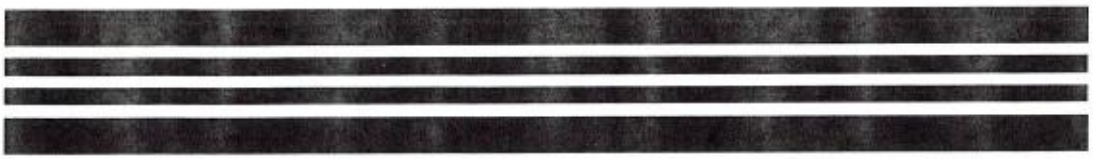

EIS 453

AB019126

# Princes Highway, Minnamurra River to Bombo, Kiama : environmental impact statement, July 1986

# PRINCES HIGHWAY
# MINNAMURRA RIVER TO BOMBO
# KIAMA



DMR

## ENVIRONMENTAL IMPACT
## STATEMENT



DEPARTMENT OF MAIN ROADS N.S.W.

# PRINCES HIGHWAY
# MINNAMURRA RIVER TO BOMBO
# KIAMA


## ENVIRONMENTAL IMPACT
## STATEMENT

JULY 1986

DEPARTMENT OF MAIN ROADS N.S.W.

DEPARTMENT OF MAIN ROADS, NEW SOUTH WALES

S.H. 1 - PRINCES HIGHWAY
PROPOSED RECONSTRUCTION
MINNAMURRA RIVER TO BOMBO
KIAMA

ENVIRONMENTAL IMPACT STATEMENT

CLAUSE 59 CERTIFICATION

This is to certify that the subject Environmental Impact Statement has been prepared in accordance with Clauses 57 and 58 of the Environmental Planning and Assessment Regulation, 1980.

Warren J. Atkinson
Principal-in-Charge
Environmental Studies
Dames & Moore

June 1986

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# SUMMARY

## THE PROPOSAL

The Department of Main Roads, NSW (DMR) proposes to upgrade a section of the Prince Highway on the South Coast of NSW, north of Kiama. Kiama is a coastal town approximately 112 km from Sydney.

The section of Highway proposed for upgrading is situated in the northern suburbs of Kiama. The carriageway would be realigned and widened from two lanes to four lanes, with shoulders and a median strip. There is 4.3 km of Highway involved commencing at the bridge over the Minnamurra River then extending south to Bombo. The resultant carriageway will provided drivers with a better line-of-sight, safer driving conditions and free flow of traffic.

Upgrading will involve the duplication of the existing bridge over the Minnamurra River, on its eastern side. From the bridge to just north of Oxley Avenue, the Highway travels between the Minnamurra River on the west, and the Kiama Golf Course and a basalt cliff on the east. Widening of the Highway will require some filling of the River. To reduce effects on the River it is proposed that a vertical reinforced earth wall be constructed for the majority of this section. The Highway widening will also encroach upon a small section of the Kiama Golf Course, and a section of the basalt cliff will be removed. However, it will not affect houses located on top of the cliff.

From Oxley Avenue to Bombo the proposed upgrading is contained largely within the Kiama Council Arterial Road zoning. Some land acquisition will be required from the frontages of properties, however driveways and access will be maintained. In conjunction with the upgrading of this southern section, a traffic management plan will be implemented. This will involve changing the nature of intersections to reduce the number of conflict points along the Highway, and to allow a freer flow for traffic.

As part of the traffic management plan, the number of right turns to the north will be reduced. However, left turns will be available at

be denied and a service road constructed from Iluka Crescent paralleling the Highway to North Kiama Drive. Access from North Kiama Drive to the existing Highway will be maintained. The Highway will be realigned to the west at this point and south to Bombo. An overbridge is proposed for construction from North Kiama Drive, across the new Highway alignment to join Barton Drive and its extension. Barton Drive is the southern access road from the subdivision area called Gainsborough Estate.

Gainsborough Estate is located on the western side of the Highway and is a relatively new and developing northern suburb of Kiama. Current access from the Estate is from Meehan Drive at its northern end.

Connecting ramps are proposed to join the Highway and the Barton Drive extension, which will join the overbridge allowing east-west movement of traffic from residences located on either side of the Highway.

The Highway realignment on Bombo hill traverses an abandoned quarry which will require filling for the new Highway and access ramps. The existing Highway will be retained to provide access to the new carriageway, which continues south to rejoin the existing Highway adjacent to Bombo station. The Highway then continues south to join the Kiama by-pass road.

## ALTERNATIVES

Seven alternatives were considered; the no project alternative, two separate route corridors with variations, and one proposed by a local residents group (RANKS). The route corridors are referred to as the Princes Highway Options and the Swamp Road Options. The Princes Highway Options follow the alignment of the existing Highway. The Swamp Road Options follow a route corridor to the west of the existing Highway alignment, the Minnamurra River and the associated wetland area known as the Terragong Swamp. While similar to the Swamp Road Options at its northern end, the RANKS option veers further west over its southern section then joining Terralong Street at Kiama.

Within the Princes Highway corridor three alternatives were identified for the section of Highway from the Minnamurra River bridge to Oxley

Avenue. These alternatives were denoted Schemes A, D and E. The major differences between the Schemes relate to the encroachment into the River, excavation of the basalt cliff and encroachment onto the Kiama Golf Course.

Scheme A significantly encroaches into the Minnamurra River but very little into the basalt cliff or Golf Course. Scheme D significantly encroaches into the basalt cliff, house blocks located on top of the cliff and the Golf Course but very little into the Minnamurra River. Scheme E is a compromise between Schemes A and D. Encroachment into the River is not as significant as Scheme A, excavation of the basalt cliff is not as significant as Scheme D. House blocks will not be affected. The Scheme remains within the Arterial Road zoning for most of its length.

The Swamp Road corridor alternative traverses predominantly rural agricultural land. Two options were proposed and denoted Schemes B and C. Both Schemes leave the Princes Highway at the intersection of Swamp Road and the Highway north of the Minnamurra River bridge. They follow a generally south westerly alignment to cross the upper reaches of the Minnamurra River around Terragong Swamp. The crossing of the Minnamurra River and swamp will require a 1 km bridge. The alignments then separate, Scheme B travelling south and southeast towards Kiama and Scheme C diverging east to Bombo hill to join the Princes Highway.

The Swamp Road Options are considered more environmentally damaging than upgrading the existing Highway corridor.

A new road would be required to be constructed to Highway Standards including substantial earthworks and consequently a higher construction costs. The new road would divide rural properties which may result in units that are not viable. A 1 km long bridge would be required which must be designed to ensure that the swamp and flood plains over which it passes are not significantly disturbed and downstream biota are not affected. A new road would significantly change the rural landscape character of the area and its scenic quality. The Schemes also traverse the recently designated Parbury Estate subdivision area.

Scheme C traverses the designated and operating quarry areas which would affect quarry operations. This Scheme would be highly visible from the existing Highway south of Bombo as it travels downhill to join the Kiama by-pass road.

The Swamp Road Options would divert through traffic around the northern suburbs of Kiama. However, traffic data indicates that the majority of non-holiday traffic is local and commuter traffic generated from the developing northern suburbs of Kiama.

While the RANKS option avoids the operating quarry areas and the Parbury Estate, it traverses land zoned scenic protection, a section of the Jamberoo Valley which is the subject of Ministerial control, and a potential urban expansion area.

## THE NEED

The need for an upgraded road system in the northern suburbs of Kiama is based on two major factors.

Firstly, during peak holiday periods congestion along the Princes Highway occurs both to the north and south of Kiama, causing delays and a reduced traffic flow. Although peak traffic occurs for relatively short periods of time, it has been identified as being up to 48% higher than Annual Average Daily Traffic (AADT) volumes during non-holiday periods. The Kiama business centre has been identified as being the main bottleneck. A by-pass road is currently being constructed to alleviate this problem.

Secondly, during the non-holiday periods the majority of traffic using the Highway has been identified as local and commuter traffic. Recent AADT counts indicate that volumes are 14,000 to 16,000 vehicles per day. On a two lane carriageway, such as the existing Highway, planning guidelines indicate that over 12,000 vehicles per day will cause decreased levels of service with substantial drops in speed and even stoppages. As the northern suburbs of Kiama continue to develop, traffic levels on the Highway will increase. Consequently, there is a need to upgrade the existing traffic facility to adequately cope with existing traffic volumes and future traffic growth.

## KEY ISSUES

The key environmental issues of the proposed Scheme E relate to the terrestrial, aquatic, social, transportation, visual and atmospheric environments.

### Terrestrial

- Vegetation of the basalt cliff will be totally removed. However, the final landform will allow some areas for revegetation.

- Some land will be acquired from the Golf Course and a small number of properties located between Oxley Avenue and Bombo adjacent to the Highway. This is not expected to affect their use. Driveways and access points will be maintained.

### Aquatic

- Water quality of the Minnamurra River will be affected during construction of the River embankment for short periods of time. The use of a reinforced earth wall was selected to minimise disturbance to the river channel.

- The hydrology of the Minnamurra River will have increased current velocities in periods of flood flow but these are unlikely to significantly change the existing overall sediments transport patterns. Flood levels upstream would be increased but to a lesser extent than Scheme A. Current velocities in periods of low river flow would be increased by less than 10% with Scheme E.

- Aquatic biology will be affected by the Highway reconstruction. Approximately 5% of the main stand of mangroves will be removed during construction and part of the scattered mangrove stands further south. Minor and short duration silting may have no discernable impact whereas infilling is likely to result in mangrove death. While increased turbidity can affect other organisms such as oysters, fish and seagrasses, no adverse impacts are anticipated.

- Construction of the Highway is not expected to significantly alter the existing hydrological or sediment transport patterns and therefore no significant impacts on the wetland communities are anticipated.

**Social**

- The local communities of the northern suburbs of Kiama will benefit from the upgraded Highway and traffic management plan through easier and safer access from east to west and to and from the Highway, shorter travelling times to Kiama, and safer journeys free from traffic congestion.

- Access to the river will be maintained for tourism and recreation purposes. The Kiama Golf Course will not be adversely affected by the Highway upgrading. Land acquired from Reserves will not affect their use.

- Residences located on top of the basalt cliff will not be adversely affected.

**Transport**

- Short term impacts will result from construction activities as lanes are removed from service for short periods of time.

- Long term benefits will result from a better road system.

**Visual**

- Change to the visual "Gateway to Kiama" as it currently exists will be significant. However, vegetation will be replaced wherever possible to maintain the green corridor effect.

- Change in view of road will provide better lines of sight along the Highway and distant views of the Jamberoo Valley area.

- There will be change in localised views for residents living close to the Highway.

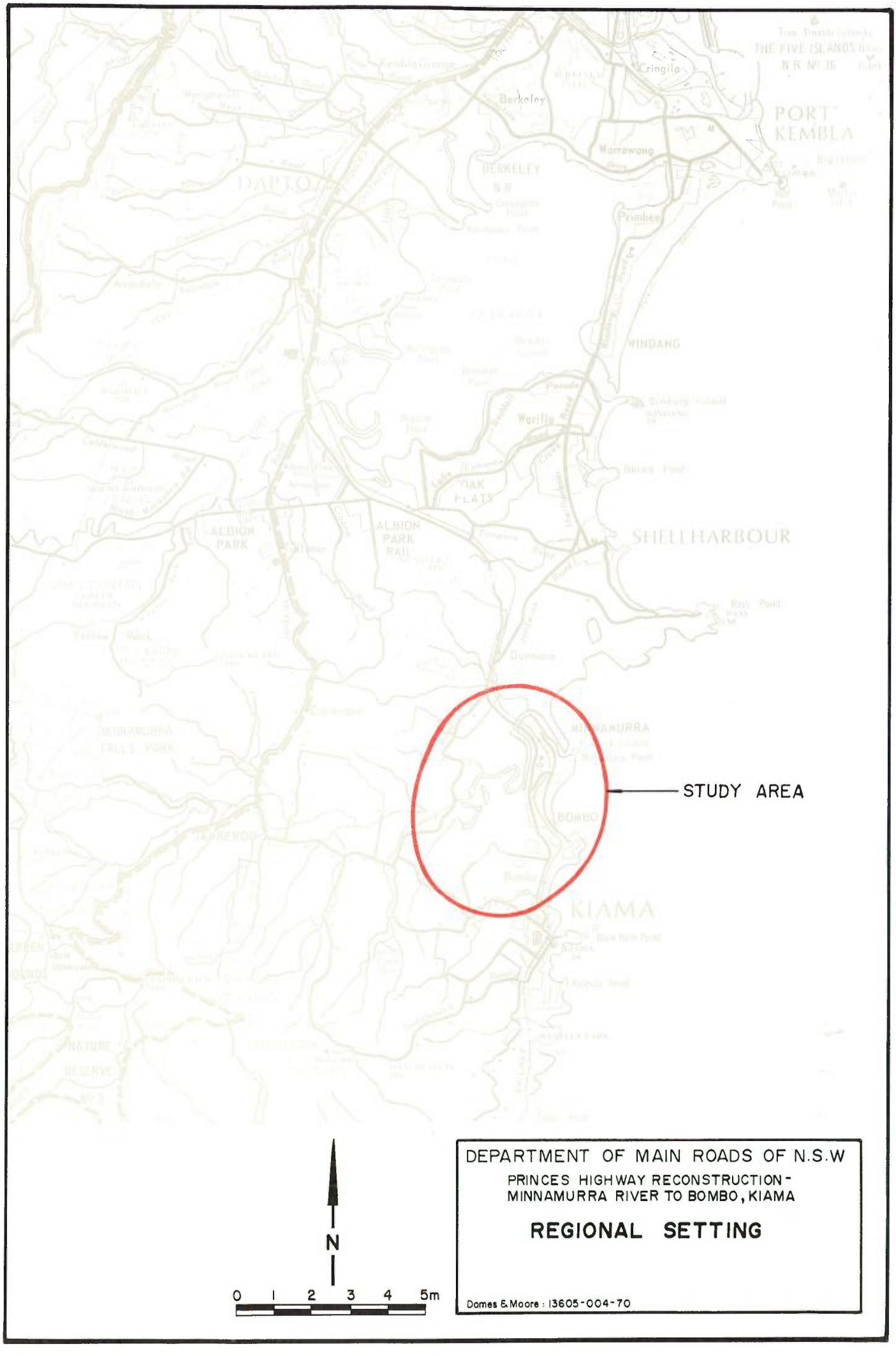
**Atmospheric**

- Noise levels will increase for a number of residences located adjacent to the Highway. Measures to reduce this involve the use of earth and acoustic barriers or screens and speed restrictions to ensure noise levels do not increase beyond present levels.

- Vibration and overpressure levels from blasting will not be significant during the construction phase providing blasting activities fall within the standards outlined.

**CONCLUSION**

Having regard to the need for an upgraded road, the alternatives, and to the safeguard measures proposed to reduce environmental impacts, it is considered that the environmental consequences of proceeding with the proposed Scheme E for reconstruction of the Princes Highway are acceptable and that this project should be approved for construction.




DEPARTMENT OF MAIN ROADS OF N.S.W

PRINCES HIGHWAY RECONSTRUCTION - MINNAMURRA RIVER TO BOMBO, KIAMA

**REGIONAL SETTING**

Domes & Moore : 13605-004-70

## 1.0 INTRODUCTION

The Department of Main Roads of NSW (DMR) proposes to upgrade the road system north of Kiama. The existing road system from Sydney includes the Princes Highway and the F6 (Southern) Freeway as shown on Figure 1.1. The F6 Freeway is presently being constructed to Yallah, south of Wollongong. From Yallah, the Princes Highway is the major transport corridor south.

As the South Coast areas of NSW have developed over recent years, the volume of traffic has increased. The traffic consists of not only through traffic and holiday traffic but also commuter and local traffic. Areas such as Kiama have become popular locations for urban development, with residents commuting to locations such as Wollongong for employment.

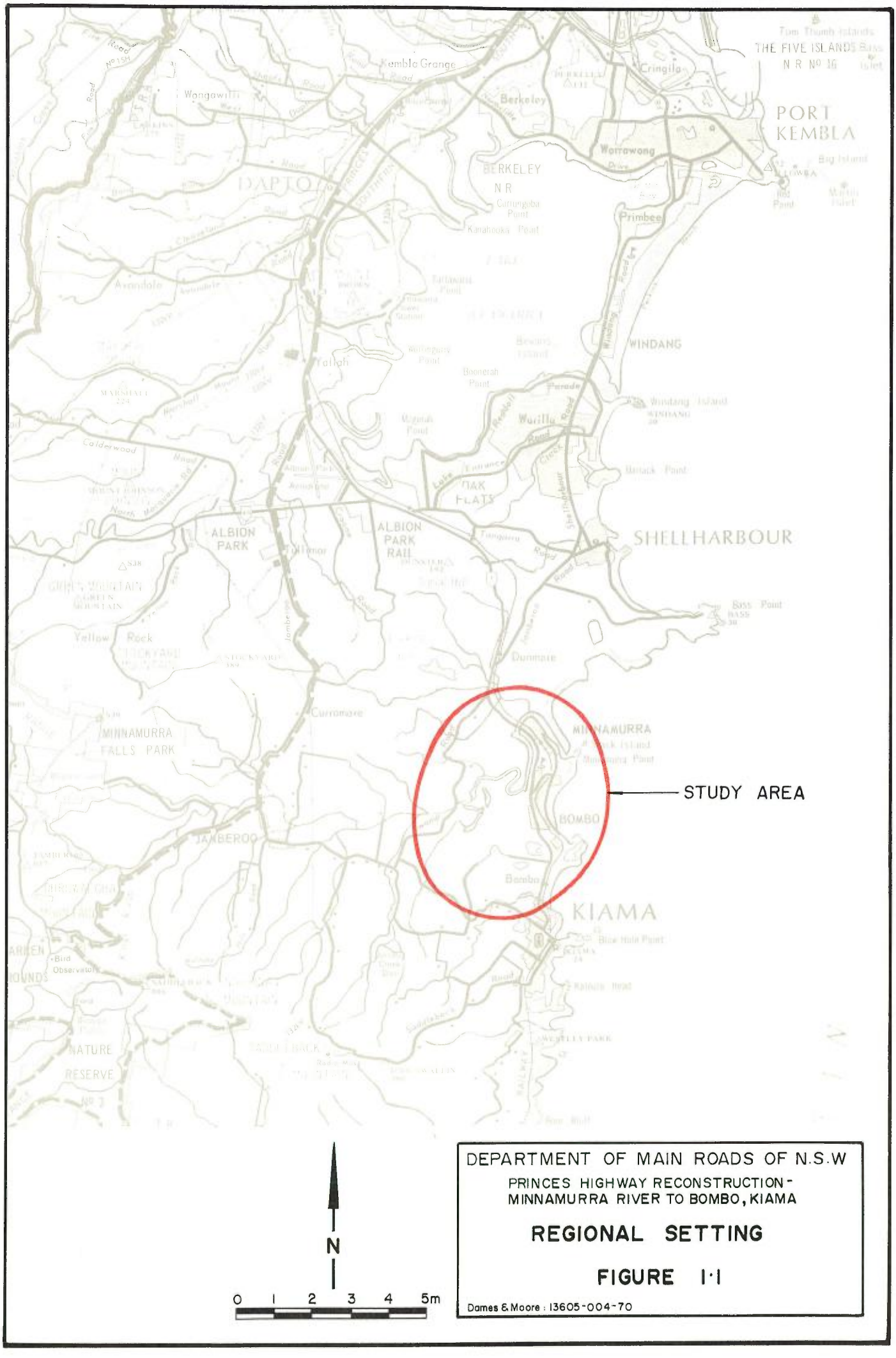
In association with the F6 Freeway to Yallah, the DMR proposes to upgrade sections of the Princes Highway south of Yallah. Reconstruction works have been completed for a section of the Highway south of Kiama. The construction of a by-pass road around Kiama is being undertaken to redirect traffic around the main business centre. During major holiday periods, extreme traffic delays are often experienced north and south of Kiama due to the volumes of traffic passing through the business centre.

Two alternative route corridors have been identified for the proposed road system upgrading. One corridor follows the existing Princes Highway route from south of Dunmore to Bombo. It involves reconstruction of the Highway to a dual carriageway and implementation of a traffic management plan.

The Highway corridor passes through the northern suburbs of Kiama including Minnamurra and Kiama Downs. Areas to the east are older and more established, whereas areas to the west include the Gainsborough Estate, a new and developing residential subdivision area. Traffic volumes and population growth in this area are significantly higher than in others areas in Kiama.

A traffic management scheme has been developed by the DMR to allow for traffic flow in an east-west direction in addition to the predominant north-south movement which currently exists. This scheme has been designed to enable an uninterrupted flow of traffic along the Highway while allowing residents on the east of the Highway adequate access to proposed new services and facilities in the Gainsborough Estate. Maintaining access will be achieved by reducing traffic movements at a number of intersections along the Highway and by construction of an overbridge.

The alternative route corridor traverses rural agricultural land to the west of the existing Highway and to the east of the Jamberoo Valley. The area is used predominantly for dairy farming and cattle grazing. The route would require the construction of a new road easement including a 1 km bridge over the upper reaches of the Minnamurra River and associated wetland area.




DEPARTMENT OF MAIN ROADS OF N.S.W

PRINCES HIGHWAY RECONSTRUCTION - MINNAMURRA RIVER TO BOMBO, KIAMA

**REGIONAL SETTING**

**FIGURE 1·1**

Dames & Moore : 13605-004-70

# 2.0 BACKGROUND TO PROPOSAL

## 2.1 EXISTING ROAD SYSTEM

Transport facilities along the coastal area south of Wollongong to Nowra are subjected to a variety of pressures including local, commuter and peak recreational traffic of which the study corridor is an extreme example.

The Princes Highway (State Highway No.1 - hereafter referred to as SH1) is the principal road transport facility for the coastal portion of the Municipality of Kiama.

Within the corridor to the south of Dunmore, SH1 is the only major road link to the South Coast from the Wollongong Metropolitan area. From Dunmore to Kiama township, SH1 is two lanes and generally has poor alignment and sighting distances. North of Dunmore, an alternative route to Wollongong is provided by Main Road No. 522 (MR522) along the eastern shores of Lake Illawarra. North of Dapto on SH1, alternative access to Wollongong and areas to the north is provided by the F6 Freeway.

Other roads in the corridor perform a rural and urban access function. Swamp Road is a local rural access road that runs between the Princes Highway and Main Road No. 264 (MR264). From its intersection with the Highway north of the Minnamurra River, Swamp Road follows an alignment through rural lands and across the Terragong Swamp to intersect with MR264 midway between Kiama and Jamberoo. MR264 provides rural and tourist access to the Jamberoo Valley from the township of Kiama.

## 2.2 NEED TO UPGRADE EXISTING ROAD SYSTEM

### 2.2.1 Regional Traffic Characteristics and Trends

The current problems being experienced within the corridor cannot be simply allocated to an individual section. It is important to highlight a number of transportation and related land use factors. These include:

- The present access to the F6 Freeway;

- The extreme congestion in holiday periods through Kiama township;

- The high growth rate of residential land use and its effect on corridor traffic volumes;

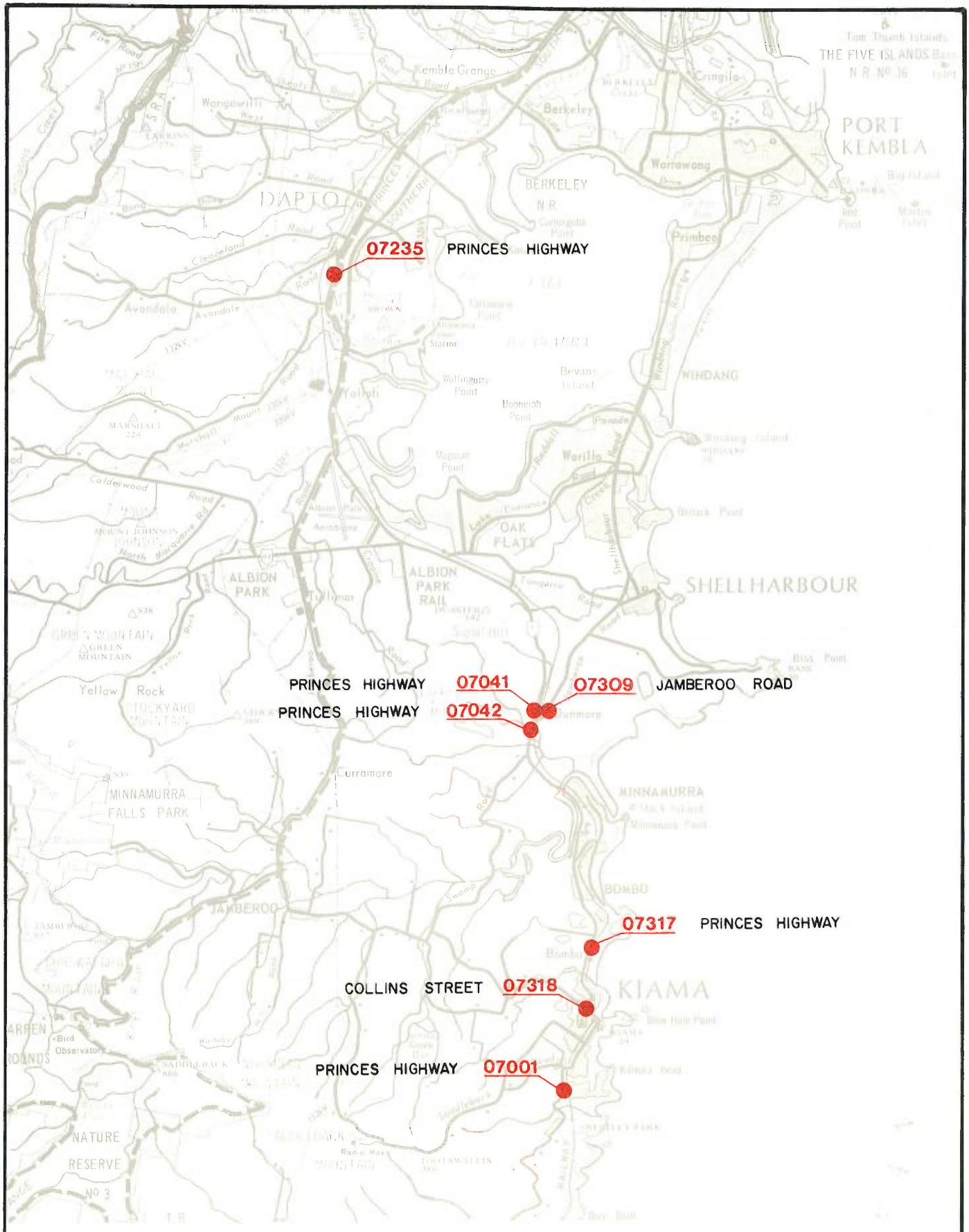
- The extreme peaking characteristic of the traffic.

The Princes Highway (SH1) within the corridor is heavily affected in holiday periods by the bottleneck situation that occurs from traffic leaving the F6 Freeway at Dapto and flowing onto SH1 (refer Figure 2.1). Furthermore, south of Albion Park, additional traffic is added to a two lane flow at the junction with MR522.

A construction programme is extending the F6 Freeway south to Yallah. This will not significantly improve the situation in the study corridor. A bottleneck currently exists at Dunmore (north of Kiama) at the junction of MR522 and the Highway, for traffic moving south, and moving north the bottleneck occurs at Omega at the Highway junction with "The Sandtrack".

A second factor which is important in understanding the present corridor situation is the effect of Kiama township. At present the Princes Highway runs through the commercial centre of Kiama causing extreme conflict between local and recreational/tourist traffic. When this congestion interacts with the problems to the north of Dunmore, extreme delays have been experienced. A construction programme is under way to build the Kiama By-Pass road from Bombo around the main Kiama commercial centre to Kiama Heights at Wier Street. The completion of this by-pass is expected to relieve delays associated with the commercial centre during peak periods.

Another important consideration is the high internal rate of population growth of the Municipality of Kiama. The annual average growth rate of the Municipality between 1976 and 1981 was over 6.2% compared to 1.8% for the Illawarra Region and 1.5% for the State. In the last ten years, Kiama has increasingly functioned as a commuter area for




**LEGEND**

07317 COUNT STATION

N

0 1 2 3 4 5m

DEPARTMENT OF MAIN ROADS OF N.S.W

PRINCES HIGHWAY RECONSTRUCTION - MINNAMURRA RIVER TO BOMBO, KIAMA

## COUNT STATIONS

## FIGURE 2·1

Dames & Moore : 13605-004-70

Wollongong and to a lesser extent, Sydney. Residential land was cheaper than in areas to the north up to the early 1980's but values have since moved up to equal other attractive coastal areas of NSW. The area also continues to attract retired persons as well as functioning as the rural service centre for the Jamberoo and Gerringong subregion. It is also a major holiday and day-tripper location during the summer period, with large numbers of visitors and holiday makers from Sydney, Wollongong and rural areas of the State.

Even though all components of traffic have probably experienced some growth due to population and associated landuse changes, the biggest increase in the corridor is due to growth of local traffic. This effect can be demonstrated by reference to Departmental traffic volume data. Annual Average Daily Traffic (AADT) Volumes for the corridor from Dapto to Kiama are shown in Table 2.1. Annual average growth rates for traffic for the periods 1974 to 1978, 1978 to 1982 and 1974 to 1982 are shown in Table 2.2. Figure 2.1 shows the location of DMR traffic counting stations. The most recent AADT counts (DMR, 1984) exclude counting stations at Bombo (No. 07317) and Kiama (No. 07318) and consequently they have not been used in assessing average growth rates.

Inspection of Table 2.2 indicates that growth in traffic along the relevant section of SH1 has been associated with substantial residential development. From field observations, this has occurred in the vicinity of Albion Park Rail and the northern suburbs of Kiama. Growth rates for the 1978 to 1982 period are substantially higher (around 8%) within the corridor (i.e. between Dunmore and Bombo) than is the case at either end of this section of SH1 (i.e. Dapto and South Kiama growth rates are in the vicinity of 2 to 5%).

Another important consideration is the extreme peaking characteristic of the traffic. Variation in traffic volumes between holiday periods and normal working days is illustrated in Table 2.3. The data presented in Table 2.3 was collected at the South Kiama permanent counting station (No. 07001). Although AADT's show a decline in 1982 of approximately 5,000 vehicles between South Kiama and Bombo (refer Table

TABLE 2.1

REGIONAL TRAFFIC VOLUMES*
DMR : AADT

| COUNT STATION | 1974 | 1976 | 1978 | 1980 | 1982 | 1984 |
|---|---|---|---|---|---|---|
| Dapto (07235) Sth of Avondale Rd | 13280 | 17630 | 18230 | 20120 | 21410 | 19400 |
| Dunmore Nth (Hwy) (07041) | 6080 | 7040 | 6570 | 8570 | 8970 | 9280 |
| Dunmore (MR522) (07309) | 5300 | - | 6380 | 7990 | 7670 | 8080 |
| Dunmore (Hwy) SH1 (07042) | 10440 | - | 12050 | 15970 | 16460 | 14200 |
| Bombo SH1 (07317) | 11500 | - | 12010 | - | 16830 | - |
| Kiama (Nth of Centre) (07318) SH1 | 11740 | - | 13770 | - | 15900 | - |
| Kiama (SH1) Nth of Marks St (P07001) | 7530 | 8470 | 9380 | 10610 | 11570 | 11930 |

* Unadjusted for Heavy Vehicles

Source: DMR

TABLE 2.2

ANNUAL AVERAGE GROWTH RATES
FOR SELECTED COUNTING STATIONS

1974/78, 1978/82 and 1974/82

| LOCATIONS AND NUMBER | 1974/1978 | 1978/1982 | 1974/1982 |
|---|---|---|---|
| Dapto SH1, South of Avondale Rd (07235) | 8.24 | 4.10 | 6.15 |
| Albion Park SH1, East of MR262 (07040) | 6.47 | 1.67 | 4.05 |
| Dunmore SH1, North of MR522 (07041) | 1.95 | 8.09 | 4.98 |
| Dunmore MR522, East of SH1, (07309) | 4.74 | 4.70* | 4.72 |
| Dunmore SH1, South of MR522 (07042) | 3.65 | 8.10 | 5.86 |
| Bombo SH1 (07317) | 1.08 | 8.80 | 4.86 |
| Kiama SH1, North of Centre (07318) | 3.93 | 3.65 | 3.86 |
| Kiama SH1, North of Marks Street, South of Centre (P07001) | 5.64 | 5.38 | 5.51 |

* Station 07039 recorded a reduction in AADT from 1980 to 1982. However, annual average growth rate for 1978-80 was 11.9%.

Source: DMR

## TABLE 2.3

## HOLIDAY TRAFFIC FLOWS (SOUTH KIAMA, 1982)

| PERIOD (1982) | Fri | Sat | Sun | Mon | Tue | Wed | Thu | Total |
|---|---|---|---|---|---|---|---|---|
| Jan 1-7 | 17280 | 21130 | 21600 | 16800 | 14390 | 14280 | 13980 | 119460 |
| Jan 8-14 | 18350 | 19090 | 21310 | 15240 | 13310 | 14030 | 13640 | 114970 |
| Jan 29-Feb 4 [1] | 21000 | 21690 | 18830 | 19160 | 11890 | 9320 | 9640 | 111530 |
| Feb 5-11 | 12610 | 12110 | 15530 | 10360 | 9150 | 9520 | 9970 | 79250 |
| Apr 9-15 [2] | 21930 | 17110 | 20630 | 20450 | 17650 | 10280 | 10000 | 118050 |
| Apr 16-22 | 12140 | 10260 | 12060 | 9640 | 9220 | 9330 | 9770 | 72420 |
| Jun 11-17 [3] | 14740 | 14620 | 12650 | 15460 | 9430 | 8640 | 8710 | 84250 |
| Jun 18-24 | 10840 | 10060 | 11340 | 8550 | 8180 | 8010 | 8360 | 65340 |
| Oct 1-7 [4] | 18750 | 18840 | 15460 | 20260 | 11720 | 8700 | 8910 | 102640 |
| Oct 8-14 | 11620 | 9270 | 11180 | 8990 | 8730 | 8750 | 8900 | 67440 |
| Dec 17-23 | 13960 | 13200 | 14340 | 11770 | 10960 | 11240 | 12350 | 87820 |
| Dec 24-30 [5] | 14240 | 13830 | 22150 | 21570 | 19890 | 17630 | 17690 | 127000 |

1 Australia Day long weekend
2 Easter
3 Queens Birthday long weekend
4 Labour Day long weekend
5 Christmas week

Source: DMR

2.1), this station is the closest permanent counting station to the corridor. The points of interest are the extent to which holiday volumes exceed the AADT and the significant drop in volumes between holiday periods and normal workday periods.

