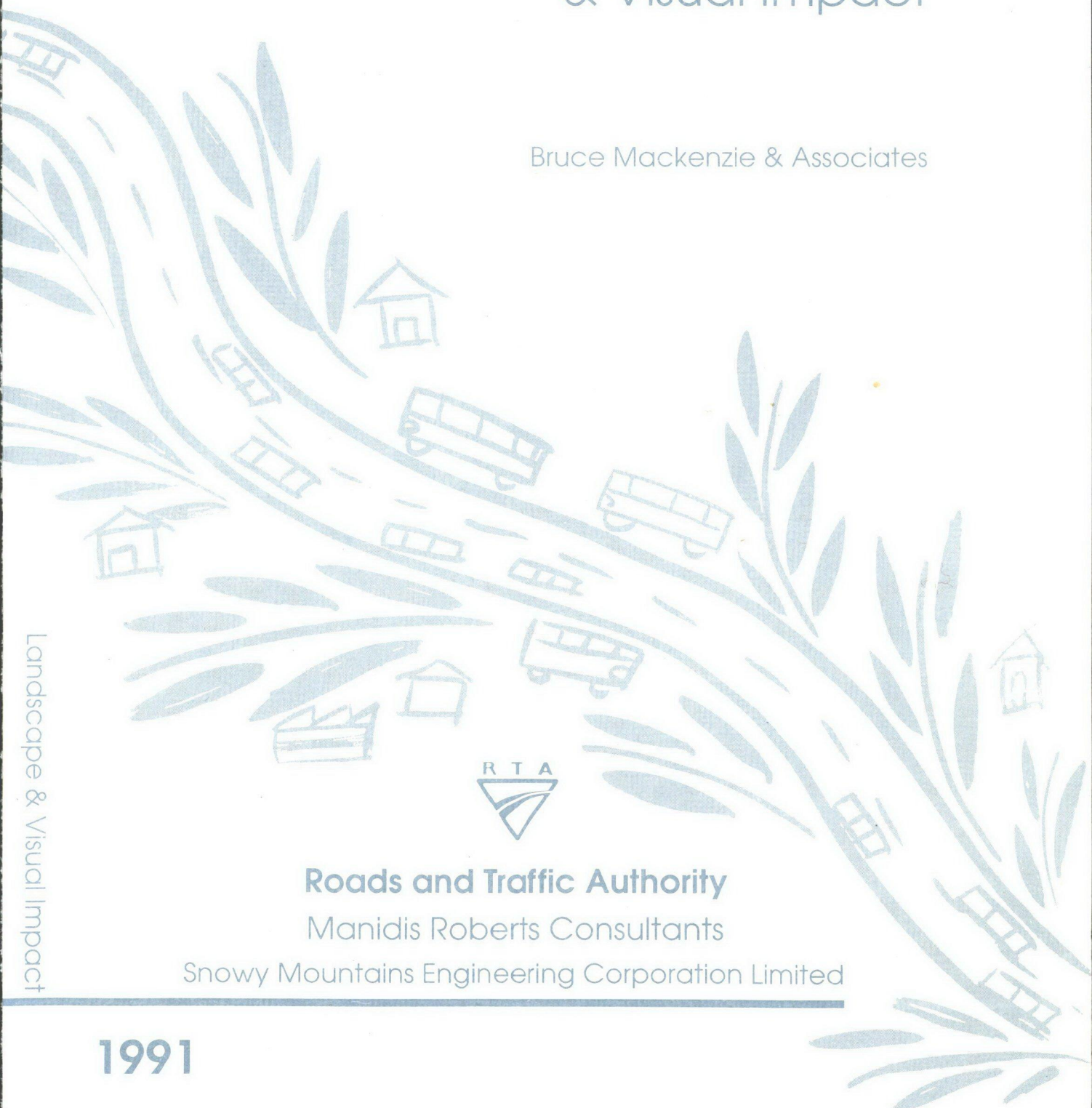
SPECIALIST WORKING PAPER FOR ENVIRONMENTAL IMPACT STATEMENT

North West Transport Link Western Section

Landscape & Visual Impact

Bruce Mackenzie & Associates



Roads and Traffic Authority

Manidis Roberts Consultants

Snowy Mountains Engineering Corporation Limited

1991

North West Transport Link Western Section

Landscape & Visual Impact

Bruce Mackenzie & Associates
in conjunction with
Olsen Environmental Services
& Jackson Teece Chesterman Willis Pty Ltd

1991

Prepared in Sydney for
Manidis Roberts Consultants
and
Snowy Mountains Engineering Corporation Limited
on behalf of the
NSW Roads and Traffic Authority

NORTH WEST TRANSPORT LINKS ENVIRONMENTAL IMPACT STATEMENT

OLD WINDSOR ROAD TO PENNANT HILLS ROAD

Roads and Traffic Authority
Snowy Mountains Engineering Corporation

LANDSCAPE & VISUAL IMPACT : October 1991
Bruce Mackenzie & Associates Pty Ltd Landscape Architects

in conjunction with:

Olsen Environmental Services – Ecological Advice
Jackson Teece Chesterman Willis Consultants Pty Ltd – Urban Design Advice

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OLD WINDSOR ROAD TO PENNANT HILLS ROAD

Roads and Traffic Authority
Snowy Mountains Engineering Corporation

LANDSCAPE & VISUAL IMPACT

1. INTRODUCTION

This report of existing conditions and assessment of the landscape and visual impact of the proposals has been prepared for the Snowy Mountains Engineering Corporation in conjunction with Manidis Roberts Consultants. This report is primarily concerned with the transport links to the west of Pennant Hills Road. However, the same authors are also responsible for the report on landscape and visual impact within the eastern study area. Therefore, much of the comment of this report will coincide with that of the study for the eastern section.

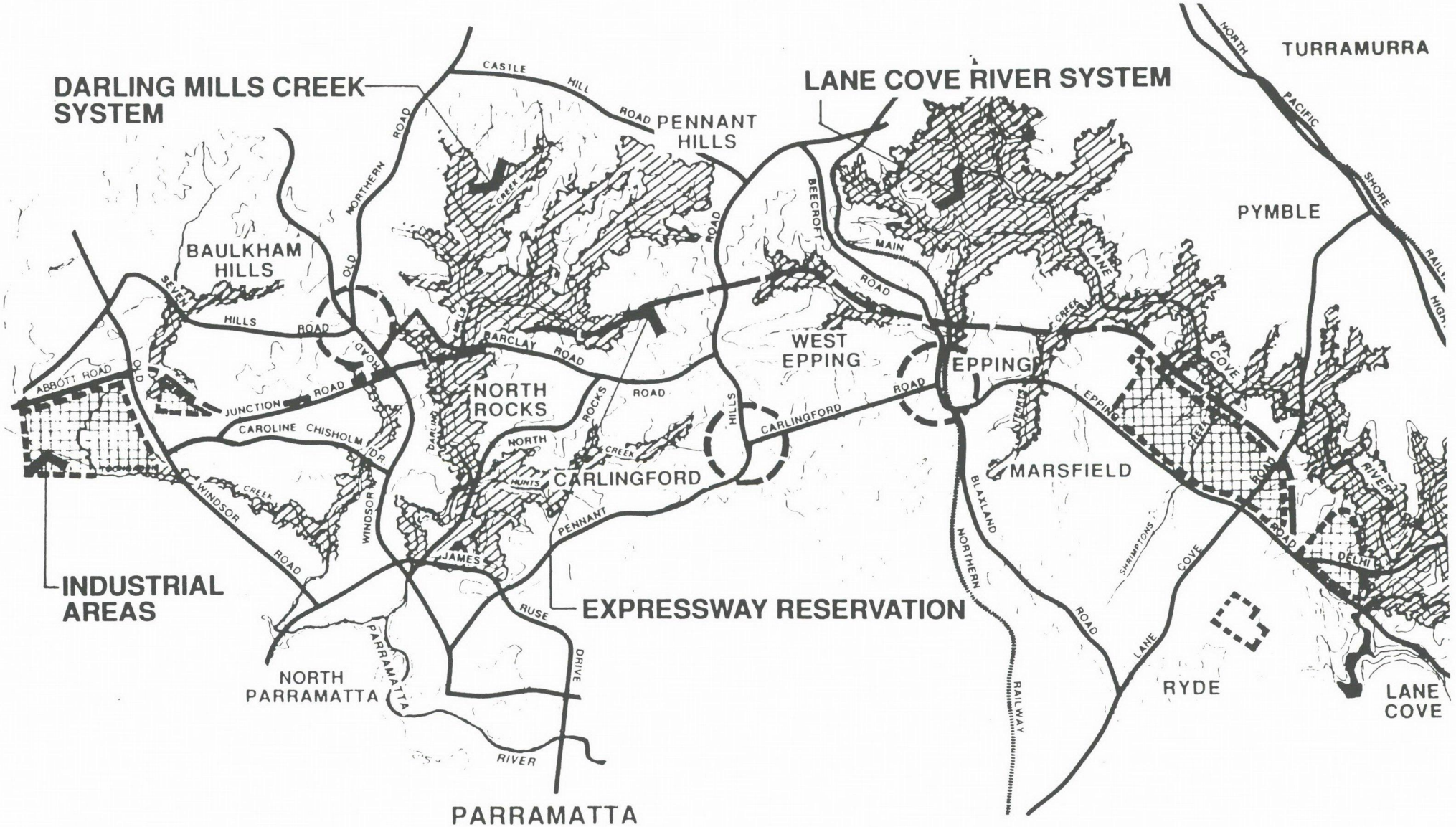
1.1 BACKGROUND

Bruce Mackenzie & Associates prepared the report 'Landscape Study' April 1989 as part of the EIS for the F2 Castlereagh Freeway which became the subject of the Commission of Enquiry conducted by Commissioner John Woodward. An additional report was subsequently prepared entitled 'Landscape Study: Visual Assessment of Noise Barriers' October 1989.

The original landscape study dealt with the then designated freeway alignment, located within the F2 Reservation, and endeavoured to illustrate its visual impact and its effect upon the landscape qualities of the corridor generally and particularly its more environmentally sensitive areas.

1.1.1 Urban Bushland Qualities

The experience of the enquiry process gave emphasis to the fact that urban bushland qualities needed to be given more attention and importance in the evaluation of transport proposals. This was borne out in the content of many submissions to the enquiry and in the conclusions and recommendations of the Commissioner's report.



Old Windsor Road to Epping Road Lane Cove
OVERALL STUDY AREA (WEST & EAST)

FIGURE
1.1

1.1.2 Alternative Transport Solutions

However, the recommendations contained in the Commissioner's report included also the need to investigate alternative transport solutions and/or transport route alignments. The brief for this current study includes in its objectives investigation and assessment of those other alternatives.

1.1.3 Arterial Road Upgrades

Of particular interest in regard to landscape and visual impact is the proposition that alternative options to be investigated might involve upgrading of existing arterial roads in the general area including, for example such routes as Seven Hills, Windsor, Barclay, North Rocks and Pennant Hills Roads, and to the east, Carlingford and Epping Roads.

Other options of a similar nature were also considered possible using existing traffic routes.

1.1.4 Acceptable Noise Levels

A major implication of this type of alternative draws attention to the further requirement of the Commissioner's recommendations which identified certain standards to be obtained relating to acceptable noise levels for homes adjacent to a transport route. This in turn would involve noise barrier structures which constitute substantial new vertical and very visible elements in the road environment – and consequently in the environmental margins of the road.

1.1.5 Arterial Road : Magnitude

Of much importance too, is the potential of the arterial road upgrade option to need a new road formation in physical dimensions equal to or larger than that of say an expressway standard in order to achieve traffic handling functions of more or less equal capacity.

This factor introduces the prospect of significant effects being imposed upon existing landscape and visual conditions because of the sheer scale of the new transport corridor and the resultant destruction of existing circumstances that would include homes and other properties, trees, gardens and other amenities which contribute to the environmental character of a local area.

1.1.6 Limited Perspective

The F2 Commission of Enquiry dealt with a specific proposal which focused upon a single route aligned within a designated corridor which contained to a large extent, bushland and open space. Consequently, discussion and argument tended to centre upon impacts to urban bushland qualities and the alternative impacts of the expressway construction and operation, on homes bordering the reservation.

1.1.7 Emotive Issues

The present study of landscape and visual impacts addresses a much broader area of potential change including possibly severe impact upon bushland quality and similarly severe impact upon extensive residential environments quite remote from the bushland. In the latter case, the residential domain can be an equally emotive subject for debate when considering environmental qualities and potential change or impairment.

This report endeavours to examine these issues and to convey as clearly as it is able, the reality of impacts to specific environments, the broader environment and to short term and long term circumstances.

It is fair to anticipate that this report will not recommend better versions of conventional practices which can only ever expect to enjoy short-term success. However, knowledge of the prevailing conditions prior to undertaking the study, pre-empts the notion that some immediate relief from existing traffic circumstances may be a critical need prior to establishing the early stages of a long term programme of benefit.

1.2 REPORT OBJECTIVES

The landscape study will endeavour to provide ...

- an understanding and description of the existing site conditions.
- assessment of the relative value of existing features and characteristics of the landscape and its current landuses.
- evaluation of the nature and physical forms of transport options and the corridors that are aligned with them.
- estimated impact of the options in terms of effect upon
  - landform
  - vegetation
  - visual qualities
  - access opportunities
  - recreational values
  - existing living/working lifestyles.
- recommmendations for reducing impacts and enhancing the quality of possible changes.

Quality of life is understood by the landscape architect to be the over-riding issue and this concept requires that considerations be given to many issues, including:

- matters of efficiency
- preservation of the integrity of natural areas and human living and working environments.
- concerns for safety and health.

1.3 STUDY PROCESSES

1.3.1 Undertake broad site investigations by travelling through the local street network and conducting detail examinations on foot, to obtain a realistic understanding of the area and the relevant issues.

1.3.2 Record detail information of the existing conditions making full use of photographic material.

1.3.3 Compile relevant information from records of the client organisation, other consultant studies and scientific data, municipal authorities and community groups, in conjunction with site inspections, to prepare background maps of landuses, landuse corridors, drainage, topographical and vegetational information.

1.3.4 In consultation with design engineers, compose three-dimensional images of proposals including possible alternatives.

1.3.5 Describe in words and with diagrams the physical changes and effects of the proposals in the context of existing landscape and landuse conditions.

1.3.6 Examine construction methods, alignments, associated structures and road furniture in the context of visual and physical impact on surroundings; make comment and recommendation on possible variations to reduce undesirable impacts as may be appropriate.

1.3.7 Consider the environment internal to the road corridor as well as that of its margins.

1.3.8 Make recommendations in consideration of preserving or offering suitable alternatives for the existing pedestrian facility of the general area and particularly that which tends to traverse, and be divided by, the road corridor.

1.3.9 Prepare, in conjunction with a written report, graphic communication designed to provide reasonable evidence of existing and changed conditions, in forms that are suitable for both professional and general public viewing.

1.3.10 Endeavour to describe the relative environmental benefits and disbenefits of the alternative options in terms of present and future circumstances.

1.3.11 Describe the general and detail effects of a recommended proposal or the various alternatives and include both negative and positive values so as to assist members of the public in understanding the environmental consequences and to be able to assess their own conclusions.

2. SUMMARY

2.1 GENERALLY

The summary briefly describes the general content of each of the report's section headings.

2.2 STUDY AREA : Existing Conditions (Section 3)

The discussion refers to the natural characteristics of the general area over which the transport links have been investigated. While interest extends to the overall corridor length, ie. from Old Windsor Road to Epping Road, Lane Cove, this report focuses on the area to the west of Pennant Hills Road.

Typically, land development has followed the logical patterns which would be defined by the natural landscape. The study area is divided between the terrain of Hawkesbury Sandstone and Wianamatta Shale geology and the soil characteristics which result. Consequently, land development and loss of natural conditions has coincided with the more fertile shale-derived soils, while natural conditions and vegetation have survived in the typically rugged and agriculturally unproductive environment of the sandstone country.

Most of the study area consists of developed land which is predominently residential. Landscape qualities within the residential zones, including both vegetation (introduced and occasionally, remnant indigenous examples) and built-up characteristics, are of good quality. The designated F2 Expressway Reservation traverses both developed and more or less natural environments. Consequently, in the circumstances of largely-cleared land, the reservation has become a respository of some of the better aspects of surviving urban bushland.

Landuse maps are included to show the relationship of the transport corridors to land development types and open space.

2.3 EXPRESSWAY RESERVATION (Sub-Section 3.2)

This section describes the expressway proposal within the reservation corridor to the extent that it affects its existing immediate margins. Issues considered are mainly those of relative dimensions, levels and the relationship of the road formation to the landform around it. The section endeavours also to provide the reader with a quick overview and orientation of the expressway route in segments, and to the circumstances of the land and land development around it.

2.4 EXPRESSWAY ALIGNMENT : OPTIONS (Sub-Section 3.3)

This sub-section is developed in order to consider the four alignment variations which are later discussed in the report (Section 6.2). The existing environmental values, both natural and built environments, involving Mahers Road and the area immediately to the west, raise a number

of difficult design issues. These values are briefly described as a background to the consideration of alignment options. To some extent, the primary question is one of determining whether bushland qualities or residential property should have priority when making design decisions.

2.5 NORTH ROCKS ROAD CORRIDOR (Sub-Section 3.4)

North Rocks Road as a major arterial road development in conjunction with the expressway reservation is one of the two recommended proposals presented in the E.I.S. A brief description of the existing North Rocks Road Corridor is provided.

2.6 OTHER OPTION CORRIDORS (Sub-Section 3.5)

Seven Hills Road, Murray Farm Road, Copeland Road, Pennant Hills Road and an extension of Carlingford Road were investigated as possible alternative options for arterial road development. This sub-section refers to their existing circumstances.

2.7 VEGETATION AND LAND UNITS (Section 4)

The more significant aspects of the existing vegetation and its relationship to geological land units are discussed in the context of landscape and conservation values. These values are of importance when considering the potential impacts of the road transport proposals. A more detailed account of vegetation is presented in the report prepared by Mt. King Ecologocial Surveys (Flora and Fauna Evaluation – Bushland Effect and Management). The question ... bushland or homes? ... in relation to long term values is discussed in this section.

2.8 POTENTIAL IMPACTS (Section 5)

Impacts are examined in order to assist the understanding of the relevant implications of the proposals. For example, the present-day reality of a major road construction can raise the possibility of effects that society is not fully acquainted with and certainly not accustomed to ... effects of scale and magnitude unusual in suburban circumstances.

2.9 EXPRESSWAY : EFFECTS AND PROPOSED LANDSCAPE TREATMENT (Section 6)

The expressway proposal (in the designated reservation) is described as a concept design so that its general effects can be undertood in visual and landscape impact terms. Also, with the assistance of diagrams, recommendations for landscape treatment including mitigative measures, are presented. Discussion of alignment options related to the sensitive bushland and residential zones around the western end of Mahers Road is further developed and a general summary of the expressway proposal's impacts is provided.

2.10 ARTERIAL ROAD: EFFECTS AND PROPOSED LANDSCAPE TREATMENT (Section 7)

A similar brief account of typical effects is discussed in this section using cross-section diagrams, to illustrate the scale and the potential impact of the arterial road proposal based on the North Rocks Road alignment. Typical conceptual landscape treatment in a representative location is also presented in a plan diagram (Fig. 7.7). A summary of the arterial road proposal is included.

2.11 EXPRESSWAY & ARTERIAL ROAD PROPOSALS COMPARED (Section 9)

Based on the discussion 'Potential Impacts' (Section 5), the expressway and arterial road proposals are discussed and compared using the basic criteria which are listedbelow. The sequence of impacts does not necessarily represent an order of priority or importance – particular impact types will vary in severity from site to site according to detail circumstances.

Severe Impacts

1. Division of built and/or natural environments.
2. Division created between built and natural environments.
3. Physical destruction and loss of natural bushland.
4. Changes to the quality of the community environment as a consequence of the effects of division and destruction.

Lesser Impacts

1. Partial loss of property and consequent loss of landuse values.
2. Introduction of new and undesirable activity in the immediate neighbourhood as a replacement of familiar existing circumstances.
3. Loss of trees/vegetation.
4. Loss of views.
5. Introduction of new and undesirable views.
6. Loss of amenity through the introduction of visual effects and noise which are disagreeable or discomforting.

2.12 CONCLUSION (Section 10)

In conclusion, the report makes its recommendation by choosing a transport option but only in conjunction with the acceptance of other important provisions. The provisions identify the need to incorporate the immediate transport solution in a comprehensive and long term transport and landuse plan.

3. STUDY AREA : EXISTING CONDITIONS

This section discusses the study area in general landscape terms and briefly examines the existing conditions of the various option corridors and the relationships of the proposed road options with their respective margins. The study area is divided into the following headings:

- GENERAL STUDY AREA
- EXPRESSWAY RESERVATION
- NORTH ROCKS ROAD CORRIDOR
- OTHER OPTIONS CORRIDORS :
  - Seven Hills Road
  - Murray Farm Road
  - Copeland Road
  - Pennant Hills Road
  - Carlingford Road - West

3.1 GENERAL STUDY AREA

The general area of landscape interest of this study lies between Old Windsor Road, Baulkham Hills, and the Lane Cove River valley, Lane Cove but specifically this document deals with the existing conditions and possible effects of new transport corridor proposals west of Pennant Hills Road.

Pennant Hills Road follows one of a number of prominent north/south ridgelines which represent important aspects of the traditional pattern of transport access, landuse and land development throughout Sydney's history of growth. Where once these transport spines provided access to their margins while maintaining roles as major distributors, present-day demands, with or without the planning of transport corridors, have created their own traffic patterns which necessarily improvise with the lay of the land. The study area in this context represents a cross-country route. Existing traffic conditions have already established such a pattern.

3.1.1 Landform

Coincidentally, the ridgeline of Pennant Hills Road divides the water catchment area of the Lane Cove River, which flows to the south east, from the Darling Mills and Toongabbie Creek systems which flow generally south west. Original landform has played an important part in shaping both the natural and built environments of the transport options study area; elevated plateau and flattened ridges contrast with entrenched valley systems. Over the study area, the distinctive relationships of ridge and valley formations reduce progressively west of Windsor Road where shale soils and undulating country predominate. The physically spectacular Hawkesbury Sandstone environment with its steep slopes, rocky streambeds and outcrops, terminates fairly abruptly in the Darling Mills Creek system just east of Windsor Road.

The land formation generally divided between Wianamatta Shale and Hawkesbury Sandstone, and between plateau, ridgetop and valley profiles has a positive influence on natural landscape characteristics and on the way land has been subsequently used and developed.

3.1.2 Vegetation

Vegetation typical of sandstone country is featured extensively within the Darling Mills Creek system, whereas the original vegetation of the shale derived soils is now barely represented. (The character, condition and distribution of vegetation throughout the study area are discussed in more detail elsewhere in this document and also in the separate study undertaken by the consultants, Mt King Ecological Surveys.)

3.1.3 Land Development Characteristics

The land development characteristics have related to natural landform, soils and drainage to the extent that in some cases the more important roads followed major ridgelines which defined the boundaries of natural watersheds. The catchment of Darling Mills Creek and its tributaries, for example, is bounded by Old Northern Road, Castle Hill Road, Pennant Hills Road and North Rocks/Barclay Roads. Toongabbie Creek drains the land west of Windsor Road in less dramatic terrain, and combining with Darling Mills Creek at North Parramatta, forms the Parramatta River.

Better quality soils and more even topography attracted rural and semi-rural activities to the undulating country and the flatter ridgetops. Urban development followed ridgelines and the more significant road corridors. In recent times, residential development has expanded to the edgelines of valley profiles and further west has gradually overtaken the open fields of earlier and recent rural activities. The combination of clearing for rural use and subsequent replacement with residential development has left the land largely devoid of natural vegetation except in the rugged sandstone valleys and to a lesser extent along parts of the valley floor of Toongabbie Creek.

The reservation of the originally designated Castlereagh Expressway Reserve is distinguished by its association in part with the bushland qualities and somewhat wild character of the Darling Mills Creek environment. West of Windsor Road where residential development is gradually infilling the land within the open network of suburban roads, the expressway reservation exists to a large extent as a corridor of clear grassland with sparsely occurring tree groups and individual specimens, some of which are large and mature.

North Rocks Road and other potential arterial road options which have been investigated, typically traverse established and settled residential domains. The vegetative character of these areas can be mainly identified with domestic gardens in a mix with sparsely occurring remnant groups and small stands of original forest character. Beyond the immediate impact of sometimes very busy local traffic corridors, the residential environments are usually peaceful and quietly attractive situations without especially significant features, except perhaps at vantage points overlooking bushland; their main characteristics amongst a mix of old and new development are observed as being harmonious and convenient places of residence.

Schools, other institutions and public reserves occur frequently throughout the study area and often adjacent to arterial roads. Industrial and commercial land uses do not feature prominently in the mix of landuses where residential development is the predominate type.

3.1.4 Existing Traffic Conditions

The physical amenity and visual qualites of the study area are undesirably affected by the presence of existing traffic streams on main roads, creating noise impacts, hazard potential and fragmentation of residential land units. These effects diminish the human amenity value of the broad landscape environment and particularly of residential areas.

Landuse maps incorporated in this report give an overview of existing landuses and demonstrate the disposition of residential development, other landuses, parkland and bushland as follows:

- LANDUSE: Reservation
  - Old Windsor Road to Pennant Hills Road
  - Set of six plans : Figures 3.4 to 3.9

- LANDUSE: Arterial Road Proposal
  - North Rocks Road
  - Set of four plans : Figures 3.11 to 3.14

- LANDUSE: Other Arterial Options
  - Seven Hills Road
    Set of three plans : Figures 3.16 to 3.18
  - Murray Farm Road
    Set of three plans : Figures 3.20 to 3.22
  - Pennant Hills Road
    Set of three plans : Figures 3.24 to 3.26

3.2 EXPRESSWAY RESERVATION

The following is a brief description of existing conditions along the reservation corridor with references to the relationship of the expressway concept to the immediate margins. Diagrams showing indicative cross-sections relate to typical situations of cut and fill which would occur along the route. A more detailed discussion of the expressway proposal is provided in Section 6 of this report.

3.2.1 Old Windsor Road – Toongabbie Creek

The expressway proposal would connect with Old Windsor Road and Abbott Road to form an at-grade intersection. The overall width of the new road and its entry and exit ramps would affect properties around the existing Abbott Road/Old Windsor Road intersection, and on the edges of the reservation between Old Windsor Road and Toongabbie Creek.

To the east the carriageways would cross Toongabbie Creek on bridge structures cutting through the corridor of trees bordering the creek and then follow a tributary creekline alongside industrial sites on Gibbon Road (Diag. A). The expressway formation would be on fill either side of Toongabbie Creek and further eastward come to level with existing grades before entering an excavated section. The reservation around this creek crossing zone is relatively broad, making provision for a possible future intersection and expressway development to the north. Generally the reservation site is flat in appearance with very gentle grades. Outside the creek profile, the road reserve is almost treeless with a grassed surface.

DIAGRAM A:
JUST EAST OF TOONGABBIE CREEK AND ALONGSIDE INDUSTRIAL SITES BORDERING GIBBON ROAD (APPROX. CH. 3300.)

3.2.2 Toongabbie Creek to Windsor Road

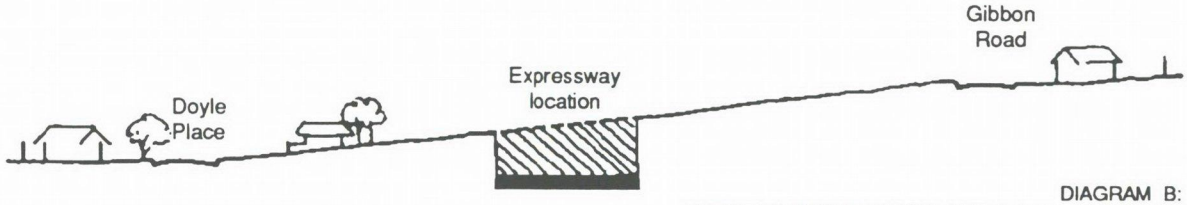


DIAGRAM B:
BETWEEN DOYLE PLACE AND GIBBON ROAD APPROACHING LANGDON ROAD (APPROX. CH. 4000.)

At this point (Diag. B), the carriageway would be in cut up to 10 metres in depth and largely out of sight from Gibbon Road to the south and the rear of properties off Goodhall Avenue and Doyle Place to the north.

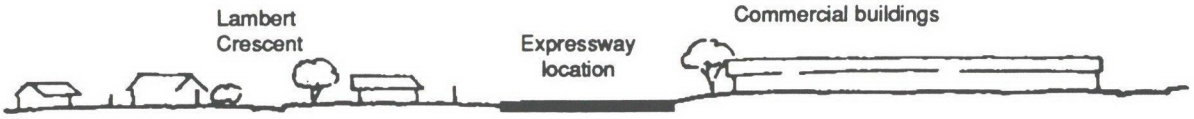


DIAGRAM C:
ADJACENT TO THE LOCAL SHOPPING CENTRE ON
LANGDON ROAD (APPROX. CH. 4300)

The formation in this location would be generally at existing grades and involve light cuts and fills. Margins would be available after construction, adjacent to the rear boundary of housing to the north and commercial development to the south (Diag. C). The reservation is generally grassed with occasional trees throughout most of this section.

RESERVATION WITH GIBBON ROAD ON THE RIGHT AND THE SHOPPING CENTRE IN THE BACKGROUND (VIEW EAST).

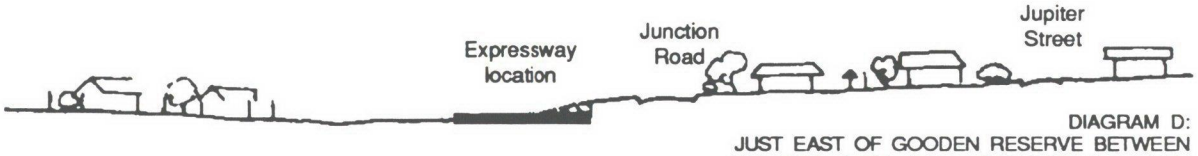


DIAGRAM D:
JUST EAST OF GOODEN RESERVE BETWEEN
JUNCTION ROAD AND LEATHERWOOD COURT
(APPROX. CH. 5000)

The carriageway would be approximately at grade (Diag. D) on its northern edge some distance from the rear boundary line of housing in the vicinity of Tamboura Avenue and Grevillea Grove and in approx. 3.0 metres cut bordering Junction Road. The existing reservation and its margins remain relatively flat throughout this section. The road would not be overviewed from houses on the south side of Junction Road because of the 3.0 m deep excavation.

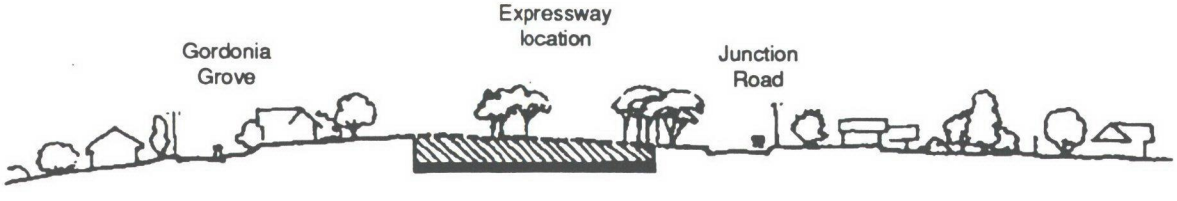


DIAGRAM E:
ALONGSIDE JUNCTION ROAD APPROACHING
CROPLEY DRIVE (APPROX. CH. 562O)

As shown in Diag. E the road would be in deep cut (approx. 7 m) between the rear fence lines of houses on Gordonia Grove and Junction Road. In the otherwise almost treeless grassed corridor, mature native tree species are distributed in a band along the centreline and southern margin in this vicinity. A centrally aligned expressway could affect many trees at this point.

THE ROAD RESERVATION LOOKING WEST NEAR THE INTERSECTION OF JUNCTION ROAD AND CROPLEY DRIVE, BAULKHAM HILLS. IN VIEW AT THE LEFT IS A SMALL BUT DENSE STAND OF MATURE EUCALYPTS (*E. PILULARIS, E. CREBRA AND E. ACMENIOIDES).*

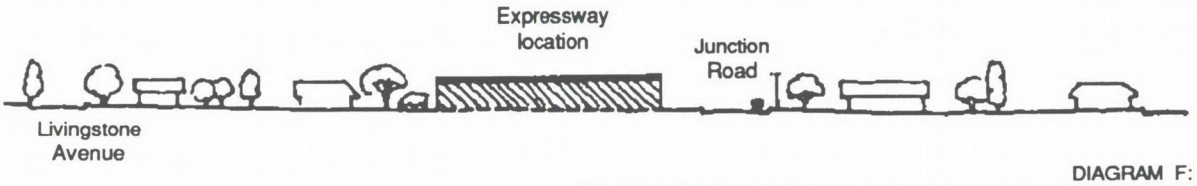
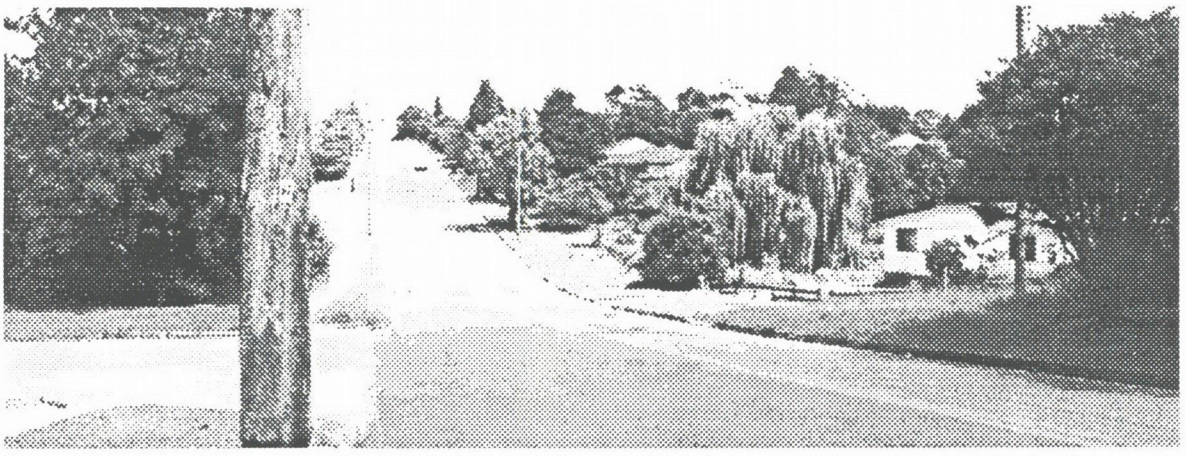


DIAGRAM F:
THE RESERVATION ADJACENT TO JUNCTION ROAD WHERE IT CROSSES QUARRY CREEK (APPROX. CH. 6800)



VIEW OF JUNCTION ROAD LOOKING WEST WITH QUARRY CREEK CROSSING AT THE LOW POINT. THE RESERVATION LIES IMMEDIATELY TO THE RIGHT, PARALLEL TO JUNCTION ROAD.

Junction Road has moderately steep grades up to its intersection with Windsor Road which the expressway would pass under in deep excavation. Diagram F shows a momentary low point alongside Junction Road where it crosses a branch of Quarry Creek. The expressway construction at this point would be on a high fill embankment above existing ground levels. In this situation the new road formation would be highly visible and stand well above the rooftops of adjoining houses on both sides.

From about Model Farms Road through to Windsor Road on the northern side, a line of houses would be removed by the road construction leaving the rear fencelines of houses on Craig and Livingstone Avenues facing the reservation.

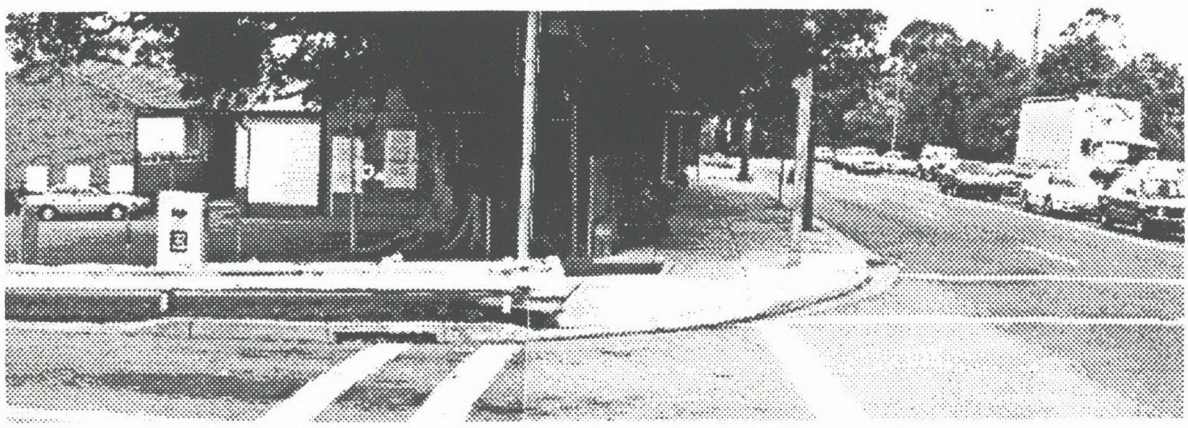
3.2.3 Windsor Road/Junction Road Intersection

At the intersection of Junction Road and Windsor Road, the expressway, in deep cut, would be largely out of sight. However, intersection requirements involving entry and exit ramps to connect with Windsor Road on the ridgeline would constitute new visible traffic streams. Commercial uses exist on one corner, a large school site, Baulkham Hills Public, on another and residential uses on the remaining two. The construction width of an expressway, including intersecting ramps, would cut through existing properties immediately to the north of the school site and the reservation of Junction Road.

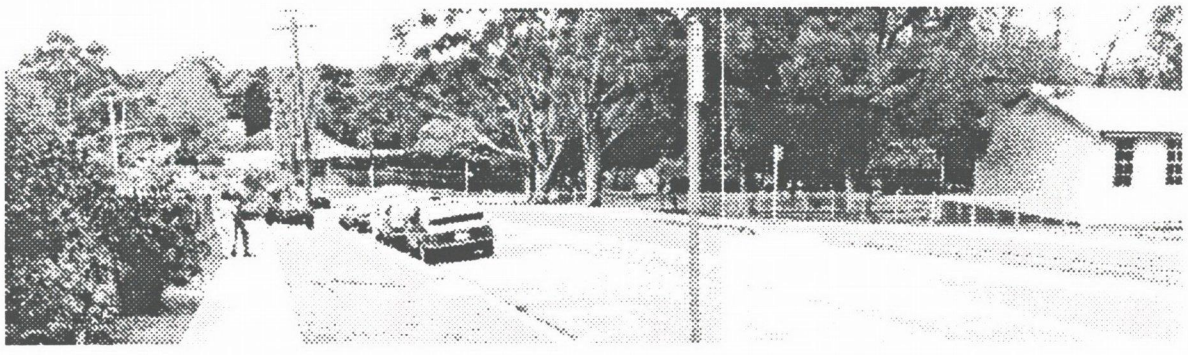
The school includes an old masonry building of interest (1876) sited close to Windsor Road. Newer school buildings are generally located off Russell Street away from the expressway reservation. School buildings of only moderate value adjacent to Linton Street would be affected by an expressway construction and a western exit ramp. Further east, near Petrina Crescent and the eastern end of Russell Street, an area of sportsfields, used by the school, on a flat bench above the valley of Darling Mills Creek, would be subdivided and reduced by the expressway.

At the corner of Linton Street and Windsor Road, two mature Moreton Bay Figs (*Ficus macrophylla)* are located just inside the school boundary. These trees are valuable boundary elements on the busy corner and could be in conflict with the design layout of an intersection zone which would be required in an expressway development.

VIEW WEST ALONG JUNCTION ROAD FROM THE WINDSOR ROAD INTERSECTION.



WINDSOR ROAD LOOKING SOUTH FROM THE CORNER OF LINTON STREET. TWO MATURE MORETON BAY FIGTREES (*FICUS MACROPHYLLA*) ARE LOCATED INSIDE THE BOUNDARY OF BAULKHAM HILLS PUBLIC SCHOOL ON THE LEFT.



THE EXPRESSWAY PROPOSAL IN DEEP CUT WOULD PASS THROUGH LINTON STREET SHOWN HERE ADJACENT TO BAULKHAM HILLS PUBLIC SCHOOL. THE VIEW EAST IS FROM THE CORNER OF WINDSOR ROAD AND LINTON STREET.

3.2.4 Darling Mills Creek

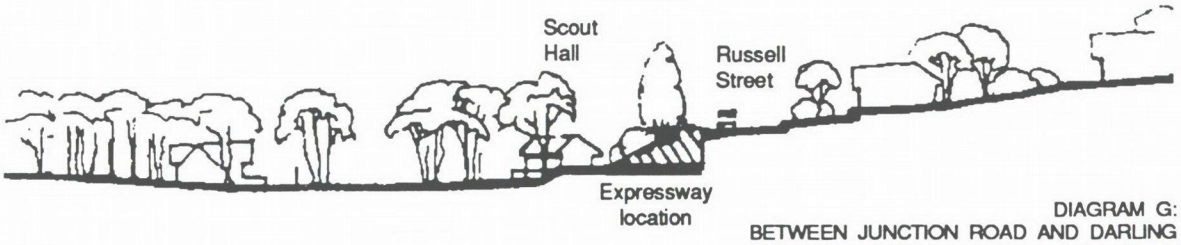


DIAGRAM G:
BETWEEN JUNCTION ROAD AND DARLING MILLS CREEK AT THE EASTERN END OF RUSSELL STREET (APPROX. CH. 7400)

The valley of Darling Mills Creek is rugged and heavily wooded, with a drier, rocky terrain on its upper slopes and minor escarpments supporting a well developed open woodland and a typical sandstone flora understorey. On the lower slopes and valley floor, a tall robust forest occurs and in the creekbed zone some rainforest species are evident. The ruggedness of the valley sides has probably helped to preserve much of the natural character which still persists. At present, Barclay Road presents steep grades to a typically busy and fast flowing traffic stream which crosses Darling Mills Creek on a low-level bridge.

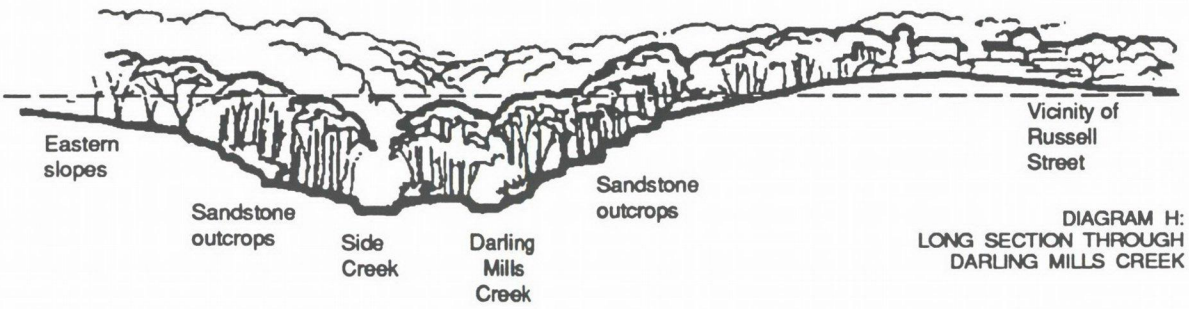
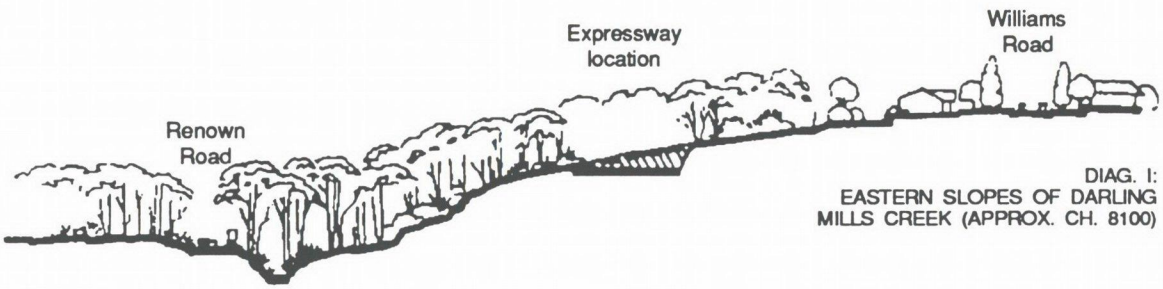


DIAGRAM H:
LONG SECTION THROUGH DARLING MILLS CREEK

THE CROSS-SECTION DEPICTS THE VALLEY PROFILE OF DARLING MILLS CREEK LOOKING SOUTH WHERE THE EXPRESSWAY WOULD BRIDGE THE VALLEY.

The expressway in this location would cross the valley at a high level on relatively flat grades, emerging from the playing fields zone of Baulkham Hills Public School on the west (Diag. H) and cutting into the side slope on the eastern edge of the valley near Williams Road.

The cut into the side slope would be initially into rocky outcrops and attractive bushland at the top of steep wooded slopes falling to the valley floor.



DIAG. I:
EASTERN SLOPES OF DARLING MILLS CREEK (APPROX. CH. 8100)

About 200 metres to the east the designated corridor skirts the rear boundaries of houses, which front onto Williams Road (Diag. I), and is situated on a moderate side slope which continues towards Barclay Road. This section is lightly wooded, with small to medium sized trees, typically Eucalypts. The rear garden areas of the houses generally look out onto this attractive stand of trees. The road would continue in cut prior to crossing a small side stream on fill and re-entering cut section to go under Barclay Road.

Throughout this section the new carriageway would be generally at a lower level to the housing on either side off Williams Road, Perry Street and Barclay Road.

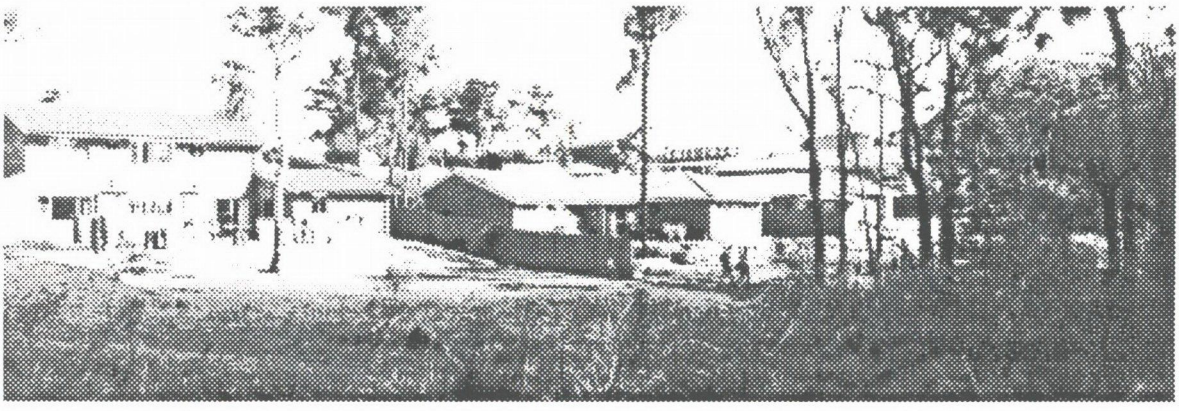
AFTER CROSSING DARLING MILLS CREEK, THE EXPRESSWAY ROUTE WOULD CUT INTO THE ROCKY ESCARPMENT OF THE VALLEY PROFILE SHOWN HERE.

THE TREED RESERVATION BORDERING THE REAR OF PROPERTIES ON WILLIAMS ROAD, NORTH ROCKS.

3.2.5 Hepburn Road/Dale Place

After passing under Barclay Road in cut, the expressway would move onto fill to cross a shallow fold in the land immediately below Hepburn Road and Dale Place. In this general area a new subdivision and recently built housing backs onto the expressway reservation. At present the outlook from the houses is onto young tree stands over a mixed groundcover of native and weed species including grasses. The outlook is attractive and the trees represent the beginnings of forested slopes falling down towards a tributary of Darling Mills Creek to the north. The road on fill would cut into the trees and provide a block to views of the trees beyond. Between the southern edge of the proposed road construction and the residential boundary lies a roughly mown margin under scattered trees.

To the south around Hepburn Road, the existing new housing estate on rising land would overlook the road on fill.



NEW RESIDENTIAL DEVELOPMENT BELOW CARLTON ROAD, HEPBURN ROAD AND DALE PLACE WOULD OVERLOOK THE EXPRESSWAY WHERE IT PASSES ON FILL JUST BEYOND THEIR REAR BOUNDARIES.

3.2.6 Muirfield High School – Yale Close

The expressway would pass through cut section on the broad ridge slopes below Muirfield High School. The cut would be of variable depth around 2 to 4 metres, which would tend to reduce the presence of the road from viewpoints within the school grounds. Sportsfields make up the larger part of the school site bordering the reservation. The quality of bushland on this section is poor, having been previously disturbed and since regenerated with a reduction of natural species diversity.

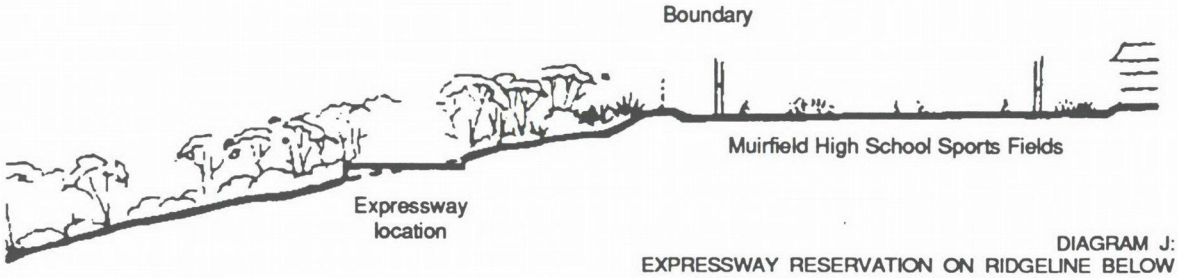
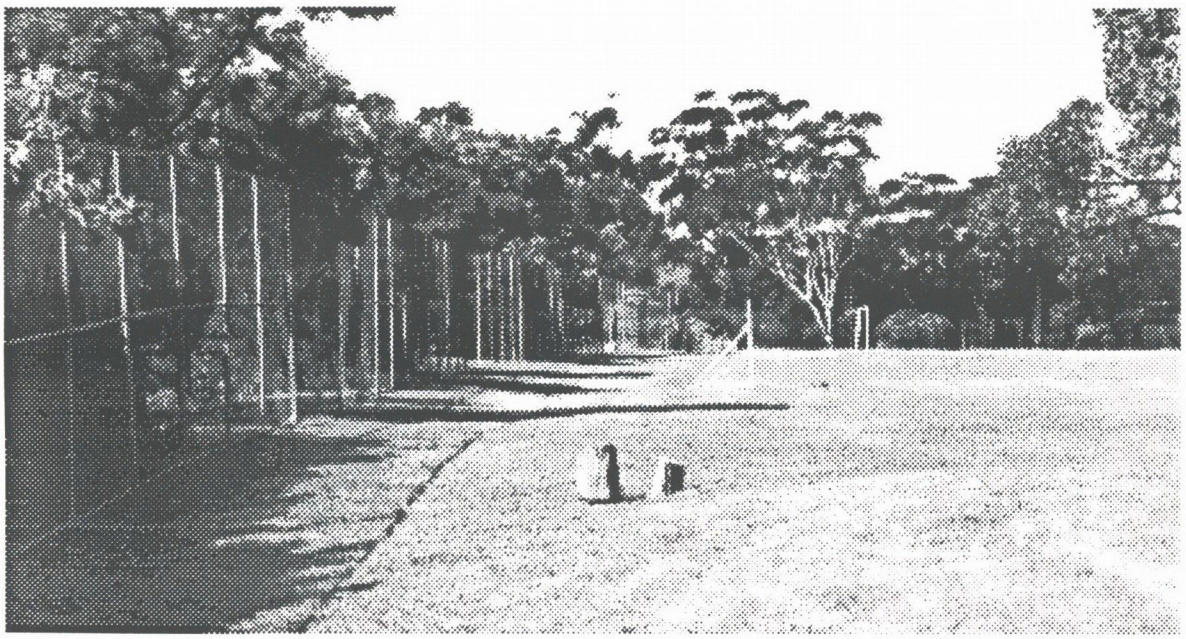


DIAGRAM J:
EXPRESSWAY RESERVATION ON RIDGELINE BELOW MUIRFIELD HIGH SCHOOL (APPROX. CH. 10620)



THE ROAD IN CUT BELOW MUIRFIELD HIGH SCHOOL WOULD BE CLOSE TO BUT LARGELY OUT OF SITE FROM THE SCHOOL'S PLAYING FIELDS. MAIN SCHOOL BUILDINGS ARE RELATIVELY DISTANT FROM THE ROUTE. THE EXISTING BUSHLAND IN THE AREA APPEARS TO BE A REGROWTH OF POORER QUALITY WITH SOME WEED INTRUSION.

Below Yale Close the expressway would come out of cut and be momentarily very visible before re-entering cut section on the next ridgeline. At this point below Yale Close, the road would cross a small V-shaped lateral valley which falls steeply towards the main creekline below. Although the road at its centre would occur on a line some 8–10 metres out of the gully profile, the construction would still be below the ground levels of Yale Close houses. This would create a difficult situation in regard to visual screening.

THE PHOTOGRAPH BELOW SHOWS THE CLOSE PROXIMITY OF NEW HOUSES ON YALE CLOSE OVERLOOKING A STEEP V-SHAPED SIDE GULLY WHICH WOULD BE SPANNED BY THE EXPRESSWAY

3.3 EXPRESSWAY ALIGNMENT OPTIONS – MAHERS ROAD

3.3.1 Environmental Impacts

The notional plan for an expressway allows for the consideration of alignment options in the area lying between Muirfield High School and Oakes Road. The alternatives have been investigated in response to issues involving environmental impacts, some of which would be severe. These impacts relate to concern for both bushland and residential environmental qualities. Vegetation Maps 1/3 and 2/3 (refer to Figures 4.2 to 4.5) cover the area of concern and indicate the distribution of various vegetation types.

The area consists of a creekline in the reservation following the north side of Mahers Road, which becomes part of a widening valley formation after it leaves the western end of Mahers Road. The creek ultimately joins Darling Mills Creek and the valley formation, supporting a diverse mix of bushland associations, becomes relatively deep, broad and rugged. A branching valley runs off to the north towards Aiken Road with Merelynne Road lying to the west.

Steep rocky slopes form the northern sides of the valley to the west of Mahers Road and moderately steep slopes feature on the south flank where rock outcropping also occurs.

Between the western end of Mahers Road and Oakes Road, a corridor of tall trees consisting of mostly *Eucalyptus saligna* (Sydney Blue Gum) forms a stand measuring approximately two hectares. The understorey to the Blue Gums is a mix of exotic weed and native species with weeds being the dominant inclusion. The creekline, draining urban areas is heavily weed-infested and weedy characteristics tend to follow the stream down into the broad valley.

Beyond the western end of Mahers Road on the north side of the creek, the steep slopes support a tall forest of high quality in terms of natural composition and physical character. These qualities continue along the valley side and are enhanced by an understorey closer to the creek, which is both unusual and especially attractive.

The understorey, reliant upon the moist forest conditions which prevail, includes species such as *Ceratopetalum gummiferum* (NSW Christmas Bush), *C. appetalum* (Coachwood) and other rainforest-related species. The display of Christmas Bush in abundance is of special note.

The southern slopes to the creek support a drier and more open forest but still feature trees of grand proportions and a diverse mix of sandstone flora. On the flatter slopes towards the creek and also on slopes closer to property boundaries, past disturbances have introduced weed and grass species and left disturbed ground surfaces.

The significant features of the general area described above are:

- The rugged topography and apparent wild quality of the broad panorama of bush-land cover.
- The north slope to the creek just downstream from the end of Mahers Road, with its rich and visually beautiful natural circumstances.
- The comparatively extensive stand of *Eucalyptus saligna* which is both spec-tacular in physical form and to some extent rare as an example of the type within the Sydney region.

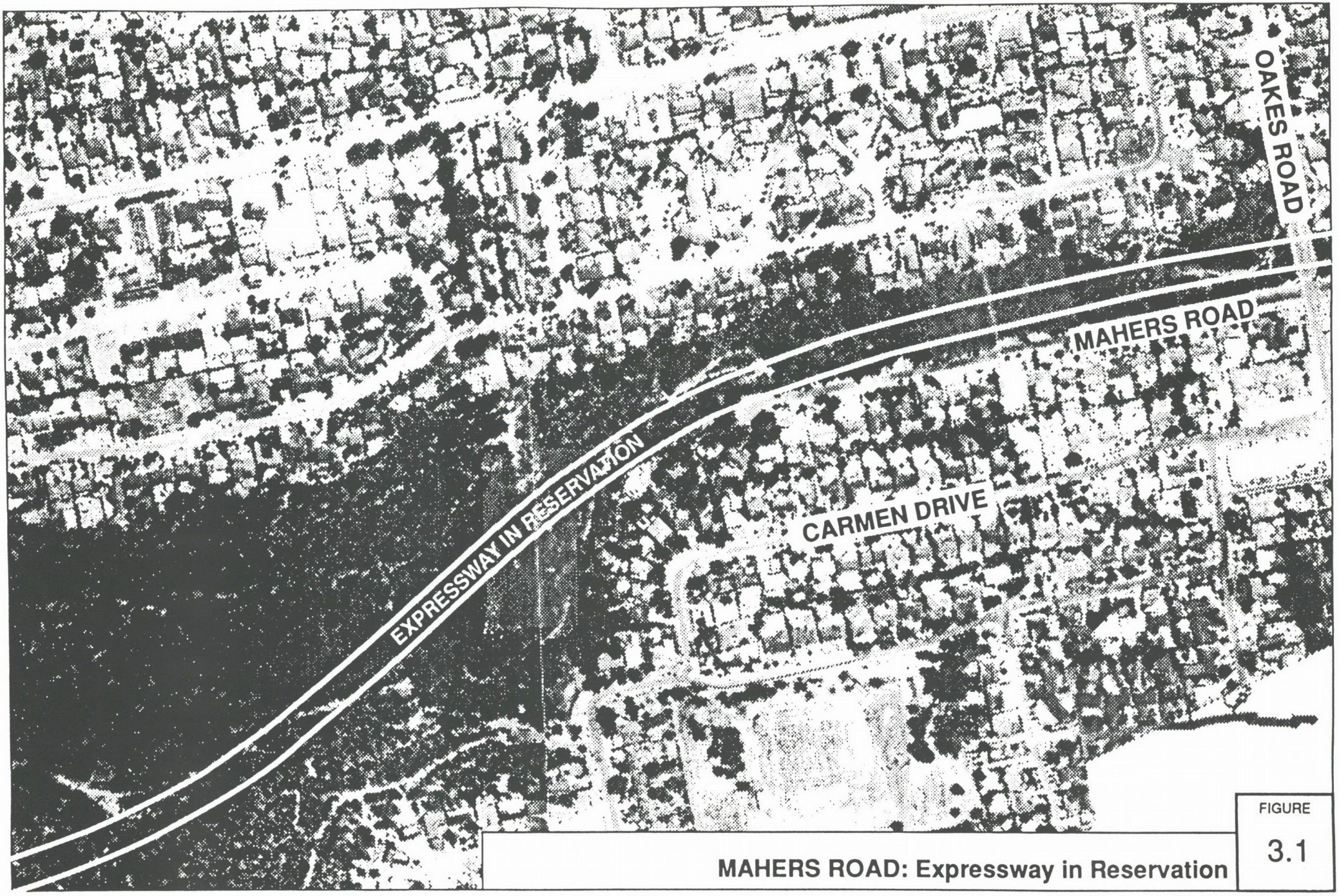


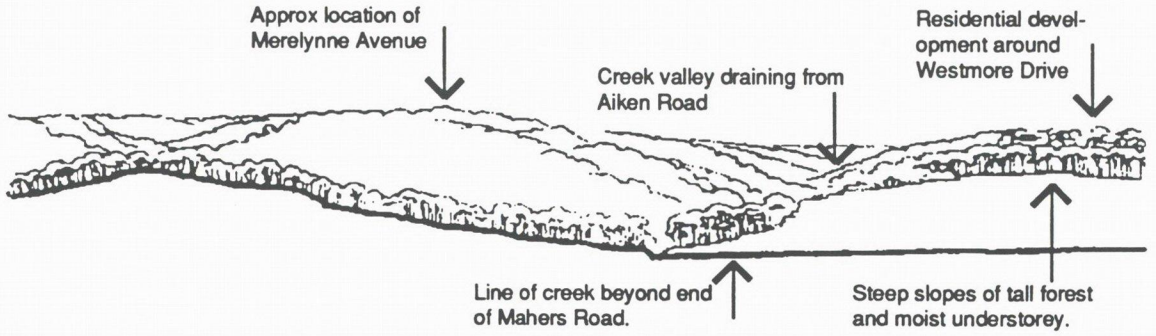
FIGURE 3.1

MAHERS ROAD: Expressway in Reservation

THIS PHOTOGRAPH SHOWS THE DRIER FOREST ENVIRONMENT BORDERING THE WESTERN END OF WESTMORE DRIVE AT THE HIGHER LEVEL ABOVE THE CREEK. THE EXPRESSWAY EXCAVATED THROUGH THIS AREA (SEE OPTION A IN FIG. 6.11) WOULD DESTROY VAUABLE BUSHLAND, BUT ALSO INTERFERE WITH THE GROUND WATER REGIME AND THREATEN THE MOIST FOREST ENVIRONMENT ON THE LOWER SLOPES.

