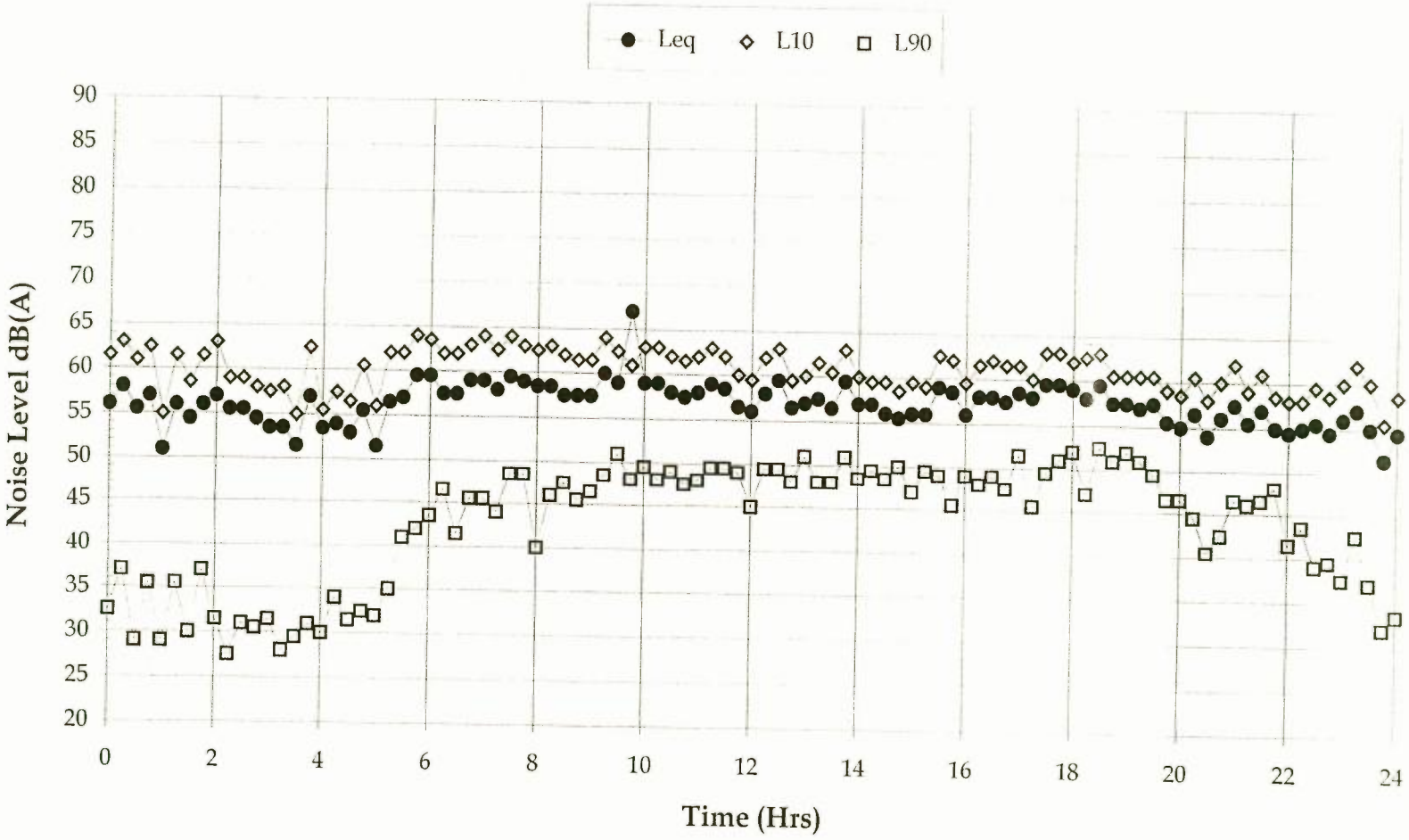


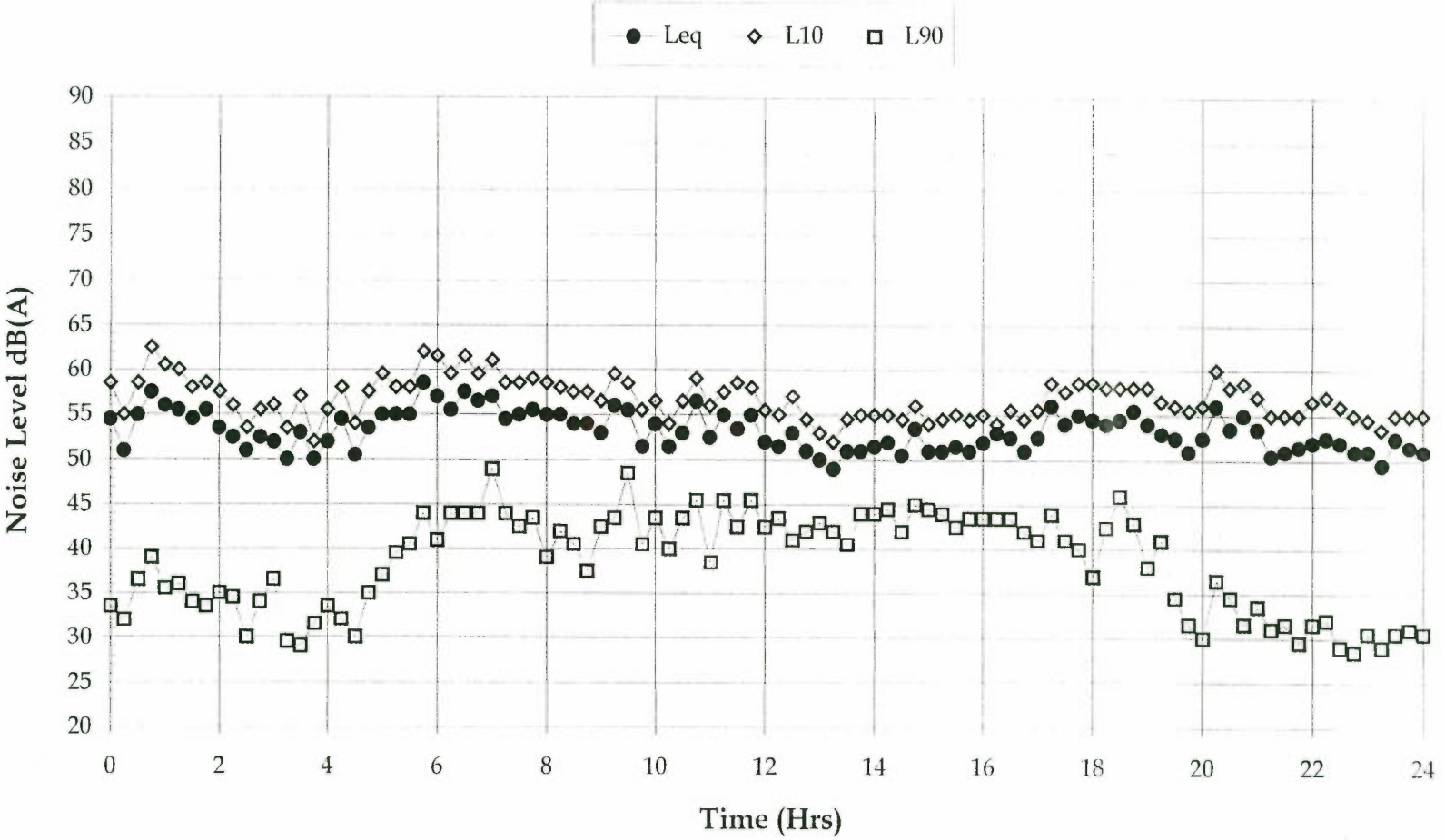
Location E (Rose) (120m from highway)
11 September 1997



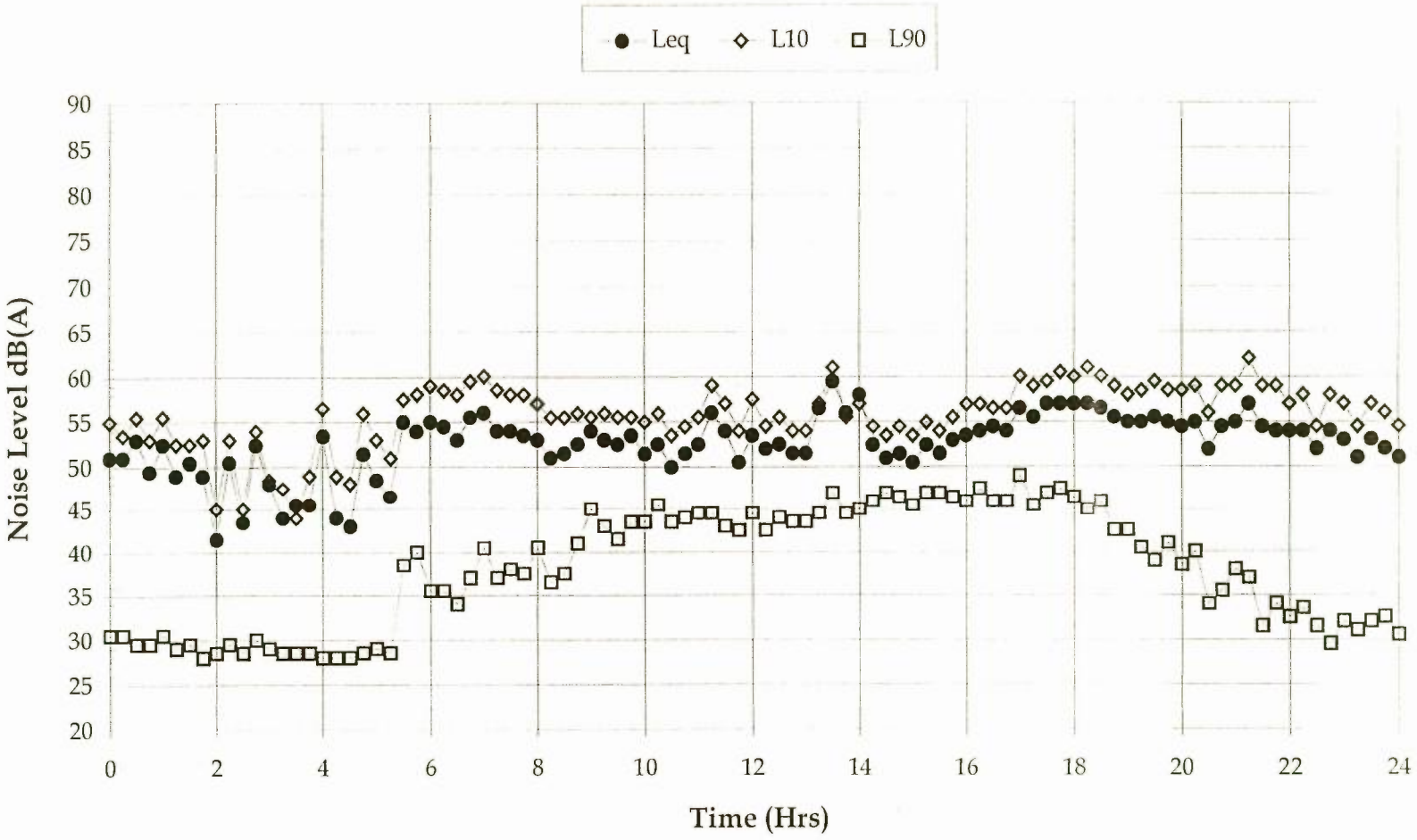
Location E (Rose) (120m from highway)
12 September 1997



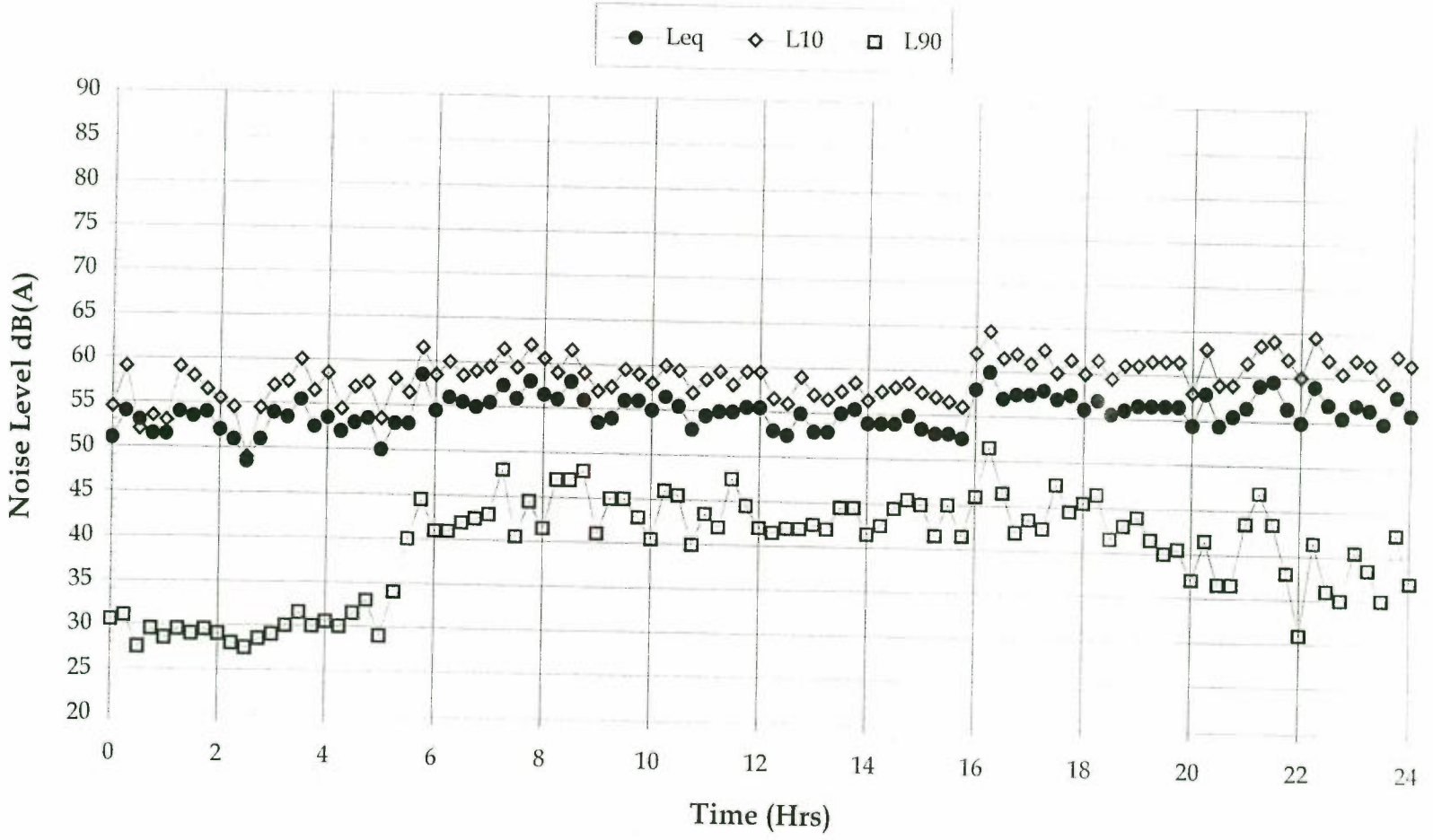
Location E (Rose) (120m from highway)
13 September 1997