For the 1982 count, Boxing Day (Sunday 26th December), registered the highest daily traffic volume for the year. The volume was approximately 54% higher than the preceding Sunday and over 91% higher than the AADT. Other significant variations are shown for the Easter Holidays, Australia Day and Labour Day long weekends. Similar peaking characteristics were recorded at the South Kiama count station (No. 07001) for 1984. Holiday peak traffic has been identified as up to 48% higher than the AADT but occurs for relatively short periods. If a similar percentage was applied to the Princes Highway immediately north of Kiama, traffic volumes in the vicinity of 30,000 vehicles a day can be estimated for the peak holiday periods. This data should also be considered in relation to the earlier discussions concerning the F6 Freeway and the congestion associated with Kiama township.

### 2.2.2 Traffic Projections

Projections of traffic growth were completed for selected stations for the years 1990 and 1995. As shown in Table 2.4, the most apparent feature of the projections is the high component of local traffic generated in the section from SH1 at Bombo to the intersection of MR522 and SH1 at Dunmore. These projections have used a minimum traffic growth assumption with a simple straight-line trend analysis. It is important to emphasise that the projections assumed that there will be no changes in the present system. As discussed in Section 2.2.1, the Kiama by-pass should alleviate peak holiday queuing associated with the commercial centre, particularly at the end of weekends, which would reduce congestion from Bombo to the north. It is also important to stress the new residential development areas to the north of Kiama. The addition of 390 vacant lots in the Gainsborough Estate on the western side of SH1 will generate major traffic increases, and the areas east of the Highway would also generate minor traffic increases from small pockets of infill development.

TABLE 2.4

TRAFFIC PROJECTIONS 1990 AND 1995
FOR SELECTED STATIONS

| LOCATION AND NUMBER | 1990 | 1995 |
|---|---|---|
| Dapto SH1, South of Avondale Rd (07235) | 30726 | 36040 |
| Dunmore SH1, North of MR522 (07041) | 12427 | 14529 |
| Dunmore SH1, South of MR522 (07042) | 23748 | 28150 |
| Dunmore MR522, East of SH1 (07309) | 12159 | 14540 |
| Bombo SH1 (07317) | 21655 | 25103 |
| Kiama SH1, North of Centre (07318) | 23750 | 28094 |
| Kiama SH1, North of Marks Street, South of Centre (P07001) | 15359 | 17786 |

Projections for the count stations at Dunmore (No. 07042) and Bombo (No. 07317) indicate average daily volumes in excess of 20,000 vehicles by 1990. Planning guidelines adopted by the DMR indicate that traffic conditions along a two lane carriageway will begin to deteriorate when the AADT exceeds 12,000 vehicles. Given the projected daily traffic and the continued higher holiday traffic peaks, traffic on the existing carriageway would be over capacity.

### 2.2.3 Need for Local Road

A review of traffic characteristics, trends and projections indicated that, with the exception of major holiday periods, the majority of traffic using the Princes Highway is local and commuter traffic.

Daily traffic volumes in the study corridor, based on survey data and AADT counts, were assessed at approximately 14,000 - 16,000 vehicles. These volumes exceed Highway planning guidelines for traffic on the existing carriageway.

Consequently, on the basis that the existing Highway facilities are endeavouring to handle traffic volumes beyond the design capacity, and future projections indicate continuing growth, there is a need to upgrade the existing carriageway or construct a new road to ensure that adequate traffic conditions are maintained.

## 2.3 ENVIRONMENTAL ASSESSMENT PROCEDURES

Since the Department of Main Roads, under its enabling legislation, does not seek development consent for main road construction activities, reconstruction of the Princes Highway falls under Part V of the Environmental Planning and Assessment Act, 1979. The NSW Department of Main Roads is the Determining Authority for its road developments and is required under Sections 111 and 112 of the Act to take into account the environmental consequences of such developments before making any decisions to proceed with them. Having examined the likely environmental effects, the Department of Main Roads has decided that the preparation of an Environmental Impact Statement is required for the proposal. The Act requires that the Impact Statement be prepared in

accordance with Clauses 57 and 58 of the Environmental Planning and Assessment Regulation, 1980.

The Department of Main Roads has consulted with the Department of Environment and Planning concerning the form and content of this Environmental Impact Statement and a copy of the "Directors Requirements" are included as Annex A of this document.

# 3.0 LOCAL ENVIRONMENT

## 3.1 STUDY AREA

The area under study for the location of the road corridors is to the north of the township of Kiama. Kiama is between Wollongong and Nowra on the South Coast of NSW, approximately 120 km from Sydney.

The road options under consideration are included in two route corridors. The study area and corridor alternatives are shown in Figure 3.1. Route options within one corridor have been identified for the upgrading of the existing Princes Highway from the bridge over the Minnamurra River to Bombo. The route options in the alternative corridor are located to the west of the Highway in the vicinity of Swamp Road and the Terragong Swamp.

The following sections describe the environment of the study area. The main features are the Minnamurra River and the associated wetlands, the urban areas adjacent to the Princes Highway and associated Kiama township, new subdivision areas, and the rural environment to the west through which Swamp Road passes.

## 3.2 CLIMATE

The South Coast area is one of high humidity and high rainfall with Kiama receiving 1247 mm of rain in an average year.

Rainfall reaches a peak of about 80-90 mm per month in the late summer-early autumn period and a trough of about 50 mm per month in late winter-early spring. Warm season rainfall is generally more reliable than cool season rainfall.

Average temperature ranges are as follows:

| | |
|---|---|
| Summer - maximum 27°C | Winter - maximum 17°C |
| minimum 18°C | - minimum 8°C |

Prevailing winds in summer are south and northeast, and in winter, west and southwest.

Such favourable climatic conditions provide good plant growth for most of the year. This relatively high soil-water status means that vegetative methods can be effectively used to control most forms of surface soil erosion.

## 3.3 LANDFORM, GEOLOGY AND SOILS

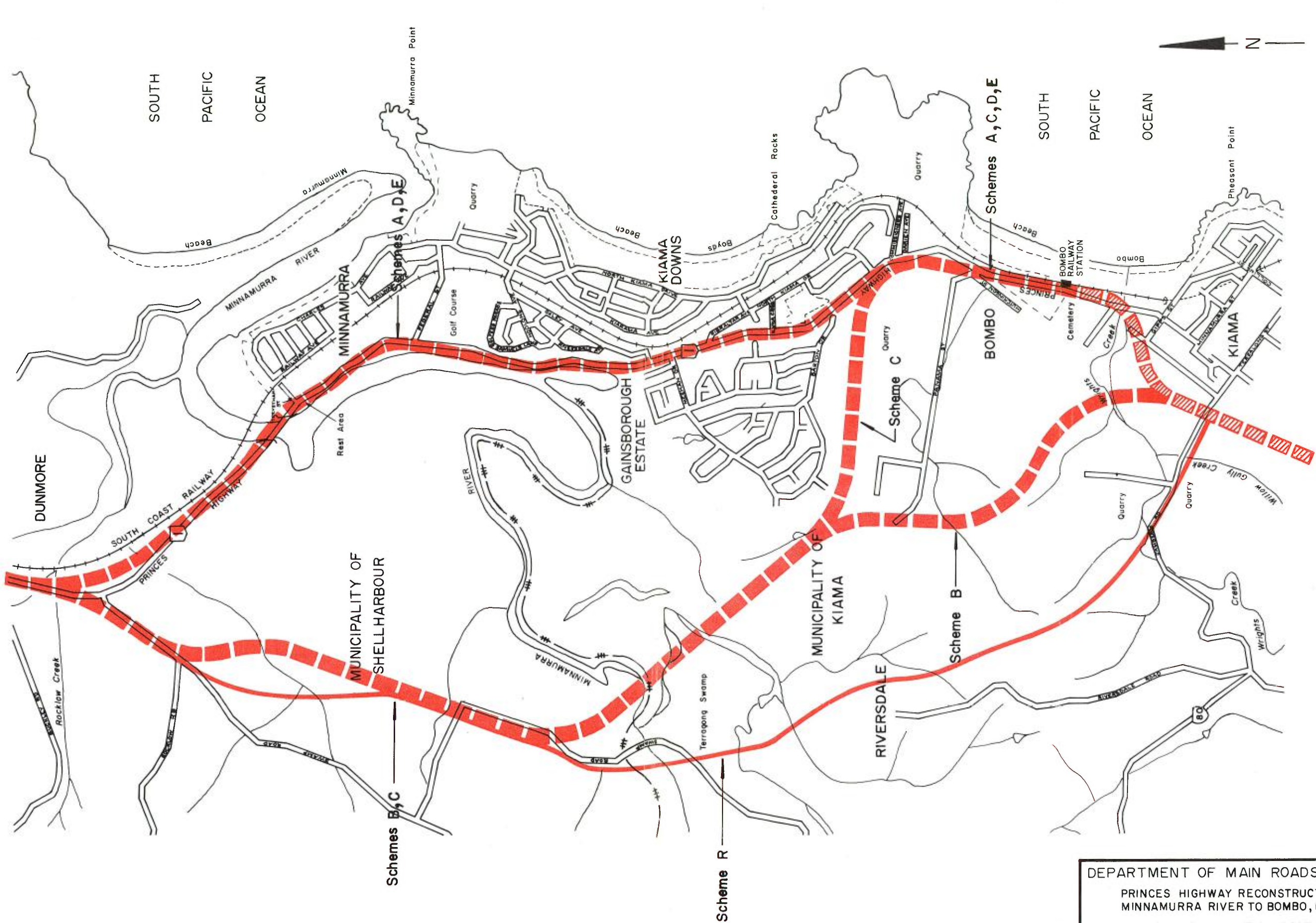
### 3.3.1 Landform

The Soil Conservation Service has mapped terrain for the Kiama Municipality. The terrain classes used are: Hillcrest and ridges; Sideslopes; Footslopes; Floodplains; Drainage plains; Incised drainage channel; Disturbed terrain; Bench; Water Bodies; Swamps; Escarpment; Beaches; Dunes and Rock platforms. Figure 3.2 shows the main classes of terrain within the study area.

The coastal belt contains a wide variety of landforms including cliffs, rock platforms and sand beaches. "Disturbed terrain" refers to quarrying activities around Bombo. To the west of the Princes Highway are the low rolling hills which form a backdrop to Kiama. They are generally of gentle relief but there are some steeper slopes associated with the edges of basalt flows. The main terrain type traversed by both alternative corridors is the wetlands of the Minnamurra River. These include the Terragong Swamp which was drained about sixty years ago and the estuarine wetlands surrounding the river.

The Minnamurra River estuary has been recognised as being of local and regional significance and worthy of conservation. This has resulted in its designation under State Environmental Planning Policy No.14 as Coastal Wetlands. Another smaller area has been designated at Bombo near the junction of Wrights Creek and Willow Gully Creek.

The estuary and wetlands support a wide variety of bird life and any development adjacent to them or further upstream, might affect the water flow or quality, and vegetation. Sand mining has already



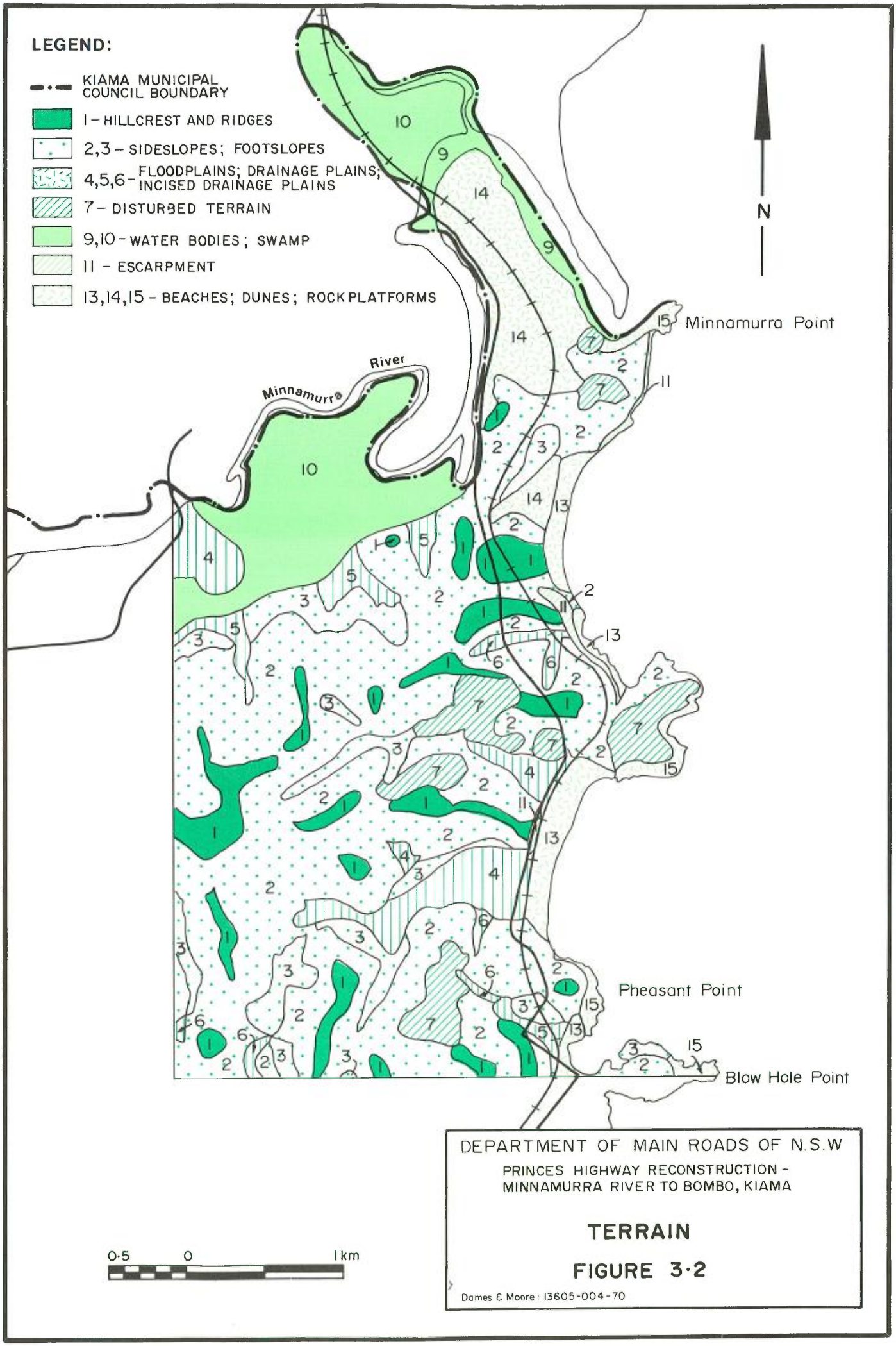

DEPARTMENT OF MAIN ROADS OF N.S.W.

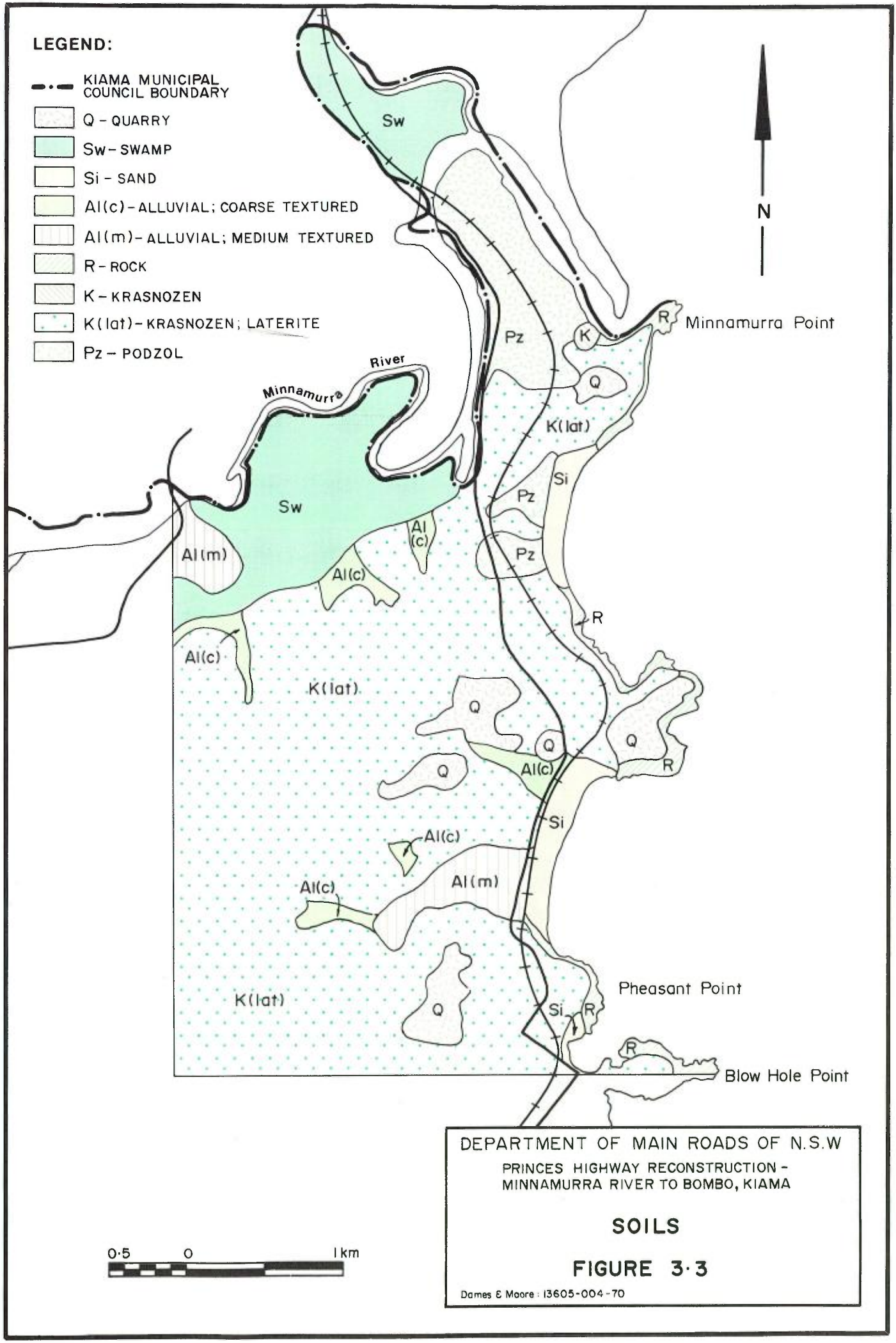
PRINCES HIGHWAY RECONSTRUCTION - MINNAMURRA RIVER TO BOMBO, KIAMA

**STUDY AREA AND CORRIDOR ALTERNATIVES**

**FIGURE 3·1**

Dames & Moore : 13605-004-70


LEGEND:
KIAMA MUNICIPAL COUNCIL BOUNDARY
1 – HILLCREST AND RIDGES
2,3 – SIDESLOPES; FOOTSLOPES
4,5,6 – FLOODPLAINS; DRAINAGE PLAINS; INCISED DRAINAGE PLAINS
7 – DISTURBED TERRAIN
9,10 – WATER BODIES; SWAMP
11 – ESCARPMENT
13,14,15 – BEACHES; DUNES; ROCK PLATFORMS
N
Minnamurra River
Minnamurra Point
Pheasant Point
Blow Hole Point
0·5 0 1 km
DEPARTMENT OF MAIN ROADS OF N.S.W
PRINCES HIGHWAY RECONSTRUCTION – MINNAMURRA RIVER TO BOMBO, KIAMA
TERRAIN
FIGURE 3·2
Dames & Moore : 13605-004-70


LEGEND:
KIAMA MUNICIPAL COUNCIL BOUNDARY
Q - QUARRY
Sw - SWAMP
Si - SAND
Al(c) - ALLUVIAL; COARSE TEXTURED
Al(m) - ALLUVIAL; MEDIUM TEXTURED
R - ROCK
K - KRASNOZEN
K(lat) - KRASNOZEN; LATERITE
Pz - PODZOL
N
Minnamurra River
Minnamurra Point
Pheasant Point
Blow Hole Point
0·5 0 1 km
DEPARTMENT OF MAIN ROADS OF N.S.W
PRINCES HIGHWAY RECONSTRUCTION - MINNAMURRA RIVER TO BOMBO, KIAMA
SOILS
FIGURE 3·3
Dames & Moore : 13605-004-70

occurred to the west of the River and the proximity of the area to population centres further accentuates its environmental vulnerability.

The River floods frequently due to the very high rainfall. Terragong Swamp is regularly inundated by floodwaters and the River estuary.

### 3.3.2 Geology

The geological units with the main areas of outcrop in the area traversed by the alternative corridors are the Gerringong Volcanics on the rolling hills around Kiama and Quarternary Alluvium on the coastal flats.

The Gerringong Volcanics give the Kiama area its distinctive landform and soil associations not found elsewhere in the Illawarra region. The extensive outcrop of the Bombo Latite Member west of Kiama has been dissected by numerous small streams, resulting in valleys with moderate to steep sideslopes. This volcanic flow is primarily porphyritic basalt and gives rise to distinctive krasnozem soils.

The Quarternary Alluvium has been deposited on the flood plain of the Minnamurra River and its tributaries. The type of sediment depends on the source material and the environment of deposition. On the flood plains and coastal flats it is usually clay or loam with occasional gravels.

### 3.3.3 Soils

The soils of the Kiama Municipality has been mapped by the Soil Conservation Service. The following is a key, based on the above work, of the main soils encountered by the alternatives. This is further outlined in broad terms on Figure 3.3 and summarised in Table 3.1.

**Podzols (Pz)**

These soils are deep and acidic. They occur on the Kiama Downs Golf Course which is located adjacent to the Highway. Erosion is not a

TABLE 3.1

SOILS

| PARENT MATERIAL | MAPPING UNIT | MAJOR LIMITATIONS |
|---|---|---|
| Dune Sand | Pz - podzol | Excessive drainage, high wind erosion hazard |
| Alluvium | | |
| On flood plains<br>. texture of upper 30 cm finer than silty loam | Al(m) - Alluvial soils (medium textured) | Flooding |
| . texture of upper 30 cm coarser than silty loam | Al(c) - Alluvial soils (coarse textured) | Flooding, stoniness |
| Swamp soils, gleyed with high organic matter content<br>. texture of upper 30 cm finer than silty clay loam : coastal swamp | Sw - Swamp soils | Flooding, poor drainage |
| Volcanics : basalt or latites C horizon greater than 60 cm deep : gradual texture increase with depth | K - Krasnozem | Mass movement on slopes greater than 15% |

problem because of their low relief and high infiltration, provided a stable vegetative cover is maintained. However, this soil type is susceptible to wind erosion if the vegetation is disturbed.

**Alluvial Soils (Al(m) and Al(c))**

Two types of alluvial soil have been identified - a medium textured type and a coarse textured type. The medium textured soils occur on the flood plains of the Minnamurra River including Terragong Swamp and also in the vicinity of Wrights Creek. These soils have moderate to high fertility and are used for improved pastures or fodder crops.

The coarse textured soils occur in small pockets adjacent to the medium textured soils. Stones are common throughout the profile and water-holding capacity is low.

In both cases, flooding is a restriction on development, and erosion will occur during heavy rains or floods, particularly if vegetation is removed.

**Swamp Soils (Sw)**

These soils are deep, acidic and rich in organic matter. They occur in the Minnamurra Swamp area, which is permanently inundated, and Terragong Swamp which has been drained.

In the natural state these swamps are areas of deposition and consequently have a very low erosion hazard. However careful management is required to minimise soil loss if they are drained as they have a high soil erodibility rating. Where drained, these soils are suitable for extensive grazing. However, flooding restricts other uses and increases the erosion hazard, particularly if vegetative cover is removed or disturbed.

**Krasnozems (K)**

Krasnozems, are primarily associated with outcrops of the Bombo Latite Member. They are red to dark brown well structured soils with a

gradational texture profile. The upper profile tends to a friable loam to clay loam with good crumb structure and reasonably high organic content. Clay content tends to increase with depth, but acidity remains constant throughout the profile.

They are good agricultural soils. However, use is limited as mass movement may occur on this soil type on slopes above 15%. Apart from these steep slopes, the erosion hazard is moderate, due to the low erodibility of the surface soil.

**Other Soils**

Lithosols (Li) occur in isolated pockets in the area studied, associated with the Bombo Latite Member. They are often stony and shallow and occur on moderately steep sideslopes and, as such, are susceptible to sheet and gully erosion when their vegetative cover is disturbed.

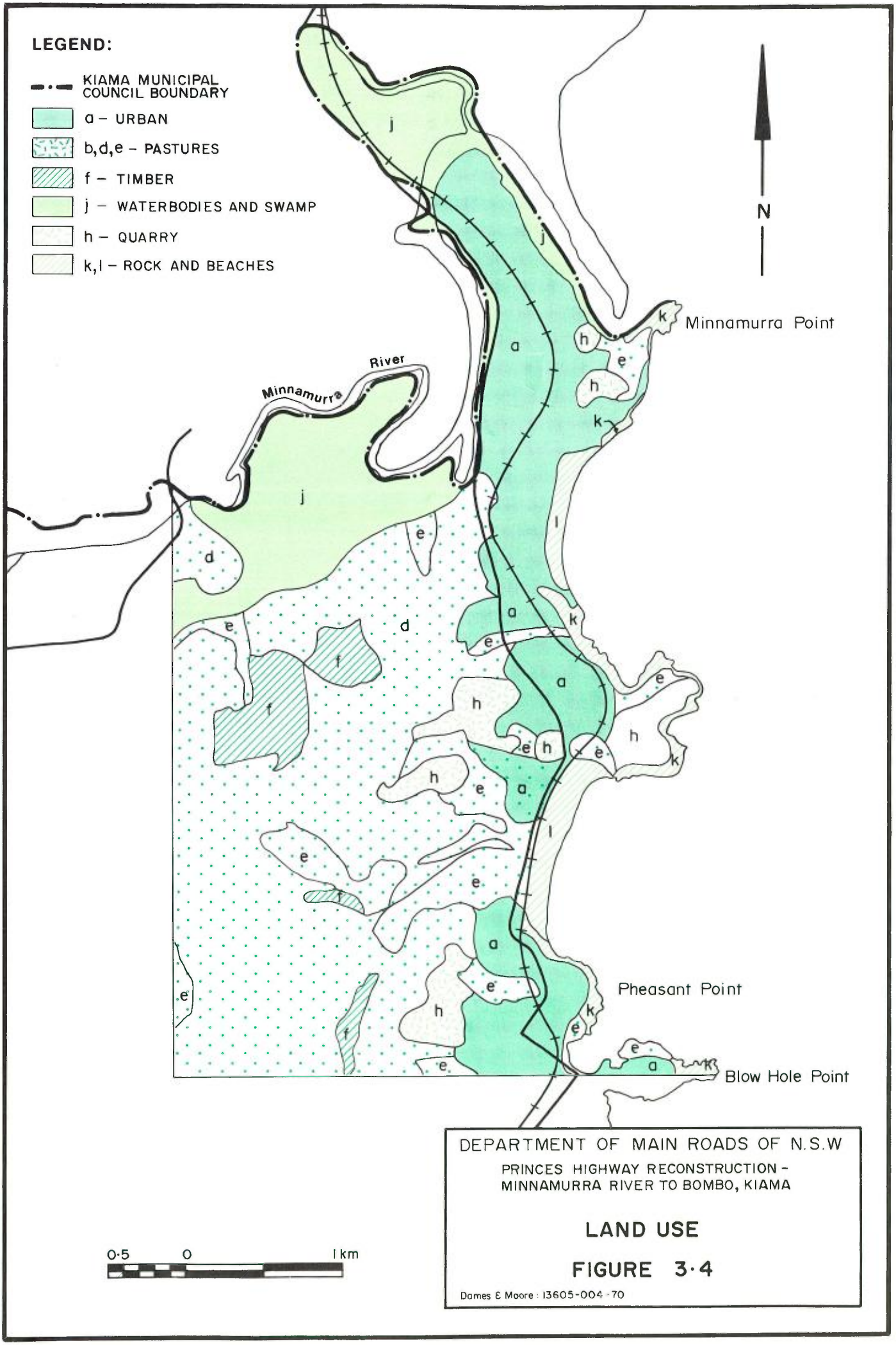
## 3.4 LAND USE

Figure 3.4 shows the distribution of land use classes in the study area. The most distinctive land use in the area, particularly adjacent to the Princes Highway from the Minnamurra River, is residential. The Gainsborough Estate is a relatively new subdivision, and Pacific Village to the south of the area is even less developed.

As one moves westward, the area becomes essentially rural in character with a proportion of hobby farms and small rural retreats. The main commercial grazing enterprises are for dairy and beef production, but many holdings are being abandoned as the pressure for subdivision into smaller lots increases.

Many farms in the Jamberoo Valley are composed of 2 or 3 non-contiguous holdings - often comprising a main farm, a dry run and a swamp lot. These latter uses occur in the general area under study.

Areas of timber still occur, mostly where the land was generally unsuitable for pasture improvement, e.g. steep slopes. Casuarina


LEGEND:
KIAMA MUNICIPAL COUNCIL BOUNDARY
a – URBAN
b,d,e – PASTURES
f – TIMBER
j – WATERBODIES AND SWAMP
h – QUARRY
k,l – ROCK AND BEACHES
N
Minnamurra River
Minnamurra Point
Pheasant Point
Blow Hole Point
0·5 0 1 km
DEPARTMENT OF MAIN ROADS OF N.S.W
PRINCES HIGHWAY RECONSTRUCTION - MINNAMURRA RIVER TO BOMBO, KIAMA
LAND USE
FIGURE 3·4
Dames & Moore : 13605-004-70

glauca (swamp oak) occurs along the river and a large eucalypt forest with limited remnant rainforest occurs to the east of the Swamp Road area.

There are no State Forests, National Parks or Nature Reserves in the general area. However areas of coastal wetlands importance are delineated in Figure 3.5.

### 3.4.1 Mining

Quarrying for Bombo latite, for use as aggregate and railway ballast, has occured and still continues in the area.

Latite is suitable or potentially suitable for the production of high grade coarse aggregate and underlies some of the area. It is understood that the Boral and State Rail Authority quarrying operations near Bombo are valid for 60 years. Figure 3.6 shows areas identified as overlaying predominantly sound aggregate - potentially suitable for high quality aggregate, and the proposed limit to quarrying.

Mining for sand has previously occurred north of the Minnamurra River, in and adjacent to the Swamp Road area. The sand extraction has created a number of artificial lakes, one of which was owned by Sole Brothers who had originally planned to develop an entertainment park. An application by another landholder to mine sand close to the River precipitated the designation of the area as coastal wetland under the State Environmental Planning Policy No.14.

### 3.4.2 Agriculture and Grazing

Figure 3.7 outlines the agricultural capability classes in the area. The majority of the study area is Class 3 with pockets of Classes 4 and 5.

A definition of classes is outlined in Table 3.2. Land of prime crop and pasture potential is defined by Classes 1, 2 and 3.

## TABLE 3.2

## CLASSIFICATION OF AGRICULTURAL LAND

**CLASS 1** : Land capable of regular cultivation for cropping or intensive horticulture. Has a very good capability for agriculture, where there is only minor or no constraints to sustained high levels of production. Will include irrigated areas with high production.

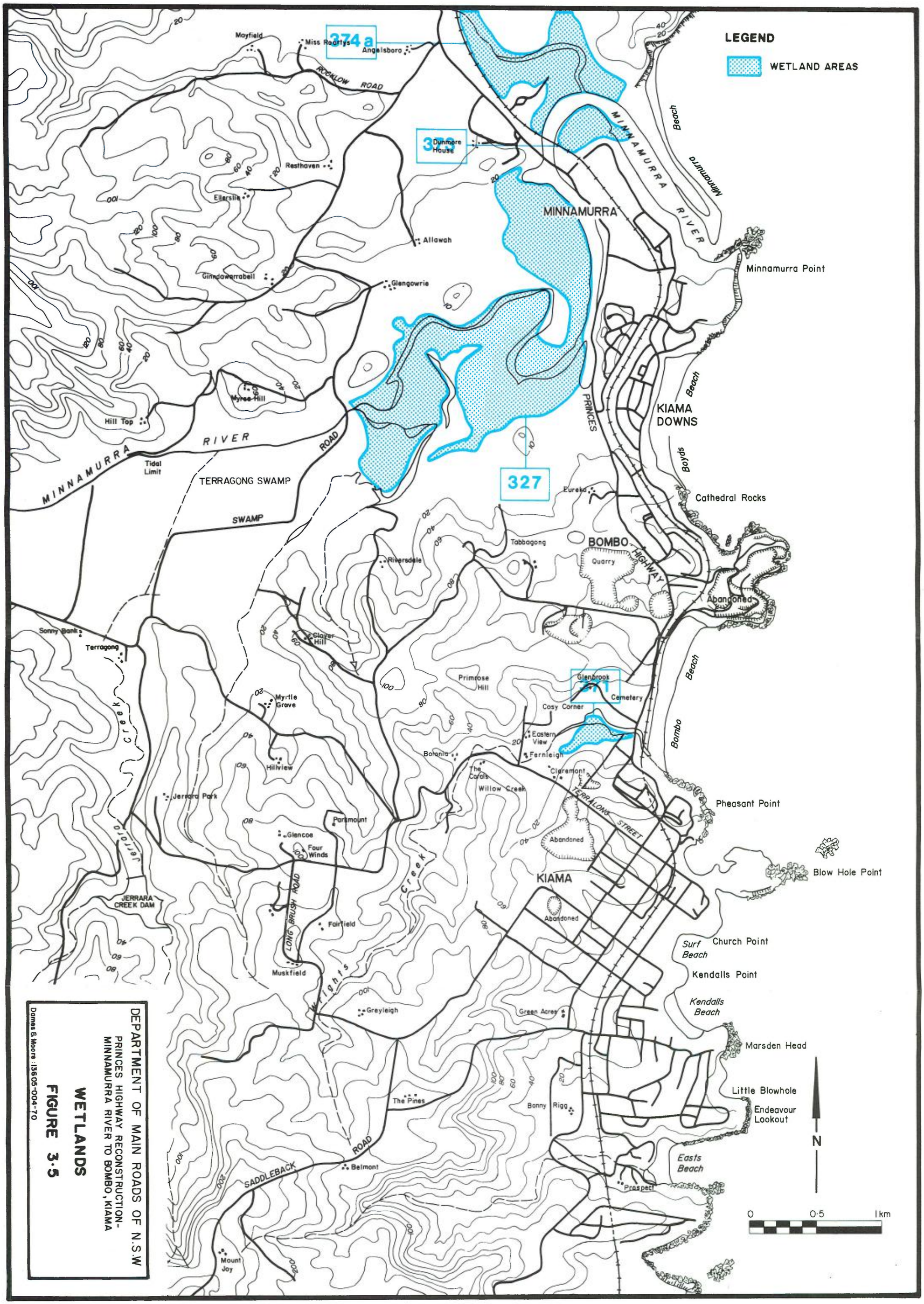
**CLASS 2** : Land suitable for cultivation for cropping, but not suited to continuous cropping or intensive horticulture. Has good capability for agriculture, but where constraints limit the cropping phase to a rotation with improved pastures and thus reduce the overall level of production.