THIS SCENE DEPICTS SOMETHING OF THE INFORMAL RECREATIONAL VALUE AND SELF-GENERATED ADVENTURE PLAY OPPORTUNITIES WHICH URBAN BUSHLAND OFFERS. THE 'PRIVATE PROPERTY' IS ESTABLISHED IN ROCKY TERRAIN IN THE EXPRESSWAY RESERVATION.

THE EXISTING BUSHLAND IS DRAMATIC JUST WEST OF THE END OF MAHERS ROAD. THE SLOPES ARE STEEP AND DISPLAY A RICH ASSOCIATION OF TALL DENSE FOREST AND MOIST LUXURIANT UNDERSTOREY. BEYOND LIES THE BROAD VALLEY SYSTEM OF DARLING MILLS CREEK AND ITS TRIBUTARY STREAMS WHERE A WIDE VISTA OF BUSHLAND AND FOREST IS REVEALED.



DIAGRAMMATIC SECTIONAL PERSPECTIVE LOOKING NORTH ACROSS MAIN STREAM SYSTEM TOWARDS MERELYNNE AVENUE.

THESE VIEWS, OBTAINED IMMEDIATELY TO THE WEST OF MAHERS ROAD, REVEAL AN UNUSUAL DISPLAY OF LIGHT REFLECTING OFF THE TEXTURE OF CHRISTMAS BUSH (*CERATOPETALUM GUMMIFERUM*) AND ASSOCIATED SPECIES WHICH FORM A MOIST UNDERSTOREY. THE CHRISTMAS BUSH, A POPULAR GARDEN PLANT AND COMMERCIALLY-MARKETED FLOWER CROP, IS RARELY SEEN IN SUCH ABUNDANCE, PARTICULARLY WITHIN URBAN AREAS.

AT THE TRANSITION POINT BETWEEN THE URBAN DEVELOPMENT OF MAHERS ROAD AND BUSHLAND TO THE WEST, THE STREAM AND ITS MARGINS SUPPORT TYPICAL URBAN WEEDGROWTH. THE STAND OF BLUE GUM ADJACENT TO MAHERS ROAD TERMINATES IN THIS ZONE.

MAHERS ROAD: LOOKING EAST TOWARDS OAKES ROAD SHOWING THE FINE STAND OF SYDNEY BLUE GUM (*EUCALYPTUS SALIGNA*) EXISTING IN THE EXPRESSWAY RESERVATION. ALONG THE DEGRADED WATERCOURSE ASSOCIATED WITH THE BLUE GUMS, WEEDGROWTH FORMS A RAMPANT UNDERSTOREY IN COMBINATION WITH SOME REMNANT NATIVE SPECIES.

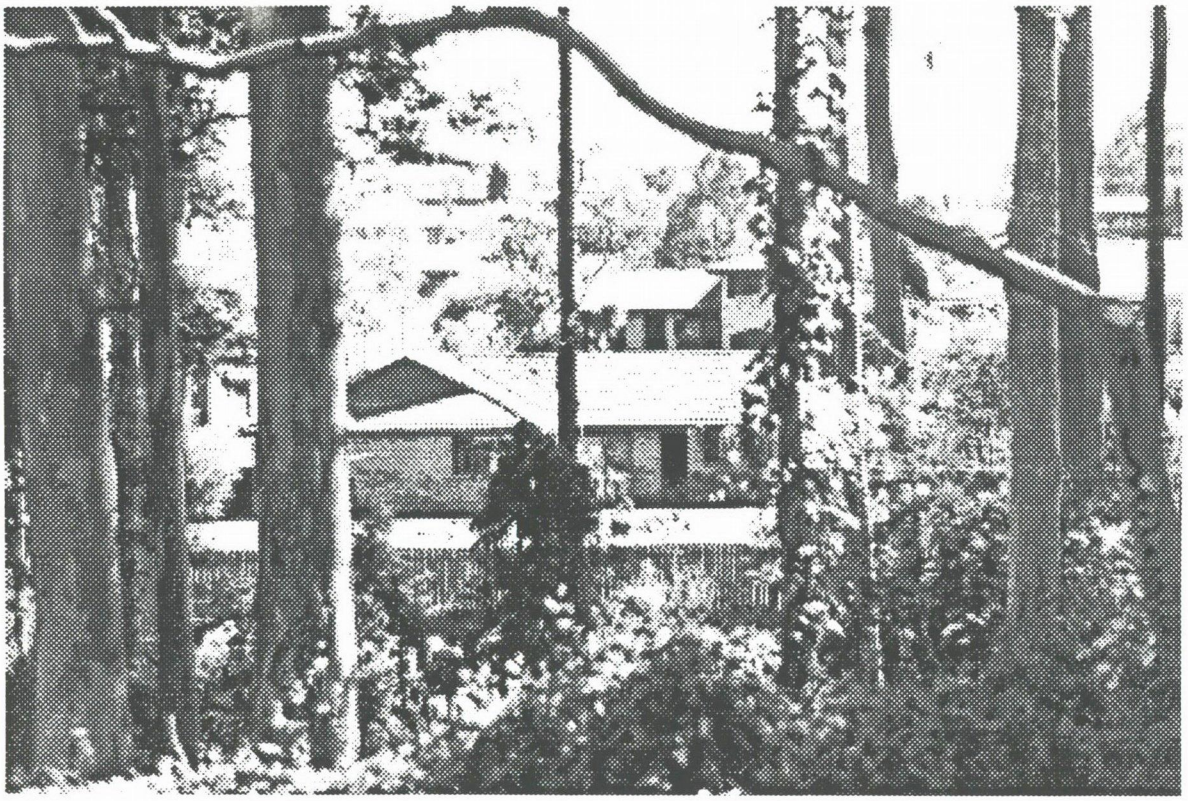
The residential environment bordering the bushland area is itself neat, relatively new and attractive. Well cared-for gardens and modern homes feature. Properties immediately bordering the bushland typically have views out to more or less natural conditions of good quality. Homes forming a second line from those on the bushland edge, and beyond, would typically not have clear views to the bushland.

North Rocks and Pennant Hills Roads, some distance from the bushland environment, create narrow corridors or noise and disturbance because of heavy traffic. However, between these corridors and the bushland edges the suburban environment is quiet and peaceful.

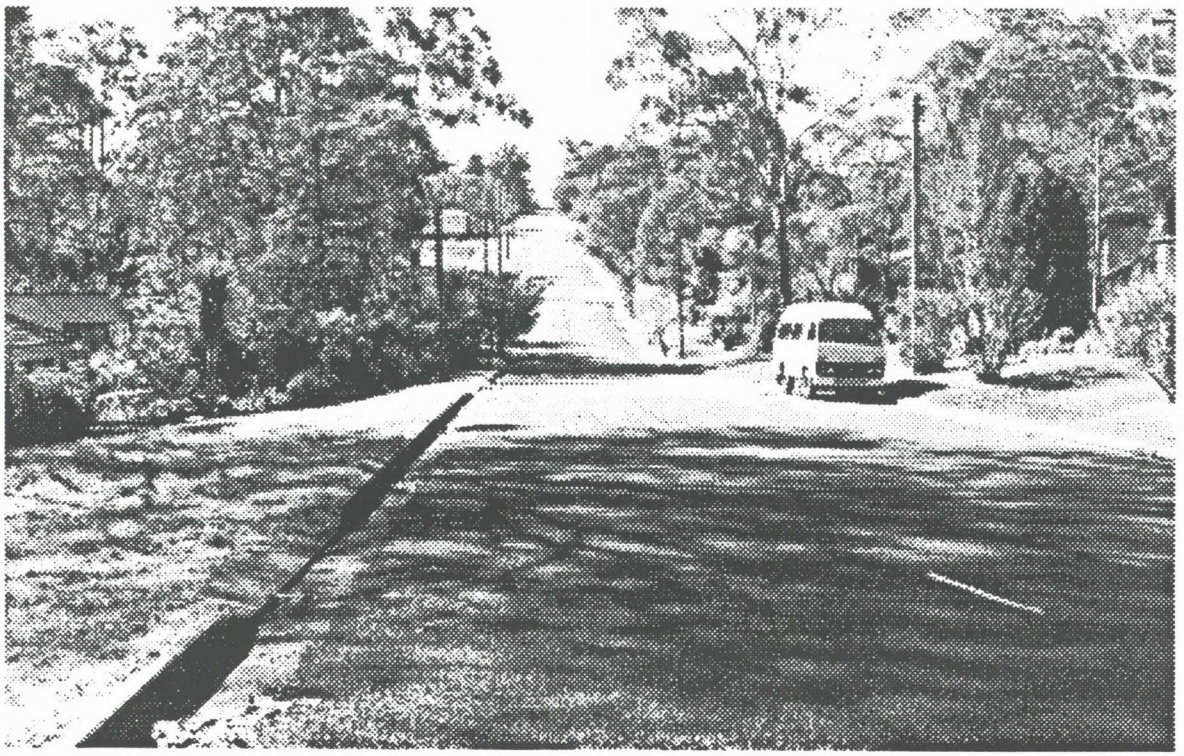
In consideration of the various attributes of the bushland and residential environments described above, different road alignment options have been developed for the expressway proposal. The matter of determining a best solution is difficult and in this context the design options are described in Section 6.2.

3.3.2 Oakes Road to Pennant Hills Road

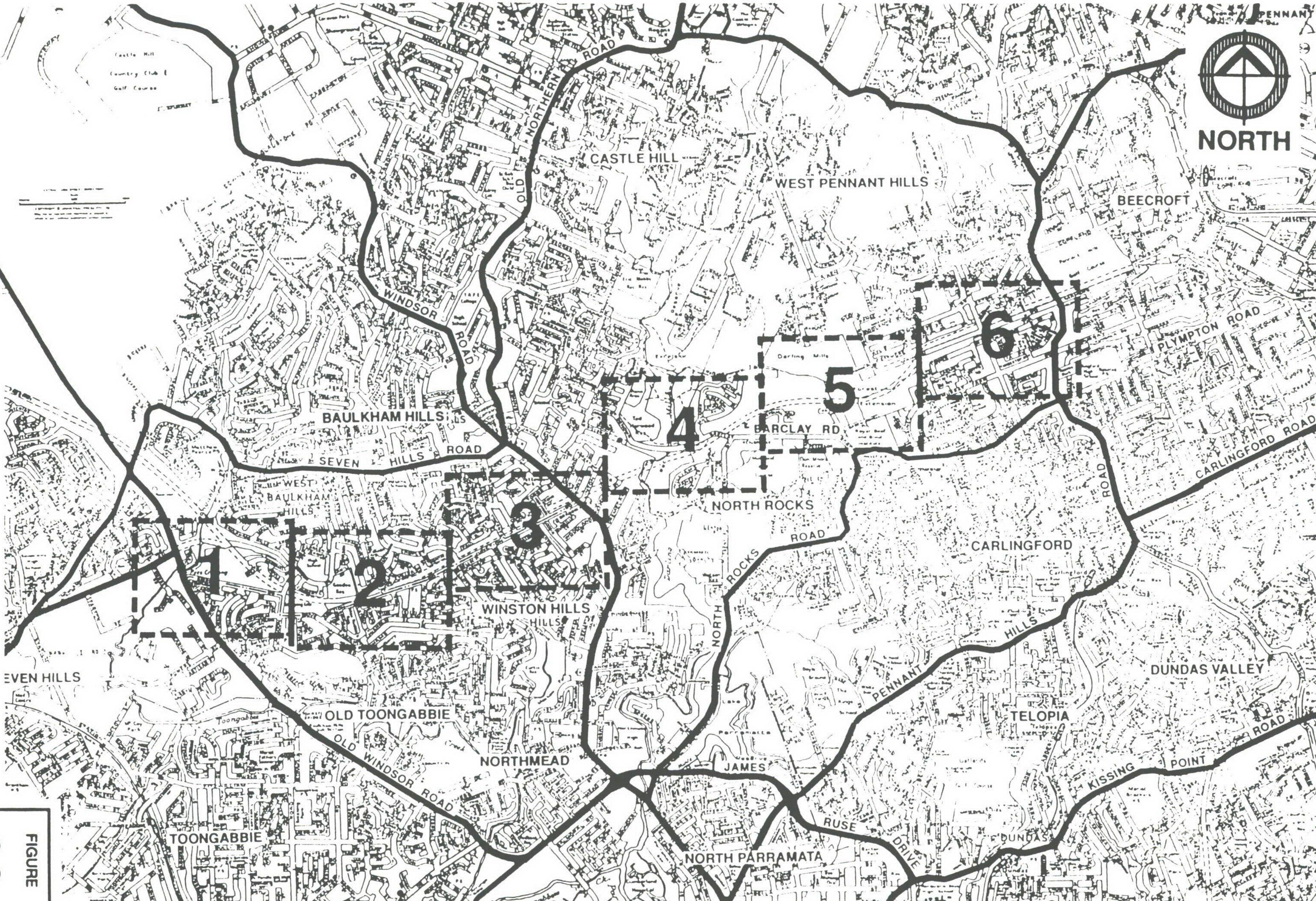
The expressway from Oakes Road would go into excavation to form a deep cut under Pennant Hills Road. At the same time, existing Mahers Road at the side of the expressway reservation, climbs moderately steep grades to intersect with Pennant Hills Road. A complex intersection construction would be required to connect traffic including public transport between the expressway and Pennant Hills Road to the north and south. This would result in major disruption to existing land levels and properties in Mahers Road along the approaches to Pennant Hills Road and along the margins of Pennant Hills Road itself.



PHOTOGRAPH SHOWING THE CLOSE RELATIONSHIP OF THE RESERVATION AND THE BLUE GUMS WITH RESIDENTIAL PROPERTIES OF WESTMORE DRIVE.

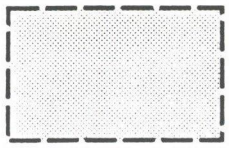


MAHERS ROAD: LOOKING EAST TOWARDS PENNANT HILLS ROAD, CARLINGFORD. THE EXPRESSWAY RESERVATION LIES IMMEDIATELY TO THE LEFT.



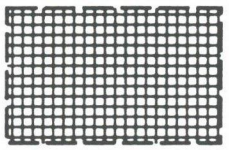
Expressway in Reservation
LANDUSE PLANS : LOCATION MAP

FIGURE 3.2

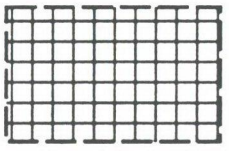


RESIDENTIAL

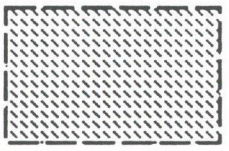
SPECIAL USES



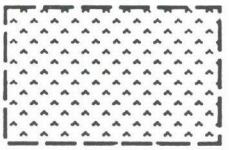
BUSINESS



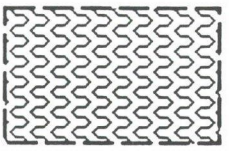
INDUSTRY



OPEN SPACE



RURAL



STATE FOREST

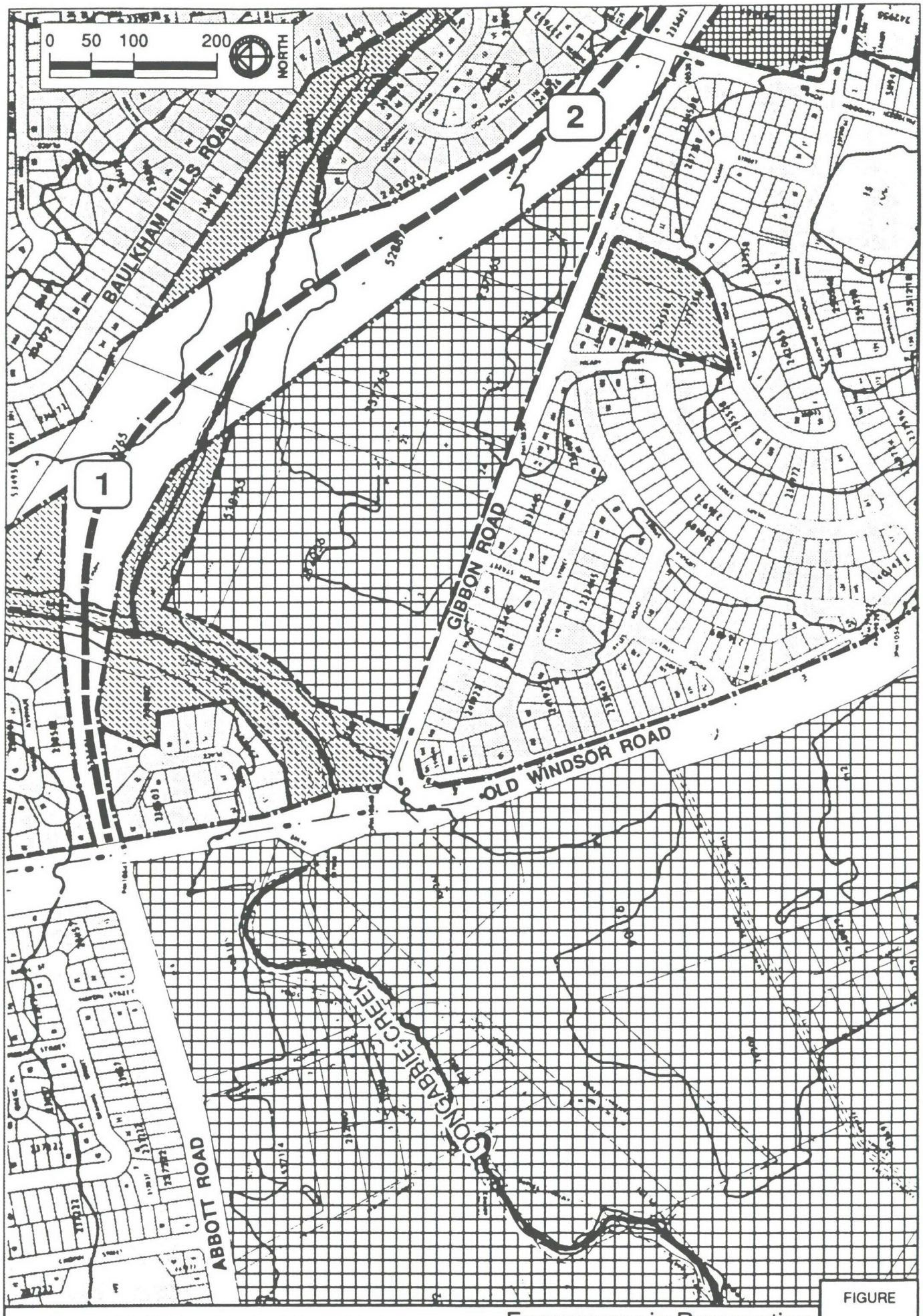
2 LOCATIONS OF INDICATIVE SECTION DIAGRAMS

ROAD RESERVATION

SNOWY MOUNTAINS ENGINEERING CORPORATION
BRUCE MACKENZIE AND ASSOCIATES PTY LTY LANDSCAPE ARCHITECTS

LEGEND: LANDUSE

FIGURE 3.3



OLD WINDSOR ROAD TO PENNANT HILLS ROAD

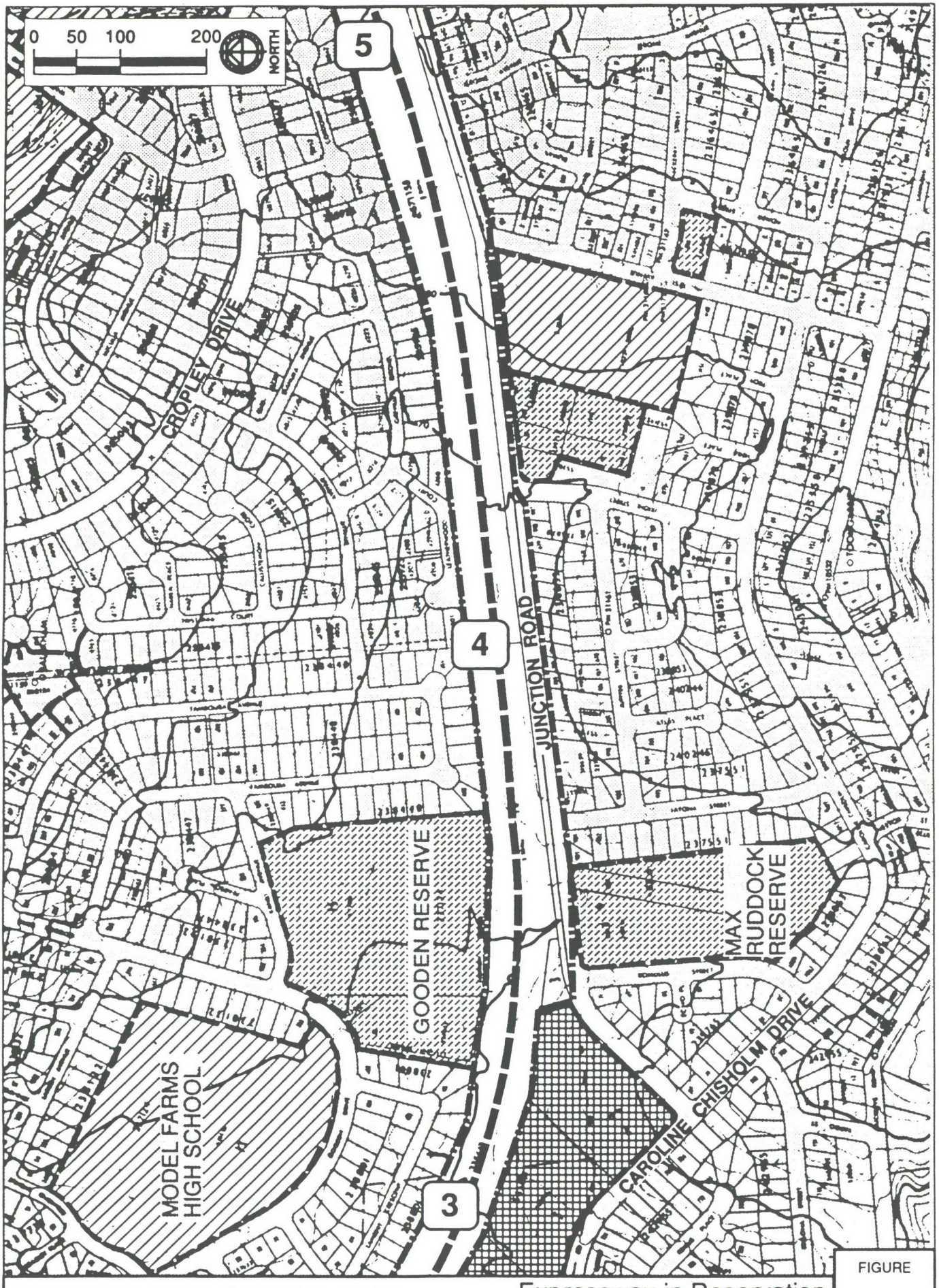
SNOWY MOUNTAINS ENGINEERING CORPORATION
BRUCE MACKENZIE AND ASSOCIATES PTY LTD LANDSCAPE ARCHITECTS

Expressway in Reservation

LANDUSE : **MAP 1/6**

FIGURE

3.4



OLD WINDSOR ROAD TO PENNANT HILLS ROAD

SNOWY MOUNTAINS ENGINEERING CORPORATION
BRUCE MACKENZIE AND ASSOCIATES PTY LTD LANDSCAPE ARCHITECTS

Expressway in Reservation

LANDUSE : **MAP 2/6**

FIGURE

3.5

OLD WINDSOR ROAD TO PENNANT HILLS ROAD

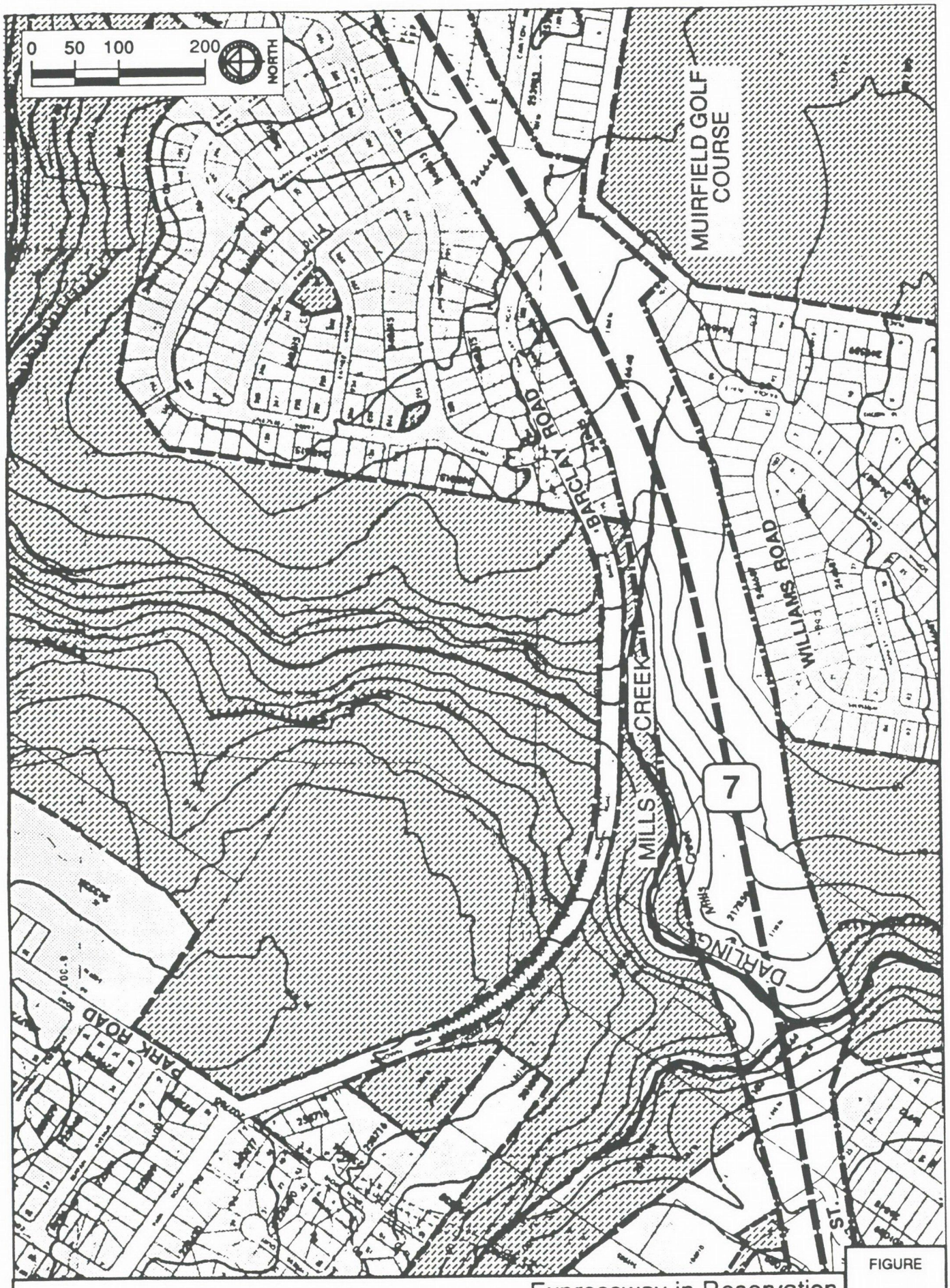
SNOWY MOUNTAINS ENGINEERING CORPORATION
BRUCE MACKENZIE AND ASSOCIATES PTY LTD LANDSCAPE ARCHITECTS

Expressway in Reservation

LANDUSE : **MAP 3/6**

FIGURE

3.6



OLD WINDSOR ROAD TO PENNANT HILLS ROAD

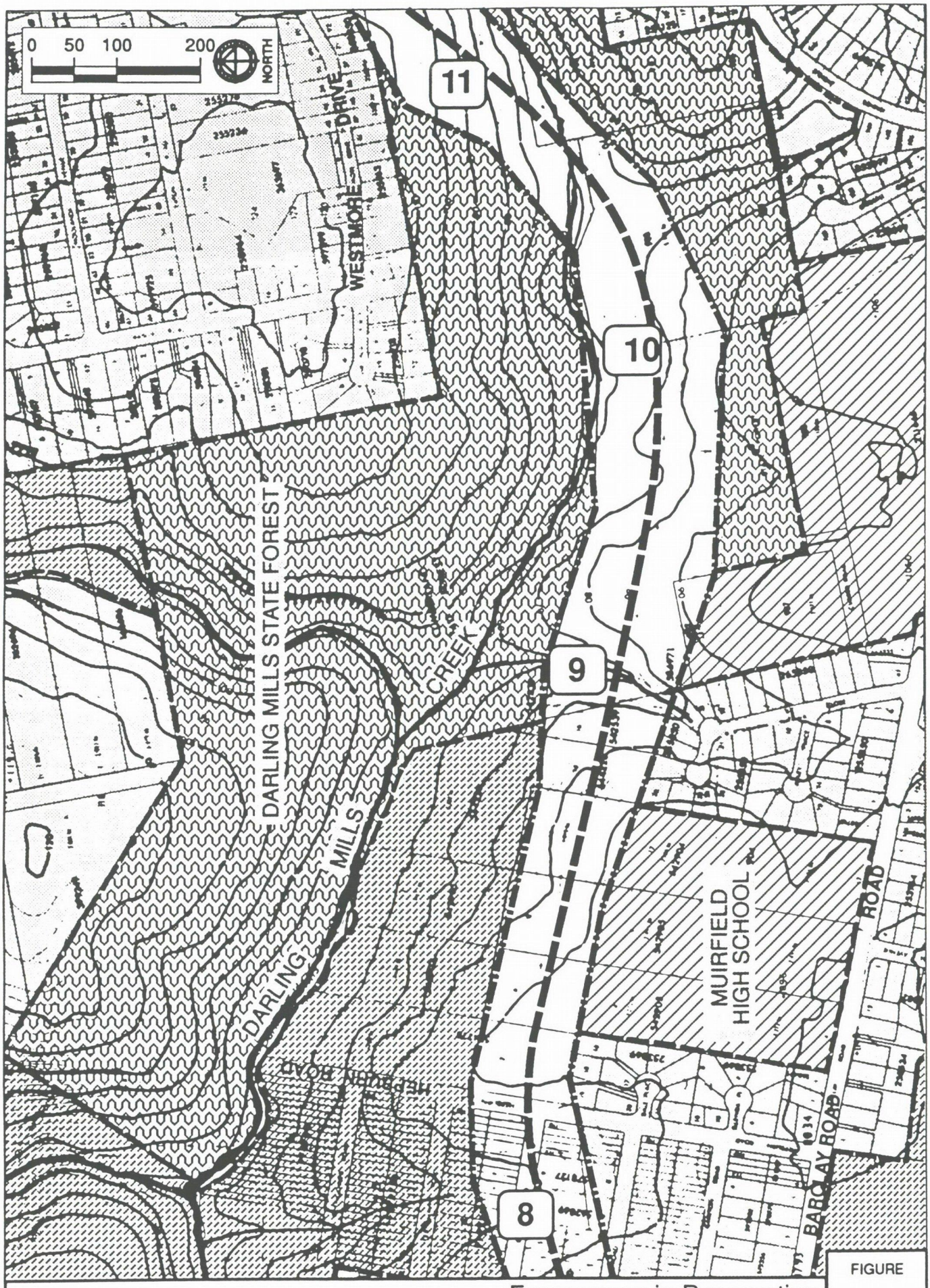
SNOWY MOUNTAINS ENGINEERING CORPORATION
BRUCE MACKENZIE AND ASSOCIATES PTY LTD LANDSCAPE ARCHITECTS

Expressway in Reservation

LANDUSE : **MAP 4/6**

FIGURE

3.7



OLD WINDSOR ROAD TO PENNANT HILLS ROAD

SNOWY MOUNTAINS ENGINEERING CORPORATION
BRUCE MACKENZIE AND ASSOCIATES PTY LTD LANDSCAPE ARCHITECTS

Expressway in Reservation

LANDUSE : **MAP 5/6**

FIGURE

3.8

OLD WINDSOR ROAD TO PENNANT HILLS ROAD

SNOWY MOUNTAINS ENGINEERING CORPORATION
BRUCE MACKENZIE AND ASSOCIATES PTY LTD LANDSCAPE ARCHITECTS

Expressway in Reservation

LANDUSE : **MAP 6/6**

FIGURE
3.9

3.4 NORTH ROCKS ROAD

North Rocks Road has been developed as an arterial road proposal within the course of the transport links study. A later section of this report describes and illustrates the nature of the arterial road proposal in regard to its functions, layout and scale.

The arterial road concept envisages the F2 expressway reservation being utilised between Old Windsor Road and Barclay Road as the initial major segment followed by an alignment located along North Rocks Road to connect with Pennant Hills Road. At Pennant Hills Road the arterial road proposal would turn south to make a connection with Carlingford Road. A general description of the expressway reservation is provided in Section 3.2. The alignment would leave the reservation corridor at about the point where Perry Street connects with Barclay Road at the north western corner of Muirfield Golf Course, a large and typical golf course open space adjoining North Rocks Road.

From there the arterial road would follow Barclay Road into North Rocks Road which is located on a flattened ridgeline profile of the Darling Mills Creek valley formation. Attractive housing borders the existing carriageway to form the predominent landuse along the route. Housing is generally of a sufficient age to have developed relatively mature gardens and trees. These make a significant contribution to the existing corridor. Groups of mature trees occur forming small but impressive stands in terms of height and maturity on footpaths and in gardens; an interesting group occurs near the western boundary of the Royal Deaf and Blind Institute. The Institute occupies a large site with an assemblage of buildings set back from the road. A line of semi-mature Camphor Laurel trees lies close to the road boundary. Opposite is the local shopping centre set below the south edge of North Rocks Road on an excavated site.

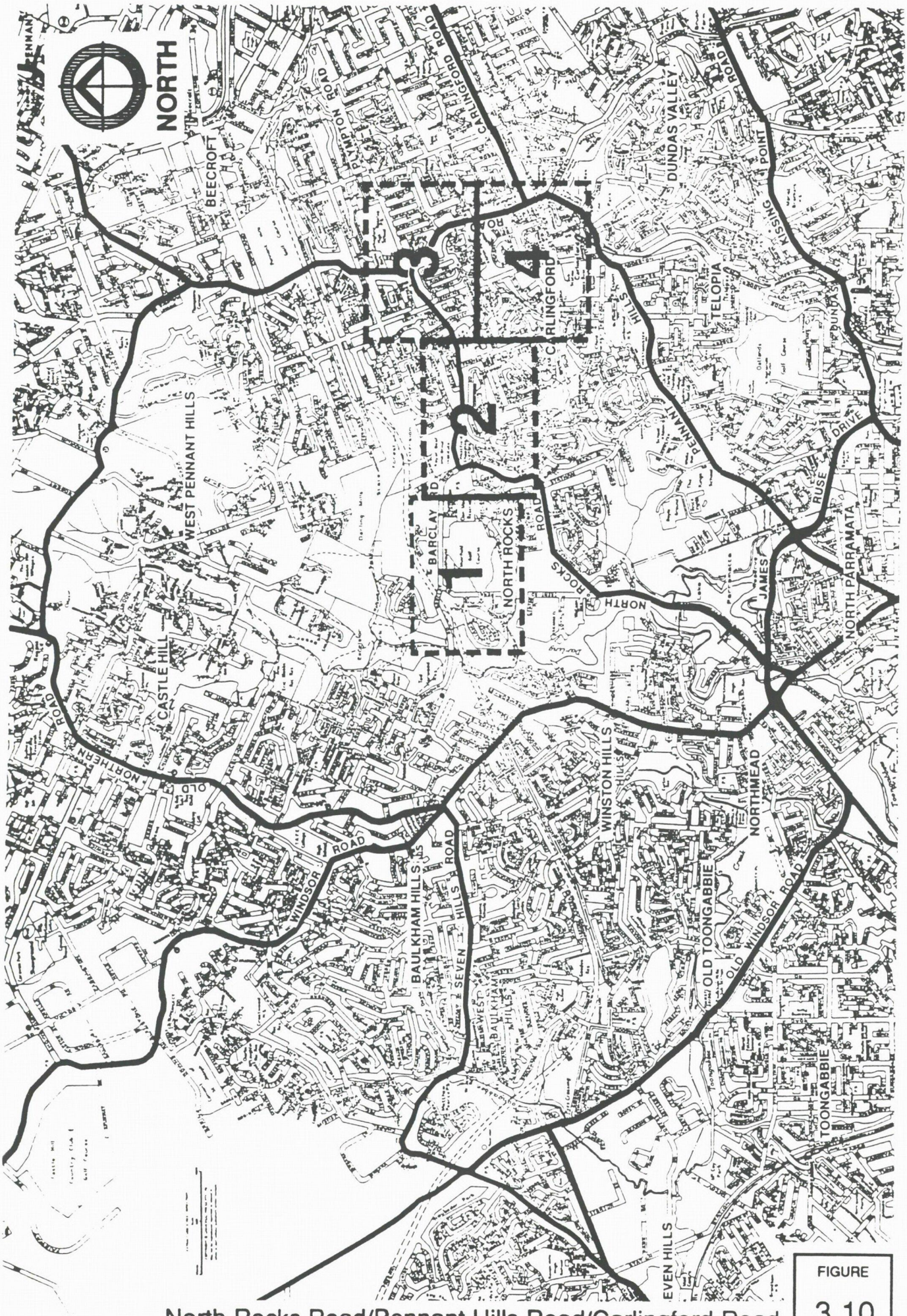
Muirfield High School is situated on the north margin of North Rocks Road also on a large site with buildings set back 30–35 metres from the road edge. Semi-mature Eucalypts and and small experimental farm lots occur also, set back from the road edge.

North Rocks Park with community buildings, sportsfields and tennis/net ball courts, children's playground and carparks is an important local facility. Other uses include a cemetery, a small open space reserve, a Telecom site, a plants nursery and some recent town housing. Other newly-constructed individual houses also occur.

The existing road corridor is attractive in its present circumstances as a suburban residential zone although existing and worsening traffic conditions impinge upon its environmental quality.

3.4.1 Landuse Maps : North Rocks Road

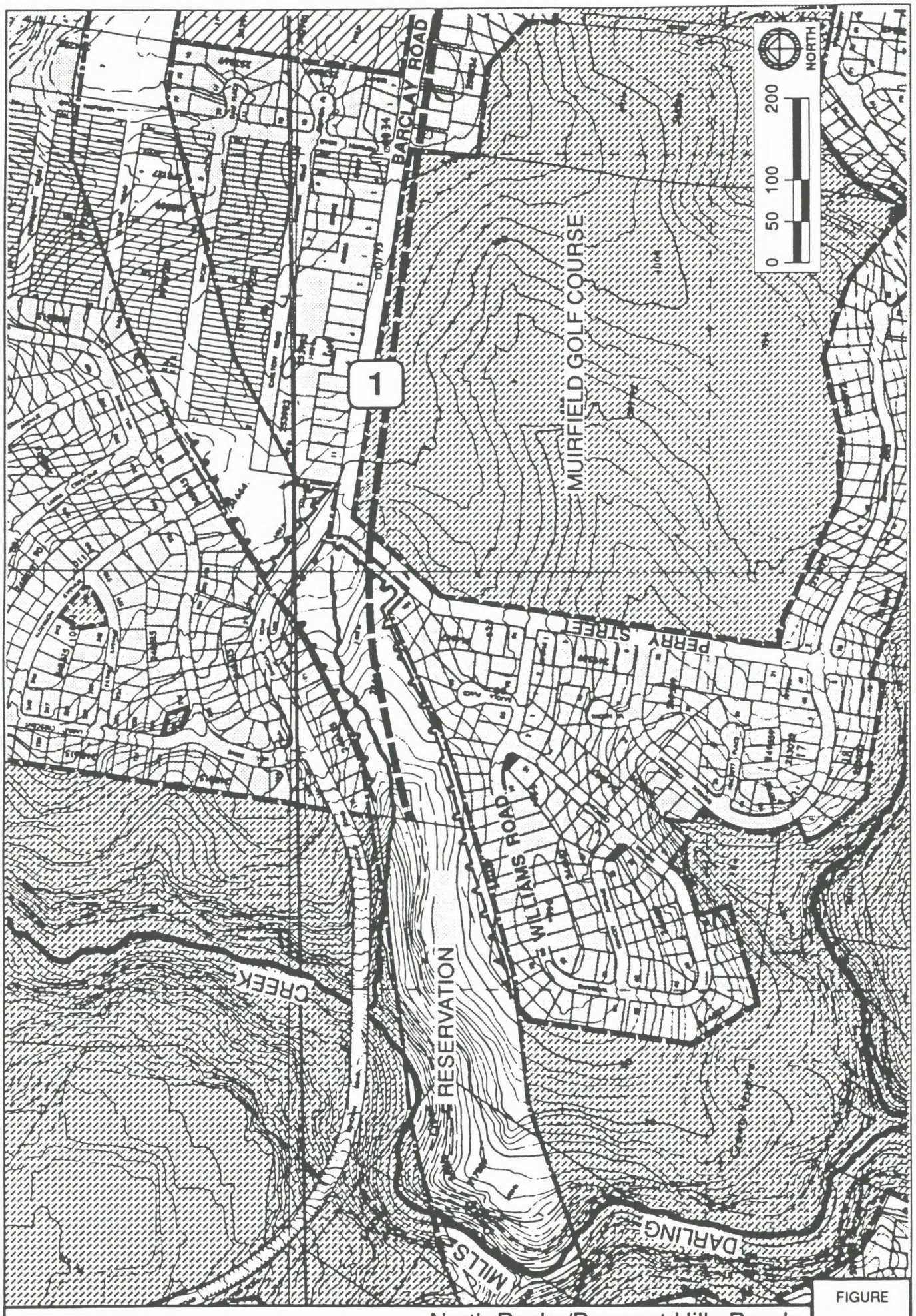
The following landuse maps (4) cover the Arterial Road proposal from the point where it leaves the expressway reservation through to Carlingford Road following North Rocks Road and Pennant Hills Road. The segment in the reservation is included in Figures 3.11–3.14 (Expressway in Reservation). Refer also to Legend : Landuse Fig. 3.3.



North Rocks Road/Pennant Hills Road/Carlingford Road

LANDUSE PLANS : LOCATION MAP

FIGURE 3.10



OLD WINDSOR ROAD TO PENNANT HILLS ROAD

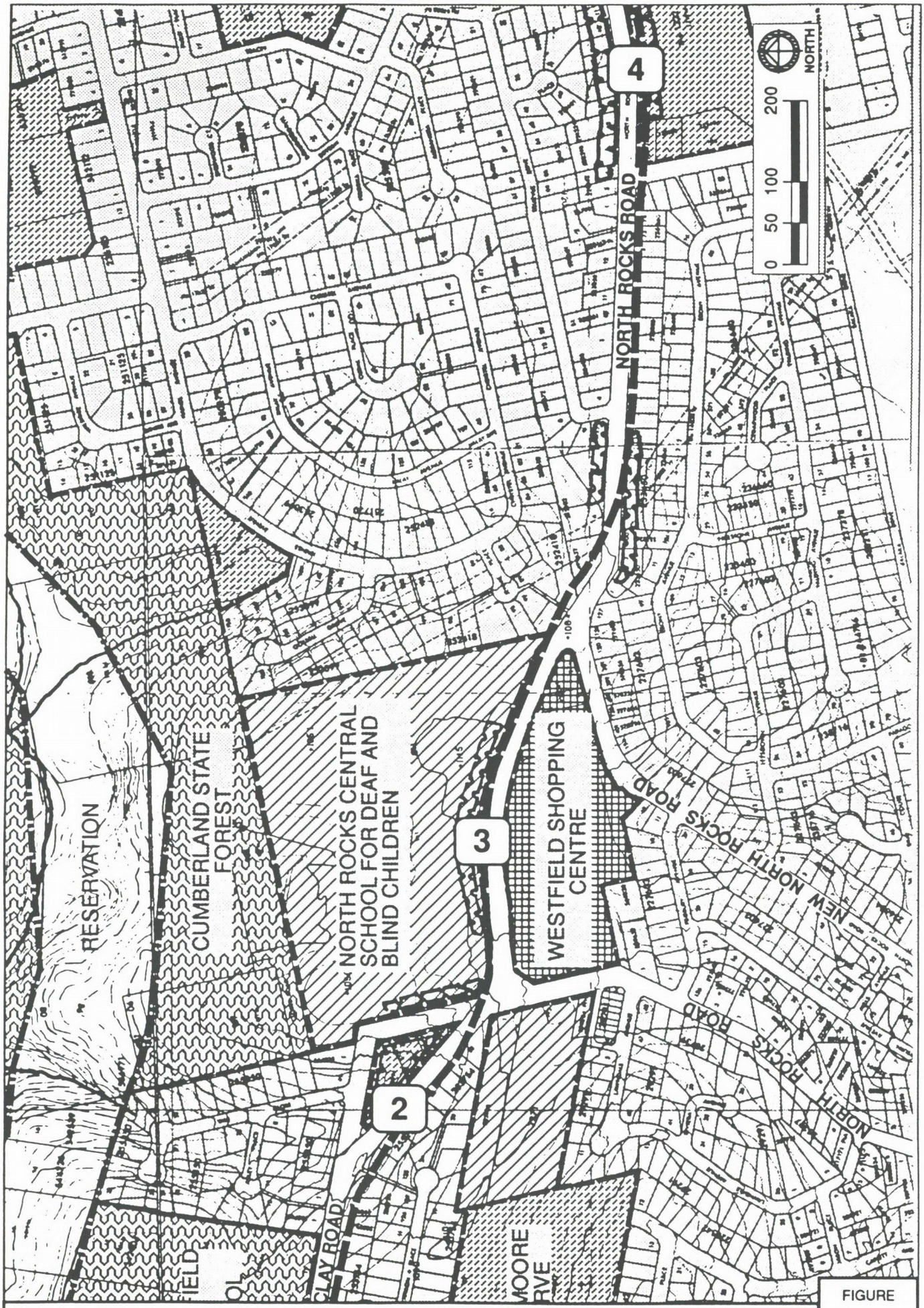
SNOWY MOUNTAINS ENGINEERING CORPORATION
BRUCE MACKENZIE AND ASSOCIATES PTY LTD LANDSCAPE ARCHITECTS

North Rocks/Pennant Hills Roads

LANDUSE : **MAP 1/4**

FIGURE

3.11



OLD WINDSOR ROAD TO PENNANT HILLS ROAD

SNOWY MOUNTAINS ENGINEERING CORPORATION
BRUCE MACKENZIE AND ASSOCIATES PTY LTD LANDSCAPE ARCHITECTS

North Rocks/Pennant Hills Roads

LANDUSE : **MAP 2/4**

FIGURE

3.12

OLD WINDSOR ROAD TO PENNANT HILLS ROAD

North Rocks/Pennant Hills Roads

LANDUSE : **MAP 3/4**

FIGURE

3.13

SNOWY MOUNTAINS ENGINEERING CORPORATION
BRUCE MACKENZIE AND ASSOCIATES PTY LTD LANDSCAPE ARCHITECTS

OLD WINDSOR ROAD TO PENNANT HILLS ROAD

North Rocks/Pennant Hills Roads

LANDUSE : **MAP 4/4**

FIGURE

3.14

SNOWY MOUNTAINS ENGINEERING CORPORATION
BRUCE MACKENZIE AND ASSOCIATES PTY LTD LANDSCAPE ARCHITECTS

NORTH ROCKS ROAD (NEAR THE CORNER OF BELLEVUE DRIVE) LOOKING WEST.

3.5 OTHER OPTIONS CORRIDORS

The other options briefly discussed here were investigated in order to identify the better or more likely solutions which may have been developed as design proposals. Their initial selection was made either because of their existing functions as traffic routes or because of their possible suitability related to topography and as logical connecting alignments. Within the study areas generally, virtually all land has already been committed to urban development other than designated open space reservations and the actual reservation of the F2 Expressway corridor. The prospect of investigating and analysing a study area in an objective response to the landbase without being severely constrainted by existing landuse conditions or the existing road network was not a possibility.

Each of the following options in this report section was investigated, mapped and assessed in terms of existing conditions and potential impacts. They were subsequently rejected for various reasons, including, but not only because of visual or landscape impact.

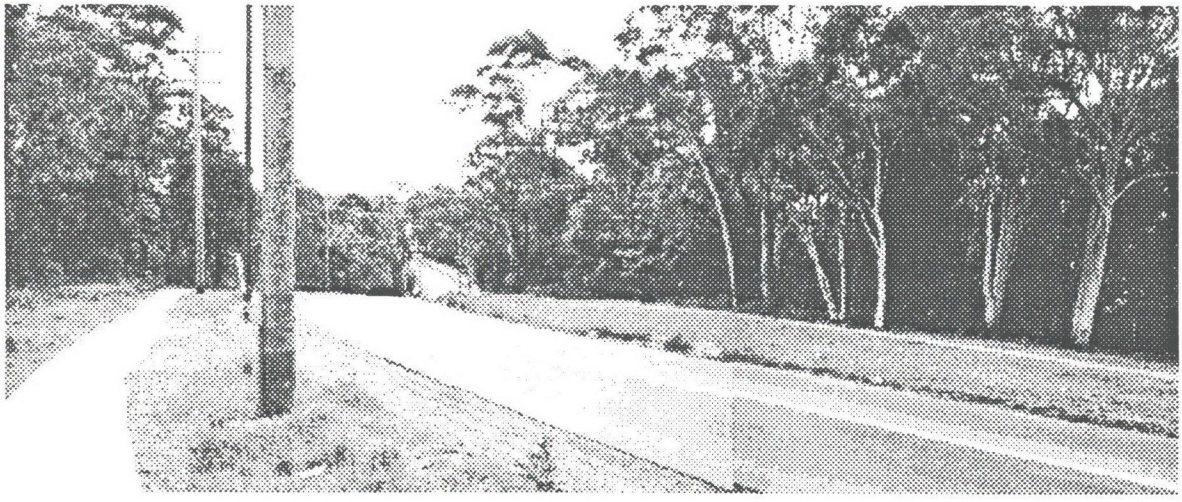
3.5.1 Seven Hills Road

Seven Hills Road, from Old Windsor Road to Windsor Road, is at times, during the day, busy with local traffic although generally functioning as a two lane road with parking margins. Brief segments have been widened including the western end approaching the up-graded Old Windsor Road. Low density, single storey dwellings line most of Seven Hills Road with undeveloped open land still existing around the intersection with Old Windsor Road.

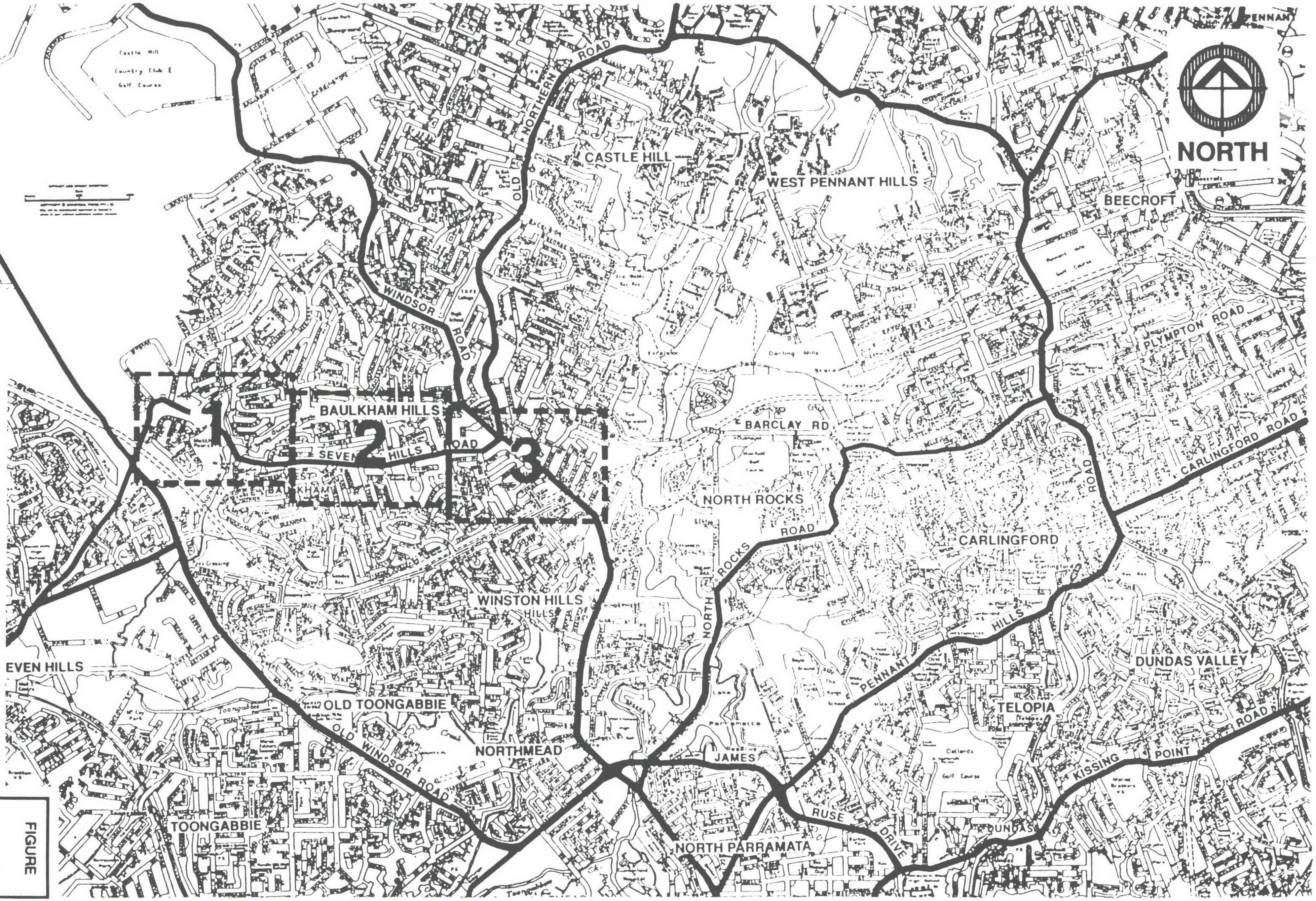
Apart from typical domestic gardens in relatively new housing development (some older exceptions), the only significant vegetation lies in the corridor of Toongabbie Creek. Remnant native species with a weedy understorey form a narrow band along the creek where the road crosses and adjacent to Seven Hills Road in Sophia Doyle Reserve.

The land is undulating and largely featureless. Towards Windsor Road older housing stock occurs and along Windsor Road itself towards the expressway reservation, older housing and commercial properties adjoin. Traffic on Windsor Road is heavy at most times and the properties bordering it are sometimes in poor condition.

An arterial road development of Seven Hills Road would either require a continuous strip of demolition of houses or if retained within the existing reservation, create an unsatisfactory road and housing relationship. Noise walls, if installed, would provide limited benefit because of the repetitive breaks which would be required to allow vehicle access to driveways and in the narrow corridor of Seven Hills Road's existing reservation, noise walls would be out of scale with the residential environment and be visually oppressive. With no noise wall construction, noise levels on the upgraded roadway would be unacceptable according to the standards adopted.