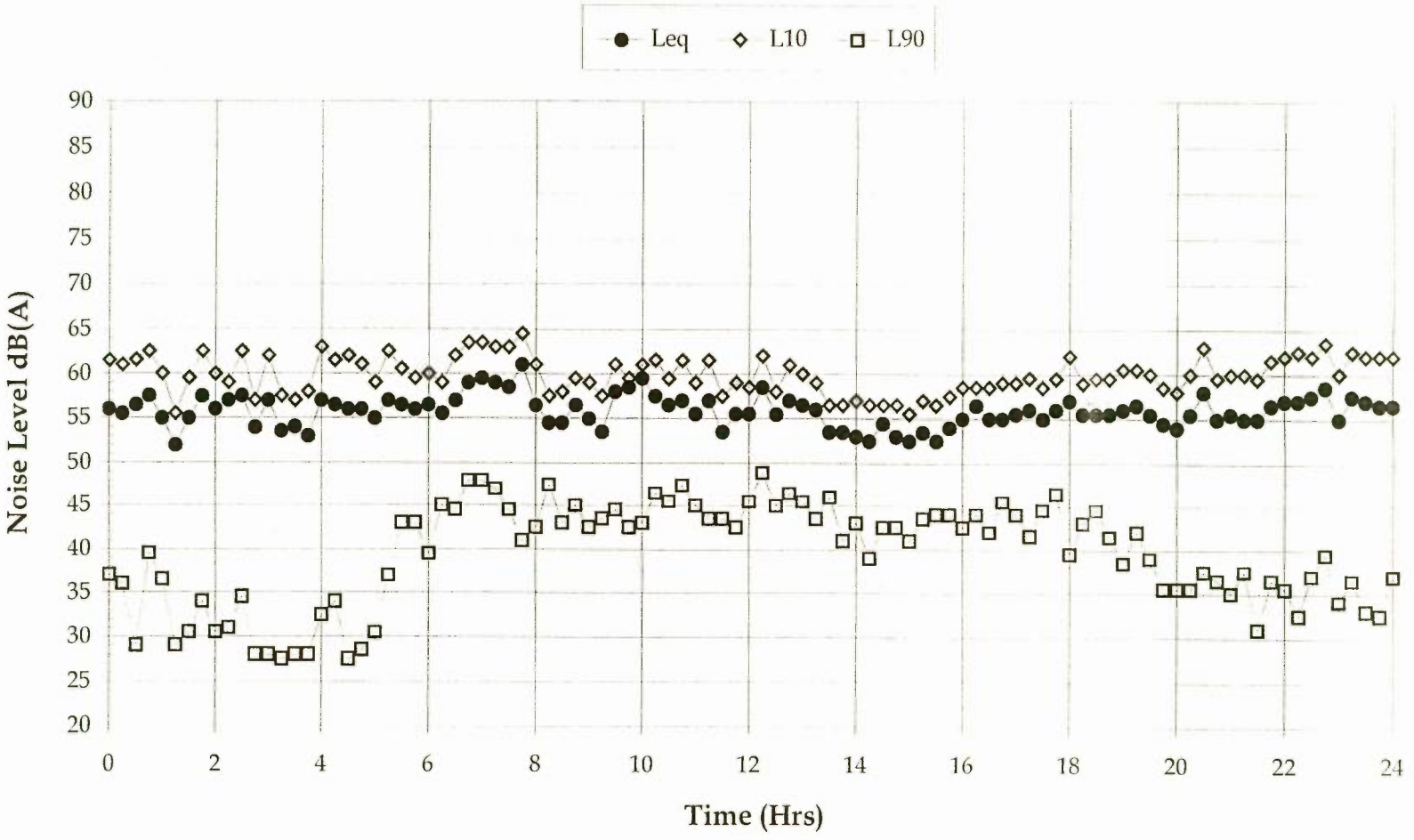
Location E (Rose) (120m from highway)
14 September 1997



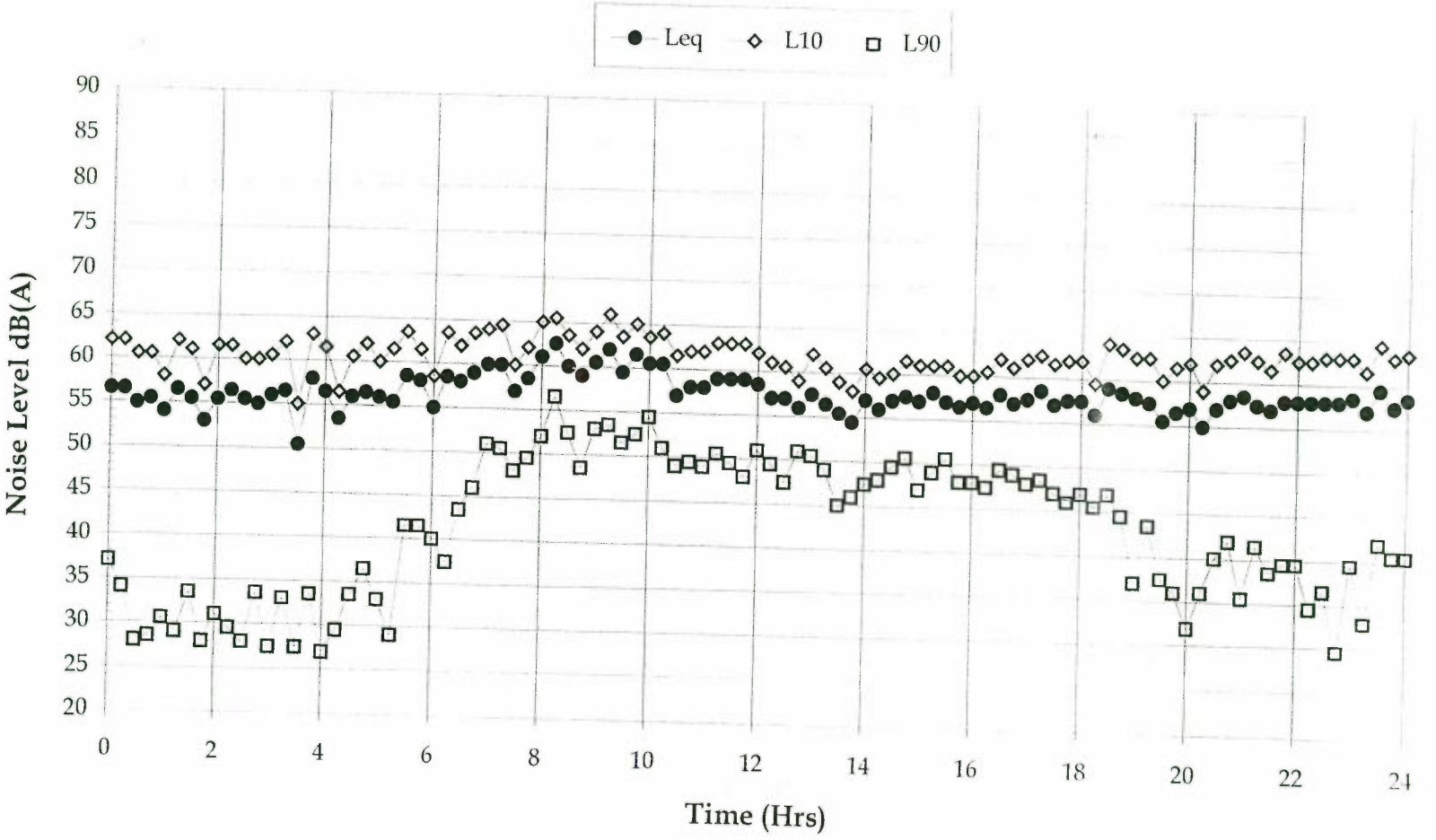
Location E (Rose) (120m from highway)
15 September 1997



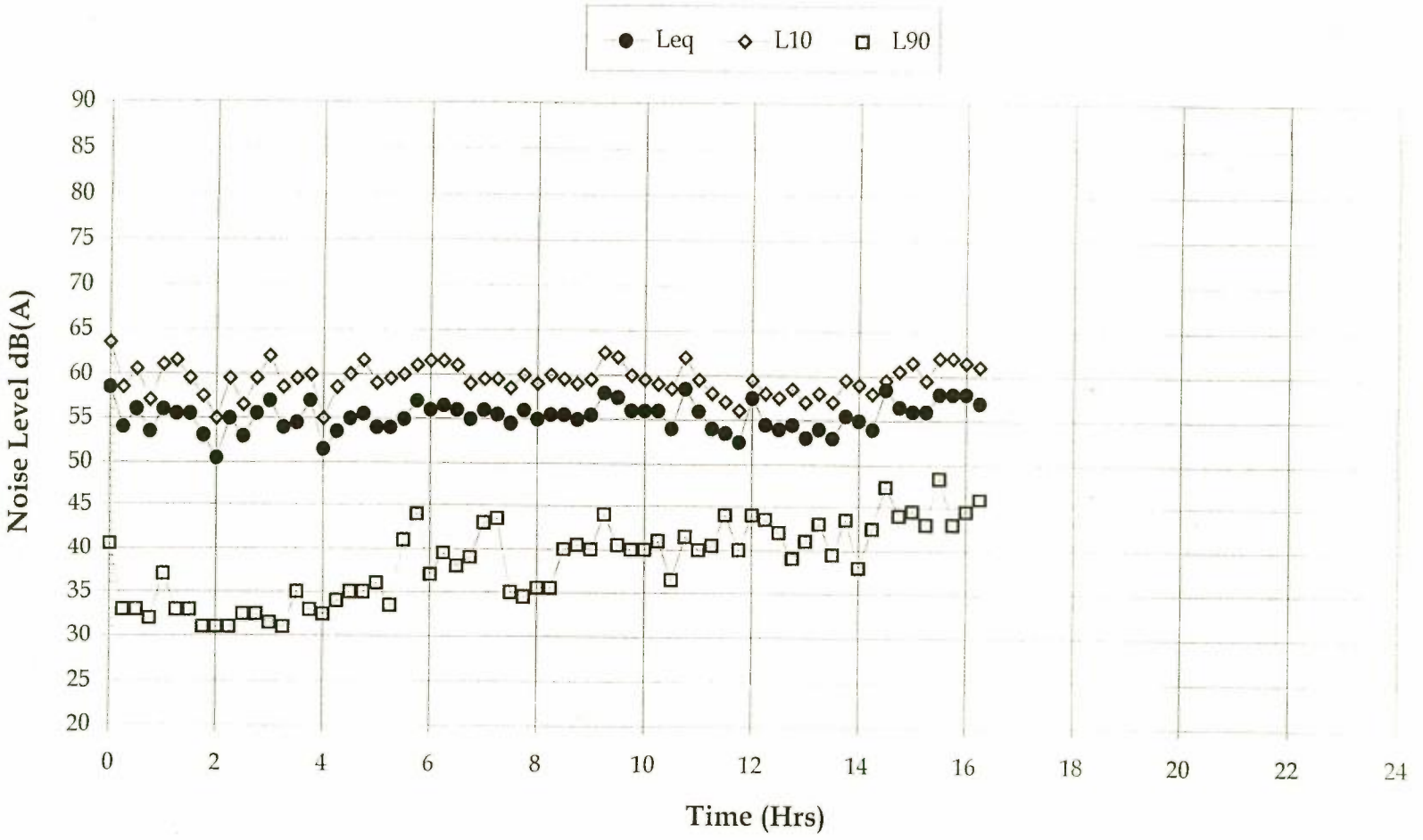
Location E (Rose) (120m from highway)
16 September 1997



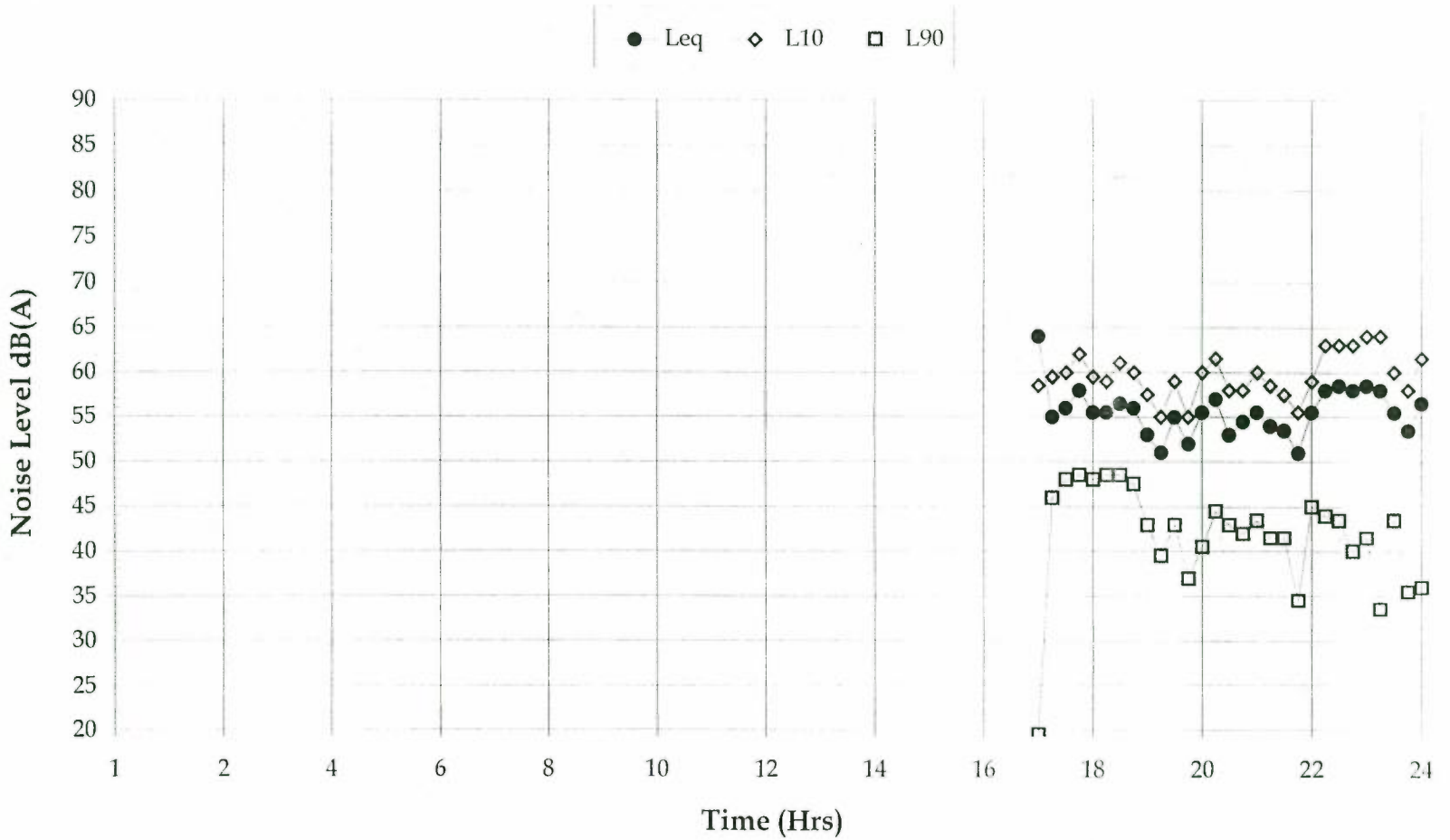
Location E (Rose) (120m from highway)
17 September 1997