**CLASS 3** : Land suitable for grazing. Well suited to pasture improvement and can be cultivated for an occasional cash crop or forage crop in conjunction with pasture management. Overall level of production is moderate as a result of high environmental costs which limit the frequency of ground disturbance. Has a moderate capability for agriculture. Pasture lands are capable of sustained high levels of production, although conservation measures may be required.

**CLASS 4** : Land suitable for grazing and not suitable for cultivation. Agriculture is based on native pastures or improved pastures relying on minimum tillage techniques. Overall level of production is low. Environmental constraints make arable agriculture uneconomic.

**CLASS 5** : Land suited for only rough grazing or land not suited to agriculture. Agricultural production is very low or zero. Severe or absolute constraints to production imposed by environmental factors.

Source: Rural Land Evaluation Manual - DEP (1981)



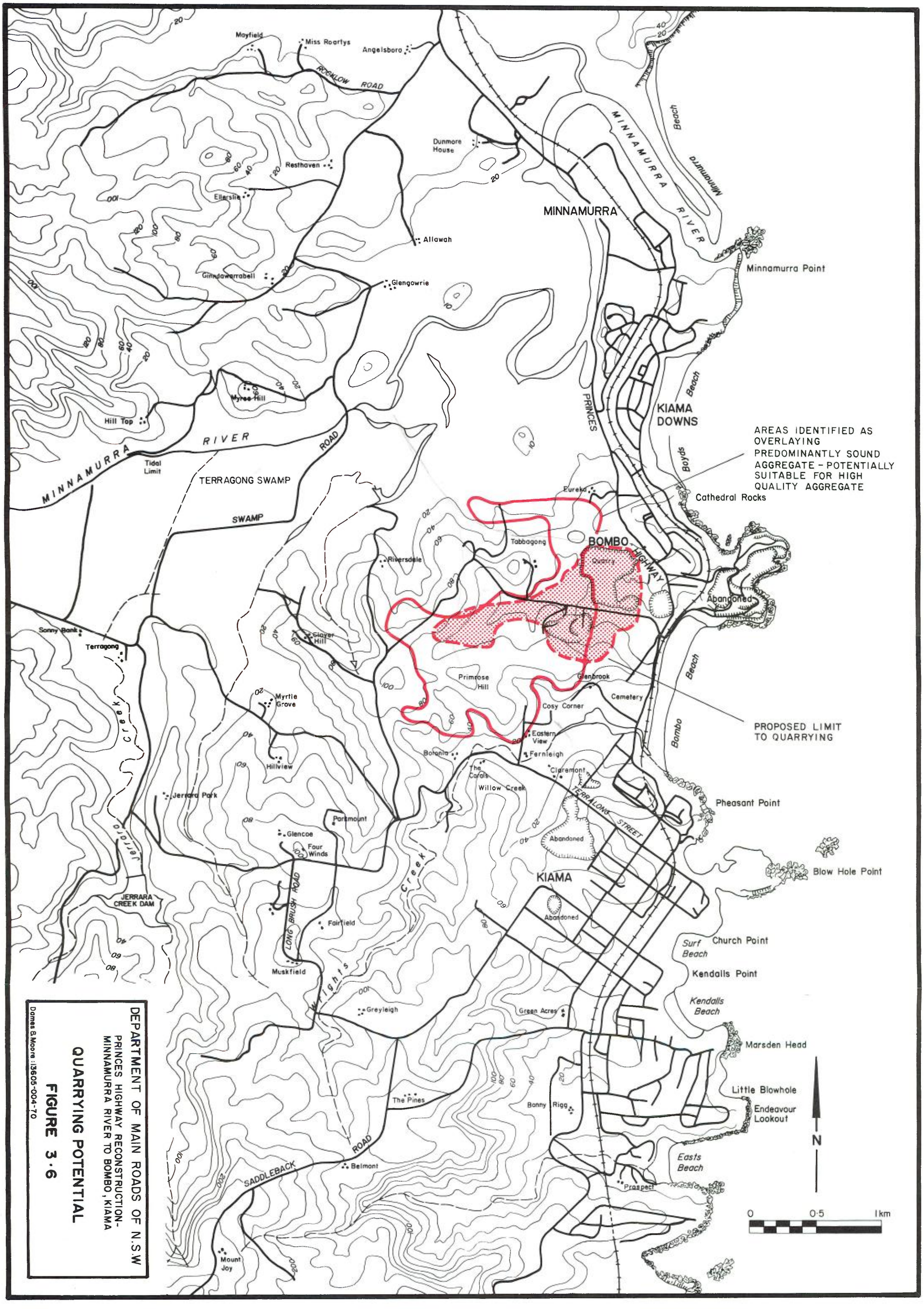

DEPARTMENT OF MAIN ROADS OF N.S.W

PRINCES HIGHWAY RECONSTRUCTION-
MINNAMURRA RIVER TO BOMBO, KIAMA

**WETLANDS**

**FIGURE 3·5**

Dames & Moore : 13605-004-70



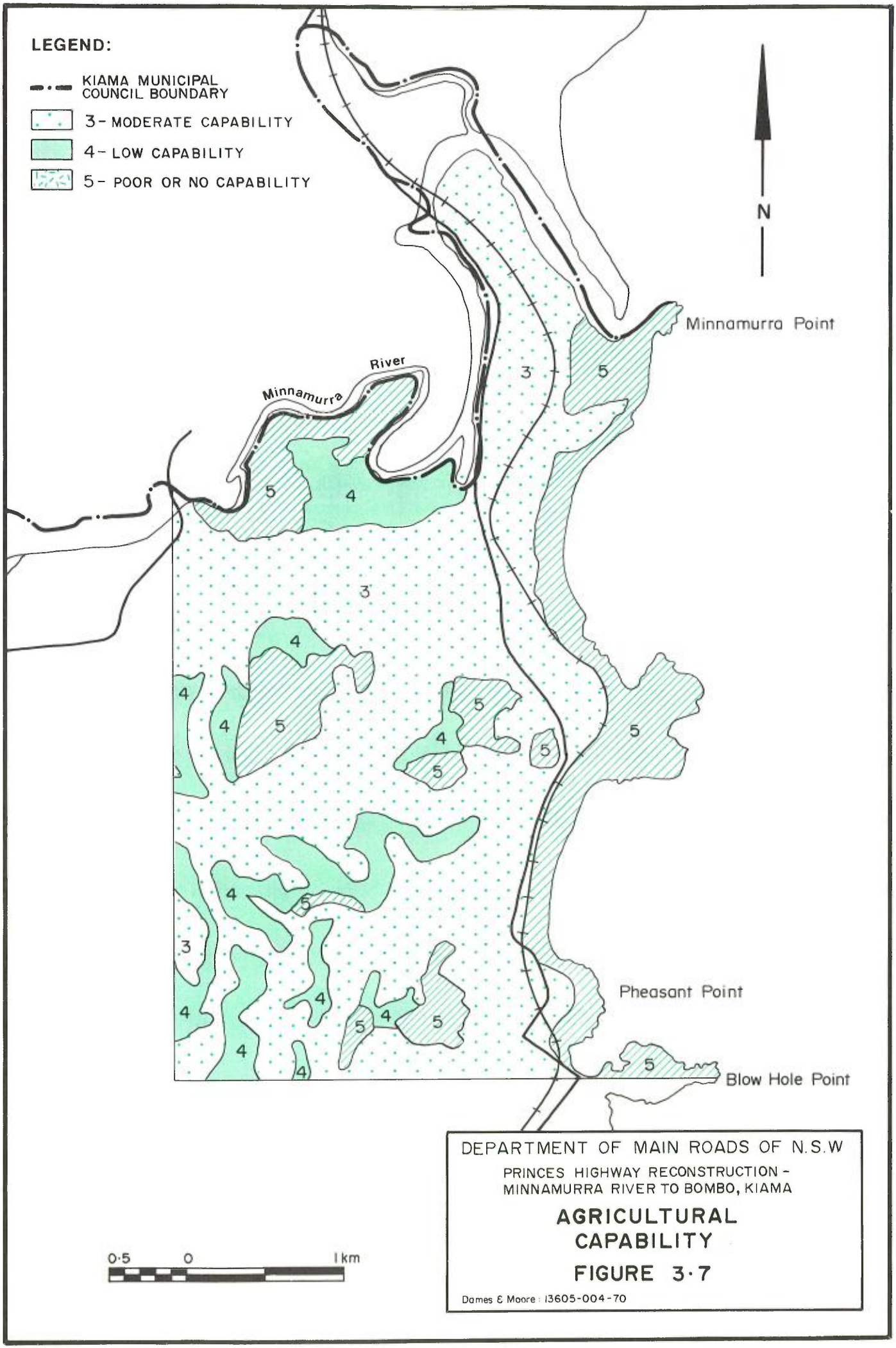

DEPARTMENT OF MAIN ROADS OF N.S.W

PRINCES HIGHWAY RECONSTRUCTION-
MINNAMURRA RIVER TO BOMBO, KIAMA

**QUARRYING POTENTIAL**

**FIGURE 3·6**

Dames & Moore : 13605-004-70




DEPARTMENT OF MAIN ROADS OF N.S.W

PRINCES HIGHWAY RECONSTRUCTION - MINNAMURRA RIVER TO BOMBO, KIAMA

# AGRICULTURAL CAPABILITY

## FIGURE 3·7

Dames & Moore : 13605-004-70

The Soil Conservation Service has mapped rural land use capability for the Kiama Municipality. This classification does not indicate the specific crop or enterprise most suitable but identifies the most appropriate land management practices in order to maintain the soil resource. The classification takes into account climate, soil, slope, terrain, topography and soil erosion. Table 3.3 outlines the system.

In the general area being considered most rural capability classes are represented as shown on Figure 3.8. Areas suitable for cultivation and grazing are interspersed with areas of steep slopes, cliffs and swamps.

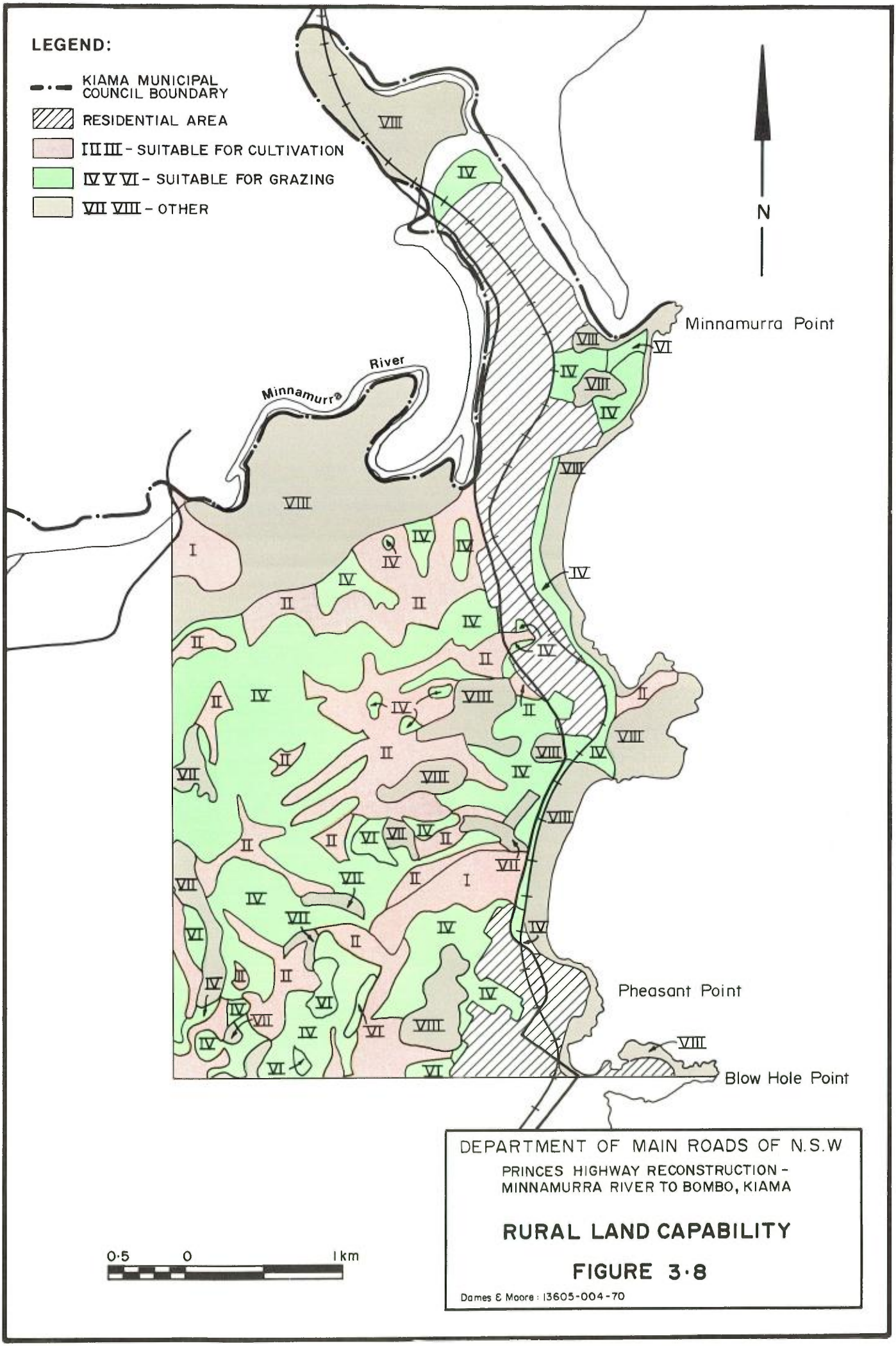
Despite the availability of land suitable for grazing (based upon both the Department of Agriculture and Soil Conservation Service assessments) and indeed a proportion of prime agricultural land, the area is likely to come under increasing pressure from speculative influences, particularly if further declines occur in the profitability of dairy production, the main commercial enterprise in the area. The non-contiguous nature of the better grazing land in the area and the fragmentation of rural properties also suggest that amalgamation for economies of scale in dairying would be difficult. Further, the actual areas affected by the road alignment would not be a significant factor in assessing rural profitability unless access in particular cases was crucial or caused further fragmentation of the rural holdings. A decline in the rural activity in the area has occurred despite the introduction of land use controls which were intended to retain rural land in viable agricultural parcels. Transferable milk quotas have enabled farmers to buy larger, more economic farms elsewhere and take advantage of inflated coastal land prices. Many of these smaller holdings have subsequently been purchased for hobby farms. Beef production is the other activity in the area, but it is generally carried out in conjunction with dairying or hobby farms. Farm sizes are generally too small for an economic beef grazing enterprise.

The grazing land in the area is based on both improved and native pastures. Species sown in improved pastures include perennial rye, Italian rye, phalaris, cockfoot, and white, red and subterranean clovers. Paspalum dominates large areas of pasture on the alluvial flats and lower hills, where soil moisture is greater. Kikuya grass

TABLE 3.3

RURAL LAND CAPABILITY

| LAND CLASSIFICATION AND SOIL CONSERVATION PRACTICES | | | | INTERPRETATIONS AND IMPLICATIONS |
|---|---|---|---|---|
| SUITABLE FOR REGULAR CULTIVATION | | I | No special soil conservation works or practices | Land suitable for a wide variety of uses. Where soils are fertile, this is land with the highest potential for agriculture, and may be cultivated for vegetable and fruit production, cereal and other grain crops, energy crops, fodder and forage crops, and sugar cane in specific areas. Includes "prime agricultural land". |
| | | II | Soil conservation practices such as strip cropping, conservation tillage and adequate crop rotation | Usually gently sloping land suitable for a wide variety of agricultural uses. Has a high potential for production of crops on fertile soils similar to Class I, but increasing limitations to production due to site conditions. Includes "prime agricultural land". |
| | | III | Structural soil conservation works such as graded banks, water ways and diversion banks, together with soil conservation practices such as conservation tillage and adequate crop rotation | Sloping land suitable for cropping on a rotational basis. Generally used for the production of the same type of crops as listed for Class I, although productivity will vary depending upon soil fertility. Individual yields may be the same as for Classes I and II, but increasing restrictions due to the erosion hazard will reduce the total yield over time. Soil erosion problems are often severe. Generally fair to good agricultural land. |
| SUITABLE FOR GRAZING | OCCASIONAL CULTIVATION | IV | Soil conservation practices such as pasture improvement, stock control, application of fertilizer and minimal cultivation for the establishment or re-establishment of permanent pasture | Land not suitable for cultivation on a regular basis owing to limitations of slope, gadient, soil erosion, shallowness or rockiness, climate, or a combination of these factors. Comprises the better classes of grazing land of the State and can be cultivated for an occasional crop, particularly a fodder crop, or for pasture renewal. Not suited to the range of agricultural uses listed for Classes I to III. If used for "hobby farms", adequate provision should be made for water supply, effluent disposal and selection of safe building sites and access roads. |
| | | V | Structural soil conservation works such as absorption banks, diversion banks and contour ripping, together with the practices as in Class VI | Land not suitable for cultivation on a regular basis owing to considerable limitations of slope, gradient, soil erosion, shallowness or rockiness, climate, or a combination of these factors. Soil erosion problems are often severe. Production is generally lower than for grazing lands in Class IV. Can be cultivated for an occasional crop, particularly a fodder crop or for pasture renewal. Not suited to the range of agricultural uses listed in Classes I and III. If used for "hobby farms", adequate provision should be made for water supply, effluent disposal, and selection of safe building sites and access roads. |
| | NO CULTIVATION | VI | Soil conservation practices include limitation of stock, broadcasting of seed and fertilizer, prevention of fire and destruction of vermin. May include some isolated structural works. | Productivity will vary due to soil depth and soil fertility. Comprises the less productive grazing lands. If used for "hobby farms", adequate provision should be made for water supply, effluent disposal, and selection of safe building sites and access roads |
| OTHER | | VII | Land best suited for green timber. Generally stock shoud be excluded. | Generally comprises areas of steep slopes with shallow soils. Clearing of timber from these sites is not recommended. Where clearing has occurred, the area should be allowed to revert to timber. |
| | | VIII | Cliffs, lakes or swamps | Land unusable for agricultural or pastoral uses. Recommended uses are those compatible with the preservation of the natural vegetation, namely; water supply catchments, wildlife refuges, national and state parks and scenic areas. |




DEPARTMENT OF MAIN ROADS OF N.S.W

PRINCES HIGHWAY RECONSTRUCTION - MINNAMURRA RIVER TO BOMBO, KIAMA

# RURAL LAND CAPABILITY

## FIGURE 3·8

Dames & Moore : 13605-004-70

was originally planted on steeper slopes to check erosion and weed infestation - it is now present in most pastures and provides excellent fodder when immature. Although it is less palatable when rank and overgrown, it is grazed by cattle when other feed is scarce. Common weeds are bracken fern, blackberry, lantana and purple top.

The only other agricultural activity identified in the area is a hydroponics farm to the west of the Swamp Road alternative.

### 3.4.3 Muncipality of Kiama - Local Environmental Plan No.5

The Municipality of Kiama - Local Environmental Plan No.5 came into force in 1981. Under this plan the zoning within the study area is shown in Figure 3.9. Areas adjacent to the Highway are generally Residential 2(a) or Open Space 6(a) - Existing Recreation. The Golf Course located opposite Minnamurra River is zoned Open Space 6(b) - Private Recreation. Areas of Special Uses zoning are located on the hill above Bombo (the site of Bombo Public School which is now a playing field) and the cemetery south of Bombo railway station.

The Industrial zoning located opposite the northern end of Bombo Beach is designated 4(b) - Extractive Industrial and 4(c) - Light Industrial. The Railway Blue Metal Quarry and Boral Quarry are currently operating in this location.

This zoning is surrounded by 7(d) Rural Environment Protection - Scenic, except on its eastern edge where it abuts the Arterial Road zoning and 2(d) - Residential "D". A 20 m buffer area surrounds the industrially zoned area.

The existing alignment of the Princes Highway falls within the road reservation zoned for Arterial Road use.

To the west of the Highway the area is zoned Rural Environmental Protection - 7(d) - Scenic, and adjacent to the Minnamurra River, Rural Environment Protection 7(b) - Estuarine Wetlands. The purpose of this zoning is to protect the scenic qualities of the area and the wetland environment.

The estuarine wetland area at the north of the Minnamurra River was recently designated under the State Environmental Planning Policy No.14 - Coastal Wetlands. The aim of the policy is "to ensure that the coastal wetlands are preserved and protected in the environmental and economic interests of the State". The designated wetlands fall within the study area and are traversed by the Swamp Road route corridor under consideration. The corridor cannot be moved further west as it will intrude on the Jamberoo Valley area.

A study has recently been completed for the preparation of a draft regional environmental plan to introduce appropriate conservation planning controls over the Jamberoo Valley. The boundary of the Jamberoo Valley area is indicated in Figure 3.10. The Swamp Road corridor parallels this boundary.

Rural areas to the west of the Highway and in the Swamp Road area are zoned Rural 1(a).

South of the Bombo cemetery, the land is zoned 7(b) Rural Environment Protection - Scenic and is adjoined by 2(d) - Residential "D" and Arterial Roads zoning. The Arterial Road zoning is reserved for the Kiama By-Pass. The 2(d) and 7(b) zonings are bounded by Terralong Street. South of Terralong Street the land is zoned 1(a) Rural "A".

### 3.4.4 Other Land Uses

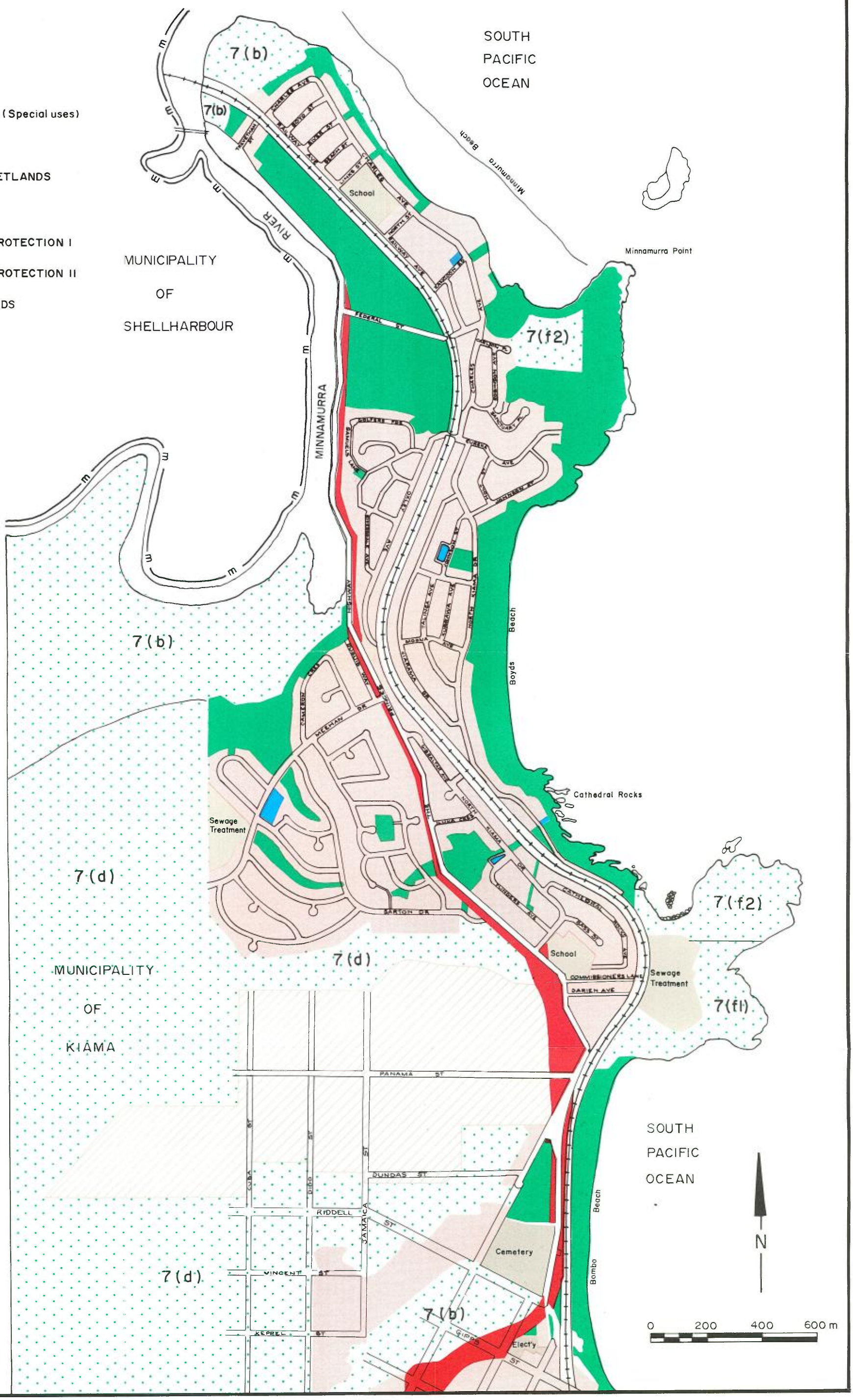
#### Transmission Lines

Figure 3.11 shows the location of the transmission lines, Telecom cables and water and sewerage facilities. Detailed searches are carried out by the Department of Main Roads prior to any major works initiated to ensure minimum disruption to the services.

Numerous powerlines are located throughout the area, particularly in the western section where many terminate on rural properties. The 11kV transmission lines which lie near or are adjacent to the Princes Highway are located near Trevethan Street and Oxley Avenue, following the Highway to its intersection with Terralong Street. A substation is

**LEGEND**

- RESIDENTIAL
- BUSINESS
- INDUSTRIAL
- SPECIAL USES (Special uses)
- OPEN SPACE
- 7(b) ESTUARINE WETLANDS
- 7(d) SCENIC
- 7(f1) FORESHORE PROTECTION I
- 7(f2) FORESHORE PROTECTION II
- ARTERIAL ROADS



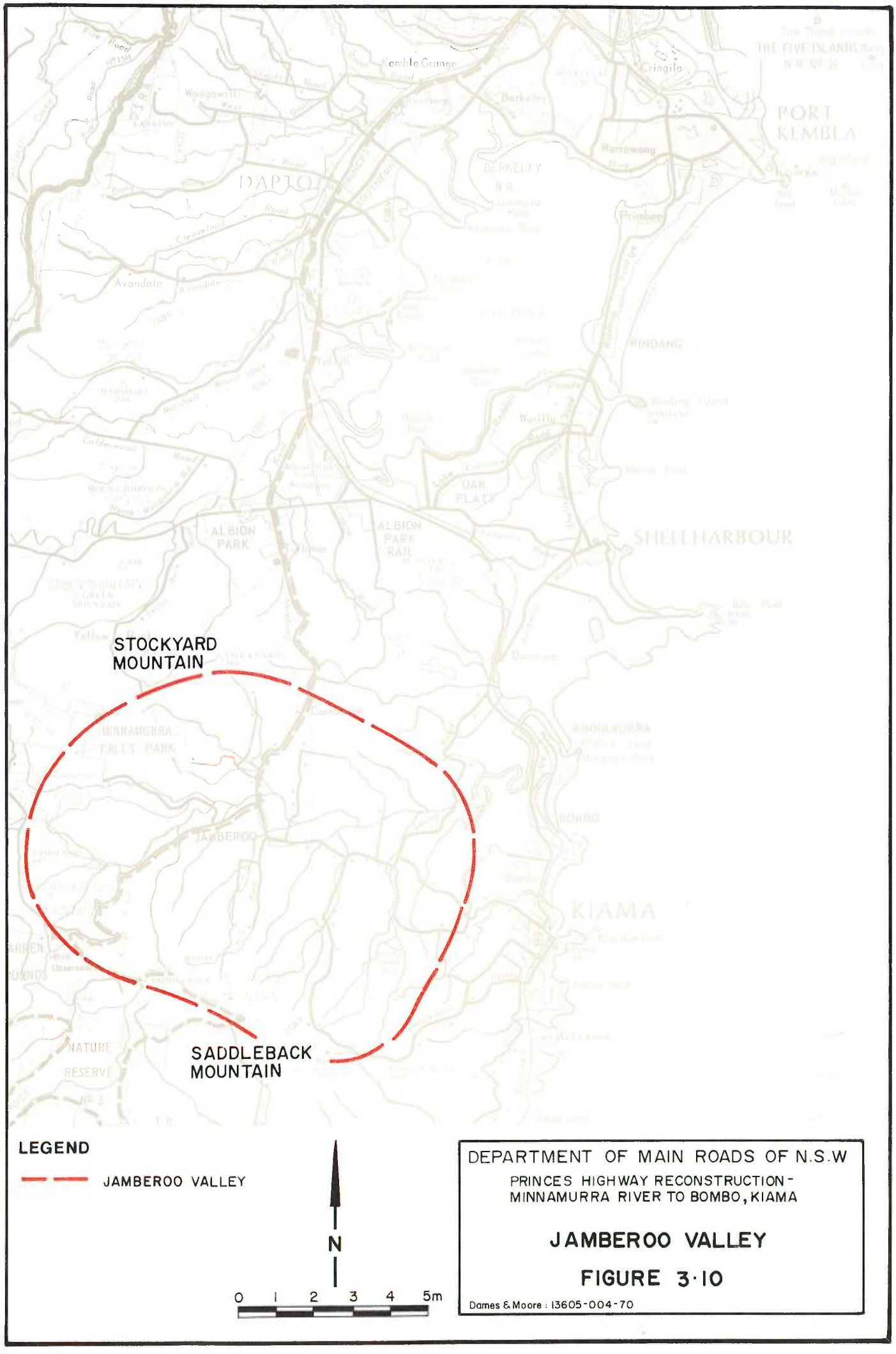

DEPARTMENT OF MAIN ROADS OF N.S.W.

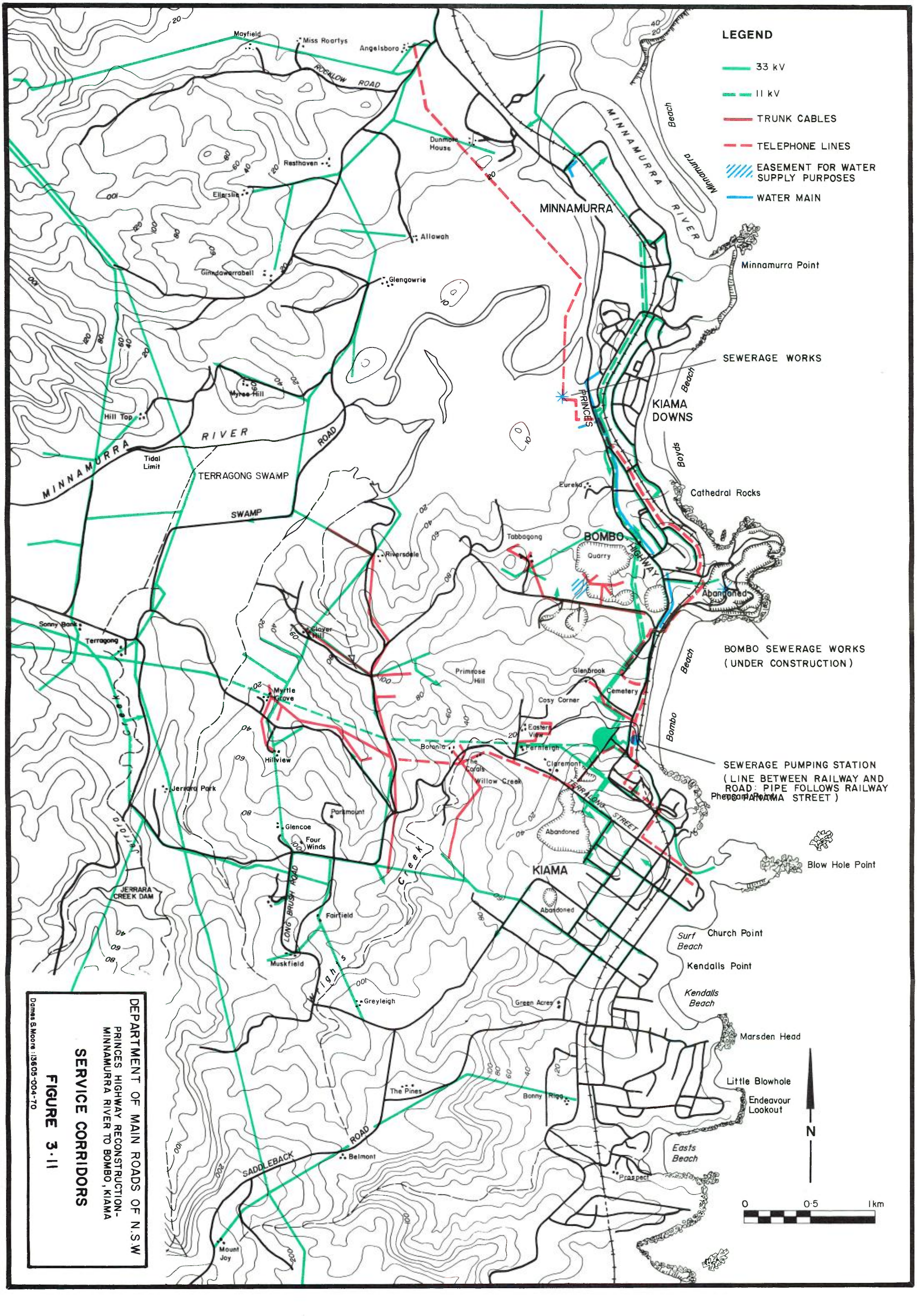
PRINCES HIGHWAY RECONSTRUCTION - MINNAMURRA RIVER TO BOMBO, KIAMA

**CONSOLIDATED ZONING**

**FIGURE 3.9**

Dames & Moore : 13605-004-70


STOCKYARD
MOUNTAIN
SADDLEBACK
MOUNTAIN
LEGEND
JAMBEROO VALLEY
N
0 1 2 3 4 5m
DEPARTMENT OF MAIN ROADS OF N.S.W
PRINCES HIGHWAY RECONSTRUCTION -
MINNAMURRA RIVER TO BOMBO, KIAMA
JAMBEROO VALLEY
FIGURE 3·10
Dames & Moore : 13605-004-70




DEPARTMENT OF MAIN ROADS OF N.S.W

PRINCES HIGHWAY RECONSTRUCTION-
MINNAMURRA RIVER TO BOMBO, KIAMA

**SERVICE CORRIDORS**

**FIGURE 3·11**

Dames & Moore : 13605-004-70

located at Gipps and Hutchinson Streets. Here, the lines branch in 3 directions: south along Hutchinson, Minnamurra, Brown, Terralong and Thomson Streets; west towards Fernleigh Homestead and east to Kiama Light-House.