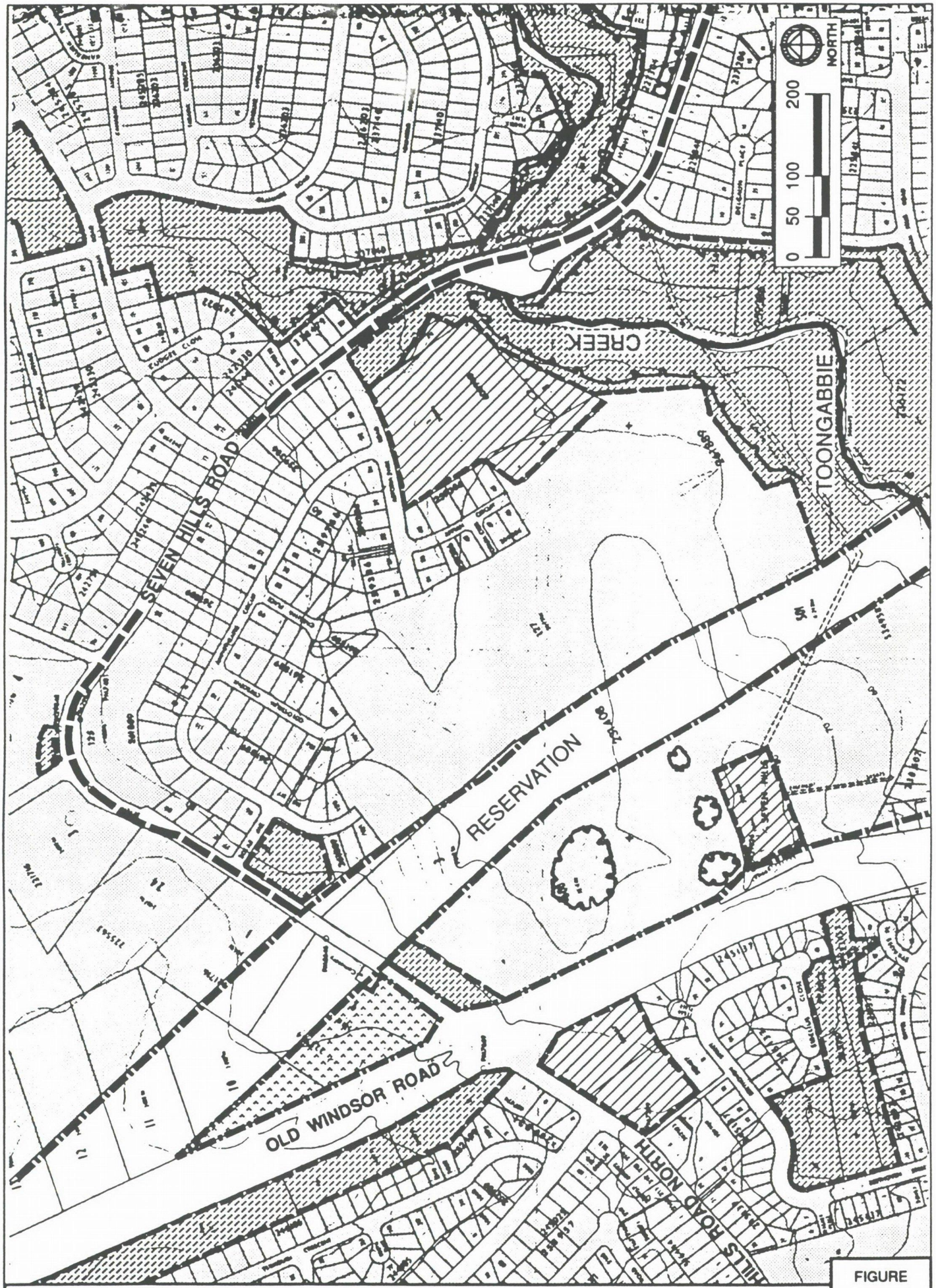


SEVEN HILLS ROAD LOOKING WEST NEAR MARINA ROAD. THE DIP IN THE ROAD REPRESENTS TOONGABBIE CREEK. BUSHLAND ON THE RIGHT IS IN SOPHIA DOYLE RESERVE.



Seven Hills Road
LANDUSE PLANS : LOCATION MAP

FIGURE 3.15



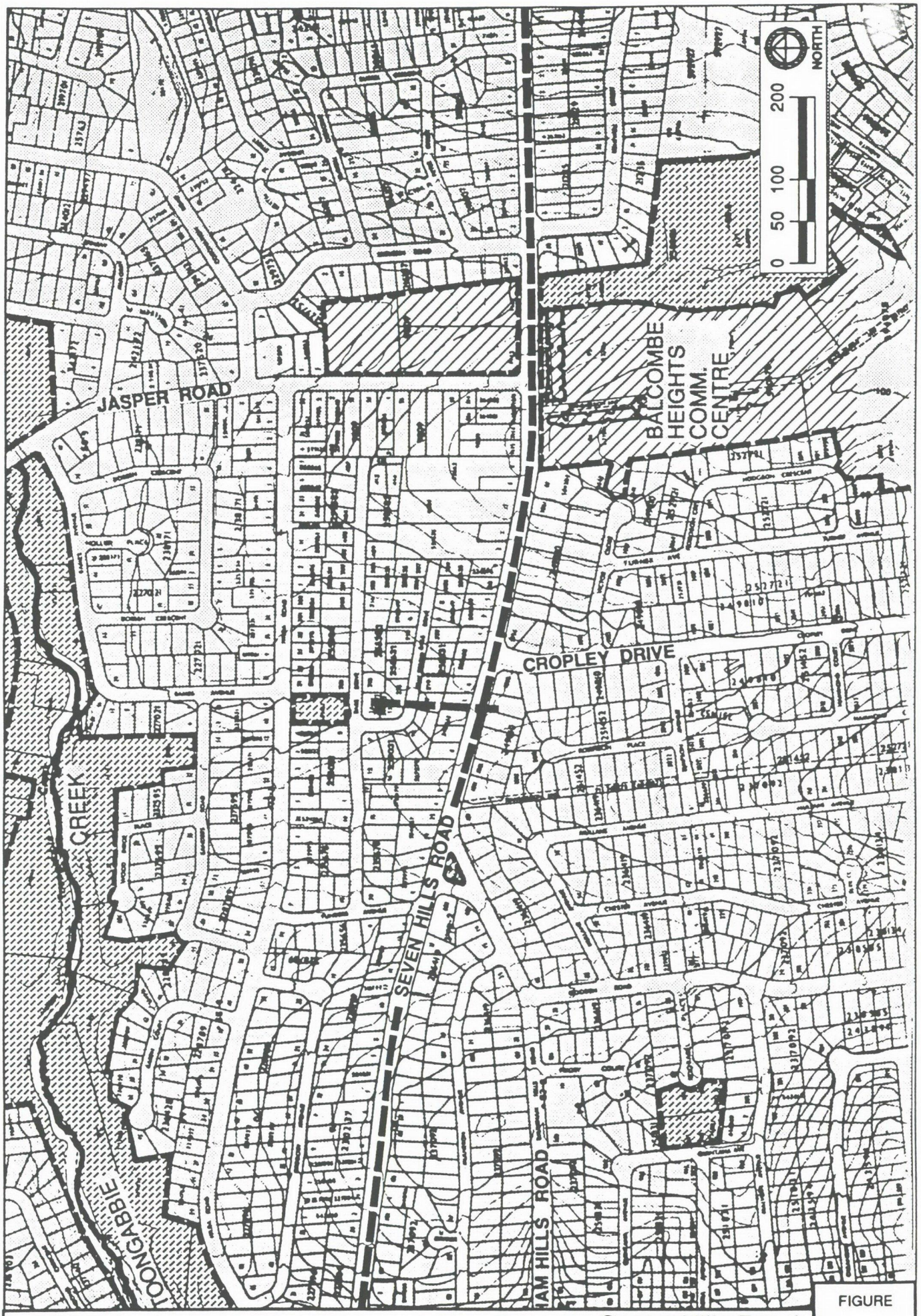
OLD WINDSOR ROAD TO PENNANT HILLS ROAD

SNOWY MOUNTAINS ENGINEERING CORPORATION
BRUCE MACKENZIE AND ASSOCIATES PTY LTD LANDSCAPE ARCHITECTS

Seven Hills Road

LANDUSE : **MAP 1/3**

FIGURE
3.16



OLD WINDSOR ROAD TO PENNANT HILLS ROAD

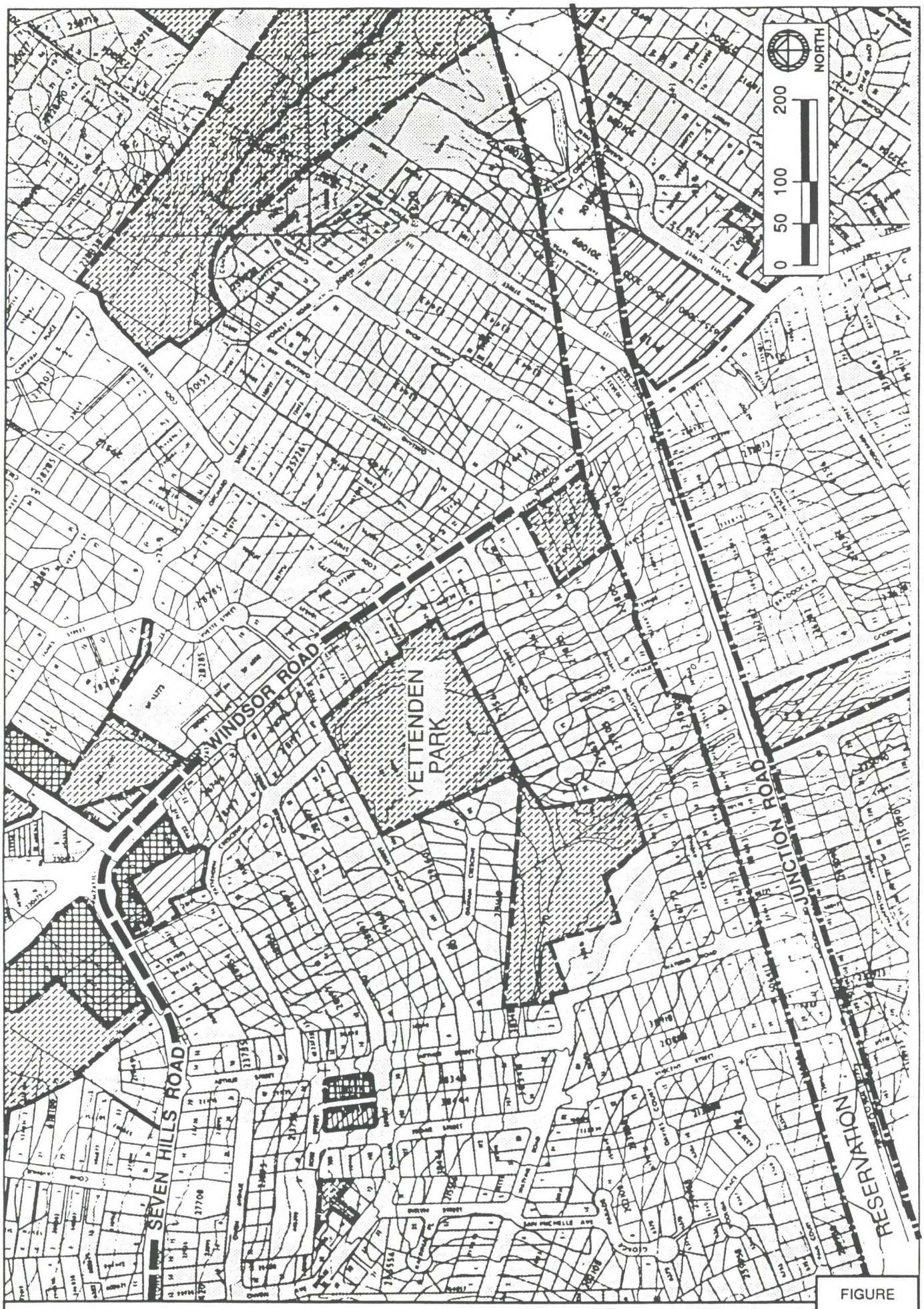
SNOWY MOUNTAINS ENGINEERING CORPORATION
BRUCE MACKENZIE AND ASSOCIATES PTY LTD LANDSCAPE ARCHITECTS

Seven Hills Road

LANDUSE : **MAP 2/3**

FIGURE

3.17



OLD WINDSOR ROAD TO PENNANT HILLS ROAD

SNOWY MOUNTAINS ENGINEERING CORPORATION
BRUCE MACKENZIE AND ASSOCIATES PTY LTD LANDSCAPE ARCHITECTS

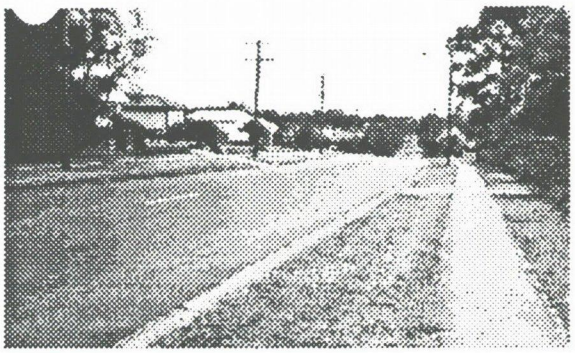
Seven Hills Road

LANDUSE : **MAP 3/3**

FIGURE

3.18

SEVEN HILLS ROAD : EAST FROM MARINA ROAD.



SEVEN HILLS ROAD : WEST FROM KENNETH AVENUE.

3.5.2 Murray Farm Road

The interest in Murray Farm Road stemmed from its mostly straight and relatively even alignment which on plan connected the eastern section of Devlins Creek with the expressway reservation in the Cumberland State Forest.

Other benefits that might have been derived from this alignment were the opportunities to miss entirely the more critical natural environment qualities in Devlins Creek in the eastern study zone and those associated with the western end of Mahers Road.

Between Muirfield High School and Haines Avenue (a western extension of Murray Farm Road), the alignment would cut through bushland of good quality. Thereafter from about the corner of Dryden Avenue the alignment would follow the straight path of existing Murray Farm Road to cross Pennant Hills Road and connect with the expressway reservation at Cheltenham Park.

MURRAY FARM ROAD : VIEW EAST FROM MARWOOD DRIVE.

Very recent modern housing is associated with the western end and housing stock tends to be older towards the eastern and older development zone of Beecroft/Epping. The roadway enjoys a peaceful and pleasing environment with established houses and gardens, and occasional large specimens of native trees. Towards Devlins Creek good quality native vegetation would be encountered.

Some traffic pressure has developed between a roundabout at Oakes Road and Pennant Hills Road; however, a road closure on the eastern edge of Pennant Hills Road establishes calm traffic conditions beyond. Towards Haines Avenue west of Oakes Road, Murray Farm Road is similarly relatively calm in traffic terms.

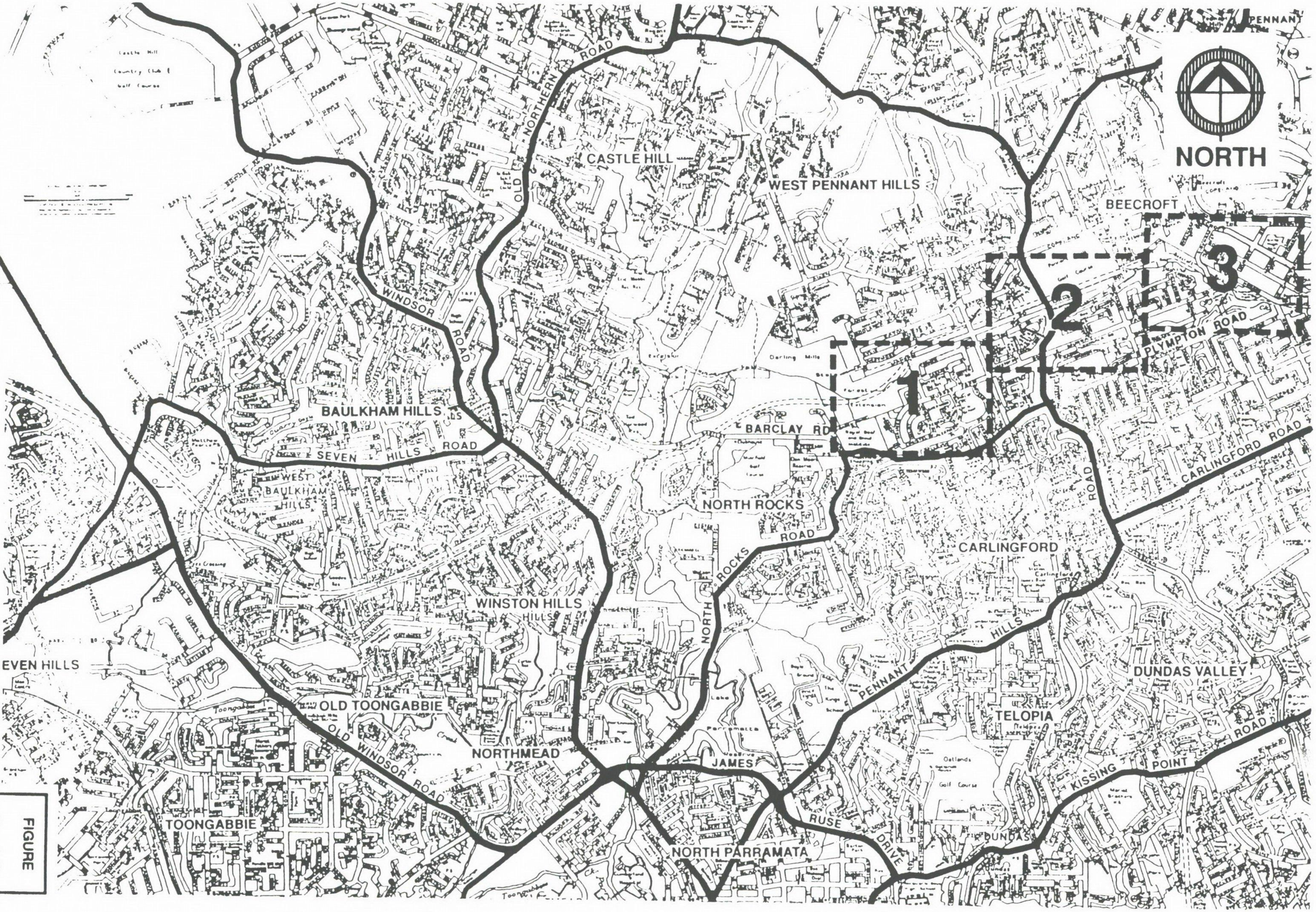
An arterial road development in these circumstances would have a severe impact not only on existing development along the road edges where a continuous strip of housing would be lost, but also over a much broader margin distant from construction.

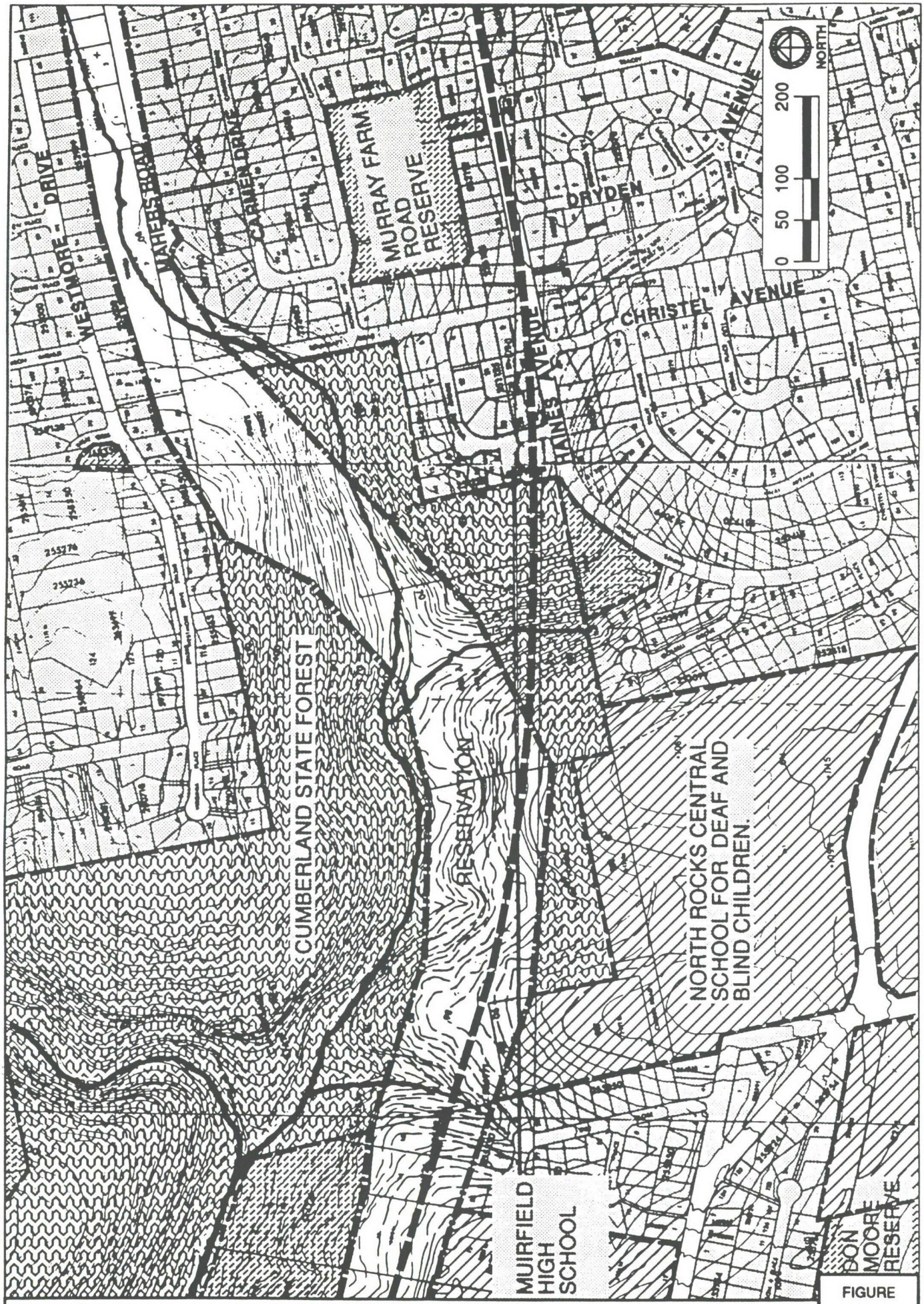
Between the alignment of Murray Farm Road and Devlins Creek, a large segment of residential development would be effectively cut off from its present surroundings.

MURRAY FARM ROAD : VIEW EAST FROM THE RIDGELINE OF PENNANT HILLS ROAD.

Murray Farm Road
LANDUSE PLANS : LOCATION MAP

FIGURE 3.19





OLD WINDSOR ROAD TO PENNANT HILLS ROAD

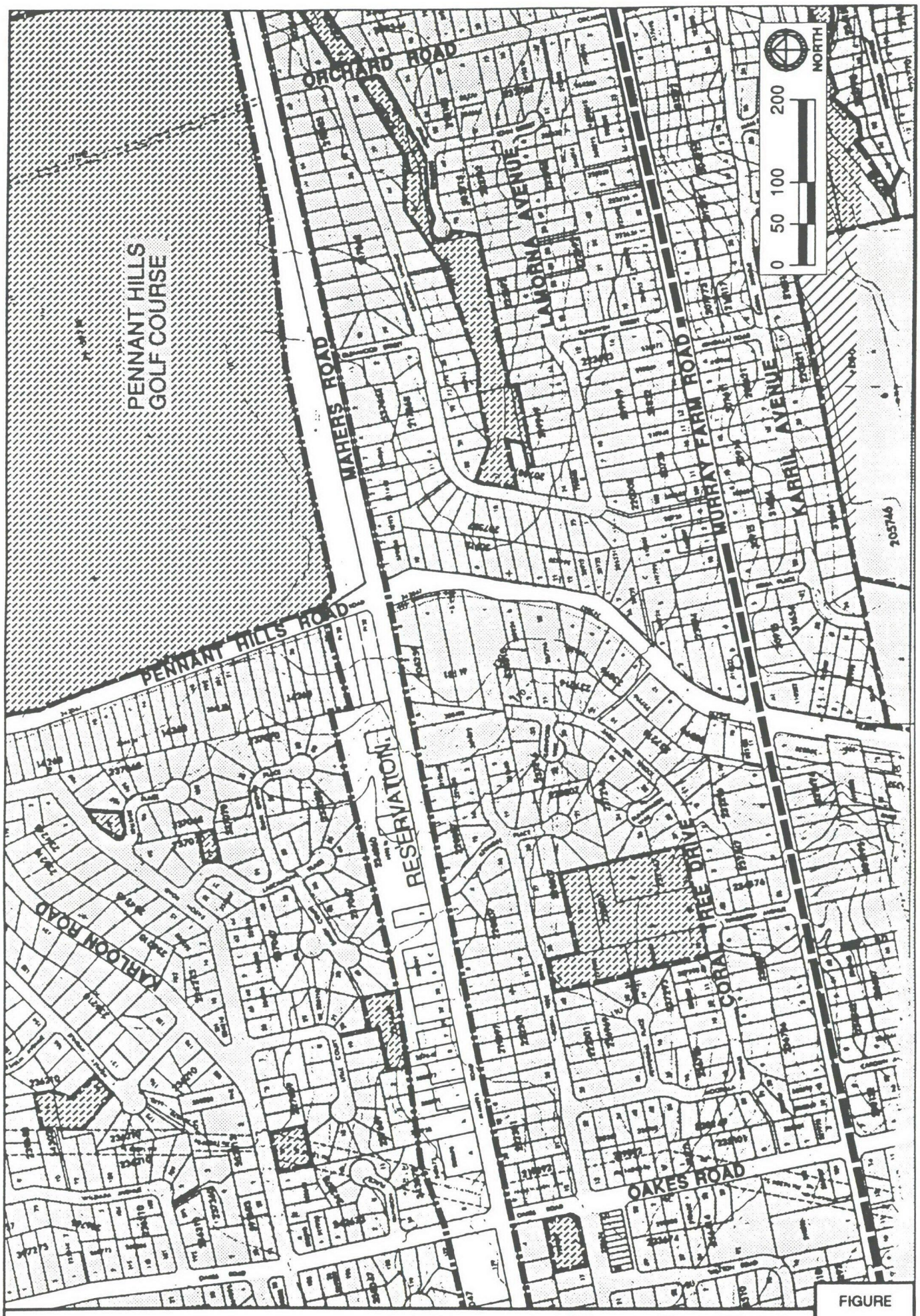
SNOWY MOUNTAINS ENGINEERING CORPORATION
BRUCE MACKENZIE AND ASSOCIATES PTY LTD LANDSCAPE ARCHITECTS

Murray Farm Road

LANDUSE : **MAP 1/3**

FIGURE

3.20



OLD WINDSOR ROAD TO PENNANT HILLS ROAD

SNOWY MOUNTAINS ENGINEERING CORPORATION
BRUCE MACKENZIE AND ASSOCIATES PTY LTD LANDSCAPE ARCHITECTS

Murray Farm Road

LANDUSE : **MAP 2/3**

FIGURE

3.21

OLD WINDSOR ROAD TO PENNANT HILLS ROAD

SNOWY MOUNTAINS ENGINEERING CORPORATION
BRUCE MACKENZIE AND ASSOCIATES PTY LTD LANDSCAPE ARCHITECTS

Murray Farm Road

LANDUSE : **MAP 3/3**

FIGURE

3.22

3.5.3 Copeland Road

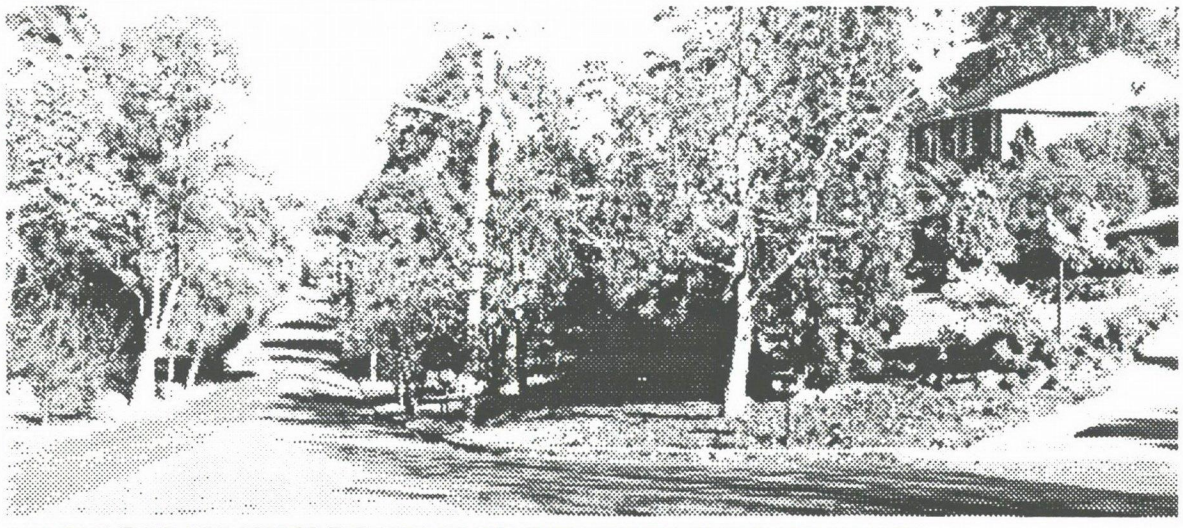
An alignment following Copeland Road from the Main Northern Line at Beecroft and cutting down to the western end of Mahers Road was investigated. On plan the alignment demonstrated an optional path which bypassed the Devlins Creek environment and passed through the western section of Mahers Road. The option, to be successful, relied upon the feasibility of a complex development being considered for a segment between Beecroft Station and Somerset Road. This latter proposal would have involved the construction of an elevated roadway over the railway line.

Copeland Road is typically a 10–12 metre wide pavement, bounded on both sides by single storey housing, the exception being a pocket of recently constructed townhousing on both sides of the road between Hull Road and Burns Road. Good stands of Eucalypts and well-established gardens embellish the road's edges and, in conjunction with relatively light traffic flows, an attractive street scene has been created. The arterial road construction would destroy all housing facing the northern edge of Copeland Road. Housing of a similar character facing Rorke Street, Burns Road North, Cardinal Avenue and Penryn Avenue, would also be lost.

The impact on housing at and near the Pennant Hills Road intersection would be severe. The terrain is steeply undulating and the effect of cuts and fills would be signficiant, expanding the physical and visual impact of the new large road, especially across the open space of Pennant Hills Golf Course which lies immediately south.

The extension of the alignment which would connect Copeland Road and the western section of the expressway reservation near Mahers Road, traverses an area of relatively new residential housing. The housing is typically 10–20 years old of one or two storey brick and tile construction. The houses are set in well-maintained semi-mature gardens in quiet culs-de-sac. The new alignment would impact most severely on Ashley Avenue, the western end of Karloon Road and Westmore Drive cutting diagonally across the existing street pattern. The alignment would then cut through the stand of Sydney Blue Gums (Eucalyptus saligna) adjoining Mahers Road and then Carmen Drive before connecting back to the expressway reservation.

On the ground this alignment would have a severe impact on its immediate margins and also from distant viewpoints. Loss of housing would be extensive.



ASHLEY AVENUE LIES ACROSS THE PATH OF THE ALIGNMENT WHICH WAS INVESTIGATED.

3.5.4 Pennant Hills Road

The section of Pennant Hills Road from Pennant Hills Golf Course to Carlingford Road could be subject to upgrading, as a transport corridor, in varying degrees dependent upon the transport link option which would be adopted.

Each option under consideration would affect Pennant Hills Road in terms of widening, major intersection construction and construction of noise walls. These changes would involve loss of property and established trees (both mature native species and exotic garden species) on one side or the other, but mostly on the western edge.

At Mahers Road an interchange construction would be required if the expressway is built in the reservation. This interchange construction would be extensive and require large sweeping ramp lines to connect the expressway and Pennant Hills Road in all four directions. The north-south alignment of Pennant Hills Road in the intersection zone would take a smoother curve moving to the west and leaving a segment of road separated. Access to homes in this separated segment would be provided via a new access road from Lamorna Avenue. (Refer also to Report Section 6.2.6 'Oakes Road to Pennant Hills Road').

If the expressway (or an arterial road) from the west is to be built in the reservation and it is to be terminated at Pennant Hills Road, the extent of intersection construction would be slightly reduced though still of substantial size. Connections to the north and south would still be needed. In this case the new transport route would continue south on Pennant Hills Road to connect with Carlingford Road. To accommodate both the north-south traffic of Pennant Hills Road and that of the new east-west link, the construction corridor would be broader than the arterial road standard described elsewhere in this report, and would typically require continuous lines of houses to be acquired.

Where road widening would not occur on parts of the eastern margin, existing houses would face the increasing traffic loads created by an arterial road upgrading. This would raise the need for noise abatement measures. In these cases wall construction would have to occur at or inside property lines. Driveway access to properties would be direct from the arterial road.

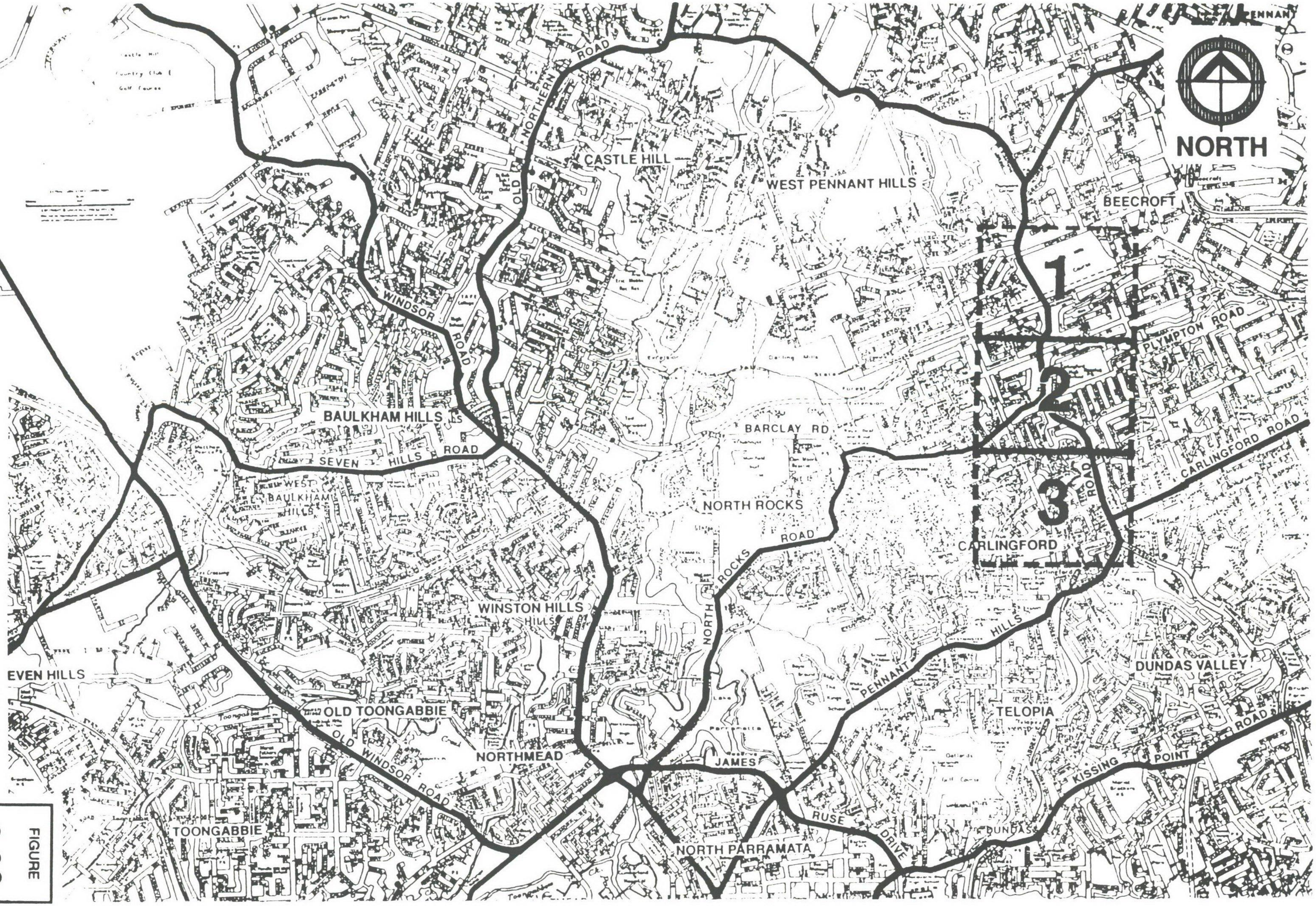
PENNANT HILLS ROAD LOOKING NORTH FROM ALAMEIN AVENUE.

On both the eastern and western sides additional widening would occur at intersections with North Rocks Road and Alamein Avenue, causing reduction of front yard spaces or removal of houses.

Where properties would be lost, residual spaces would in places be of a size capable of supporting heavy planting and sometimes earth mounds. In these situations, noise walls and new road formation would be well screened. The more difficult visual impacts would be felt where properties remain close to the road edge (typically on the eastern side) and particularly where front yards would be foreshortened.

Pennant Hills Road is located on a distinct natural ridgeline and its visual effects as a major transport route – traffic streams and noise walls, would be largely confined to the immediate margins as the road would not be overviewed.

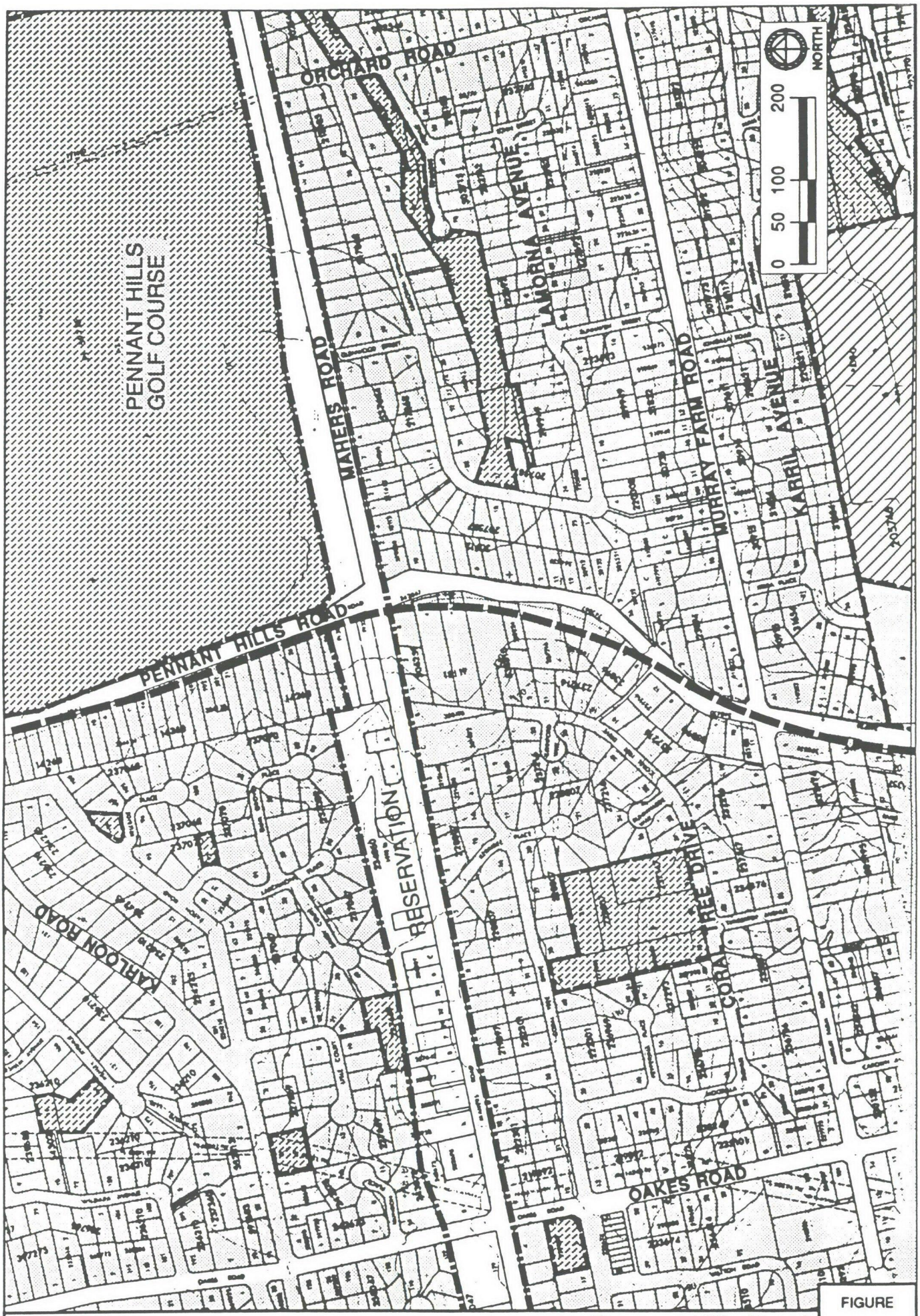
The arterial road development of Pennant Hills Road would connect to the Carlingford Road arterial proposal (prepared by Maunsell). On the western margin of Pennant Hills Road near the intersection with Carlingford Road, the grounds of Buckland House and the Church of Jesus Christ would be affected by the widening causing loss of trees and reduced expanse of lawns.



Pennant Hills Road

LANDUSE PLANS : LOCATION MAP

FIGURE 3.23



OLD WINDSOR ROAD TO PENNANT HILLS ROAD

SNOWY MOUNTAINS ENGINEERING CORPORATION
BRUCE MACKENZIE AND ASSOCIATES PTY LTD LANDSCAPE ARCHITECTS

Pennant Hills Road

LANDUSE : **MAP 1/3**

FIGURE

3.24

OLD WINDSOR ROAD TO PENNANT HILLS ROAD

SNOWY MOUNTAINS ENGINEERING CORPORATION
BRUCE MACKENZIE AND ASSOCIATES PTY LTD LANDSCAPE ARCHITECTS

Pennant Hills Road

LANDUSE : **MAP 2/3**

FIGURE

3.25

OLD WINDSOR ROAD TO PENNANT HILLS ROAD

SNOWY MOUNTAINS ENGINEERING CORPORATION
BRUCE MACKENZIE AND ASSOCIATES PTY LTD LANDSCAPE ARCHITECTS

Pennant Hills Road

LANDUSE : **MAP 3/3**

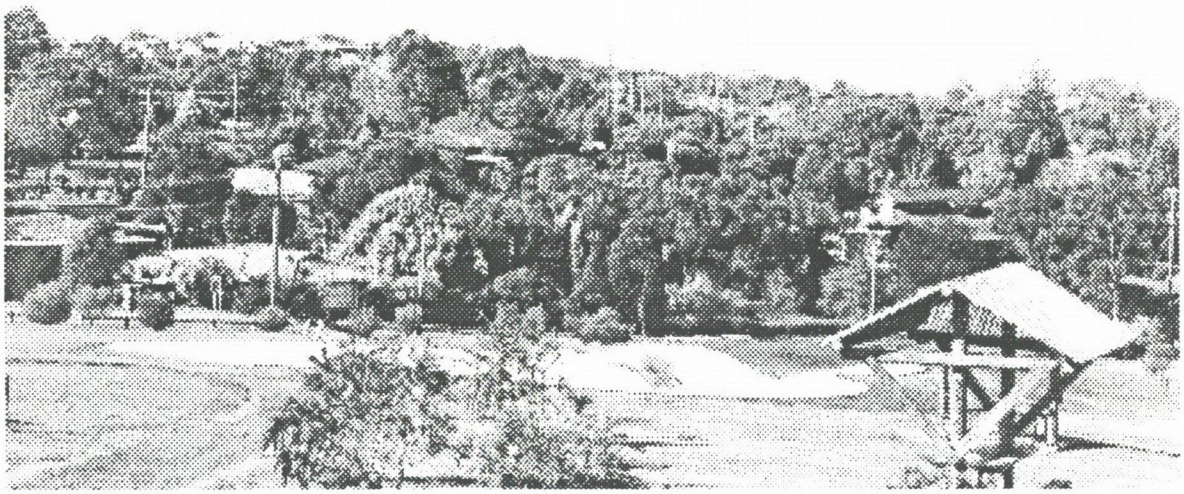
FIGURE

3.26

3.5.5 Carlingford Road – West

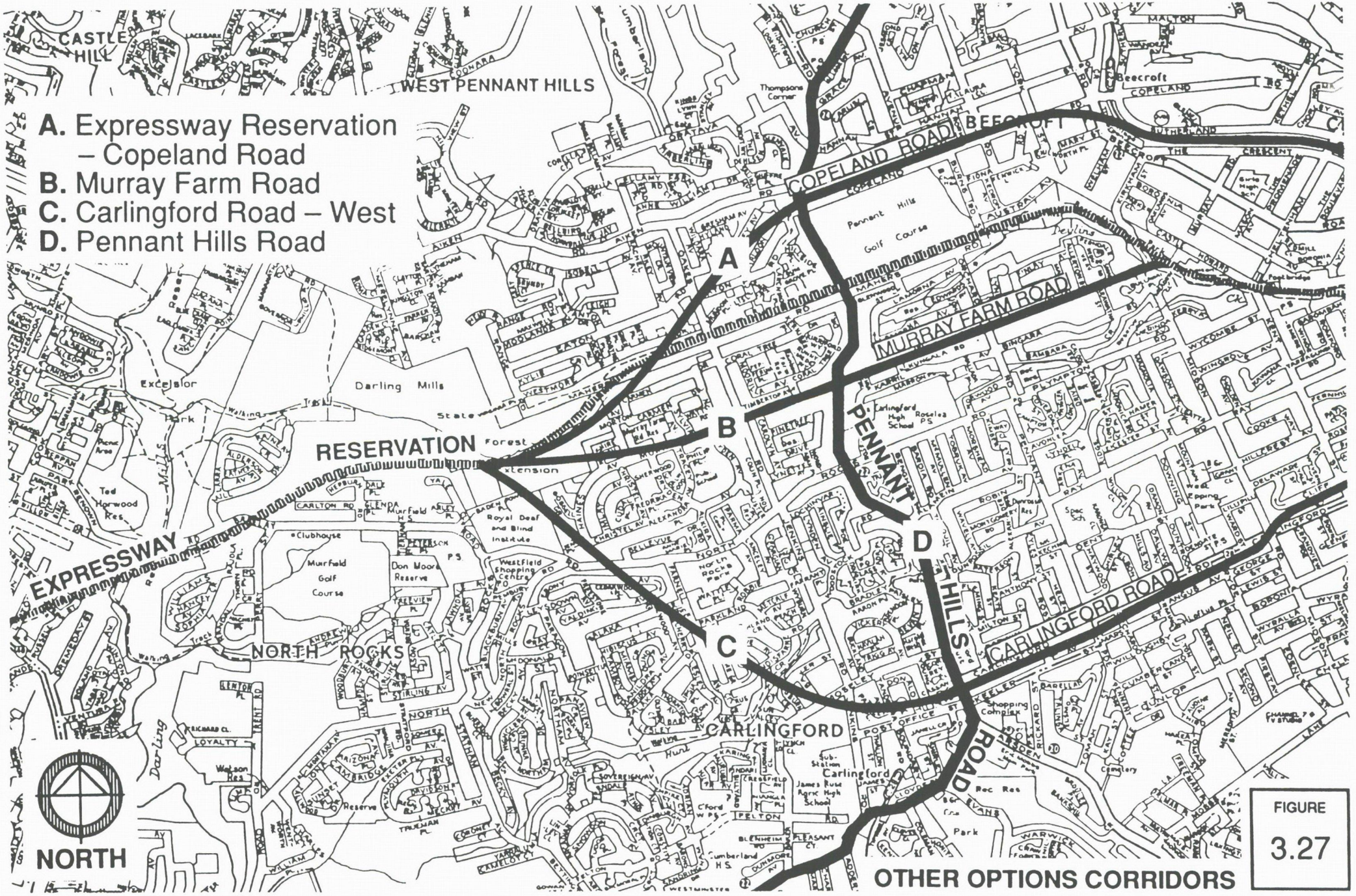
This route option was investigated on site in the interest of achieving, if feasible, a direct connection between the Carlingford Road arterial proposal (prepared by Maunsell Pty Ltd) and the expressway reservation in the Cumberland State Forest near the Royal Deaf and Blind Institute, North Rocks.

The proposal was dismissed mainly because of the extensive loss and disruption of property that would be caused by the route cutting at an angle through the existing street network. The angled path would leave many unworkable residual spaces in addition to the total losses that would be unavoidable throughout the housing sub-division.



VIEW OVER THE VALLEY FORM WEST FROM CARLINGFORD ROAD FOLLOWING THE LINE OF THE POWER TRANS-MISSION CORRIDOR.

NEW MEDIUM DENSITY HOUSING DEVELOPMENT ON GOSSELL GROVE WHERE THE ALIGNMENT EXTENSION WOULD CONNECT WITH THE EXPRESSWAY RESERVATION IN THE CUMBERLAND STATE FOREST.


A. Expressway Reservation – Copeland Road
B. Murray Farm Road
C. Carlingford Road – West
D. Pennant Hills Road
A
B
C
D
COPELAND ROAD
MURRAY FARM ROAD
PENNANT HILLS ROAD
CARLINGFORD ROAD
EXPRESSWAY RESERVATION
CASTLE HILL
WEST PENNANT HILLS
BEECROFT
CARLINGFORD
NORTH ROCKS
Pennant Hills Golf Course
Darling Mills State Forest
Murfield Golf Course
Carlingford High School
Cumberland H.S.
NORTH
OTHER OPTIONS CORRIDORS
FIGURE 3.27

4. VEGETATION AND LAND UNITS

Refer to Vegetation Associations Maps Figures 4.1 to 4.5.

4.1 LAND UNITS

For the purpose of this investigation, the study can be divided into discussions of two broad land units on the basis of geology and topography:

a. The hilly and gently undulating lands on Wianamatta Shales.
b. The deep gorge and plateau lands of the Hawkesbury Sandstones in the vicinity of Darling Mills Creek and its tributaries.

4.1.1 Unit 1. Wianamatta Shales

- Topography

Hilly to undulating with shallow valleys - moderate to gentle slopes generally in the range of 1:5 to 1:20 but flatter gradients more common towards the western part of the study area.

- Soils

Clay soils of the Cumberland Association are derived from the shales. These red podzolics have a deep clay 'A' horizon and heavy clay 'B' horizon over grey weathered shale. Cumberland soils are relatively productive.

- Vegetation

The original vegetation of the Wianamatta Shales consisted of tall open forest of *Eucalyptus saligna* in the east and *Eucalyptus tereticornis* in the west. As the topography and soils of the shales have attracted agricultural and urban development, little remains of the native vegetation of this unit. The most significant remnants associated with the expressway reservation are:

A stand of *Eucalyptus saligna* forest with weed-infested understorey alongside the western section of Mahers Road, West Pennant Hills.

A weed infested stand of *Eucalyptus saligna* forest on a tributary of Toongabbie Creek.

A small heavily thinned forest (*E.pilularis, E.punctata, E. sp* and *Angophora subvelutina*) on a transition soil.

Other examples of remnant natural vegetation can be found in individual trees and groups of trees that can be found adjacent to Mahers Road (*E.saligna*) and Junction Road (*E.tereticornis, E.crebra, E.acmenioides, Angophora floribunda*).

4.1.2 Unit 2. Hawkesbury Sandstone

- Topography

Gorge and plateau - gentle to moderate slopes on the plateau adjoining Darling Mills Creek valley. Darling Mills Creek and its tributaries have formed a gorge up to approximately 60m deep (at the Renown Road/Barclay Road Bridge), with steep to extremely steep side slopes and rock escarpments over 10m in height.

- Soils

This land unit includes two soil associations, Hammondville and Hawkesbury. Hammondville soils are developed from mixed parent materials of sandstone and shale. In these yellow podzolics, the depth of the 'A' horizon varies, the 'B' horizon is clay and is underlain by sandstone. In the vicinity of Darling Mills Creek, Hammondville soils are generally found on plateau edges and upper slopes.

Soils of the Hawkesbury Association are skeletal having a poorly developed 'A' horizon and a shallow grey or yellow sandy and stony 'B' horizon over sandstone.

Hawkesbury soils mostly occur on valley side slopes but are also found on at least one area of adjacent plateau.

- Vegetation

In contrast to Land Unit 1 substantial tracts of natural vegetation representing the Hawkesbury Sandstone communities remain intact, largely within the valley of Darling Mills Creek. The gentle to moderate slopes of plateau lands have mostly been cleared for agriculture, residential, institutional and recreational development.

Five natural vegetation associations are described for this land unit.

– Tall Open Forest.

Eucalyptus pilularis, E.piperita, Angophora costata. Syncarpia glomulifera is also present.
Occurrence: Valley bottom and side slopes including the heads of tributary valleys. This association forms a continuous band along the bottom and lower slopes of the Darling Mills Creek valley.
Soils: Hammondville and Hawkesbury Associations.
In the valley section immediately below the western end of Mahers Road and in some of the more sheltered entrenched valley sections, *E.pilularis* is more common and a well developed tall understorey occurs. Typical understorey species are:
Callicoma serratifolia, Ceratopetalum gummiferum and Culcita dubia. *Ceratopetalum apetalum* is common on stream banks. These areas are identified on the vegetation map.

Canopy cover in the more exposed sections is almost reduced to woodland density and a lower shrubby understorey is present.

– Medium to Tall Forest

Eucalyptus pilularis, E.gummifera, E.eugenioides, E.globoidea, E.resinifera, Angophora costata, Syncarpia glomulifera.
Occurrence: Plateau edge and upper slopes.
Soils: Hammondville Association.

Several vegetation associations of limited occurrence have been included here. Their proximity to cleared and developed areas on the plateau has generally lead to disturbance of some form and often to changes in forest composition.

– Medium to Tall Open Forest.
Eucalyptus pilularis, Angophora bakeri.
Occurrence: Exposed side slopes.
Soils: Hawkesbury Association.
Typically *E.pilularis* forms a tall woodland with *Angophora bakeri* making an understorey. *E.piperita* is often present.

– Woodland/Shrubland.
Eucalyptus gummifera, Angophora bakeri. E.haemastoma (may also be present).
Occurrence: Usually exposed upper slopes and plateau edge.
Soils: Hawkesbury Association.
Typical understorey species are *Banksia serrata, Petrophile fucifolia, Leptospermum attenuatum* and *Acacia suaveolens.*

• Open Shrubland.
Angophora hispida, Banksia aspleniifolia.
Occurrence: Located in one area only on plateau top north of the valley.
Soils: Hawkesbury Association.

4.2 CONSERVATION VALUES

4.2.1 *Eucalyptus saligna* : Tall Open Forest

Of the various associations present, *Eucalyptus saligna*, (Tall Open Forest - Land Unit 1, Mahers Road and Toongabbie Creek) is of greatest conservation value. Only 1% or 100 ha of this association remains in the Sydney region. (D.Benson, ecologist, Royal Botanic Gardens, Sydney.)

Eucalyptus saligna forest is poorly represented in conservation reserves.

The stand of *Eucalyptus saligna* forest near Toongabbie Creek is small and lacking natural undergrowth but is clear of the proposed roadway alignment and falls within an open space reserve. Intensive management to control weeds, re-establish indigenous undergrowth and encourage regeneration will be necessary if the conservation value of this stand is to be maintained.

Eucalyptus saligna forest adjacent to the westernmost section of Mahers Road is in better condition and of greater extent (approximately 2 ha) but earthworks, clearing, rubbish dumping and weed invasion have caused gaps in the forest canopy and have reduced the diversity and abundance of native understorey species. This forest remnant lies directly in the expressway reservation and even if the carriageway alignment is moved as far as possible towards the northern edge but still within the 50 metre wide reservation, the strip of forest left alongside Mahers Road would be too fragmented to be viable, even with intensive management, as a representative of the natural association.

If the proposed road is located outside the reservation to allow retention of all or most of the stand of trees, management works would be required over some years to control weeds and stimulate regeneration. A programme of continuing management at a reduced level, would then be advisable because the small size of the forest remnant and its long boundaries against residential development predispose its invasion by exotic species.

Without management attention, the corridor of trees could remain for a long time period as an attractive feature in the local area and as visible evidence of the original forest type. However, its long-term value as a reasonably self-regenerating bushland corridor would be greatly enhanced by appropriate attention to its management.

4.2.2 Natural Vegetation Associations : Hawkesbury Sandstone

Natural vegetation associations of the Hawkesbury Sandstone (Land Unit 2) are generally well represented in conservation reserves. However, further consideration should be given to the conservation needs of the following associations:

- Tall Open Forest:

Eucalyptus pilularis, E.piperita, Angophora costata (not plentiful in the Sydney region). The areas with tall moist understorey (noted 2a on vegetation maps) are of special conservation value. These forests are mostly in excellent condition.

- Medium to Tall Forest

Eucalyptus pilularis, E.gummifera, E.eugenioides, E.globoidea, E.resinifera, Angophora costata and *Syncarpia glomulifera.* These forests occur on Hammondville soils and are typically not well conserved. However, stands of this association in the vicinity of the reservation corridor are relatively small and have generally been disturbed. Such forest examples will require rehabilitation works of varying intensity to maintain conservation values.

- Open Shrubland:

Angophora hispida - Banksia aspleniifolia is significant because of its limited occurrence. A single area of open shrubland has been located in the vicinity. It is in good condition.

4.2.3 Condition of Natural Vegetation

Edge zones of natural vegetation have been affected by clearing, rubbish dumping and urban runoff. Service tracks and the installation of sewer mains have extended disturbance into the valleys including damage to stream banks.

Invasion of exotic plants has followed much of this disturbance particularly along urban edges and drainage lines. However, broad continuous areas of natural vegetation remain in excellent condition.

4.2.4 Viability of Natural Vegetation

Even in the absence of any new disturbance, exotic species invasion of edges and drainage lines, without bushland management, can be expected to intensify. Broad areas of bushland not subject to stormwater runoff from urban areas should remain in good condition well into the future.

In determining a transport route associated with bushland, consideration would ideally be given to retaining bushland areas in a form that is capable of being viable in a persisting way.

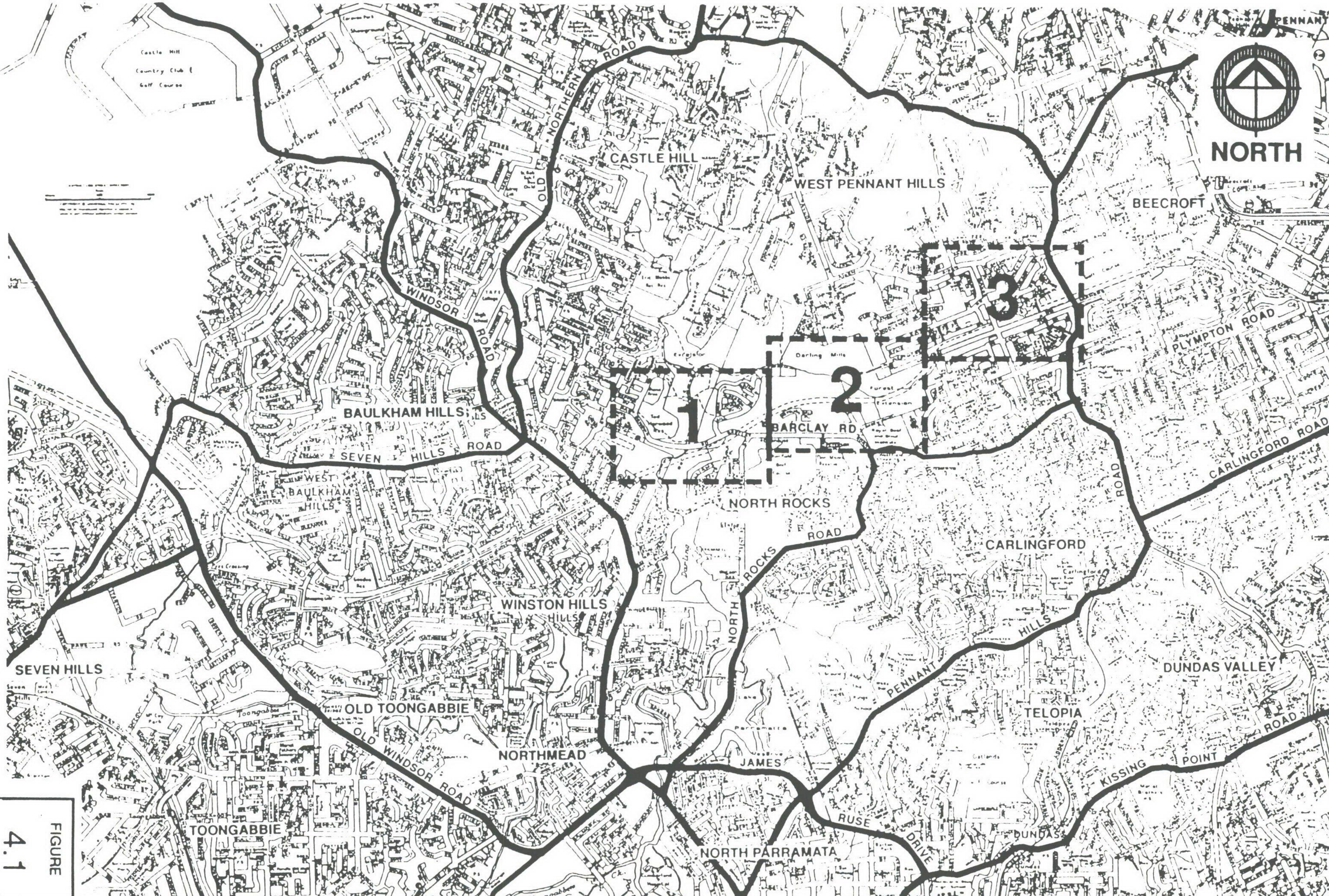
Some aspects of such a policy would be:

- Minimise fragmentation of bushland areas.
- Preserve large tracts with shortest possible overall edge dimension.
- Incorporate appropriate barriers on edges where possible.
- Favour retention of those existing areas that are able to remain free from urban runoff.