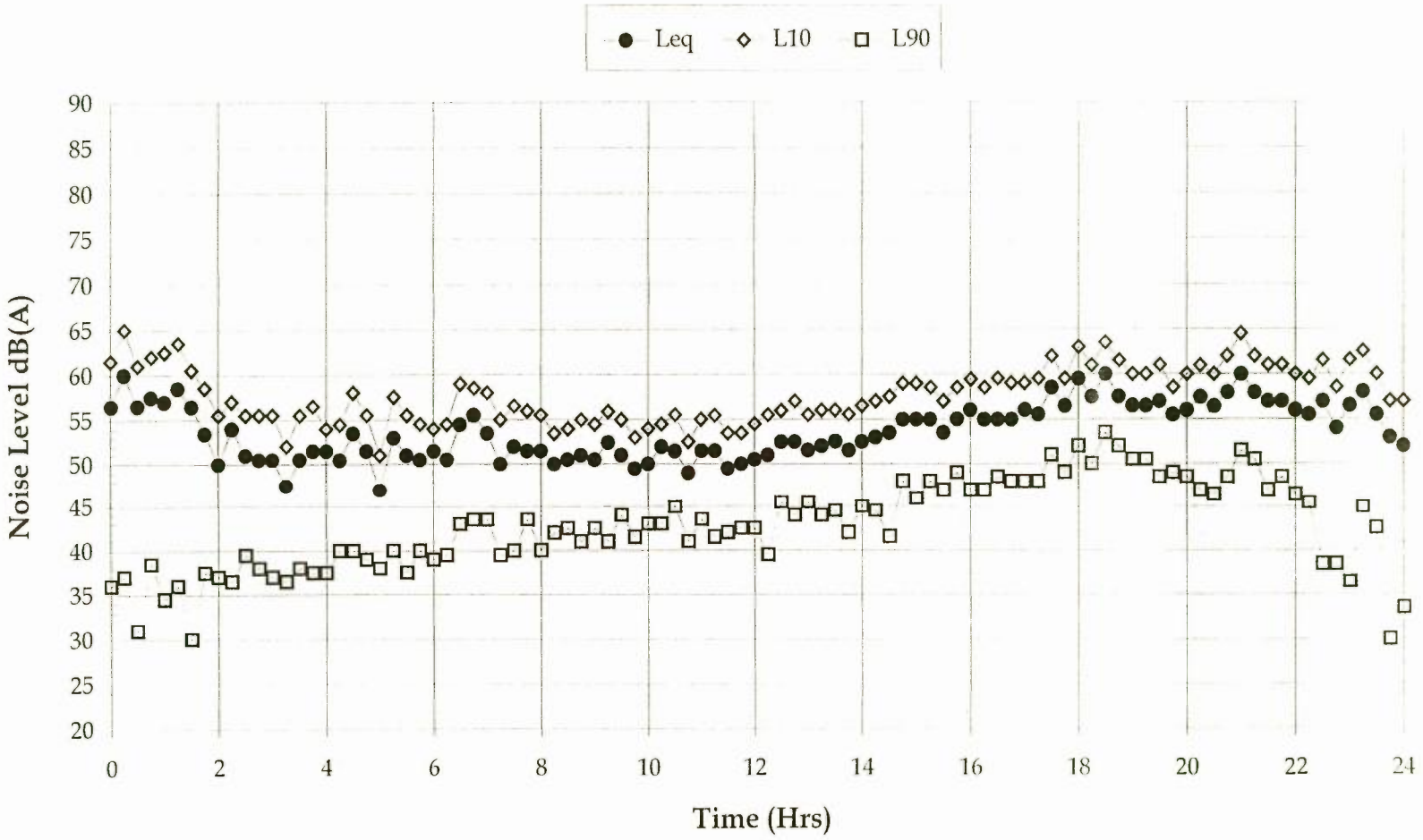
Location E (Rose) (120m from highway)
18 September 1997



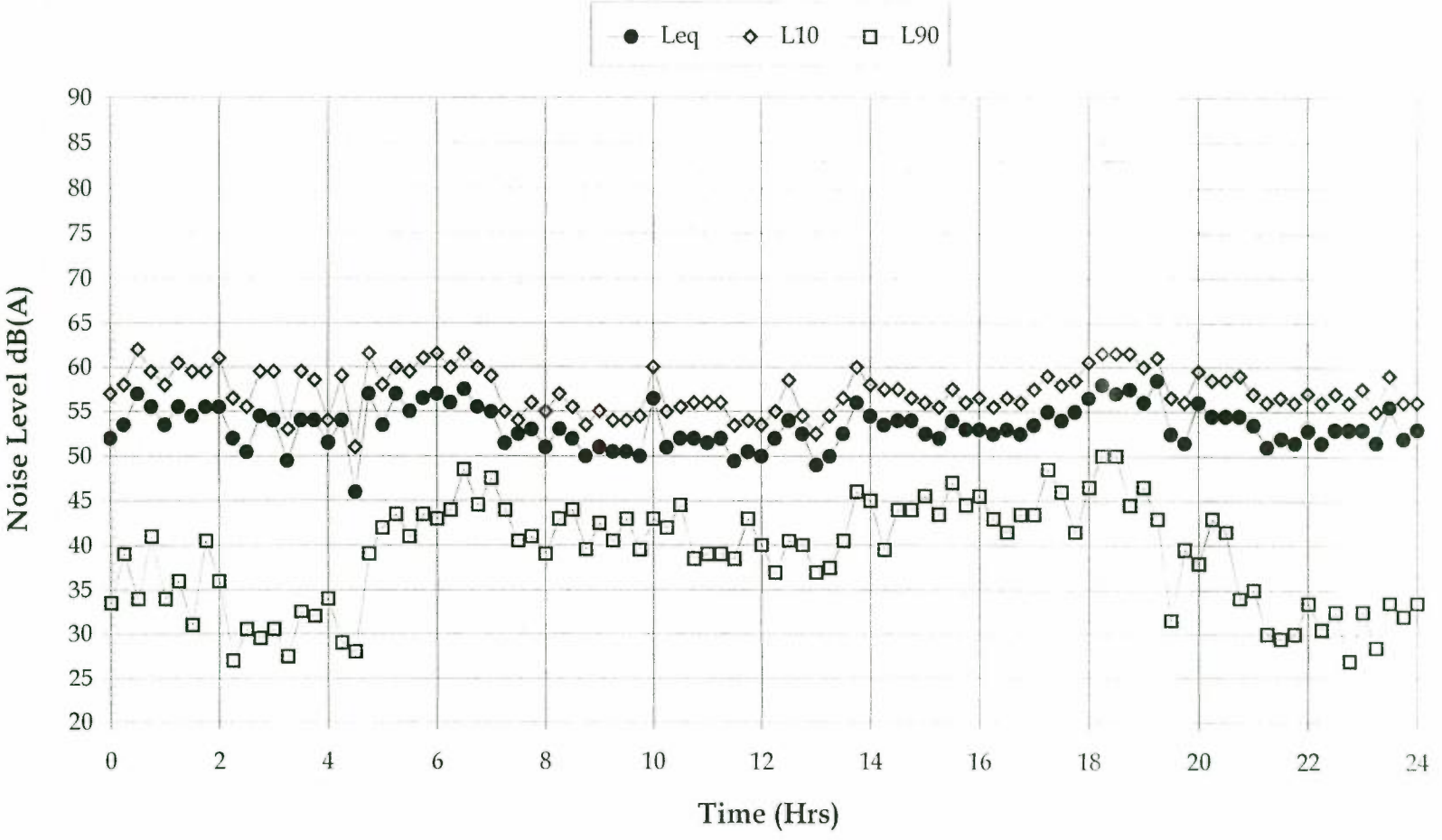
Location F (Houston) (100m from highway)
11 September,1997



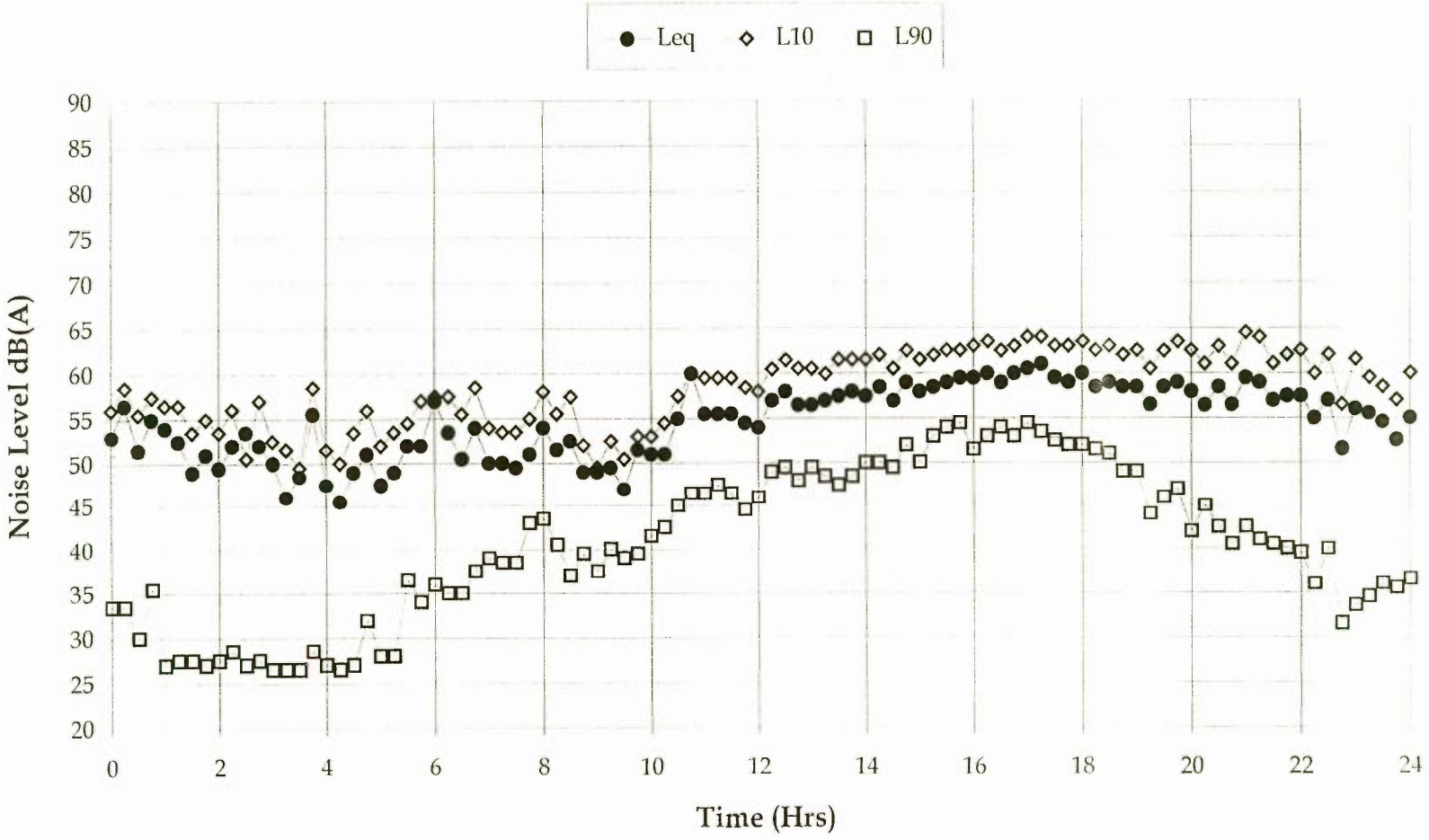
Location F (Houston) (100m from highway)
12 September,1997