In the Swamp Road area, transmission lines generally run adjacent to or in the vicinty of Swamp Road, branching to Dunmore House, Allawah, Glengowrie, Ellerslie, Ginnda Warrabell, Myree Hill, Riverdale. Tabbagong and Eastern View homesteads.

The 33 kV line travels adjacent to the Princes Highway, approximately 300 m to the east (along the eastern boundary of the golf course), then follows Oxley Avenue and joins the Princes Highway. The line then branches to the Blue Metal Quarry before entering Hutchinson Street then to Riddell, Minnamurra, Brown, Terralong and Thomsons Streets. At the substation, it branches westward via Fernleigh and Myrtle Grove properties.

**Telecom Cables**

The major co-axial cable runs in a north-south direction approximately 400 m west of the Princes Highway and Minnamurra River, traversing the wetlands area. It crosses the river, joining the Highway for a short distance before deviating along Gibraltar Avenue and Oxley Avenue to Cathedral Rocks Avenue. It then parallels the rail line at Bombo to Hutchinson Street where it crosses the Highway and traverses the western side of North Kiama Park and the Cemetery. The cable then branches, one section terminating in Kiama township, the other section travelling west and terminating at Riversdale Road, west of Bombo.

Minor Telecom cables are generally located to the west in the vicinity of Riversdale Road. Minor cables are also located within the Blue Metal Quarry Complex.

**Water Mains**

The major water mains are located along the Princes Highway from just north of Oxley Ave to Kiama Drive and from Darien Avenue to Panama

Street. The pipeline traverses the railway line to the sewerage pumping station just south of Spring Creek. Sewerage works are located west of the Highway at Oxley Avenue and are under construction at Bass Point.

## 3.5 HYDROLOGY AND DRAINAGE

The study area lies within the Minnamurra River catchment and is bissected by a number of tributaries and drainage channels. The Minnamurra River flows east from Jamberoo Valley through the tidal estuary to the Pacific Ocean.

Associated with the Minnamurra River are a number of tributaries, rivulets, lagoons and a large swamp and wetland area. The major swamp area is the Terragong Swamp, a section of which was drained in the past. The swamp area is subject to flood and inundation after heavy rainfall. The existing Swamp Road can become impassible from flooding.

Further details of the estuary and river system are discussed in Section 5.0.

## 3.6 BIOLOGY

### 3.6.1 Vegetation

The remnant vegetation in the Kiama area is scattered and few stands remain. The general pattern of vegetation is directly attributable to the historic development of agriculture and mining in the Kiama area and subsequent residential development. Much of the vegetation in rural areas west of Kiama has been replaced with improved pastures. There are few remaining significant stands of vegetation. They are situated in areas which were considered unsuitable for pasture improvement.

Remnant areas include uncleared scrubs and heaths, some Eucalypt and Syncarpia forests, areas of open forest including rainforest species, and the areas of saltmarsh and swamp oak associated with the Minnamurra River and wetland. Vegetation species associated with the wetland

include mangroves, swamp oak (Casuarina glauca) and Melaleuca species, samphire and other succulent small shrubs, sedges, grasses and reeds, and other herbs.

### 3.6.2 Wildlife

Wetland fauna can be discriminated by species according to their temporal and spatial utilization of the habitat. In most cases development will have greatest affect upon those sedentary species that rely predominantly on this habitat for such activities as feeding, reproducing and nesting. The major interference or destruction of the estuarine habitat of the Minnamurra River could not only cause localized extinctions to these species but of a consequence result in the decrease in numbers of other fauna species relevant to some extent on this habitat.

Before determining the extent of the impact upon this area, it is necessary to recognise that estuarine fauna will exhibit spatial patterning at several different scales of zonation. The major scale of zonation is the horizontal one from seaward to landward within the mangrove stand - the causal factors being due most likely to elevation and tidal inundation. The other scale is the vertical zonation, related to the distance above and below the sediment surface. Any significant alteration of these two zones through such processes as sedimentation, pollution accumulation and direct anthropological intrusions would place serious pressures upon the habitat.

Along with aquatic fauna, birds are the main and most obvious fauna group of the mangrove habitat. Over 200 bird species have been recorded at some time in Australian mangroves (Adams et al 1985) of which only 14 are sedentary. Of the species, only the Mangrove Heron and Warbler would rely totally on mangroves and marshes within the study area. The other species rely to varying degrees on the estuarine environment, the separation of their niches achieved by different feeding strategies and times relative to the tidal cycle. An increase in turbidity or pollution would lead to a deterioration of the quality of feeding grounds, to the detriment of the species diversity of the area.

The number of mammals utilising this particular area is small. Of the species listed, the Platypus (Ornitnorhynchus aratinus) and the Water Rat (Hydronys chrysogoster) are the least numerous and most susceptible to many of the impacts of the development. With the surrounding urban area, the Brown Rat (Rattus norregious) would be expected to inhabit this area, while the Swamp Rat (Rattus letreolus), specialised for wetland habitats, would be the most numerous and least susceptable of the terrestrial mammals found here. The Grey-headed Flying Fox (Pteropus poliocephalus) and the Black Flying Fox (Pteropus alecto) utilise the mangrove stands for feeding or roosting purposes. Although other mammal species may be observed within the estuarine area of the Minnamurra River, they may be classified as visitors and therefore the area would not be an essential habitat for them.

Because of the problems posed by the saline conditions, reptiles and amphibians are relatively rare in the estuarine wetlands. Only the arboreal species e.g. tree snakes, could be expected to inhabit these areas.

Some fauna species likely to be found in the Minnamurra wetland are listed below.

**Avifauna**

**(i) Passerines**

| | |
|---|---|
| Mangrove Warbler | Gerygone levigaster cantator |
| Scarlet Honeyeater | Myzomela sanguinolenta |
| Grey Fantail | Rhipidura fuliginosa |
| White-browed scrub-wren | Sericornis frontalis frontalis |
| Brown Warbler | Gerygone mouki richmondi |
| Variegated Wren | Malurus lamberti |
| Little Cuckoo-shrike | Coracina papuensis |
| Spangled Drongo | Dicrurus bracteatus |

**(ii) Non-Passerines**

| | |
|---|---|
| Hoary-headed Grebe | Podiceps poliocephalus |
| Australian Pelican | Pelecanus conspicillatus |
| Little Black Cormorant | Phalacrocorax sulcirostris |

| | |
|---|---|
| Little Pied Cormorant | Phalacrocorax melanoleucos |
| Mangrove Heron | Butorides striatus |
| Mountain Duck | Tadorna tadornoides |
| Black Duck | Anas superciliosa |
| Chestnut Teal | Anas castanea |
| White-breasted sea-eagle | Haliaetus leucogaster |
| Osprey | Pandion haliaetus |
| Pied Oystercatcher | Haemotopus ostralegus |
| Sooty Oystercatcher | Haemotopus fuliginosus |
| Mongolian Dotterel | Charadrius mongolus |
| Large Dotterel | Charadrius leschenaultii |
| Whimbrel | Numenious phaeopus |
| Eastern Curlew | Numenious madagascariensis |
| Red-necked Avocet | Recurvirostra novaehollandiae |

**Mammals**

| | |
|---|---|
| Platypus | Ornithorhynchus anatinus |
| Water Rat | Hydromys chrysogaster |
| Swamp Rat | Rattus lutreolus |
| Grey-headed Flying Fox | Pteropus poliocephalus |
| Black Flying Fox | Pteropus alecto |
| Brown Rat | Rattus norvegicus |

## 3.7 ARCHAEOLOGY

The study area lies within the territory of the "Wodi Wodi" tribe or language group. The Aboriginal people belonging to this tribe and living on or in the vicinity of the coast were known as the "Illawarra tribe". Wodi Wodi territory encompasses an area of some 2,600 $km^2$, the boundaries of which extended from Wollongong to a point just north of the Shoalhaven River, and inland to Picton and Moss Vale.

Aboriginal sites of different kinds are known to be numerous in the Minnamurra area. The National Parks and Wildlife register lists a total of 25 Aboriginal sites within a few kilometres of the Princes Highway. The density and distribution of sites indicates that the area provided an abundance of ocean, estuarine and wetland resources and

that specialised resources exploitation occurred. The most common and extensive sites identified are Aboriginal shell midden deposits in coastal dune areas.

## 3.8 CULTURAL AND HISTORICAL ASPECTS

The first recorded history of the Kiama area was by George Bass who, while exploring the coast, discovered the Blowhole on 6th December 1797, after anchoring in the bay later named Kiama Harbour.

Exploration of the Kiama coast was undertaken in October 1819 by Surveyor-General, John Oxley and Deputy Surveyor-General, James Meehan.

Oxley reported to Governor Macquarie that the land between what is known as Minnamurra and Black Head was high and bold, the bush difficult to travel over and the soil good but sandy, with only a few sandy beaches (Bayley, 1960).

Prior to settlement of the Illawarra, the Kiama area was penetrated by cedar getters travelling by sea. The area was dominated by subtropical rainforest. This severely hampered transportation of the cedar logs which were carried overland to the coast for shipping.

Settlement of the Illawarra after 1816 precipitated the growth of cedar getting in the region.

The first permanent settler in Kiama was David Smith who came to the area in 1821, and began felling cedar forests surrounding Kiama, where he built a residence in 1832.

The surrounding countryside was gradually opened up under large acreage land grants and cedar getting was then followed by farming.

The cultivation of a number of crops was undertaken in the area including wheat cultivation (with a flour mill at Minnamurra) however dairy farming was to become the dominant industry. Many of the crops which had been cultivated were unsuited to the wet coastal climate. Dairy farming however flourished as the result of volcanic soils and

adequate rainfall and with the introduction of paspalum grass and, in the 1930's, kikuyu grass from Kenya.

In the 1870's, blue metal extraction (basalt) was to become a supplementary industry to dairy farming in the area.

The site of Kiama township was reserved by the government in 1826 and proclaimed in 1836. Kiama was proclaimed a Municipality in 1859 and included much of the present day area from the Minnamurra River west to the Kangaroo River and south to Crooked River. Three wards make up the Municipality - Kiama, Jamberoo and Gerringong.

The Kiama district today has a number of buildings/sites of historical interest, a number of which date back to early settlement of the area.

The Kiama and District Historical Society has established a walking trail which covers 26 items of heritage significance. Included on the the trail is the Bank of NSW (completed 1888) Manning Street, the former Commercial Bank building (1881), the Terrace Shops (c.1900) formerly the Quarry Cottages and a number of other sites and buildings of historic interest.

Buildings of Kiama and district of historic significance which are listed in the register of the National Trust (NTA, 1982) are presented in Table 3.4.

There are no sites, buildings or structures adjacent to the section of the Princes Highway proposed for reconstruction, which have been documented as being of European historical significance.

There are two historically significant buildings located adjacent to the northern section of Swamp Road. These buildings which were formerly used as a school and headmasters residence were constructed around 1881 and are recorded in the Register of the National Trust.

Dunmore house, constructed around 1868-1872 is another building of historic significance which is located south of Swamp Road on the Princes Highway. This building is classified by the National Trust.

## TABLE 3.4

## HISTORIC PLACES : KIAMA DISTRICT

| ITEM | DATE OF CONSTRUCTION | NATIONAL TRUST LISTING |
|---|---|---|
| **ALBION PARK** | | |
| All Saint's Anglican Church | 1874 | Recorded |
| St. Andrews Presbyterian Church Godsell | 1907 | Recorded |
| Dunsters Lane<br>The Hill Homestead<br>Toongla Tullimbar Road | c1865 | Recorded<br>Classified |
| **DUNMORE** | | |
| Princes Highway<br>Dunmore House, formerly Peterborough.<br>North of Kiama, just south of Swamp Rd | 1868-1872<br>1909 - additions | Classified |
| Swamp Road<br>Former School and Headmasters Residence | c1881 | Recorded |
| Wiragulla Road<br>Across the Paterson River, 1 km east of Woodville Dunmore Bridge | 1899 | Recorded |
| **GERRINGONG** | | |
| Princes Highway<br>Renfrew Park | c1850 | Recorded |
| Other (inadequate location information)<br>Rose Valley, Alne Bank, including barn and cemetery, house | 1851. | Classified |
| **JAMBEROO** | | |
| Jamberoo Valley Landscape Conservation Area: boundaries of the Jamberoo Basin follow the sweep of the western and southern escarpments to the Saddleback Mountain spur on the south, to the low range of hills on the north, and the easterly boundary of the pasture land. | | |
| Allowrie Street<br>St Stephens Presbyterian Church | 1875-76 | Recorded |
| Churchill Street<br>Anglican Church of the Resurrection-E.T. Blacket | 1865 | Recorded |

**TABLE 3.4 (cont)**

| ITEM | DATE OF CONSTRUCTION | NATIONAL TRUST LISTING |
|---|---|---|
| Public School | 1876 | Recorded |
| Macquarie Street | | |
| Methodist Chruch, W. Boles | 1878 | Recorded |
| Minnamurra Lane | | |
| Minnamurra House | Early 1840s | Classified |
| Other | | |
| Fredericks Big Star Stores | | Recorded |
| Next to Jamberoo Hotel, Former Georgian Shop | | Recorded |
| St Matthews Roman Catholic Church | 1875 | Recorded |
| Culwalla - 2 km east of Jamberoo on main road | 1858 | Classified |
| Terragong House: Paddock | 1858 | Classified |
| Main House (back section rebuilt) | c1890 | |
| **KIAMA** | | |
| Bong Bong Street | | |
| 38 : Cottage | | Recorded |
| 43 : Cottage | | Recorded |
| 64-66 : Mt Vernon | 1874 | Recorded |
| Collins Street | | |
| 24-40 Terraces | c1885 | Recorded |
| Hindmarsh Park Precinct | | Classified |
| Hartwell Crescent | | |
| Hartwell House | 1858 | Classified |
| Manning Street | | |
| Cnr Manning and Bong Bong Streets | | Classified |
| Kiama Veterinary Services formerly CBC Bank | | Classified |
| Bank of NSW attrib. Salmon & Power | 1887 | Classified |
| Uniting Church including front lawn and pine trees | 1858 | Classified |
| Grand Hotel | | Classified |
| ANZ Bank, inclduing stables, rear garden and fences | | Classified |
| Council Chambers and pine tree at rear | 1915 | Classified |
| Council Engineering Office Building | 1900-1902 | Classified |
| RSL Sub-Branch Hall | 1900 | Classified |
| Post Office grounds and pine trees | 1877-78 | Classified |
| J. Barnet | | |

TABLE 3.4 (cont)

| ITEM | DATE OF CONSTRUCTION | NATIONAL TRUST LISTING |
|---|---|---|
| Minnamurra Street | | |
| Cnr Shoalhaven Street Kiama Infants School, formerly Primary School | | Recorded |
| 1st Section | 1871 | |
| G.A. Mansfield Verandahs | 1874 | |
| G.A. Mansfield Wing | 1879 | |
| W.E. Kemp Two Storey Wing | 1883 | |
| W.E. Kemp Small Single Storey Addition | 1893 | |
| Princes Highway | | |
| 117 : Aughinvar | | Recorded |
| Shoalhaven Street | | |
| 72 : House | | Recorded |
| Terralong Street | | |
| Cnr Manning Street, Kiama Govt., Building Group comprising: | | |
| Post Office and outbuilding, Court House, grounds and trees. A. Dawson | 1860 | Classified |
| Police Station. J. Barnet | 1884 | Classified |
| Police Station Residence. J. Barnet | 1867 | Classified |
| Additions W.L. Vernon | 1902 | Classified |
| Cnr Shoalhaven Street | | |
| Scots Presbyterian Chruch including surrounding land and Norfolk Island Pines. Nave completed, spire and vestry later | 1860-63 | Classified |
| Other | | |
| Kiama Light House. E.O. Moriarty J. Barnet | 1887 | Classified |
| Anglican Christ Church. E.J. Blacket | 1859 | Recorded |

## 3.9 LANDSCAPE AND SCENIC QUALITY

The existing landscape and scenic quality of the area is fairly typical of that part of the South Coast of NSW. The scenic quality of the area can be attributed to the combination of densely vegetated escarpment and upper slopes, cleared pastoral valley floors and the self contained system of the Minnamurra River and its associated wetlands.

The topography, vegetation and land use define the landscape and scenic quality of the area. The main landscape elements which make up the scenic quality of the area are the Minnamurra River and wetlands, the Terragong Swamp, the northern suburbs of Kiama, the hills containing the river and pastoral lands.

The topography varies from flat beaches and headlands along the coast line including the undulating river valley, wetlands and swamp area, to the undulating rural areas inland. Hilly areas extend west to Jamberoo and the Illawarra Escarpment.

The few remaining areas of vegetation near the coastline are scattered and tend to dominate land near the Minnamurra River. Residential and rural land uses have cleared the majority of vegetation. The Minnamurra River and associated wetland area support shrubland, woodland and other wetland vegetation. Other vegetation in the area includes open forest, rainforest species, lantana and figs.

The land use along coastal areas is predominantly urban residential and it is now encroaching westward into the predominantly rural areas. The rural areas are largely cleared pasture land that support dairy farms. The other major land use activity in the area is quarrying. A number of abandoned and operating quarries exist on headlands and at Bombo.

Road corridors in the study area are visible from both local and distant viewing locations. The Princes Highway can be seen locally from houses fronting and overlooking the Highway. The Swamp Road corridor is visible from localised areas and some high points behind Kiama township. Photographs 3.1 and 3.2 show the Highway from a

location overlooking the Kiama Golf Course (looking north) and a view of the Swamp Road corridor from Riversdale Road respectively.

The scenic quality of the region is described in the Illawarra Regional Plan Landscape and Environmental Study (1981). Areas were ranked from one to five according to their relative scenic quality, five being the highest and one being the lowest. The Minnamurra River area has a ranking of three, (medium visual quality) while the area to the west has a score of two. Areas associated with water bodies scored higher than flatter areas within the region. Those areas with the higher visual quality rating included the steeper slopes adjacent to the Escarpment.

The visual quality rating is based on the assumption that the following factors contribute most to scenic quality:

- Terrain contrast:
- Steep forested slopes:
- Natural contrast:
- Cliffed escarpments.

The assumptions made in the above study in assessing visual quality tend to under-rate the significance of the cleared pasture. These undulating hills, particularly when viewed from the valley floor or from major ridges, present a highly scenic landscape of a distinctive rural character. This rural character can be attributed to the broad patterns created by the contrast of fields, scattered farmhouses and clusters of trees.

Threats to scenic quality come from the pressure for urban expansion, rural residential subdivision, tourist/recreation developments and corresponding infrastructure such as roads and power lines.

## 3.10 TOURISM AND RECREATION

A review of tourism and recreation within Kiama Municipality and the study area has been undertaken. The results of this review are set out in Working Paper F.

PHOTOGRAPH 3·1 : PRINCES HIGHWAY AND KIAMA GOLF COURSE - LOOKING NORTH FROM GOLFERS PARADE.

PHOTOGRAPH 3·2 : SWAMP ROAD AREA LOOKING SOUTH FROM RIVERSDALE ROAD.

The area within the Municipality provides for a diversity of recreational activities and has traditionally attracted a significant level of tourist visitation. Both water and land based activities are common, including use of the beaches, off-shore zones, the rivers and the inland rural land areas of natural vegetation.

Specific attractions include the Kiama Blowhole, Minnamurra Falls Reserve, Jamberoo Park and Wild Country Park. In summer, the beaches around Kiama experience very heavy use.

Kiama experiences the peak influx of visitors in the summer holiday period during which time it is estimated that the Municipal population increases by between 15,000 and 25,000. Other concentrations occur during Easter, October and on weekends during summer. Little tourist data exists for the Municipality in isolation and further analysis must be based on data for the Illawarra Tourist Region.

The Minnamurra River Estuary and lower reaches fall within the study area. This is used for fishing and boating. Two coastal beaches, Boyds Beach and Bombo Beach, are located in proximity to the study area.

Kiama Golf Course runs adjacent to the eastern side of the Princes Highway. It is an 18 hole course with a licenced club house.

The rural area in the western section of the study area has no major tourist interest in itself but is traversed by people travelling into the hinterland, in particular to Jamberoo Park and for rural car touring.

# 4.0 EVALUATION OF ALTERNATIVES

## 4.1 INTRODUCTION

This section contains an evaluation of the alternative routes in the study area based on traffic needs of the corridor and environmental and engineering considerations.

Seven major options have been investigated as alternatives for improving the traffic corridor. These seven options represent three major alternatives which are considered to represent the most practicable options available given the existing topography, land use and transport network of the region. The three major alternatives considered are:

1. The No Project Option
2. The Princes Highway Corridor Options
3. The Swamp Road Corridor Options

The Swamp Road Options and Princes Highway Options are shown in Figure 4.1

The Swamp Road options vary from the Princes Highway options in their location and reconnection to the existing transport network. The area has been evaluated as an alternative corridor. Two major options within this corridor considered are denoted Scheme B and Scheme C. Another option, suggested late in the study by a local resident group (RANKS), has also been investigated and is shown in Figures 4.1 and 4.7 as Scheme R.

The Princes Highway corridor includes three options which vary in design through the section of road from the Minnamurra River to Oxley Avenue. Three alternatives are proposed regarding the level of earthworks required in this location. These options are denoted Scheme A, Scheme D and Scheme E. The proposed upgrading from Oxley Avenue to Bombo is the same for each option.

DEPARTMENT OF MAIN ROADS OF N.S.W.

PRINCES HIGHWAY RECONSTRUCTION - MINNAMURRA RIVER TO BOMBO, KIAMA

**CORRIDOR OPTIONS**

**FIGURE 4·1**

Dames & Moore : 13605-004-70

DUNMORE

Rocklow Creek

SOUTH COAST RAILWAY

PRINCES HIGHWAY

SOUTH PACIFIC OCEAN

Beach

MINNAMURRA RIVER

MINNAMURRA

Rest Area

MINNAMURRA

MUNICIPALITY OF SHELLHARBOUR

Schemes B,C

Schemes A,D,E

Minnamurra Point

Golf Course

Quarry

RIVER

MINNAMURRA

GAINSBOROUGH ESTATE

KIAMA DOWNS

Beach

Terragong Swamp

Scheme R

Bayds

Cathederal Rocks

MUNICIPALITY OF KIAMA

RIVERSDALE

Scheme C

Quarry

Quarry

Scheme B

BOMBO

Schemes A,C,D,E

Beach

SOUTH PACIFIC OCEAN

Cemetery

BOMBO RAILWAY STATION

Wrights Creek

Bombo

Quarry

Quarry

Willow Gully Creek

Wrights Creek

KIAMA

Pheasant Point

N

0 0·5 1km

The schemes proposed are dictated by the overall transportation situation as it exists on the South Coast, between Wollongong and Nowra. The F6 (Southern) Freeway currently ends at Yallah and its proposed extension is considered unlikely in the foreseeable future. The limiting factors are the costs involved (tentative estimate $50M (1984) to construct a two-lane standard carriageway) and that the work could not be completed within a reasonable time scale, even if funds were available. In addition, the Freeway would only be of use to through-traffic because of the necessity to limit the number of access points for local traffic. It is considered that future long distance traffic levels are not sufficient to justify the construction of the F6 at this time.

Each option has been assessed in the context of how it will service the traffic needs of the corridor, taking into consideration the existing system and the Kiama By-Pass, which is currently being constructed. To enable comparison of the alternatives, each option has been assessed on the following transportation criteria:

- Local land use planning;
- Existing local and regional traffic;
- Future traffic needs;
- Road user cost.

## 4.2 NO PROJECT OPTION

The first alternative is to leave the existing road system as is and to implement traffic management activities in conjunction with the Kiama By-Pass.

During current operating conditions, daily traffic volumes on SH1 range from 14,000 to 16,000 vehicles which is over the Highway planning guideline capacity of 12,000 for a two lane carriageway. This traffic is largely local and commuter traffic. During holiday periods the traffic volume significantly increases causing congestion along the Highway.

Problems affecting both north and south flows are associated with the Kiama business centre but may be alleviated with the completion of the

Kiama by-pass road. Traffic flows at these volumes have decreased the level of service of the road with drops in speed and even stoppages.

Available traffic data indicates that the existing Highway experiences situations of extremely high traffic volumes during peak holiday periods. Even daily traffic volumes exceed free-flow criteria. As discussed in Section 2, these peak holiday flows occur at various intervals during the year. The Christmas - New Year period, Easter and Australia Day long weekend are three examples of when traffic volumes are very high. The Labour Day and Queens Birthday long weekends also experience traffic volumes higher than the preceding and following weekends but are lower than those recorded during the peak holiday periods mentioned earlier.

Data obtained from the DMR permanent count station at South Kiama (No. 07001) illustrates a significant drop in traffic between the months of January and February. This drop can be explained by the end of school holidays. An example of the change in volumes is seen by comparing traffic flows on the Monday of the Australia Day weekend to the following Monday. For 1984, the volume of traffic dropped from 17,440 vehicles on Monday, 31st January (a public holiday) to 10,100 vehicles on Monday, 6th February (a school and work day), a drop of 42% in traffic volume. A more significant drop in traffic volumes is seen in comparing Easter Monday (1984) to the following Monday. Figures indicate a 48% drop in traffic volumes from 19,180 vehicles to 10,030 vehicles.

The no project alternative represents the least cost option but would provide only short term solutions to traffic problems in the Kiama region. Future traffic projections based on previous growth trends have been outlined in Section 2. Based on these projections, annual average daily traffic volumes for the Minnamurra River to Bombo section of the Princes Highway have been estimated in the vicinity of 25,000 to 28,000 vehicles by 1995. If these projections were realised then sections of the Princes Highway, such as between Minnamurra River and Bombo, would not have sufficient capacity to handle peak volumes at a satisfactory level of service.

## 4.3 THE PRINCES HIGHWAY OPTIONS

The options for the Princes Highway propose the construction of a dual carriageway along the existing Highway between the Minnamurra River and Bombo. The proposal is part of an overall scheme to upgrade the Princes Highway from the end of the proposed F6 Freeway extension at Yallah, through to the Kiama by-pass at Bombo. The overall scheme would result in the duplication of the Princes Highway from Yallah to Bombo. South of Bombo, the Highway will join the Kiama by-pass directing through-traffic around the business centre in Kiama, rejoining the existing Highway on the southern edge of Kiama township.

Three alternative options have been developed for the section of Highway from the Minnamurra River bridge to the Oxley Avenue intersection. This section of road is bounded to the west by the Minnamurra River and associated wetlands, and to the east by the Kiama Golf Course and the basalt cliff which has houses located on top of it fronting onto Samuels Lane.

The options were developed in consideration of the requirements for cutting the cliff and/or filling the river to accommodate the necessary realignment and widening of the Highway. The options considered are referred to as Schemes A, D and E. The design for the section of Highway from Oxley Avenue to Bombo is the same for all Schemes.

**Scheme A**

Scheme A (shown in Figure 4.2) is designed to ensure an improved alignment of the Princes Highway to ease traffic congestion.

The design proposed requires the duplication of the bridge over the Minnamurra River on the eastern side of the existing bridge. This is similar for Schemes D and E.

Direct impacts on vegetation of a second parallel road bridge will be minimal. Provided embankments do not extend beyond the current river bank, subsequent alteration in the composition of saltmarsh should be minimal.

The boat ramp which is currently located at the southern end and on the eastern side of the bridge must be relocated. It is proposed that access to a new ramp, to be located east of the duplicated bridge, will be maintained.

The road widening will encroach on the existing truck and car stopping area on the western side of the Highway. However, this will not significantly affect its use. The relocation of a public telephone booth and bus shelter on the southern corner of Trevethan Street will also be required.

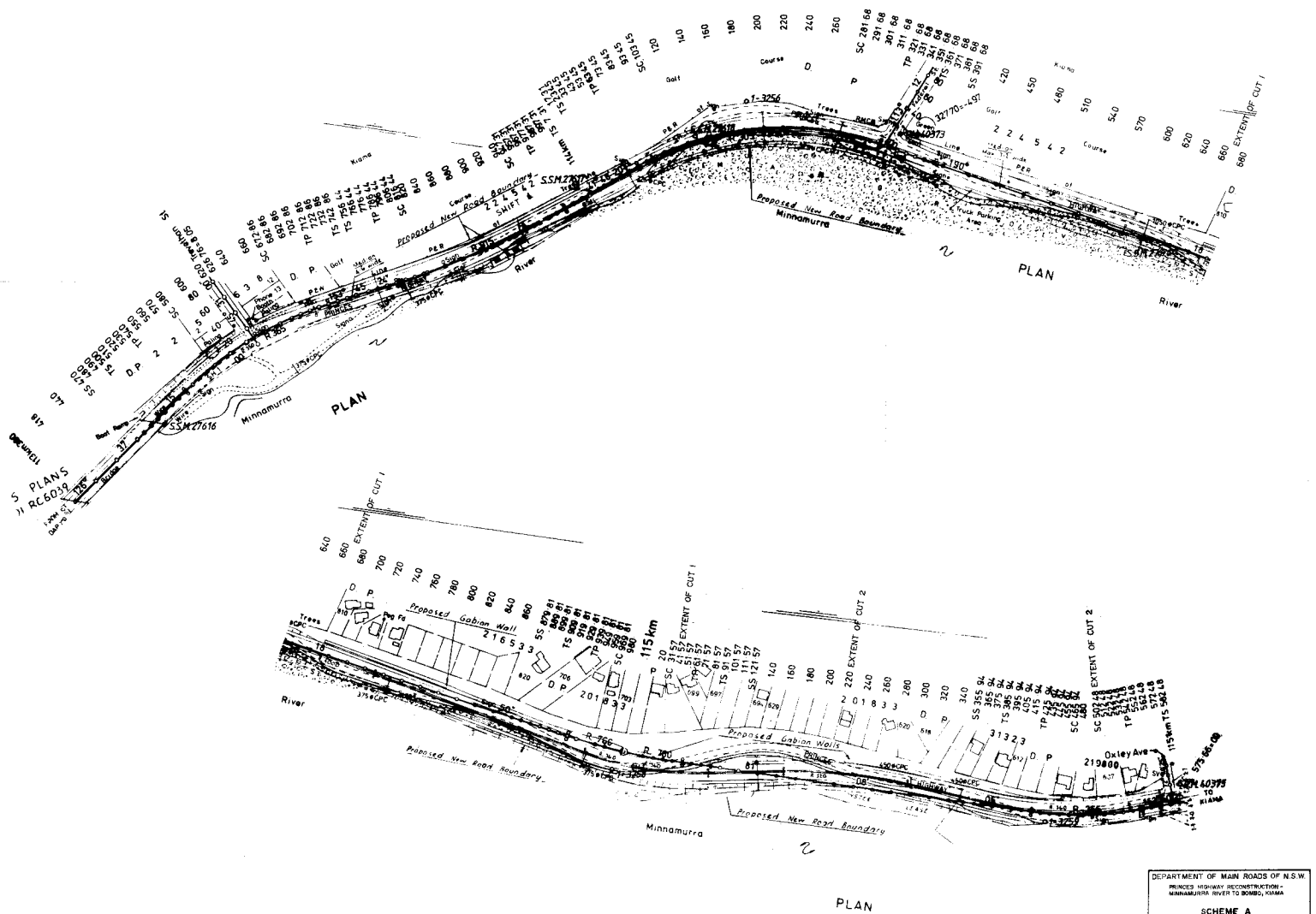
Sufficient land space is available in that location to adequately accommodate their relocation. Access to Trevethan Street and associated residential houses will be maintained.

The Highway parallels the western boundary of the Kiama Golf Course for approximately 990 m. To maintain the desired alignment, a small portion of the Golf Course must be acquired. The loss of the land will not affect the Golf Course operation or the player's game. The closest "green" to the Highway is No.3 which is located on the southern side of Federal Street.

Areas of filling required to accommodate the Highway widening commence 100 m from the truck parking area on the western side of the Highway. Fill is required for almost the entire length of the river as it parallels the Highway. Areas of embankment intrusion vary in width. The most signficant area of fill required is the backwater area. The following figures are approximate total quantities of fill required for the River:

- Below Mean High Water Level: 20,000 $m^3$
- Above Mean High Water Level: 41,600 $m^3$

A detailed study was undertaken to determine the effects of the road widening on the river and estuarine environment. The results are outlined in the Working Papers. The results show that little change to hydraulic conditions for tidal flows will occur. Nevertheless there would be some local variations about the works themselves. Velocity




DEPARTMENT OF MAIN ROADS OF N.S.W.

PRINCES HIGHWAY RECONSTRUCTION - MINNAMURRA RIVER TO BOMBO, KIAMA

SCHEME A

FIGURE 4-2a

increases will occur during floods and these increases will exacerbate river bed changes.

The results of the study showed that the widening could have a number of detrimental impacts if Scheme A were to result in increased water turbidity and changes to the existing erosion/sedimentation patterns in the River.

Increased turbidity would have effects on three major groups of organisms: oysters, fish and seagrasses. Sediments on the channel bottom and exposed flats are predominantly sands. Muddy sands occur in seagrass beds, and muds within the mangroves and sheltered areas. The effects of the proposed Highway reconstruction on water quality would be limited to a short term increase in turbidity during the construction period. In the long term, some accretion may result providing some irregular areas for recolonisation, but most would be removed by flood flows.

Channel changes would affect the mangrove and seagrass communities. Both mangroves and seagrasses are resistant to erosion and may colonise accreted areas. However a combination of increased siltation and erosion pressure would be highly detrimental.

Filling of the River would directly remove approximately 20% of the main stand of mangrove and part of the remainder will also be affected by siltation from embankments, particularly during construction.

Even with no significant net alteration in erosion and deposition, alterations to the wetland vegetation may be expected. Such a process is likely to be in operation naturally, and has been modified by earlier drainage programmes and in the past by construction of the existing road.

Computer modelling has shown that velocities in periods of low flow would increase by about 10% with the construction of Scheme A. Under maximum flood flow, using data for an estimated 20 year flood, combined with an ebbing spring tide, maximum current velocities would increase from approximately 150 cm/sec to approximately 170 cm/sec. This would

result in some additional erosion and sediment transport but is unlikely to change existing overall sediment transport patterns significantly.

The major area where excavation is required is the cliff on the eastern side of the Highway south of the Golf Course. The basalt cliff must be cut to allow for the road widening. The estimated cut required is 46,240 cubic metres. Gabion walls would be constructed and revegetation proposed above the wall. The gabion walls, proposed in two locations, would extend for approximately 400 m from the southern boundary of the Golf Course, south, then for about 300 m north of Oxley Avenue.

The major features of the existing cliff are the dense vegetation, consisting of fig and rainforest species, shrubs, and the house-blocks located on top of the cliff on Samuels Lane and Oxley Avenue.