Narrow strips of vegetation retained between the freeway and developed areas will not be viable and will have little natural conservation value in the long term.

VEGETATION ASSOCIATIONS PLANS : LOCATION MAP

FIGURE 4.1



TALL OPEN FOREST :
Eucalyptus saligna
Topography : Shallow valley
Soils : Cumberland Association

1

TALL OPEN FOREST :
Eucalyptus pilularis, E.piperita, Angophora costata, Syncarpia glomulifera
Topography : Valley bottom and side slopes
Soils : Hammondville association and Hawkesbury association

2

Areas mapped 2a have a well developed tall understorey including Callicoma serratifolia, Ceratopetalum gummiferum and Culcita dubia.

2a

MEDIUM TO TALL OPEN FOREST :
Eucalyptus pilularis, E.gummifera, Angophora costata, E.eugenioides, E.globoidea, E.resinifera and Syncarpia glomulifera.
Topography : Plateau
Soils : Hammondville association

3

MEDIUM TO TALL OPEN FOREST :
Eucalyptus pilularis, E.piperita, Angophora bakeri
Topography : Slopes
Soils : Hammondville association

4

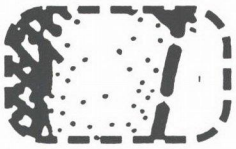
WOODLAND / SHRUBLAND :
Eucalyptus gummifera, Angophora bakeri
Topography : Exposed upper slopes
Soils : Hawkesbury association

5

SHRUBLAND :
Angophora cordifolia, Banksia asplenifolia, Leptospermum attenuatum
Topography : Plateau
Soils : Hawkesbury association

6

GRASS



EXOTIC WEED SPECIES :
Includes small areas of grass

RESIDENTIAL MARGINS (typically)

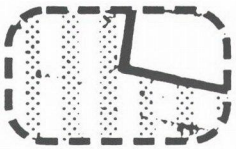
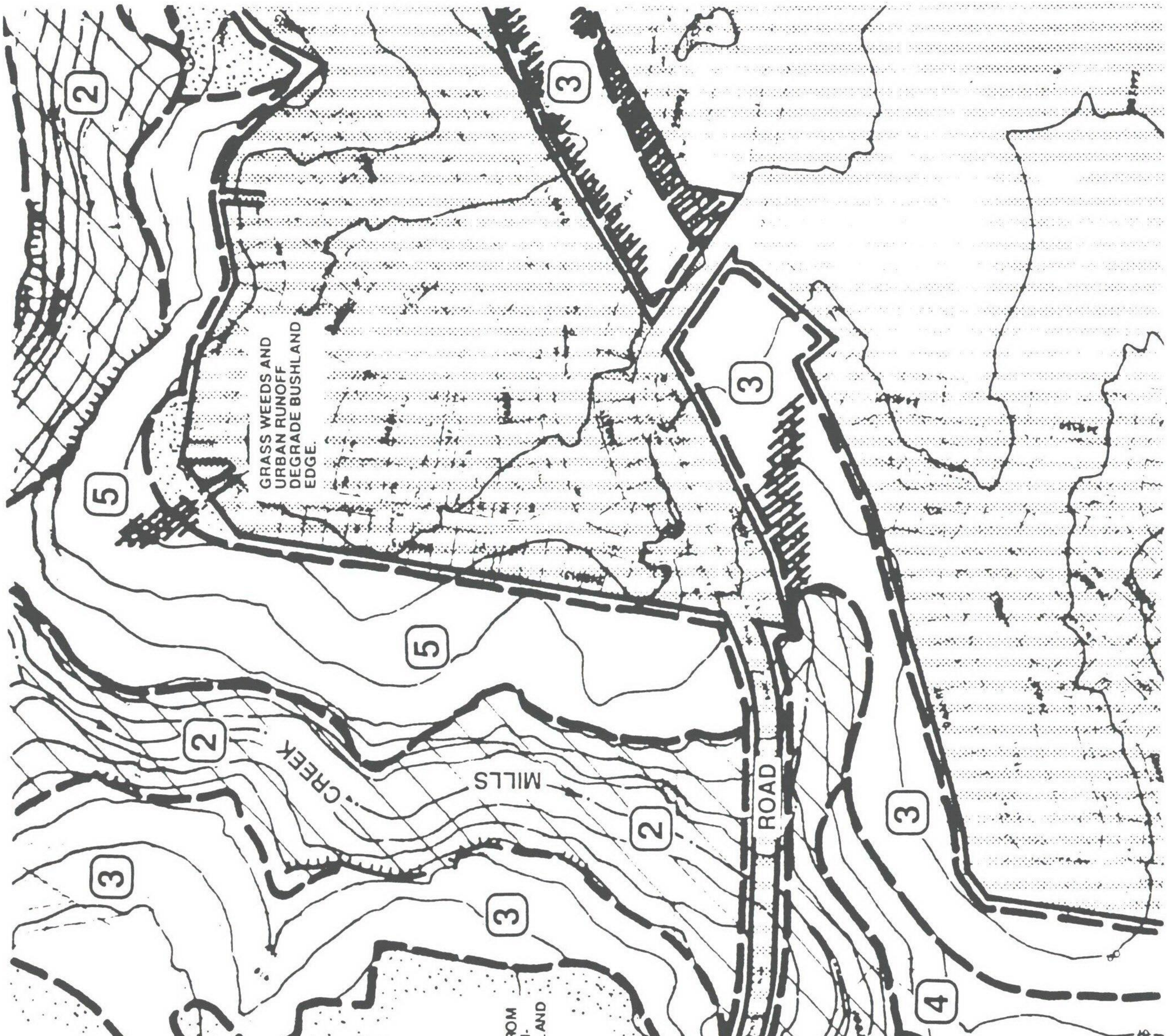


FIGURE 4.2

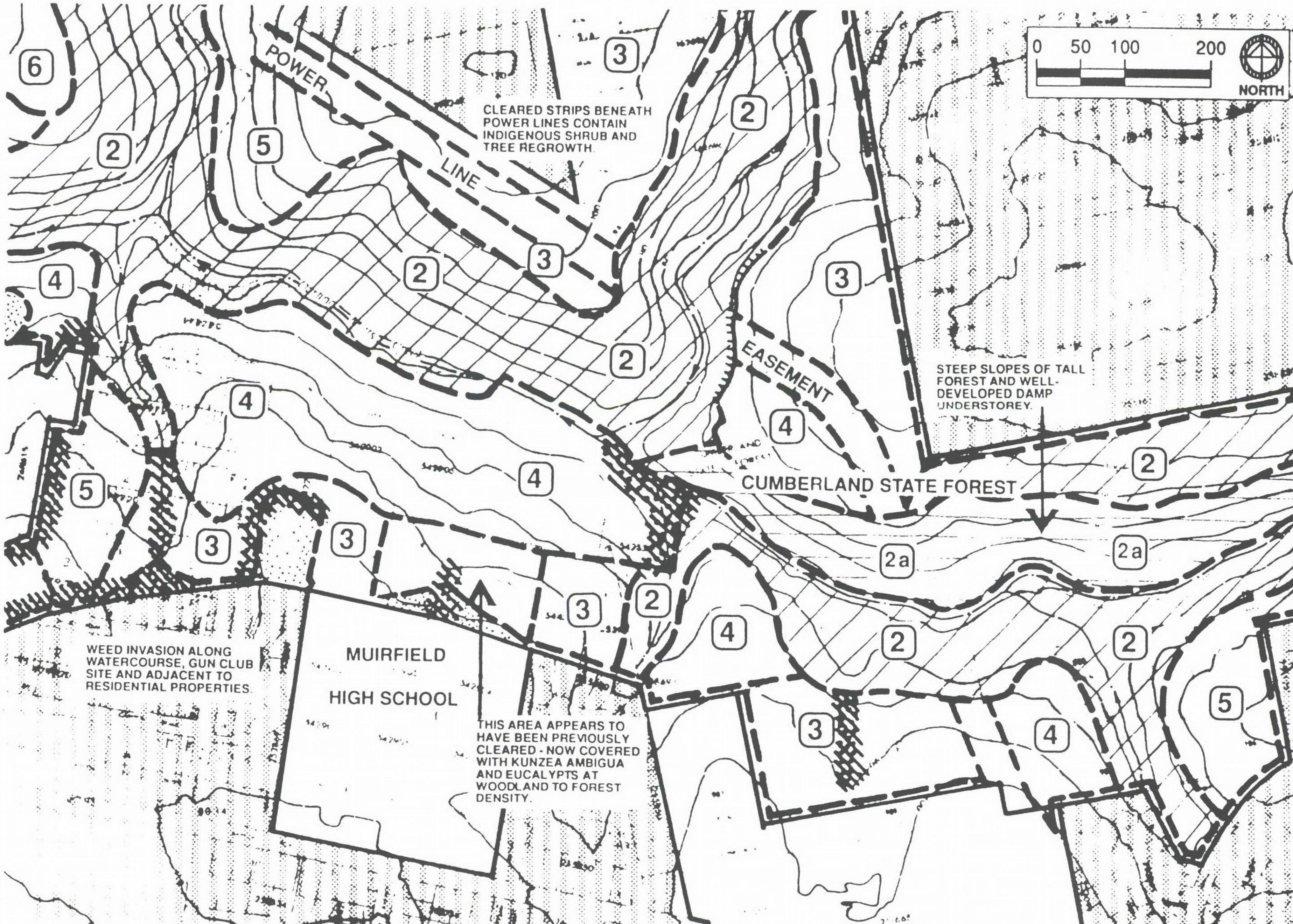
LEGEND : VEGETATION ASSOCIATIONS



FIGURE

4.3

VEGETATION ASSOCIATIONS : MAP 1/3



VEGETATION ASSOCIATIONS : MAP 2/3

FIGURE 4.4

FIGURE 4.5

VEGETATION ASSOCIATIONS : MAP 3/3

4.3 LANDSCAPE VALUES

4.3.1 Darling Mills Creek System

From many vantage points around its perimeter the valley of Darling Mills Creek provides extensive views of an apparently wild nature. Although glimpses of surrounding development are usually visible from the valley rim, nature dominates the broad scene and the wild valley stretches out below, seemingly uninterrupted and untamed.

These visual and 'wilderness' experience values within the overall urban setting should be given due weight in deciding the outcome of transport route options.

Because the scale of modern road construction has the potential to dominate and completely change the character of the valley, a route that skirts the valley and avoids crossings should always be favoured. Ideally such a route would follow gentler slopes of the valley perimeter, avoid large cuts and fills and allow a natural vegetation screen to be retained on each side to separate it from the valley proper and from adjoining developed areas.

4.3.2 Bushland or Homes

Bushland in urban areas has many qualities which relate to aesthetic, scientific, recreational and visual values. Bushland can be indirectly valuable by being a part of a widespread network of parts which provides a resource of additional benefits, such as urban birdlife which can affect the quality of life in the city, in places quite remote from the bushland itself.

Bushland can be, in varying degrees, still representative of nature with species diversity and self-definitive regimes of interacting components. These sometimes less-obvious attributes can provide a special sense of spectacle and intrigue quite distinct from the more commonplace aspect of visual beauty.

The survival of such qualities in urban areas gives Sydney a certain distinction in a world of cities where the evidence of natural regimes and natural dynamics of this sort are rare.

It can be reasonable then to identify the better examples of Sydney's bushland as being parts of the cultural, as well as natural heritage of the city.

However, under a common heading of 'bushland' a great variety of qualities prevail which cover wild nature in an urban compromise through to totally despoiled nature in a still-vegetated form. For example, surviving native trees in small or large stands, while spectacular in size and visual detail, need not necessarily be still surviving representations of wild nature. In many instances, left to their own resources, in their urban circumstances, they would not survive; without proper management, rampant weedgrowth would inhibit any further regeneration of the native species present.

Other examples of 'bushland' as a generalised feature, include remnant trees and groups of trees, standing over a generally alien floor say of grass and weeds, where nothing distinguishes the indigenous trees from others of the same species which may have been actually planted.

In these cases the value of the trees relates to their size and maturity and visual qualities. In effect, the time needed to replace them, in the event of loss, is the critical factor rather than uniqueness, and their replacement in time, is practicable. Refer also to Clause 5.5.1 Vegetation : A Range of Values.

Whereas, natural habitats which exhibit authentic ecological integrity, though varying in degrees of uniqueness, are irreplaceable. Only with care and competent management will they survive at all, but if lost, they remain lost forever. When the simple question, bushland or homes?, is contemplated, these matters referred to above warrant serious consideration.

4.3.3 Homes or Bushland

Residential environments, to be functional and supportive of urban lifestyle in the sense of being sociologically healthy, like healthy tracts of nature, need to enjoy structural integrity and cohesiveness. Fragmentation of living environments, whether those of nature or those of the city, can lead to deterioration of the original resource.

What follows can be either a progression towards wasteland or a change leading to renewal and a different environment. Matters of this sort need to be considered in the context of resolving transport options in the study area.

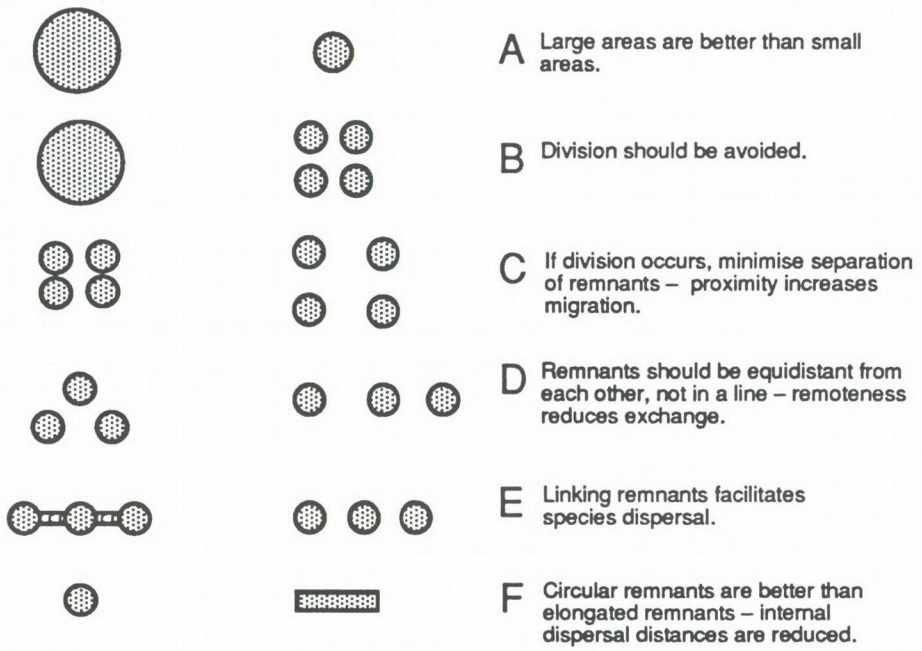
While some 'bush' is dispensable and replaceable, other bush is unique and irreplaceable. Whether or not actually 'in view', bushland can be of significant value to people in the region. In some ways all homes and their inhabitants have an association with and benefit from the better qualities of bushland. Conversely, in the expressway reservation both homes and bushland are bound in a close association, so that the concept of 'homes or the bush?' as a simple question misrepresents the real situation. The potential for negative visual and landscape impacts upon homes and bushland, in whatever option being considered, has significant implications for people generally, whether or not their homes are situated close to the bush.

4.3.4 Geometric Principles for the Design of Natural Reserves

These geometric principles, derived from the island biogeographic studies of Diamond (1975) illustrate designs that reduce species extinction rates. The example of these principles is included in this discussion concerning transport options because it relates to the understanding of management of urban bushland. The policies addressed indicate the potential impacts resulting from fragmentation, divisiveness and exposure of new edges to incompatible adjacent activity.

Principle A: Large reserves are better than small reserves. A large reserve can hold more species at equilibrium and will have lower extinction rates.
Principle B: The reserve should be divided into as few disjunctive areas as possible. Separate reserves in an inhomogeneous reserve may each favour the survival of a different group of species.
Principle C: If the available area is to be broken into disjunctive reserves then these reserves should be close together. Proximity will increase immigration rates between reserves.
Principle D: Where several disjunctive reserves occur they should be grouped equidistant from one another rather than grouped linearly. This arrangement will allow populations to recolonise or be recolonised from another reserve. In the linear arrangement the terminal reserves are relatively remote from each other, reducing exchange of colonists.
Principle E: Connecting reserves by corridors of protected habitat will facilitate species dispersal.
Principle F: Reserves should be as nearly circular in shape as possible. This condition will minimise dispersal distances within the reserve. Elongated reserves may promote local extinctions in the outlying parts.

It is of interest to consider the common ground of these principles where they may also apply to the habitats of communities of a human population; where fragmentation and divisiveness can be destructive of the status quo; and conversely, where larger and cohesive communities ... "can hold more species at equilibrium and will have lower extinction rates".



Geometric Principles for the Design of Natural Reserves (Diamond 1975)

5. POTENTIAL IMPACTS

5.1 GENERALLY

The assessment of impacts relevant to visual and landscape values, covers many issues and consequences which are equally applicable to the expressway in the reservation and arterial road options over the study areas to the west and east of Pennant Hills Road. In the short term the transport option that involves a major road being constructed through existing developed areas must have a significant impact. In some places, the impact could be severe.

In the longer term it is conceivable that changes, either planned or simply those resulting from natural responses to new conditions, could bring about effects which would be moulded to the reality of the new road function. These changes would relate to existing landuses being modified, new landuses being introduced and adjustments being made in existing situations to the way that properties are used. In time, new and different land development types could be promoted by a changed set of circumstances and opportunities.

Where important and irreplaceable qualities are reduced in value or destroyed, such as in the case of rare or high quality natural environments, the long term negative effect will be irreversible.

In other cases, initial impacts can be progressively modified as time passes, allowing added design measures, such as planted screens and replacement vegetation, to develop. Beyond repair works and screening, further measures may be taken with the compliance and participation of other management authorities, such as local Councils, to expand new vegetation into a larger corridor than just that of the roadway; in effect making significant contributions to a future period as compensation for existing qualities being compromised.

Relevant to the consideration of potential impacts is the relatively unplanned and dynamic change process taking place within the study area in the form of an expanding growth of random traffic pressure; a process that has its own physically and socially debilitating problems.

5.2 MECHANICAL FACTORS

The discussion and assessment of impacts makes important the consideration of the physical scale of an expressway or major arterial development and their various component parts and added devices, for example:

5.2.1 Widths

The mechanics of the expressway as described herein would involve the building of a new carriageway in the order of 30 metres wide, varying from place to place according to local design conditions or constraints. This width is equal to one and a half times the width of an average suburban road reservation of 20 metres between front fencelines. Arterial road options as proposed can be of varying widths including a possible overall widths of 36 metres and more.

5.2.2 Cuts and Fills

To gain desirable functional and safety standards, the expressway option must, to some extent, be cut through ridges and be built on fill over low areas. These factors have an important impact on how the road might be observed from its margins. For example, a typical house can be 5 metres high at the ridgeline of its conventional gable roof. The expressway can be on fills of up to 10 metres and more out of the ground.

In excavated cut sections, the expressway could be either completely or partially out of sight dependent upon the depth of the cut and the orientation of slopes on either side. The expressway as proposed would have variable cut section depths of up to 10 metres or more.

An arterial road construction at intersections would be designed to meet other roads at a common level and would be constructed over its length to a large extent at or close to existing grades and so avoid major cuts and fills. However, each intersection zone would be comparatively consuming of land space and existing properties. Where the arterial might be designed to provide grade-separated intersections, like the expressway, it would be involved in large cuts and/or fills.

5.2.3 Noise Walls ... Heights and Scale

Whether on fill or in cut, the major road, expressway or arterial, would have noise insulating walls constructed along much of its edge zones. These walls to be effective as sound absorbing or sound-deflecting structures, can be as high (in places) as 5–6 metres (ie. again as high as or higher than the ridgeline of a typical house). A suburban paling fence is typically about 1.6 metres high and at 1.8 metres most people cannot see over it.

Noise insulating barriers also, in many circumstances, need to be more or less continuous as linear formations, to be successful. And, although transparent screens are a possibility, they are functionally less efficient, more expensive to build and because they attract grime can look dirty and require regular maintenance. Therefore, although transparent screens will in some situations be desirable, noise barriers are typically opaque and consequently will screen views, wholly or partly, to whatever may have previously been seen beyond them; they also would screen, in many situations, the view of the road and its streams of traffic.

While they are designed to be beneficial, the benefits of noise walls are provided at a cost, including construction cost, maintenance cost, interference with outlook, and the inclusion, in a human domain, of elements which are very large and seemingly out-of-scale with the accustomed human living environment.

Where space can be made available, other measures can be introduced, involving landscape design of earth mounding, robust planting and sometimes a combination of elements, to either delete the view of noise walls or to visually soften their impact or simply to reduce their apparent physical size.

Where appropriate space is not available, very little can be done and in some situations where severe space constraints demand the use of edge walls to retain the road on fill, noise barriers would add further height at the tops of retaining walls. The subsequent overall height of

retaining walls and noise walls in combination can be substantial and encompass heights of 15 metres or more.

5.2.4 Space Requirements Generally

The expressway or major arterial road in any case would need significant space for their basic functional purposes and basic formations; any added measures designed to mitigate visual impact are themselves typically space consuming; all of which places an impossible stress on the means of conserving space and minimising interference to properties and people.

5.3 VISUAL LINKAGE

The expressway pavement construction width of 30 metres or more, including traffic lanes, bus lanes and shoulders, can create a visual sense of division in the broad landscape and within the existing neighbourhood. Basic aims of landscape design would include the desire to preserve existing visual linkages or establish new linkages across the expressway. This typically would involve protection of existing vegetation and establishing new plantings to conform with either the existing character of the margins or with an overall design theme developed for the new roadway.

The expressway, as proposed, with public transport lanes occupying the median zone, offers little opportunity for planting within its paved corridor.

Any further provisions of space for planting, say between bus lanes and traffic lanes, would occur at the expense of more land being taken and further encroachment upon built-up margins taking place. Planting within the corridor of the expressway, often contained as it would be between high noise walls, unless of significant scale, would only offer decorative value to the road user. Any plantings to be effective as visual linkages would need to be of trees of some stature which would relate to the tree species either preserved on the margins or introduced as new plantings.

Endeavours would be made to confine the constructed edges of the expressway, where it passes through treed or forested sections, as precisely as possible so that a maximum retention of existing trees can be made close to the pavement edges.

The use of steel guard fence or new jersey kerb would be strongly recommended where existing trees or new tree planting can be included at the edges of the carriageway. Any other residual land surfaces within the road formation such as large traffic islands and localised medians (bus stops, intersection zones) would be tree planted and protected from conflict with vehicles using appropriate edge constructions.

Similar constraints to maintaining or replacing visual linkages apply to the concept of a major arterial road development. High noise walls can impede views across the road carriageways and the constructed width can be in excess of 30 metres.

5.4 CONSTRUCTION IMPACTS

The visual impact of construction would cover a period from the beginning of demolition through to the point where plant screening, where applicable, would take effect.

The visual impact resulting from construction would be affected by the proximity of the works to particular viewpoints. Construction activity occurring immediately adjacent to houses and other properties, and exposed at close hand wherever other traffic routes cross the construction corridor would be very significant in this respect.

More distant views obtained across undulating terrain from high points in the topography would have less significance except where special environmental qualities are involved e.g. in the sensitive bushland areas between Muirfield High School and Mahers Road.

Close views from properties and long distance views generally, would be varied, in terms of exposure, by the factor of cut and fill circumstances, so that where construction is in excavated segments it will be, to varying degrees, screened from sight. Conversely, where fill formations are required the road construction will be more prominently exposed and affected by the actual height of fill over existing grades, such as along Junction Road near Quarry Creek and adjacent to Hepburn Road and Dale Place.

Cut and fill circumstances, as just described, apply almost entirely to an expressway construction. In the case of arterial road development, deep cut sections would be not be applicable except where approaches to tunnelling would be required. The arterial road construction generally would be at existing grade and visible along its entire length to close and oblique viewpoints.

During a three year construction period the visible stages would be:

- Demolition, where required, of houses and other property.
- Earthworks involving large plant and equipment.
- Pavement construction and installation of road furniture, guardrails, balustrades, signposting, etc.
- Erection of noise wall barriers.
- Installation of planting treatment.

Time spans required for screen planting to be effective (i.e. against noise walls and the road edge generally) would cover a two to five year period after completion of planting. Refer also to discussion in Report Section 7.1.2.

Scarred margins against road construction in bushland would require two to three years to be superficially repaired in visual terms. Cut rock faces would require five to ten years to be visually softened by normal weathering processes, subject to variation caused by north/south orientation where shaded surfaces would tend to discolour more rapidly.

5.5 VEGETATION

5.5.1 A Range of Values

Existing vegetation covers a range of values from excellent examples of natural/aesthetically distinctive community structure through to commonplace but significant domestic, institutional and commercial plantings on developed sites. The degree of impact caused by a major road construction would vary accordingly so that in some instances losses would be permanent and irreplaceable and in others, losses would be severe in the short term but capable of reinstatement over a longer time span.

Therefore, different criteria may be adopted in relation to vegetation of various types in differing circumstances to determine its value to the community. A rough descending order of importance follows:

1. Vegetation that is part of a contiguous and still relatively natural community of species complexity ...
   a. having minimal weed impact,
   b. slight to moderate weed impact, or
   c. capable of reinstatement with good bushland management.

2. Vegetation as in 1a, 1b, and 1c, dependent on location in relation to a broader vegetative community and/or habitat resource as ...
   a. part of a core area, or
   b. part of an edge zone.

3. Vegetation as above, points 1 and 2, exposed to a variable zone of overview.

4. Vegetation which constitutes part of an overall recreational resource which to a large extent is reliant for its success, upon being apparently complete and cohesive (particularly when its natural qualities are still well preserved and when those qualities are significant aspects of its value as a recreational resource).

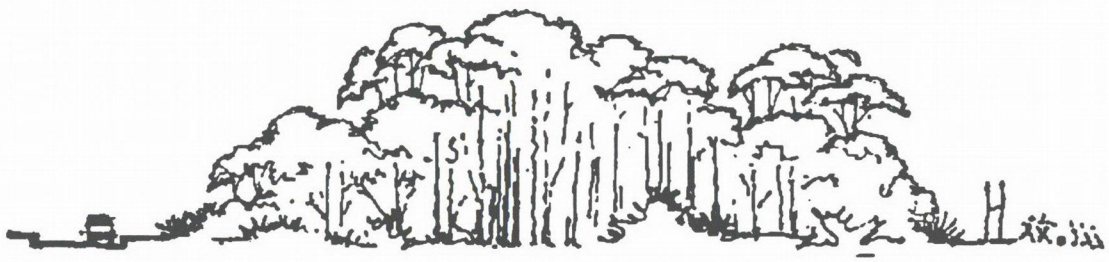
5. Vegetation which forms a particular niche in a structure of plant associations which are reliant upon each other for protection eg. a canopy protecting an understorey, an understorey resisting weed intrusions, an edge buffer sheltering interior zones, a marshland community controlling and protecting a process of water retention or distribution, or a fringe population which protects and reinforces the functions of say, the marshland. Habitat quality, as a resource of wildlife, is affected by the impacts upon vegetation as described above.

6. Vegetation which is mature, healthy and substantial, and whether or not able to be classified as 'natural remnants', is nevertheless valuable as visual elements in the community environment. Examples of this sort are found along the expressway reservation corridor where tall mature trees stand over a mix of native and exotic species and where the size of the stands is too small or too narrow to be capable of genuine reinstatement as natural elements. Other examples occur in random locations associated with arterial road options for instance on North Rocks Road near Baden Powell Place.

7. Mature trees as groups or individual specimens of indigenous, introduced native or exotic species which are valuable as visual elements or which together with similar examples, can distinguish a site or local area.

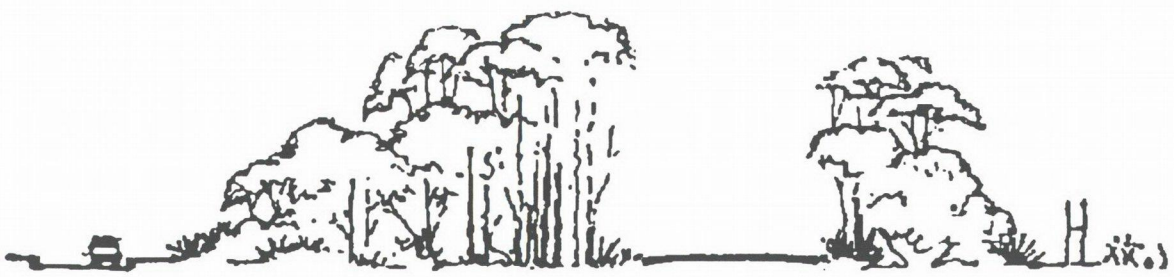
8. Vegetation generally, typically that which represents domestic gardens, which in conjunction with like examples, demonstrates or contributes to a visual character which represents the cultural existence of the local community.

* Items 1 to 5 above refer to resource material (ie. of genuine natural composition) which once lost, is not recoverable, at least not within urban circumstances. Naturally-inspired plantings can be undertaken with success, simulating a superficial character which can resemble natural circumstances, but genuine intrinsic nature, as a phenomenon, cannot be re-invented. Any losses of this sort are permanent losses.



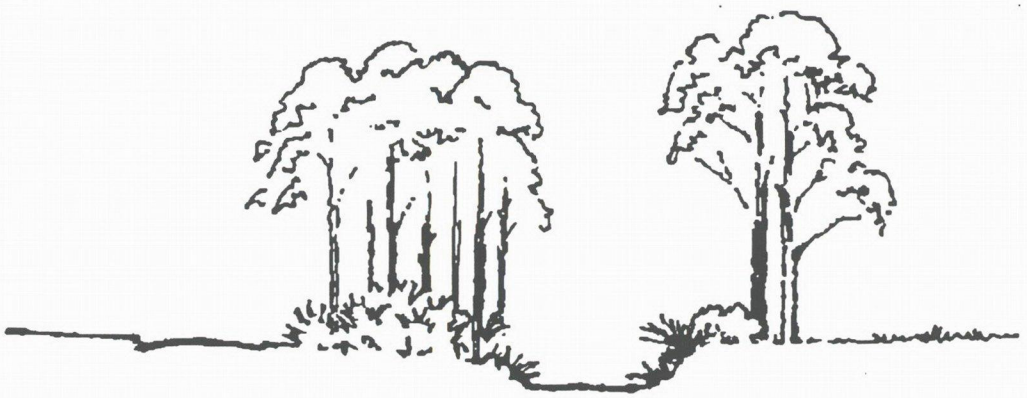
NATURAL REMNANTS

BUSHLAND CAN HAVE QUALITIES BEYOND VISUAL AND RECREATIONAL VALUES AND OFFER A DEMONSTRATION OF NATURE AS IN SPECIES DIVERSITY AND NATURAL FORCES IN A SELF-DEFINING SYSTEM. TO SURVIVE AS A RELATIVELY NATURAL UNIT WITH OR WITHOUT MANAGEMENT, IT NEEDS TO BE COHESIVE AND PROTECTED FROM COMPETING ELEMENTS.



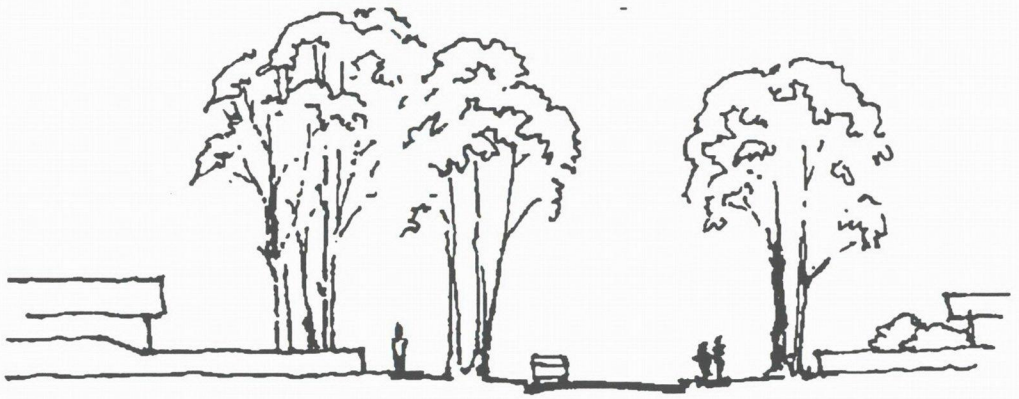
FRAGMENTATION

CONSTRUCTION CORRIDORS FOR ROADS, SEWERS, POWERLINES, WATERMAINS AND STORM-WATER DRAINS CAN FRAGMENT SMALL NATURAL EXAMPLES TO THE EXTENT THAT THEY CANNOT CONTINUE TO SURVIVE.



BUSHLAND REDUCED TO TREES AND WEEDY UNDERSTOREY

IN THESE CASES VALUE RELATES TO THE SIZE AND MATURITY OF THE STANDS OF SURVIVING TREES WHERE TRULY NATURAL CONDITIONS HAVE BEEN LOST.



REMNANT NATIVE TREES AND GROUPS IN BUILT ENVIRONMENTS

TREES IN THESE SITUATIONS ARE SUBJECT TO MANAGEMENT AS PARTS OF URBAN CIRCUMSTANCES – WHILE THEY DEMONSTRATE EVIDENCE OF ORIGINAL NATURE, THEY NOW CONTRIBUTE AS MATURE SPECIMENS AND IMPORTANT VISUAL ELEMENTS.

MATURE VEGETATION IN RESIDENTIAL AND COMMERCIAL AREAS

MATURE DOMESTIC VEGETATION IS TYPICALLY ATTRACTIVE AND PROVIDES A COHESIVE VISUAL QUALITY IN THE RESIDENTIAL ENVIRONMENT.

5.6 SEVERE IMPACTS

The more severe landscape and visual impacts of the expressway proposal would fall into the following categories and be subject to individual assessment of severity at each specific location. Therefore the list does not represent a precise order of impact or priority.

1. Division of built and natural environments.
2. Division created between built and natural environments.
3. Physical destruction and loss of natural bushland.
4. Changes to the quality of the community environment as a consequence of the effects of division and destruction.

5.7 LESSER IMPACTS

Lesser impacts are those that are capable of being reduced as a result of applied mitigative measures. These lesser impacts can still range in degree from minor to severe dependent upon specific circumstances involving the extent of change and the success of new measures designed to modify the changes. (The passing of time, in some instances, would allow mitigative measures to become more effective in reducing impact.) These categories are as follows:

1. Partial loss of property and consequent loss of landuse values.
2. Introduction of new and undesirable activity in the immediate neighbourhood as a replacement of familiar existing circumstances.
3. Loss of trees/vegetation.
4. Loss of views.
5. Introduction of new and undesirable views.
6. Loss of amenity through the introduction of visual effects and noise which are disagreeable or discomforting.

6. EXPRESSWAY : EFFECTS AND PROPOSED LANDSCAPE TREATMENT

These notes should be read in conjunction with cross-section diagrams (Nos. 1 to 12) which describe construction formations and mitigative effects. Approximate locations of cross-section diagrams are shown on Landuse Maps 1/6 to 6/6 (Figures 3.4 to 3.9).

6.1 OLD WINDSOR ROAD TO MUIRFIELD HIGH SCHOOL

The expressway proposal is described in this report section 6.1 covering the segment Old Windsor Road to Muirfield High School. Between the high school and Pennant Hills Road the design proposal considers alternative alignment options in relation to particular environmental issues (see earlier discussion in Section 3.3). The alignment options are further described in the following section 6.2 'Alignment Options (Expressway)' and the discussion of the remaining expressway segment extends to its connection with Pennant Hills Road.

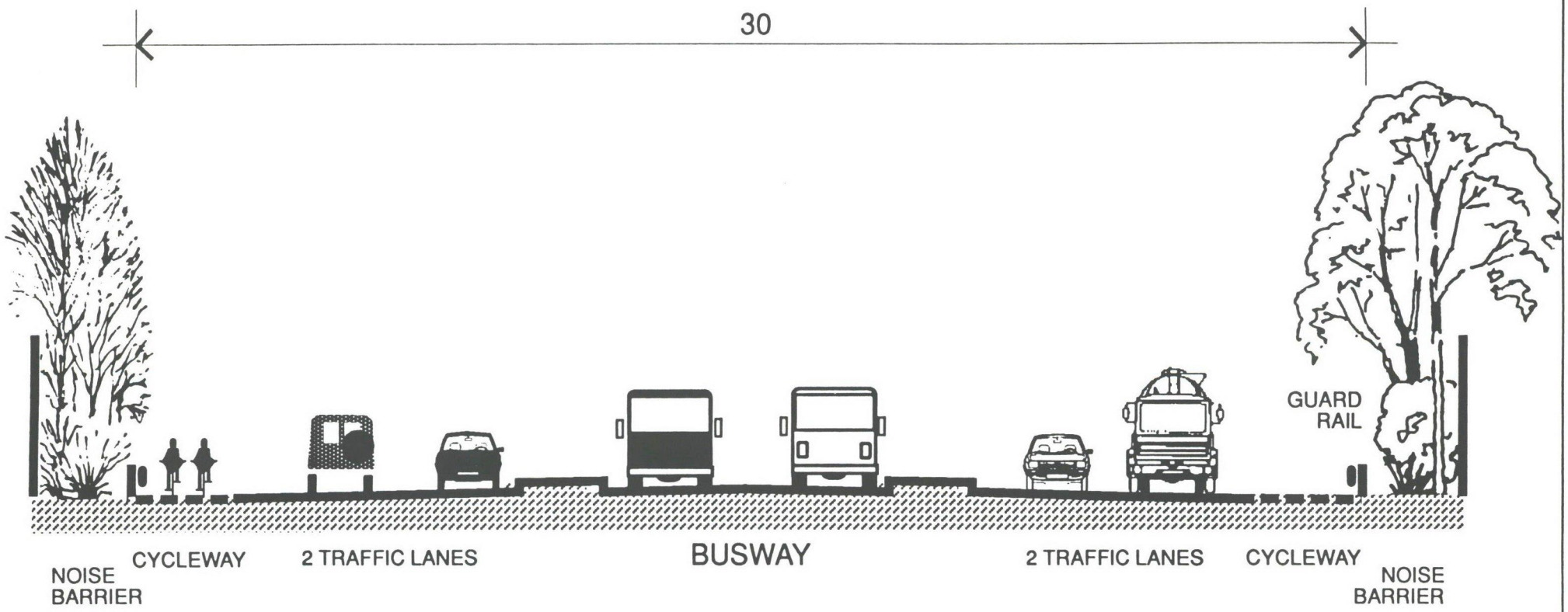
6.1.1 Typical Section (Fig. 6.1)

This cross-section shows the expressway proposal in its basic layout which would be subject to variation in specific locations related to intersection geometry and other design factors such as exit and entry ramps, and provisions for widening at bus stops. A description of the typical section follows:

- Two dedicated public transport lanes would be in the centre of the road separated from general traffic by 2.0 m wide medians.
- Two traffic lanes would occur on each side for private and commercial vehicles and on the shoulders where appropriate would be cycleways which would also serve as vehicle break-down lanes.
- Where space allows, a margin would be provided for planting adjacent to the cycleways and additional to planting space which may be provided beyond the noise wall lines.
- Trees in the margins adjacent to the cycleways would be of species, of moderate size because of their proximity to the edges of pavement construction, such as Casuarinas, Melaleucas and smaller Eucalyptus.
- Design speeds for traffic on the expressway would require steel guardrail or new jersey kerb to safeguard against tree and vehicle conflicts.
- Planting would not otherwise be possible across the width of the carriageways except where large traffic islands would provide suitable spaces.

6.1.2 Intersection of Old Windsor Road and Abbott Road

The expressway formation at its intersection with Old Windsor Road leaves a very narrow margin against houses at its northern edge which front onto Valerie Avenue. On its southern margin houses would be lost to allow for pavement widths required to accommodate connecting and turning lanes between the expressway and Old Windsor Road. Residual land left after construction would provide substantial space for landscape treatment.



This diagram shows a basic cross-section that the expressway would follow subject to design variations in particular locations (on-off ramps etc) and, where space allows, margins for planting inside noise barriers.

FIGURE 6.1

A TYPICAL CROSS-SECTION EXPRESSWAY IN THE RESERVATION

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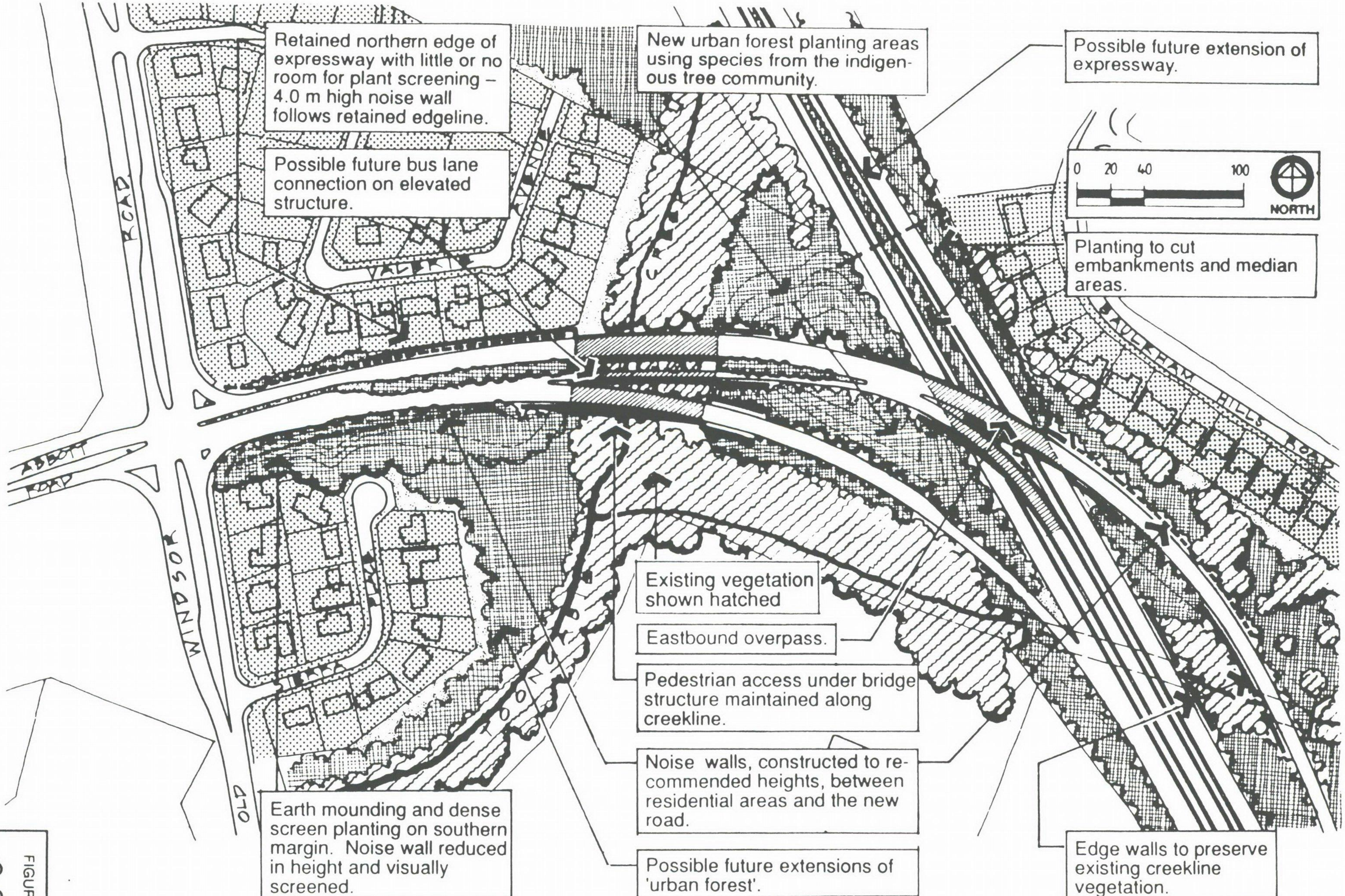


FIGURE 6.2

Toongabbie Creek Environs
LANDSCAPE PROPOSAL

On the northern edge, east-bound lanes would be ramped to gain height over Toongabbie Creek and then to form an overpass to cross a possible future northern extension of the expressway. The ramping would require the expressway edge to be retained adjacent to the rear boundaries of properties on Valerie Avenue. A noise wall of up to 4.0 m height would be constructed over the retained edge. Only minimal planting would be possible along this edge and the wall construction would be visible to houses.

On the south side between Old Windsor Road and Toongabbie Creek, earth mounding and planting would visually screen the noise wall installation which in turn would be reduced in height because of the mounding. Refer to plan diagram – Fig. 6.2.

6.1.3 Toongabbie Creek and Section 1 (East of Toongabbie Creek at Ch. 3300 – Fig. 6.3)

Bridge structures would be used to carry expressway and future bus lane pavements across Toongabbie Creek. Abutment wall design would be developed so as to limit the loss of existing trees bordering the creek.

The bridge and abutment design would provide for pedestrian access along the creek and under the expressway formation.

A tributary stream would be converted to culvert structures to flow under the expressway construction. Edge retaining walls would be used to form abutments to the culvert entry and exit points in order to preserve existing trees, which form a corridor along the stream, as closely as possible to the road edges.

The eastbound expressway lanes and the future central bus lanes would be elevated over the carriageways which would be subject to possible future extension to the north. The elevated lanes would form bridge structures. New landform would be created to relate the bridge abutment zones to the surrounding terrain. A high and broad mounded landform would result. Proposed tree plantations using the native species of the original landscape would be established over the new landform and on the residual margins of the expressway reserve. The various construction forms would be well-absorbed, visually, into the new treed landscape. Dense screen planting would be applied against noise walls and reservation boundaries where appropriate.

6.1.4 Section 2 (West of Langdon Road at Ch. 4000 – Fig. 6.3)

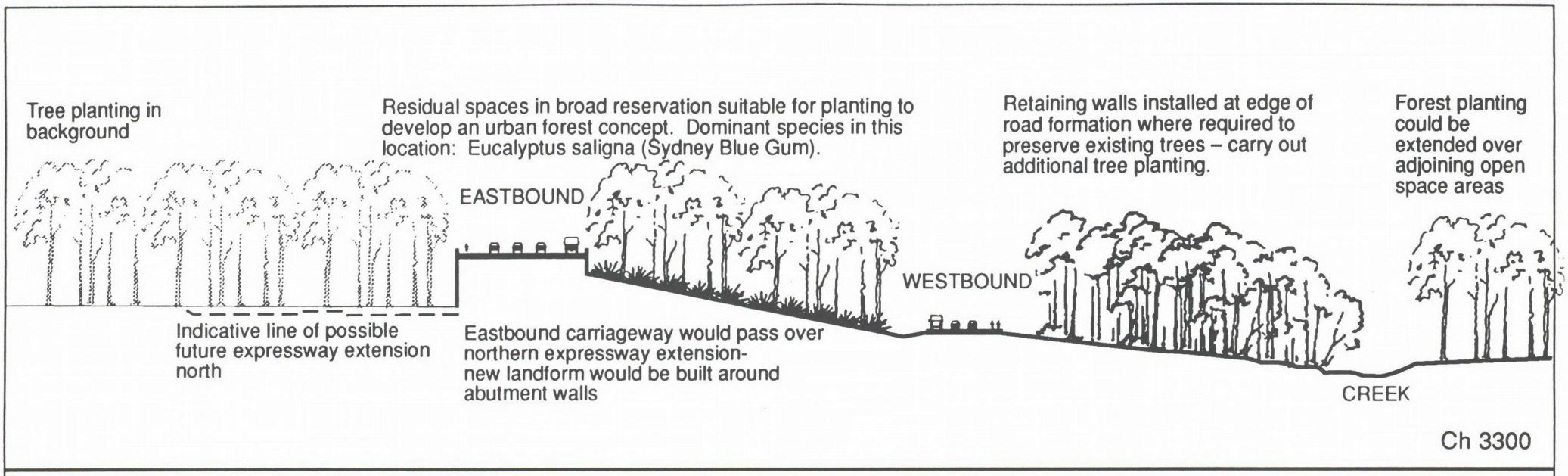
This example of the expressway in deep cut shows planting that would extend over the excavated margins of the reservation. The cut embankments would be terraced as required to provide suitable planting conditions. The deep excavation would reduce the required height of noise walls which would be integrated with the planting scheme. On the southern edge at this point against Gibbon Road there would be no noise wall construction. The expressway formation in cut would be out of sight from its margins.

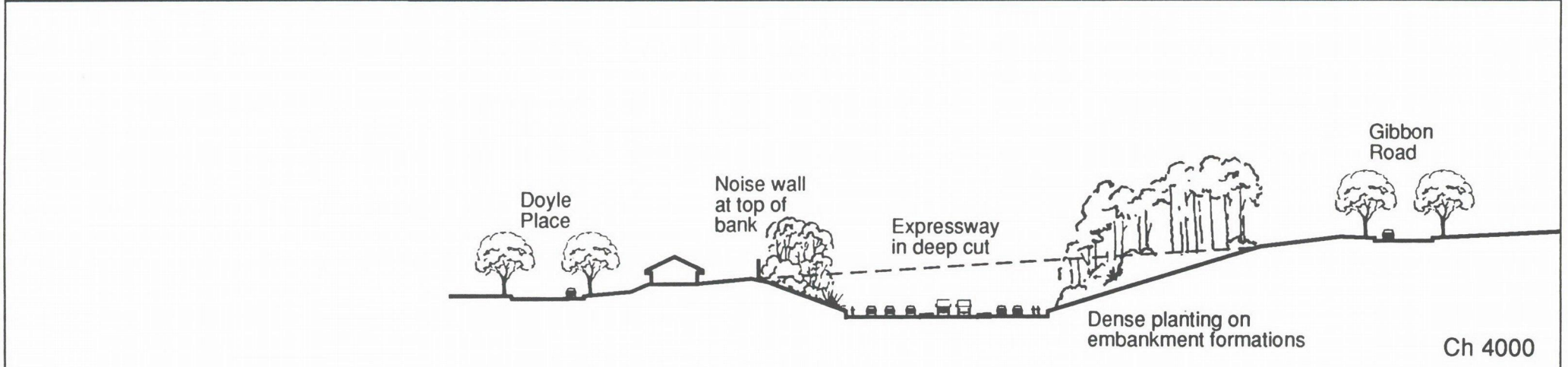
6.1.5 Section 3 (Adjacent to Shopping Centre on corner of Langdon Road and Caroline Chisholm Drive at Ch. 4300 – Fig. 6.4)

The expressway, more or less at natural grade, would leave sufficient space for earth mounding and planting against the rear boundaries of houses off Lambert Crescent. A noise wall on the earth mound would be well-concealed within planting. The view from houses would be of screen planting. On the south side a narrow margin would be available for tree planting between the road edge and the adjoining shopping centre. The expressway at this point and at the previous Section 2 is widened by an additional east bound lane from Old Windsor Road merging with the eastern carriageway.

6.1.6 Section 4 (East of Gooden Reserve at Ch. 5000 – Fig. 6.4)

The expressway in light cut alongside Junction Road would be treated similarly to Section 3 with earth mounding on its northern boundary against the rear property lines of housing (Tamboura Avenue) and dense planting throughout. A noise wall would be screened by planting and the new roadway would be out of sight from its northern margins. On the south margin at this point the alignment would sweep in a long curve and come close to the reservation of Junction Road, leaving only a narrow margin for tree planting. A noise wall would be installed above the excavated edge.





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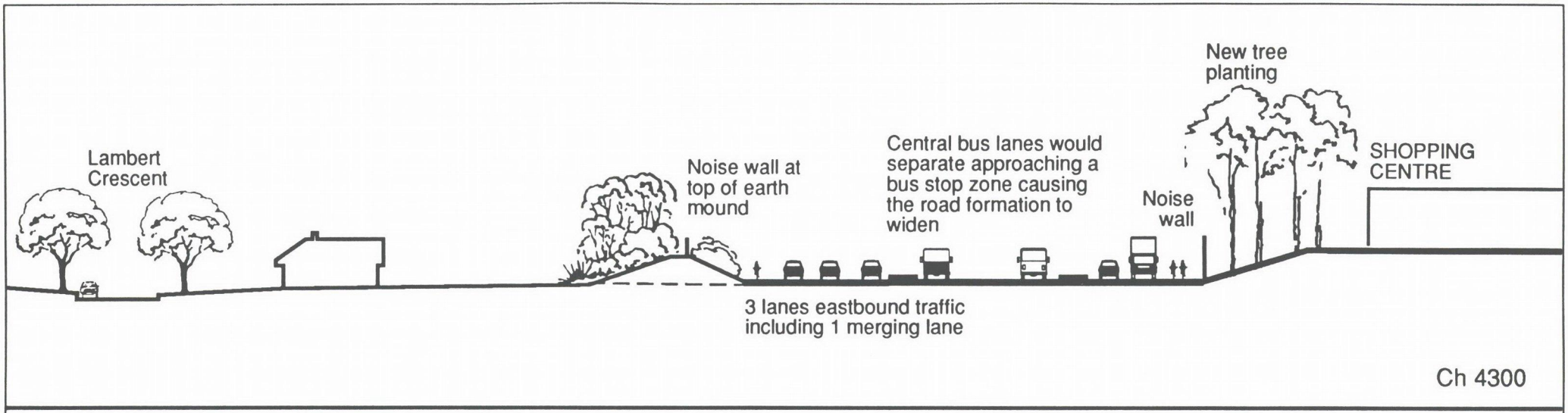
SECTIONS 1 & 2
EXPRESSWAY IN THE RESERVATION

FIGURE
6.3



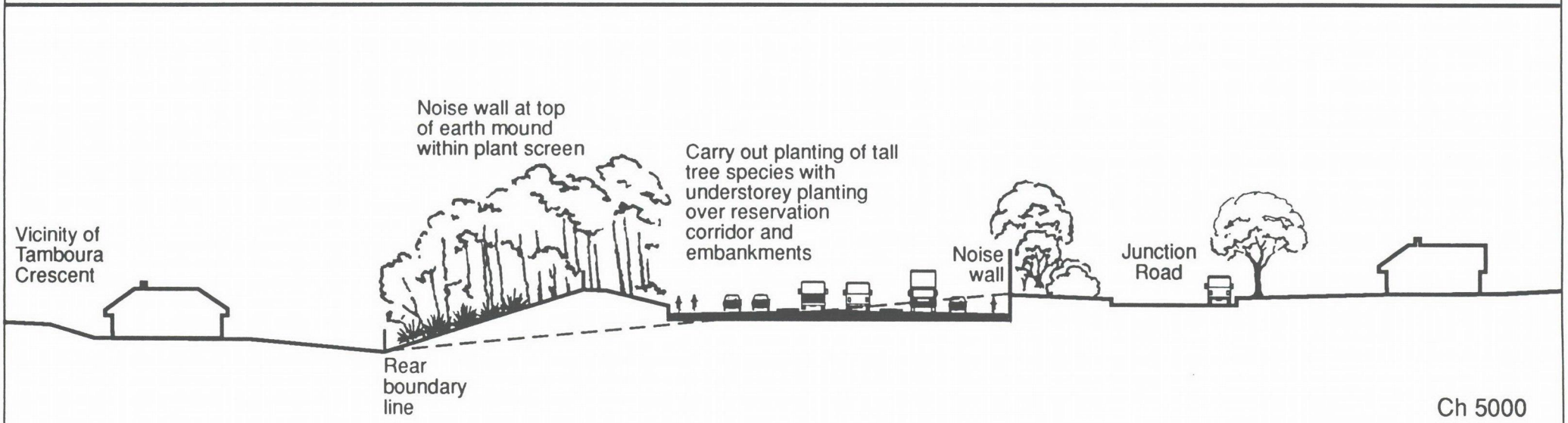


FIGURE 6.4

SECTIONS 3 & 4
EXPRESSWAY IN THE RESERVATION

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6.1.7 Section 5 (West of Cropley Drive at Ch. 5700 – Fig. 6.5)

A bus stop zone around the central public transport lanes would cause a widening of the expressway formation to include a broad median and the separation of the two bus lanes. The road would be in deep cut retained at its edges with walls leaving satisfactory margins for planting at natural grade. 4.0 m high noise walls would be visually contained within the planted margins.

6.1.8 Section 6 (Vicinity of Quarry Creek/Goodwin Road at Ch. 6600 – Fig. 6.5)

After leaving the deep cut of Section 5, the expressway would move onto a high fill formation as it passes over a branch of Quarry Creek which flows south under Junction Road.

The fill height would be substantial (in the order of 10.0 metres) and because of a widening of the carriageway that would occur on the approach to the Windsor Road intersection, the retaining walls of the fill formation would fall close to the edges of the reservation corridor. As a result, little space would be available for landscape treatment. The cross-section at Chainage 6600 illustrated in Figure 6.5 indicates two possible treatments installed at the edges to reduce the visual impact of high retaining walls. One detail allows for a stepped retaining wall construction to create terraces for bulky planting against the high wall formation. The other involves a possible wall detail which incorporates a ledged construction which combines the retaining wall technique known as reinforced earth and a series of ledges suitable for robust planting. This construction technique could create a 'green wall' effect using vegetation as the main visual element.