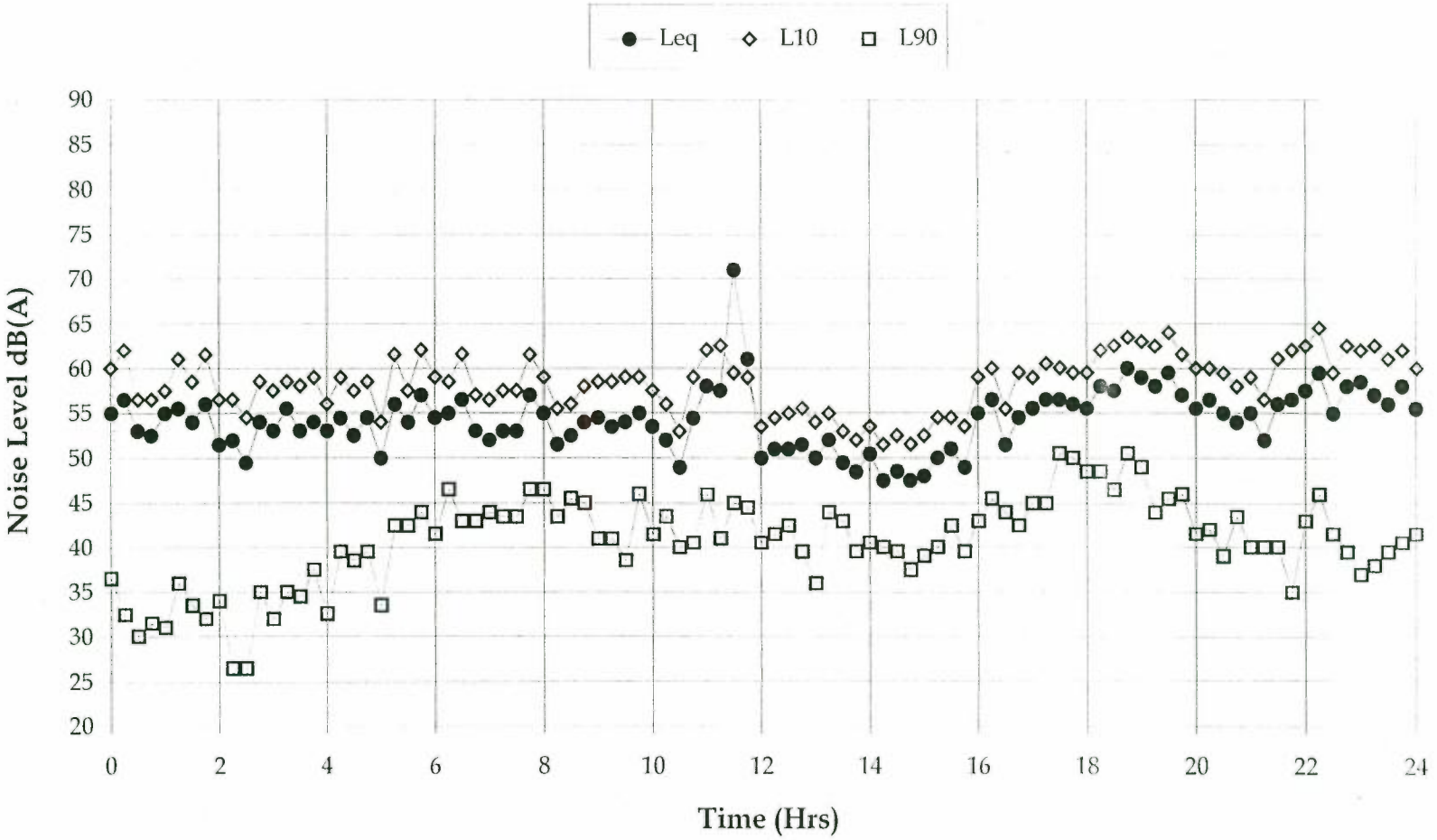
Location F (Houston) (100m from highway)
13 September,1997



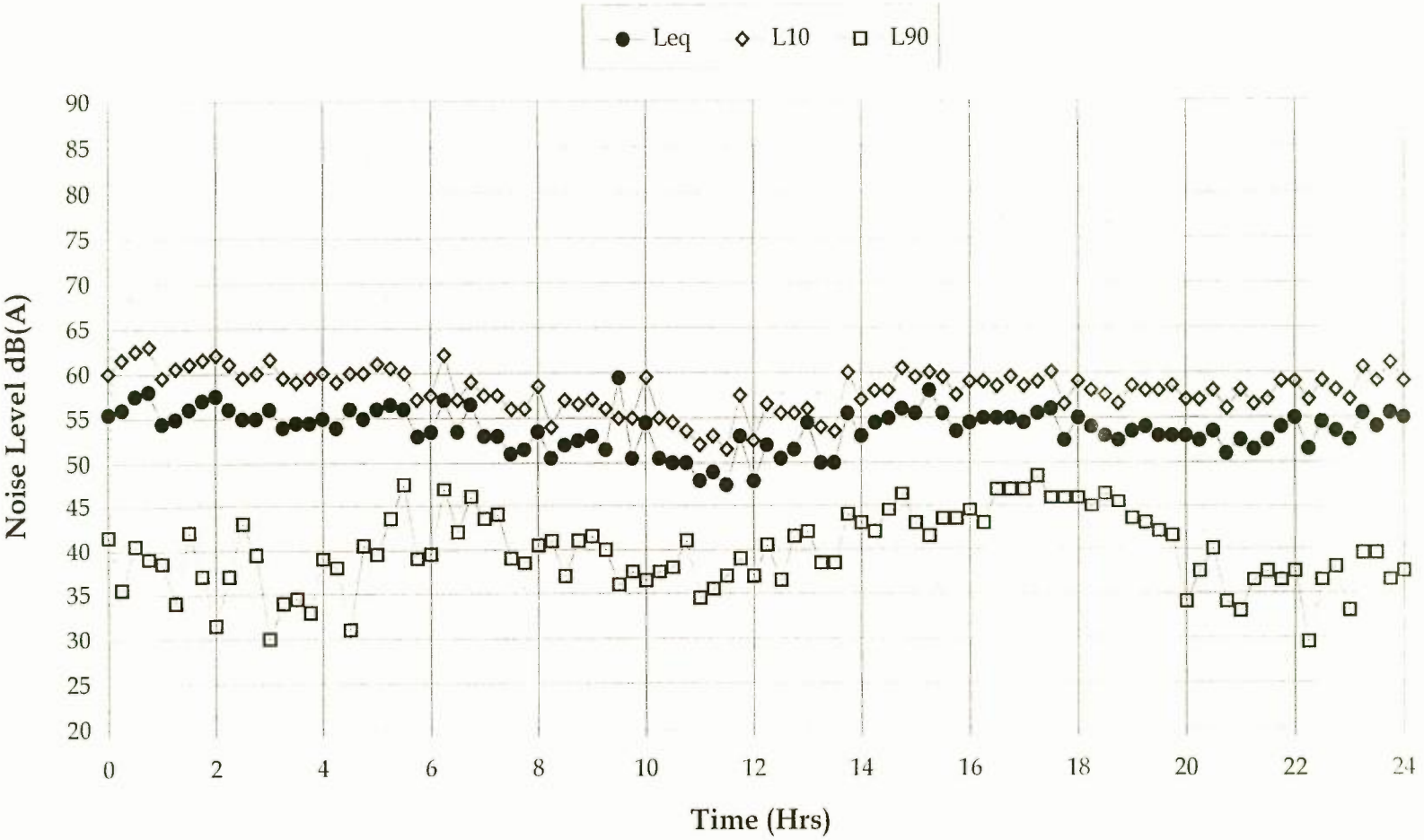
Location F (Houston) (100m from highway)
14 September,1997



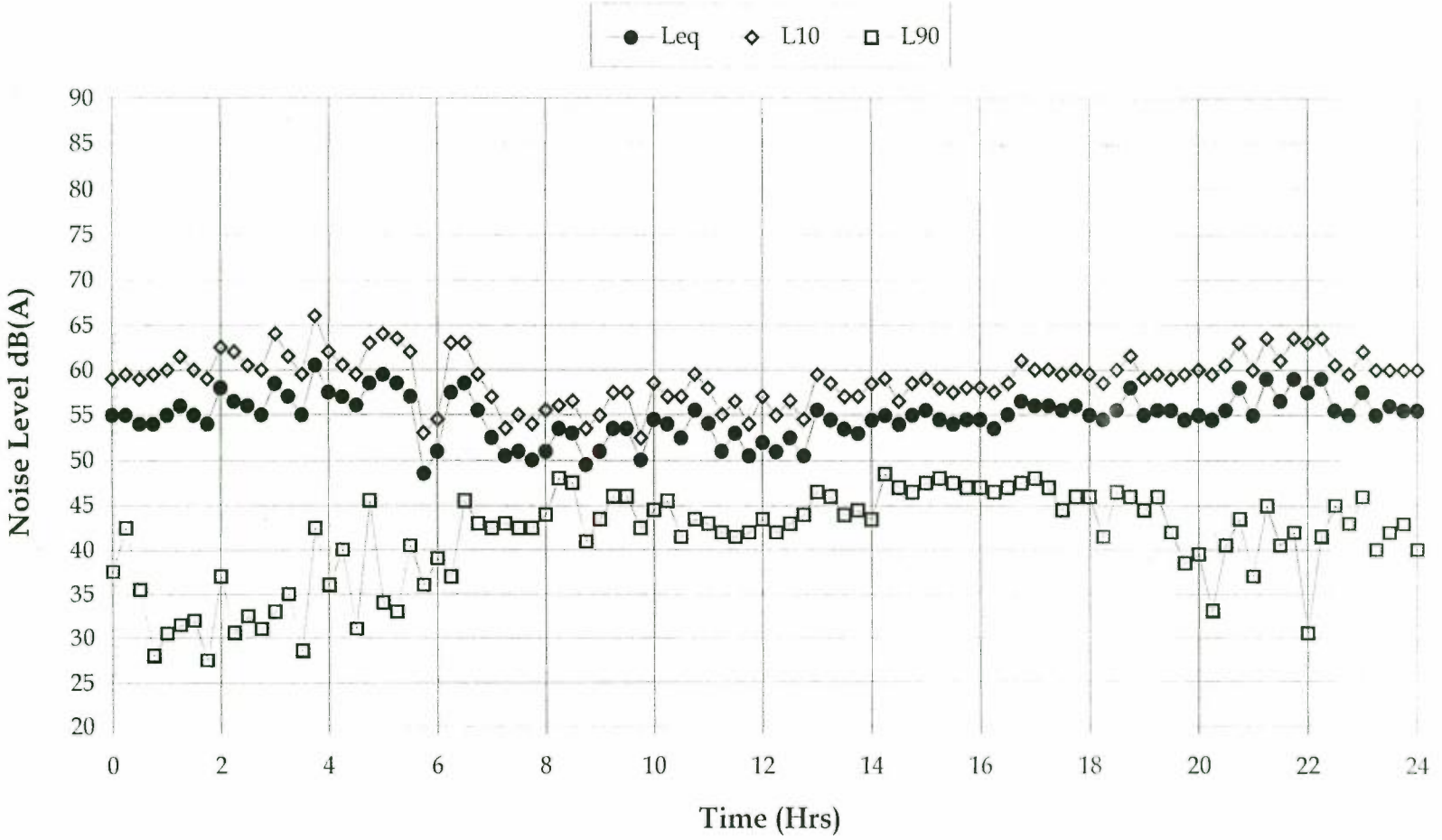
Location F (Houston) (100m from highway)
15 September,1997



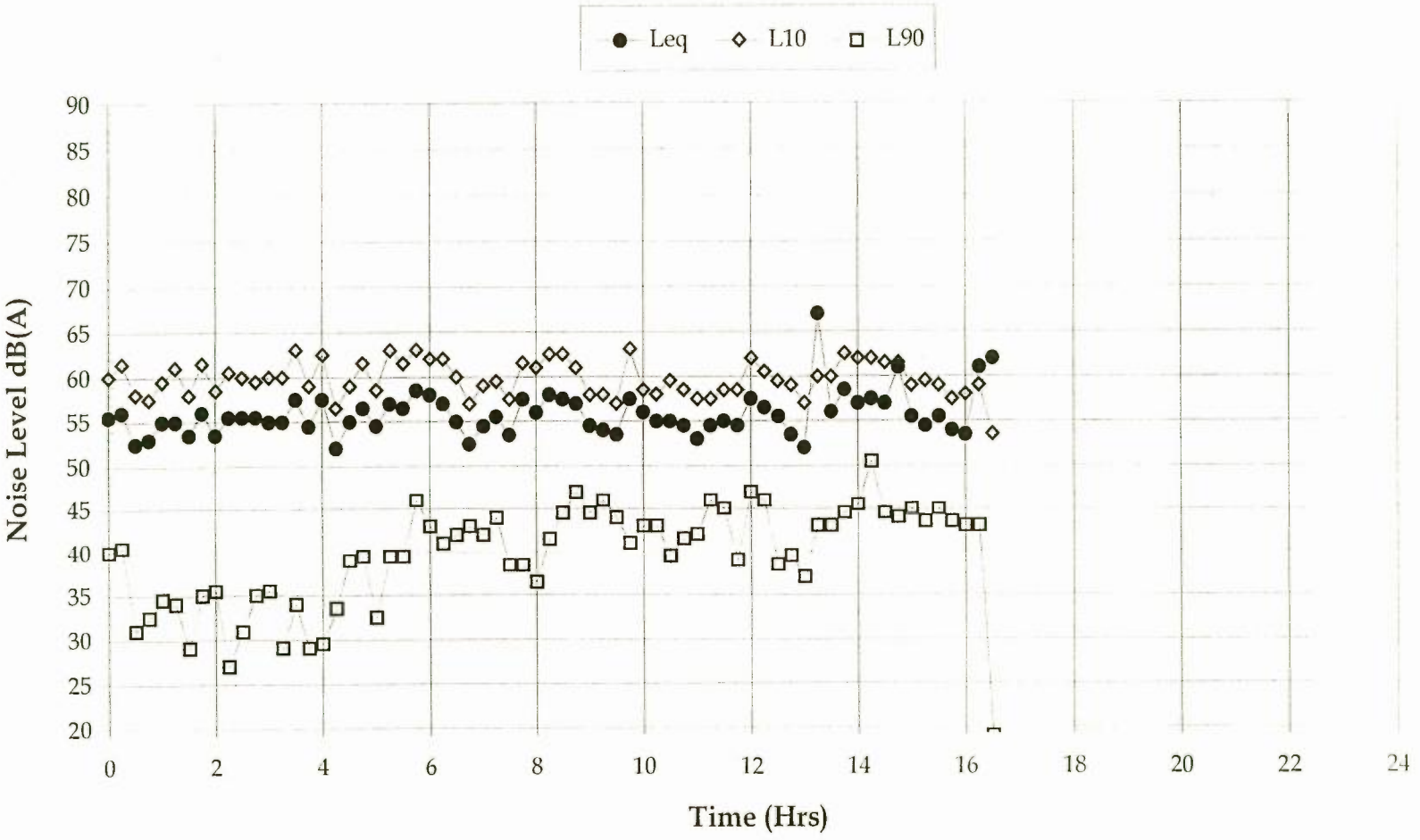
Location F (Houston) (100m from highway)
16 September,1997