Much of the vegetation on the cliff is regrowth and many if not most of the species can be expected to be present elsewhere about the estuary, although perhaps not commonly as vegetation has been largely cleared elsewhere in the district. The area cannot be regarded as virgin rainforest deserving of absolute protection as there is lantana infestation and a high level of other alien species.

Other vegetation that would be affected by the road reconstruction includes a large Morton Bay figtree, and other roadside vegetation. The Morton Bay figtree is located approximately 200 m north of Federal Street on the western side of the Highway.

The road widening from the River to Oxley Avenue falls within the Arterial Road zoning outlined in the Kiama Municipal Local Environmental Plan No.5.

From Oxley Avenue to Bombo the proposed widening generally follows the same route of the existing Highway alignment. Residential houses and some private and public open space reserves are located adjacent to the Highway. Designated land would be utilised to accommodate the carriageway. In some sections, additional land would be required from

house-blocks and public and private open space reserves. The acquisition of the land is not expected to affect these areas significantly. Ten intersections occur along this section of the Highway. From Iluka Crescent to North Kiama Drive a service road is proposed adjacent to the Highway which would connect with North Kiama Drive. At this intersection, the Highway alignment is proposed further west, and the existing carriageway would be used as an extension of North Kiama Drive, connecting with the new Highway alignment at Bombo. The proposed overbridge would connect the existing Highway with an extension of Barton Drive. Access ramps are proposed at this location. The Barton Drive extension, realigned Highway and access ramps traverse an abandoned quarry which is adjacent to the existing Railway and Boral quarries.

**Scheme D**

The alternative Scheme D option (shown in Figure 4.3) differs from Scheme A only in the proposed treatment of the reconstruction of the Highway from the Minnamurra River to Oxley Avenue. The proposed alignment generally follows Scheme A however it is a more easterly alignment and the treatment of areas of earthworks differ. Scheme D is designed to avoid any intrusion into the River and changes to the estuary. The proposed design would have little effect on the river and estuarine environment. However, the alignment would require the acquisition of a strip of the Golf Course land almost the total length of its western boundary. Maximum width required is 28 m. Although the area is not extremely large (0.5 ha) from a total area of approximately 23.0 ha, the road widening would significantly encroach on Green No.3 (located on the southern corner of Federal Street) and the associated fairways. Loss of this area would require rearrangement of the Golf Course layout or total acquisition of the area by the DMR. The costs of either of these alternatives are likely to be prohibitive.

The other significant design change would be the extensive excavation required of the basalt cliff on the eastern side of the Highway. Excavation requirements would commence at the southern end of the Golf Course and would include up to 14 m intrusion into existing house-block boundaries. This intrusion would affect 13 properties along approx-

imately 280 m of carriageway length. All existing vegetation would be removed from the cliff. However, the majority of river vegetation would remain.

Filling of the backwater would be required to accommodate the widened road and some turbidity could be caused during construction. However, this is not likely to affect the estuary significantly.

The estimated cut and fill required for this Scheme is:

Cut - 62,200 $m^3$
Fill - Above Mean High Water Level : 18,200 $m^3$
- Below Mean High Water Level : 9,000 $m^3$

The effect on the River would be insignificant. Studies have shown that filling of the backwater area of the River would not affect hydrological conditions. Some sedimentation and turbidity would be caused during construction. However, these would be short-term effects, and are not likely to affect the biota significantly.

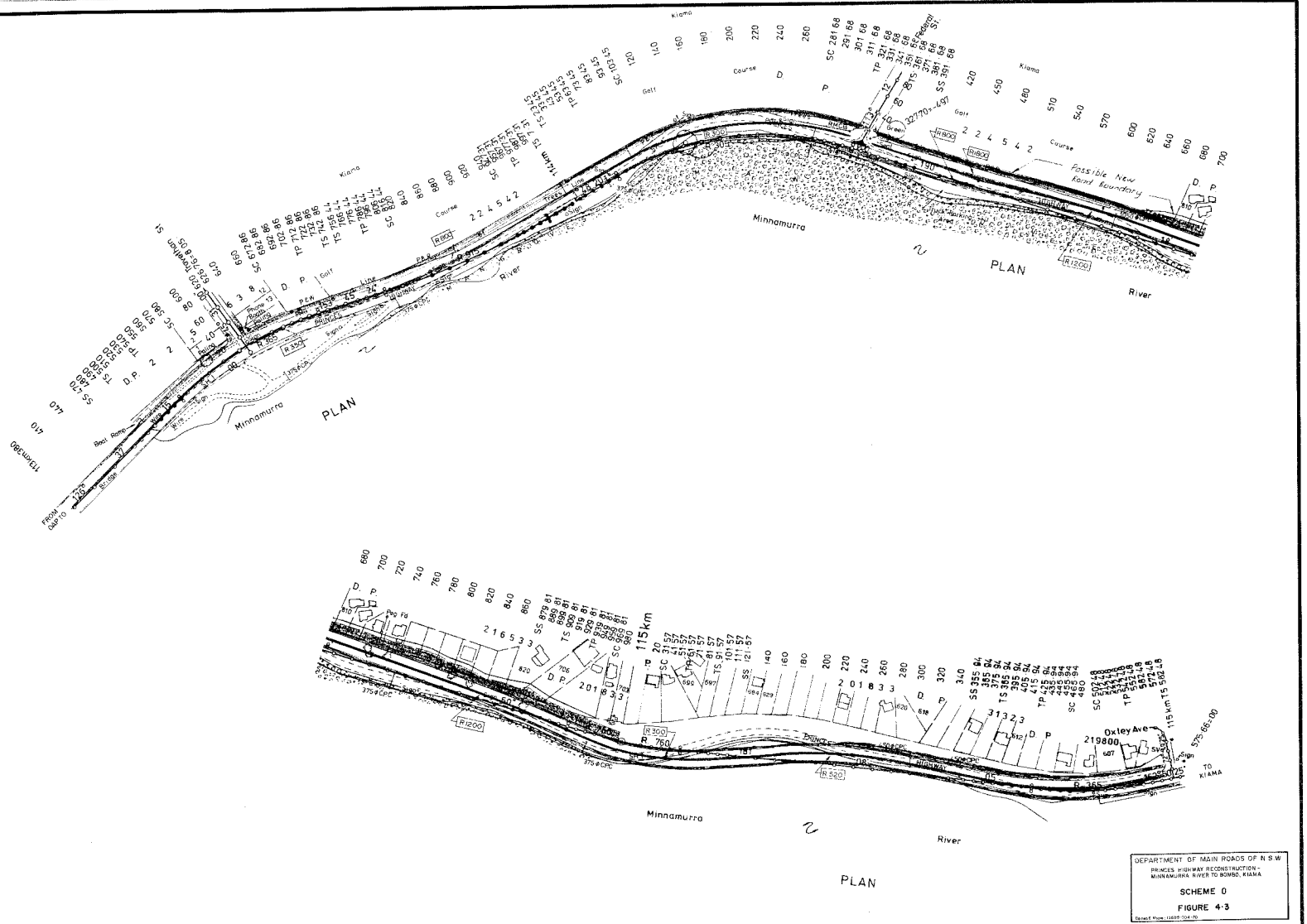
**Scheme E**

This Scheme (shown in Figure 4.4) has been designed as a compromise between Schemes A and D for the section of road from the Minnamurra River Bridge to Oxley Avenue.

The treatment of the western boundary of the Highway varies in that less fill is required to accommodate the proposed realignment and widening than Scheme A but more is required than Scheme D. It is proposed that a reinforced earth wall be constructed to minimise intrusion into the River. The following figures have been estimated as follows:

Fill : Above Mean High Water Level : 24,400 $m^3$
: Below Mean High Water Level : 10,300 $m^3$

The total fill required for the river is 700 $m^3$, and 9600 $m^3$ for the backwater, below Mean High Water Level.

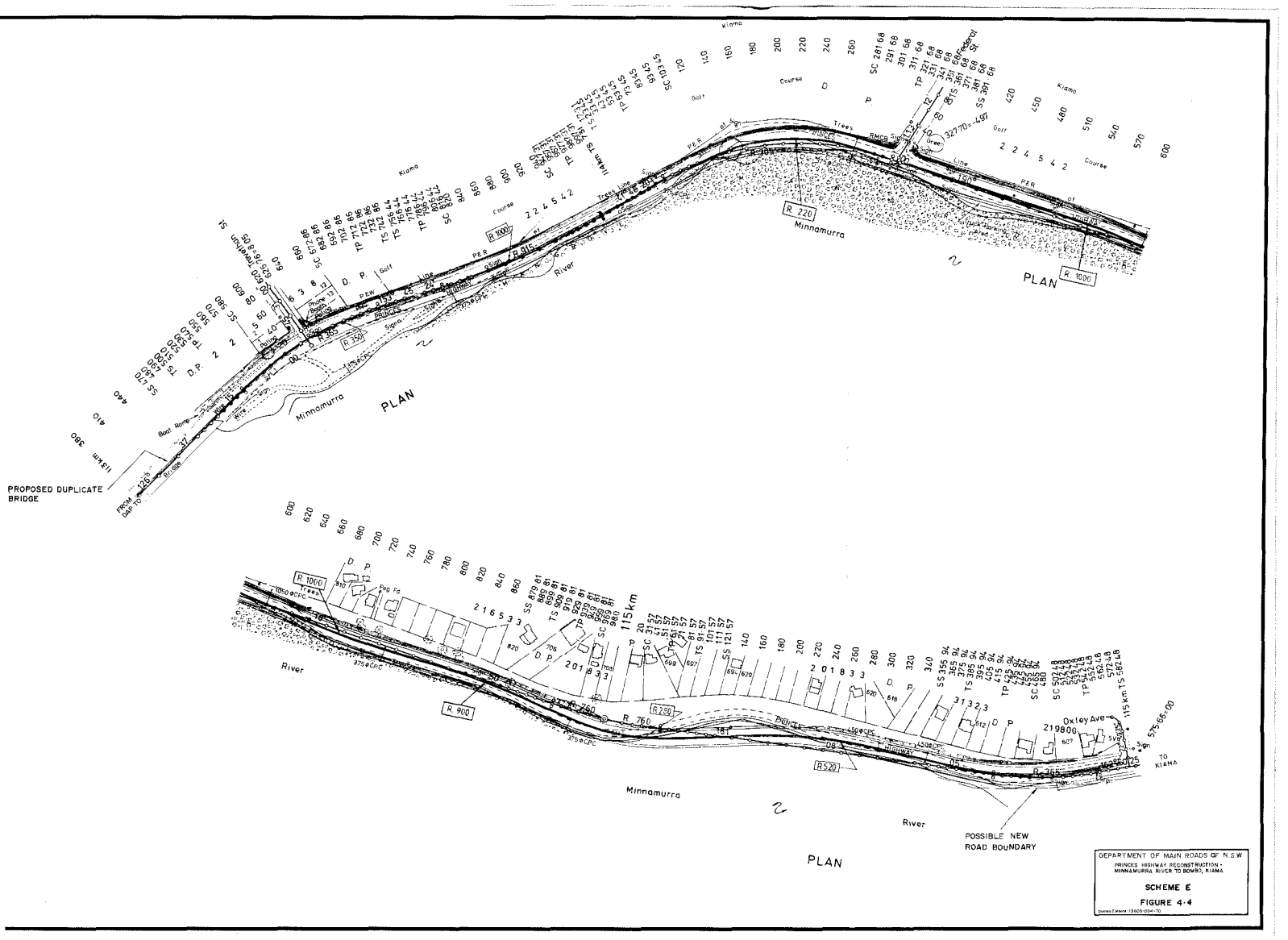



DEPARTMENT OF MAIN ROADS OF N.S.W.

PRINCES HIGHWAY RECONSTRUCTION - MINNAMURRA RIVER TO BOMBO, KIAMA

SCHEME 0

FIGURE 4·3


PROPOSED DUPLICATE BRIDGE
PLAN
Minnamurra
River
Kiama
Golf Course
Trees
Oxley Ave
TO KIAMA
POSSIBLE NEW ROAD BOUNDARY
DEPARTMENT OF MAIN ROADS OF N.S.W.
PRINCES HIGHWAY RECONSTRUCTION - MINNAMURRA RIVER TO BOMBO, KIAMA
SCHEME E
FIGURE 4·4

Increases in sedimentation and turbidity would be limited to the construction phase. However, effects would be limited to short-term increases which would not be expected to significantly affect the biota of the river and estuary. Channel changes, caused by increases in flood velocities would be less significant than those for Scheme A except in the worst possible case (see Working Paper D).

The Highway widening is not expected to significantly alter the existing hydrological or sediment transport patterns, and therefore no significant impacts on the wetland communities are anticipated.

The total cut required is 37,500 $m^3$, largely in the vicinity of the cliff. Two sections of excavation are involved : approximately 320 m of cliff opposite the river and approximately 310 m north of Oxley Avenue. Gabion walls are proposed in these locations.

Scheme E would not require the acquisition of housing blocks or areas of the Golf Course. The new road boundary would abut the house-block boundaries.

## 4.4 THE SWAMP ROAD OPTIONS

The Swamp Road options propose an alternative corridor from the Princes Highway to the west of the existing Highway alignment.

These options were considered as part of a corridor which would involve the construction of a new road easement for its entire length. The alignment and condition of the existing Swamp Road would not be suitable for the proposed transport facility.

To the west of the proposed corridor is the Jamberoo Valley which is the subject of a Section 101 Direction under the Environmental Planning and Assessment Act.

The primary function of the existing Swamp Road is rural access. Field traffic surveys indicated a daily volume along Swamp Road at 500 vehicles over a 24-hour period. Swamp Road also provides access to the Kiama - Jamberoo Road (MR264) and the Jamberoo Valley and township.

Consequently, local and recreational traffic movement in areas north-west of Kiama would use Swamp Road.

Future growth in traffic along Swamp Road is not expected to be substantial. Future urban expansion of Kiama is expected to occur to the east of the ridgeline that divides the Jamberoo Valley from the coastal areas of Kiama. A recent Urban Expansion Study prepared by Kiama Municipal Council identified a study area east of the ridgeline based on:

- The Illawarra Regional Landscape and Environmental Study which recommends protection of the rural agricultural landscape of the valley;

- The Section 101 Direction currently applying to the Jamberoo Valley which enforces the State Government's policy concerning the visual significance of the valley and the need to protect it.

Consequently, future development and subsequent traffic generation is expected to be concentrated within and immediately adjacent to the existing Kiama urban areas. The increase in tourist or recreational traffic using Swamp Road to gain access to the Jamberoo Valley and scenic areas such as Minnamurra Falls is also not expected to be substantial. More direct access from the majority of the Wollongong urban areas and areas to the north is provided from Albion Park via MR266.

The Swamp Road corridor traverses low-lying rural areas to the west of the estuarine wetlands of the Minnamurra River - Terragong Swamp. Some areas to the east of the corridor have been altered from its rural nature by sand mining activities on a number of properties. The area is subject to flooding and used mainly for dairying activities, although this use is changing with the pressure for sub-division into smaller holdings, and the declining profitability of dairying. As the corridor moves eastwards towards Bombo, the slope of the terrain increases before dropping down on the edge of new and planned urban development. The corridor approaches the aggregate and railway ballast quarry areas at Bombo. It is expected that these quarries will extend further west in the future, within their designated boundaries.

The scenic quality of the area is typical of its rural nature. The landscape character of low-lying hills and visual qualities enhance the scenic rural environment.

The corridor traverses the upper tidal limits of the Minnamurra River and Terragong Swamp within the recently designated coastal wetland area under SEPP No.14. A crossing of this area should be by bridge to minimise disruption to the existing waterways and flood patterns, and to ensure the road is above flood levels. The extent of inundation by flood water is generally within an area bounded by the Minnamurra River and one of its tributaries. The narrowest possible bridge location is approximately 1 km in length. Bridge locations further west would require a longer length.

Vegetation within the corridor is sparse. However, two areas of significance are in the Casuarina glauca forest, which is in the vicinity of the Terragong Swamp area, and a forest stand on the hill slopes near Tabbagong, a property west of Bombo. Such areas are regarded as important as the general area was extensively logged in the early days of the colony and Kiama Municipal Council seeks to retain as much of the existing vegetation as possible.

The Swamp Road corridor dissects a number of local access roads to properties in the area. This includes an alignment between two man-made lakes, one of which is called the Model Marine Lake near the northern end of the corridor. The Model Marine Lake is used for powered model boats. Provision of access would need to be considered pending the construction of a road.

The southern section of the corridor for Schemes B and C traverses land zoned for industrial and residential purposes. Much of the area is as yet undeveloped and predominantly pasture land. Several alternative routes could be considered to join the corridor to the existing road network of the Highway or the Kiama by-pass. However, the land use and steepness of the terrain is a limiting factor for potential alignments.

Scheme B involves the construction of dual carriageways from the intersection of Swamp Road and the Princes Highway through rural lands,

across the southern edge of the Terragong Swamp to a point just north of Terralong Street, west of Bombo. This Scheme is 6.2 km in length.

Scheme C involves the construction of dual carriageways in a similar design as Scheme B. However, the route departs from the alignment beyond the Terragong Swamp. The proposed route swings in an easterly direction and travels along the northern side of the quarries to rejoin the Highway at Bombo. This Scheme is 6.8 km in length.

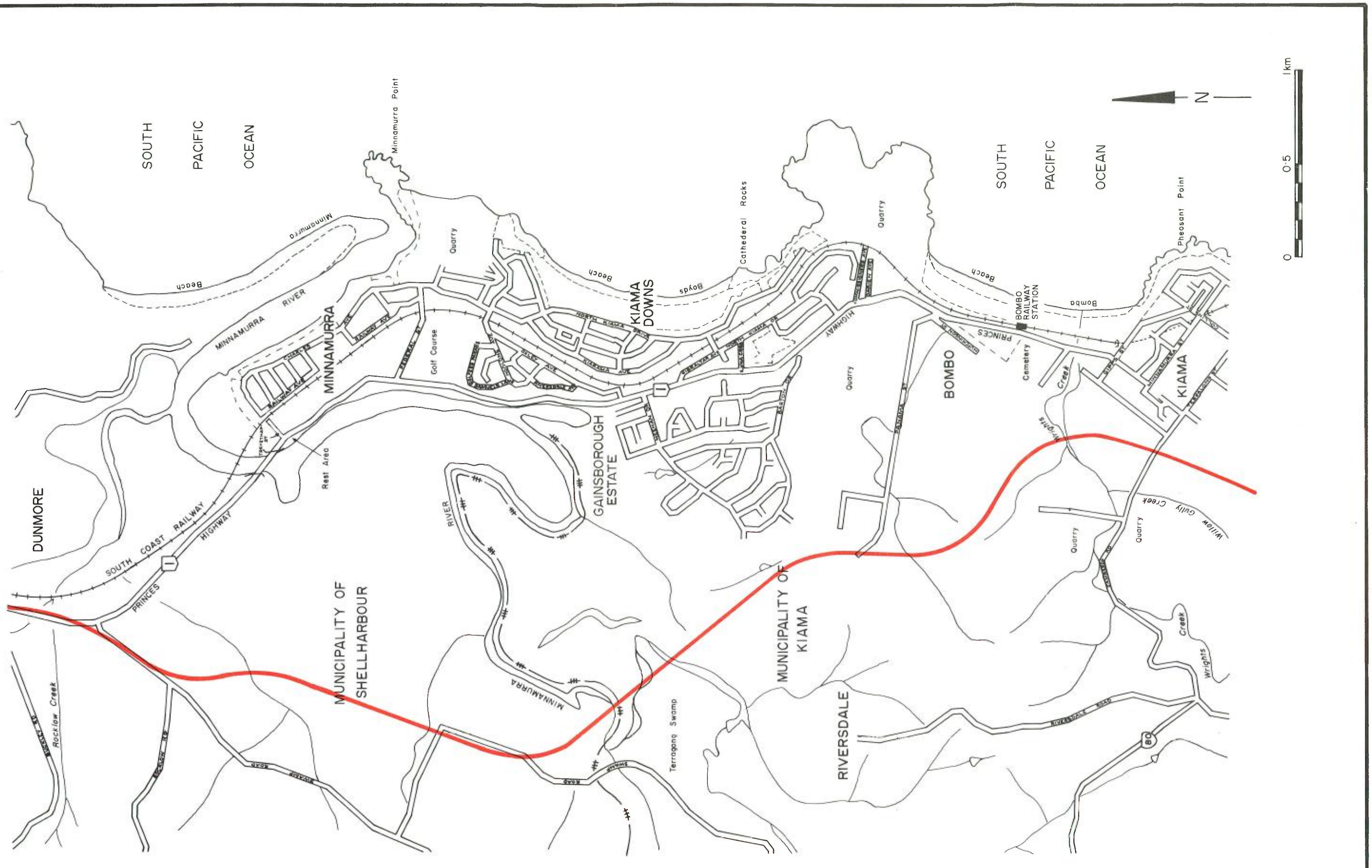
**Scheme B**

The proposed alignment for Scheme B (shown in Figure 4.5) leaves the Princes Highway at Dunmore, travelling in a generally south-west direction before crossing the Minnamurra wetland area. Initially it follows the existing Swamp Road alignment for approximately 500 m then diverts to a more southerly alignment at the Rocklow Road intersection. Approximately 100 m north of Rocklow Road are two buildings classified by the National Trust. These are a former school and head-masters residence. The alignment would not disturb these buildings. To the west of this area are Dunmore House, an historic homestead, and two small man-made lakes which are the remnants of past sand mining activities. The more southern pond (Model Marine Lake) is currently used by a model boat club, predominantly on weekends.

Further south the route passes several dwellings and then between the two man-made lakes. The route then passes to the west of two small hills and through a small saddle to cross the existing Swamp Road alignment. To the west of the saddle is a residence whose access is from Swamp Road. The residence is located on the western side of the hill approximately 250 m from the route alignment.

To the east of the alignment is a property called "Allawah", approximately 250 m from the proposed route. The access to the property is from Swamp Road. The proposed route alignment crosses this access road.

After crossing Swamp Road, the route then parallels Swamp Road for approximately 500 m on its western side. The property "Glengowrie" is located approximately 125 m to the east of the first crossing with an




DEPARTMENT OF MAIN ROADS OF N.S.W.

PRINCES HIGHWAY RECONSTRUCTION - MINNAMURRA RIVER TO BOMBO, KIAMA

**SCHEME B**

**FIGURE 4·5**

Dames & Moore : 13605-004-70

access track to the west of Swamp Road. Associated with "Glengowrie" is a past sand mining operation, located on the bank of the Minnamurra River. The remnant lake now appears to be used as a dam.

After the route crosses Swamp Road for the second time, it swings to the south-east traversing a small hill. This alignment is required to gain height for a bridge required to cross the Terragong Swamp. The bridge is required for two reasons: firstly to ensure it is above the flood plain and secondly to minimise disturbance to the wetland area.

The bridge would intersect the uppermost reaches of the tidal wetland. The area is primarily Casuarina glauca forest with trees 10-15 m high on and near the stream courses and lagoons, with areas of sedgeland (Juncus kraussii), reedbed (Phragmites) and samphire (Sarcocornia) between and behind forest areas. The route would intersect 600 m of Casuarina forest. This possibly could be avoided.

The bridge would cross the Minnamurra River and one of its tributaries in two locations. In addition a number of lagoons would be traversed. Considerable care in the design and construction of the bridge would be required to ensure minimum disturbance and sedimentation.

The route follows a generally southeast alignment to the base of the hills west of Bombo. The route then travels approximately 500 m up the hill to the point where Scheme C diverges to the east (see later).

Scheme B continues in a southerly direction towards Kiama. It traverses areas zoned 7(d) - Rural Environmental Protection - Scenic which adjoin the Gainsborough Estate to the east.

The alignment would either intersect or pass very close to the only remaining forest stand at Tabbagong, located on the hill northeast of the quarry. It is one of the few forest areas left in the district. The stand has been considerably modified by weed invasion, clearing on the edges and apparently selective logging.

The bulk of the tree-covered area is classified as open forest (Syncarpia glomulifera). It is particularly noteworthy because a large

proportion of the trees are mature (and so are probably original rather than secondary growth). Tree heights reach 25m in places and the average tree cover is of the order of 60%. Eucalypts are present (E.maculata, E.sieberi, E.consideniana) but are relatively few, and large trees are absent, hence the likelihood of past selective logging.

The understorey has been considerably modified by grazing and weed invasion, with lantana as the main component (cover about 40%). Some species of the original understorey remain, particularly Breynia oblongifolia, Acacia bineruata and Exocarpos cupressiformis.

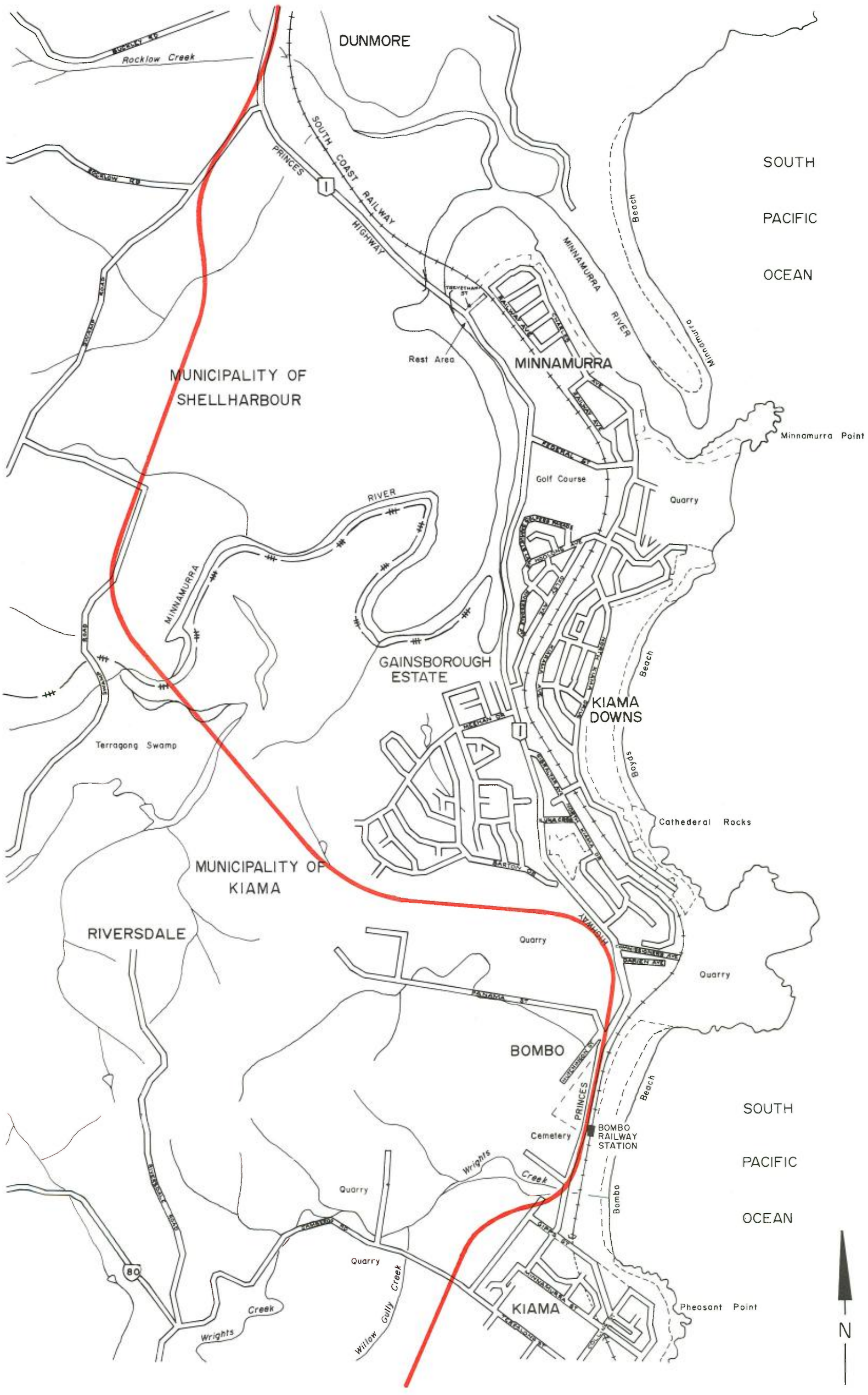
A spring-fed stream drains to the southwest of the stand. Originally likely to have carried rainforest or wet sclerophyll forest, the gully areas have been cleared or partly cleared in the past but considerable regeneration has subsequently occurred. The vegetation contains a number of the rainforest species together with a large number of alien species. The ground cover is dominated by almost continuous lantana and blackberry thicket while trees include several introduced conifers. There are also stands of rangoon cane which are apparently in demand locally for furniture and fishing rod making.

From Tabbagong the route travels down hill to cross the middle of the designated quarry areas at Bombo. These operating quarries are being worked in a westerly direction within the designated area zoned on the Kiama Municipality LEP. They have an expected life of 60 years.

On the southern side of the quarries, the route traverses the side of the hill and across Spring Creek to join the Kiama By-Pass south of Terralong Street. The route parallels scenic and estuarine wetland areas (Rural Environmental Protection zones) and residentially zoned land.

**Scheme C**

This Scheme (shown in Figure 4.6) follows the same alignment as Scheme B to the west of Bombo. From there it diverts east along a ridge to Bombo hill and joins the Princes Highway. The total length of Scheme C is approximately 6.8 km.




DEPARTMENT OF MAIN ROADS OF N.S.W.

PRINCES HIGHWAY RECONSTRUCTION - MINNAMURRA RIVER TO BOMBO, KIAMA

**SCHEME C**

**FIGURE 4·6**

Dames & Moore : 13605-004-70

The proposed easterly route traverses the southern boundary of the Gainsborough Estate through Rural Environmental Protection - Scenic zoning. To maintain a straight alignment, the route passes through the operating quarry area at Bombo. The alignment then turns in a south-easterly direction to join the proposed realignment of the Princes Highway. The new alignment of the Highway is west of the existing route and passes through an abandoned quarry currently used for light industrial purposes.

**Local Residents Proposal (Ranks Scheme)**

A local residents group (RANKS - Residents Association of Northern Kiama Suburbs) has proposed an alternative Swamp Road route as an option for redirecting through-traffic away from the Highway (see Figure 4.7, Scheme R). The group totally opposes the widening of the existing Highway and considers that the Schemes B and C were impractical because they traverse the operating quarry areas, the new Parbury Estate subdivision area and the routes are highly visible. The route generally follows Scheme B and C from the turnoff at Dunmore but travels in a more westerly alignment. It crosses the existing Swamp Road in the same location as Schemes B and C. It then veers further west, following Swamp Road to a point where the Minnamurra River and Terragong Swamp is traversed. The bridge location commences about 0.25 km upstream of the proposed Scheme B and C and, from its southerly alignment, ends about 0.63 km west of the Scheme B and C bridge. The bridge is approximately 780 m long. The route then follows a south easterly alignment, crossing Riversdale Road, then downhill to clip the corner of the designated quarry area. It then follows a creek line west of Primrose Hill and uphill to join Terralong Street and the Kiama by-pass. The route traverses land zoned predominantly rural and scenic protection.

The route also traverses a section of the Jamberoo Valley area which is the subject of Ministerial control under Section 101 of the Environmental Planning and Assessment Act. This was introduced as an interim measure to protect the valley from perceived development pressures thought likely to erode its heritage significance and scenic quality. In addition, the route traverses an area identified in the

Kiama Municipal Council Urban Expansion Study which may be potentially capable/suitable for future urban use. Of the three areas identified in the study, this area is considered to have the highest priority

The route connection with Terralong Street is considered unsuitable for two main reasons. Firstly, half of the by-pass road, which is currently being constructed to relieve the congestion in Kiama, would be duplicated. Secondly, the road system to Kiama should allow tourist/ recreation drivers a clear alternative of either passing through Kiama for the services available or by-passing Kiama completely.

The route would avoid the designated quarry area, reducing the potential conflict that exists with the Scheme C alternative. Also, it generally follows gullies rather than ridgelines, minimising its prominance on the landscape. However, this would impact creek environments. In addition it traverses the Jamberoo Valley area which has been avoided by Schemes B and C.

On the basis that this route offered no environmental advantages over Schemes B and C, costing of the Scheme was not undertaken.

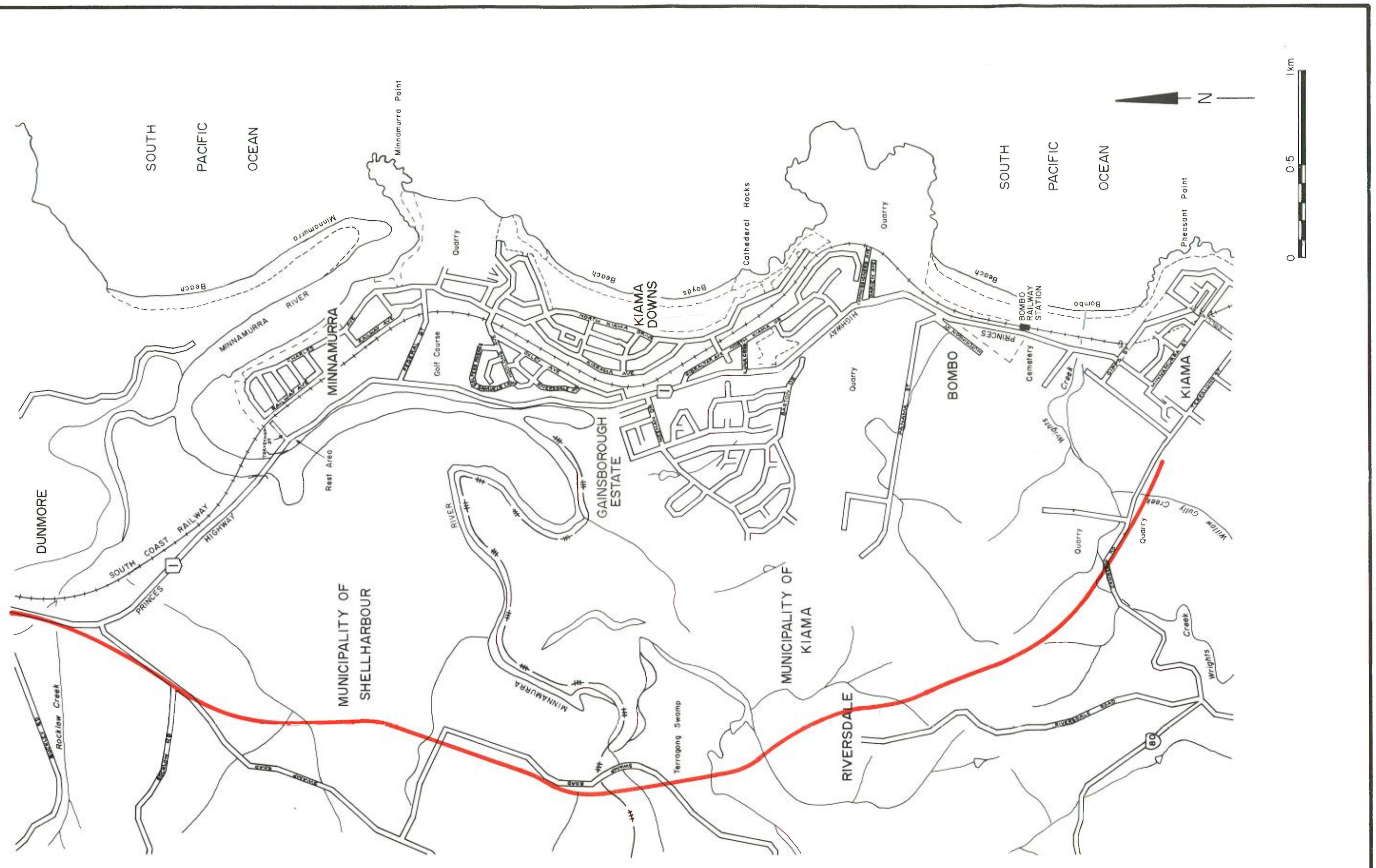
## 4.5 COMPARISON OF ALTERNATIVES

The principal route alternatives are the Princes Highway corridor and the Swamp Road corridor. Within these corridor alternatives the Princes Highway Options and the Swamp Road options have been selected to satisfy the basic transportation criteria of the existing and projected traffic needs, capital costs and environmental factors.