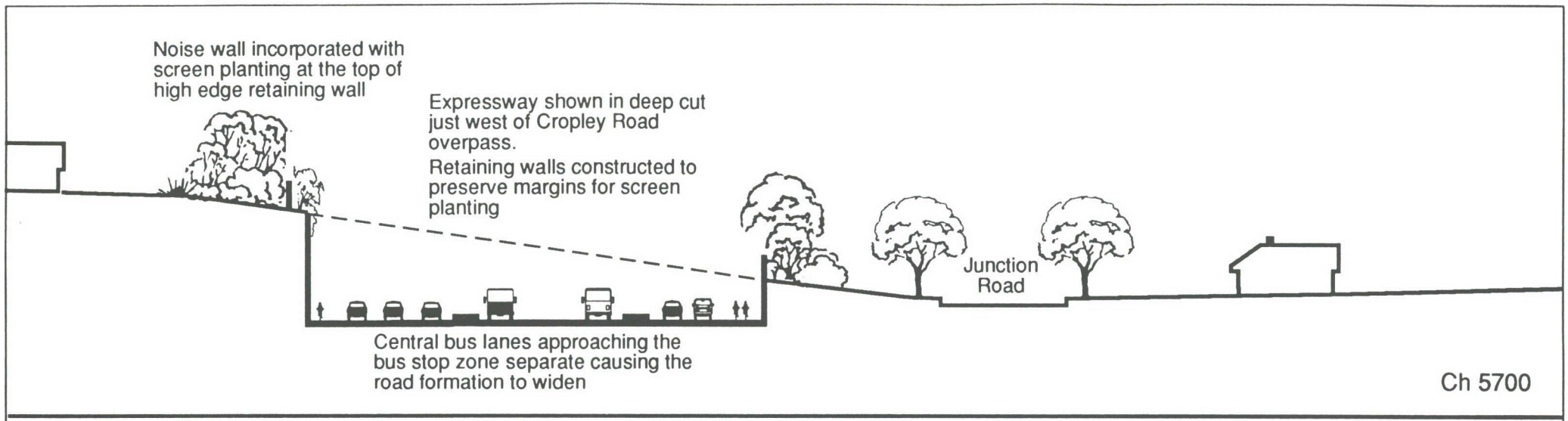
The views from Junction Road on the south and from houses on the north side of the reservation would be directly onto the retaining wall constructions, which would also include noise walls erected on top. Planting required to soften and visually screen the large wall constructions would include a mix of fast-developing species and, on the south wall, slower shade-tolerant types that would, in time, provide a dense cover of vegetation. Fast-growing species would include such as Eucalyptus, Casuarina and Melaleuca species, and slower-growing or shade-tolerant species such as Pittosporum and Tristaniopsis.

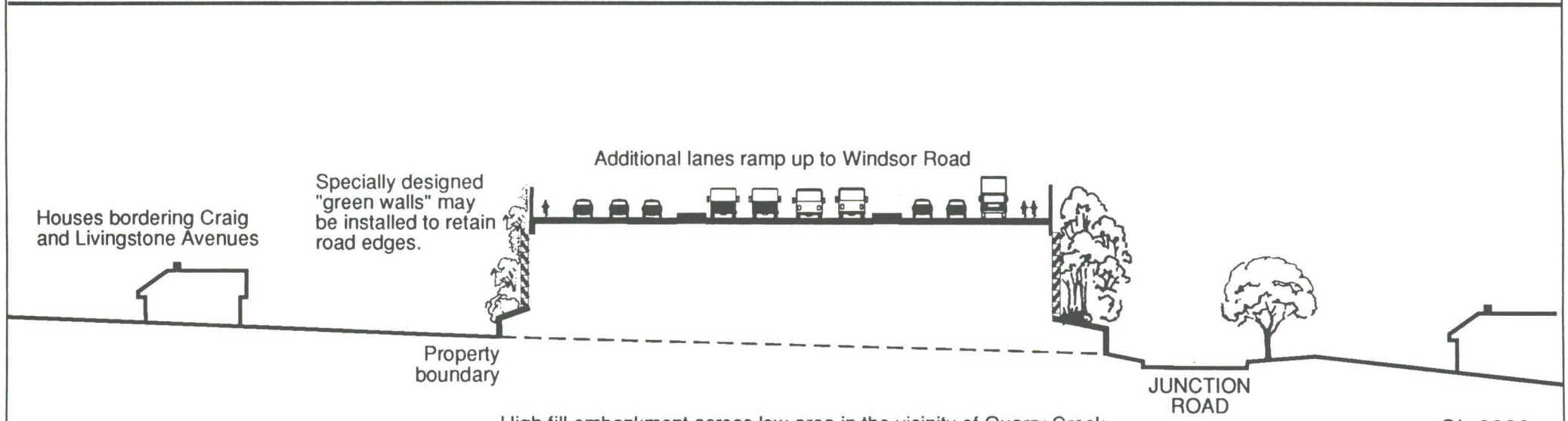
Towards Windsor Road the fill formation would reduce prior to going into a deep cut to pass under Windsor Road.

6.1.9 Section 7 (South eastern slopes of Darling Mills Creek near Williams Road at Ch. 7900 – Fig. 6.7)
Section 8 (Hepburn Road/Dale Place at Ch. 9000 – Fig. 6.7)

These sections illustrate the recommended treatment of constructing walls alongside bushland (Section 7) and trees (Section 8) to avoid spilled earth batters and to retain valuable vegetation close to road edges.

In Section 8 the south side of the road is shown as a filled embankment where no trees, or few trees exist, so that new heavy planting can be installed to screen the expressway and its noise walls from houses. The existing view to trees on the north side of the expressway would be virtually eliminated. A new view of vegetation applied to the embankment would take its place.





High fill embankment across low area in the vicinity of Quarry Creek. Road formation widens to accommodate additional public transport and oher traffic lanes which would ramp up to the intersection with Windsor Road.High retaining walls would be required with noise walls on road shoulders. Limited planting would visually soften the edge walls.

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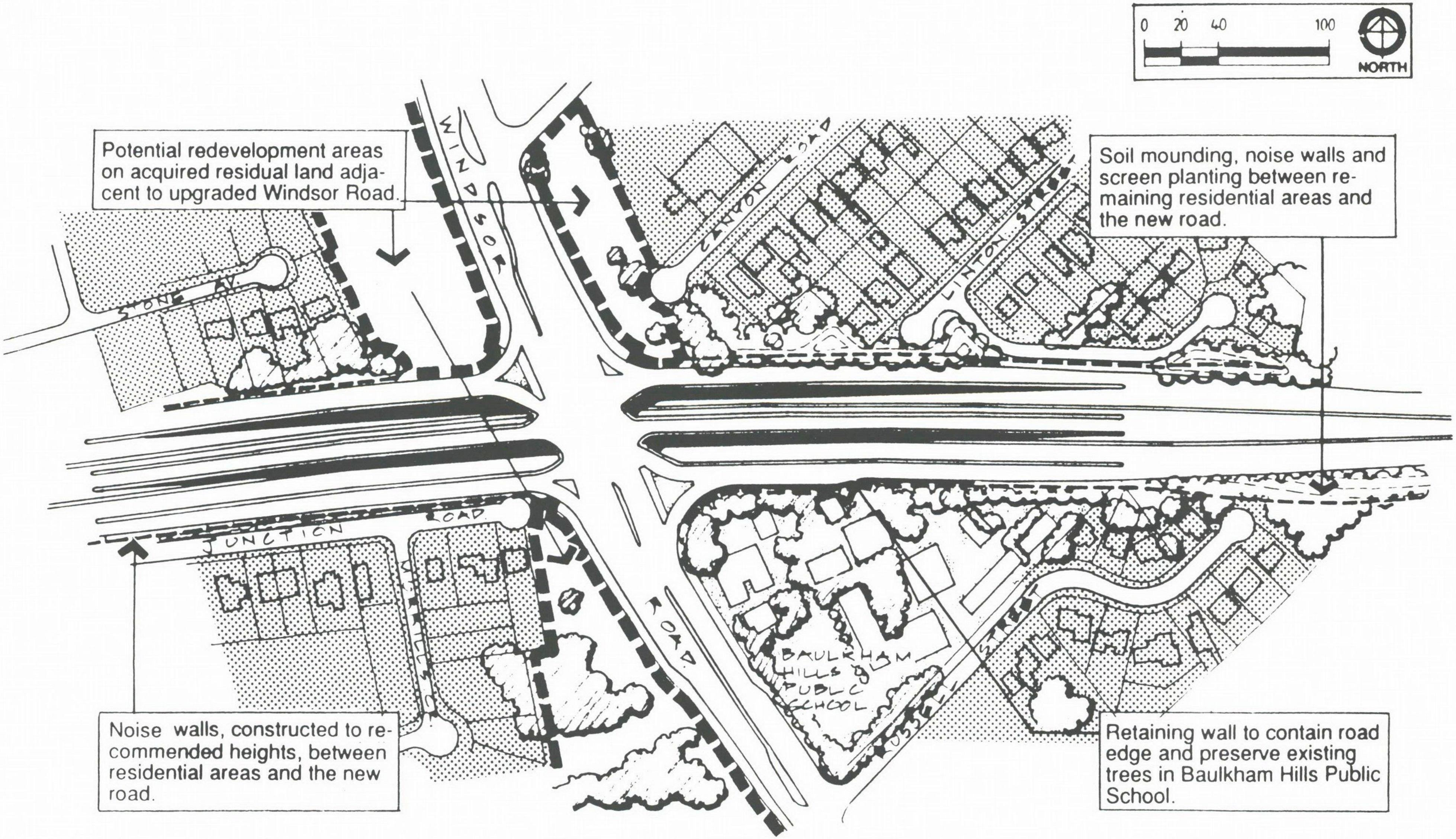
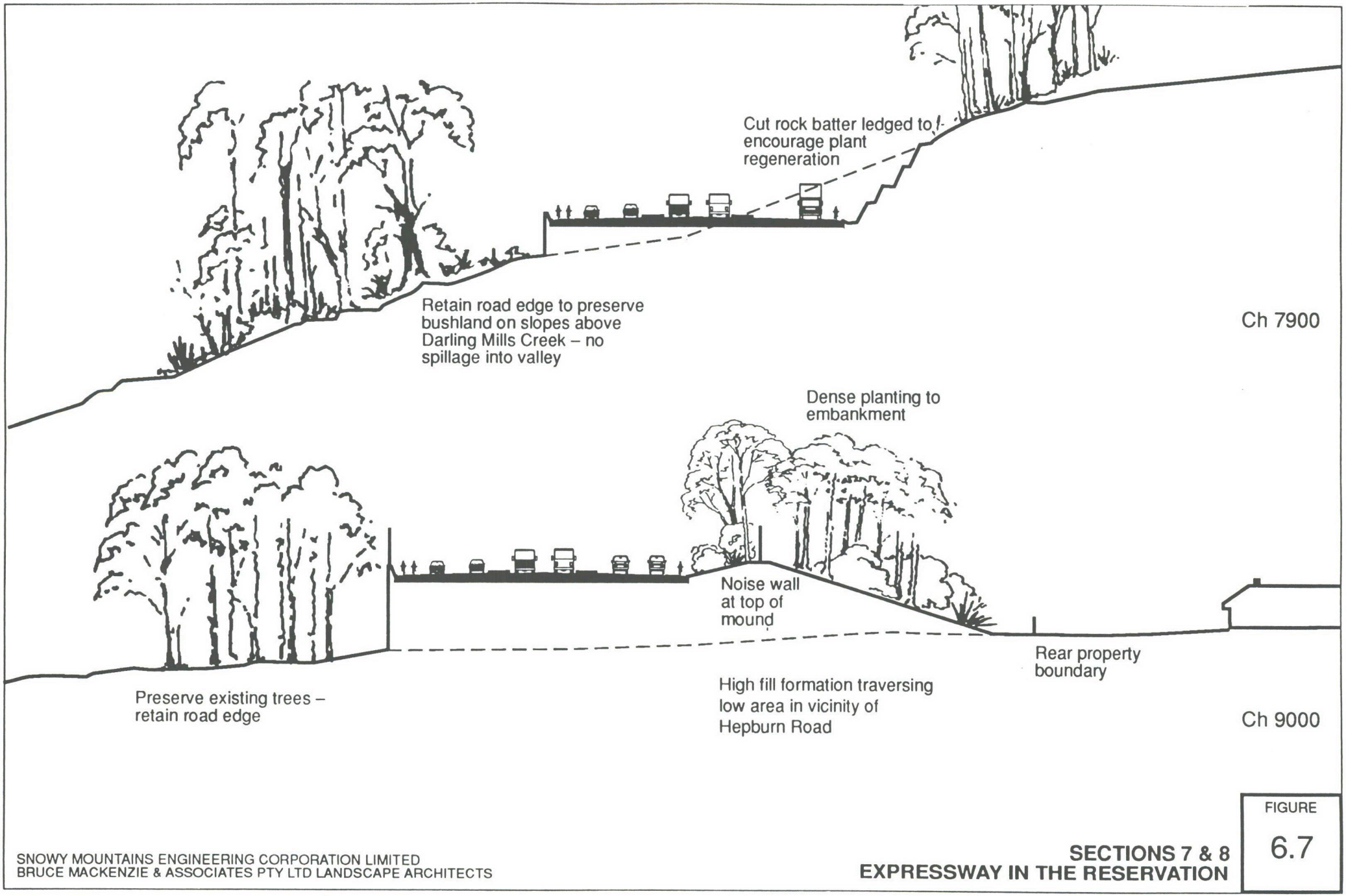
SECTIONS 5 & 6
EXPRESSWAY IN THE RESERVATION

FIGURE
6.5



Windsor Road Intersection
LANDSCAPE PROPOSAL

FIGURE
6.6



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SECTIONS 7 & 8
EXPRESSWAY IN THE RESERVATION

FIGURE
6.7

6.1.10 Sections 9A and 9B (Vicinity of Yale Close at Ch. 9615 Figs. 6.8 and 6.9)

The two sections illustrate options that have been investigatged for treating the difficult relationship that would occur between the expressway proposal and houses on the bushland edge bordering Yale Close.

Section 9A would propose a short bridge section located on crisply defined abutment walls to preserve as much of the existing bushland and trees as possible, while maintaining views and pedestrian access down the V-shaped gully. A negative factor would be the shaded dry environment which would be created under the bridge.

The view from the houses towards the road would be barely screened by the existing vegetation and a clear view of the bridge structure and noise wall would be likely, suspended across the broad view to the valley below. Little of the actual road traffic would be seen.

Additional screen planting within the bush gully would not be practicable without making a significant change to the existing bushland character.

Section 9B shows an alternative which places the road on fill with a retaining wall on the low side and a fill batter on the high side sloping back into the gully profile. The fill embankment would allow dense screen planting to be installed between the road and the housing edge.

This alternative would be less costly but would cause the loss of existing trees and bush cover. Planting applied to the embankment would be effective as screening but existing views to the valley below the top of the noise wall would be eliminated.

An important feature of the alternative option 9A is the facility it provides for pedestrian access from the urban edge to the bushland system of Darling Mills Creek beyond. In conjunction with the establishment of a suitable pedestrian right of way from the urban areas to the south, this alternative 9A would be recommended.

CROSS-SECTION 9A indicates the expressway supported on an elevated structure at a creek crossing.

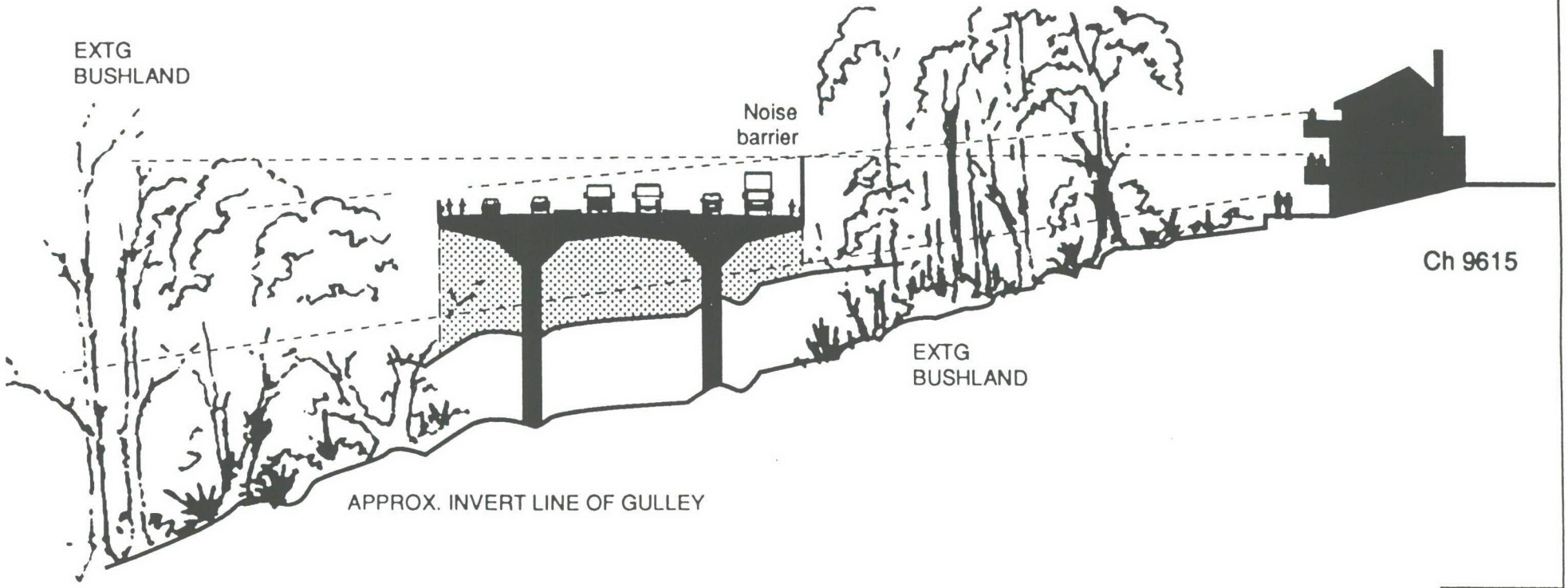
Existing terrain and open vegetation would be retained adjacent to roadway.

Physical and visual access retained under the structure.

Noise barrier largely on view from house only softened by existing vegetation.

View of traffic stream reduced by noise barrier.

Additional tree planting between house and roadway would require modification/loss of existing bushland conditions.



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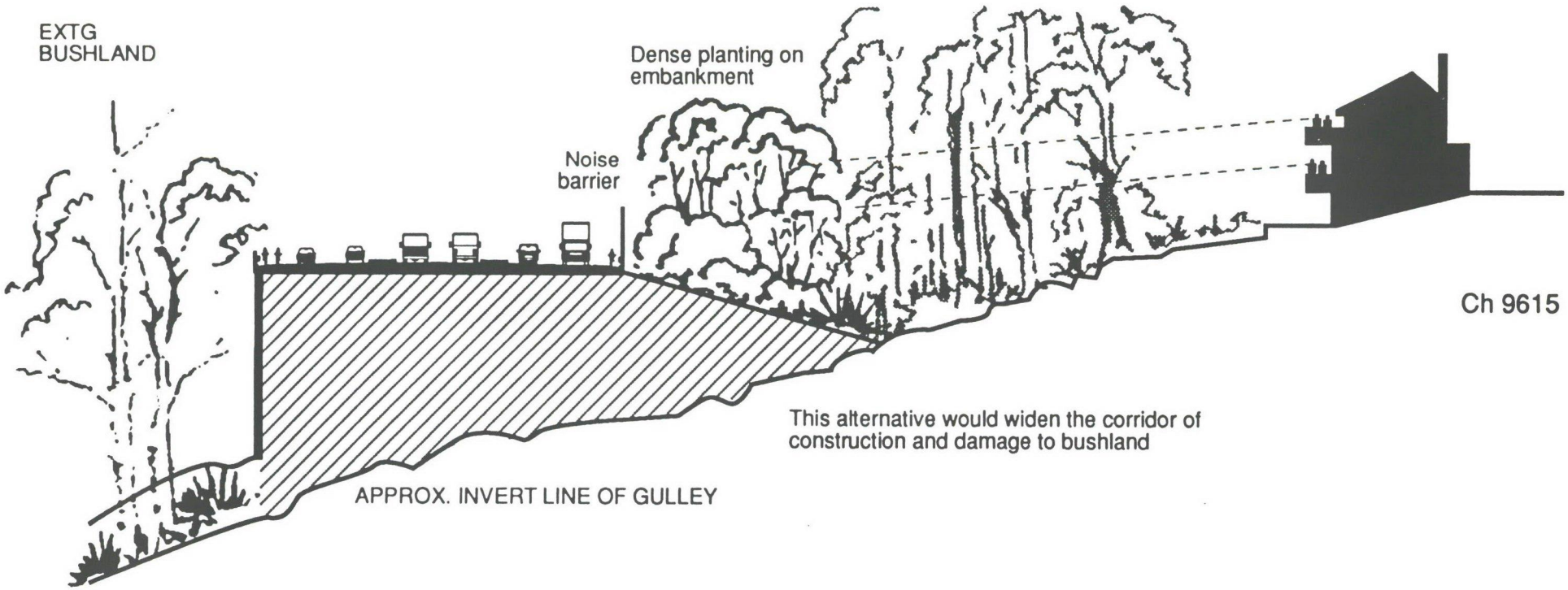
SECTION 9A
EXPRESSWAY IN THE RESERVATION

FIGURE
6.8

CROSS-SECTION 9B shows the expressway crossing the creek profile on fill (see alternative example C/S 9A).
The fill formation creates a high wall on the downslope edge.
The wall would be vertical to minimise intrusion onto the slope below.
Fill slope constructed on high side would allow dense planting and the development of more effective screening from the housing edge.



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SECTION 9B
EXPRESSWAY IN THE RESERVATION

FIGURE
6.9

6.2 ALIGNMENT OPTIONS (EXPRESSWAY) : MUIRFIELD HIGH SCHOOL TO PENNANT HILLS ROAD

(Refer to plan 'Alignment Options' – Fig. 6.11 and discussion of the existing site in report section 3.3.)

6.2.1 Northern Alignment Option A

This route has been investigated in order to avoid the more distinctive qualities of the natural features which occur towards the base of the northern slope to the west of Mahers Road, and to avoid the property loss of the southern alignment (Option D). The alignment of Option A veers north to the east of Muirfield High School to cross the creek on a relatively high bridge structure in order to traverse the north slope at a higher level and further downstream from the end of Mahers Road.

In this option the stand of Sydney Blue Gum could be partly avoided. The route below Westmore Drive across the top of the north slope, however, still poses a threat to the environment of the lower slopes because of interference to the water table as a result of making a deep excavation; it would also require a larger loss of valuable bushland in taking a longer path through the area by comparison with other options.

In crossing the main creek at a point much further downstream, this alignment would tend to visually subdivide the broad valley formation and interfere more with its recreational values than in the other cases. The road would also run closer to houses in Westmore Drive and Virginia Place.

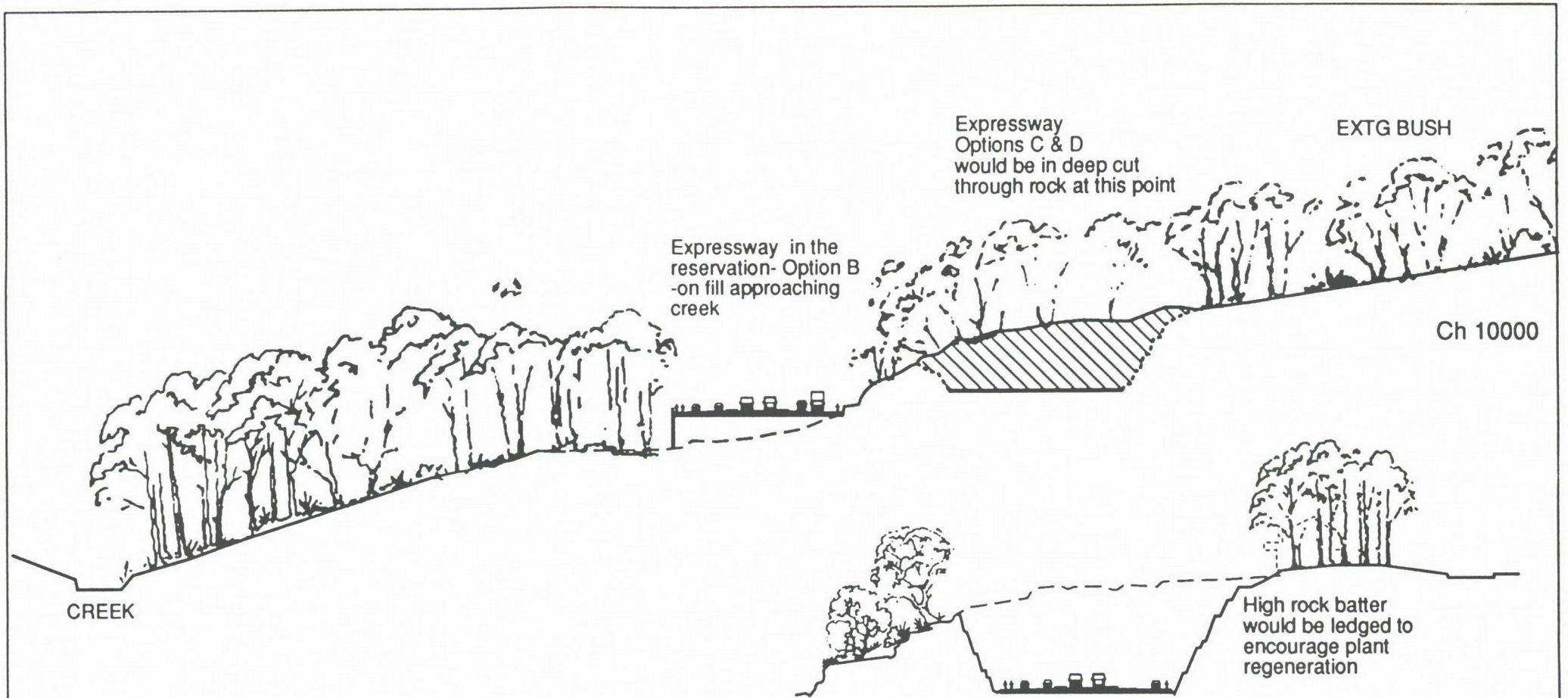
6.2.2 Alignment in the Reservation Option B

Located precisely in the reservation corridor, the expressway formation would cause the loss of most of the stand of Blue Gums.

Leaving the Muirfield High School area the alignment would cross the creek at a lower level and go into deep cut section to traverse the steep slopes to the north of the creek. This would affect the existing qualities severely, leaving the slope divided with exposed cut rock faces.

Interference with the watertable as a result of the deep excavation would affect the condition of the forest below and above the roadway. Introduction of a corridor of light, sun and draft would further alter the edge conditions on each side of the cut, so that the whole of the surrounding slope condition would be altered.

The alignment would seem to have as its positive value, the retention of existing homes. However, in the event of an expressway being built in the reservation, Mahers Road would become a reduced width service road accessing existing properties. The changed outlook for homes presently fronting Mahers Road, in this case, would be towards the expressway's noise walls with the existing Blue Gum stand mostly removed, leaving scattered individual trees on the far side of the corridor. Any other negative aspects of the expressway would also be near at hand.



0PTIONS PROFILES THROUGH BUSHLAND APPROACHING MAHERS ROAD

FIGURE 6.10

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SECTIONS 10 & 11
EXPRESSWAY IN THE RESERVATION

The undesirable aspects of Option B led to the step of moving the design proposal south to a location more aligned with the pavement of Mahers Road than that of the expressway reservation (Option C).

6.2.3 Central Alignment Option C

This option takes the road formation gradually down the southern slope of the valley after leaving the high school to pass over the creek just off the end of Mahers Road at the foot of the northern slope. It would encroach onto the lower slope momentarily to the extent of approximately 40.0 metres. It would be at level with the slope at the road's northern edgeline, and would be contained on both edges within retaining walls. The creek would go into culverts and pedestrian access would be directed down the valley on the southern slope to pass under the expressway at a bridge crossing over a small side gulley.

Dependent upon its detail resolution, this alignment, Option C, could preserve a large proportion of the Blue Gum stand and interfere only slightly with the toe of the northern slope leaving its forest environment almost intact. The airspace over the creek, where the road would pass the projection of the northern slope, would be utilised and would represent a minor environmental cost, bearing in mind the weed conditions associated with the creekbed in this section. A large natural rockface and overhang on the south side of the creek would be mostly destroyed by this alignment.

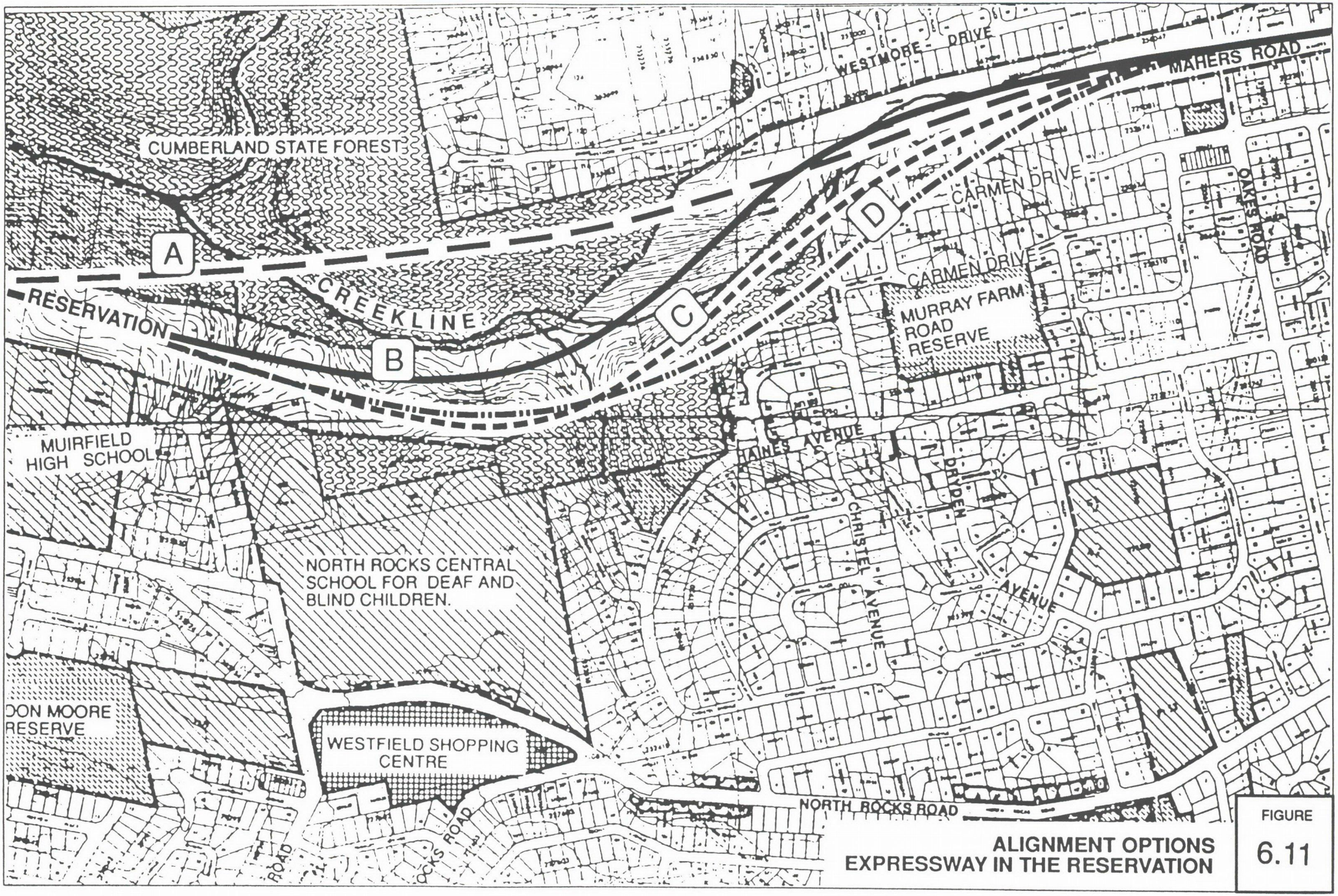
Additional homes would be lost at the end of Mahers Road and to the west of Carmen Drive.

6.2.4 Southern Alignment Option D

The more southern alignment of Option D would follow a path traversing the south slopes of the main valley heading east from Muirfield High School to cross a small lateral gulley before going into a deeply excavated section approaching Mahers Road. The route would take a line running close to Wiltshire and Moreton Avenues and cut through the bend in Carmen Drive to merge with Mahers Road near Oakes Road.

The value of this option would be to retain most of the Blue Gum stand and avoid completely the north slope environment above the creek and the main creekline itself.

The cost would be the loss of many additional homes between Wiltshire Avenue and Oakes Road.



ALIGNMENT OPTIONS
EXPRESSWAY IN THE RESERVATION

FIGURE
6.11

6.2.5 Connection with Merelynne Ave

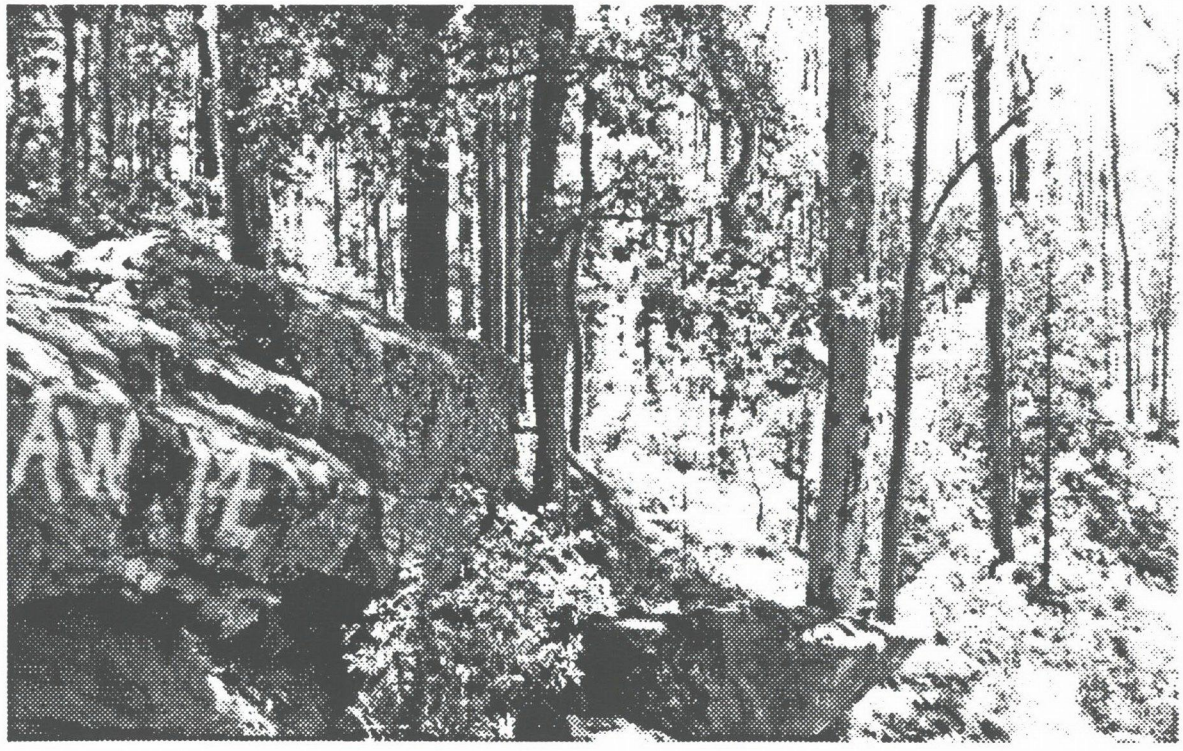
While the proposed connection to Merelynne Avenue does not form part of the present submission of options, its realisation in the future would introduce a new impact on bushland qualities. The connection would entail a crossing of the main valley or the valley which runs to the north depending on whether or not an expressway option would be chosen and which options would be proceeded with. Both valleys are broad and deep so that a construction involving a substantial bridge would be expensive and cause much damage to the bushland. The route to the north would also be divisive of the broad natural environment.

Option A, taking the northerly route, would have some slight advantage over the others if the Merelynne Avenue connection was to be made.

6.2.6 Bushland Reinstatement

Recommended landscape policy for an alignment option would be to preserve existing natural vegetation and terrain character right up to the edges of the road using, where necessary, steep or perpendicular retaining walls. Added planting of species from the immediate local plant community would be used only to reinstate damage where necessary.

The new road segment through the bushland would be envisaged as a discrete corridor contrasting with its bushland surroundings.



NORTH SIDE OF THE CREEK AT THE WESTERN END OF MAHERS ROAD.

6.2.7 Oakes Road to Pennant Hills Road

Just to the west of the intersection of Mahers Road and Oakes Road, a bus stop would be located around the central bus lanes causing a widening of the overall carriageway. From this point the expressway on its approach to Pennant Hills Road would increase in width to include connecting lanes and would continue in deepening cut to form an underpass to Pennant Hills Road. The physical impact and visual effect would include ramps on sweeping curves, retaining walls and earth embankments, and noise walls constructed typically adjacent to pavement edges and sometimes on top of retaining walls.

The resulting interchange zone would cover a substantial area leaving large traffic islands, median spaces and residual margins at the edges of construction. To a large extent dense screen planting would be possible to soften and hide noise wall and construction edges. In the larger traffic islands existing mature trees would be retained and extensive new stands of tree planting would be installed.

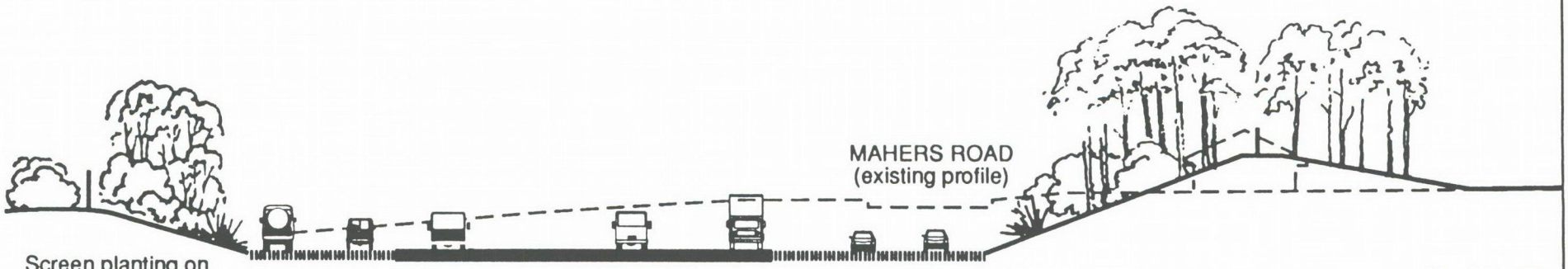
These plantings, using the tall canopy species of the planting theme, such as Blackbutt, Blue Gum and Red Mahogany, would form prominent skyline views on the ridgeline and be visible from a broad surrounding zone. In time, they would provide a valuable visual impact.

Demolition of properties on the northwest, southwest and southeast corners of the interchange pattern would leave residual margins suitable to a large part for soil mounding and screen planting. Pennant Hills Road realigned partly to the west would leave a small segment of existing road and properties on the southeast quarter. A new access road would be constructed from Lamorna Avenue to the cut-off segment of Pennant Hills Road which would be reduced in width. Residual space would result, allowing effective planting alongside the new Pennant Hills Road alignment.

The ramp connection from Pennant Hills Road going east would cut into the south-west corner of the golfcourse, removing some established planted trees and possibly some native trees which border Mahers Road near the corner. A replanting of trees would be undertaken to connect the existing tree avenues of Pennant Hills Road with the native trees alongside Mahers Road. Screen planting would follow the ramp in conjunction with a low noise wall so that the new view from the golfcourse would be onto a planted edge under trees.

An alternative proposal allows for the expressway from the west being terminated at Pennant Hills Road and turned south as an arterial connection to the Carlingford Road option developed by Maunsell for the eastern study area. In this alternative, the extent of interchange construction would be partly reduced though still substantial, involving similar ramp connections between the expressway and Pennant Hills Road to the north, the west and the south.

In both interchange constructions the underpass of Pennant Hills Road would require deep excavations and high retaining walls. The walls in these cases would be treated with a design pattern to reduce their large-scale impact and to provide graphic design interest at the intersection zone.



Screen planting on embankment against noise wall

Ch 11400

In deep cut east of Oakes Road, the expressway cross-section would begin to wden, to provide entry and exit turning ramps, as it approaches the proposed interchange at Pennant Hills Road

Where space allows on residual margins substantial planting and earth mounding can be installed. In this case tall tree species would be used in conjunction with bulky shrub planting. Noise wall on top of mound.

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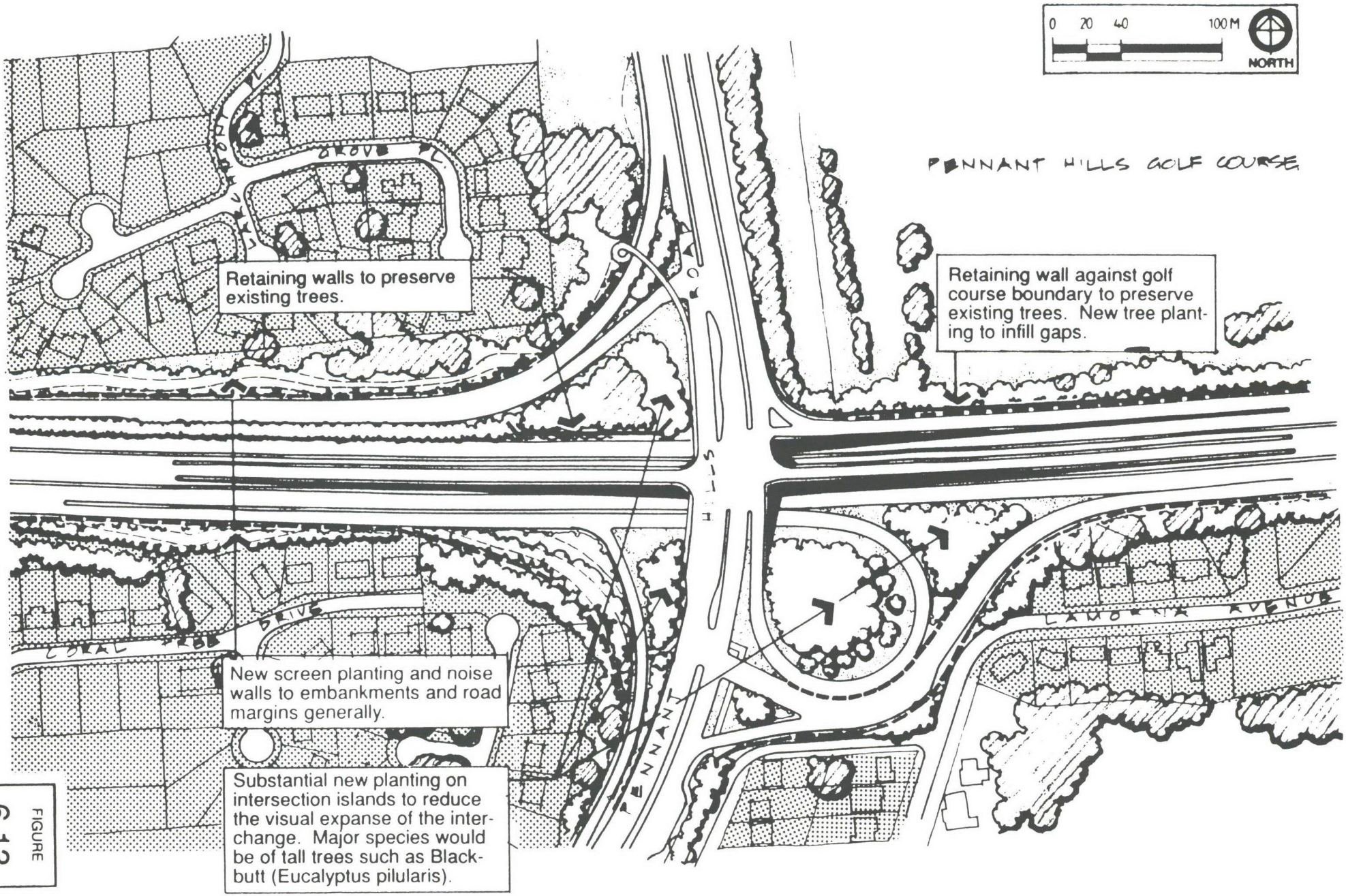
SECTION 12
EXPRESSWAY IN THE RESERVATION

FIGURE
6.12



Pennant Hills Road Intersection
LANDSCAPE PROPOSAL

FIGURE 6.13

6.3 SEVERE IMPACTS

6.3.1 Expressway in the Reservation (Generally)

The more severe impacts of the expressway in the reservation would be :

- The destruction and division of natural environment within the valley system just west of Mahers Road, including natural qualities of uncommon distinction (the north slopes of the creek to the west of Mahers Road).

- The interference with houses and other property outside the reservation on the south side of Mahers Road and at intersection zones - Old Windsor Road, Windsor Road and Pennant Hills Road.

- The destruction of most of the *Eucalyptus saligna* (Sydney Blue Gum) stand bordering Mahers Road – this stand being less than natural as a species association because of its weed-dominated understorey, but rare in Sydney as an example of the particular canopy species in terms of numbers and maturity.

- The loss of sportsfields located across and along the reservation on the north-east boundary of Baulkham Hills Public School.

- Exposure of high wall effects where noise walls or noise walls combined with retaining walls would occur in close proximity to otherwise unaffected properties. These situations, typically involving intersection ramps and connections and possibly service access roads, would arise in locations where little or no space could be provided for plant screening. The potential harshness of the view to the walls would be increased by the contrast which would be brought about by the marked change from accustomed existing conditions.

6.3.2 Recommended Alignment Option (Muirfield High School to Oakes Road)

Option C would be favoured amongst the four alignment options described because of its reduced interference with the better bushland qualities and the relatively low number of houses affected by it in comparison with Option D which would largely avoid the main bushland impacts but at the cost of a much larger number of houses being affected.

Options A and B would be very destructive of the better bushland qualities while also affecting severely the houses along Mahers Road, either by actual demolition or in the event of their retention, by presenting an untenable prospect of the expressway at close hand.

From the viewpoint of visual impacts and landscape conservation, the contemplated future connection to Merelynne Avenue, which might have favoured OptionA, should be abandoned entirely.

6.4 LESSER IMPACTS

Division : Built Environment

- The undesirable division of built environment by the expressway would be modified by the fact that the designated reservation preceded the development of much new residential land west of Windsor Road. The open grassed corridor of the reservation signifies the pre-established division. Some older residential and commercial stock would be demolished or severely divided around the intersection of Windsor and Junction Roads.

- East of Windsor Road, playing fields and the Darling Mills valley formation have already created implied boundaries alongside urban development on either side of the valley.

- Casual and random crossings of the reservation by pedestrians and local vehicles where they can now occur, would be largely curtailed and focused upon designated underpasses and overpasses.

Division : Between Natural and Built Environments

- Significant natural environment is represented by the Darling Mills Creek system and the expressway, to a large extent, would follow an edgeline between the bushland open space system and private property. Access to the open space would be restricted to crossings and under-passes provided. (The proposed high bridge structure would provide a suitable crossing of the main valley profile without undue impact on conditions in the valley proper.)

Loss of Views : Changed Outlook

- Between Old Windsor and Windsor Roads, views of consequence in relation to the expressway proposal, would be those from properties immediately adjacent to the reservation. Because of the flat to moderately undulating land, viewpoints generally would not occur beyond the first line of houses. Some exceptions may occur, but these, at greater distances from the corridor, would not represent particularly sensitive situations.

- At the edges, existing views are typically of a vacant corridor with other built edges lying in the distance. The outlooks are relatively featureless but in their simplicity are attractive. In a few cases, substantial trees are near at hand or otherwise well in the background (e.g. the narrow treed corridor of Toongabbie Creek or the vegetation of distant gardens) but most of the vegetative character of the reservation is one of grass. The changed outlook after construction would be mainly an abrupt shortening of the existing views. In most cases the new view would be of planted edges of the reservation with noise walls either wholly or partly screened by planting. In some situations the roadway would be in excavation and the view would be to plant screening and less prominent noise walls.

- At Windsor Road the expressway would pass under in deep excavation. However, the resulting corridor of demolition and the interconnecting ramps would create completely new edgelines and residual spaces which could lead to new development and possibly new land-uses.

- Between Windsor Road and Darling Mills Creek, houses on the south side of the expressway would be elevated over the expressway and views towards the valley of Darling Mills Creek would include the road carriageways and noise walls in the foreground. Dense screen planting would be established between houses and the roadway on residual land left after construction. Towards the valley, the bridge approaches would be retained by edge walls and noise walls would be constructed on top of them. Plant screening would partly obscure or soften the outlook onto the expressway edge.

- The expressway corridor is mostly treed with native species from the valley edge of Darling Mills Creek on the eastern side, through to Muirfield High School. Residential edges would look onto the expressway's noise walls and where applicable, retaining walls, through spaced trees preserved outside the construction edges. This would represent a significant change from existing circumstances. Across the shallow valley form in the vicinity of Hepburn Road, houses on the south side would look onto the new road on a high fill construction which would be screened in time by new planting.

- East of Muirfield High School the expressway formation would be clearly on view from houses on Yale Close and it would partly obscure the view into and across the valley.

- From higher viewpoints around the edges of bushland through to Mahers Road, the path of the expressway would be overviewed to various degrees depending upon the alignment option adopted.

- Recreationists using the bushland open space system would be affected by the expressway crossing the valley between Muirfield High School and Mahers Road because in this part of the open space reserve, the expressway construction would be visible from most surrounding viewpoints and would restrict pedestrian movement to a small bridge location.

- Outlook qualities in regard to houses on Mahers Road and Westmore Drive west of Oakes Road would be subject to the variations which have been previously discussed under 'Alignment Options (Expressway)' Section 6.2. If the expressway is constructed within the reservation and replaces the stand of Blue Gums, the outlook from Westmore Drive and Mahers Road would be severely changed. If the expressway was moved south to preserve the Blue Gums, views from Westmore Drive would be only slightly affected. Views from the rear of houses on Carmen Drive would be towards new screen planting (on residual margins after demolition) with the Blue Gums to be observed in the background.

- Between Oakes Road and Pennant Hills Road the development of the proposed interchange zone would have similar impacts to those described for Windsor Road. The substantial levels changes between Oakes Road and Pennant Hills Road would create long sweeping ramp constructions which in turn would have severe effects on some existing properties. Houses remaining beyond the edges of construction would look onto heavy planting margins which would in time form new skyline views in most cases.

7. ARTERIAL ROAD : EFFECTS AND PROPOSED LANDSCAPE TREATMENT

7.1 GENERALLY

The design form illustrated in this report (see A Typical Cross-section Figures 7.1–7.2) represents the option which would provide an appropriate arterial road alternative to the proposed expressway in the reservation, in terms of traffic handling capacity.

The option necessarily constitutes a broad corridor to accommodate six lanes of traffic, two public transport lanes and shoulder widths for bicycle lanes and breakdown provisions. A wide median designed to provide for turning and queuing lanes at intersections, adds further width to the overall cross-section. Therefore, without any additional width for planting within the road corridor, the width of this option mid-block is in the order of 36 metres. The addition of noise walls, and the margins required on most edgelines to take up differences in levels, would add more width. In these circumstances, space for screen planting and earth mounding can only occur on residual margins which may result from the partial demolition of existing properties required for road construction.

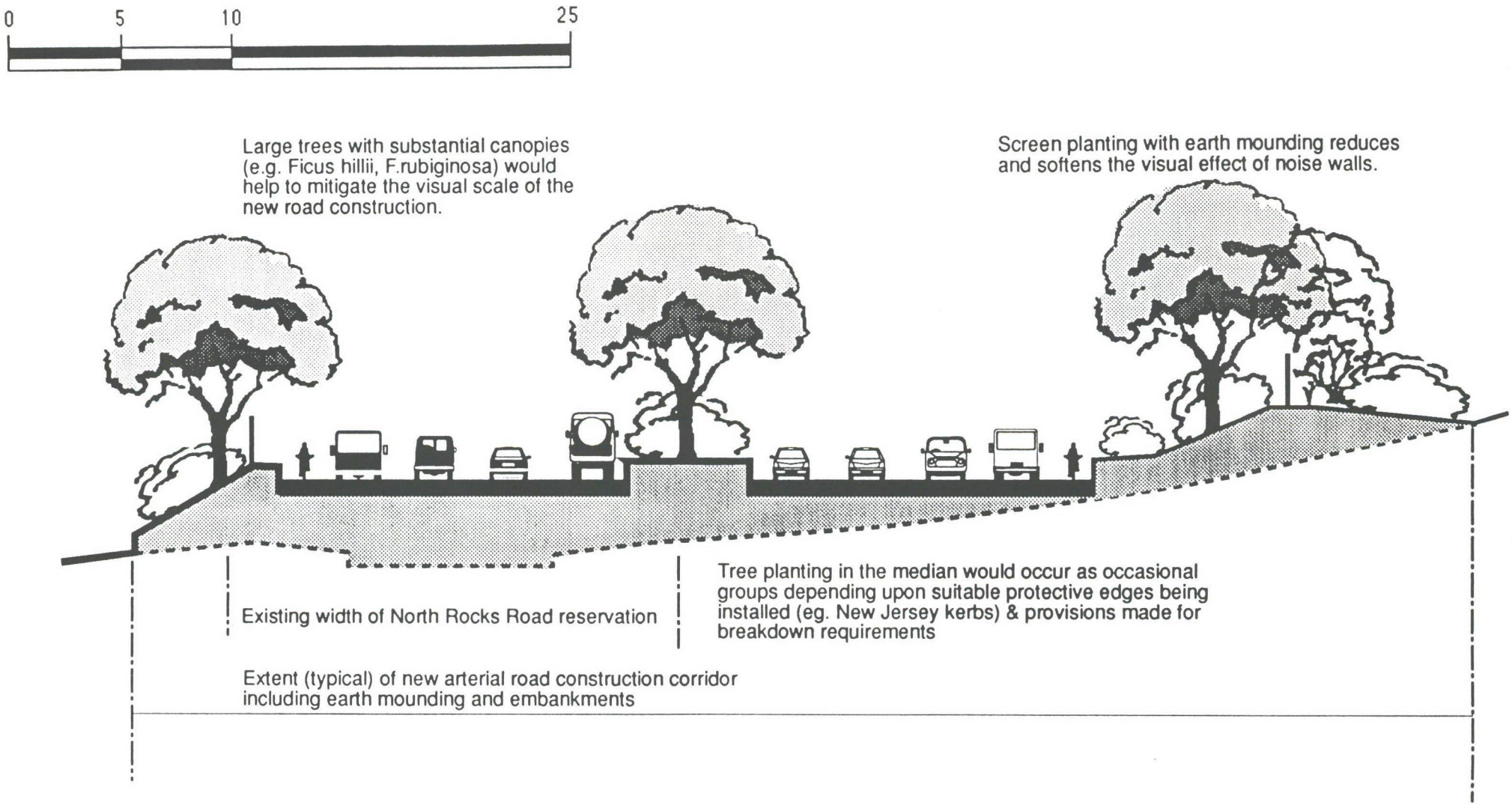
The magnitude of the arterial road option, as described above, would make necessary along most of its route, the acquisition of at least one line of existing properties on one side or the other. In some places, properties on both sides would be affected. At intersection zones, the pattern of connecting lanes, even though the intersections would be established generally on existing grades, would encroach upon additional properties.

Similar to an expressway development, the arterial road of more or less equal capacity, would carry heavy traffic loads, including large commercial vehicles; noise levels would be such that noise abatement measures would have to be taken to meet the standards required. These measures in the forms of walls and earth mounding can be typically 3.5 to 5.0 metres high and sometimes higher. Where land space for earth mounding and screen planting is not available, noise walls would be exposed and be visually dominating

In these cases, minimal planting would sometimes be possible to soften the effects of walls rather than to screen them. In some situations architectural design treatment of the wall surfaces may be appropriate to help to integrate them into the local environment. This treatment can include colour and texture or pattern effects, and in some instances, transparent panelling. Urban art may also be considered.

Noise walls to be effective need to be constructed in unbroken lines so that, in combination with heavy traffic streams, they would forbid random crossing of the arterial road by pedestrians.

Crossing points would occur at traffic light controlled intersections. These intersections, typically, would be of some magnitude so that crossings by pedestrians would be subject to delays, and delay time would be spent in noisy circumstances alien to pedestrians in suburban environments.



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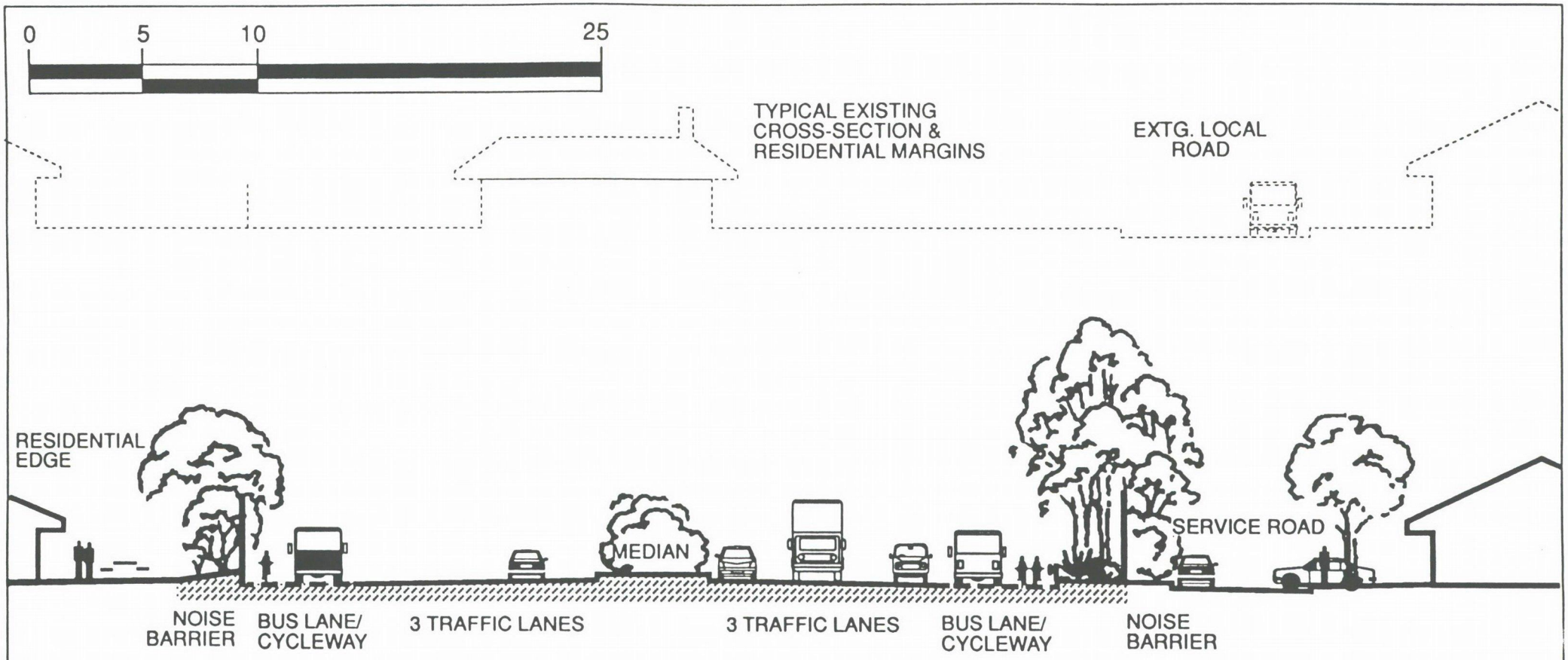
ARTERIAL ROAD (INCL BUS LANES) : A TYPICAL CROSS-SECTION NORTH ROCKS ROAD

FIGURE 7.1



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A TYPICAL CROSS-SECTION
ARTERIAL ROAD PROPOSAL

FIGURE
7.2

Regardless of the measures that might be taken to soften the impact of the arterial road, to reduce its apparent scale and to green its corridor, the new road would be a divisive element in the community and would constitute a new common boundary to community development which would be split into separate components.