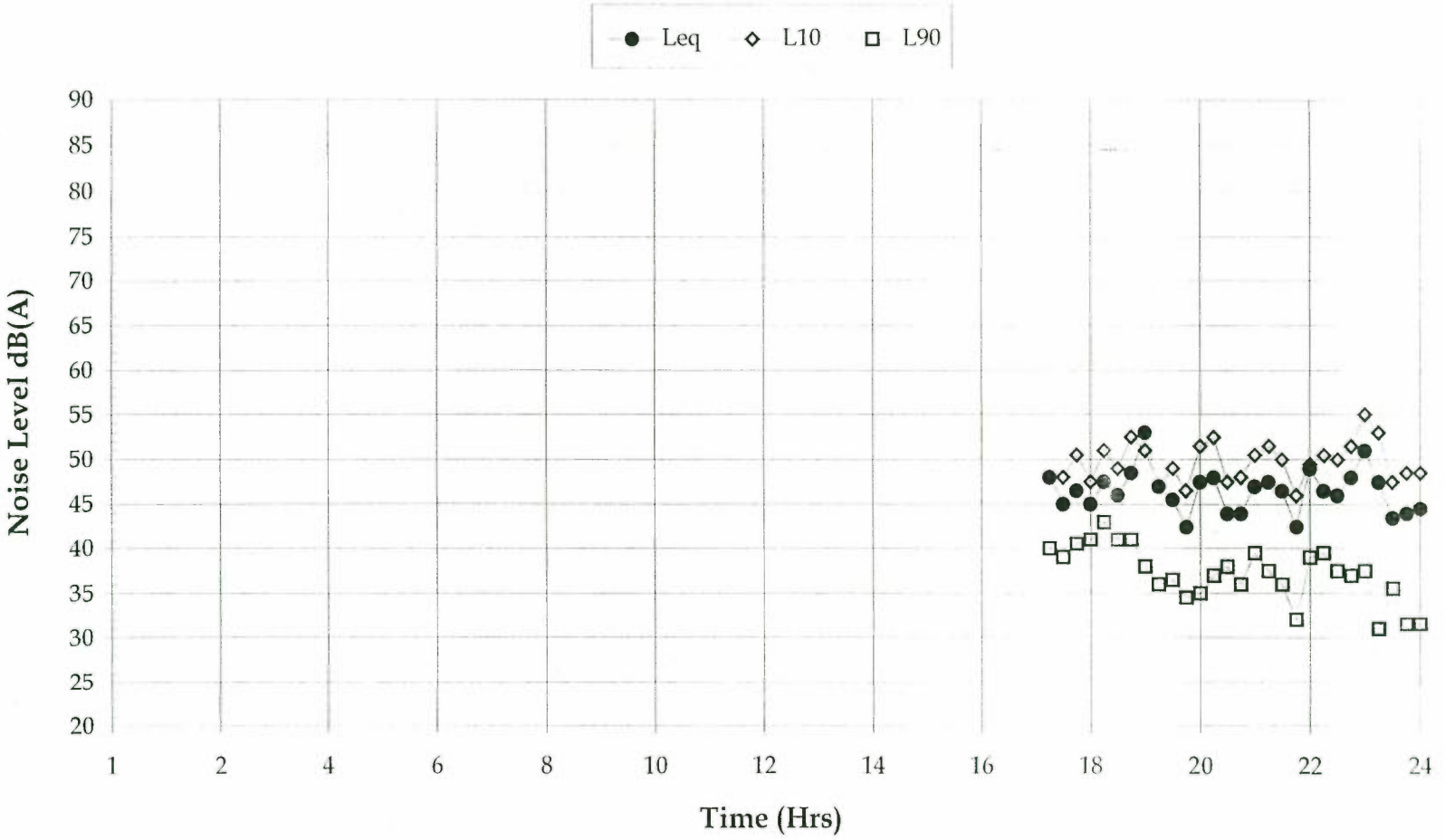
Location F (Houston) (100m from highway)
17 September,1997



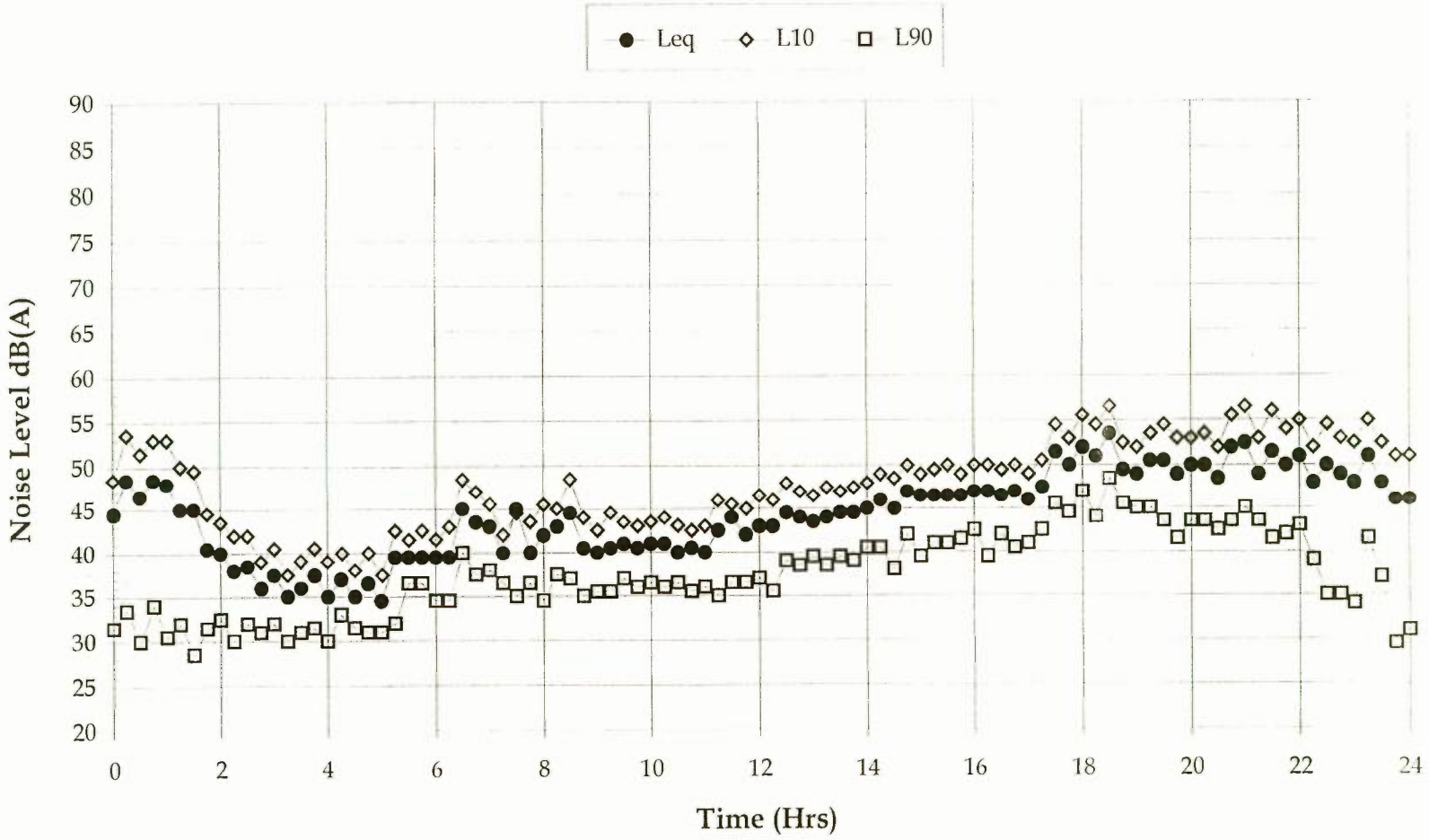
Location F (Houston) (100m from highway)
18 September,1997



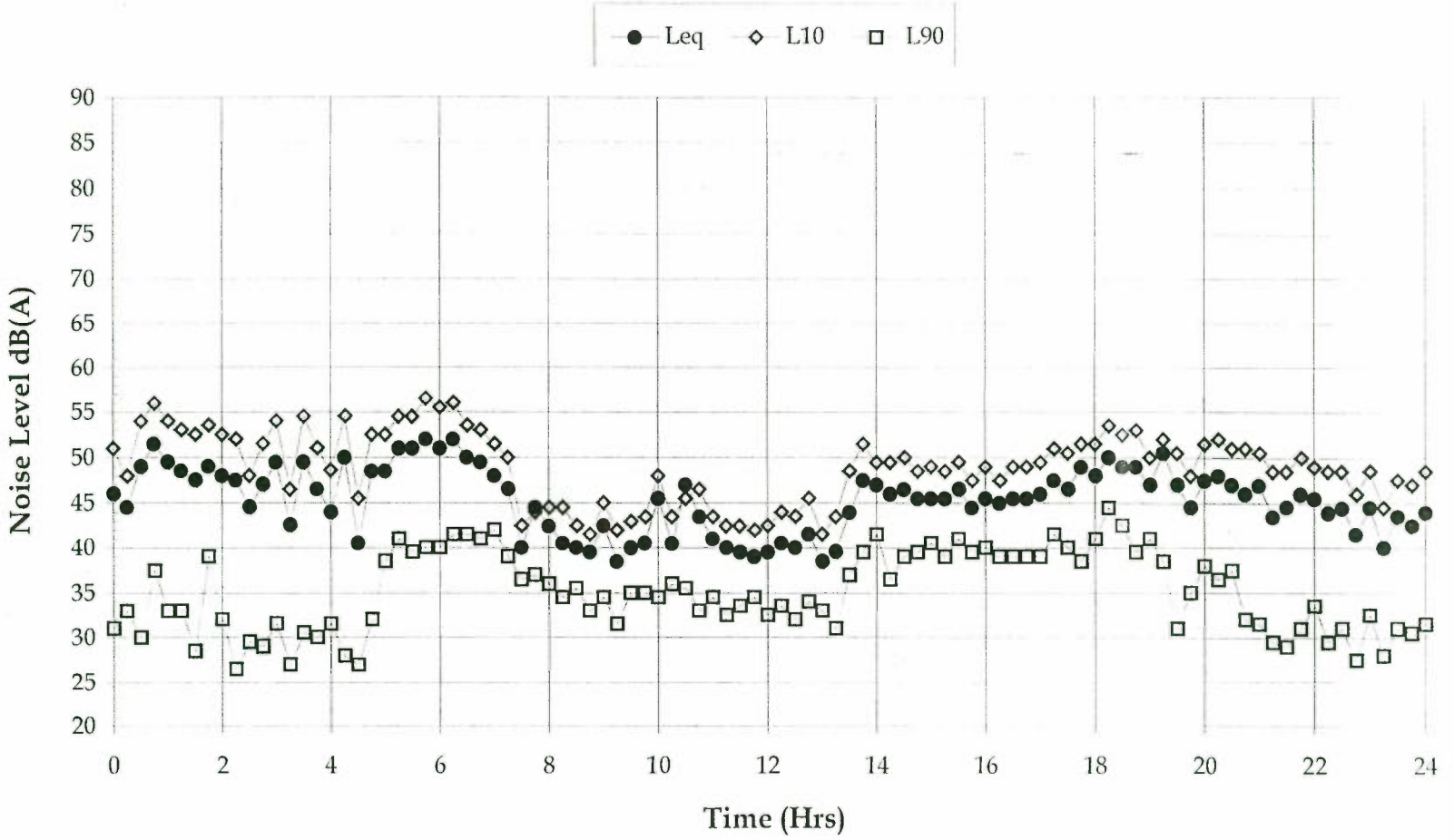
Location G (Houston) (460m from highway)
11 September,1997



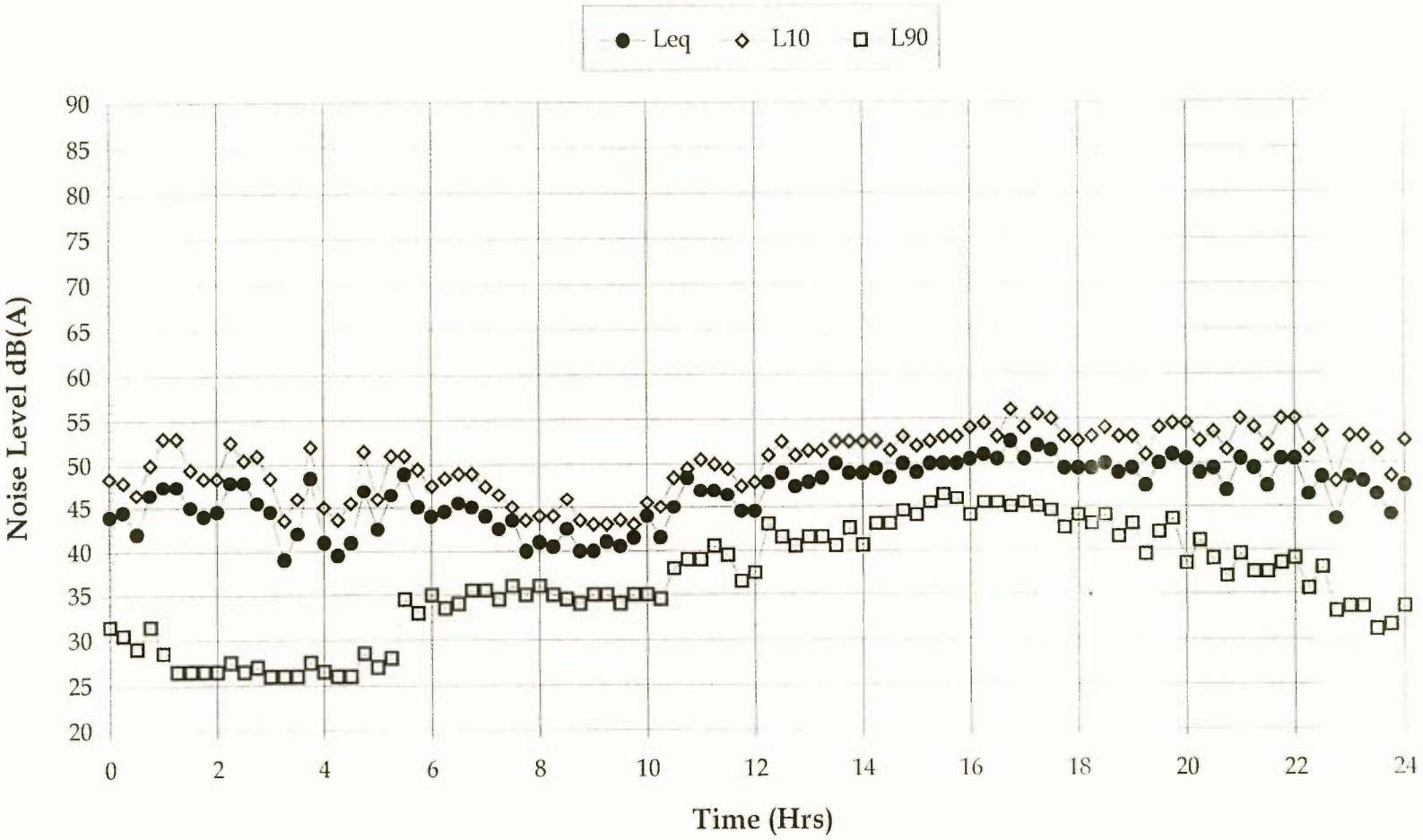
Location G (Houston) (460m from highway)
12 September,1997