The Princes Highway options would involve a lower construction cost just involving the widening and improving the alignment of the existing road corridor.

Since the Swamp Road options involve construction of a long section of new road works, they have a higher construction cost.

The no action option has the least construction cost. It involves no




DEPARTMENT OF MAIN ROADS OF N.S.W.

PRINCES HIGHWAY RECONSTRUCTION - MINNAMURRA RIVER TO BOMBO, KIAMA

LOCAL RESIDENTS PROPOSAL

FIGURE 4·7

Dames & Moore : 13605-004-70

immediate major construction activities. Stree closures, intersection reconstruction and signing may be works associated with this option.

### 4.5.1 Transportation Criteria

The options involving the Princes Highway (SH1) are more attractive than the Swamp Road option for a number of reasons. Firstly, existing traffic volumes indicate that the corridor currently operates over the desirable capacity level of service for much of the year. (See Section 4.2). Holiday peak traffic occurs for relatively short periods. These holiday peaks occur at specific times throughout the year creating intense but short lived congestion of SH1 around Kiama. Apart from the major holiday peaks, the isolated high day peak is usually associated with the weekend.

It is considered that the location of the Swamp Road alternative will not reduce the traffic capacity problems that already exist on the study section of the Highway. It would not relieve congestion during holiday periods as some travellers would be destined to stop in Kiama before they travel further south. A second consideration is that the development of a completely new route (i.e. a Swamp Road option) would not cater to the main component of normal traffic growth which is local traffic associated with the development of Kiama and Albion Park. Even though local traffic will probably increase at a slower rate than in the 1978-1982 period, the Princes Highway requires upgrading or improvement to satisfactorily accommodate existing traffic levels. The Highway upgrading would better serve the local traffic than a Swamp Road route as the majority of traffic using the existing road is local traffic, with the exception of holiday periods (refer Section 2).

Also, works have already commenced on the construction of a by-pass road around the Kiama business centre to overcome peak congestion through the town during holiday periods. Much of the existing traffic congestion can be attributed to the bottleneck that occurs when this peak recreation traffic is forced to interact with local traffic through the shopping area. The removal of through traffic from the business area should have a significant beneficial impact on the flow of traffic through Kiama during holiday periods.

### 4.5.2 Economic Considerations

The construction costs of all the route alternatives are shown in Table 4.1. The cost of constructing a new road through the Swamp Road area is $7 million - $10 million higher than the cost of options proposed to widen the existing Highway corridor.

The higher costs can be attributed to two major factors: the new road easement and the bridge required to traverse the wetland area.

### 4.5.3 Environmental Considerations

**Visual Impact**

It is considered that the Princes Highway options would create the least overall visual impact.

As the carriageway is an existing feature on the landscape its widening and realignment would not significantly conflict with any recognised scenic or undisturbed landscape. The widening would not change the character of the area except in the vicinity of the River where vegetation removal from excavation of the cliff and filling of the River would contrast sharply with the existing visual environment. The area has been described by local residents as the "Gateway to Kiama". However, little of the area can be seen by travellers due to the rapid and hazardous traffic movement and the limited stopping locations along this section of road. The initial visual changes caused by road construction would diminish significantly as re-established vegetation grows.

The Swamp Road options on the other hand pass through the relatively undisturbed rural area which has a significant scenic quality when viewed from the valley floor or from major ridges. The construction of a road corridor would significantly conflict with the rural character of the area and disturb the patterns and contrasts of the fields, scattered farm houses and clusters of trees. The area could be considered part of the Jamberoo Valley landscape.

TABLE 4.1

TOTAL CONSTRUCTION COSTS

| SCHEME | COST ($ MILLION) |
|---|---|
| A | 16.5 |
| B | 23.5 |
| C | 27.0 |
| D | 17.5 |
| E | 18.0* |

* Includes a vertical reinforced earth retaining wall where required along Minnamurra River.

**Disturbance to Vegetation**

The Princes Highway options have a significant impact on local vegetation. The densely vegetated cliff and mangroves in the River will be the largest areas of vegetation disturbed. Other roadside vegetation will be removed including a large Morton Bay Figtree near the Federal Street intersection.

Much of the vegetation can be re-established after the completion of construction works, particularly roadside vegetation and some cliff vegetation. Under Scheme A, it is proposed to re-establish mangroves. The construction of Scheme D would completely remove all cliff vegetation but the larger percentage of mangroves and seagrasses would remain undisturbed. The Scheme E proposal would remove cliff vegetation but allows for re-vegetation. Re-establishment is not proposed for river vegetation, but the vertical retaining wall would allow retention of some of the mangroves and seagrasses on the eastern side of Minnamurra River.

The Swamp Road proposals will disturb areas of pasture land and two of the few remaining areas of forest stands. The most significant area is the Casuarina glauca forest associated with the wetland area and with the proposed bridge crossing of the River and swamp for Schemes B and C. The location of this bridge is determined by minimum length and height requirements. The other area of vegetation likely to be disturbed is the forest stand between Riversdale and Tabbagong. Both Schemes B and C and the RANKS scheme traverse this area.

**Effect on Properties**

The Princes Highway options have varying effects on residences. Schemes A and E have little effect on the majority of residences. The widening and realignment would reduce the distance of houses from the Highway boundary and in some locations the acquisition of small sections of properties would be required.

Scheme D requires the acquisition of a section of the western boundary of the Golf Course, up to 28 m in width, and acquisition of 13 houses

located on top of the cliff. Minor acquisitions of land are also required from Oxley Avenue to Bombo. The minor acquisitions include house-blocks and open space and reserve areas.

The Swamp Road options traverse rural properties and houses are located along the route in various places. Scheme B traverses the operating quarry area of Bombo and new residential subdivision areas east of Cosy Corner and Eastern View on the north-western outskirts of Kiama. Scheme C also traverses the operating quarry area at Bombo.

The RANKS scheme passes Glengowrie and Riversdale scenic protection areas, and a section of the Jamberoo Valley which is the subject of Ministerial control.

Significantly more land is required for acquisition to accommodate all of the Swamp Road alternatives than it is for the Princes Highway alternatives. The majority of land required for Highway Schemes A and E falls within the designated Arterial Road zoning.

**Disturbance to Landform and Terrain**

Landform and terrain disturbance occurs from road construction works in general, including cutting and filling activities. The steeper the landform, the more significant the cut.

The Princes Highway corridor options require earthworks to accommodate the road widening and realignment as do the Swamp Road corridor options. Table 4.2 shows the total earthworks required for most of the options. The Swamp Road Schemes (B and C) require significantly more earthworks than the Princes Highway options and would be indicative of the requirements for the RANKS scheme. Scheme E requires the least amount of total earthworks.

**Disturbance to Minnamurra River**

The disturbance to the Minnamurra River and wetlands area would occur from filling and bridging activities, and from any changes in the channel or sedimentation patterns.

TABLE 4.2

TOTAL EARTHWORKS

| SCHEME | TOTAL EARTHWORKS ($m^3$) |
|---|---|
| A | 438,000 |
| B | 750,000 |
| C | 915,000 |
| D | 438,000 |
| E | 414,000 |

The impact of filling the River adjacent to the Highway has been the subject of a detailed study. The results of the study show that Scheme D will have little effect on the River and flood flow velocity. Scheme A will have twice the effect of Scheme D and Scheme E. Sedimentation and channel changes caused by Schemes D and E would not significantly affect the river and estuarine environment.

Bridging of the Minnamurra River on the Swamp Road corridor is not expected to significantly affect the River providing special care in the design and construction methods is undertaken. The routes traverse the estuarine wetland which is subject to inundation and flooding. The bridge designs would need special care to ensure minimal restrictions of flood waters and minimum disturbance to the wetlands. While a bridge of only 112 m is required for the Princes Highway Schemes to cross the Minnamurra River, Schemes B and C require a bridge approximately 640 m length and the RANKS Scheme approximately 780 m.

**Conflict of Land Use**

A new road corridor can conflict with other land uses if it is not a compatible land use. Significant conflict may also arise where the presence of a new road reservation severes the land from any existing or likely future activities.

Of the Princes Highway options, the most significant conflict occurs with Scheme D where the proposed design encroaches on the Kiama Golf Course and house-blocks located on top of the cliff. If that scheme were implemented, the house-blocks would require acquisition and the Golf Course may require re-designing or acquisition.

Schemes A and E encroach on a small section of the Golf Course. However, they will not affect its functioning in any way. No house-blocks are required with these Schemes.

From Oxley Avenue to Bombo the acquisition of small sections of land from approximately 15 blocks is required, together with some small areas of open space and recreation reserves. This is the same for Schemes A, D and E.

The existing Highway is to some extent a barrier separating the more established suburbs of Minnamurra and Kiama Downs on its east from the new residential suburb of the Gainsborough Estate on the west. The ease of access east-west is restricted by traffic volumes on the Highway and there is currently only one access road (Meehan Drive) into the Gainsborough Estate. A second road, Barton Drive, is planned to connect with the Highway but has not yet been constructed.

With the existing traffic volumes on the Highway, access for local traffic can be severely limited, particularly during holiday and weekend periods, from congestion along the Highway. It is considered that implementation of a traffic management plan will be necessary in the near future to reduce the number of conflict points at intersections in order to maintain a satisfactory level of service. This will be necessary with or without the proposed Highway widening. As development and urban expansion continues, increases in local traffic will occur from natural growth. As the existing traffic volumes are high at present, the Highway acts as a barrier between the communities. The implementation of the traffic management plan will reduce this problem,allowing for easier traffic movement while maintaining north-south movement of traffic.

The predominant farming activity in the vicinity of the Swamp Road corridor is a potential source of conflict. These options would have a significant impact on the management practices of properties because of the severing effect of the new road easement.

Another potential source of conflict arises from rural-residential subdivision activity. The Swamp Road options affect freehold land whereas Princes Highway Schemes A, D and E largely fall within the Arterial Road zoning, a designated road corridor.

A potential conflict exists where the Swamp Road options traverse the designated quarry area at Bombo. The compatability of land uses is somewhat dependent on future quarrying activities. The existing operating quarries have approximately 60 years of life and construction of a road would limit the options for quarrying in affected parts of the area.

While the RANKS Scheme just clips the corner of the designated quarry area, it does traverse scenic protection land and part of the Jamberoo Valley.

The area designated under SEPP No. 14 - Coastal Westlands, is traversed by all of the Swamp Road corridor options. A potential conflict exists with the SEPP No. 14 designation as the policy aim is to "ensure that the coastal wetlands are preserved and protected".

**Other Land Uses**

Potential conflict exists with the location of transmission lines, Telecom cables and water mains. However, both corridors will affect these services and it is not expected any construction or line reconstruction difficulties will arise.

**Archaeology**

It is possible that a midden site exists under Green No.3 of the Golf Course adjacent to the Highway. Scheme D would affect the Green, but Scheme A and E do not require encroachment on the Golf Course at that location.

Farming activities in the Swamp Road area have removed signs of past Aboriginal activities.

**Culture and History**

There are no historical buildings likely to be affected by the Princes Highway corridor options.

In the northern section of Swamp Road there are two historically significant buildings. These would not be affected by the Swamp Road corridor.

**Tourism and Recreation**

From the recreational/tourism perspective the most significant sites along the section of the Princes Highway are the Minnamurra River Estuary and Kiama Golf Course.

The adoption of Scheme A, D or E would require the temporary restriction of access to the River during the construction phase along this section of Highway. Additionally, the number of access points to the River would be permanently decreased and provision for stopping restricted.

The boat launching ramps adjacent to the bridge and abutting the public oyster lease would require demolition. However, as well constructed ramps are available nearby, this should not cause any significant problems.

It is proposed that the boat launching ramp adjacent to the Bridge be reconstructed adjacent to the new bridge on its eastern side.

Encroachment on to some land of the Kiama Golf Course would be necessary for Highway reconstruction. To minimise the impact on the course for Schemes A and E, trees bordering the course from the Highway should be maintained, access to and from Federal Street should be maintained and/or improved, and land resumption minimised. Scheme D requires significant encroachment onto the Golf Course land.

The adoption of the Swamp Road alternatives would have minimal impact from a recreational perspective. The opportunity for motor touring in a quiet rural setting would be forgone but it is expected the Swamp Road experiences relatively little use for motor touring purposes. This road currently provides an alternative access route to the attractions of the Jamberoo Valley (linking with old Jamberoo Road). However, an exit road from the Kiama By-Pass will ensure that access to it is not restricted and may be improved to this area.

With regard to the Model Marine Lake, provision for access could be made pending construction of these alternatives.

The adoption of the Scheme C would have much the same effect on tourist income derived from passing trade in the town of Kiama as the reconstruction proposal. Some income may be lost as a result of the By-Pass. However, traffic would still be brought near to Kiama if the new road joined the By-Pass route at Bombo.

The adoption of this alternative would result in the provision of two well defined access routes to Kiama, thus providing some variation from a motor touring perspective.

The alternatives of linking up the Swamp Road route to the By-pass west of Spring Creek (Scheme B) or to Terralong Street (RANKS Scheme) would have little adverse effects on the number of tourists who are destined for Kiama. However, their effects on income derived from passing trade from traffic passing through Kiama would be more detrimental than the adoption of the other alternatives, as through traffic would not be directed as close to Kiama's commerical centre.

The most important function of the study of this section of the Princes Highway from a tourist perspective is its role as part of the major southern touring route. Schemes A, C, D and E bring south bound traffic close to Kiama via the Princes Highway. Tourists may have the incentive to drive into central Kiama to stop for provisions or an overnight stay. This should not adversely affect the level of visitors who have Kiama as their main destination. By improving access and alleviating peak traffic congestion, visitors may be encouraged, or have greater incentive, to make Kiama their major destination. Some loss of these visitors is likely with Scheme B and the RANKS Scheme.

**Community Impact Assessment**

Community impact and evaluation have been assessed through the use of a Community Impact Assessment Sheet (CIAS). The method is useful for evaluation of the total impact of a project on an existing community. The CIAS tabulates all the tangible and intangible costs and benefits of a project for alternative schemes. It identifies who will benefit from each proposed scheme and who will pay. Once groups in a community have been identified, they can be classed as either producers of the effect or consumers of it. Each producer or consumer has an objective or set of objectives. The objectives provide the factors against which the benefits and costs of a policy can be assessed. The approach includes all relevant items in the framework, whether they be monetary or other terms. Each alternative is then given a score or rank which meets the objective positively or negatively.

Table 4.3 identifies the producers and consumers and their objectives. Each Scheme has been ranked from -B to +B. The ranking -B indicates the Scheme is of no improvement, -A indicates the Scheme is of little improvement, A indicates no change, +A indicates some improvement, and +B indicates the most improvement to meet the objectives.

Several assumptions were made to complete the CIAS. The first assumption was that a traffic management plan was required for the section of Highway from the Minnamurra Bridge to Bombo. The second assumption was that the Kiama by-pass was operating, reducing the congestion along the Princes Highway, particularly during peak holiday periods and on weekends.

The measures used to evaluate each objective for each group are outlined below. The measures used can be based on none monetary values and the perceived needs of the community.

1. DMR - existing traffic network, cost of construction, existing traffic flows, traffic origins and destinations, community needs, traffic accidents;

2. Road Safety Council/NRMA - number of accidents along Highway, standard of road, volume of traffic, safety of roads;

3. NSW Police - number of roads, traffic volumes standard of road, traffic accidents;

4. Kiama - Muicipal Council - community needs, cost of construction, impact on Kiama, impact on community, future planning, loss of trees;

5. Residents - (a) travel time, safety, residential amenity,community cohesion, environmental quality; (b) travel time, safety, residential amenity, community cohesion, environmental quality; (c) access, safety, environmental quality (including noise and air quality) property devaluation (d) potential for disturbance to house foundations, loss of trees.

6. Road Users (a) travel time, access, safety; (b) travel time, safety; (c) travel time, safety; (d) travel time, safety, stop off points.

7. (a) existing community cohesion, residential amenity, DMR planning, traffic conjestion, environmental quality, access between suburbs, Highway "barrier" effect, "Gateway to Kiama"; (b) existing environmental quality, residential amenity, community cohesion, road safety.

8. Direct access to Kiama;

9. Direct access to Kiama:

10. Extraction of resource potential

11. Viability of property, maintain rural environment

12. Access to river, maintenance of aquatic environment

13. Potential for future subdivision

14. Maintenance of Golf Course

15. Access to Kiama, visual quality

16. Access to Kiama

17. Maintenance of Wetland area, environment quality, landscape and scenic quality.

## 4.6 CONCLUSIONS

Table 4.4 summarises the community impact assessment sheet as shown in Table 4.3. The rankings indicate that the Princes Highway corridor (Schemes A, D and E) meet more of the community objectives overall than the Swamp Road corridor (Schemes B, C and the RANKS Scheme).

Of the Princes Highway options, Scheme E meets more of the community objectives.

On the basis of traffic needs, environmental and engineering criteria and the CIAS, the Princes Highway corridor Scheme E has been identified as the preferred route.

TABLE 4.3

COMMUNITY IMPACT ASSESSMENT

| GROUPS | OBJECTIVES | A | B | C | D | E | R |
|---|---|---|---|---|---|---|---|
| **PRODUCERS** | | | | | | | |
| 1. **DMR** | To cater effectively for all traffic movements, north and south of Kiama for the road users in a manner which minimises the overall costs and impacts on the community at large | +A | -B | -A | +A | +B | -B |
| 2. **Road Safety Council/NRMA** | To maximise road safety on the Princes Highway | +A | -A | -A | +A | +A | -A |
| 3. **NSW Police** | To minimise transport related demands on the police force | +A | -A | -A | +A | +A | -A |
| 4. **Kiama Municipal Council** | To provide a transportation network within the Municipality that services the needs of Kiama residents and which minimises the overall costs and impacts to the community at large | +A | -B | -B | +A | +B | -B |
| **CONSUMERS** | | | | | | | |
| 5. **Residents** | | | | | | | |
| a. Existing Residents of Kiama | To improve the road transport network and access to Kiama which minimises travelling time and maintains and/or improves environmental quality | +A | A | A | +A | +B | A |
| Existing Residents of North Kiama | | | | | | | |
| b. - General | To ensure that the area is provided with and efficient and economical transport service, protect residential amenity, community cohesion, transport access and environmental quality | +A | A | A | +A | +B | A |
| c. - Adjacent to Highway | To ensure that the environmental quality and property values, that access and safety is maintained or improved | +A | A | A | +A | +B | A |
| d. - Samuels Lane | To minimise house disturbance potential and traffic noise | -A | +B | +B | -B | -A | +B |
| 6. **Road Users** | | | | | | | |
| a. Local | To ensure the road transport network and access to Kiama and surrounding areas, minimises travelling time and maximises safety | +A | -B | -B | +A | +B | -B |
| | To ensure and maintain easy access between suburbs (N-S and E-W) and to local recreation areas, e.g. boat ramps | +A | A | A | +A | +B | A |
| b. Commuters | | | | | | | |
| - Sydney/Wollongong/Kiama | To maintain and/or improve existing levels of service of the transport network and ease of access | +A | -B | -B | +A | +B | -B |
| c. Through-Traffic | To maintain and/or improve existing levels of service of the transport network and remove congestion problems | +A | -A | +A | +A | +A | -A |
| d. Recreation/Tourist Traffic | To maintain and/or improve existing levels of service while maintaining access to Kiama shopping centre and easing congestion at peak periods | +A | -B | +A | +A | +A | -B |
| 7. **Residents Action Groups** | | | | | | | |
| a. RANKS (residents Association of the Northern Kiama Suburbs | To ensure Highway is not widened, to protect residential amenity, community cohesion and the river environment | -B | +B | +B | -B | -B | +B |
| | To maintain access from east to west across the Highway | -B | A | A | -B | -B | A |
| | To ensure traffic conjestion is eased and minimised through the northern suburbs of Kiama | -B | +B | +B | -B | -B | +B |
| | To ensure the DMR is considering all alternative options, including the Swamp Road Schemes | A | +B | +B | A | A | +B |

**TABLE 4.3 (cont)**

| GROUPS | OBJECTIVES | A | B | C | D | E | R |
|---|---|---|---|---|---|---|---|
| b. Minnamurra Progress Association | To protect the environmental quality, residential amenity, community cohesion, safety and other valued attributes | -A | +A | +A | -A | -A | +A |
| 8. **Tourist Business Owners/ operators** | To ensure travellers have the option of passing through or stopping in Kiama | +A | -A | +A | +A | +B | -A |
| 9. **Service Providers** | To ensure the continued efficient and economic delivery of services to the client groups | +A | -A | +A | +A | +B | -A |
| 10. **Quarry Operators** | To maintain access and maximum utilisation of the resource | +A | -B | -B | +A | +B | -B |
| 11. **Rural Landholders** | To ensure viable agricultural units are maintained and land use is not disrupted or severed by a transport corridor | +A | -B | -B | +A | +B | -B |
| | To protect residential amenity and maintain or improve environmental quality | +A | -B | -B | +A | +B | -B |
| 12. **River Users** | To ensure that all activities and access are maintained | +B | -B | -B | +B | +B | -B |
| 13. **Rural Residents/Subdivided** | To ensure that environmental quality is maintained and a road corridor does not disrupt potential subdivision areas | +A | A | A | +B | +B | A |
| 14. **Golf Course Users** | To ensure traffic is minimised on Federal Street and the golf course is wholly maintained | -A | -B | -B | -A | -A | -B |
| 15. **Visitors** | To maintain and/or improve environmental quality, particularly visual quality | +A | -B | +A | +A | +A | -B |
| 16. **Other Business Owners/ Operator** | To ensure easy access into the Kiama business centre | +A | -B | +A | +A | +A | -B |
| 17. **Conservation Groups** | To ensure the disruption to the wetland area is minimised | -B | -B | -B | +B | +A | -B |

TABLE 4.4

SUMMARY OF CIAS

| SCHEME RANKING | A | B | C | D | E | R |
|---|---|---|---|---|---|---|
| + B | 1 | 4 | 4 | 3 | 15 | 4 |
| + A | 20 | 1 | 7 | 19 | 7 | 1 |
| A | 1 | 6 | 6 | 1 | 1 | 6 |
| - A | 3 | 12 | 2 | 2 | 3 | 5 |
| - B | 4 | 12 | 10 | 4 | 3 | 13 |

# 5.0 DESCRIPTION OF ENVIRONMENT AFFECTED BY THE PREFERRED ROUTE

The preferred route is the Princes Highway Scheme E. Figure 5.1 shows details of the route. The following description discusses the existing terrestrial, aquatic, social, transportation, visual and atmospheric environment.

## 5.1 TERRESTRIAL

### 5.1.1 Land Use

The preferred route traverses the residential areas of the northern suburbs of Kiama. The urban areas vary in development level from the more established suburbs of Minnamurra and Kiama Downs on the east of the Highway, to the new residential development areas of the Gainsborough Estate on the west of the Highway. Recreation areas along the route include the Kiama Golf Course and other smaller reserves and open space areas. At the southern end of the route, at Bombo, are two operating quarries and an abandoned quarry. Landform, geology, soils, mining, service corridors and zoning have been discussed in detail in Section 3.0.

### 5.1.2 Vegetation

A field survey of the proposed route was undertaken to examine the terrestrial ecology likely to be affected by the preferred route.

The field survey identified the vegetative structure, the main species present and other associated species, the level of alien species and other signs of disturbance. Species were identified with reference to Beadle et al. (1982) and Williams and Harden (1979).

Maps showing distribution of native vegetation in the Minnamurra estuary were compiled from aerial photography (1981 colour and 1984 monochrome) with ground truth provided by:

Detailed observation immediately about the preferred route:

- Distant ground observation of areas directly visible from the preferred route;

- Reference to mapping in Carne (1981) and Moss (1979).

Zieria granulata is a threatened species known to be restricted to the district. Herbarium specimens were examined at the National Herbarium, Sydney, to determine collecting localities. The possibility of the species being present was a primary reason for maximising plant collection along the preferred route.

The vegetation directly affected by the preferred route option is:

- Tidal wetland

  - saltmarsh at the bridge crossing
  - mangrove for part of the alignment on the western side of the Highway;

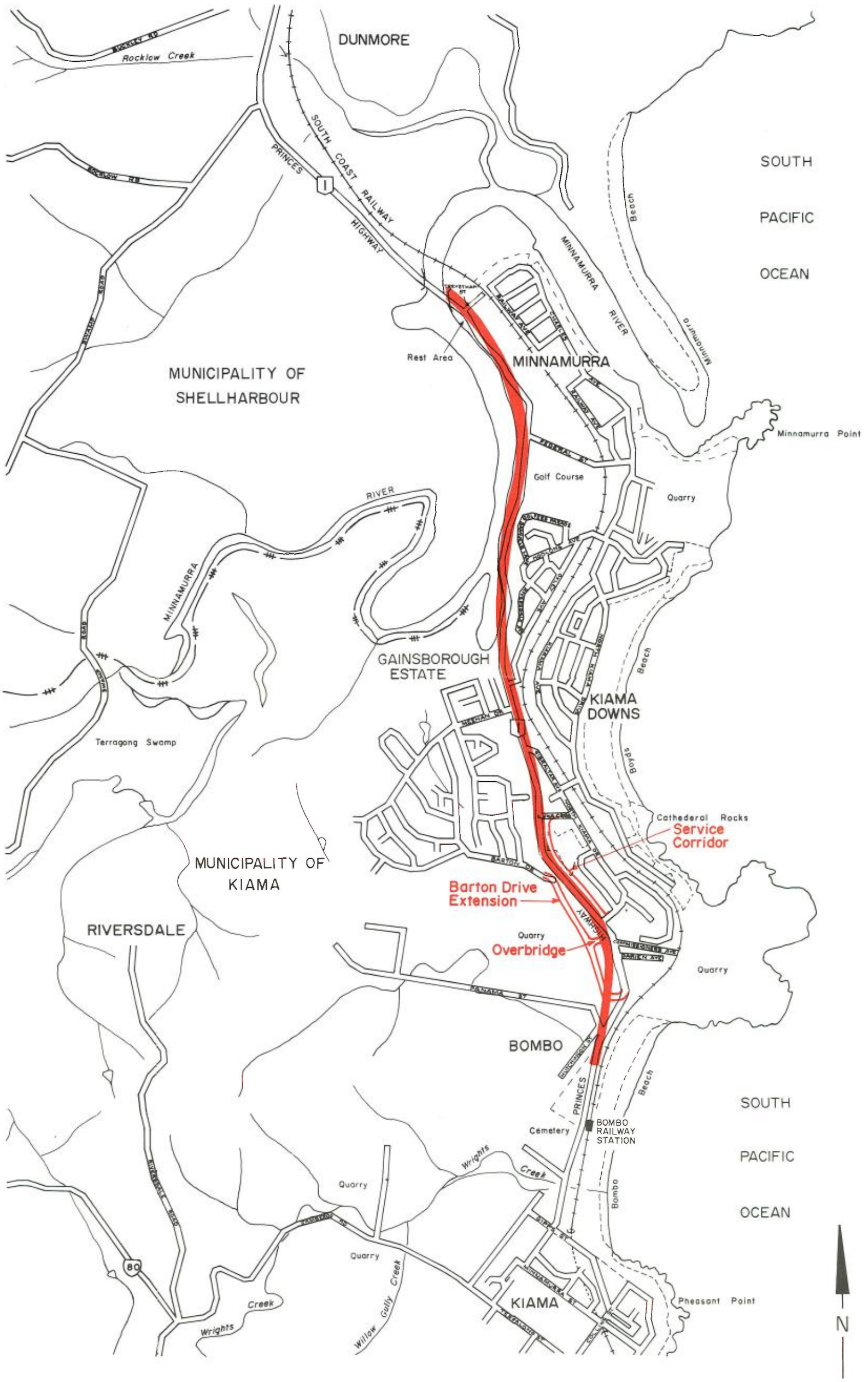
- River bank and roadside vegetation west of the Highway; a narrow strip of closed scrub consisting primarily of rainforest species;

- Cliff vegetation on the eastern side of the Highway which is lantana infested but contains rainforest remnants for much of its length.

Vegetation distribution in and adjoining the estuary is shown in Figure 5.2. Figure 5.3 provides more detail along the immediate route.

**Bridge Crossing**

The northern approach to the bridge over the Minnamurra River is cleared landward of high water mark. Two mature oak trees are present. Between high water mark and the River is a narrow (15m) strip of saltmarsh with mangrove on the river edge. The marsh area is reedbed of Phragmites australia along the eastern side of the existing bridge and Juncus kraussii elsewhere. A small stand of colonising Casuarina is on the proposed bridgeline.



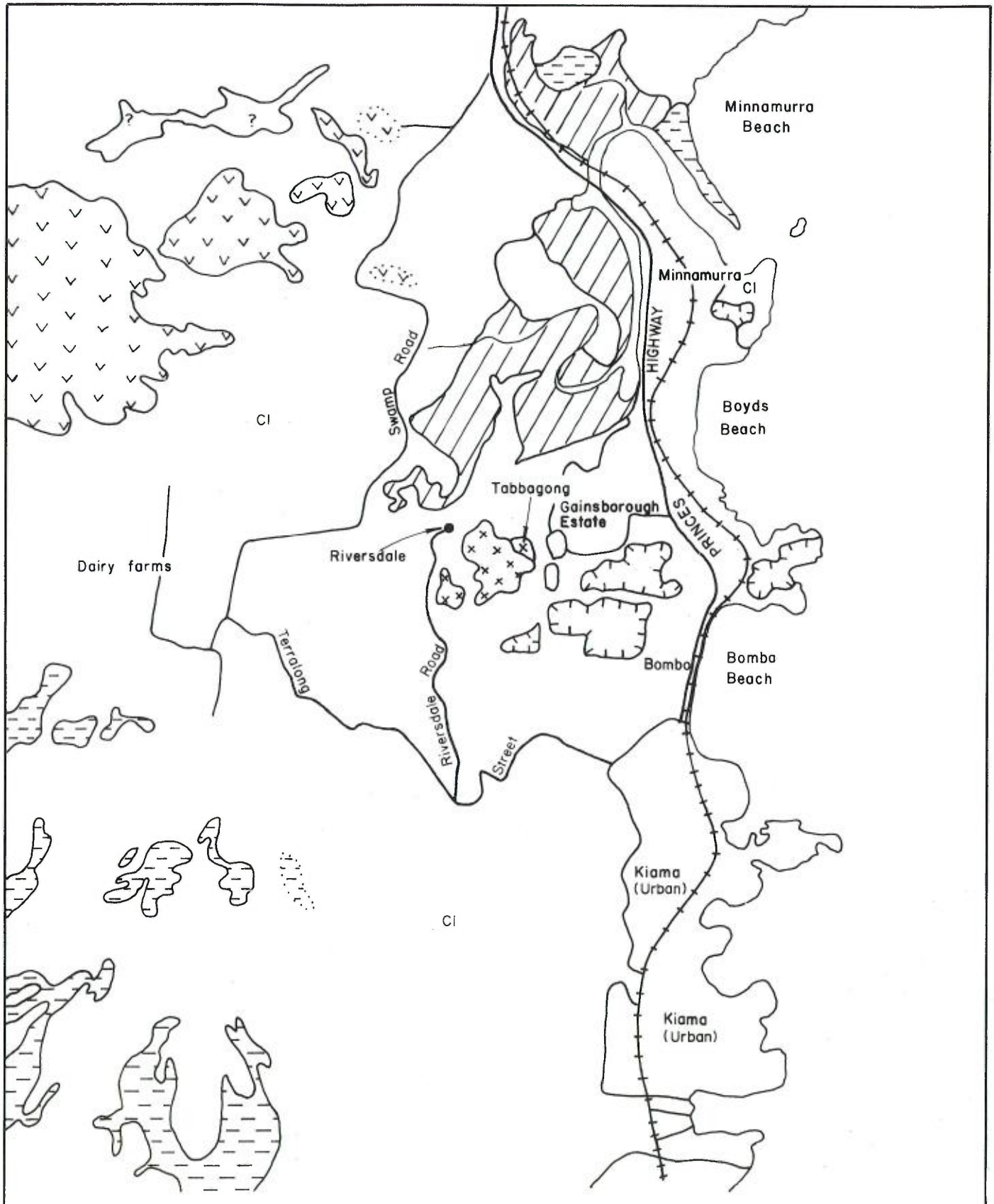

DEPARTMENT OF MAIN ROADS OF N.S.W.