7.1.1 Outlook Factors: Planting Time Spans

At the immediate edge margins of the finished arterial, the outlook towards the road from remaining properties would vary in quality. In the best cases the new view would be towards heavy planting on residual margins, which would provide a visually pleasing buffer, possibly equal to or better than the view which might have previously been obtained.

In the poorest cases, the new views could be towards high walls perhaps with an intervening strip of roadway functioning as a service road for access to properties.

The overview of the new road corridor could, in time, be enhanced by the development of large trees located in the median, in traffic islands and on the road edges, in a fairly continuous corridor of vegetated effect.

Time spans involved for the development of plantings, as described above, to an initial stage of effectiveness, would be two to five years for screen planting and five to ten years for large tree planting. Development of plantings in these time periods would achieve heights and bulk capable of equalling those of noise walls and become visible as canopies across the road corridor. Development of large tree canopies would begin to take effect within 15–25 years, depending upon species selected and growing conditions.

Tree planting of the road corridor to be effective requires opportunity to use the median space. This, in turn, requires certain design measures to be taken which allow tree planting while providing for safety and vehicle breakdown requirements.

Given that the arterial road construction would follow existing grades, views from houses one line or more removed from the road edge would remain much the same. Oblique views from these positions may observe the new larger road where it climbs a slope on the opposite side of a dip in the topography. However, these views would be modified by distance and at a later date, with new planting matured, the long views could be pleasing.

7.2 RESERVATION/NORTH ROCKS ROAD

This arterial road option would follow an alignment from Old Windsor Road along the F2 Expressway to Perry Street and then on a section of Barclay Road to North Rocks and Pennant Hills Roads to turn south to connect with Carlingford Road.

These notes should be read in conjunction with cross-section diagrams (Nos. 1 to 5) which describe construction formations and mitigative effects. Approximate locations of cross-section diagrams are shown on Landuse Maps 1/4 to 4/4 (Figures 3.11 to 3.14).

7.2.1 Representative Cross-sections

The cross-sections (Figures 7.3–7.8) illustrate the typical situations which would arise along Barclay/North Rocks Road in the event of a major arterial road being developed. The locations have been selected to demonstrate representative effects and not necessarily the fine detail of any precise line. The implications conveyed by the cross-sections are intended to be realistic and while more cross-sections could be developed, the end result in these terms would be much the same.

Similarly, the effects illustrated in these cross-sections would be representative of cross-sections taken through a new road of equal magnitude located on other existing suburban roads such Seven Hills and Murray Farm Roads.

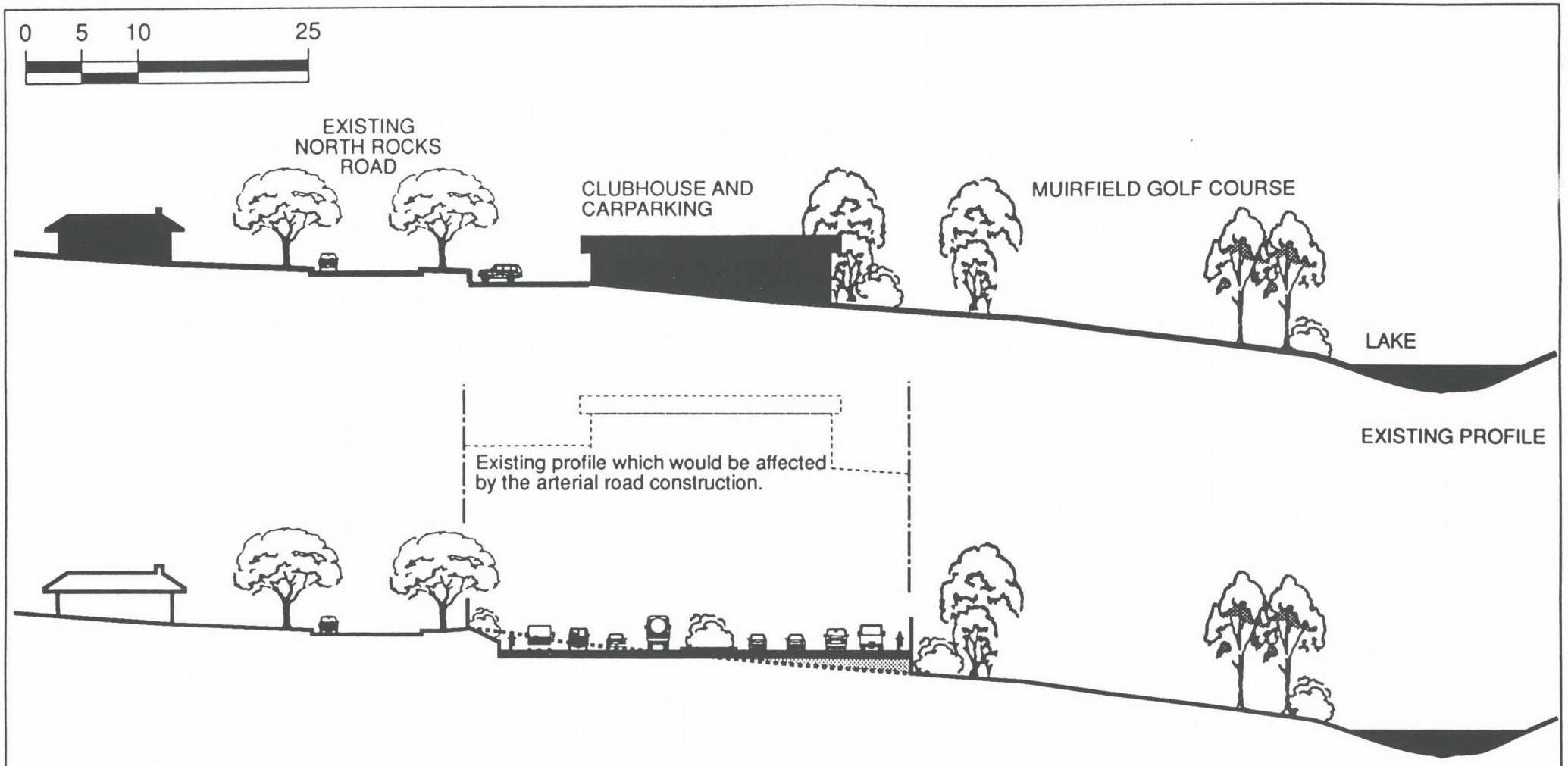
Reductions in scale would lead to reduced road widths, but where noise abatement and visual screening requirements would still apply, similar effects and mitigative treatments as those illustrated would also be required.

7.2.2 Section 1 – Fig 7.3

In this section across Barclay Road and the Muirfield Golf Course the new road would go through the site of the clubhouse building and its carpark leaving Barclay Road as a service road to properties on its north side. Visual screening on the north side would be limited as a consequence, but on the golf course edge, dense screening could be established with planting. Added tree planting would blend the road margin with the character of the golf course environment.

7.2.3 Section 2 – Fig 7.4

The new road at this point in the vicinity of Baden Powell Place would have its north edge aligned with the north edge of existing North Rocks Road causing the loss of houses on the southern margin. A group of tall native trees would be retained between Baden Powell Place and North Rocks Road. Earth mounding and screen planting would be applied to the southern margin between the road edge and the rear boundary of the next line of houses. The combination of mounding and planting would establish a reasonably pleasing outlook from housing in the vicinity of Peterson Place.



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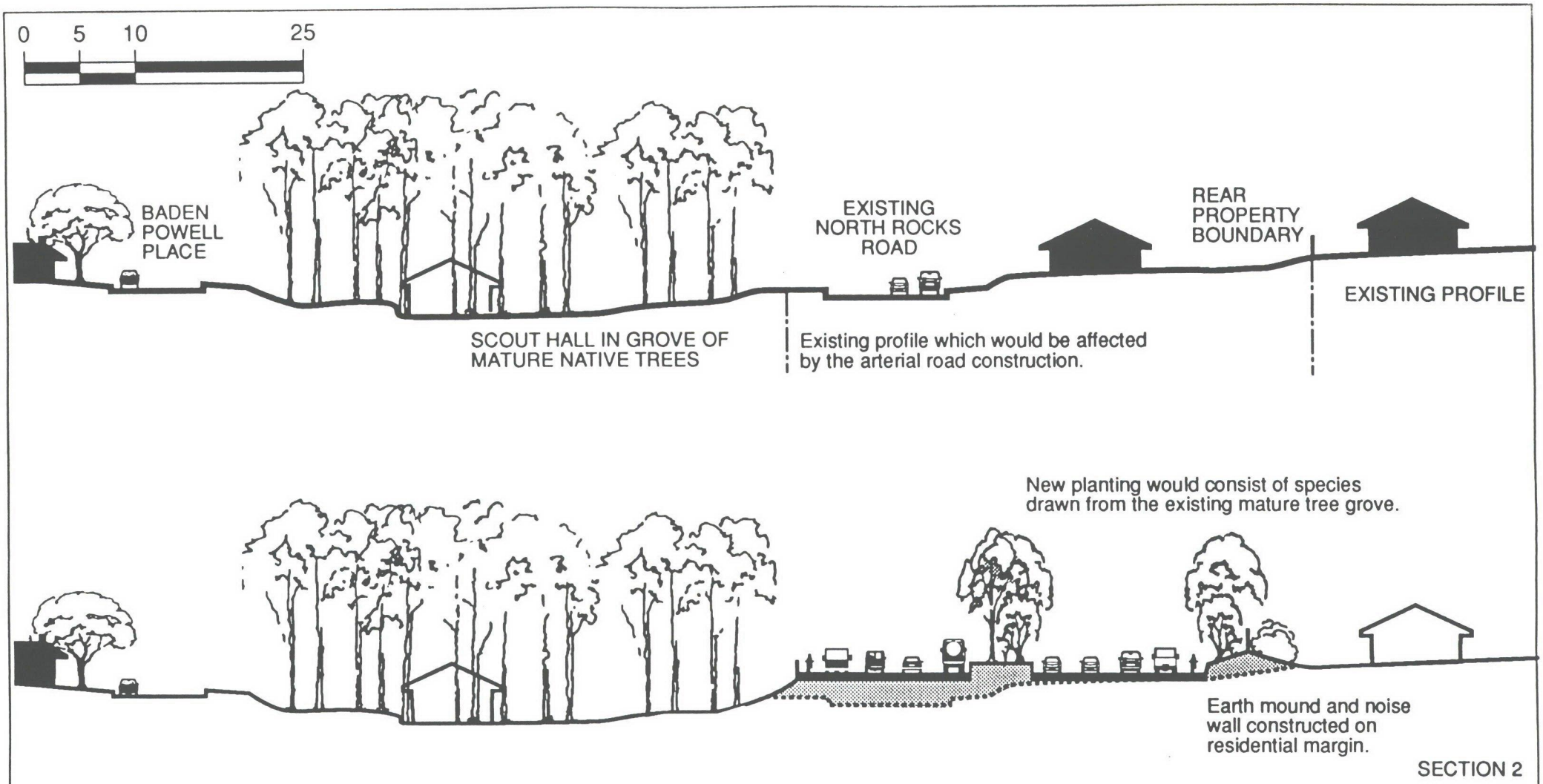
ARTERIAL ROAD (INCL BUS LANES) : A TYPICAL CROSS-SECTION NORTH ROCKS ROAD

FIGURE 7.3



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ARTERIAL ROAD (INCL BUS LANES) : A TYPICAL CROSS-SECTION NORTH ROCKS ROAD

FIGURE 7.4

7.2.4 Section 3 – Fig 7.5

At the Royal Deaf and Blind Institute the road formation would be established close to the excavated edge of the shopping centre site on the south side. Even so, an encroachment of around 15 metres would be made onto the Institute site.

Planting opportunities are very limited in this section and noise walls at the edges of the new road would be fully exposed.

7.2.5 Section 4 – Fig 7.6

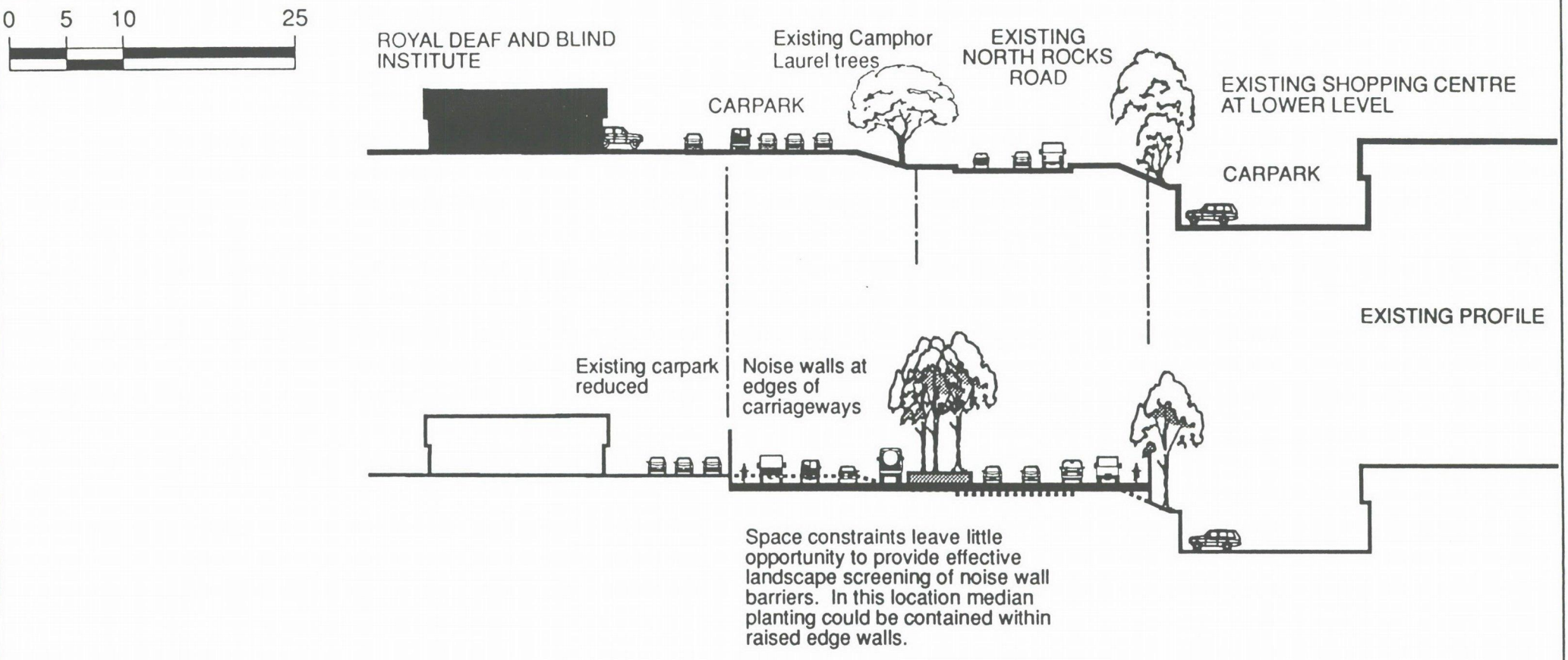
In the vicinity of North Rocks Park the new road would be located on the parkland and interfere with an existing sportsfield. North Rocks Road would remain as a service road of reduced width and large native trees alongside the road and in residential gardens would be retained.

Planting to the new roadway would be of the same native tree species as those existing alongside the road. Noise walls on each side would be largely exposed.

7.2.6 Section 5 – Fig 7.8

This profile indicates a section through North Rocks Road and Lochinvar Place near Pennant Hills Road. The comparative scale of the new arterial to existing roads is apparent. A planted embankment is shown on the low side on the limited margin available against the road edge. Any added width to the embankment would encroach upon property below the road. Existing houses fronting North Rocks Road on the high side would be lost and on the resulting residual margin a low mound and screen planting would be installed. The next property upslope would not be affected as views towards the road would be densely screened by planting.

Small scale but bulky planting would be applied to available surfaces within the road corridor. The more important planting would be of large trees, such as Ficus spp. which would develop broad canopies.



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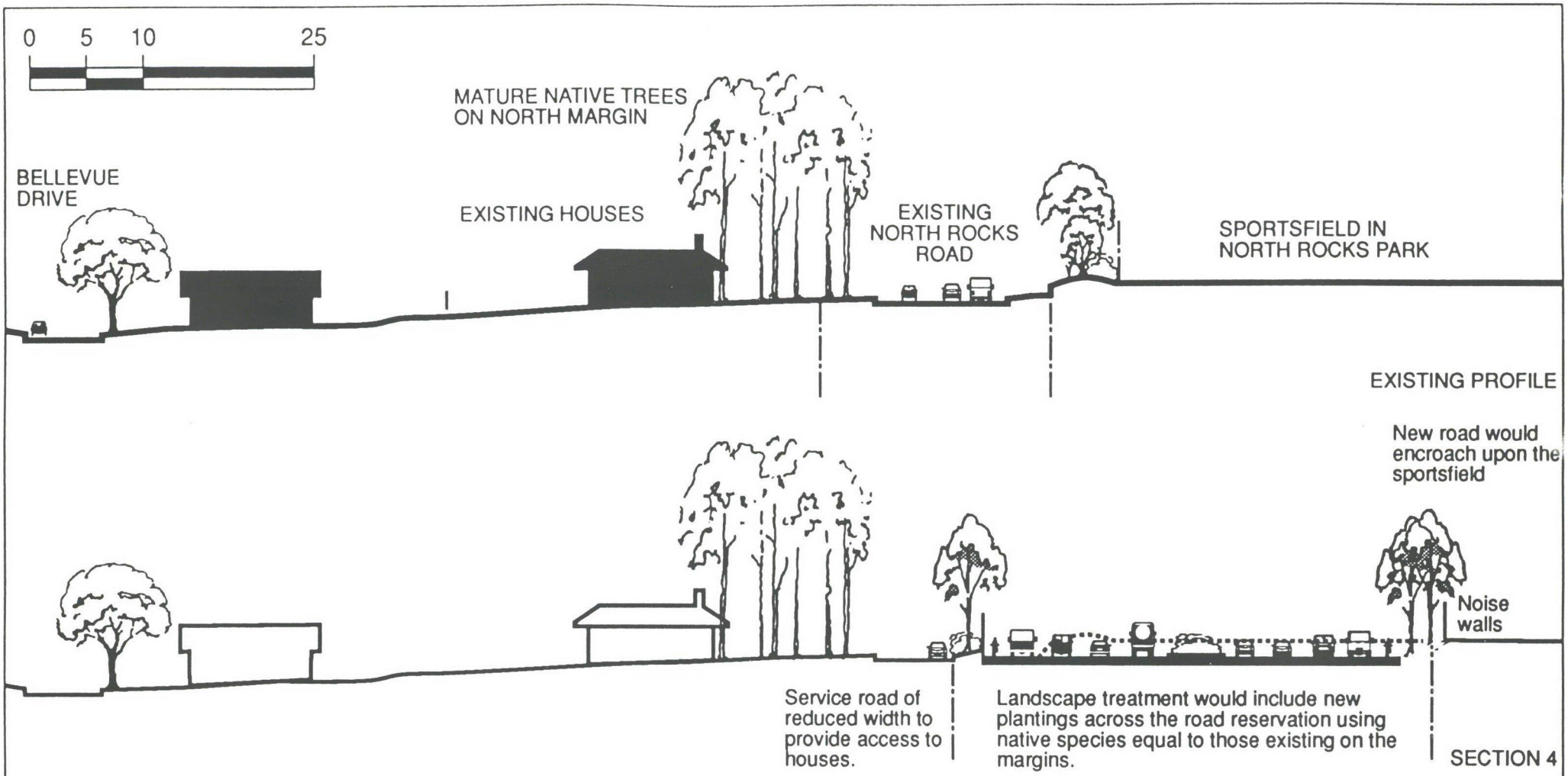
ARTERIAL ROAD (INCL BUS LANES) : A TYPICAL CROSS-SECTION NORTH ROCKS ROAD

FIGURE 7.5



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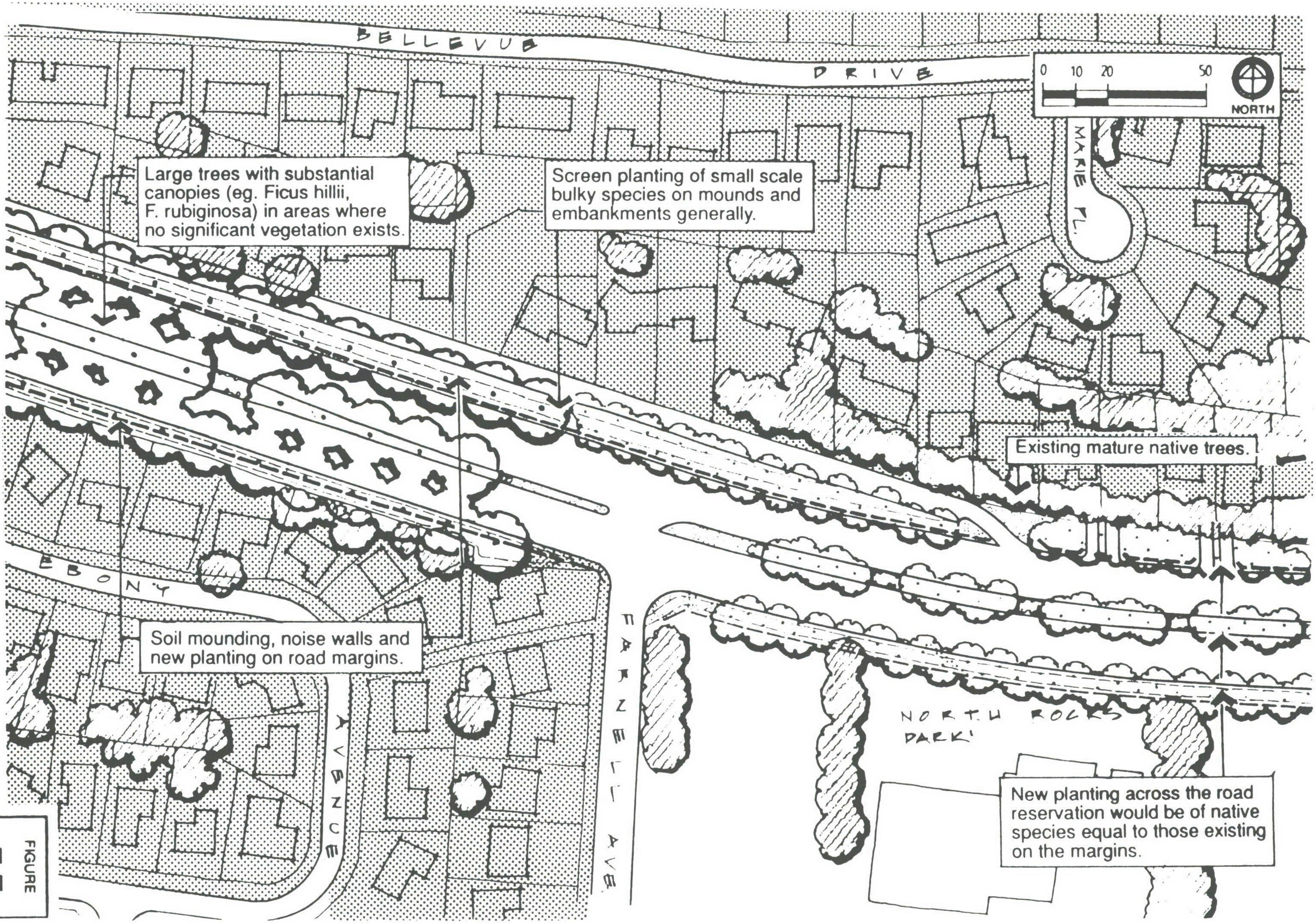
ARTERIAL ROAD (INCL BUS LANES) : A TYPICAL CROSS-SECTION NORTH ROCKS ROAD

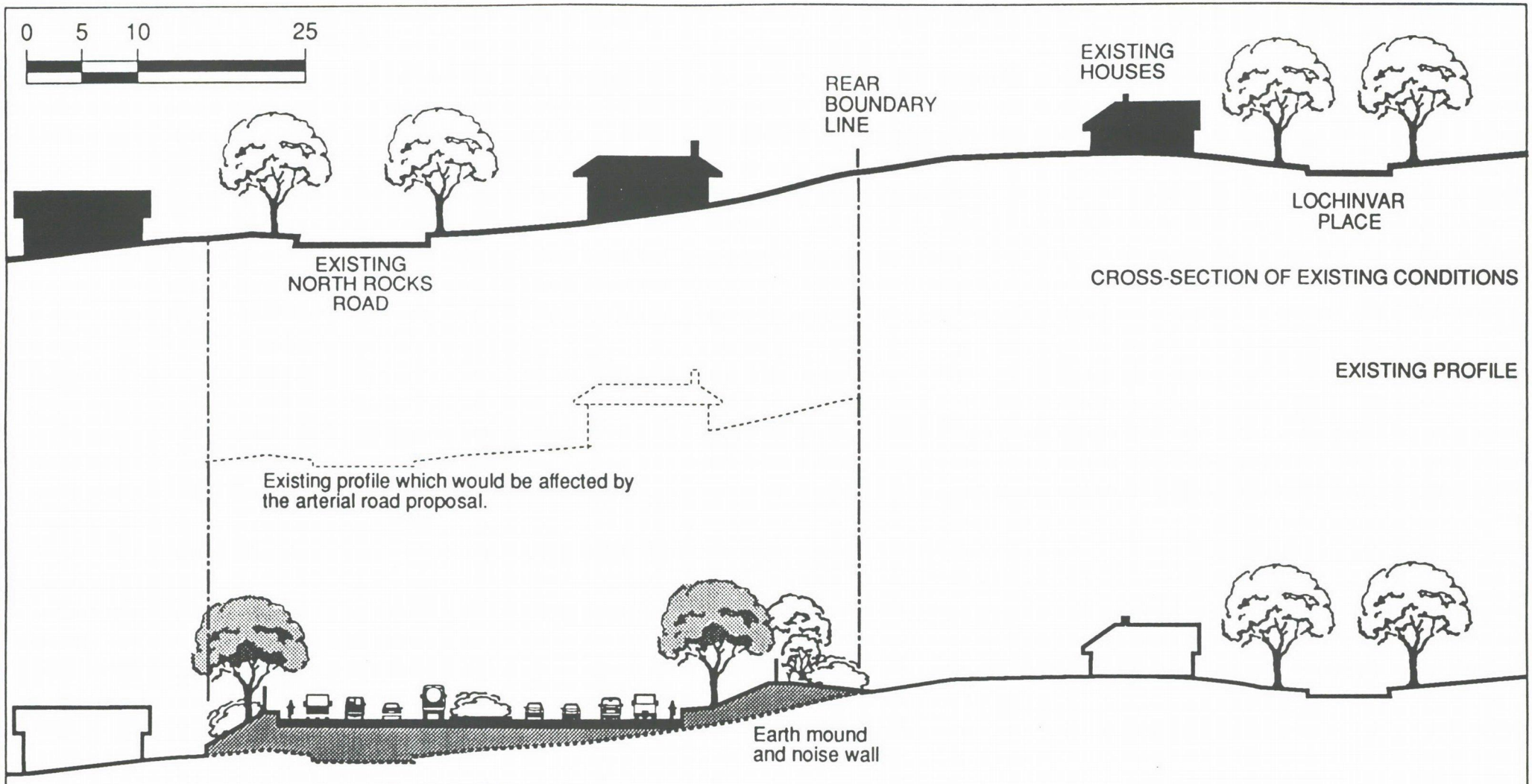
FIGURE 7.6



Arterial Road : Typical Plan – North Rocks Road

LANDSCAPE PROPOSAL

FIGURE 7.7



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ARTERIAL ROAD (INCL BUS LANES) : A TYPICALCROSS-SECTION NORTH ROCKS ROAD

FIGURE 7.8

7.3 MAIN IMPACTS

The main impacts of the arterial road option would be:

1. Extensive loss of property.
2. Serious division of the surrounding community.
3. Major restrictions to circulation of pedestrians and local vehicle movements across the corridor.
4. Changed outlook from many properties to views of poorer quality than those existing.

7.4 A FUTURE PROSPECT

Immediate impacts of the arterial road would be severe for the reasons described above. Some reduction of impact would result from development of planting effects and also as a result of the local community making adjustments to its own movement and living patterns, as in variations made to shopping, restaurant, sporting and recreational destinations.

A long term prospect could see a different situation develop which would modify to some extent the severe impacts initially incurred. This future possibility, of say 15 to 25 years duration, could include redevelopment of the margins of the road to establish more noise-tolerant or noise insulated property and landuse types; development which could take advantage of its close proximity to a major arterial and the corridor of public transport facilities. Refer to related discussion in Appendix A "Urban Design Considerations Adjacent to Transport Corridors".

8 LANDSCAPE : RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

8.1 LANDSCAPE

8.1.1 Generally

Resolution of the expressway's horizontal and vertical alignments would be determined so as to minimise impact wherever possible. Mitigative measures involving detail responses would be then applied in differing locations to screen and reduce visual impact. The arterial road alternative would be designed to fit existing grades as much as possible to reduce the need to adjust levels changes at the edges. Even so, because of the road width some edgelines may need to be retained within a low wall structure to avoid further encroachment onto property margins. Levels differences would otherwise be graded out and planted.

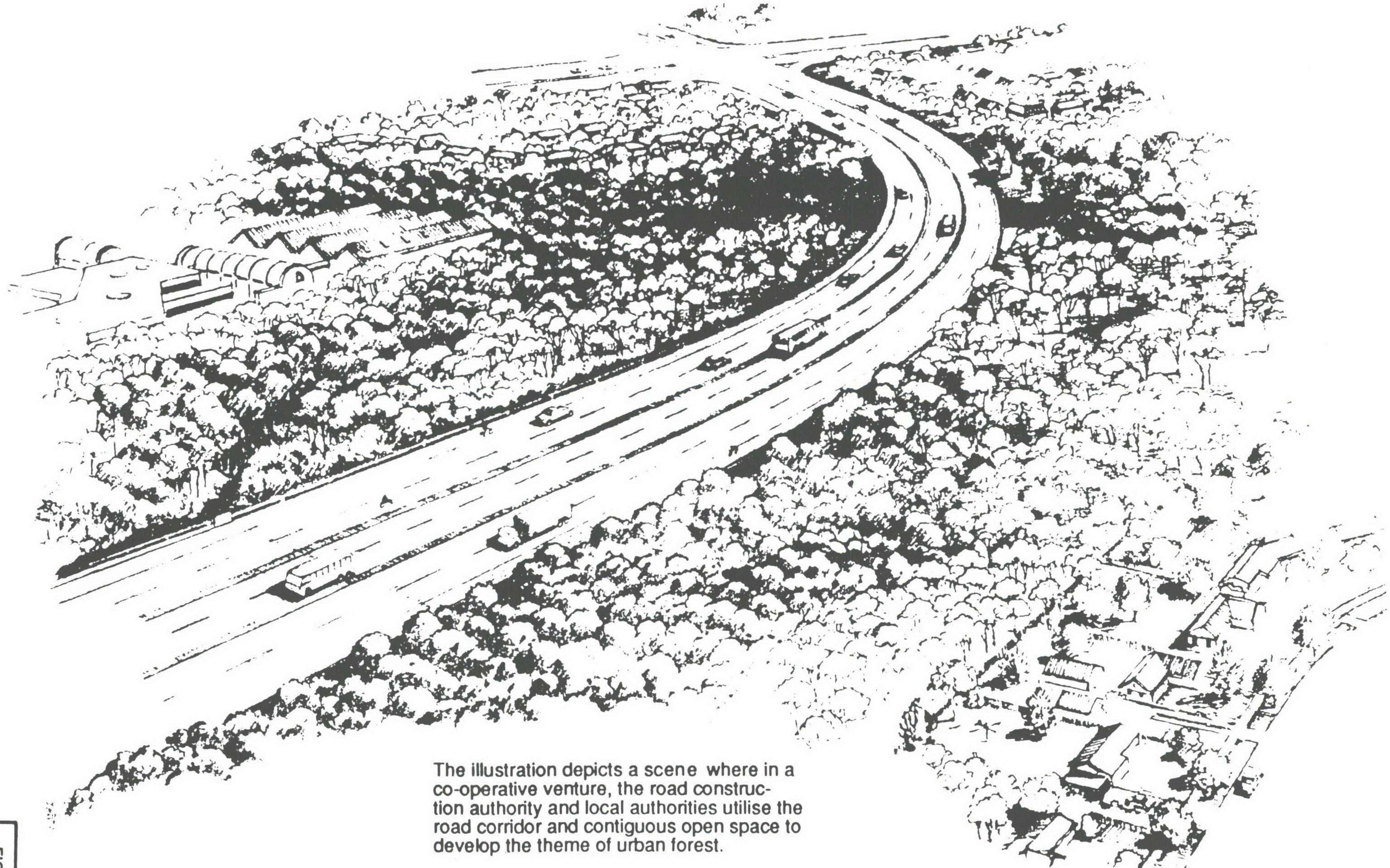
At a broader level of application, landscape treatment may include the development of a corridor theme which endeavours to achieve a substantial landscape impact, for example, along the lines of urban forestry or, in the case of an arterial road corridor, grand avenues of urban tree canopies. Similarly, as compensatory measures, networked circuits of cycleways can be developed to provide better and safer alternatives for the cycleway user. As much as possible, the divisive character of the large road formation should be modified by providing over and underpasses for the convenience of people and to reduce the feeling of constraint being imposed by an impassable barrier within residential circumstances.

8.1.2 Landscape Theme

A landscape theme appropriate to the expressway reservation corridor could include the concept of urban forestry using planting in generous proportions. Urban forestry as a theme idea envisages species composition relevant to once-natural surroundings; a scale of planting that would be largely consuming of available spaces to encourage visual linkages and develop biological corridors to provide meaningful new habitats for urban wildlife. It is a theme that is meant to be resourceful. The detail of an urban forest concept would be focused on long-lived plant materials, mostly trees, with robust characteristics and less those of decoration. Weeds can be allowed to grow in such a plantation if they are able, and fussy attention to detail maintenance would not necessarily be critical to its success.

8.1.3 Co-operative Ventures

The revegetation of the road construction corridor could become the catalyst for co-operative ventures where land contiguous to the road corridor would be included in a broader revegetative process. After decades of relentless clearing of urban bushland, it would seem to be a worthwhile investment and could include the participation of state and local government authorities as well as community organisations.



The illustration depicts a scene where in a co-operative venture, the road construction authority and local authorities utilise the road corridor and contiguous open space to develop the theme of urban forest.

FIGURE 8.1

AN URBAN FOREST

8.1.4 Screening

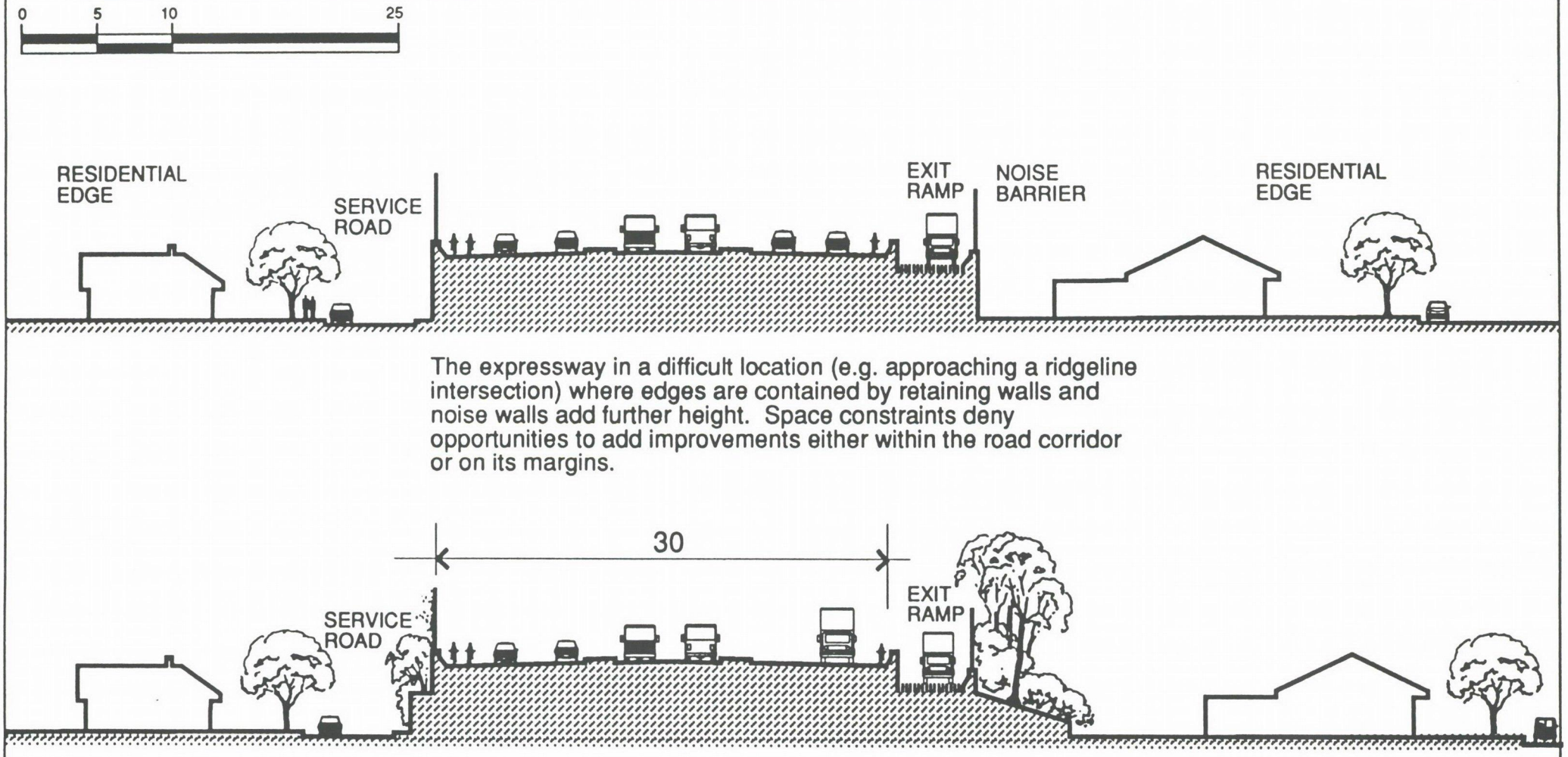
The basic aims of designing to reduce the impact of the built roadway are to visually screen it entirely where possible and otherwise to whatever extent would be practicable; to reduce the apparent scale of its structures, especially its noise wall barriers; to add landscape elements where possible (such as earth mound profiling) to assist the process of reducing noise impact and to obscure or reduce views to the traffic streams. Earth mounding, where space permits, can be constructed so that noise abatement would be achieved without the use of walls. Other situations can occur where earth mounding is formed in conjunction with noise walls so that in combination they would provide noise reduction while reducing the wall heights. (Refer to cross-section diagrams in Sections 6 and 7.)

Where possible, landscape finishes would endeavour to provide a sense of containment of the built environment rather than that of the road corridor. However, space constraints would inhibit this prospect in many situations and the introduced landscape character to a large extent would have a corridor orientation aligned to that of the road.

SCREEN PLANTING

FIGURE 8.2

Where space allows, planting can reduce the impact or screen completely the view of noise walls at the road edge



The expressway in a difficult location (e.g. approaching a ridgeline intersection) where edges are contained by retaining walls and noise walls add further height. Space constraints deny opportunities to add improvements either within the road corridor or on its margins.

In this illustration some space has been obtained for planting improvements

EXAMPLES OF LANDSCAPE TREATMENT ON THE MARGINS WHERE SPACE ALLOWS.

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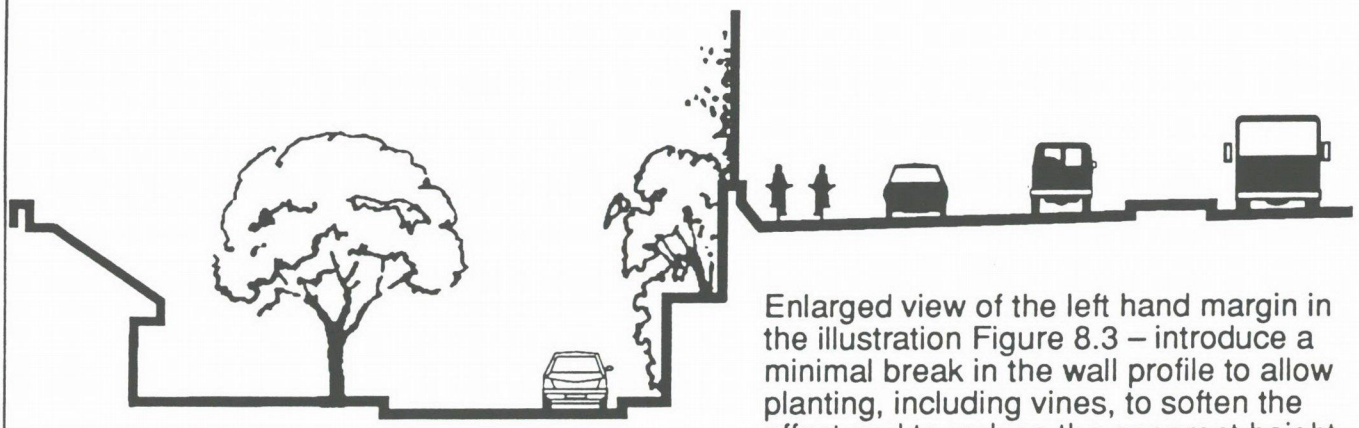
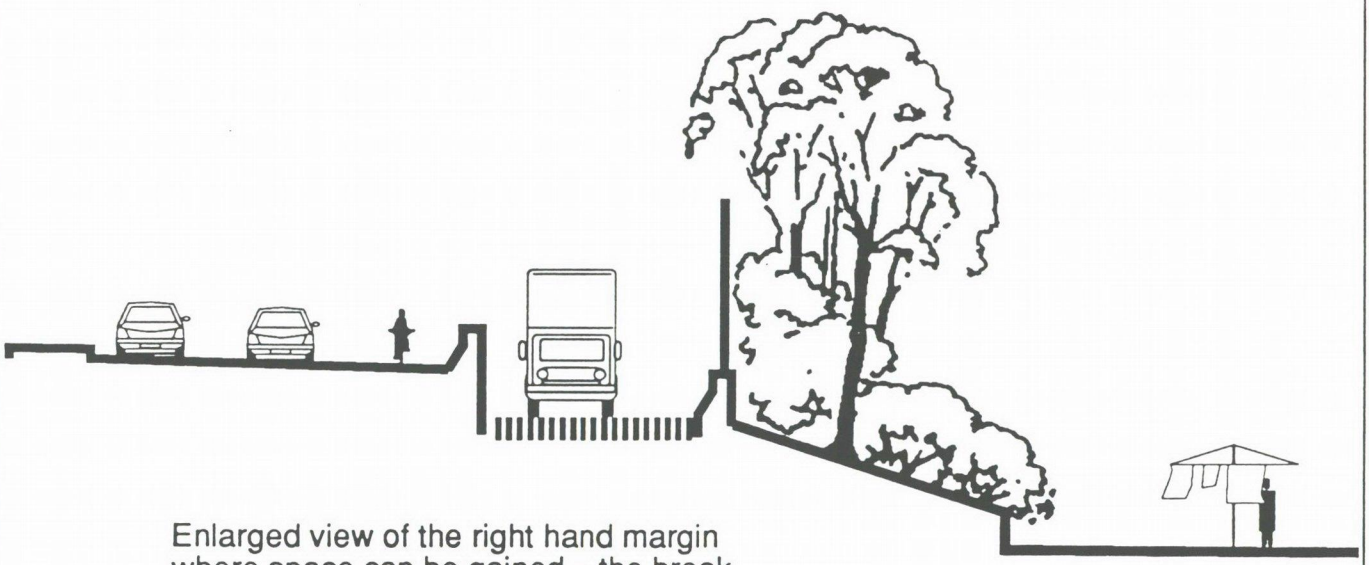
TYPICAL CROSS-SECTION EXAMPLES ARTERIAL ROAD PROPOSAL

FIGURE 8.3



Enlarged view of the left hand margin in the illustration Figure 8.3 – introduce a minimal break in the wall profile to allow planting, including vines, to soften the effect and to reduce the apparent height of the walls.



Enlarged view of the right hand margin where space can be gained – the break in the wall is expanded to allow more substantial planting to provide an effective screen - in this case against the rear garden of a house lot.

TYPICAL CROSS-SECTION EXAMPLES
EXPRESSWAY PROPOSAL

FIGURE
8.4

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8.1.5 Retention of Existing Treed Margins

In bushland and other treed areas, the road edges would be carefully contained so that existing trees would be preserved close to the new construction. Similarly, edges would be contained and construction methods arranged so that spill from earthworks would not encroach upon bushland slopes. Road construction in these situations would be undertaken largely within the carriageway zone so that interference with edgelines of bushland would be made minimal.

In bushland areas reinstatement of edges after construction would be carefully established. Replanting where required would be completely harmonious with the localised plant communities and plant propagation for reinstatement work would be carried out using seed from parent plant material located on site. Mulching would be provided using brushchip material obtained from essential clearing operations carried out on site in preparation for construction.

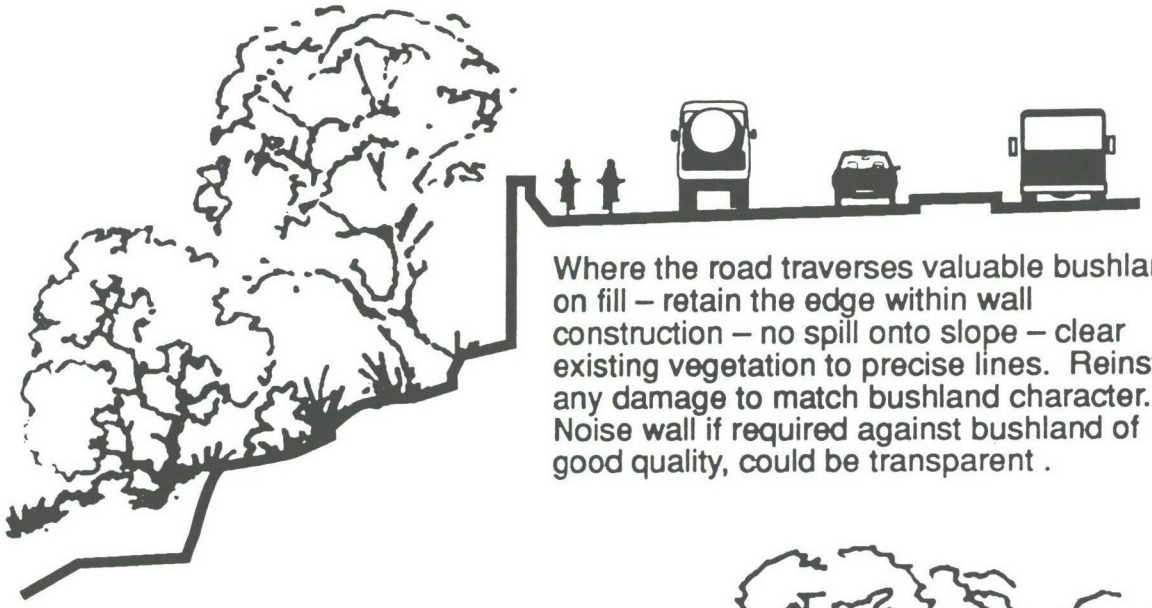
Clearing operations through bushland prior to construction would be done with precision as a first step in ensuring retention of trees close to the edges of the works.

In built-up areas similar measures would be employed to preserve existing trees on adjoining margins and in some cases, valuable trees within existing gardens. But because of space constraints that will often apply in built-up areas, planting and screening treatment may be reduced to narrow margins at the road edge. Even where demolition of existing property would take place, service road requirements to the remaining residential edges could create these situations of narrow margins at the road edge.

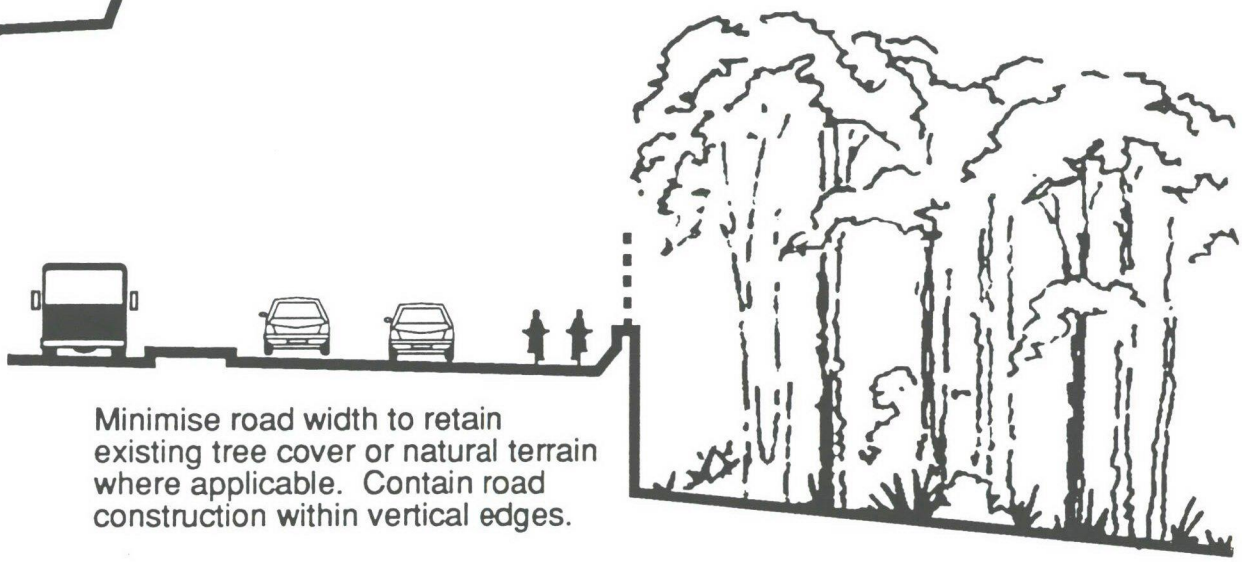
The illustration, Figure 8.6, shows how the initial impact and disruption that would be caused by the large arterial road, could in time be redressed in part by effective planting. The sketch proposes large trees arranged in extensive avenues. The planting scheme would persist along the corridor and be disciplined by a cohesive design pattern. Large trees with broad heavy canopies would help to reduce the apparent scale of the roadway and, forming their own greened corridor, would contribute to the urban circumstances of the future.

8.1.6 Planted Embankments

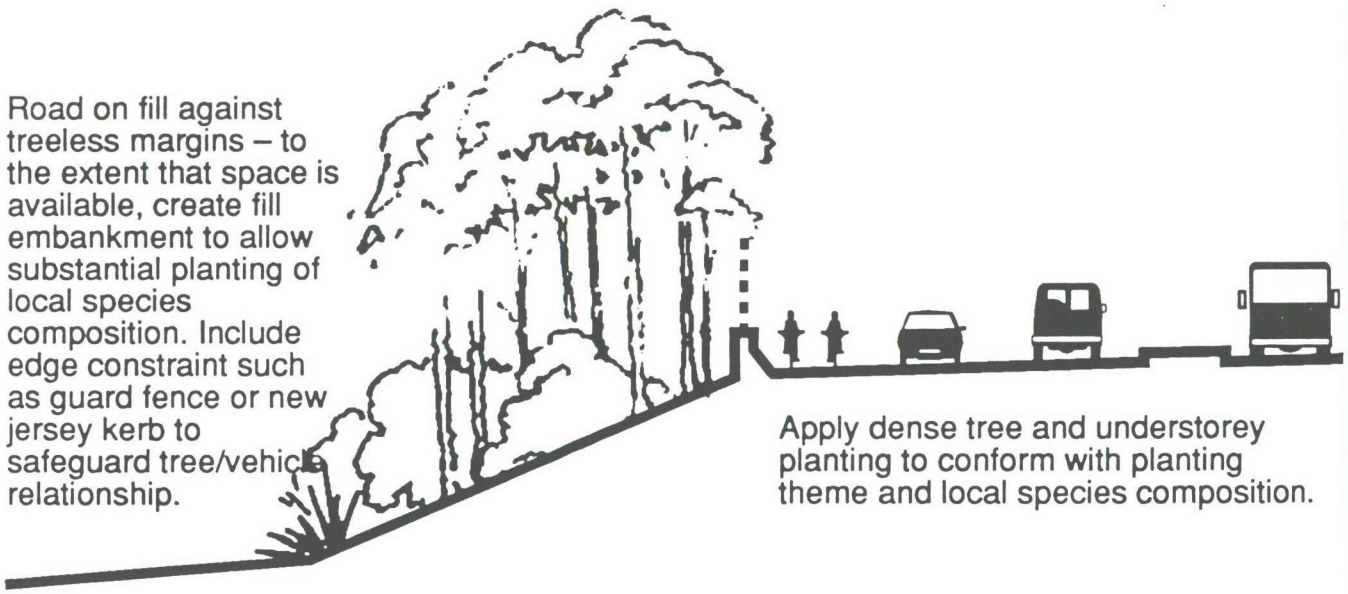
Where existing margins to proposed construction do not feature valuable vegetation, fill or cut embankments would be formed to grades suitable for new planting. The extent of grading for subsequent planting would be dependent upon the availability of residual space and this factor would be variable according to situation. Planting however, where possible, would be installed as a dense ground covering application to provide visual screening and to reduce future maintenance requirements.



Where the road traverses valuable bushland on fill – retain the edge within wall construction – no spill onto slope – clear existing vegetation to precise lines. Reinstate any damage to match bushland character. Noise wall if required against bushland of good quality, could be transparent .



Minimise road width to retain existing tree cover or natural terrain where applicable. Contain road construction within vertical edges.



Road on fill against treeless margins – to the extent that space is available, create fill embankment to allow substantial planting of local species composition. Include edge constraint such as guard fence or new jersey kerb to safeguard tree/vehicle relationship.

Apply dense tree and understorey planting to conform with planting theme and local species composition.

ROAD EDGE RETAINING WALLS & EMBANKMENT SITUATIONS

FIGURE 8.5

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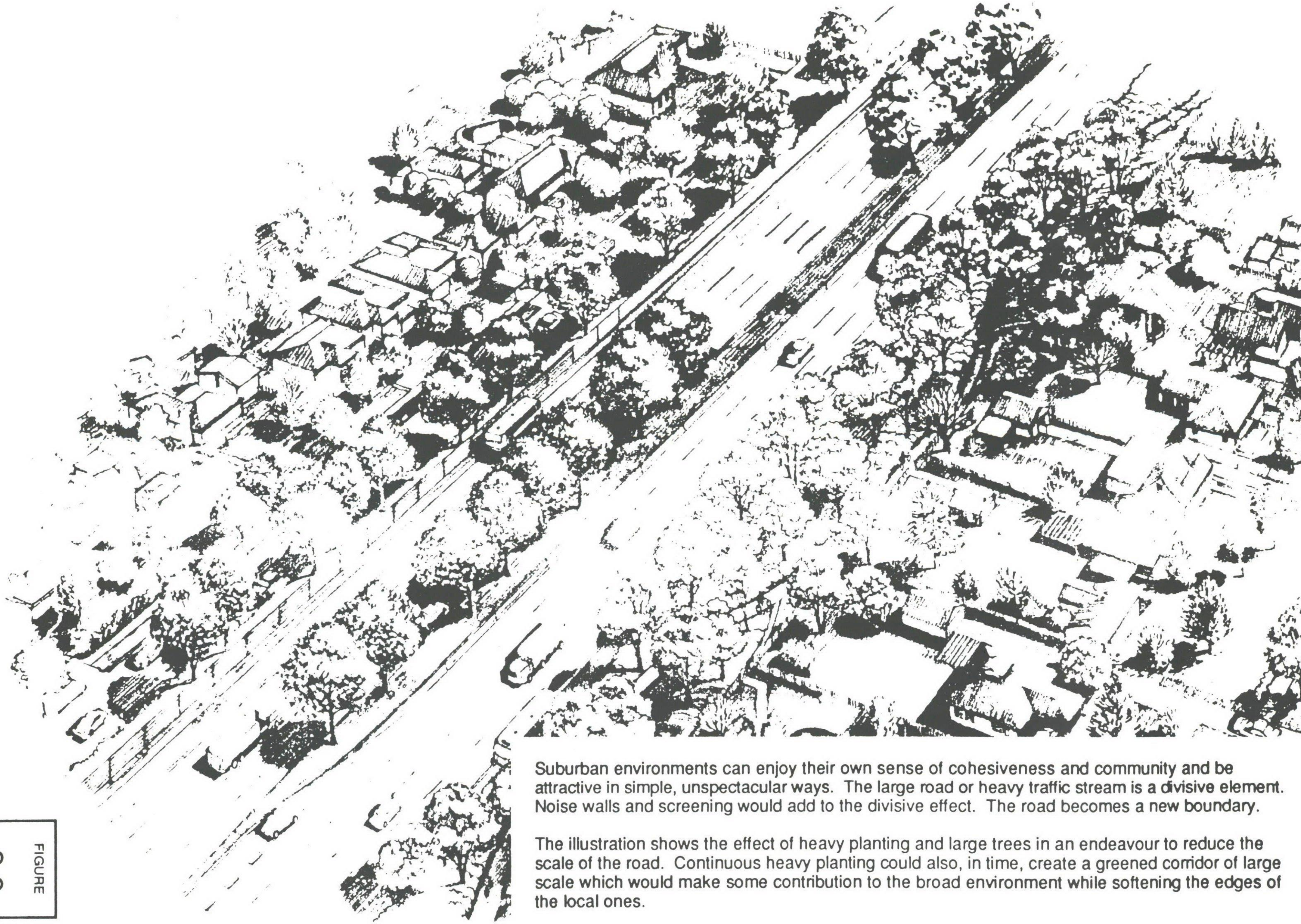


Suburban environments can enjoy their own sense of cohesiveness and community and be attractive in simple, unspectacular ways. The large road or heavy traffic stream is a divisive element. Noise walls and screening would add to the divisive effect. The road becomes a new boundary.

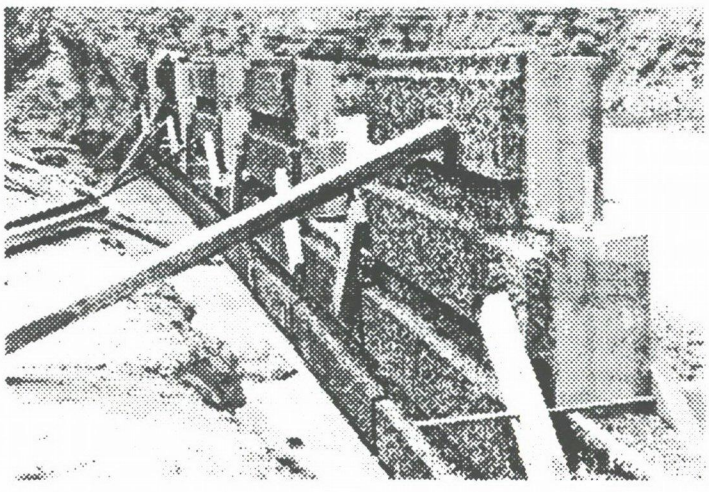
The illustration shows the effect of heavy planting and large trees in an endeavour to reduce the scale of the road. Continuous heavy planting could also, in time, create a greened corridor of large scale which would make some contribution to the broad environment while softening the edges of the local ones.