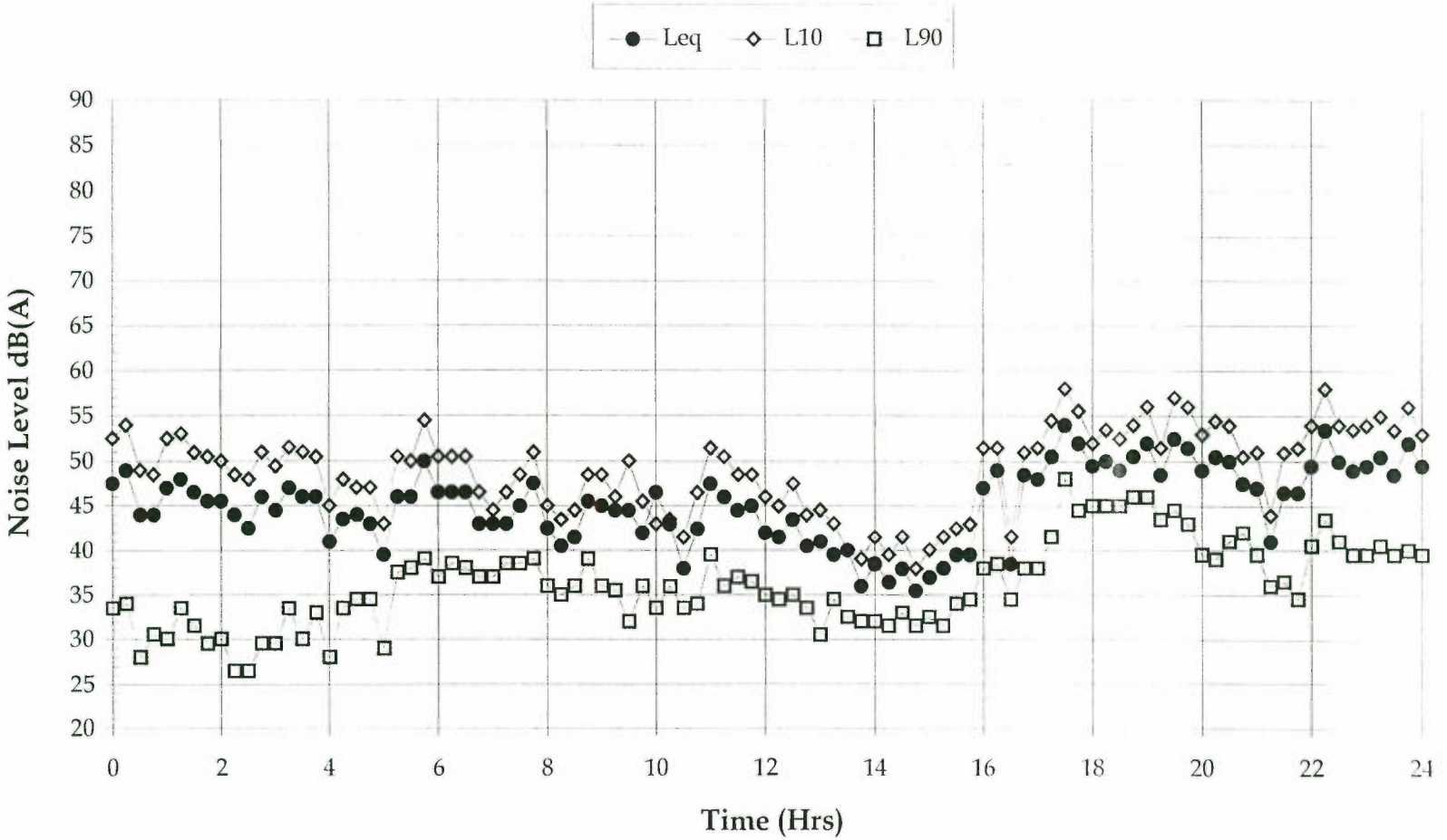
Location G (Houston) (460m from highway)
13 September,1997



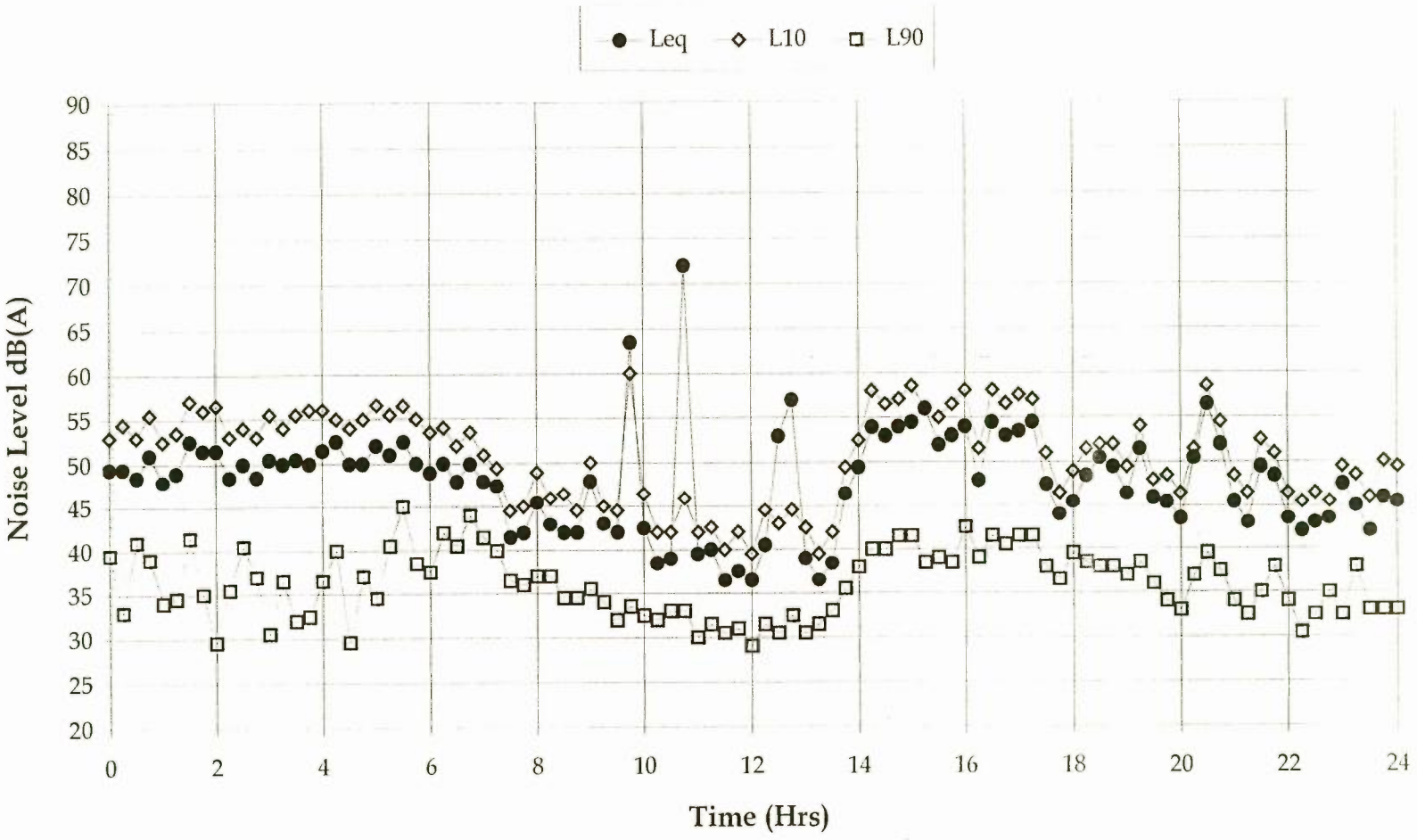
Location G (Houston) (460m from highway)
14 September,1997



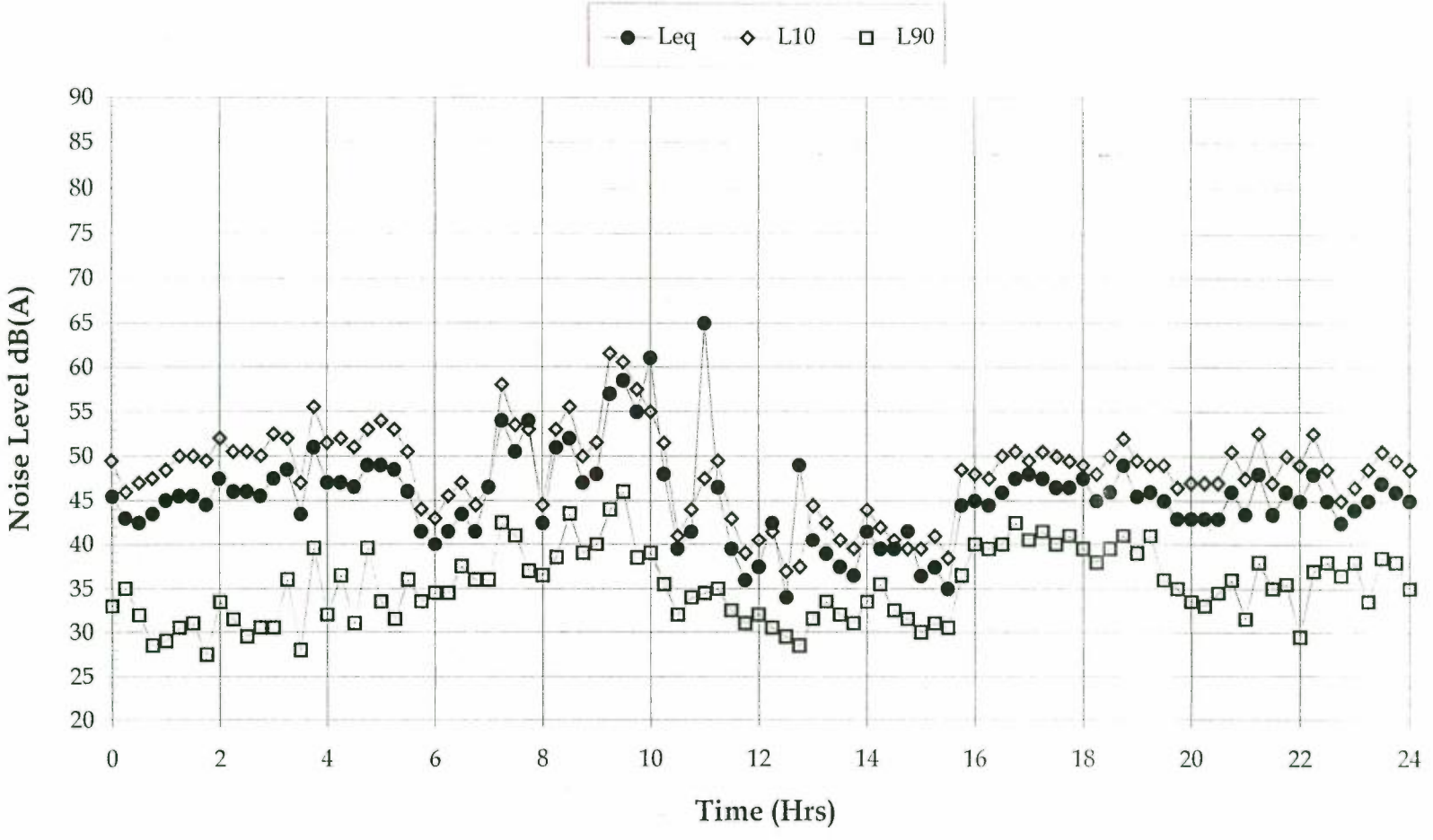
Location G (Houston) (460m from highway)
15 September,1997



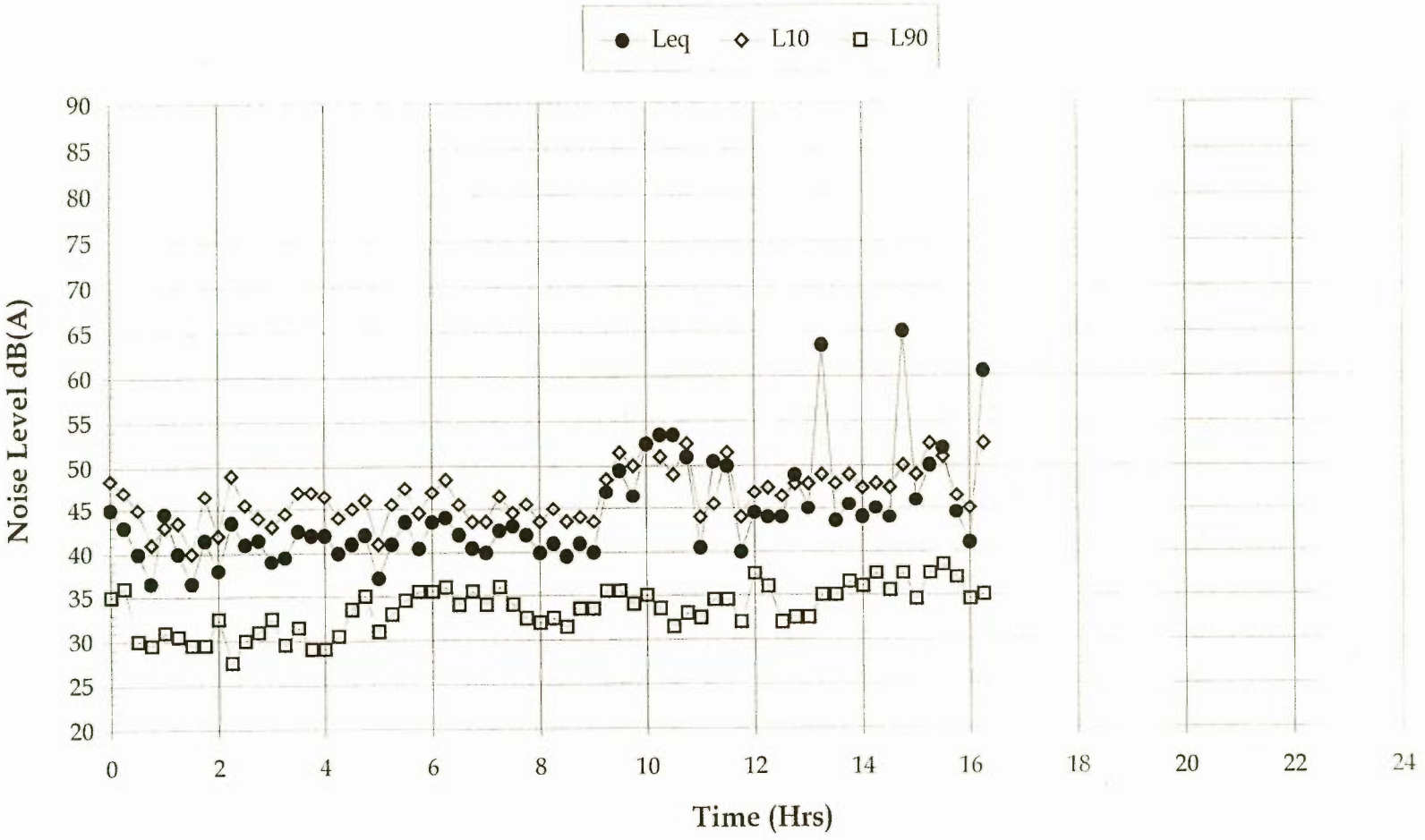
Location G (Houston) (460m from highway)
16 September,1997