PRINCES HIGHWAY RECONSTRUCTION - MINNAMURRA RIVER TO BOMBO, KIAMA

**PREFERRED ROUTE**

**FIGURE 5·1**

Dames & Moore : 13605-004-70




**LEGEND**

- UNCLEARED SCRUBS & HEATHS, SOME FOREST
- SALT MARSH & SWAMP OAK
- SYNCARPIA FORESTS
- OPEN FOREST
- Cl — CLEARED
- QUARRY

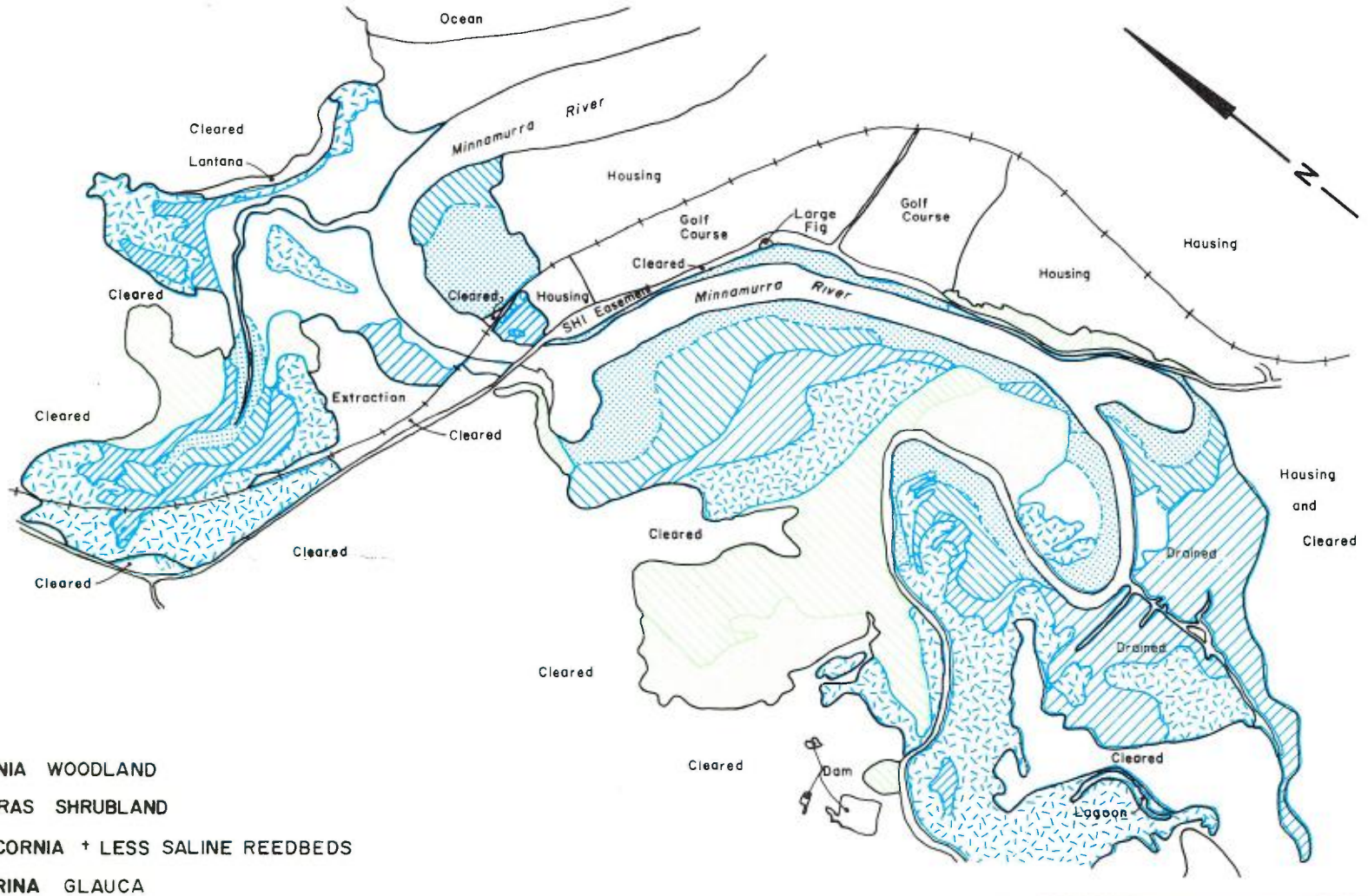
DEPARTMENT OF MAIN ROADS OF N.S.W.

PRINCES HIGHWAY RECONSTRUCTION – MINNAMURRA RIVER TO BOMBO, KIAMA

## VEGETATION DISTRIBUTION

## FIGURE 5·2

Dames & Moore 13605-004-70




## LEGEND

WETLAND

- AVICENNIA WOODLAND
- AEGICERAS SHRUBLAND
- SARCOCORNIA † LESS SALINE REEDBEDS
- CASUARINA GLAUCA
- AVICENNIA WOODLAND/AEGICERAS SHRUBLAND

OTHER

- EUCALYPTUS OPEN FOREST, UNCLEARED, DENSE TALL SHRUB /SMALL TREE LAYER
- EUCALYPTUS WOODLAND, PART CLEARED
- SCRUB OF RAINFOREST SPECIES
- LANTANA & FIGS

0 500m

DEPARTMENT OF MAIN ROADS OF N.S.W.

PRINCES HIGHWAY RECONSTRUCTION – MINNAMURRA RIVER TO BOMBO, KIAMA

# ESTUARY VEGETATION

## FIGURE 5·3

Dames & Moore : 13605-004-70

Despite the limited area, the diversity is very high. Many of the species are represented by only two or three individuals. Climbers and vines are common. Alien species also are common: lantana forms a more-or-less continuous shrub layer, while garden escapes such as Cornus capitata are frequent. The strip appears to be secondary growth, a re-establishment of the former vegetation following construction of the present road embankment. There is a very high proportion of fruit-bearing trees and the vegetation may therefore have been established by bird activity.

A single mature, very large and shapely Ficus [1] is present at 113 km 130 m.

**Eastern Hillside**

The eastern hillside between 114 km 660 m and 115 km 400 m carries a rainforest remnant of much higher diversity than the lantana-infested cliff face would suggest. Most prominent on aerial photographs are figs (E. obliqua, E. rubiginosa), some of which are very large. Up to approximately level with the 155 km 100 m mark, however, the figs form part of a low closed forest to scrub, primarily of rainforest, tall shrubs and small trees, of composition similar to that of the western road verge (see Table B.2, Working Paper B). No single species is dominant and again a number of species are represented by only a handful of individuals (eg one stinging tree, Dendrocnide excelsa).

The area has been partially cleared in the past and much of the tree layer is regrowth. Lantana is dense in small clearings and on the edge of the Highway but is sparse under the tree canopy. Garden escapes - herbs and shrubs - are frequent.

South of the 155 km 100 m mark, the hillside is largely cleared, with limited numbers of trees emergent from lantana thickets.

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[1] identified from leaf material as probably E. henneana

The southern bridge take-off is occupied by a boat ramp and approaches are cleared. Between the existing road and rail bridges is a small areas of mangrove and saltmarch (the latter samphire Sarcocornia and saltwater couch Spocobolus virginicus). Causarina has successfully colonised higher ground and parts of the railway embankment. Dumping of garden rubbish in the area has resulted in a number of garden escapes establishing. The species composition is given in Table B.1 (Working Paper B). The marsh is physically separated from other marsh areas east and west by the two bridges and their embankments.

**Saltmarsh and River Bank**

Immediately south of he present bridge, road verges and riverbank have been clearned for parking and picnicking. Native vegetation is limited to occasional mangroves to level with the 113 km 700 m mark. From this point on, the river bank (which itself is road embankment for much of its length) and tidal flats carry a closed scrub of non-halophytic species and open scrub of mangrove respectively.

Mangroves with other species (see Table B.2, Working Paper B) are present in a sparse very narrow strip to the 114 km 660 m mark. From this point for the next 600 m south there is continuous and well developed open scrub of Avicennia (height to 4 m, cover to 70%) with an often dense (cover up to 80%) lower layer of the river mangrove (Aegiceras). This area is 60-70 m at its widest, with an average width of 30-40 m (2.5 ha approx.) and the stand is very healthy.

From the 114 km 660 m marks to 115 km mangroves are limited to a narrow discontinuous strip on the immediate road edge and are present only as isolated individuals beyond the 115 km mark. The paucity of mangroves along this section would appear to result from lack of suitable substrate directly attributable to the present road's embankment.

The side of the road embankment from the 113 km to 700 m to the 114 km 700 m mark has a continuous but very narrow (3-5 m) strip of closed scrub above high water mark. The primary components are tall shrubs and small trees usually associated with rainforest (see Table B.2, Working Paper B) with some littoral species such as Banksia intergrifolia.

**Special Features and Significance**

The Illawarra Wetland Study (Moss 1979) has pointed out that the Minnamurra estuary is an outstanding feature of the Jamberoo Valley, and the outstanding wetland in the northern half of the region covered in the study (from Kioloa to Wollongong).

> "It cannot be stressed strongly enough that the values of the Minnamurra River estuary are many and that the estuary is indeed worthy of conservation."

The values are reflected in its 7(b) planning classification and designation as a Wetland area under State Environmental Planning Policy (SEPP) No.14. Primary values would include:

- The most extensive largely undrained or severely modified estuarine wetland in the region;

- A variety of wetland and dryland habitats in close juxtaposition;

- A variety of estuarine landform and a combination of volcanic and non-volcanic substrates on higher ground (eg. Carne 1981);

- Faunal habitat, probably primarily bird and marine/estuarine, enhanced by the variety of wetland (mangrove, samphire/saltwater couch, Juncus sedgeland, Casuarina forest) and the proximity of eucalypt forest and warm-temperate rainforest habitats;

- Recreational and scenic.

The estuary and its surrounds also have special significance in view of the very limited remaining native vegetation and particularly near-coastal vegetation in the district. A number of species recorded out of wetland on the present road verge and the hillside either have distributions restricted largely to the Kiama district (eg Podocarpus elatus) or are near the limits of their distribution and so have biogeographical interest (eg Diospyros pentamera) (see Table B.3, Working Paper B).

Both the strip of rainforest species on the verge and the scrubs of the hillside have particular significance because of the contribution to district plant diversity and, probably, faunal habitat. All the species are probably also represented on fringes and within the eucalypt forest near the meander bend of the Minnamurra River, but the only other obvious concentration of similar vegetation is a small area immediately west of the existing bridge. It is recognise that the hillside vegetation has been altered not only through lantana infestation but also through clearing or partial clearing and that the road verge strip is regeneration following construction of the present carriageway: nevertheless the vegetation as it stands at present still contributes significantly to floral and habitat diversity.

## 5.2 AQUATIC ENVIRONMENT

The estuary of the Minnamurra River supports an extensive area of relatively undisturbed wetland, including the largest area of mangrove between Port Hacking and the Shoalhaven River. The catchment has been classified by the National Trust (1976) as being of outstanding scenic value and the wetland designated under SEPP No. 14.

### 5.2.1 Physical Setting

The Minnamurra estuary is a semi-mature barrier estuary (Roy 1982). Upstream of the proposed road widening the estuary has a simple channel with mangrove-lined banks. At the downstream of the proposed road widening the estuary comprises a complex of branching distributory channels and mitigating middle ground shoals. The mouth of the channel is partly closed by a barrier. The main channel is mostly only a few metres deep, with occasional deeper holes present on bends and around structures, resulting from scour.

Currents were measured at a number of cross-channel profiles over a 15 hour tidal cycle. Currents within the studied section were dominated by tidal influence, with the contribution for river flow being insignificant except during times of flood. The range of velocities

observed during spring tide was 0-25 cm/sec on the flood tide and 0-22 cm/sec on the ebb tide. These are relatively low velocities.

There is little available data on flood flows in the River. The estimated average daily discharge rate for a 20 year return interval was determined to be 554 cubic metres per second, into the lower reaches of the Minnamurra estuary near Kiama (see Working Paper D).

Water in the Minnamurra River is generally saline and characteristic of an estuary with limited freshwater flow. The rainfall in the month preceeding the survey was extremely low, near the minimum recorded. Nutrient levels recorded were low, but this not unusual for estuaries in the region. During the high tide water of near oceanic salinity penetrated upstream beyond the westerly extent of the study area. At low tide a weakly developed 2-layer system was evident with fresher river water floating on top of more saline estuarine water and this extended downstream to the vicinity of the road bridge. Downstream of this point the water is well mixed.

The sediments were generally coarse to fine sands with mud and high levels of organic matter being confined to areas covered in seagrass or mangrove. This texture reflects the generally sandy nature of the surrounding areas. The estuary bottom was observed to be quite irregular on the small scale, with frequent banks, beds of seagrass, washouts and other structures. The sandy bottom was frequently covered in small current ripples. These were seen to change direction as the tide reversed.

### 5.2.2 Biological Setting

The flora of the Minnamurra estuary is dominated by wetland communities comprising mangroves, saltmarsh and seagrass (see Working Paper C). These wetlands have been mapped by NSW State Fisheries (West et al, unpub.) using aerial photography. The areas of each unit mapped are:

- Mangroves 0.434 $km^2$ Avicennia marina, Aegicevas corniclatum
- Seagrass 0.232 $km^2$ Zostera capricornia

It is probable that these areas are minimum values, due to the limit of photographic resolution, but the maximum values are unlikely to be significantly greater.

**Seagrass Ecology**

The wetlands adjacent to the proposed road widening were surveyed over four days in February 1985. The seagrass Zostera capricornia proved to be more abundant than previously mapped (West et al. unpub.). It was distributed in an almost unbroken stand 2-5 m across, along the western shoreline to the survey limits. On the eastern side of the estuary, the Zostera bands were discontinuous, apparently due to deeper water and presence of rock fill.

Zostera leaves were long (30-100 cm), dense (800-1600 leaves/$m^2$) and healthy.

Within the leaf canopy, the most commonly observed organism was a shrimp, which could be found at densities estimated at 30/$m^2$. No other epibenthic or nektonic species were found. Juvenile fish were very abundant, particularly Blackfish (Girella tricuspidata), Australian Snapper (Chrysophrys auratus), Yellowfin Bream (Acanthopagrus australis), Mullet (possibly Mugil cephalus), Dusky flathead (Platycephalus fuscus) and Silver Biddy (Gerres oratus). All species, except mullet, are of commercial importance.

**Mangrove Ecology**

Both mangrove species were more abundant and widely distributed along the western bank.

Avicennia was present as trees fringing the estuary, occasionally forming dense stands up to 6 m tall, as well as shrubs behind the fringing vegetation. Aegriceras was present as shrubs 1-2 m tall, occasionally as a fringing stand but more commonly behind it. Along the south bank Aegriceras had an unusual mallee-like growth form.

The Sydney rock oyster (Saccostrea commercialis) was abundant, principally occurring attached to the aerial roots of Avicennia. Other

common molluscs in the mangrove muds included the gastropods Pyrazus ebenincis and Bembicium amatum. Other important species within the mangroves were crabs (two species) and spiders (two species).

**Ecology of Channel Sands**

The sediments of the channel were coarse to fine sands with a minor proportion of mud. They contained a sparse macroinvertebrate fauna, principally small crustaceans and molluscs. Sediments within seagrass beds were silty sands, and had a fauna comprising crustaceans, molluscs and some polychaetes.

## 5.3 SOCIAL

### 5.3.1 Socio-economics

The study area for this section was defined as seven census collection districts from the ABS 1981 Census. These collection districts are shown in Figure 5.4.

**Population Distribution**

There are clear differences in population growth within the study area. As shown in Table 5.1, the northern four collection districts showed considerably higher growth than the Shire in the period 1976-1981. The southern section around Bombo declined while the rural collection district to the west of the Gainsborough Estate showed significant relative growth probably associated with hobby farm development.

In the latter period 1981-1985, census information was not available so estimates were derived from building approvals. This period showed a dramatic decrease in the growth rate in the districts east of the Princes Highway as the supply of vacant land had almost been built out. In contrast, there was very high growth west of the Highway associated with the Gainsborough Estate and surrounding infill development. For example, note in collection district D, the annual average growth rate was 17.9% with the figure for the total Shire at approximately 4%.

TABLE 5.1

COMPARISON OF POPULATIONS AND GROWTH RATES
from 1976 to 1981 and from 1981 to 1985

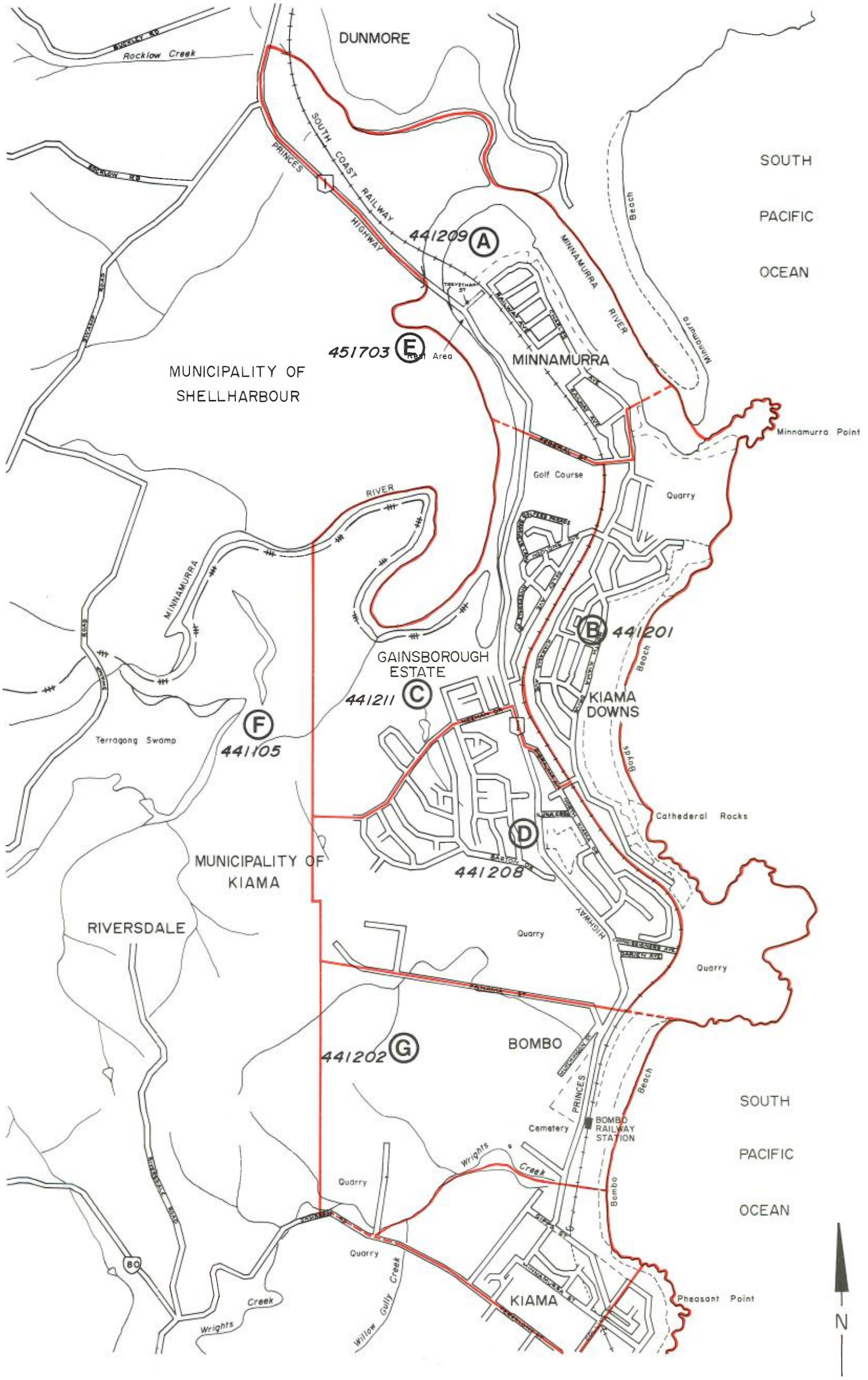
| COLLECTION DISTRICT (C.D.) | POPULATION | | GROWTH RATE 1976-81 % | 1985 [1] ESTIMATED POP. NO. | GROWTH RATE 1981-85 % |
|---|---|---|---|---|---|
| | 1976 | 1981 | | | |
| A | 415 | 556 | 6.0 | 612 | 1.9 |
| B | 601 | 1,006 | 10.8 | 1,192 | 3.5 |
| Combined C & D | 1,097 | 1,649 | 8.5 | 3,016 | 12.8 |
| C only | - | 722 | - | 908 | 4.7 |
| D only | - | 927 | - | 2,108 | 17.9 |
| E | 186 | 75 | -16.4 | Building approvals | |
| F | 197 | 280 | 7.3 | not noted for | |
| G | 78 | 55 | -6.8 | these C.D.s | |
| Kiama Shire | 8,665 | 11,368 | 5.6 | 13,400[2] | 4.3 |
| NSW | 4,777,108 | 5,126,217 | 1.4 | 5,461,400[3] | 2.7 |

Source: ABS and Dames & Moore estimates

[1] 1985 Population is estimated by multiplying the number of Building Approvals since 1981 for each C.D. by the average occupancy rate.

[2] ABS estimate only available to June 1984.

[3] ABS estimate at March 1985




DEPARTMENT OF MAIN ROADS OF N.S.W.

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**CENSUS COLLECTION DISTRICT**

**FIGURE 5·4**

Dames & Moore : 13605-004-70

**Population Projections**

Inspection of the "Urban Expansion Study" (August 1984) completed by the Kiama Municipal Council shows that the assumed growth rates for Kiama Shire range from 3.58% to 5.07% for the 1981-86 period and 2.65% to 5.07% for the 1986-91 period. As discussed in the previous section, the actual growth rate for 1981-84 was estimated at 4.3% which is consistent with the above forecast.

It is also apparent from the above study that a significant portion of new growth in the Kiama township area will be in the Parbury Estate immediately west of the Gainsborough Estate. Consequently, at least 334 or 64.6% of the 517 lots categorised as vacant land with approval and vacant land without approval in Kiama township area in the "Urban Expansion Study" are located in the northern section of the study area. There are also approximately 390 vacant lots in the existing Gainsborough Estate which constitute almost half of the lots described as existing vacant sub-divided land in the Council planning study. With the predicted lot release ranging between 25 and 85 per year through 1991, the northwestern section of the study area should continue to experience considerably higher growth rates than for the entire Municipality.

**Population Characteristics**

The most recent information available for age of the population in 1981 is shown in Table 5.2. It has been broken down by collection district and compared to Kiama Municipality and the State. Collection district A, centering on Minnamurra shows up as a significant retirement area with 28.8% of the resident population being aged 60 or older which is 10% higher than the Municipality and twice as high as the State average. All of the other collection districts in the study area are generally younger than the Municipality average.

Data presented in the "Urban Expansion Study" suggest that the growth in the Municipality is due to a higher proportion of couples without children, made up of young professionals and elderly couples. However the occupational data presented in Table 5.3 confirms the higher elder-

TABLE 5.2

COMPARISON OF AGE BREAKDOWN PROPORTIONS FOR 1981

| AREA | TOTAL POPULATION | 0-4 % | 5-9 % | 10-14 % | 15-19 % | 20-29 % | 30-44 % | 45-59 % | RETIRED 60+ % |
|---|---|---|---|---|---|---|---|---|---|
| A | 556 | 10.3 | 9.9 | 6.5 | 4.5 | 14.0 | 22.5 | 3.6 | 28.8 |
| B | 1006 | 10.0 | 10.9 | 9.2 | 6.4 | 17.2 | 23.4 | 13.1 | 9.8 |
| C | 722 | 9.1 | 10.0 | 8.5 | 7.6 | 18.0 | 19.4 | 13.2 | 14.3 |
| D | 927 | 8.6 | 9.0 | 9.3 | 9.0 | 18.0 | 22.1 | 13.0 | 11.1 |
| C+D Combined | 1649 | 8.9 | 9.4 | 8.9 | 8.4 | 18.0 | 21.0 | 13.0 | 12.5 |
| E | 75 | not available | | | | | | | |
| F | 280 | 8.2 | 7.1 | 13.6 | 6.8 | 15.7 | 21.8 | 15.0 | 11.8 |
| G | 55 | not available | | | | | | | |
| Kiama | 8665 | 8.2 | 8.8 | 8.2 | 7.0 | 15.7 | 20.0 | 14.2 | 18.0 |
| NSW | 5126217 | 7.5 | 8.7 | 8.5 | 8.4 | 16.4 | 20.6 | 15.6 | 14.5 |

Source: ABS Census data

TABLE 5.3

OCCUPATIONAL STRUCTURE : STUDY AREA AND KIAMA MUNICIPALITY, 1981

| OCCUPATION | A | | B | | C/D | | E | | F | | KIAMA MUNICIPALITY | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| Professional etc | 29 | 16.4 | 134 | 31.8 | 120 | 17.4 | n.a | n.a | 24 | 17.4 | 870 | 19.4 |
| Admin etc | 10 | 5.6 | 25 | 5.9 | 28 | 4.1 | n.a | n.a | 6 | 4.3 | 235 | 5.3 |
| Clerical | 18 | 10.2 | 60 | 14.3 | 93 | 13.5 | n.a | n.a | 9 | 6.5 | 545 | 12.2 |
| Sales workers | 19 | 10.7 | 39 | 9.3 | 51 | 7.4 | n.a | n.a | 7 | 5.1 | 354 | 7.9 |
| Farmers etc | 2 | 1.1 | 0 | 0.0 | 9 | 1.3 | n.a | n.a | 45 | 32.6 | 253 | 5.7 |
| Miners etc | 6 | 3.4 | 9 | 2.1 | 11 | 1.6 | n.a | n.a | 2 | 1.4 | 71 | 1.6 |
| Transport etc | 10 | 5.6 | 14 | 3.3 | 49 | 7.1 | n.a | n.a | 3 | 2.2 | 240 | 5.4 |
| Trades etc | 65 | 36.7 | 90 | 21.4 | 233 | 33.8 | n.a | n.a | 27 | 19.6 | 1261 | 28.2 |
| Services, Recreation etc | 15 | 8.5 | 32 | 7.6 | 58 | 8.4 | n.a | n.a | 3 | 2.2 | 389 | 7.6 |
| Armed Services | 0 | 0.0 | 2 | 0.5 | 0 | 0.0 | n.a | n.a | 0 | 0.0 | 7 | 0.2 |
| Other, not stated | 3 | 1.7 | 16 | 3.8 | 38 | 5.5 | n.a | n.a | 12 | 8.7 | 300 | 6.7 |
| Total | 177 | 100.0 | 421 | 100.0 | 690 | 100.0 | | | 138 | 100.0 | 4525 | 100.0 |

Source: A.B.S.

ly component around Minnamurra (collection district A) but suggests a higher proportion of trades people in the districts west of the Princes Highway. The professional and technical category for 1981 is below that for the Municipality in all study area districts except in collection district B which tends to be more typical of the Shire.

To summarise the characteristics of the population in the study area in 1981, the Minnamurra area was clearly the much older and more established community within the study area. Further to the south on the eastern side of the Highway was a community more typical of the Municipality which is younger with more people from professional and technical level occupations.

On the western side of the Highway in the Gainsborough Estate, there were a greater proportion of younger families with a high percentage of people from the trades and manufacturing. This observation was clearly associated with the increasing numbers of people living in Kiama and commuting to Wollongong on a daily basis. These observations in the "Urban Expansion Study" were based on the 1981 census data. Since that time, the high costs of construction and relatively high land prices have tended to bring the various communities more in line with the overall Municipal trend of relatively affluent professional couples and retirement groups. This effect was referred to as the "affordability" of future residential land.

Consequently, from a social perspective, the main differences that are now apparent and will tend to continue within the study area are probably associated more with age and family cycle than income.

**Services and Facilities**

The northern suburbs of Kiama contain few services and facilities such as large shopping centres. The closest "corner store" style shops are located on the eastern side of the Highway at Boyds Beach and Minnamurra. The closest major centre is Kiama to the south and Wollongong to the north, both places providing a wide variety of goods and services.

The suburbs of Minnamurra and Kiama Downs are self-contained in thatthe "corner-stores" are available to buy goods. However, the Gainsborough Estate residents must travel to either Kiama or to the "corner stores" across the Highway to buy supplies. A shopping complex and community centre are planned as an intergral part of the Gainsborough Estate development but they have not yet been constructed. It is expected that the residents of the Gainsborough Estate and those located on the eastern side of the Highway from the suburbs of Minnamurra and Kiama Downs will utilise the facilities. As residential development progresses, it is expected that east-west traffic movement will increase to some extent by the residents of Minnamurra and Kiama Downs making use of the facilities in the Gainsborough Estate area.

### 5.3.2 Archaeology and History

An archaeological field survey and research was undertaken of the preferred route. No aboriginal sites were directly observed during the field survey and none have been previously recorded in the National Parks and Wildlife Register.

However, during an interview with the greenkeeper at Kiama Golf Course, the occurrence of a possible insitu midden was reported. The discovery was said to have occurred decades ago and little information is now available about the site. The midden is said to lie at least a metre below the present level of turf.

There are no sites of historical significance in the vicinity of the preferred route.

### 5.3.3 Tourism and Recreation

The Princes Highway is the major route for north and south bound tourist traffic on the South Coast. Working Paper F discusses tourist use and visitation to the area in detail.

Specific recreation sites adjacent to the Highway which experience recreational use include the Minnamurra River estuary, the Kiama Golf Course at Minnamurra and a number of public reserves. Specific details of these recreation areas can be found in Working Paper F.

Reserves along the Highway which are zoned 6(a) Open Space (existing recreation) under the Municipality of Kiama Local Environmental Plan No.5 are shown in Figure 5.5 and include the Iluka Reserve and North Kiama Park in the suburb of Bombo. These reserves are generally undeveloped and provide areas of open space for the surrounding residential areas.

The site of Bombo public school (adjacent to the Highway and Commissioners Lane, Bombo) has been developed as a playing field and experiences informal local use.

Two coastal beaches, Boyds Beach and Bombo Beach, are located near the Highway but will not be affected by the proposed development. Major access from the Highway to Boyds Beach is via Gibraltar Avenue or alternatively Iluka Crescent to The Cliff Drive.

Access to Bombo Beach, from this section of the Highway, is via a turnoff overpassing the South Coast railway line (opposite Bombo Cemetery) with the line running adjacent to the Beach. At this location a gravel carpark and toilets have been established for beach visitors.

Kiama Golf Course runs adjacent to the eastern side of Princes Highway for approximately 990 m in the north of the Study Area. It is an 18 hole course with a club house.

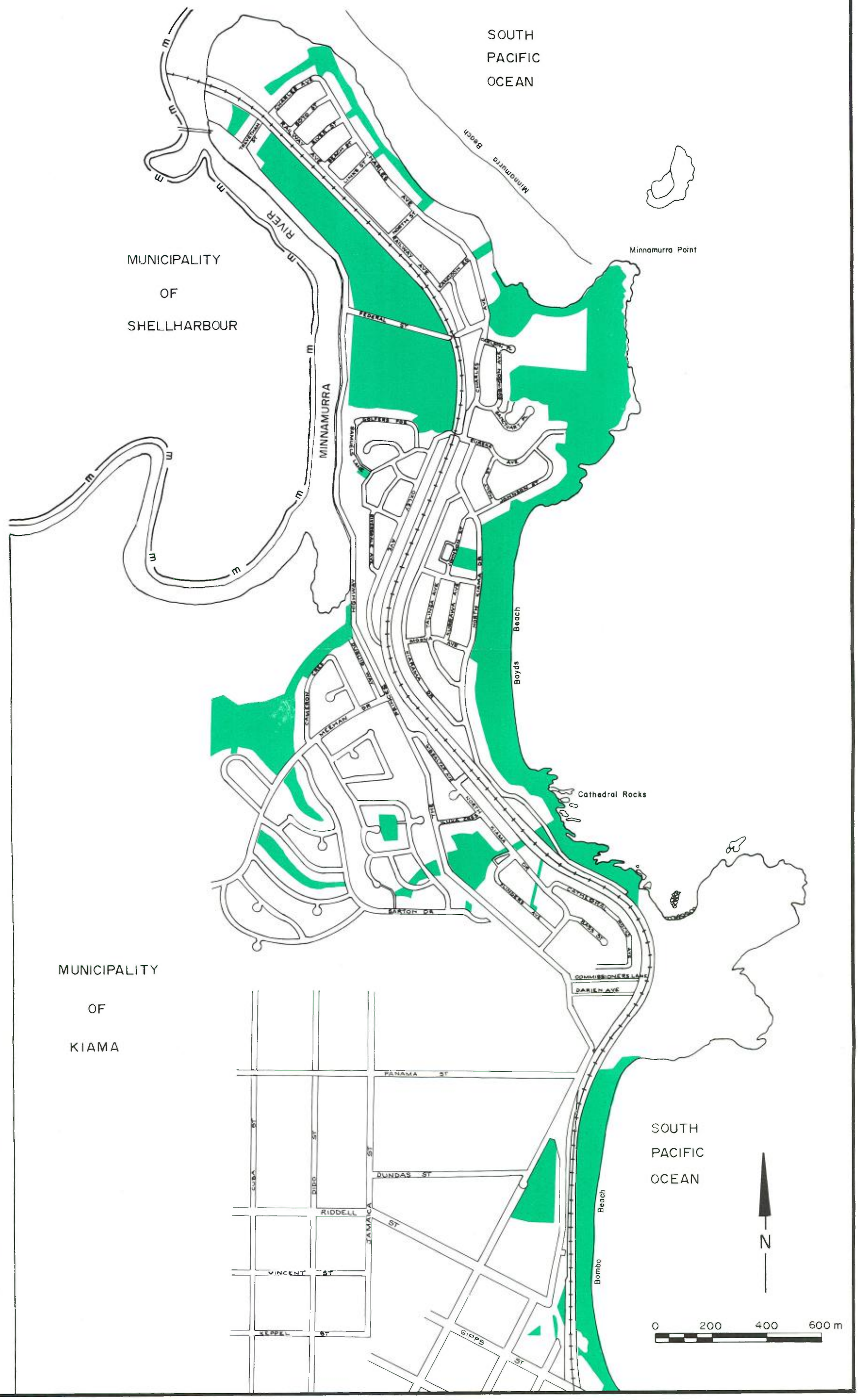
While the golf course and associated facilities are utilized by golfers on a daily basis, their use is concentrated on weekends.

The Princes Highway runs adjacent to the Minnamurra River for approximately 2 km. Relatively little opportunity for stopping is provided on this section of the Highway due to its winding nature, relative narrowness, limited number of stopping areas and the volume of traffic using the road which contribute to relatively hazardous exit and entrance conditions.

Access to the River however is generally limited to an old boat ramp abutting a public oyster lease to the south, and a track leading off

**LEGEND**

RESERVES




DEPARTMENT OF MAIN ROADS OF N.S.W.

PRINCES HIGHWAY RECONSTRUCTION -
MINNAMURRA RIVER TO BOMBO, KIAMA

**RESERVES**

**FIGURE 5·5**

Dames & Moore : 13605-004-70

Trevethan Street to a boat ramp on the eastern side of the road bridge over the Minnamurra River. Apart from these access points, mangroves generally restrict access to the River.

Recreational facilities along the River are limited and include:

- A public oyster lease, access to which is from an old ramp adjacent to the backwater off the Highway.

- A boat ramp located on the eastern side of the Minnamurra bridge. At low tides, the ramp is more difficult to use as it is separated from the channel by the mud flats.

Further, the gravel track and car stopping area on the west of the Highway, south of the bridge, provides a rest area with good views of the River.

Recreational activities on the River are generally limited to sight-seeing, boating and fishing from private boats or from the shoreline areas. There are no boat hiring facilities in the area.

Field observations have indicated that this section of the River and surrounds experiences a moderately low level of recreational use. Maximum concentrations of 15-20 people (at any one time) were observed during weekends in the summer holiday period.