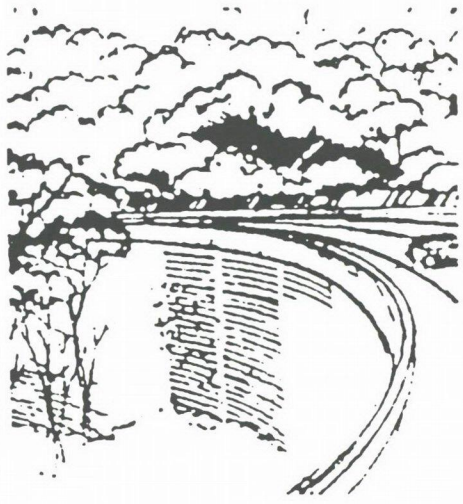
8.2 SUMMARY OF LANDSCAPE INTENTIONS

8.2.1 Preliminary Construction Procedures

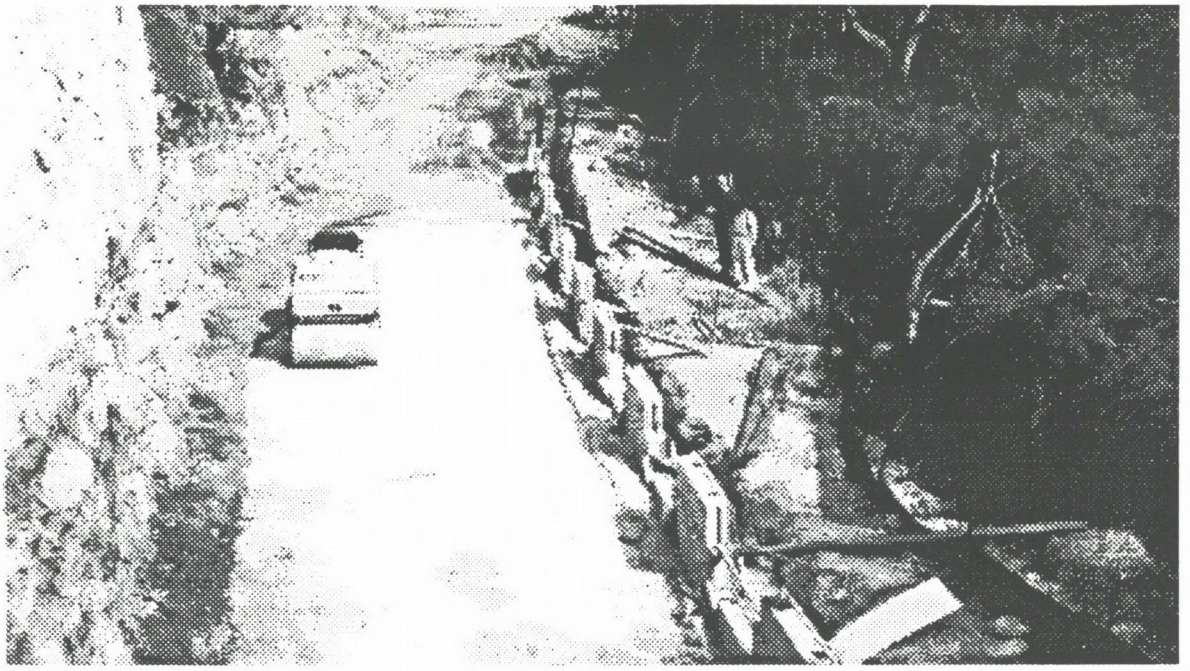
These recommendations form essential aspects of landscape design recommendations. They would apply to design documentation and to the actual construction process and refer to construction matters which can have a lasting or permanent impact on the landscape environment. The recommendations of these Sections, 8.2.1 and 8.2.2 are especially applicable to bushland and heavily vegetated areas. However in already built-up areas the principles still apply in terms of preservation of existing features and vegetation, and constraining construction to precise lines.

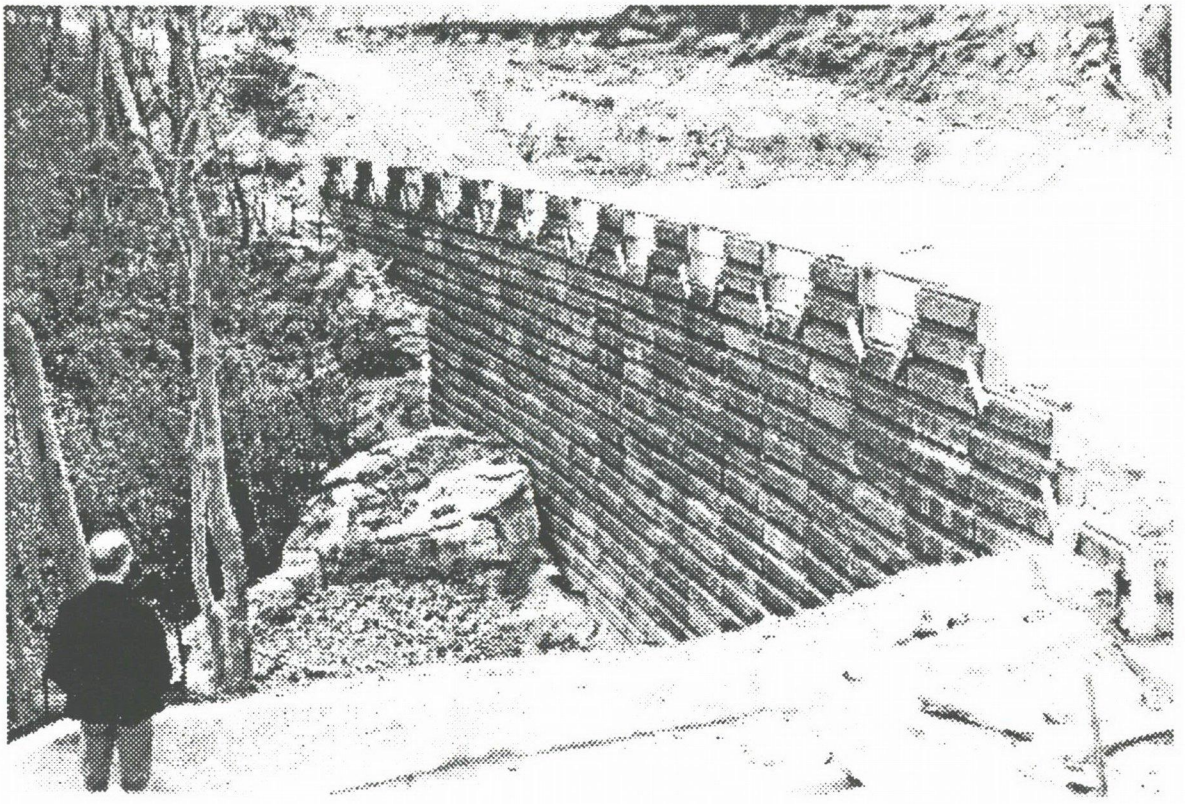
1. Establish the construction corridor on site within precise surveyed edge lines prior to clearing or other preparation work beginning.
2. Handfell trees and vegetation along and within construction lines.
3. Carry out construction, except for particular essential works (silt traps and drainage, erection of formwork, for examples), within the construction corridor, ie. as close as possible to the extent of actual lines of cut and fill.
4. Construct retaining walls prior to the placing of fill materials on downslope edgelines.
5. Arrange drilling of cut lines through rock from within the construction corridor and prior to excavation taking place.
6. Contain construction processes and where possible, construct fencing to define the precise limits of construction activity. Formal constraints in this regard should be built into the contractual obligations of all operatives to ensure control over unspecified spillage, damage to vegetation and landform, spread of debris and refuse, and storage and access for materials and equipment.
7. Prior to road and landscape design development proceeding, detail survey of landscape elements would be needed to establish locations and levels of relevant features, for example, existing mature trees and edgelines of good quality vegetation.





THESE DETAILS AND ILLUSTRATIONS OVERLEAF SHOW RETAINING WALLS IN BUSHLAND ESTABLISHED FIRST TO CONTAIN CONSTRUCTION SPILLS.





BOTH PHOTOGRAPHS DEMONSTRATE HOW A TIGHT EDGE AGAINST BUSHLAND CAN BE MAINTAINED EVEN WHEN MASSIVE CONSTRUCTION PROCEDURES ARE NECESSARY. THE LOWER PHOTOGRAPH ILLUSTRATES A RECOMMENDED CHARACTER FOR RETAINING WALLS IN SENSITIVE BUSHLAND AREAS (CONSTRUCTION BY THE ROADS AND TRAFFIC AUTHORITY).

8.2.2 Conservation of Materials

This process would be integrated with construction detailing and programming so that:

1. Grass and weed vegetation is cleared away and kept separate from other materials.
2. Seed of indigenous plant species is collected from the vegetation to be cleared from the construction corridor.
3. Indigenous and compatible existing plant material from the construction zone is converted to brush chippings and stockpiled.
4. Surface soils, friable sub-surface soils and rough clean excavated materials are stockpiled separately.
5. Surface litter consisting of leaf fall, the humus layer, accumulated seed and the general detritus of a bushland or forest floor, is either stockpiled separately or stockpiled in combination with the surface soil layer previously noted.
6. Stockpile locations, general storage areas, construction camp and depot sites should all be selected with due consideration for landscape conservation.

8.2.3 Detail Recommendations

- Species intended for the work would be tree, shrub and groundcover species selected from the indigenous plant communities of the respective locations encountered. Where appropriate, ie. when working within or in association with bushland areas species selection and combinations of species would respond to the composition of natural communities nearby.

- The fine detail of planting design would be determined by reference to actual conditions on site in conjunction with developed and detailed engineering design.

  Reference should also be made to the detail species schedules and information on species structure and distribution provided in the report prepared by Mt King Ecological Surveys, 'Flora and Fauna Evaluation (Bushland Effect and Management)' with particular reference to maps showing vegetation units.

- In many locations, existing trees of good quality are important local features and also potentially important as elements of the finished road development. Often these trees do not occur, necessarily, in areas of special bushland, but more likely as individual specimens or stands of trees in otherwise altered landscape conditions. Detail design to preserve their positions and importantly, their existing immediate soil levels, would be implemented.

- Soil provisions for planting would be drawn from stockpiled material made up of surface soils, friable sub-surface material and surface litter saved from the construction corridor. Imported soils as may be required to make-up required quantities should be of a compatible character and importantly, free of weed and grass contamination.

  All contaminated soil (including soil with weed and grass contaminations) must be removed from the site. Weedy, grassy soil from site clearing should never be used in the revegetation area.

- Except in specific urban situations, grass surfaces would be eliminated entirely from the planting design scheme. This policy would relate to aesthetic requirements in a bushland environment, minimise later maintenance and reduce the threat of further invasion of weed species into bushland. In urban areas or where bushland margins adjoin larger spaces beyond the reservation edge, grass surfaces may be appropriate as local parkland and play areas.

  Otherwise, planting is proposed as a continuous blanket of groundcover over all margins and residual spaces. Groundcover in this context refers to dense massed planting of tree and shrub species. All planting areas would need to be mulched with a suitable organic material to a depth of 100mm.

- A programme of weed management and control should be developed as an adjunct to the road and landscape construction process and carried out for at least 12 months after completion of the works.

- In bushland areas, species for landscape development and reinstatement generally, would be drawn from the natural plant communities and would be propagated using seed collected on site.

- Stockpiles of brush chip material should be located in existing cleared zones or areas cleared of weed infestation. The size and shape of stockpiles is also important. Heat build up in large stockpiles causes losses through acceleration of decomposition and in extreme cases can lead to spontaneous combustion.

- An arterial road development, typically within urban areas, would be subject to planting design which relates to the following principles:

  – Linear formations of large-canopied tree species installed to create bold avenue effects and reduce the visual scale of construction. Plan drawings and cross-sectional diagrams indicate these effects (refer to Report Section 7). Detail engineering design would determine where the opportunities would occur. In some locations, planting opportunities would be reasonably substantial including paired rows on at least one margin with similar species being installed in groups on the median (allowance would be made also for vehicle breakdown provisions).

  – Multi-stemmed groups of tall and large native tree species of the local area established at major intersections where larger traffic islands would provide suitable spaces (this same theme would apply to interchange locations in the event of an expressway being developed). In these cases a single selected species would be used as a dominant theme species, e.g. Sydney Blue Gum (*Eucalyptus saligna*) or Blackbutt (*Eucalyptus pilularis*) to establish a special focus in a given location.

– Screen planting of massed shrubs on embankments and margins of species selected to form a continuous blanket of cover and provide sufficient height to match the heights of noise wall structures. Native species of the region are recommended in this case in order to provide a selection of hardy and reliable plant types which are harmonious with the indigenous character of the local area.

– Planting of smaller tree types to add variety to massed shrub plantings and to provide suitable species for narrow margins and constrained sites. These trees would be of native species drawn from a broader regional zone but including some which are indigenous to the local area (detail design may raise the need to consider non-native species in locations where existing tree types should be matched).

8.3 KEY SPECIES FOR REVEGETATION – BUSHLAND AREAS

8.3.1 Canopy Species

Shale Soil Areas	
Angophora costata	Smooth-barked Apple
Eucalyptus globoidea	White Stringybark
Eucalyptus paniculata	Grey Ironbark
Eucalyptus pilularis	Blackbutt
Eucalyptus resinifera	Red Mahogany
Eucalyptus saligna	Sydney Blue Gum
Syncarpia glomulifera	Turpentine
Sandstone Soil Areas	
Angophora costata	Smooth-barked Apple
Eucalyptus gummifera	Red Bloodwood
Eucalyptus haemastoma	Scribbly Gum
Eucalyptus oblonga	Narrow-leaved Stringybark
Eucalyptus piperita	Sydney Peppermint

8.3.2 Screening Species

Acacia floribunda	Wattle
Acacia longifolia	Wattle
Allocasuarina littoralis	Black She-oak
Allocasuarina torulosa	Forest Oak
Banksia ericifolia	Heath-leaved Banksia
Hakea sericea	
Kunzea ambigua	Tick Bush
Leptospermum flavescens	Swamp Teatree
Pittosporum revolutum	
Pittosporum undulatum	Mock Orange
Syncarpia glomulifera	Turpentine

8.3.3 Valley Floor Species

Austromyrtus tenuifolia	
Callicoma serratifolia	Black 'Wattle'
Ceratopetalum apetalum	Coachwood
Ceratopetalum gummiferum	Christmas Bush
Cyathea cooperi	Treefern
Elaeocarpus reticulatus	Blueberry Ash
Eucalyptus saligna	Sydney Blue Gum
Tristaniopsis laurina	Water Gum

8.3.4 Understorey and Groundcover Species

To be determined according to location and guided by species schedules provided in the Flora and Fauna Evaluation Report.

8.4 PLANTING THEME : ARTERIAL ROAD CORRIDOR

Planting as indicated would be subject to detail design development in accordance with an adopted proposal. The principal planting types are noted:

8.4.1 Tall Tree Species

Tall clear-stemmed native species – typically used in broad traffic islands for visual impact while maintaining traffic sightlines.

Typical species:		
Eucalyptus pilularis	...	Blackbutt
E. resinifera	...	Red Mahogany
E. saligna	...	Sydney Blue Gum

8.4.2 Large Heavy-Canopied Trees

Broad-spreading canopy trees with dark coloured dense foliage for establishing avenues and helping to reduce the visual scale of the roadway.

Typical species:		
Ficus hillii	...	Hills Weeping Fig
F. rubiginosa	...	Port Jackson Fig

8.4.3 Screen Planting

Bulky ground covering shrubs of sizes ranging between 0.5 metres to 5.0 metres in height applied where space permits to margins and residual areas to screen views of noise walls and the road formation.

Typical species:		
Acacia floribunda	...	Gossamer Wattle
A. glaucescens	...	Coast Myall
Banksia collina	...	Banksia
B. ericifolia	...	Heath Banksia
B. spinulosa	...	Banksia
Callistemon spp. & vars.	...	Bottlebrushes
Hakea salicifolia	...	Willow Hakea
Hakea sericea	...	Needlebush
Kunzea ambigua	...	Kunzea
Leptospermum flavescens	...	Swamp Teatree
L. laevigatum	...	Coast Teatree
L. lanigerum	...	Woolly Teatree
Melaleuca nodosa	...	Melaleuca
M. linariifolia	...	Melaleuca
Pittosporum revolutum	...	Yellow Pittosporum
P. undulatum	...	Native Daphne

8.4.4 Other Trees

Trees of smaller size to intermix with screen planting in large planting areas or to be used in smaller edge margins or medians where possible.

Typical species:

Allocasuarina littoralis	...	Black She Oak
A. torulosa	...	Forest Oak
Banksia integrifolia	...	Coast Banksia
Eucalyptus haemastoma	...	Scribbly Gum
E. gummifera	...	Bloodwood
Syncarpia glomulifera	...	Turpentine
Tristaniopsis laurina	...	Water Gum

9. EXPRESSWAY & ARTERIAL ROAD PROPOSALS COMPARED

9.1 A TABLE

The following table lists the various impacts which apply to the expressway and arterial road proposals based on the earlier discussion 'Potential Impacts' (Section 5).

IMPACTS : Sheet 1

EXPRESSWAY	ARTERIAL
Division of Built Environment	
Minor to moderate	Severe
Division of Natural Environment	
Minor to moderate (subject to alignment options). Nil effect west of Darling Mills Creek System.	Nil
Division Created Between Built and Natural Environment	
Minor Nil effect west of Hepburn Road	Nil
Physical Destruction & Loss of Bushland	
Moderate to severe (subject to alignment options east of Muirfield High School)	
Minor to moderate (west of Muirfield High School)	Minor to moderate between Russell Street and Barclay/North Rocks Road junction
Changes to the Quality of the Community Environment	
Nil to moderate (Subject to outcome of Options and their effect upon bushland/natural qualities.	Severe in the short term. Subject to possible change in the long term.
Partial Loss of Property and/or Loss of Landuse Values	
Minor – west of Windsor Road. Moderate – east of Windsor Road.	Moderate to severe – in the short term.

IMPACTS : Sheet 2

EXPRESSWAY	ARTERIAL
Introduction of New/Undesirable Activity	
Minor to moderate – west of Windsor Road. Moderate to severe – east of Windsor Road.	Severe
Loss of Trees/Vegetation (other than bushland)	
Minor to severe (subject in part to the outcome of alignment options)	Moderate
Loss of Views	
Minor to severe	Severe in short term
Introduction of New/Undesirable Views	
Nil to minor – west of Windsor Road/Expressway intersection. Nil to severe – east of Windsor Road	Nil to severe
Loss of Amenity	
Severe in key locations	Minor to severe dependent upon location

10. CONCLUSION

10.1 RECOMMENDATION

This report, in conclusion, acknowledges that all options including the expressway in the reservation, the arterial alternative partly in the reservation and partly on existing roads, and their variations would be destructive of natural and urban environments.

It is proposed that the existing traffic situation in its present form is also destructive of the urban environment and without significant changes being made would continue to be destructive in terms of visual impact, divisiveness and loss of amenity, in a persistently worsening pattern.

Therefore, the option of 'doing nothing', albeit with the assumption that local area improvements could be progressively introduced (intersection development and management – traffic management plans and devices) is not favoured.

Of the other two basic alternatives, expressway (reservation), arterial (reservation/local roads), the expressway (adopting alignment Option 'C') is recommended. This recommendation is based on two underlying premises.

- The expressway proposal is less divisive of the community environment than the arterial alternative, and preserves to a much larger extent the existing status quo.
- Including its Option 'C' variation, the expressway would avoid most of its potential for causing irreversible loss of prime natural features.

It seems reasonable to accept the idea that in visual and landscape terms there is no *good* option – all must be initially destructive and there is no *other* transport corridor alternative that could be judged as being innocuous or, given appropriate mitigative treatment, could be made innocuous.

In the longer term (15 to 20 years and beyond) it is conceivable that all options could become more acceptable in terms of their relationships to new and changed edge conditions. In effect, the initial harshness of the major corridor development, could be modified as affected properties are made to function differently and new development occurs which adopts a landuse character more compatible with its edge environment.

In this context, the expressway option would seem to be the more favourable alternative given that its divisive potential would be focused on key locations and not take the form of a continuous division as would be the case over much of the arterial road alternative. In its urban circumstances, the arterial would be typically divisive and appropriate changes to edge conditions would similarly need to be relatively continuous. This process would consolidate the initial effect of creating separate communities by introducing a positive corridor of division.

A1 APPENDIX A

A1.1 Urban Design Considerations Adjacent to Transport Corridors

A separate report has been prepared as an adjunct to the landscape and visual impacts study of the western study area. Its title "Urban Design Considerations Adjacent to Transport Corridors" (Jackson Teece Chesterman Willis Consultants Pty Ltd) refers to the nature of landuses and building types in the context of noise-related conditions which are associated with modern large roadways. Building types, particularly residential buildings, and their sub-divisional layouts are examined in existing typical circumstances and also as potentially changed circumstances to identify the nature and impact of noise and the means of ameliorating its impact. At the same time, the examples demonstrated include other possible benefits which relate to urban consolidation in the broad corridor of a major transport route.

The urban design report is developed as an introductory examination of existing problems and possible beneficial changes of approach to building development types and layout. To some extent the study has been promoted by the understanding that in many situations, the large new road and existing quiet residential margins are not compatible and sometimes the association would be impossible to reconcile. In such a context, this landscape report, supported by the urban design report proposes that the rethinking of landuse and building types adjacent to transport corridors will often be the only satisfactory solution to the problem of noise and visual impacts. Any such action could be immediate or subject to longer term processes. However, to be effective and successful the process should respond to a planned and coordinated system or sequence of development and should not be left to chance.

The same urban design report raises questions in regard to interchange design and the general prospect of facilitating local area access. Also considered is the concept of incorporating useful local area amenities relating to social, retail and commercial functions. This subject matter is discussed with reference to past practice where contrasting examples of major road construction are illustrated and compared.

A.2 SCHEMATIC ILLUSTRATIONS

A2.1 Dedicated Public Transport Lanes

The illustration (Figure A.1) depicts the expressway proposal in the formation as described within this report consisting of two bus lanes in an exclusive corridor, two general traffic lanes in each direction and cycleways/breakdown lanes on each shoulder. The cross-sectional lay-out on which the drawing is developed, forms the basis of the recommended expressway proposal. It varies in detail and in dimensions and numbers of lanes according to localised design requirements, intersection zones and such like.

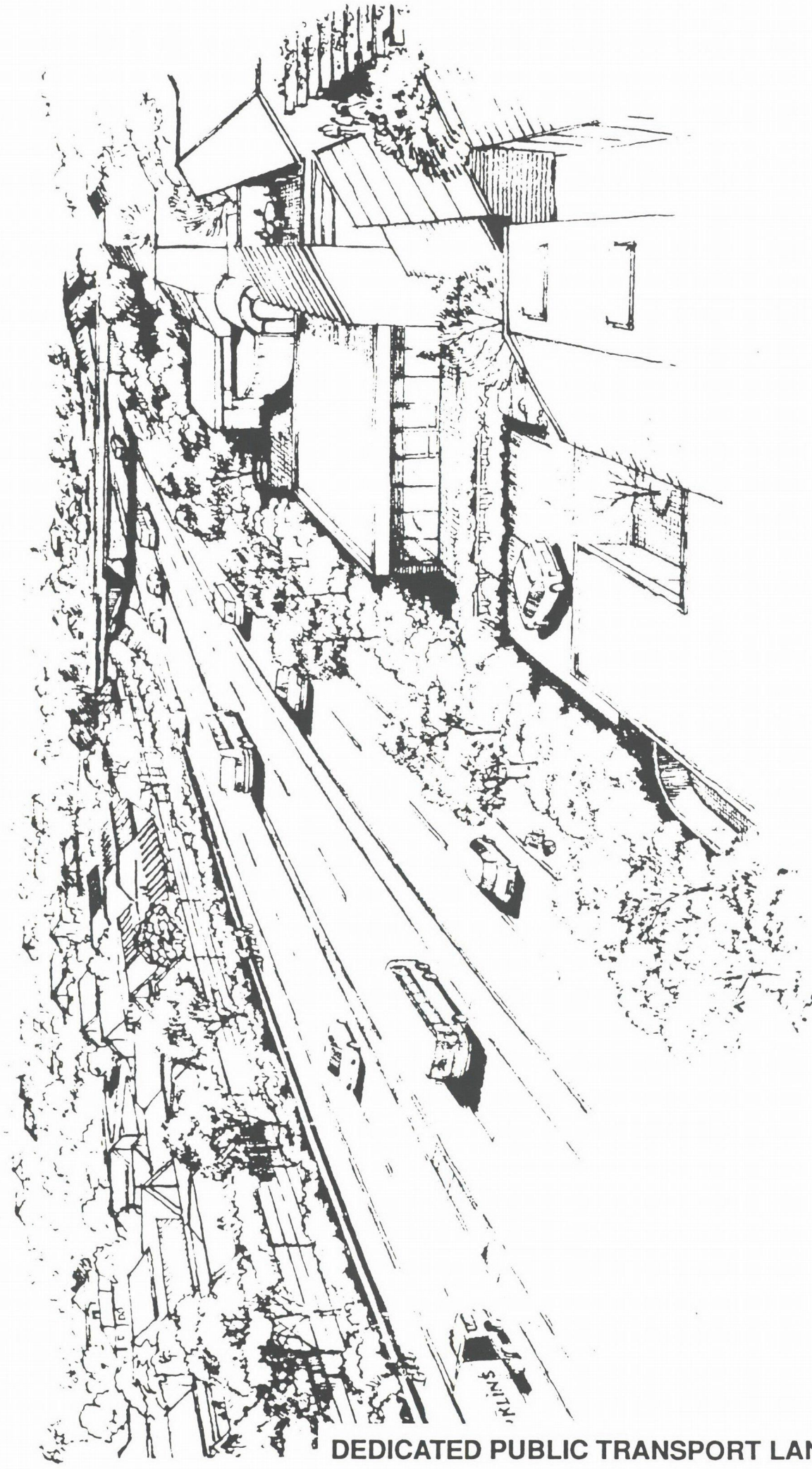
Beyond the roadway edges, the illustration demonstrates images of future changes. These changes may be various in their forms and characters but as examples of the possibilities, the artist's rendering refers to the following concepts:

- Higher-density land uses to promote a more appropriate relationship between the transport corridor and localised population density; increased population density close at hand to enhance public transport prospects in terms of user numbers.

- Enhancement of public transport user demand to promote the transport system's prospects of providing more and better services; this in turn can become a self-generating cycle of expansion and enhancement leading to a later situation where the bus lanes would be more fully utilised.

- On the far side of the expressway corridor, compact medium density housing is shown with its back to the road edge; the noise wall, if it is needed at all, would offend nobody. However, noise insulation could also be made an integral part of the building structures and the organisation of buildings and site layouts can be designed to further reduce the significance of noise impact.

- On the near side, a well-designed and appropriately vegetated development is shown, consisting of commercial offices, possibly professional suites for local practitioners, retail outlets and other community-oriented facilities. In this instance noise-insulated walls and noise tolerant uses such as carparking would address the transport corridor, and stand-alone noise wall barriers would not be needed at all. Vegetation and design qualities presented by good architectural development could contribute to the environmental quality of the transport corridor to tbe benefit of road and public transport users.



DEDICATED PUBLIC TRANSPORT LANES

FIGURE

A1

A2.2 An Evolutionary Process

This illustration shows an imagined evolutionary process where the means of transport have gradually changed while the physical corridor depicted in Figure A.2 has remained much the same. The margins of the road in this future scenario have not changed greatly other than to have the higher density residential content expanded on the far side. However, the changed composition of transport means and applications illustrates the following ideas:

1. The initial bus-related public transport system expanded progressively in terms of user demand, bus numbers and frequency of service as a result of effective promotion leading to natural growth and attractiveness of the system.

2. Increased bus traffic absorbed the capacity of the dedicated bus transit lanes, thus raising the possibility of a spillover of buses onto the normal traffic lanes in order to maintain services.

3. The logical steps in this process led to the bus system being replaced with a light or heavier-rail system in line with the new volumes of commuter requirements which would need to be serviced.

4. The original bus transit lanes included in the first stage of the expressway, eventually provided the corridor space suited to the rail transport system. The rail system with its capacity for quick loading and discharging of large passenger numbers substantially increased the overall capacity of the entire transport corridor.

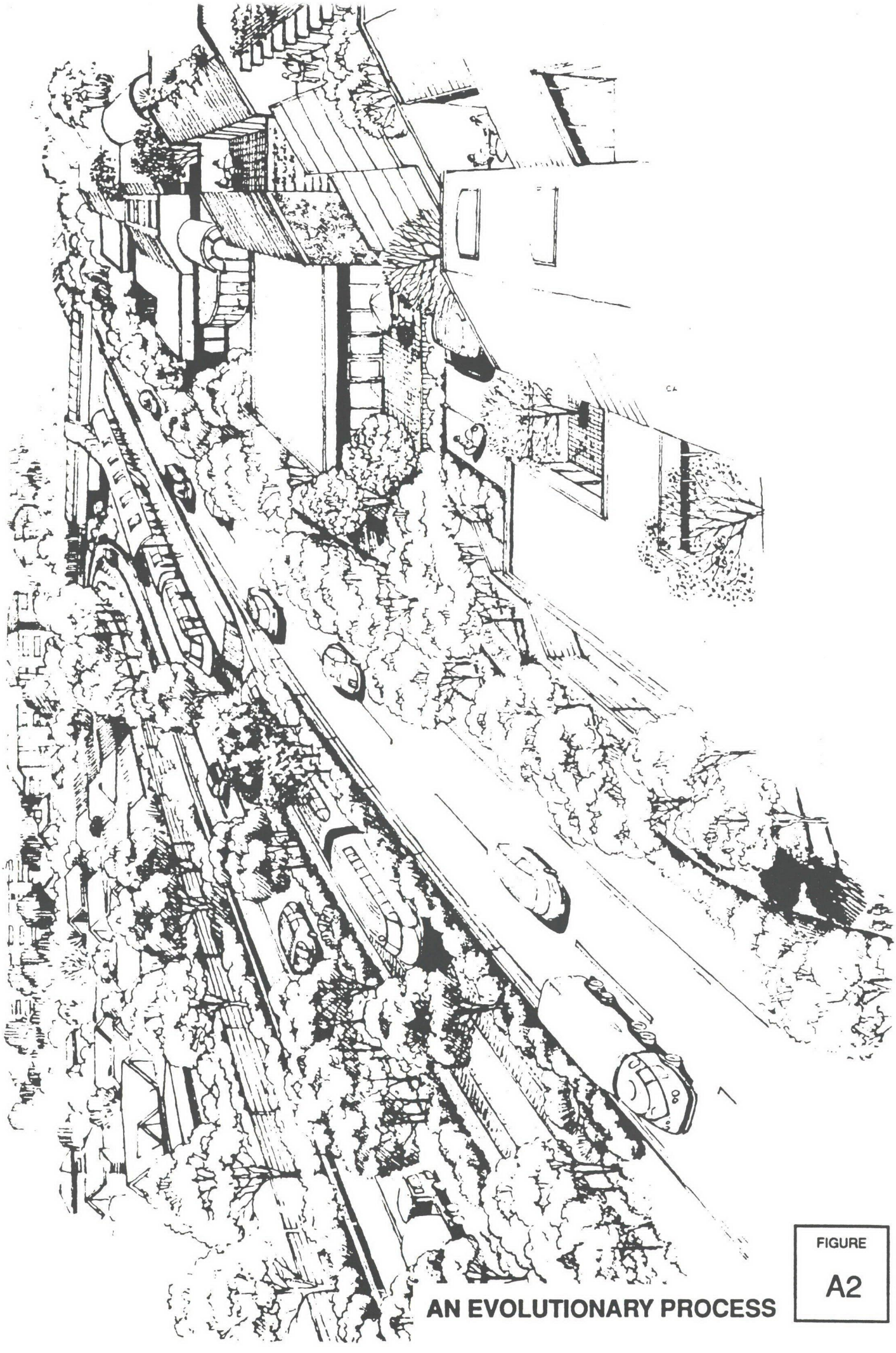
5. In this conceptual image of the future corridor (not too far removed from present-day possibilities), the trucks would be fewer in number undertaking local area deliveries which cannot be better handled by the train system. The trucks in any case would be quieter and relatively non-polluting.

6. Other transport vehicle types would include buses for local area services and mini buses and taxis for specific detail requirements. These vehicles would share the normal traffic lanes with other miscellaneous traffic.

7. The use of private vehicles in this hypothetical developed transport corridor would be minimised because of the much more favourable alternatives that would be offered by the various forms and convenience of public transport. In the meantime, in any case, private vehicle use could have become too prohibitively costly to be a primary choice for commuters.

A comprehensive plan for a new major transport corridor and its landuse margins could encompass the activities of planning and management expertise related to land development, landuse and transport planning action for the immediate and long terms.

The recommendation of this report, to select the expressway proposal based on the assessment of relative impacts upon landscape and visual quality of all alternatives, is valid only if it is part of a comprehensive and persisting future plan.



AN EVOLUTIONARY PROCESS

FIGURE

A2

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Urban Design Considerations adjacent to Transport Corridors

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September 1991

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INTRODUCTION

This report has been prepared as an adjunct to the Landscape and Visual Impacts Study by Bruce Mackenzie and Associates as part of the North West Transport Links Environmental Impact Statement.

The purpose of the study is to provide an introduction to some of the urban design issues related to the design of transport corridors.

The study looks at two situations:

Firstly, a transport link through residential subdivision. The major consideration addressed for the residential situation is the amelioration of noise impacts.

The residential subdivision is assumed to be on flat land in order to facilitate the comparison between noise reducing measures. It should be noted, however, that noise reduction **will** be greatly influenced by topography and that the values estimated in Figure 1.1 should be adjusted to take slope of land into account.

Secondly, a major road interchange in the transport corridor, which is bounded by both residential and commercial uses, is examined. Here, the principles outlined for noise amelioration remain valid, and as well the study raises design and development issues which must be considered to achieve a high quality urban environment. These issues are illustrated through a comparison of good and bad examples of major road construction.

SUMMARY

As summarised in the Landscape and Visual Impacts Study, this work is based on "the understanding that in many situations, the large new road and existing quiet residential margins are not compatible and in many cases the incompatibility is impossible to reconcile.

It proposes that the rethinking of land use and building types adjacent to transport corridors will often be the only satisfactory solution to the problem of noise and visual impacts. Any such action could be immediate or subject to longer term processes. However, to be effective and successful the process should respond to a planned and co-ordinated system or sequence of development and should not be left to chance.

The notion of including comprehensive planning and design involving the road construction authority and all relevant planning organisations is demonstrated as being essential to the overall task."

1.0 TRANSPORT CORRIDOR THROUGH RESIDENTIAL SUBDIVISION ON FLAT LAND

1.1 Background

This section aims to:

- overview noise control practices which address traffic noise problems in residential areas surrounding transport corridors:
- broadly assess these practices in terms of costs, resultant noise levels and other environmental consequences,
- present examples where satisfactory noise attenuation has been achieved through the design and layout of buildings and land-use planning.

The study is concerned with motor vehicle noise, as this generally creates the highest annoyance level when compared with other modes of transport.

The occupants of buildings can be protected from noise in the following ways:

(a) by reducing the noise level at source, by the design of quieter vehicles and quieter roads, by reducing traffic volumes, traffic speeds and modifying flow;

(b) by attenuating the noise between the source and the building, which includes vertical road alignment, spatial separation, and the use of noise screens and barriers;

(c) by the design of the building, including layout and insulation; and

(d) planning of land use adjacent the corridor so that noise tolerant activities provide a shield to sensitive areas.

This study deals only with spatial separation, noise screens, design of buildings and planning of land use. Nevertheless, all of the above means are interactive and should be investigated in a comprehensive noise reduction program.

Background, or ambient , noise levels can be considered in two situations; namely, outdoor noise level and indoor noise level. The Sydney climate encourages a lifestyle where people spend much of their time outdoors (thus without the benefit of the noise insulation provided by the building enclosure) and during summer, windows of habitable rooms should be openable for cooling purposes. Hence, acceptable outdoor noise levels should be achieved for outdoor recreation during the day and acceptable indoor noise levels in habitable rooms should not be exceeded when windows are opened, either during day or night.

As highlighted by the Commission of Enquiry into the F2, Stage 1 Freeway, considerable debate exists with regard to noise criteria. The study uses AS 2107-1987 as guide for acceptable indoor noise levels for day and night, and WHO and OECD criteria for maximum outdoor noise level during the day.

It should be noted that large sections of our population already live in areas characterised by noise levels in excess of these standards, and seem to tolerate the lowered environmental conditions in a trade-off with affordability. Nevertheless, this should not infer desirability or acceptance of a poorer quality environment.

AS 2107 - 1987

Table 1: Recommended Design Sound Levels for Different Areas of Occupancy in Buildings (Extract)

Type of occupancy/activity	Recommended design sound level	
	Satisfactory	Maximum
RESIDENTIAL BUILDINGS		
Private houses (rural and outer suburbs) -		
Recreation areas	30 dB(A)	40 dB(A)
Sleeping areas	25 dB(A)	30 dB(A)
Work areas	35 dB(A)	40 dB(A)
Private houses (inner suburbs) -		
Recreation areas	35 dB(A)	40 dB(A)
Sleeping areas	30 dB(A)	35 dB(A)
Work areas	35 dB(A)	40 dB(A)
SHOP BUILDINGS		
Show rooms	45 dB(A)	50 dB(A)
Small retail stores (general)	45 dB(A)	50 dB(A)
Speciality shops (where detailed discussion is necessary in transactions)	40 dB(A)	45 dB(A)
Supermarkets	50 dB(A)	55 dB(A)
OFFICE BUILDINGS		
Board and conference rooms	30 dB(A)	35 dB(A)
Computer rooms	45 dB(A)	55 dB(A)
Corridors and lobbies	45 dB(A)	50 dB(A)
General office areas	40 dB(A)	45 dB(A)
Private offices	35 dB(A)	40 dB(A)
Public spaces	40 dB(A)	50 dB(A)
Typing pool areas	45 dB(A)	55 dB(A)
Undercover car parks	55 dB(A)	65 dB(A)

WHO, OECD and NAL criteria for maximum external noise level	**55 dB Leq (day)** **45 dB Leq (night)**

The estimates of noise reduction noted on the study diagrams have been provided by Wilkinson, Murray, Griffith Pty Ltd. Calculation of predicted noise levels would require detailed design of the buildings, which is beyond the scope of this study.

The predicted level of noise source varies at different locations, as does the existing ambient noise level. Both will greatly affect the impact of a proposed transport corridor. For comparison purposes, this study assumes an 80dB(A) level for the noise at edge of transport corridor, and 50-60 dB(A) for existing external ambient noise level.

(It should be noted that at the Commission of Inquiry for F2, Stage1, noise emission levels of the F3 Freeway were referred to as 95dB(A) in the paper titled "Creeping Background Noise Levels") Cost information contained in the report is taken from Rawlinsons 1990 data.

It should be noted that this study is indicative of the feasibility and design process only and should be tested by specialist consultants.

1.2 Noise Control Practices

Typical noise control practices which address noise problems in residential areas surrounding transport corridors are as follows:

- Construction of a noise barrier between the corridor and the residences.
- Construction of a noise barrier between the corridor and the residences, and installation of double glazing, heavier ceiling and roof insulation to those dwellings most affected.
- Development of a wide landscaped buffer zone between the corridor and residences. In this instance, space would also permit the construction of a noise barrier on mounding, thus achieving a considerably higher overall barrier.
- Redevelopment of area adjacent the corridor to provide noise barrier residential buildings which can shield dwellings beyond.

For the purpose of this study, it is assumed that the freestanding noise barrier is 3.0 metres high. It is acknowledged that the height of these noise barriers can range from 1.5m to 8.0m. It is generally felt, however, that freestanding noise barriers become undesirable visual intrusions when their height exceeds 3.0 to 4.0 metres.

Where the freestanding noise barrier is constructed on earth mounding, it is assumed to produce an overall barrier height of 5.0 metres.

The assumed existing conditions and these options have been illustrated in Figures 1.1 and 1.2. Figure 1.1 also provides estimates of the potential noise reductions achievable, in terms of a noise source "N".

Figure 1.3 provides more details of the design principles illustrated in Proposal 1E.

1.3 Assessment of Practices

The comparative cost of each option is illustrated in Figure 1.4.

The noise levels achievable for both indoor and outdoor situations need to be calculated in relation to the estimated level of noise source. Figure 1.5 provides an example where the noise level at kerbside of corridor is 80 dB(A). For night-time situation, the indoor noise level with windows partly open should be considered; and for day-time situation both outdoor and indoor noise levels should be reviewed.

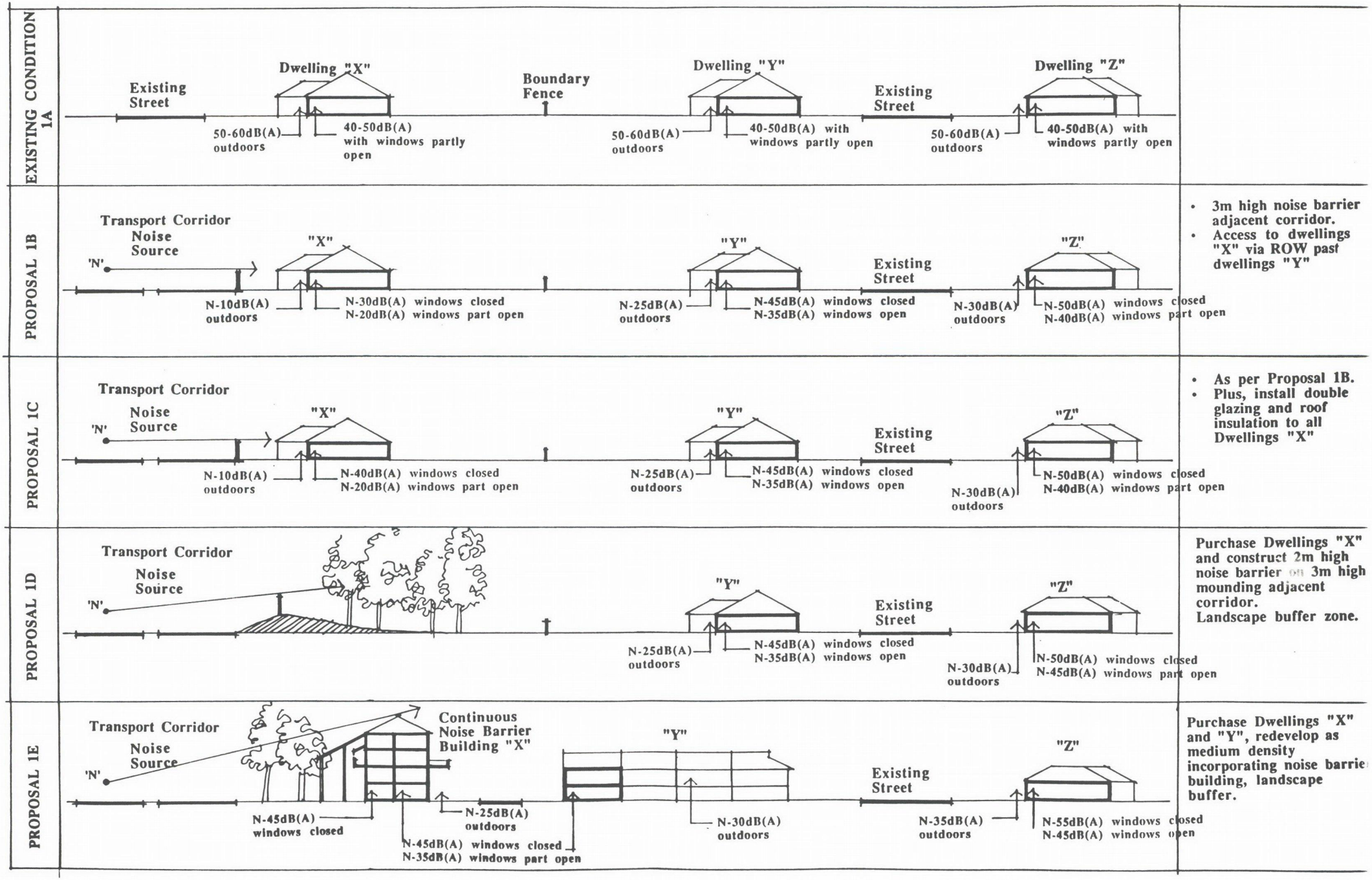
It should be noted that the site conditions will frequently be sloped, not flat. Noise reduction estimates should be adjusted accordingly.

SECTION 1 : Residential development adjacent transport corridor

Potential noise reductions achievable by distance, barriers, and construction

Figure 1.1
SECTIONS

0 10 20 30 40 50



SECTION 1 : Residential development adjacent transport corridor

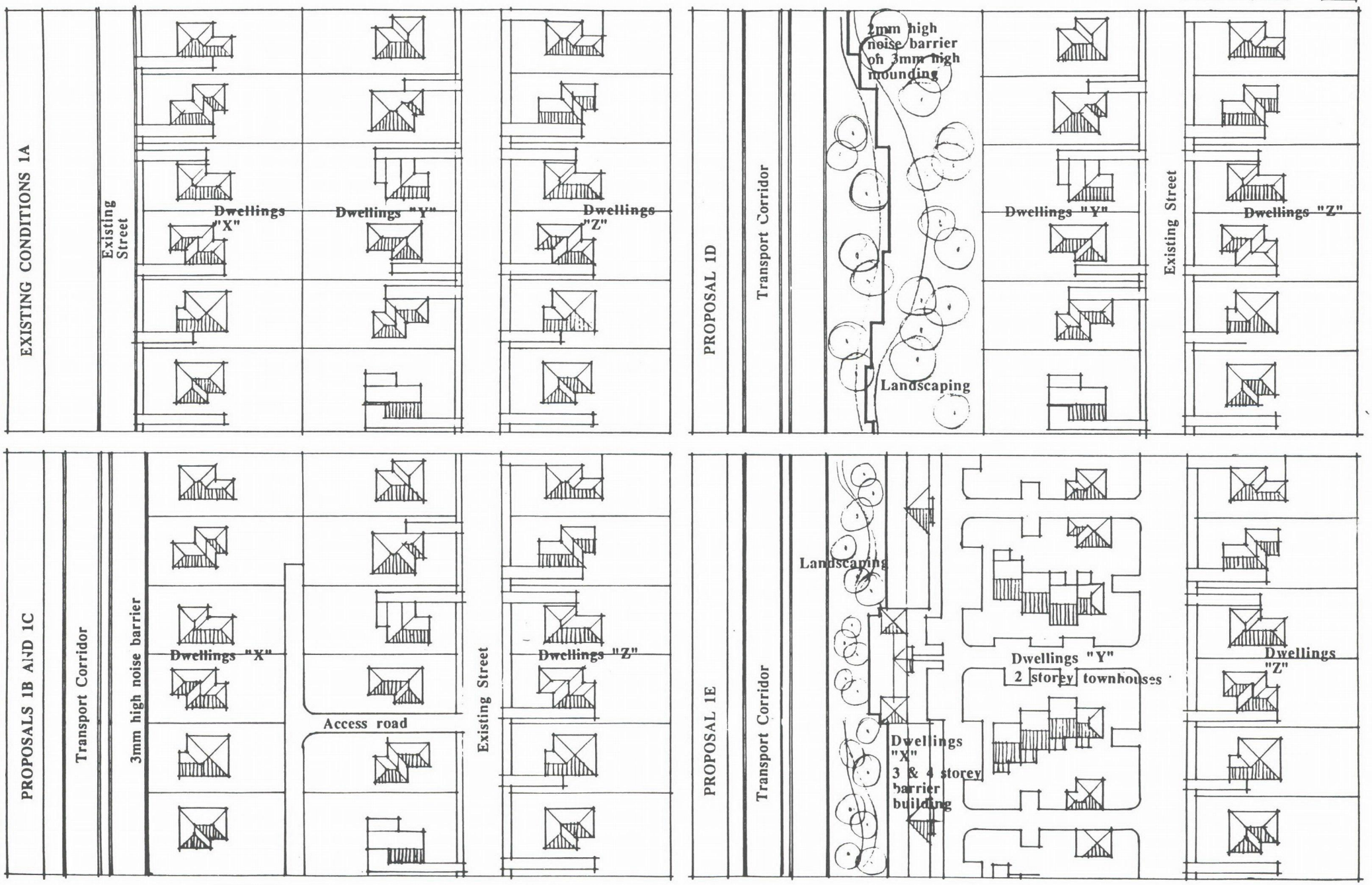
Potential noise reductions achievable by distance, barriers and construction

Figure 1.2

PLANS

Scale

0 10 20 50

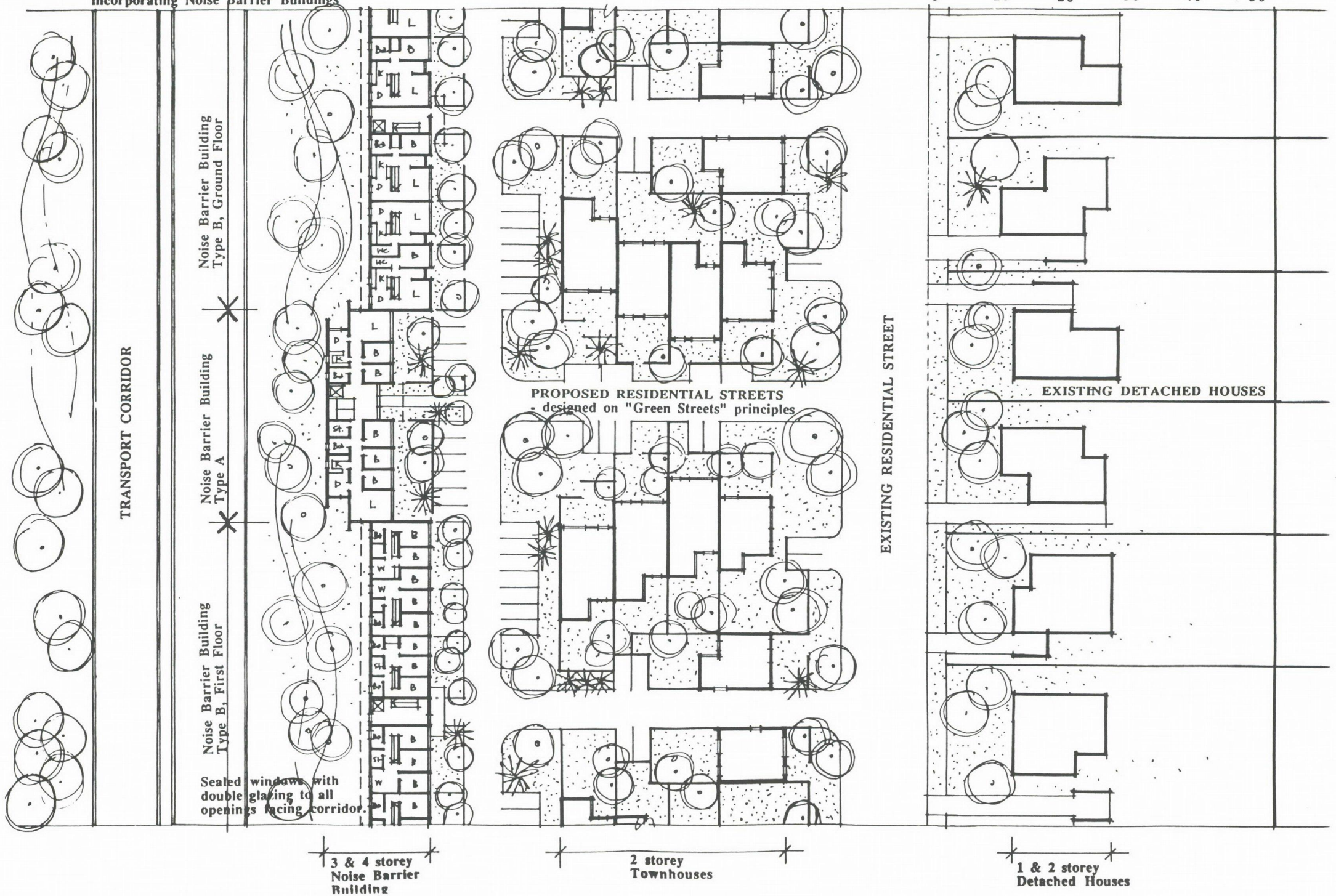


SECTION 1 : PROPOSAL 1E

TYPICAL MEDIUM DENSITY REDEVELOPMENT
incorporating Noise Barrier Buildings

Note: Building layout is illustrative of principles only.

Figure 1.3



OPINION OF COSTS, per 100m of transport corridor

	Existing Condition	Total
PROPOSAL 1A		
PROPOSAL 1B		
• 3m high noise barrier adjacent to corridor	(30,000)	
• Value of land providing access to dwellings and land occupied by barrier	(250,000)	($280,000) cost
PROPOSAL 1C		
• 3m high noise barrier adjacent to corridor	(30,000)	
• Installation of double glazing, heavier ceiling and roof insulation to closest dwellings *	(100,000)	
• Value of land providing access to dwellings and land occupied by barrier.	(250,000)	($380,000) cost
PROPOSAL 1D		
• Purchase of closest dwellings	(1,400,000)	
• Construction of 2m high noise barrier on 3m high mounding	*** (30,000)	
• Site preparation, landscape treatment, stormwater management, etc.	(100,000)	($1,530,000) cost
PROPOSAL 1E		
• Purchase of 2 rows of dwellings	(2,800,000)	
• Redevelopment as medium density which incorporates noise barrier building **	(4,256,000)	
• Landscaping adjacent corridor	(45,000)	
• Resale of medium density units **	6,210,000	$594,000 realised
• Saving on infrastructure and headworks to 33 dwellings in new release area.	1,485,000	profit

* Based on 5 dwellings at cost of $20,000 per dwelling.

** Based on: 3 x 2-bed townhouses constructed at $100,000; resold at $190,000.
8 x 3-bed townhouses constructed at $120,000; resold at $230,000.
4 x 2-bed units constructed at $90,000; resold at $140,000.
18 x 3-bed units constructed at $110,000; resold at $180,000.
Siteworks, roads and landscaping at $200,000
Professional fees - 12%
Headworks and infrastructure costs per dwelling in new release area of $45,000 per dwelling.

*** Dependent upon availability of suitable fill.

Figure 1.4

SECTION 1

Illustration of Noise Reductions Possible/Night-time Conditions

	Level of Noise at Kerb	Dwelling "X"		Dwelling "Y"		Dwelling "Z"		Australian Standard Criterion: Maximum Sound Level
		Outdoor dB(A)	Indoor dB(A)	Outdoor dB(A)	Indoor dB(A)	Outdoor dB(A)	Indoor dB(A)	
Existing Condition 1A		50-60	40-50 Windows partly open	50-60	40-50 Windows partly open	50-60	40-50 Windows partly open	30-35 dB(A) for bedrooms
Proposal 1B	80 dB(A)	70	60 Windows partly open 50 Windows closed	55	45 Windows partly open 35 Windows closed	50	40 Windows partly open 30 Windows closed	40 dB(A) for work and recreation areas.
Proposal 1C	80 dB(A)	70	60 Windows partly open 40 Windows closed	55	45 Windows partly open 35 Windows closed	50	40 Windows partly open 30 Windows closed	
Proposal 1D	80 dB(A)	N/A	N/A	55	45 Windows partly open 35 Windows closed	50	40 Windows partly open 30 Windows closed	
Proposal 1E	80 dB(A)	55	Bedrooms: 45 Windows partly open 35 Windows closed	55	45 Windows partly open 35 Windows closed	45	35 Windows partly open 25 Windows closed	

Figure 1.5

1.4 Comments

General comments and other environmental consequences require particular reference to each option and are as follows:

Existing conditions 1A:

Existing ambient noise levels will vary according to site location.

In many situations the existing noise levels are likely to exceed both the Australian Standard and WHO criteria. Nevertheless, unsatisfactory existing conditions should not imply acceptability of those noise levels.

Where existing noise levels are low, the degree to which noise increases will be a significant factor in addition to the actual level of the proposed noise environment.

Proposal 1B: Noise barrier adjacent corridor.

Due to the location of truck exhausts several metres above the road surface, low noise barriers will have limited effect. Where there is insufficient space for earth mounding and landscaping, high noise barriers degrade the environment visually. Other problems related to high noise barriers are the overshadowing of private land adjacent and subsequent loss of residential amenity.

The large spaces between the detached cottages reduce the screening effect of dwellings "X" for residential areas beyond. High noise levels are experienced a considerable distance beyond the first row of dwellings.

Access to dwellings (marked "X") can be achieved either by the retention of the local road adjacent the proposed corridor (at the expense of land on the opposite side of the corridor) or via easements which could be created between existing dwellings (marked "Y"). The latter results in the "back door" becoming the main entry point for the dwelling which may have negative consequences within the houses.

Proposal 1C: Noise barrier adjacent corridor and installation of double glazing, heavier ceiling and roof insulation to closest dwellings

Comments with regard to the noise barrier proposal 1B are equally relevant to proposal 1C.
The benefits flowing from insulation measures applied to the house itself leave the exterior noise levels unchanged.

The notion of changing the uses of rooms within the house, so that rooms away from the noise source are used for sleeping, is limited in its practicality.

Reliance on sealed windows to achieve acceptable noise levels in habitable rooms would also require air-conditioning of those rooms to meet Building Regulations. This may be considered undesirable in a residential situation.

Proposal 1D: Development of a broad landscaped buffer which incorporates noise barrier on earth mounding

Greater noise reduction at dwellings can be achieved as a result of increased spatial separation of dwellings from the corridor and an increase in the overall height of the noise barrier.

Visually the solution would be more acceptable, as more space is available to develop mounding and landscaping. The height of the mounding can allow a reduction in the height of the noise wall, and result in an increased overall barrier height.

Drainage problems need to be resolved and maintenance of landscaping also needs to be addressed. Overshadowing of adjacent properties need not be a problem due to the increased distance between the noise barrier and the dwellings.

Proposal 1E: Redevelopment of properties adjacent the corridor as medium density residential incorporating noise barrier buildings and landscaped buffer zone

Proposal 1E not only produces the greatest noise reduction to existing residential areas but also increases the number of dwellings by over 200% in the area adjacent the corridor. In so doing, it is supportive of the State Government's urban consolidation policy. The proposal would result in not only denser forms of housing but also wider choice in dwelling type. It generates population to support increased commercial and retail facilities which are proposed as nearby noise tolerant buffer zones. In the short term, however, increased population density may be controversial.

Noise barrier buildings do result in an overall cost increase per dwelling. This is related to both the increased frontage of the dwellings (as they are essentially single aspect) and the requirement for sealed double-glazed openings and ducted ventilation to rooms on the noisy side. It has been stated that a cost increase of 2-4% can be expected over sites that could have been developed had there been no noise problem[1]. Purchase of land adjacent a proposed corridor also incurs increased costs when the dwellings on that land are of medium to high quality yet require demolition.

Whilst the cost of providing the new dwellings is not cheap, the real costs should be compared with the cost of new housing on the fringes of Sydney to which all headworks and social infrastructure must be attributed.