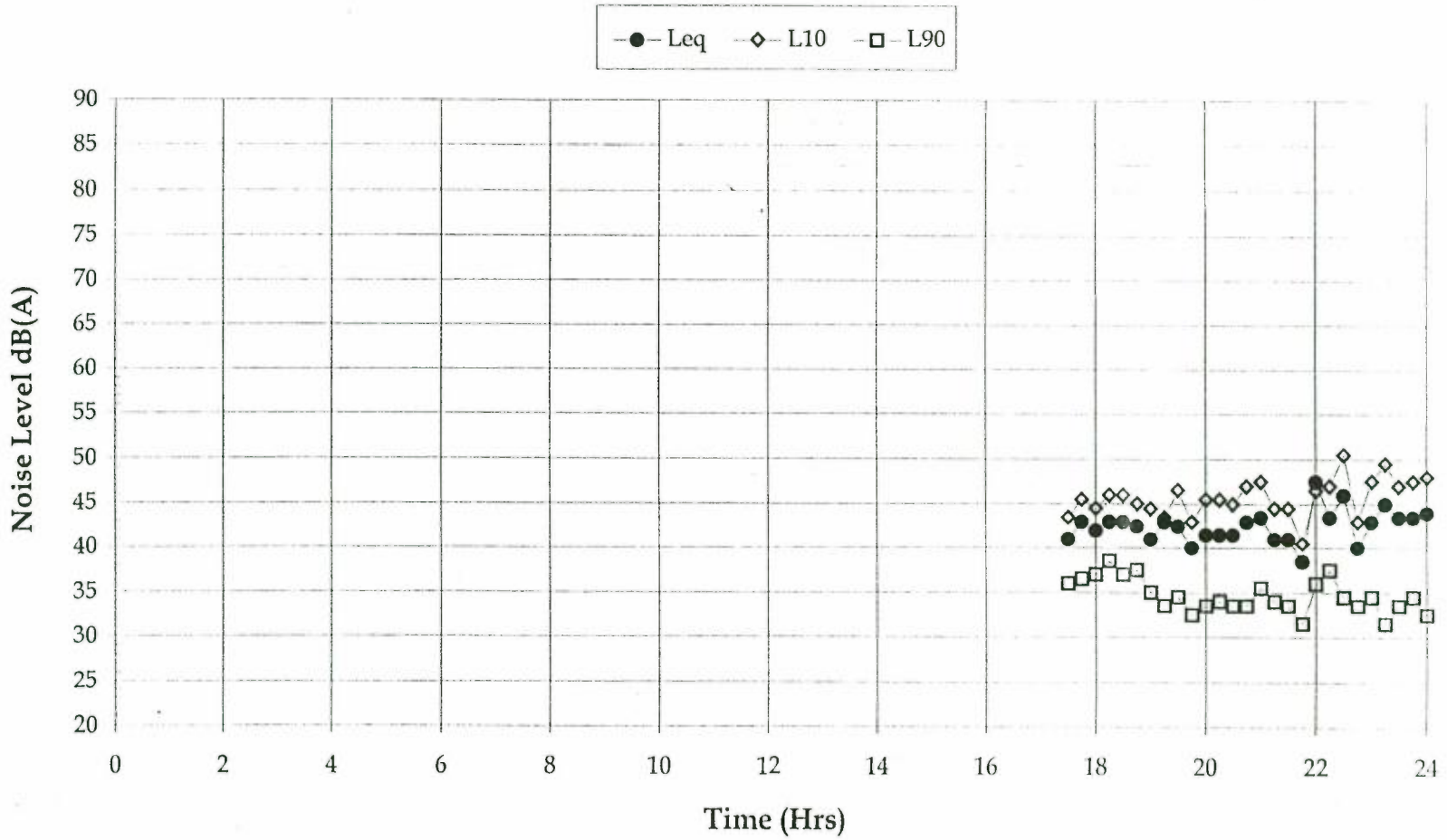
Location G (Houston) (460m from highway)
17 September,1997



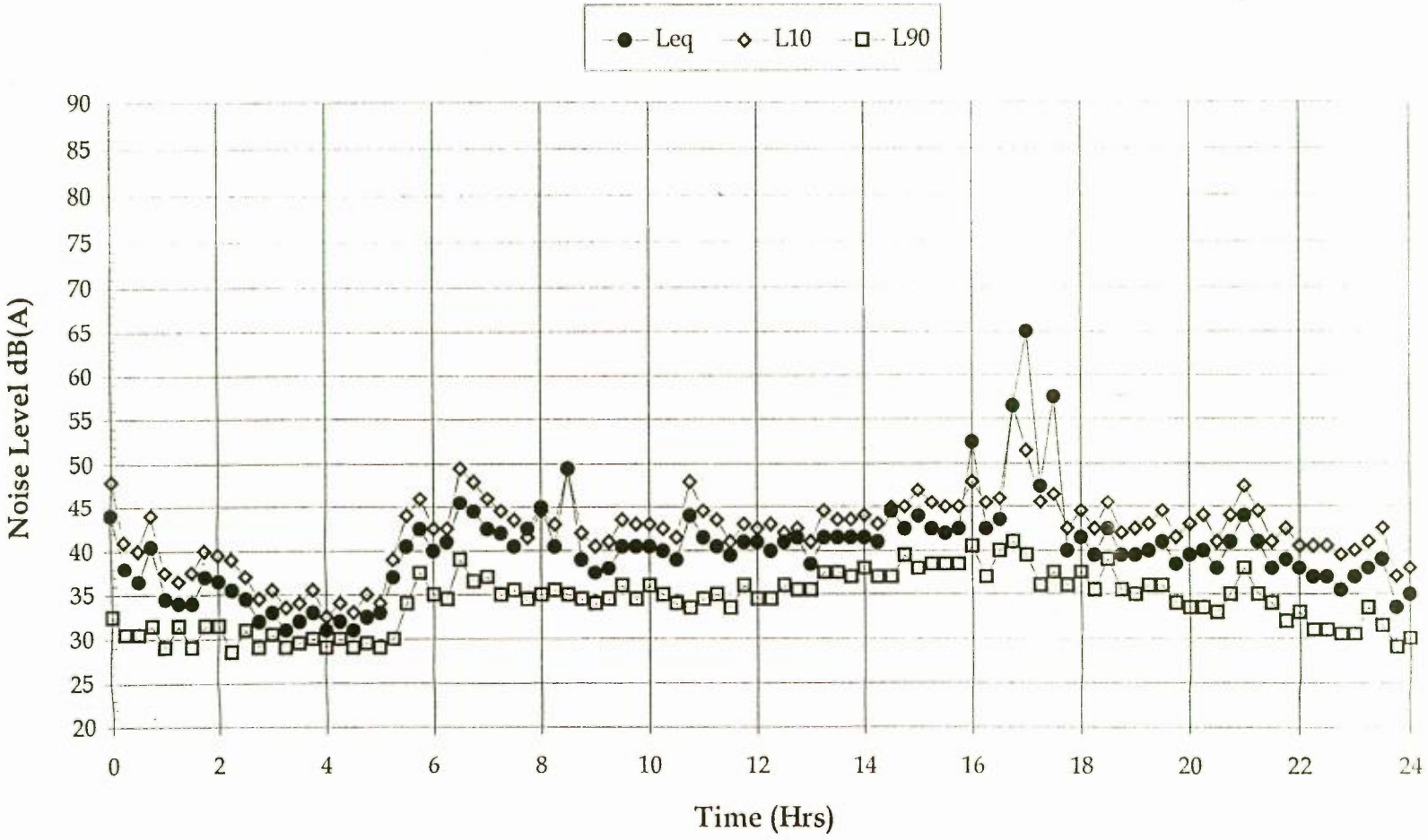
Location G (Houston) (460m from highway)
18 September,1997



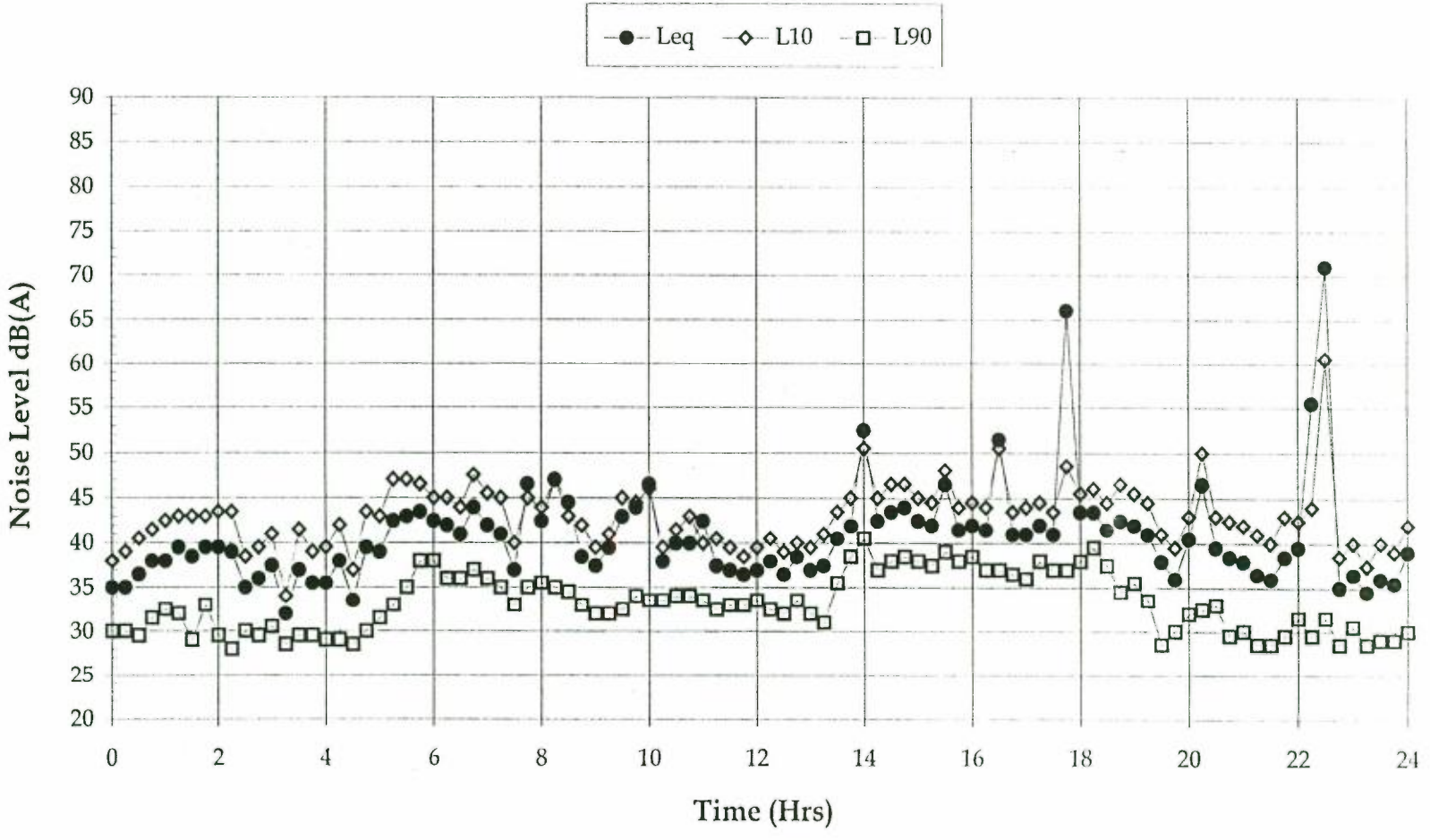
Location H (Houston) (1060m from highway)
11 September,1997