---

1 "New housing and Road Traffic Noise", Dept. of Environment, HMSO, 1972

The plan forms drawn are only intended to illustrate the design principles and have been adapted from examples presented in Section 1.5. Considerably more design work and resolution is required for a real project. Nevertheless, the design principles are as follows:

- The noise barrier building must provide a continuous shield to the noise. At breaks in the building or at points of entry/exit to the corridor, the built form should return to protect residential areas, as illustrated in Figure 1.6.
- Special consideration is required with regard to the reflection of noise by the building.
- The internal layout of the building should ensure that noise tolerant activities, e.g. services, storage, bathrooms and workspaces, shield more sensitive areas, e.g. bedrooms. If necessary, internal walls and doors can be designed to provide a further level of noise insulation.
- The work spaces and service rooms on the noisy side of the building may require sealed double-glazed openings to achieve acceptable internal noise levels. Lack of cross-ventilation of the dwellings can be overcome either by ventilating fans within the rooms or ducted ventilation.
- The length and scale of a noise barrier building solution should be considered in relation to the speed of the observer. At greater speeds the perceived length is shortened. From within the development, the relationship to other buildings and the framing and screening of views can assist in producing human scale.
- Potential monotony both from within the development and from the corridor can be relieved by setbacks and staggers in both plan and height. Tree planting to the corridor edge can provide a visual softening.
- The scale and spacing of dwellings fronting existing streets should be sympathetic to the existing building pattern. They should also provide a transition to the increased scale and bulk of a noise barrier development, as illustrated in Figure 1.7.
- Shadows cast by any taller buildings should be considered in the siting of nearby dwellings.
- Noise barrier development need not be restricted to only residential uses. Commercial and retail are potential and compatible uses within the noise barrier block. Parks, playgrounds and other community uses could occupy areas shown in Figure 1.3 as townhouses.
- For such redevelopment to be successful in reducing noise levels through building layout and design, stringent environmental controls are required for the projects.

Without such controls, rezoning of land adjacent a transport corridor to medium density residential would simply expose larger numbers of people to worsened environmental conditions.

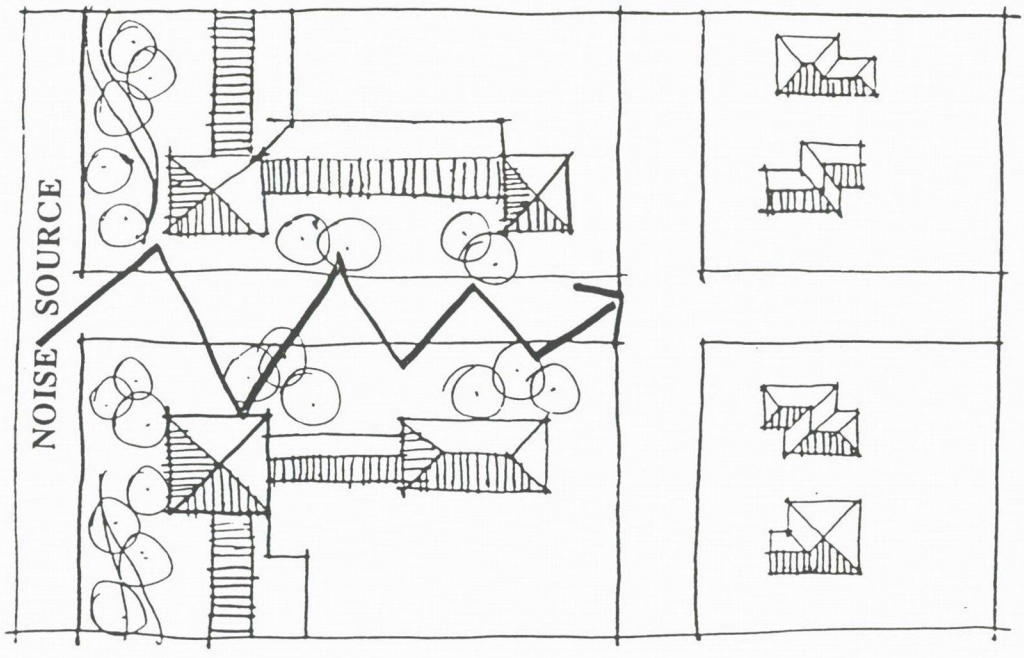


Figure 1.6 Noise barrier building must provide a continuous shield to noise.

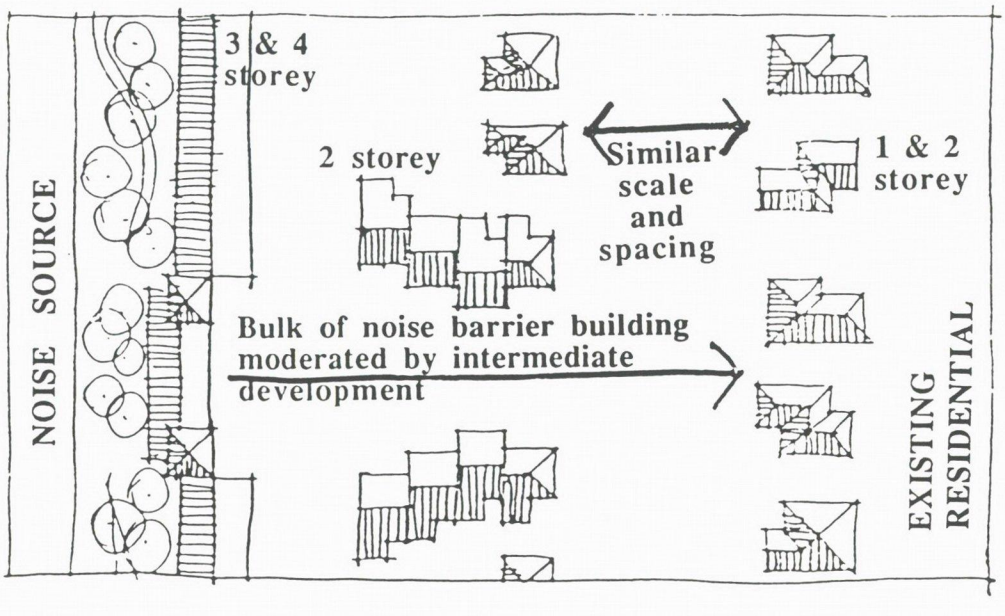


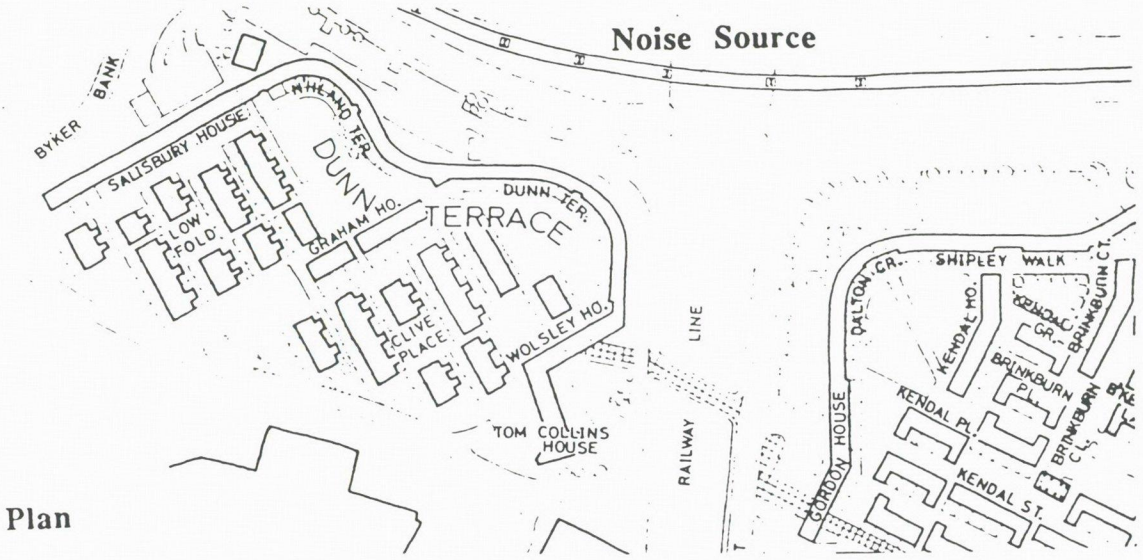
Figure 1.7 The scale and spacing of buildings to be sympathetic to existing development.

1.5 Examples of noise attenuation through design and layout of residential buildings

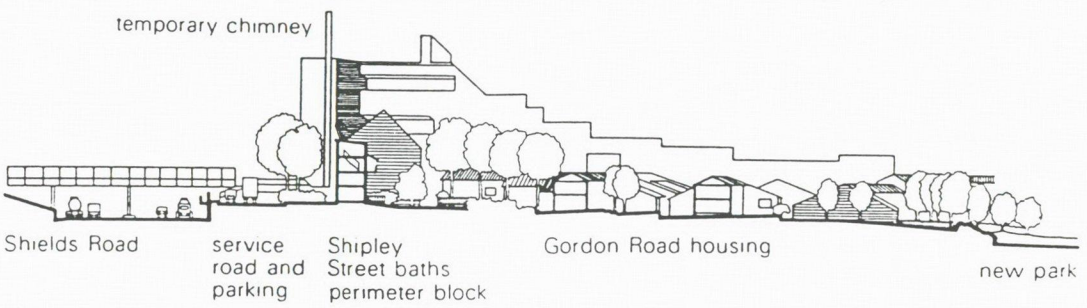
Three built examples are presented, each representing a different scale of development.

- Figure 1.8 is the Byker redevelopment in Newcastle-upon-Tyne, England, constructed 1969-1982.
- Figure 1.9 is the Manesse development in Zurich-Widikon, Switzerland, constructed 1981-1984.
- Figure 1.10 is the Dresdner Strasse development in Vienna, Austria, constructed 1976-1980.
- Figure 1.11 is the Quiet House project, Dundas, NSW, completed 1989.

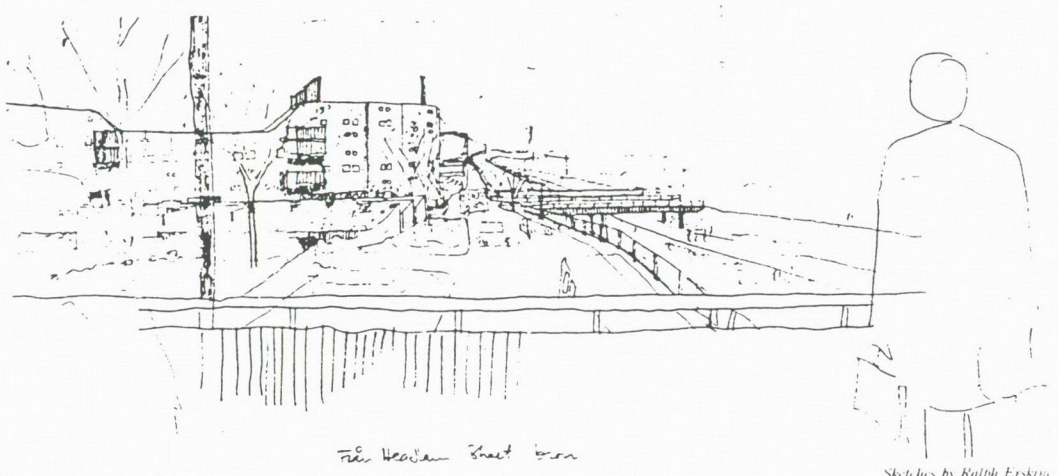
It should be noted that these are not isolated examples of built projects. Examples of such redevelopment are numerous, particularly in central European countries which have stringent noise protection controls on buildings.



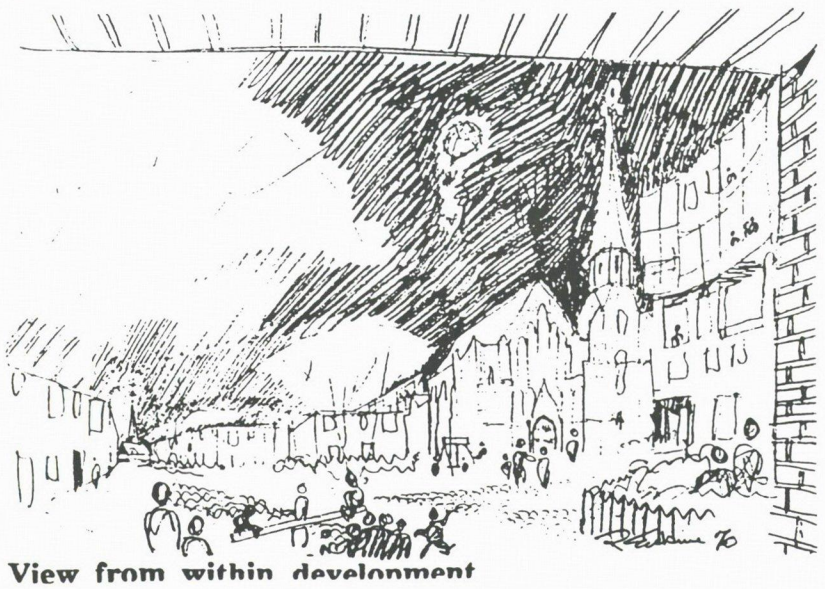
Plan



Cross section : 1/800



View from Freeway Bridge



View from within development

Figure 1.8
Byker redevelopment in Newcastle-upon-Tyne, England; Ralph Erskine, Architect (Ref: "Global Architecture 55: Ralph Erskine", ADA Edita, Tokyo, 1980)

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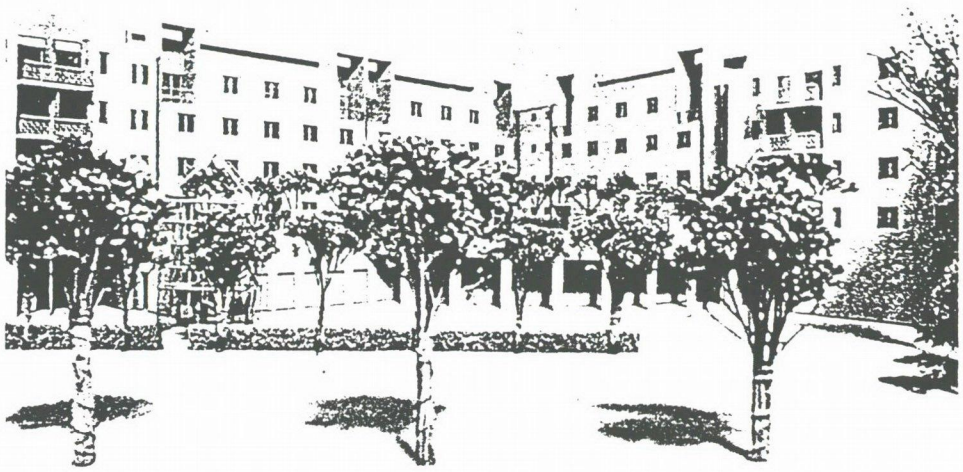

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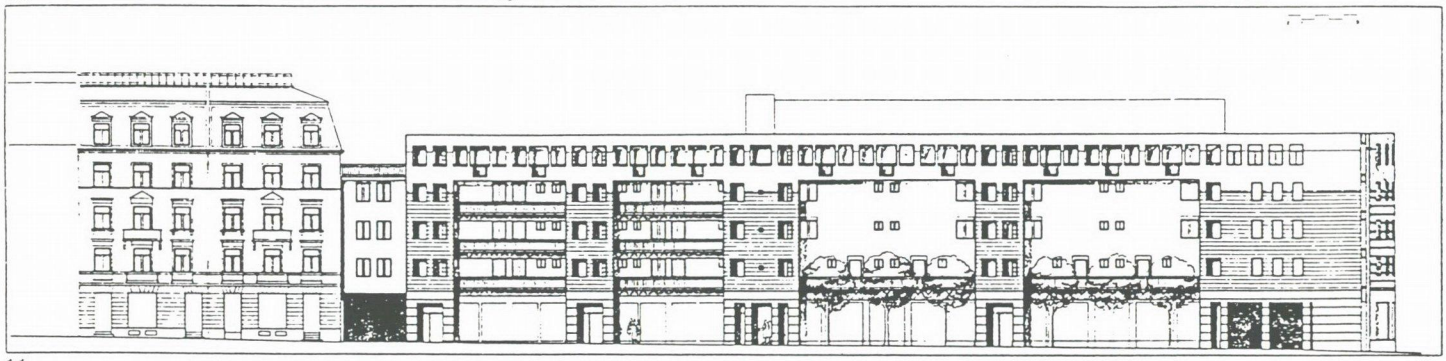

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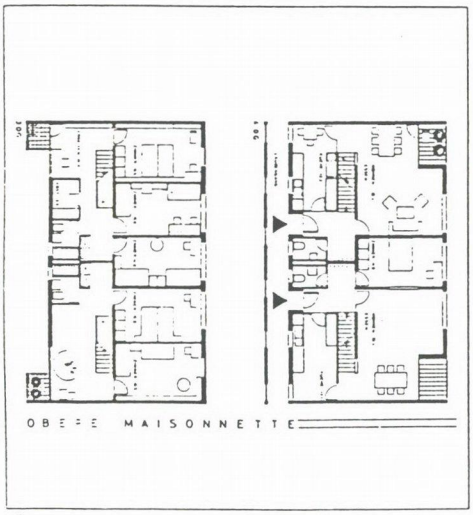

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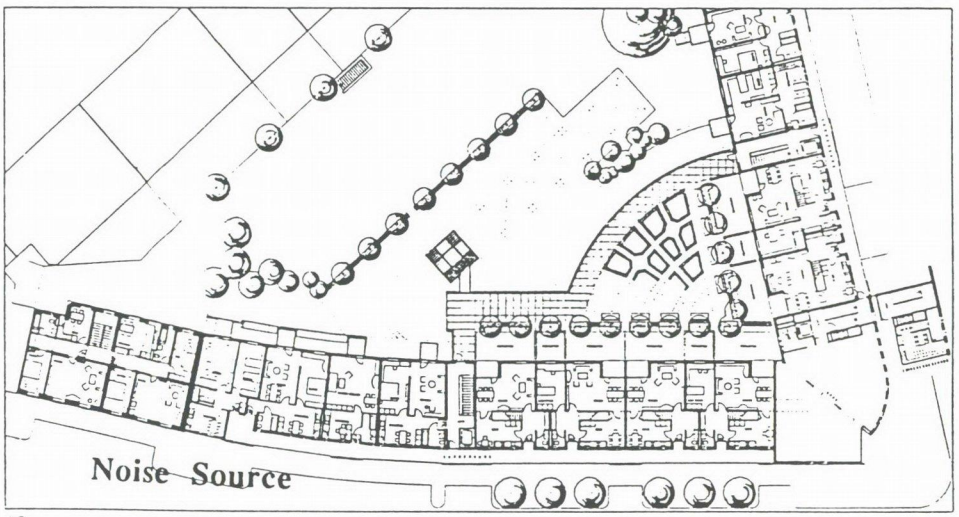

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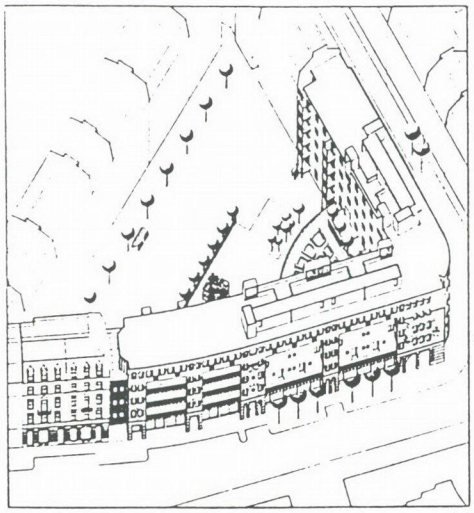

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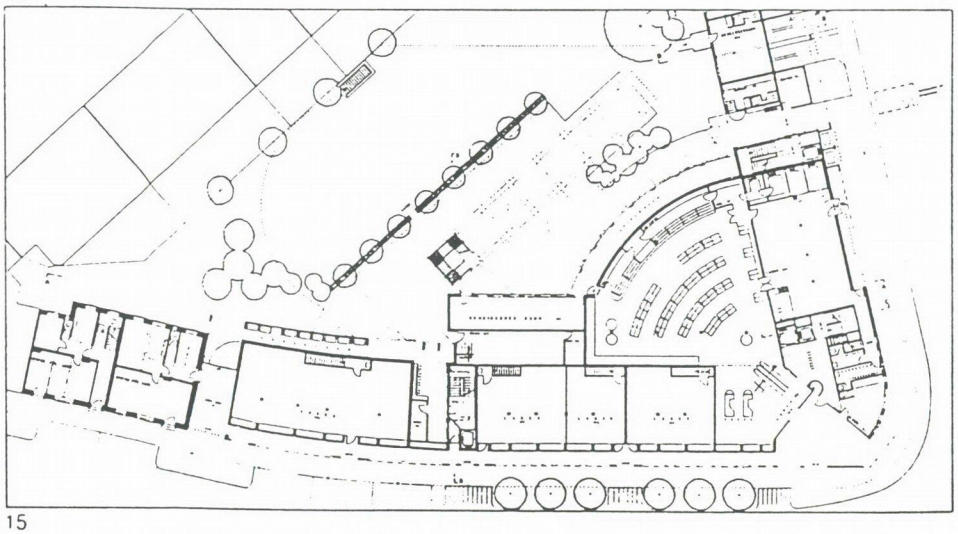

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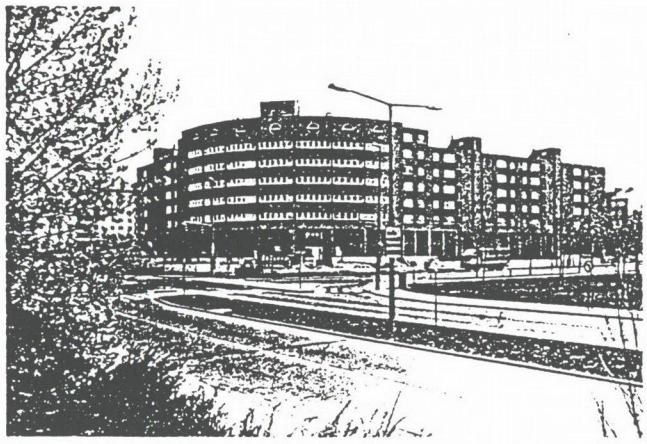
Figure 1.9
Manesse development in Zurich-Widikon, Switzerland:
ARCOOP Architects
(Ref: "Junge Architekten in Europa" by H & M Bofinger, 1983)

Duniecki · Bichler · Schober
1976–1980
XX., Dresdner Straße



Häufiger werden für den Wohnbau extrem verkehrsbelastete Situationen. Nötig wird eine Abwehr nach Außen, hier mit verglasten Laubengängen, und die Orientierung des Wohnens zum ruhigen Hof.

Heavy traffic is becoming increasingly problematical for residential buildings. Exterior measures for countering such problems are becoming necessary; met here with glassed-in, connecting balconies and oriented towards a quiet courtyard.

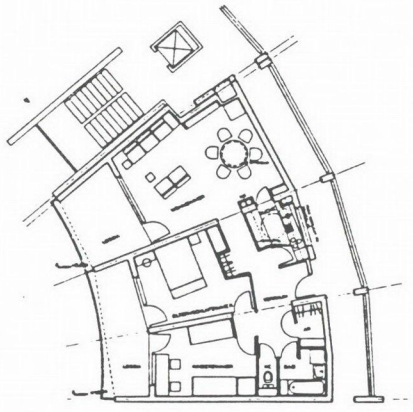


Figure 1.10
Dresdner Strasse development in Vienna, Austria: Duniecki, Bichler and Schober, Architects (Ref: "Neuer Wiener Wohnbau; New Housing in Vienna", Exhibition and book by Stadt Wien, 1988)

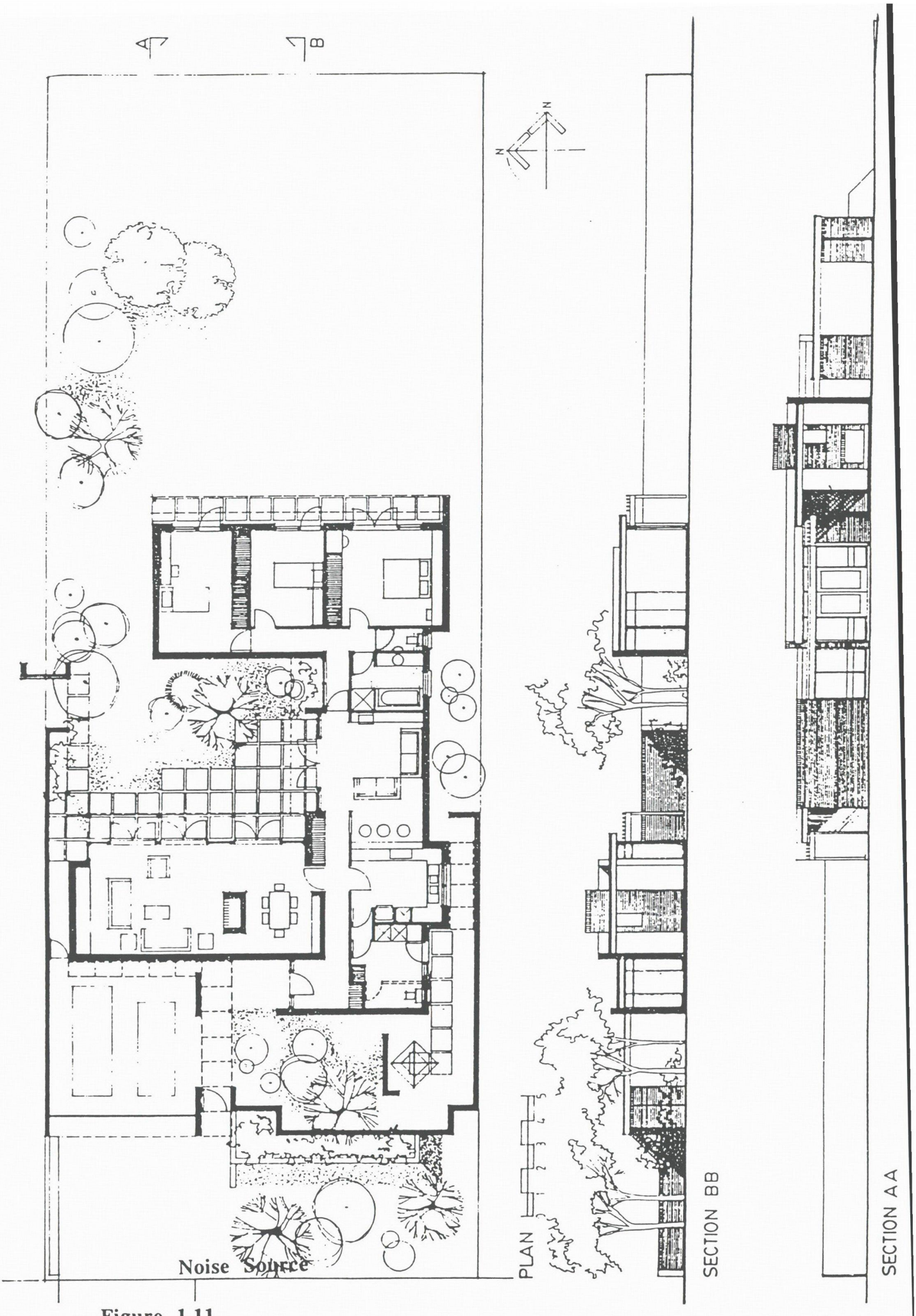


Figure 1.11
Quiet House project in Dundas, NSW; Geoffrey Le Sueur, Architect
(Ref: "Traffic Noise Reduction in the Design of Residential Buildings"
Seminar, UNSW, 1990)

2.0 A MAJOR INTERCHANGE OF TRANSPORT CORRIDOR BOUNDED BY RESIDENTIAL AND COMMERCIAL USES

2.1 Background

"Consider what happens around a major highway interchange. Let us suppose that you represent a business that is located in another city. You have arrived at your destination late at night, and are staying at a motel located along this highway interchange. To get to your motel you naturally rented an automobile at the airport. The office where you are going for your meeting is within sight of the motel, on the other side of the interchange. You get into your car and drive for several miles along service roads, along a highway in the wrong direction, along more service roads, until you have negotiated the passage between your motel and your appointment. Yes, it would have been faster to walk, except that there are several chain-link fences in your way, and you might well be killed crossing the highway.

Your meeting runs on past lunchtime and you all decide to go out to eat. Someone suggests Captain Ahab's Fish Restaurant, which is located in the parking lot of a shopping center that occupies another quadrant of the same highway interchange. You must all get into cars, drive down service roads, around and back again, to get to your lunch.

The motel, the office building, the shopping center, and the restaurant represent the ingredients of an entire city center. Their location at a highway interchange is entirely rational and predictable. All that was needed was for someone to design their relationships to each other, and to the highways, in a reasonable way. It would probably have saved money; fewer parking places would be needed, less grading, fewer roads."[2]

"Public officials charged with building highways have traditionally kept very closely to that single purpose. They have seen themselves as road-builders, who should do their jobs as efficiently as possible. Efficiency has not included a concern for the economic and social consequences of highway construction; cost and benefit have been evaluated only on the basis of numbers of vehicles that can move from point to point.

It is well known that highways have a tremendous economic impact upon the areas in which they are built. The effect in urban areas if often negative, disrupting businesses and blighting neighbourhoods. In less densely settled areas, new highways are a substantial economic stimulus: land around interchanges increases enormously in value, and whole new districts are opened up to intensive real estate development."[3]

---

2 Page 4, "An Introduction to Urban Design", Jonathon Barnett, Harper & Row publishers, New York, 1982.
3 Page 208, Ibid.

Whilst the above quotations refer to the American experience, close parallels can be drawn to the development of transport corridors in Australia over the past 30 years. Here, the traditional role of the DMR, a single purpose agency, was to design and build freeways to fulfil a single goal, that of improving traffic flow. Remedial measures to ameliorate the effect of the freeways on the city did not form part of the plans. The relationship of the motor transport system to other transport modes, to commercial/retail centres, and to the urban fabric generally, was not developed.

The converse is that when proper opportunities to gain access to a locality are provided in a new system of roads which create metropolitan accessibility, then both growth of activity and economic benefit will arise. As part of the RTA's new concerns of environmental and urban quality, these issues should be addressed.

2.2 Interchange Design

The aim of interchange design should be to contribute to the urban fabric, not only in providing ease of vehicular movement, but also in maintaining high environmental standards in terms of noise and air pollution, preserving existing activities and/or creating opportunities for improved amenity for social, commercial and retail functions.

The maintenance of high environmental standards in terms of noise, as discussed in Selection 1.0, can be achieved

(a) by reducing the noise level at source, by the design of quieter vehicles and quieter roads, by reducing traffic volumes, traffic speeds and modifying flow;
(b) by attenuating the noise between the source and the building, which includes vertical road alignment, spatial separation, and the use of noise screens and barriers;
(c) by the design of the building, including layout and insulation; and
(d) planning of land use adjacent the corridor so that noise tolerant activities provide a shield to sensitive areas.

Reduction of air pollution adjacent transport corridors can be achieved by

(a) reducing the emissions at the source, by the design of more efficient vehicles and modifying traffic volumes, speeds and flow
(b) the utilisation of alternative energy sources
(c) location of the corridor with regard to topography and air movement, and
(d) modifying air flow with barriers.

Internationally, there now exists considerable technical knowledge, experience and mechanisms to safeguard environmental standards. The very requirement for Environmental Impact Statements provides some control.

The means of preserving existing activities which are important to the city and the creation of opportunities for improved amenity are less apparent. However, Sydney does possess an example

of transport corridor design which aims to assimilate the freeway within the urban fabric. The approaches to the Sydney Harbour Bridge, which carries two lanes of public transport and eight lanes of motor vehicles, were designed as an integral part of both the northern and southern edges of the Harbour.

The bridge was built at a time when the philosophy of both architectural and engineering design embraced the creation of city form. Beyond their particular function, structures recognised their important role within the urban fabric to define spaces and develop character and civic amenity. It was only during the modern movement that buildings and engineering structures became regarded as single objects in space with little regard for their context.

Whilst this is a uni-directional link built prior to the environmental debate, and does not solve all of the problems, the design of the bridge is nevertheless worthy of consideration and provides guidance in the development of more complex systems. A photographic comparison of the environment surrounding the Harbour Bridge approaches, with some recent transport interchanges highlights many design principles.

2.3 Design Principles

The design principles are proposed in outline only and require considerably more research and work to define actions in specific locations. Nevertheless, they are as follows:

- Transport interchange design requires the collaboration of a variety of specialists, different government agencies and the participation of community groups. The design of the facility should be based on the criteria established by these groups and the design itself should be undertaken in collaboration. It should be a joint development.
- The design problem is to resolve modifications to the city and local areas not just the road network. In order to resolve the conflicts, the design must be handled in a holistic process, not linear.
- The development requires the co-operation of Local Government and the Department of Planning to undertake rezoning and determine future needs.

In terms of physical design of the facility:

- Interchange design should maintain high environmental standards in terms of noise and air pollution.
- The interchange should contribute to the amenity and activities (retail, commercial, residential and recreational) of the community.
- Maximise accessibility for all forms of transport, including pedestrian, in order to maximise activity and viability.
- Maintain close links and easy accessibility between quadrants of the interchange.

- The scale and character of its context should be respected.
- The interchange should be designed and detailed as a built form which responds to the locality, not just as an engineering structure without reference to human scale.
- The spaces created under or adjacent to the interchange should be purposeful and pleasant.

In summary, it is not to be assumed that the resolution of transport corridor design within our urban environment is simple or straight forward. However, if we are to achieve high quality living and working environments, we must pursue the multi-faceted design issues.

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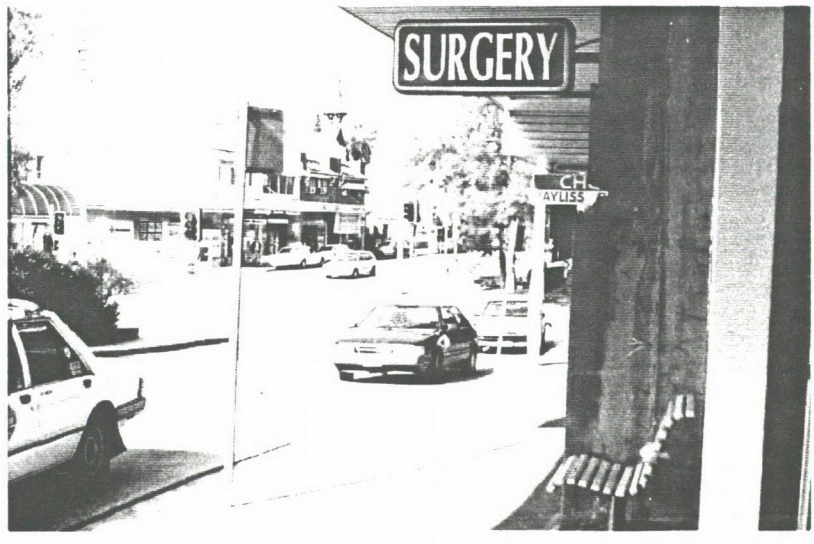
Ultimo: Lost Space

- Transport corridor unrelated to activities at street level.
- Design of freeway considers solely the automobile.

Kirribilli: Gained Space

- Transport corridor incorporates retail facilities which contribute to the activities of the community.
- Scale and character of the locality is retained.



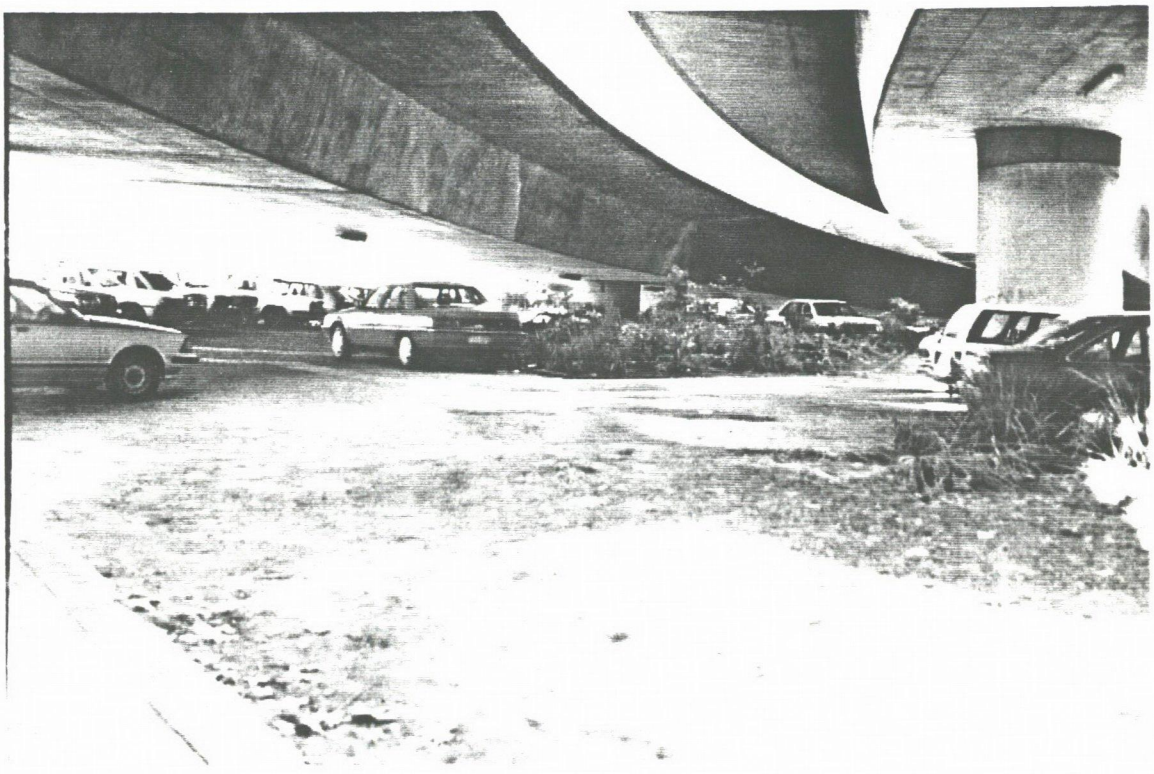
- Typical Kirribilli streetscape opposite transport corridor.

Figure 2.1

Milsons Point:

- Taxi ranks, bus stops and train station are all integrated with the motor car facility. This interaction and ease of accessibility draws people to the retail centre, thus establishing its viability

Figure 2.2



Ultimo: Lost Space

- Uninviting leftover spaces below corridor, suitable only for car parking.

The Rocks: Gained Space

- Usable spaces below corridor which fulfil an active purpose within the city.

Figure 2.3

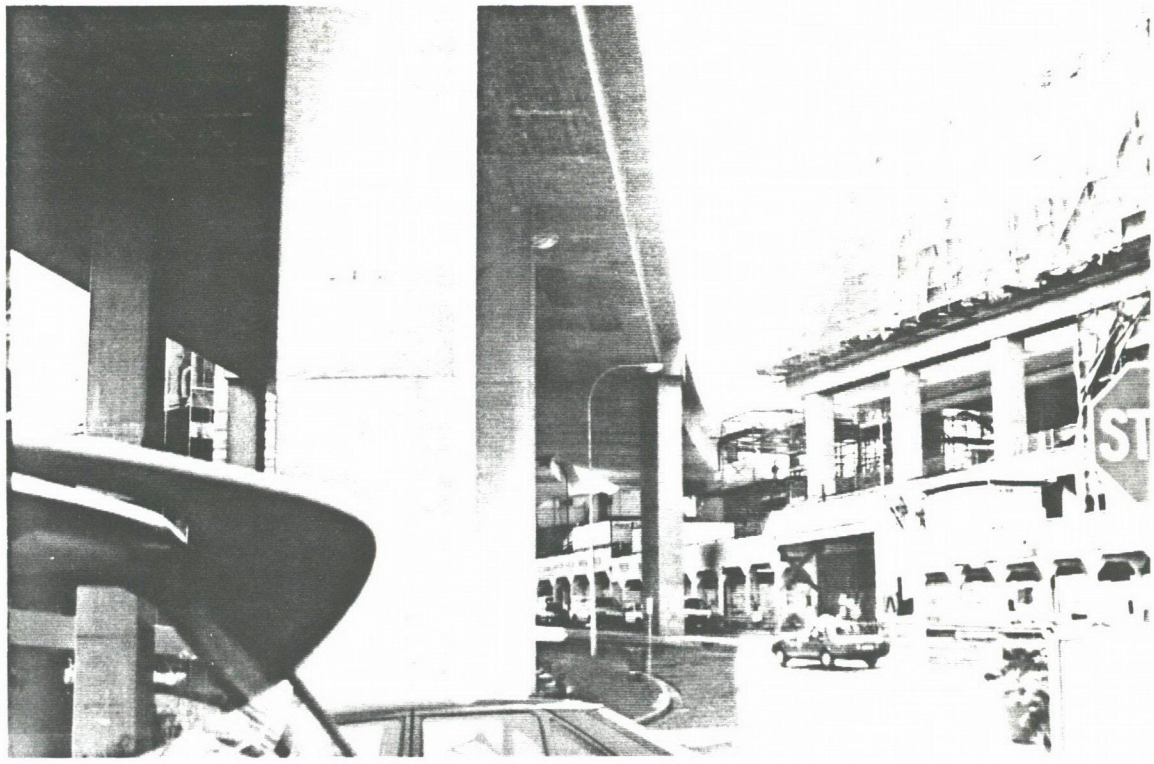
Sydney City: Lost Space

- A transport flyover unrelated to the city fabric.

Kirribilli: Gained Space

- Incorporation of commercial functions below transport corridor.
  (Perhaps the run-down nature of some of the premises may result from insufficient maintenance by the lessor.)

Figure 2.4



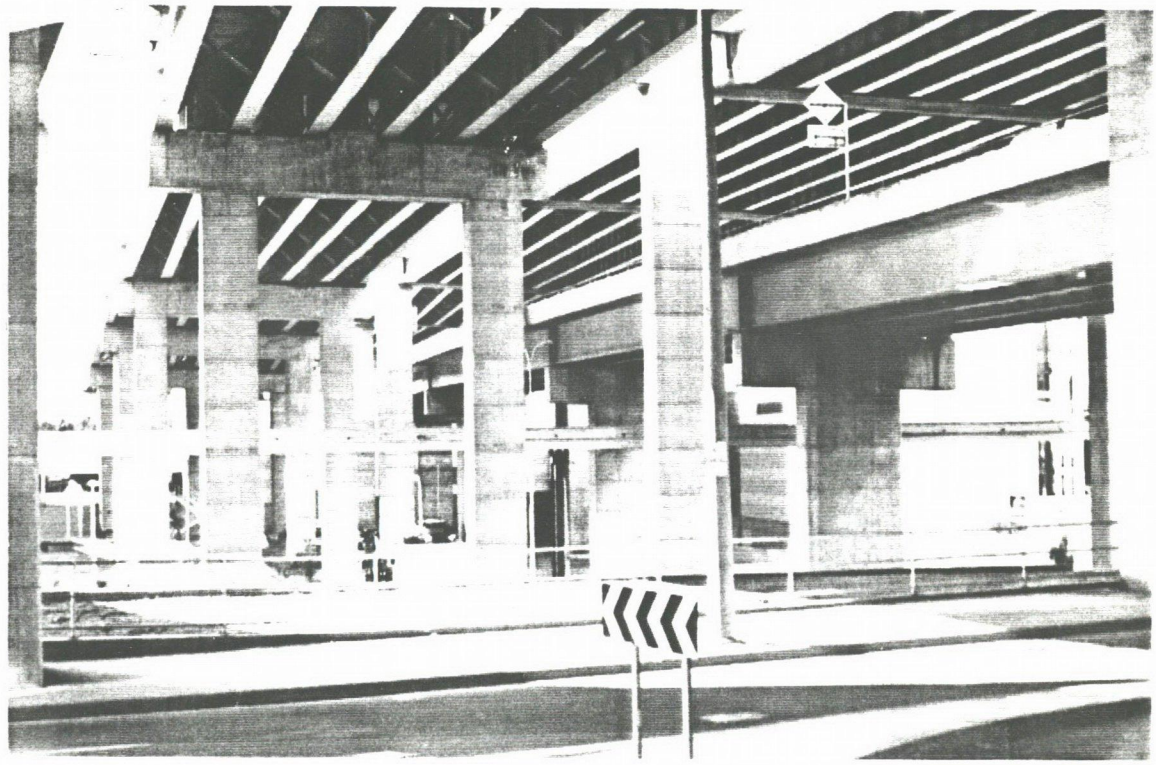
Sydney City: Lost Space

- Transport corridor ignores the city buildings and street level conditions, creating arbitrary and useless spaces.

Kirribilli: Gained Space

- Transport corridor modified original street pattern without destroying its coherence.

Figure 2.5



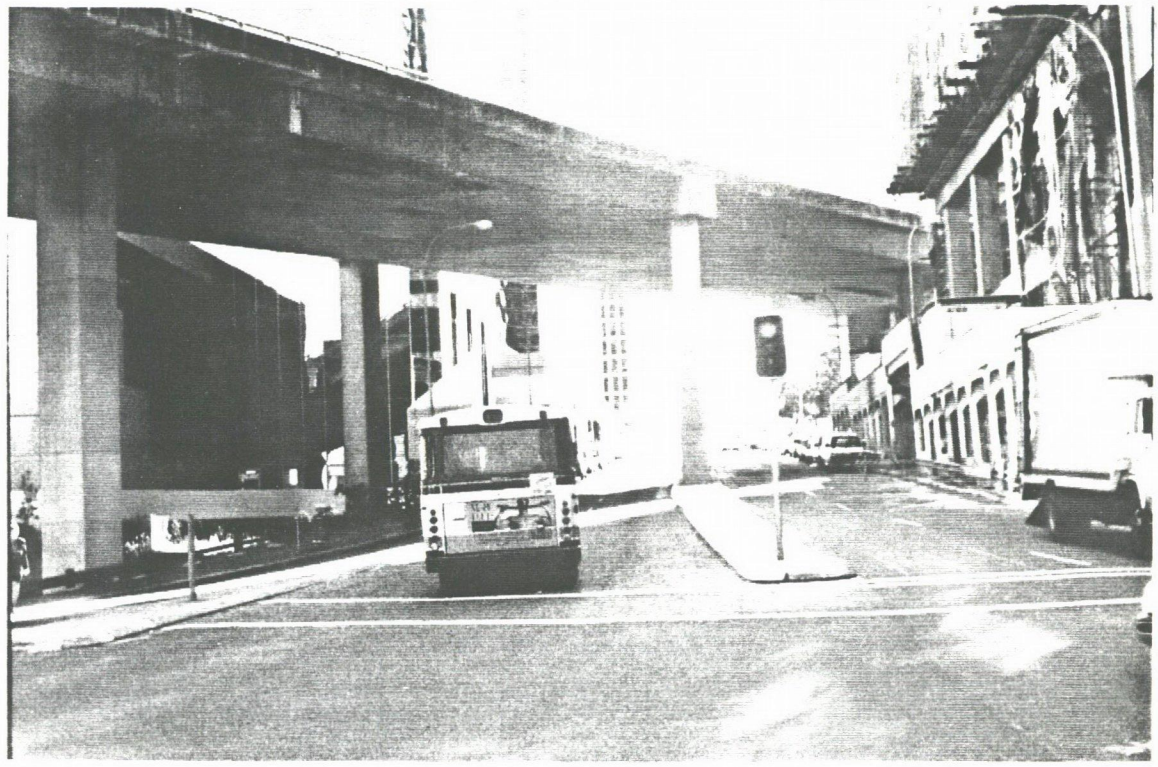
Ultimo: Lost Space

- Massing and design unrelated to human scale.
- Design considerations are concerned only with structural adequacy.

The Rocks: Gained Space

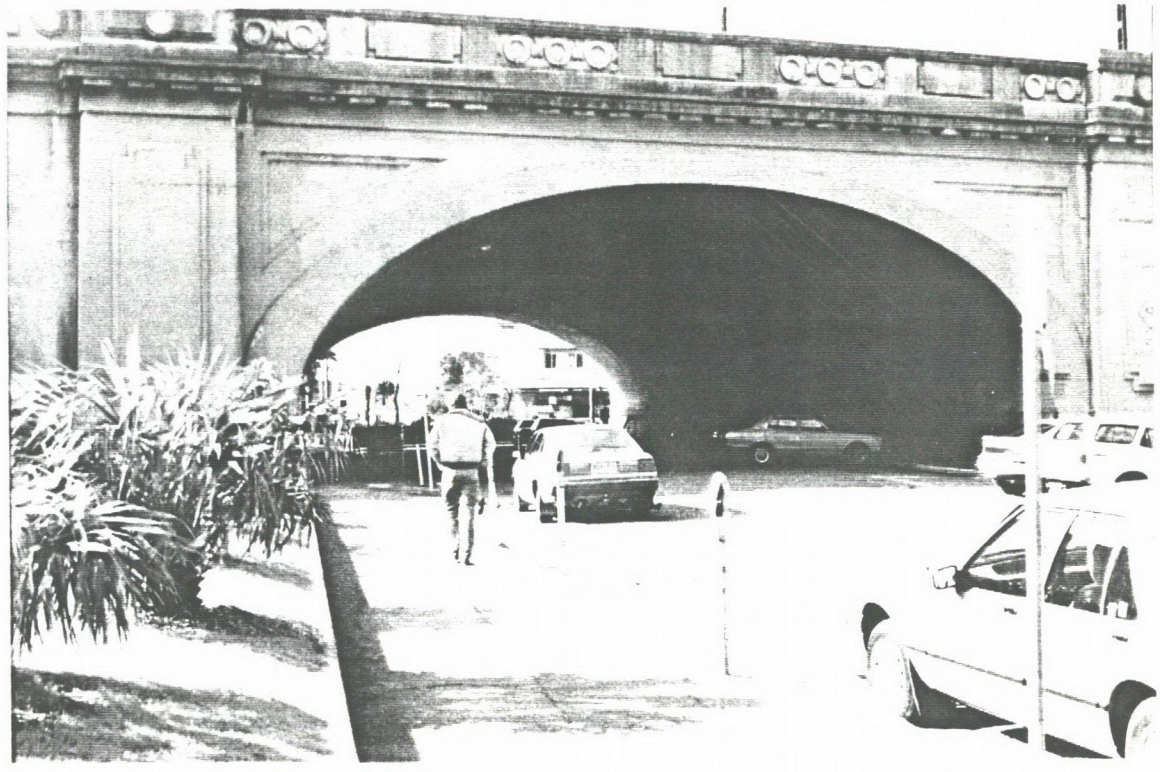
- Massing and detail of the construction related to human scale.
- Thoughtful and sensitive design which resolves both structural and urban issues.

Figure 2.6



Sydney City:

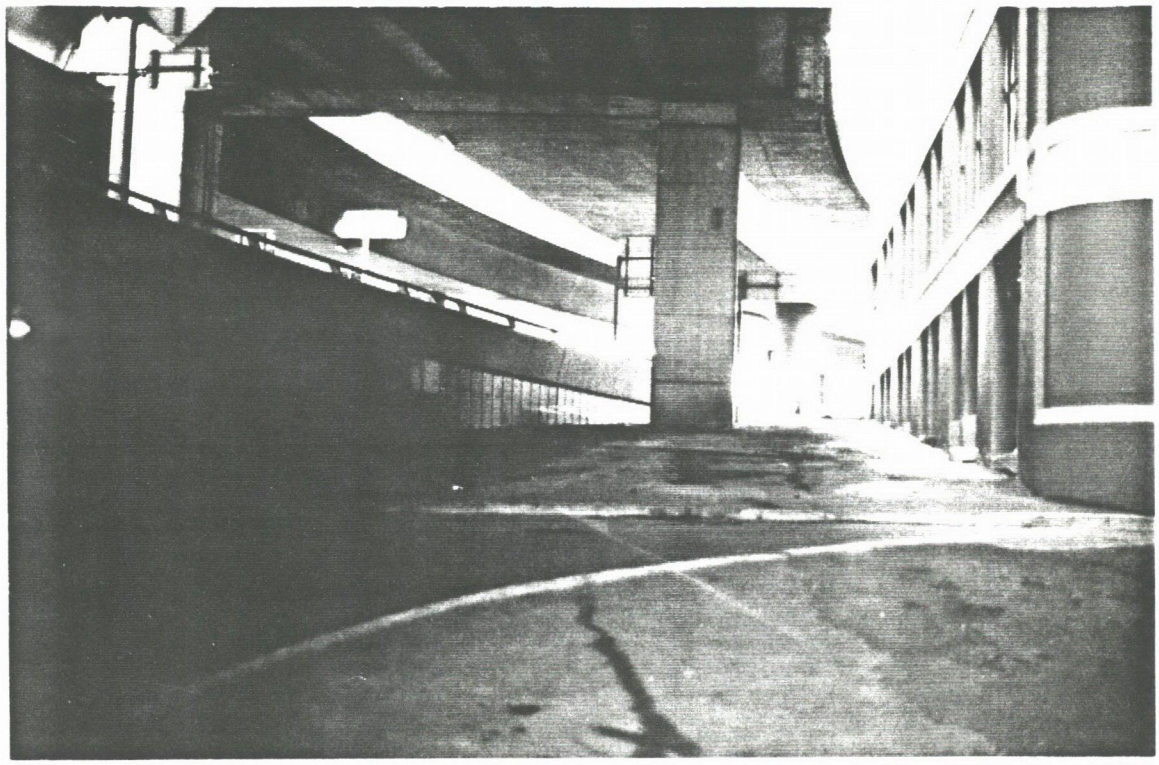
- Bridge blights the streetscape.



Milsons Point:

- Bridge makes a contribution to the streetscape by framing the view.
- Careful design consideration is given to materials, finish and articulation of the facade.

Figure 2.7



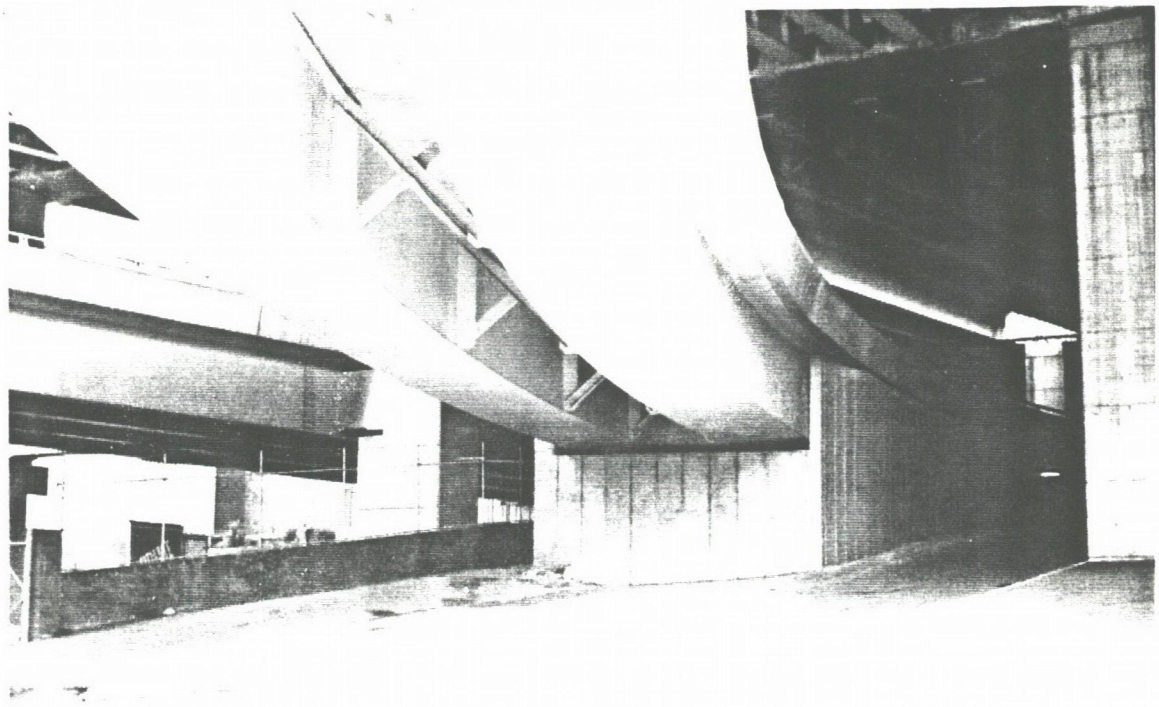
Ultimo: Lost Space

- A bleak pedestrian route.

Kirribilli: Gained Space

- An inviting pedestrian area.

Figure 2.8

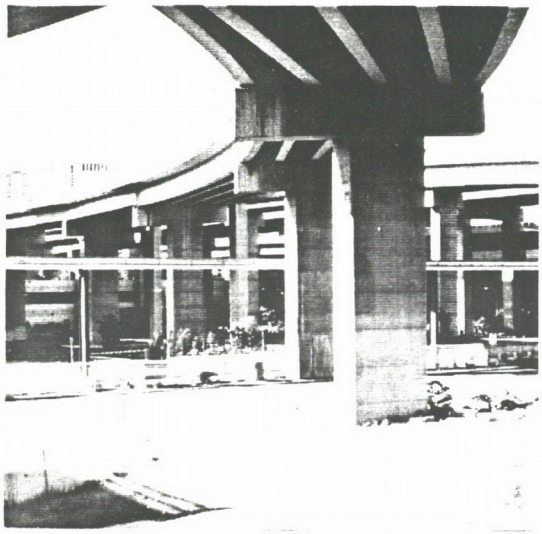


Ultimo: Lost Space

Kirribilli: Gained Space

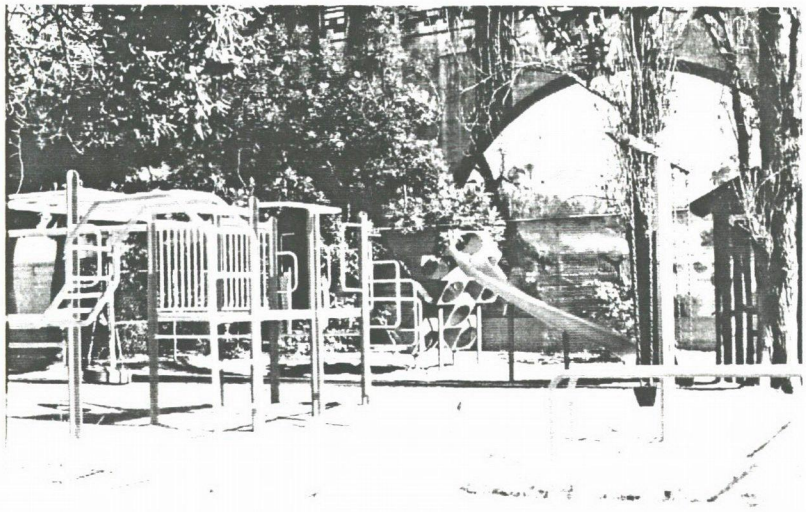
- Purposeful links under the transport corridor.

Figure 2.9



Ultimo: Lost Space

- Degraded open space; car parks and bitumen.



Milsons Point and The Rocks: Gained Space

- Amenity of the area is improved through the provision of usable green space and recreation areas.

Figure 2.10