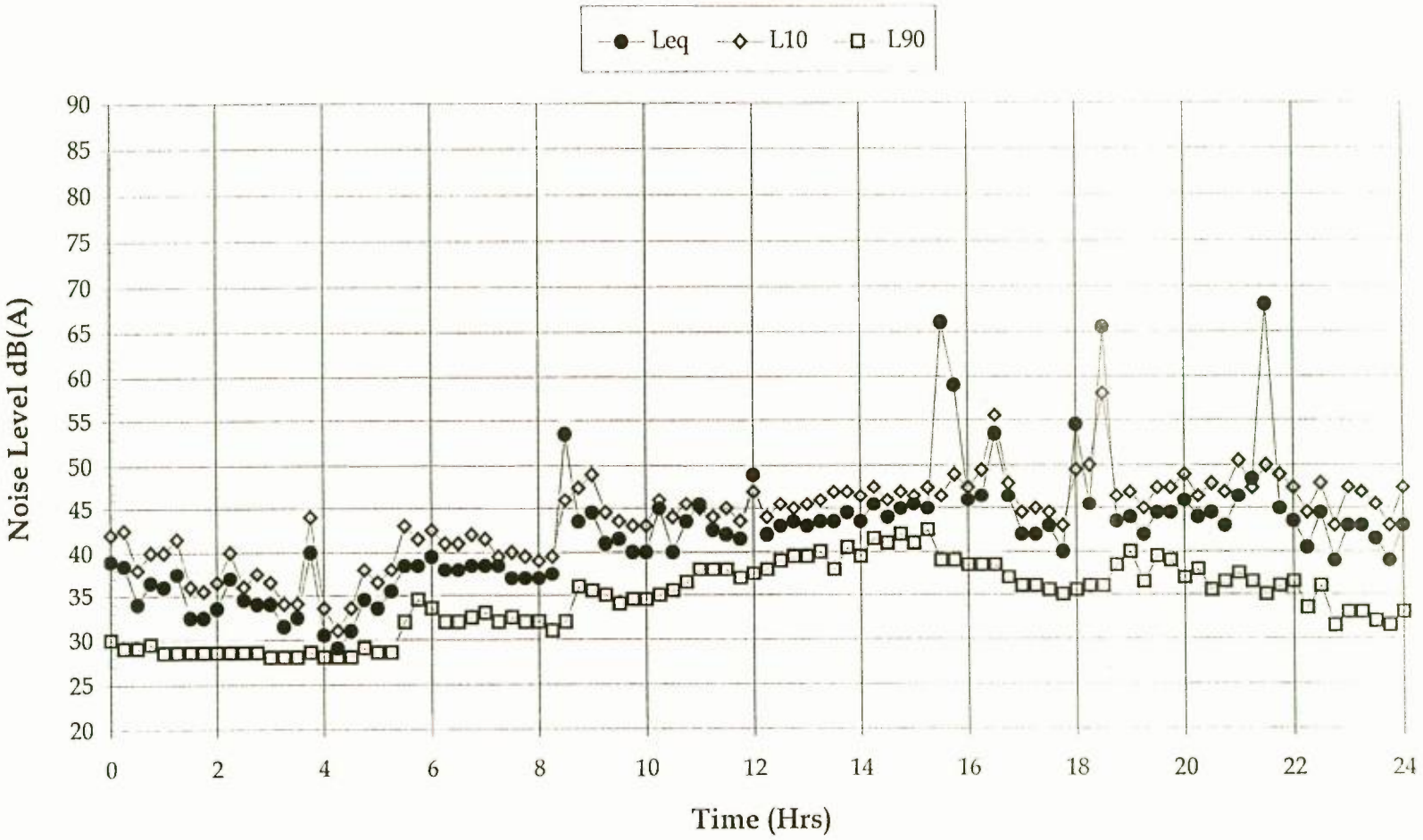
Location H (Houston) (1060m from highway)
12 September,1997



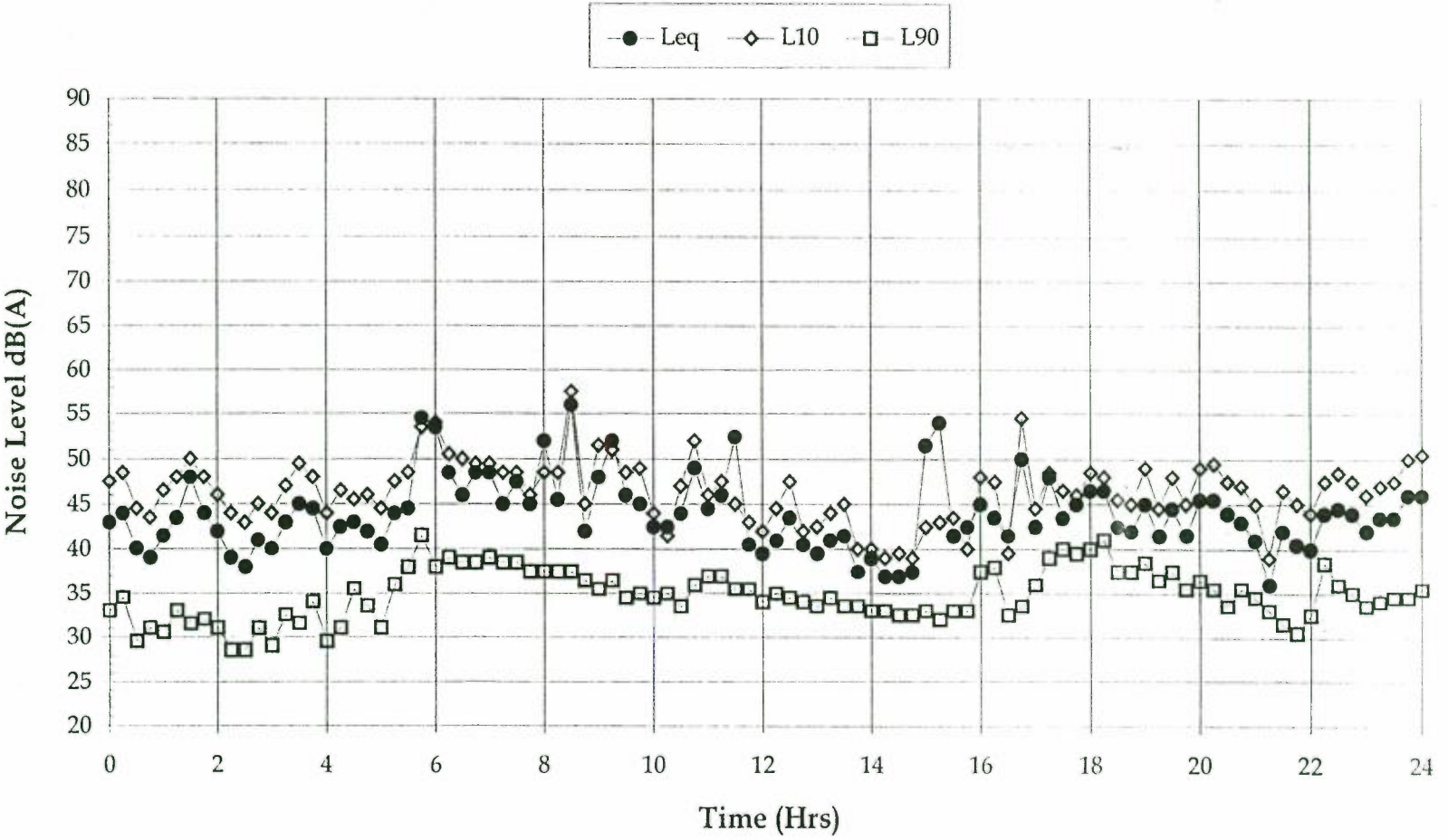
Location H (Houston) (1060m from highway)
13 September,1997



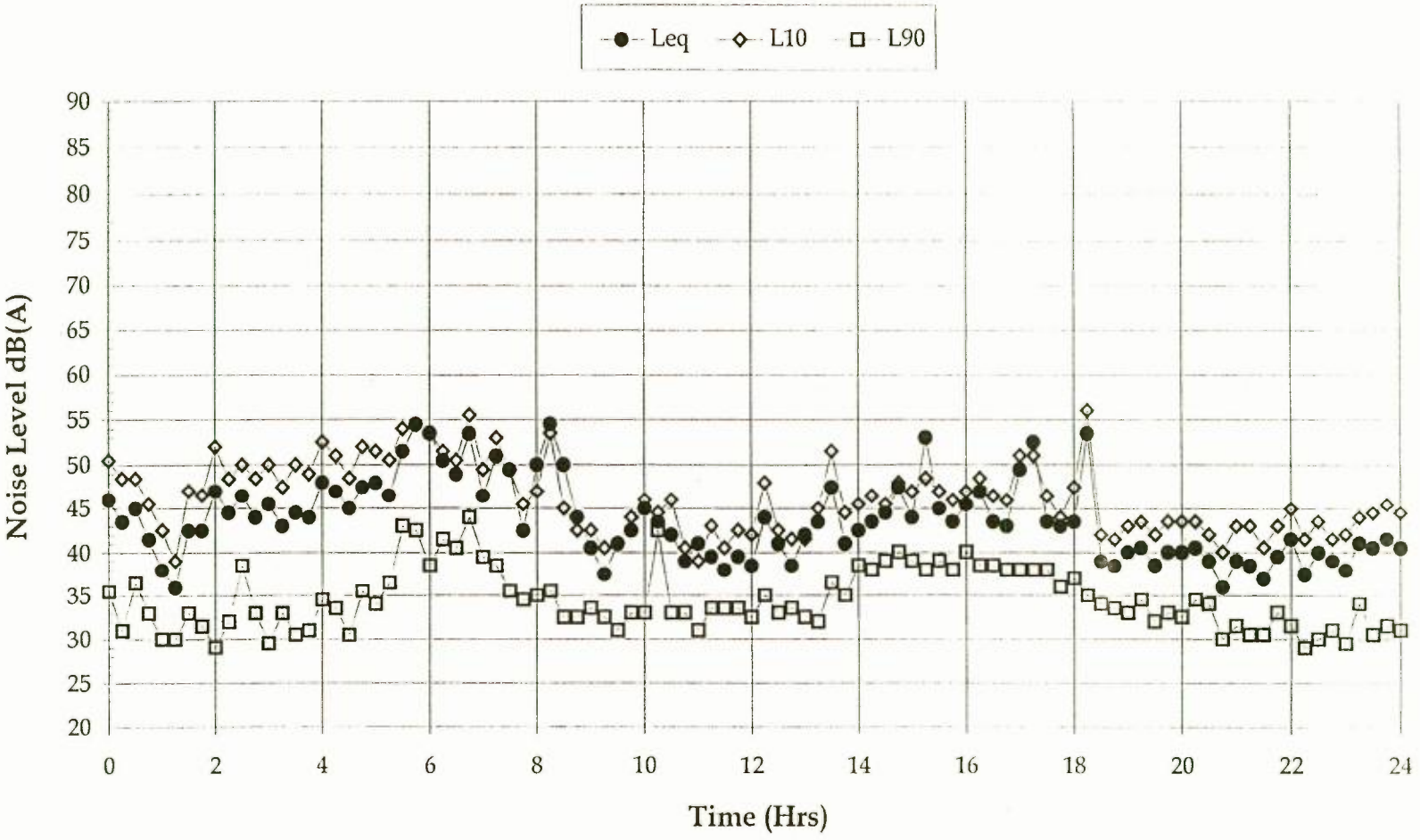
Location H (Houston) (1060m from highway)
14 September,1997



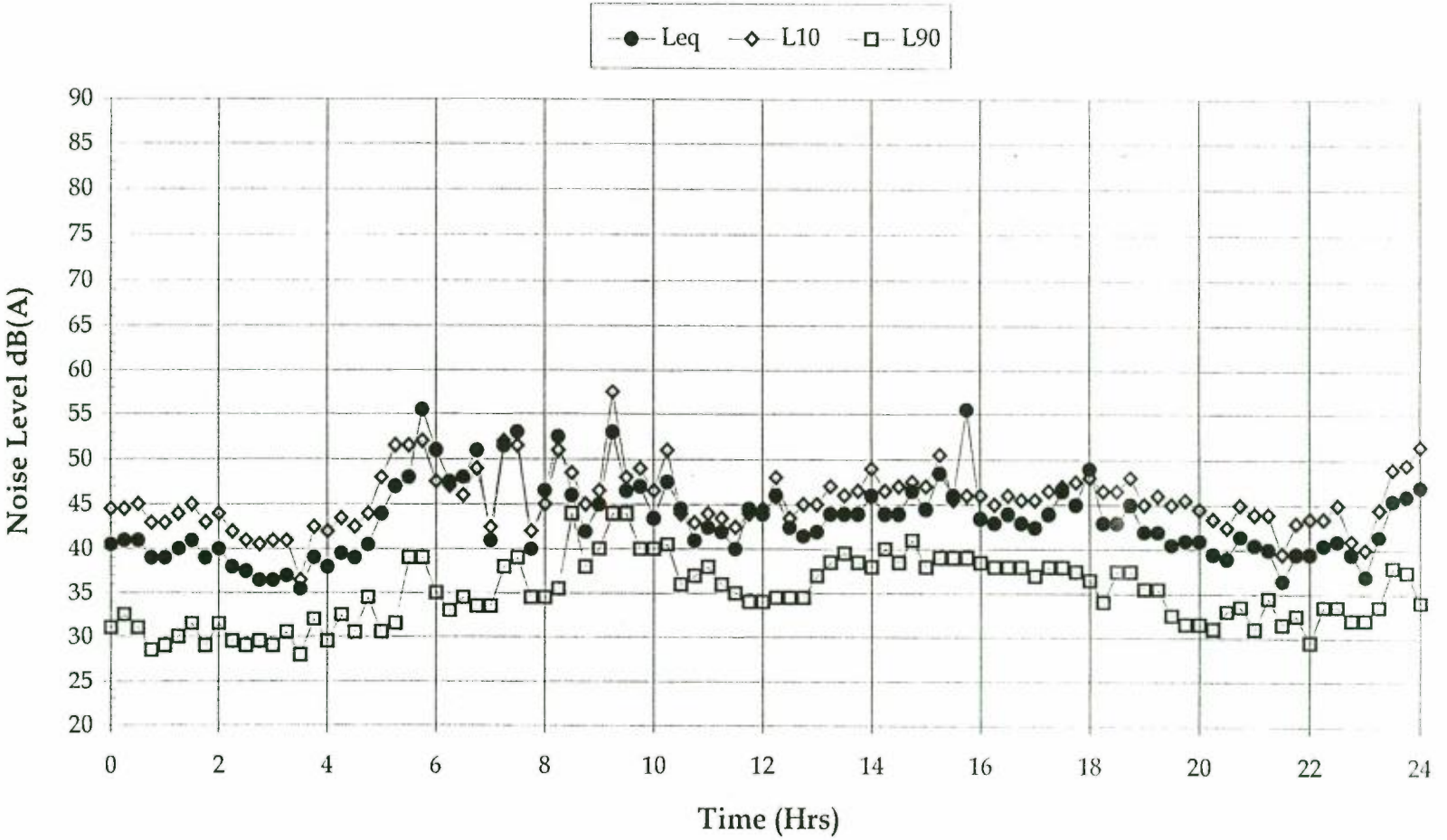
Location H (Houston) (1060m from highway)
15 September,1997



Location H (Houston) (1060m from highway)
16 September,1997



Location H (Houston) (1060m from highway)
17 September,1997



Location H (Houston) (1060m from highway)
18 September,1997