In summary, while the section of the Highway under study provides access to the Minnamurra River, Kiama Golf Course and adjacent reserves, its most significant role from a tourism perspective is as a major tourist route for visitors travelling to Kiama and other southern destinations.

The area has been referred to by local residents as a "gateway" to Kiama and the South Coast due to its aesthetically attractive surroundings. While good views of the estuary are obtainable from the Highway, the somewhat hazardous nature of the road restricts the opportunity of motor tourists for enjoying such views while driving.

## 5.4 TRANSPORT

This section describes the existing traffic conditions for the Princes Highway from the Swamp Road intersection to Bombo.

### 5.4.1 Existing Road System

The Princes Highway from Swamp Road to the Minnamurra River is a two lane sealed carriageway. The crossing of the River is by a two lane concrete bridge. Between the Minnamurra River and Oxley Avenue the Highway is located along the eastern bank of the River.

Trevethan Street, approximately 160 m south of the River, is a cul-de-sac providing access to ten houses. Access from Trevethan Street is only via the Princes Highway as the eastern end of the street is bounded by the Illawarra Railway.

From Trevethan Street for a distance of approximately 1 km, the road is bounded to the east by the Kiama Golf Course and the west by the River. Approximately 500 m south of Trevethan Street, Federal Street intersects with the Highway. Federal Street provides access under the railway line to the urban areas of Minnamurra. Federal Street is a narrow sealed carriageway through the Golf Course. Access under the railway line is via a narrow one lane underpass with a 3.2 m clearance. The Princes Highway has been slightly widened at Federal Street to allow manoeuvering for through-traffic to avoid northbound traffic turning right into Federal Street and short left turn and left merging lanes for traffic entering and leaving Federal Street.

Approximately 400 m south of Federal Street, the Highway has been cut into the side of a hill for a distance of about 1 km. Throughout this section, the road follows the alignment of the river bank. Road shoulders are narrow along the western edge and non-existent along most of the eastern side. There are a number of blind corners and advisory speeds nominate around 55 kph.

From a point approximately 300 m north of Oxley Avenue the road vears away from the Minnamurra River as the River turns to the west and the

road continues south. Oxley Avenue provides access to the residential estates of Kiama Downs and, like the Federal Street intersection, provision has been made for northbound traffic to avoid traffic turning right into Oxley Avenue.

Between Oxley Avenue and Meehan Drive, the Highway widens to three lanes: two southbound and one northbound. South of Meehan Drive, the carriageway widens to four lanes for approximately half a kilometre, although lane markings remain the same as between Oxley Avenue and Meehan Drive.

Between Gibraltar Ave and Iluka Crescent the Highway narrows to three lanes : two southbound and one northbound. From south of Iluka Crescent to North Kiama Drive, the road is a two lane carriageway with a poor alignment and surface condition. From south of North Kiama Drive to the quarry railway level crossing there is one southbound lane and two northbound lanes, providing a passing lane for traffic ascending Bombo Hill. South of the railway crossing to Spring Creek the road is a two lane carriageway.

Meehan Drive provides the only existing access to the residential areas of Gainsborough Estate. Access to residential areas of Kiama Downs east of the Princes Highway is provided by North Kiama Drive, Gibraltar Avenue and to a lesser extent Iluka Crescent.

There is only one regular DMR counting station located along the section of Highway under review. This station is located at the quarry railway level crossing at Bombo (No. 07317). The most recent available AADT count at this station was 16,830 vehicles in 1982.

As part of this study, detailed vehicle counts were taken during 1985. Intersection counts were taken at Federal Street and Oxley Avenue while volume counts have been taken on a monthly basis for the Princes Highway north and south of Federal Street since July 1985.

Intersection counts undertaken at Federal Street on 4th June, 1985 and Oxley Avenue on 4th July, 1985 indicate daily volumes on Princes Highway at these points of 12,914 vehicles and 11,370 vehicles

TABLE 5.4

SUMMARY OF TRAFFIC COUNTS : PRINCES HIGHWAY
JULY - DECEMBER 1985

| LOCATION | MAXIMUM DAILY VOLUME COUNT | MINIMUM DAILY VOLUME COUNT | AVERAGE DAILY VOLUME COUNT |
|---|---|---|---|
| SOUTH OF FEDERAL ST | | | |
| July | 15,078 | 12,520 | 13,596 |
| August | 17,026 | 12,658 | 14,348 |
| September | 19,279 | 12,167 | 14,528 |
| October | 24,241 | 12,238 | 15,209 |
| November | 18,959 | 13,041 | |
| NORTH OF FEDERAL ST | | | |
| July | 17,171 | 14,058 | 15,235 |
| August | 19,725 | 14,406 | 16,294 |
| September | 20,330 | 13,985 | 16,275 |
| October | 20,782 | 15,051 | 17,576 |
| November | 25,545 | 15,073 | 19,099 |

Source: DMR

respectively. Based on these figures, 1985 AADT's of 15,500 vehicles and 13,640 vehicles can be derived using an index of 1.2. (This index was calculated by comparing counts for the same days of the year in 1984 at the permanent count station at Kiama South (No. 07001) to the AADT for that Station).

Details of the monthly counts are shown on Table 5.4 and indicate that volumes through this section of the Highway are in the vicinity of these estimated AADT's as well as AADT's established for Bombo and Dunmore by regular DMR counts.

The survey of traffic volumes north and south of Federal Street incorporates periods of low recreational traffic demand as well as school and public holiday periods. Variations in traffic volumes can be seen by comparing the peak daily volumes associated with Boxing Day and the Friday of the Labour Day long weekend (25,545 vehicles and 24,241 vehicles respectively) with the minimum volumes associated with weekday traffic outside holiday periods (12,167 vehicles).

Growth rates for the count stations at Bombo and Dunmore were estimated in Table 2.2 (Section 2) for the periods 1974 to 1978, and 1974 to 1982. Both stations showed an increase in growth rates for these periods. Traffic volumes for 1990 and 1995 were projected in Section 2 using a straight line trend. The Bombo station shows an average daily increase to 25,013 vehicles by 1995 while Dunmore could increase to 28,150 vehicles.

A growth rate of 5.5% per annum was applied to the estimated 1985 AADT's for the Princes Highway at Oxley Avenue and Federal Street, based on growth rates established for Bombo and Dunmore from 1974 to 1982. Based on this growth rate, average daily traffic could be expected to increase to between 23,300 and 26,500 vehicles along this section by 1995.

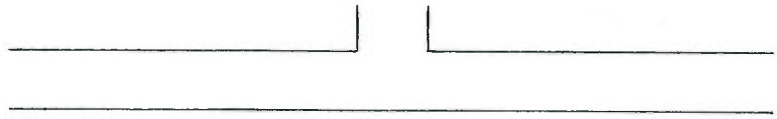
### 5.4.2 Traffic Characteristics

The traffic characteristics of the Princes Highway through Kiama are influenced by a variety of factors resulting from the townships func-

TABLE 5.5

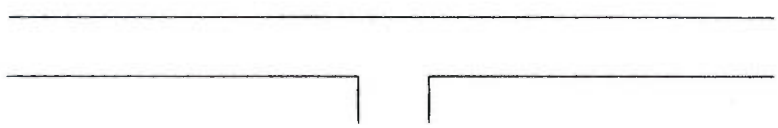
INTERSECTION COUNTS AT PEAK

a) Federal Street, Oxley Avenue and Gibraltar Ave with Princes Highway



| LOCATION | PEAK PERIOD | TRAFFIC VOLUMES | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 → | 2 ↑ | 3 ← | 4 → | 5 ↑ | 6 ← |
| | | L H T | L H T | L H T | L H T | L H T | L H T |
| Federal Street | 8 - 9 am | 332 34 366 | 29 - 29 | 114 2 116 | 62 - 62 | 4 - 4 | 578 50 628 |
| | 3 - 4 pm | 479 45 524 | 125 - 125 | 36 3 39 | 7 - 7 | 11 - 11 | 383 54 437 |
| Oxley Avenue | 8 - 9 am | 315 87 402 | 2 2 4 | 13 1 14 | 53 2 55 | 53 4 57 | 503 85 588 |
| | 3 - 4 pm | 463 53 516 | 12 3 15 | 4 2 6 | 62 6 68 | 44 1 45 | 435 58 493 |
| Gibraltar Avenue | 8 - 9 am | 370 60 430 | 10 - 10 | 44 3 47 | 6 1 7 | 6 - 6 | 493 39 532 |
| | 3.30 - 4.30 pm | 564 31 595 | 46 - 46 | 30 - 30 | 4 1 5 | 6 - 6 | 463 29 492 |

b) Meehan Drive and Princes Highway



| LOCATION | PEAK PERIOD | TRAFFIC VOLUMES | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 → | 2 ↓ | 3 ← | 4 → | 5 ↓ | 6 ← |
| | | L H T | L H T | L H T | L H T | L H T | L H T |
| Meehan Drive | 8 - 9 am | 357 61 418 | 11 1 12 | 47 4 51 | 24 - 24 | 17 1 18 | 531 42 573 |
| | 3.30 - 4.30 pm | 587 32 619 | 53 1 54 | 29 2 31 | 30 - 30 | 38 - 38 | 487 29 516 |

Note: L = Light Vehicles : H = Heavy Vehicles : T = Total
Source: DMR

tion as a rural service centre, holiday centre and commuter satellite to Wollongong. As such, the make up of traffic at any particular instant will vary according to the time of the day, week or year.

**a) Intersection Turning Movements**

Only limited data is available on intersections affected along the Highway section under review. Recent traffic counts were taken at Federal Street and Oxley Avenue and 1983 counts are available at peak periods for Meehan Drive and Gibraltar Avenue. The results of these surveys showing morning and afternoon peak volumes and turning movements are shown on Table 5.5. The incidence of commuter traffic is evident when traffic flows are compared. The Federal Street intersection experienced higher volumes of traffic turning north (movement 3) during the morning period and a significantly higher proportion of traffic turning left into Federal Street (movement 2) during the afternoon period. Through traffic movements also show a higher volume of southbound traffic during the afternoon period than the morning period at all survey points.

Both Oxley Avenue and Federal Street provide access from the residential areas of Kiama Downs and Minnamurra to the Princes Highway. The turning movements to and from both streets indicate each serves a separate function. Oxley Avenue provides access predominantly for traffic movements between the northern residential estates and the Kiama business area, while Federal Street is mainly utilised by traffic commuting to the Wollongong urban areas. Gibraltar Avenue also shows a higher incidence of traffic turning to and from the north during morning and afternoon peaks than is the case for south turning traffic. Meehan Drive, although showing a higher incidence of traffic turning to the north in the morning peak, does indicate a more even spread of vehicular movement, especially during the afternoon peak.

**b) Heavy Vehicle Movements**

Heavy vehicle traffic for this section of the Princes Highway is limited. The most recent AADT figures that included a heavy vehicle component were 1979 counts at the permanent count station at Kiama

South. Recent intersection counts at Federal Street and Oxley Avenue recorded heavy vehicle components of 9.8% and 11.5% respectively.

**c) Effect of Peak Recreational Traffic**

As the detailed surveys were undertaken on weekdays outside any holiday period, the majority of traffic can be assumed to be local or commuter traffic. Consequently a recreational traffic component was derived from existing traffic data to identify the extent of recreational traffic on this Highway section during peak recreational periods.

Limited traffic data for the Highway section concerned necessitated the use of data from the permanent count station at Kiama South. The recreational traffic component was based on the following assumptions:

- The permanent count station at Kiama South (No. 07001) was selected as the determining point for establishing the relevant peak traffic flows.

- Recreational trips were assessed as the difference between peak weekend trips and peak weekday trips. A peak weekend day was selected as representing total local and recreational trips and the peak weekday volume for the corresponding week as representing maximum local trips. Local traffic movement included both permanent residential local trips and introduced (on holiday resident) local trips.

- The peak weekend volume was determined, for the survey year 1982, as occurring on Saturday, 30th January. Although a slightly higher volume was recorded on Saturday, 26th December, the corresponding week was predominantly a holiday period and the weekday peak would be distorted.

- As the weekend peak occurred on the Saturday of the long weekend, holiday traffic influences could be attributed to Friday, Monday and Tuesday morning traffic flows. Consequently the weekday peak was selected outside these days and was Thursday, 4th February.

By using the corresponding weekend and weekday peaks for the permanent stations at Gerringong (No. 07010) and south of Nowra (No. 07053) a flow diagram was prepared to estimate the breakdown of traffic into local and recreational trips (refer Figure 5.6). The more recent 1984 AADT counts could not be used for this exercise as weekly counts at Gerringong (No. 07010) were not taken for this period.

From the flow diagram, it was estimated that during a peak holiday period, 56% of traffic was recreational traffic and 44% was local traffic within the Kiama area. Corresponding proportions of traffic breakdown for Nowra and Gerringong are consistent with the analysis. Nowra as a larger center with a more important regional service function has a higher proportion of local trips to recreational trips. Gerringong on the other hand as a smaller seaside resort, has a slightly higher proportion of recreational trips.

**d) Parking**

Parking facilities along this section of Highway consist basically of one "rest area" located between the road and river immediately south of the bridge. From Oxley Avenue for approximately 1 km north, there are limited provisions for parking due to the narrow, winding section of road as it cuts between the river and the cliff. Adjacent to the Golf Course, the road shoulders widen on both sides allowing room for vehicles to pull off the main carriageway. Parking demand is not seen as significant through this section of the Highway. Apart from the few houses associated with Trevethan Street there is no residential development directly associated with this section of road. Parking for the Golf Course is provided adjacent to the club house off Oxley Avenue. Kerbside parking exists from south of Meehan Drive to the top of Bombo hill. The remaining section of Highway to Bombo comprises gravel shoulders with limited and no specifically defined parking areas, with the exception of a small gravelled area adjacent to the road at Bombo Station.

**e) Pedestrian Traffic**

No defined pedestrian facilities exist and access is very limited from residential areas. The river bank is lined with mangroves, making the

TABLE 5.6

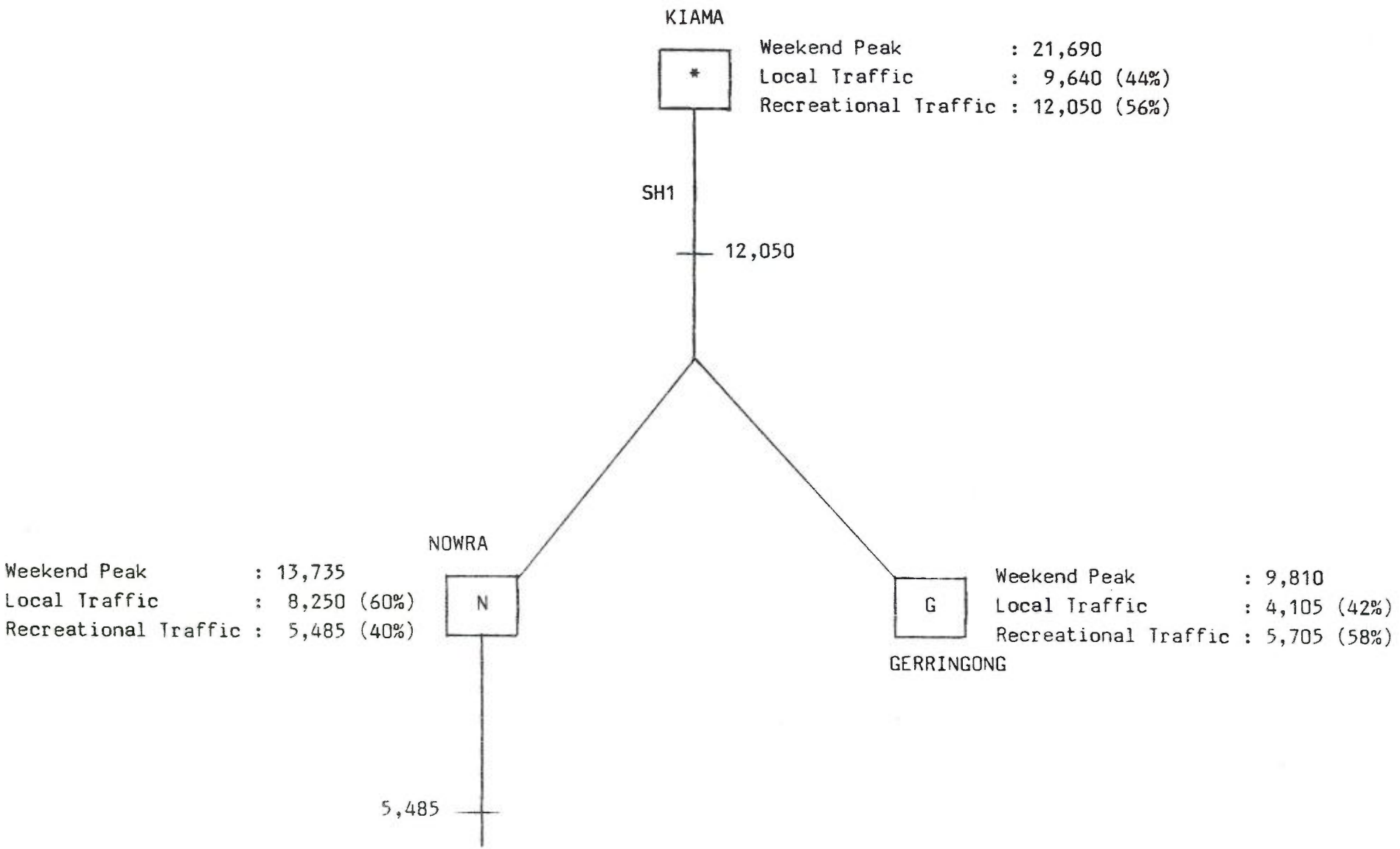
VEHICLE ACCIDENTS : PRINCES HIGHWAY
MINNAMURRA RIVER TO SPRING CREEK
January 1981 - June 1985

| LOCATION | YEAR | | | | |
|---|---|---|---|---|---|
| | 1981 | 1982 | 1983 | 1984 | 1985* |
| Minnamurra River | - | - | - | 2 | 1 |
| Federal Street | 3 | 2 | 1 | 2 | - |
| Oxley Avenue | 2 | 3 | 3 | 3 | - |
| Meehan Drive | - | - | - | 4 | 3 |
| Gibraltar Avenue | - | - | 1 | 2 | - |
| Iluka Crescent | - | 1 | 2 | 1 | 2 |
| North Kiama Drive | 2 | 7 | 4 | 10 | - |
| Darien Avenue | - | 6 | 3 | 1 | 2 |
| Panama Street | 1 | 1 | 2 | - | 2 |
| Riddell Street | 1 | - | - | - | - |
| Gipps Street | 1 | 3 | 6 | 1 | 1 |
| Miscellaneous | 4 | 1 | 2 | 5 | 4 |
| TOTAL | 14 | 24 | 24 | 31 | 15 |

* Note: 1985 Figures are only to June 30th

FIGURE 5.6

ESTIMATE OF RECREATIONAL TRAFFIC FLOWS : KIAMA - NOWRA



river relatively inaccessible. Pedestrian movement associated with the Golf Course is contained within the Course itself but golfers are required to cross Federal Street which disects the Course. Pedestrian movement along the side of the Highway is predominantly confined to the use of the gravel shoulders or the nature strip areas associated with residences fronting onto the Highway.

**f) Road Safety**

Accident data has been tabulated for the section of the Princes Highway between Minnamurra River and Spring Creek to identify any potentially dangerous or problem locations. Between January 1981 and June 1985 there were 108 car accidents along this section of Highway comprising one fatality, 50 accidents involving injury, and 57 accidents involving vehicle and property damage. Accident locations are shown on Table 5.6 and indicate that the intersection of North Kiama Drive and the Princes Highway has consistently experienced the greatest number of accidents along this section of Highway since 1982.

**g) Existing Level of Service**

The concept of "Level of Service" broadly denotes any one of a number of differing combinations of operating conditions that may occur on a given traffic lane or roadway when it is accommodating various traffic volumes (NAASRA:1982).

There are six levels of service designated from A to F representing the best to worst range of traffic conditions which may occur. The following generalised descriptions apply to uninterrupted flow as detailed in the NAASRA Guide:

- Level of Service "A"
  Is a condition of free flow with high speeds and low traffic volumes. Drivers can hold their desired speeds without delays;

- Level of Service "B"
  Is in the zone of stable flow and drivers have reasonable freedom to select their speed. Traffic volumes at this level of service have been associated with design hour volumes for rural highways;

- Level of Service "C"
  Is still in the zone of stable flow. Most drivers are restricted in their freedom to select their own speed of change lanes, overtake, etc. Operating speeds are still reasonable and this service volume is perhaps suitable for urban design conditions;

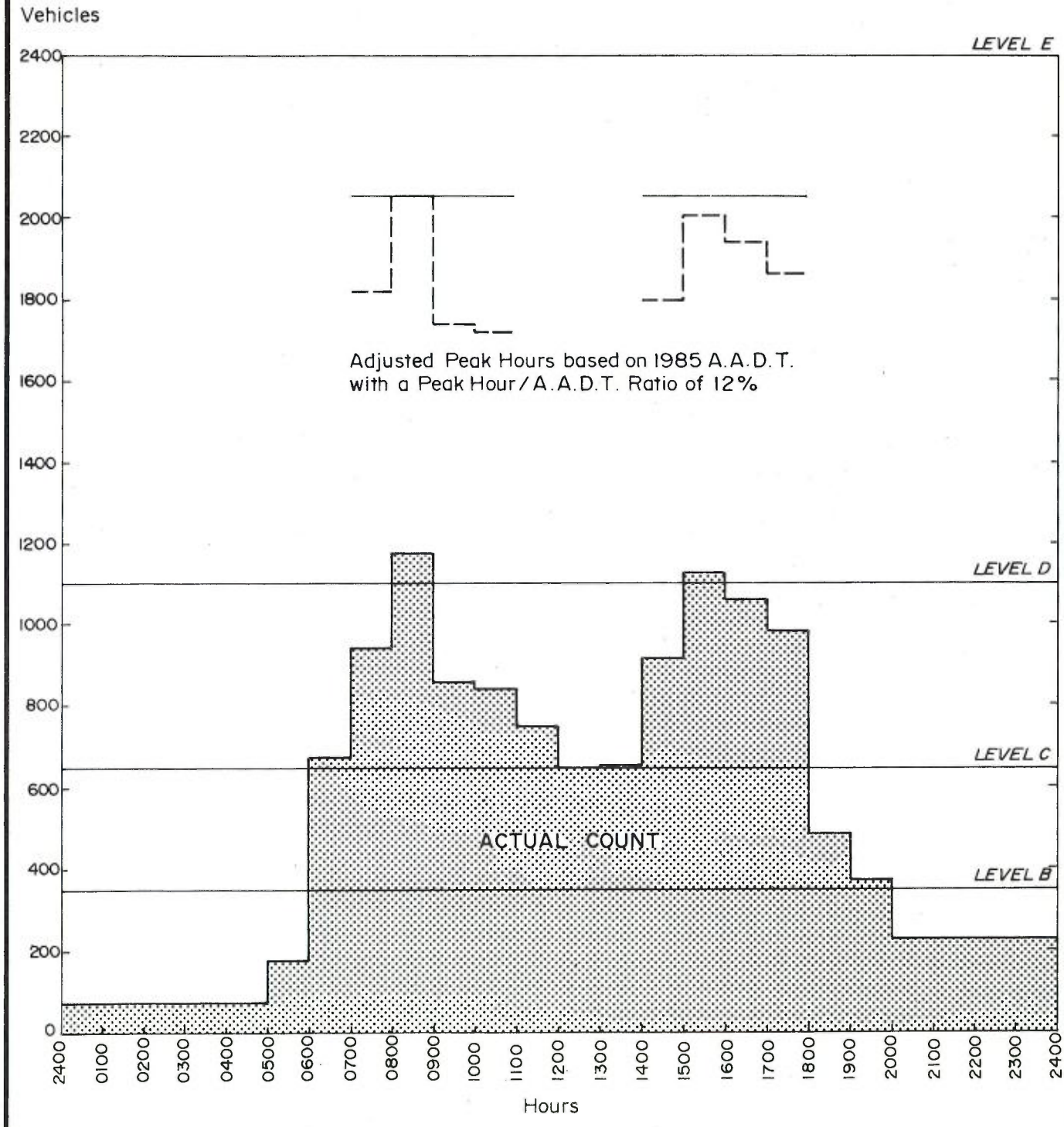
- Level of Service "D"
  Approaches unstable flow with nearly all drivers restricted. Comfort and convenience are low but may be tolerated for short periods. Fluctuations in conditions cause substantial drops in speed. This service volume corresponds to tolerable capacity;

- Level of Service "E"
  Is obtained with traffic volumes near or at capacity. Flow is unstable and there may be momentary stoppages;

- Level of Service "F"
  Describes forced flow operation at low speeds caused by demand exceeding capacity. There is stop-start operation with long queues and delays. In the extreme, both speed and volume can drop to zero. This level also occurs when the section acts as a storage area upstream from a bottleneck.

There are no strict rules associated with the application of a suitable level of service as the type of operation desired and that which can be provided is affected by a number of factors. The first four levels are accepted as producing satisfactory road conditions. However after Level of Service "D" it is generally considered that stable traffic flows may break down to forced flows and associated stoppages.

Hourly traffic data obtained from the surveys at Federal Street and Oxley Avenue intersections with the Princes Highway has been compiled and levels of service plotted as shown on the histogram in Figure 5.7. Adjustments for the 1985 AADT volumes are also shown. This analysis indicates that the Highway is currently operating at a level of service "C" for most periods outside the morning and afternoon peak when a level of service "D" is experienced. However traffic projections for 1995 indicate that the existing road may be operating at a level of




DEPARTMENT OF MAIN ROADS OF N.S.W

PRINCES HIGHWAY RECONSTRUCTION –
MINNAMURRA RIVER TO BOMBO, KIAMA

**HISTOGRAM**

**FIGURE: 5·7**

Dames & Moore: 13605-004-70

Service "E" especially during holiday periods resulting in extended periods of forced traffic flows and stoppages.

The section of Highway between Minnamurra River and Bombo currently experiences a Level of Service "C" for most occasions outside holiday periods. When traffic flows are dominated by the local traffic component, during holiday or weekend periods, a Level of Service "D" is often experienced and approaches Level of Service "E with the consequent breakdown of stable traffic flows often associated with peak holiday periods such as Christmas - New Year, Easter and the Australia Day long weekend.

## 5.5 VISUAL

The existing landscape and visual environment of the Princes Highway from the Minnamurra River Bridge to Bombo varies significantly. The Highway generally parallels the coastline, approximately 500 m to 1 km from the waters edge. The majority of this area between the Highway and coastline is urban residential development. At Bombo, the Highway is separated from the beach by the Main Southern Railway Line. This is the closest point of the Highway corridor to the coastline within the study area. Adjacent to both sides of the Highway the land is well developed with residential areas and houses fronting the Highway. In some sections there are grassed open space areas for recreation or proposed for subdivisions. On the western side of the Highway, below the hill at Bombo, there is an abandoned quarry and an operating quarry.

A viewer travelling along the Highway from the Minnamurra Bridge to Bombo experiences a variety of scenes. These include the Golf Course and tree-lined river, the densely vegetated cliff and mangroves, urban areas beyond Oxley Avenue, the quarry at Bombo, and Bombo Beach with the parallel road and railway line. The views are contrasting and add interest for the viewer. Photographs 5.1, 5.2, 5.3 and 5.4 show the contrasting sections of the road.

Distant views of the road corridor adjacent to the Minnamurra River are limited to a few isolated areas on local roads located to the west of

Kiama township. They are generally "dead end" roads used for access to houses on farms and hobby farms. Views of the road corridor tend to be obscured by existing vegetation and other developments.

The road corridor can be seen from houses located on the hill above the Golf Course in some locations. These views are interrupted by trees growing on the boundary of the Golf Course and roadside vegetation.

Houses located on top of the cliff (Samuels Lane) tend to have obscured views of the Highway corridor to the north and the south because of the vegetation that shields the road alignment and other houses. Few houses have views of the Highway directly below them due to the dense vegetation growing on the cliff.

Views of the Highway from Oxley Avenue to Bombo are limited to localised views from adjacent residences with the exception of the section past Bombo Beach. Residences on hills either end of the beach and on the lower inland areas west of the beach have direct and interrupted views of the Highway corridor.

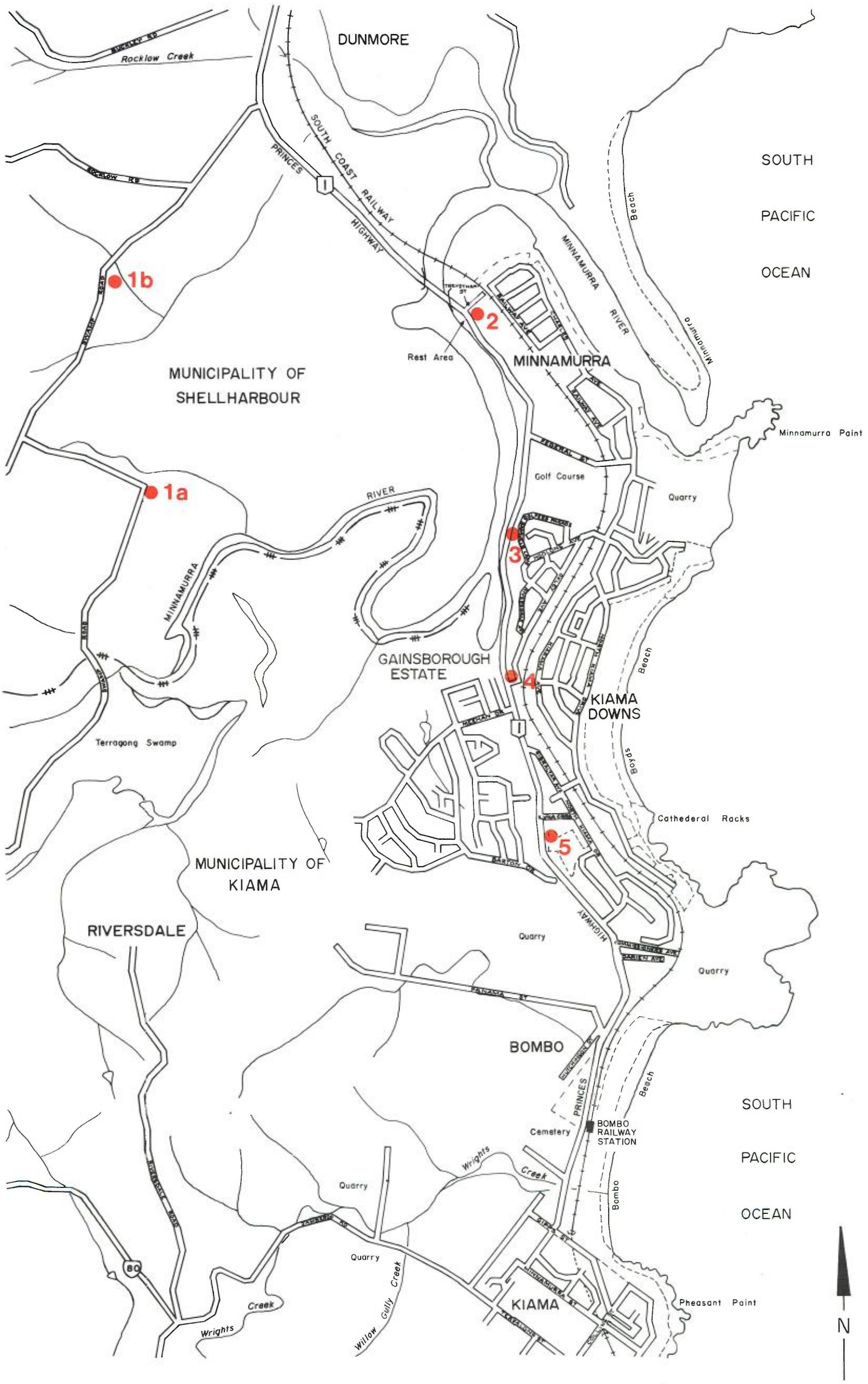
## 5.6 ATMOSPHERE

### 5.6.1 Noise

Noise levels at five locations along the proposed routes have been determined by a noise survey covering representative periods of the day and night. These measurements were made on the 21st and 22nd February 1985 and 1st March 1985. (The results are presented in Table E.1., Working Paper E).

The equipment and procedures used to collect the noise data were in compliance with standard noise measuring requirements. A summary is presented in Working Paper E. The location of the sites is shown in Figure 5.8 and a description of each site is presented in Table 5.7.

Noise levels at Sites 1a and 1b were affected by light traffic using the road and the noise of distant traffic on the Princes Highway as well as rural sounds. Measured $L_{A90}$ levels were in the range 35.3 to 42.0 dB(A), with the quietest period being late at night.




DEPARTMENT OF MAIN ROADS OF N.S.W.

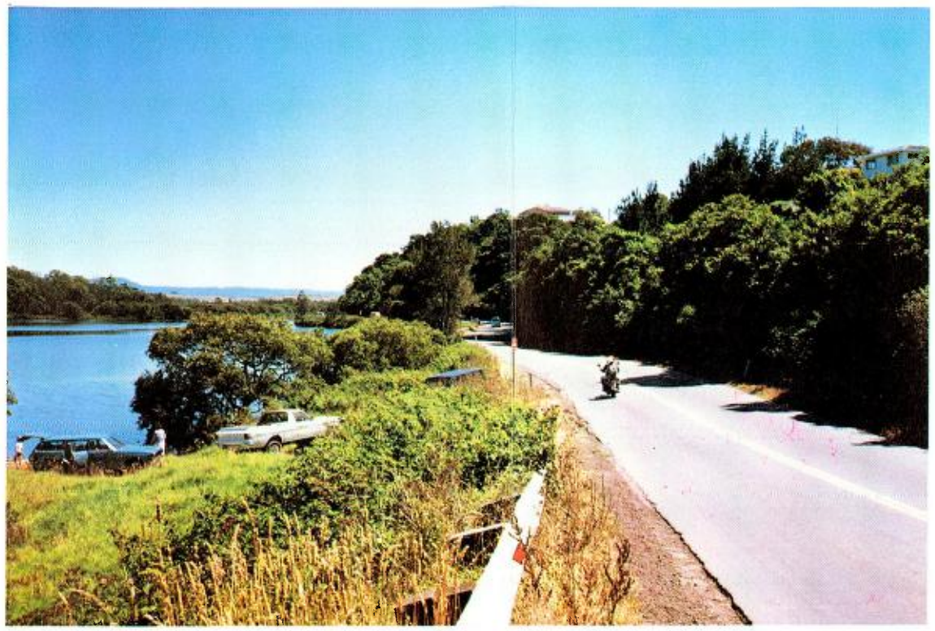
PRINCES HIGHWAY RECONSTRUCTION - MINNAMURRA RIVER TO BOMBO, KIAMA

**NOISE MONITORING LOCATIONS**

**FIGURE 5·8**

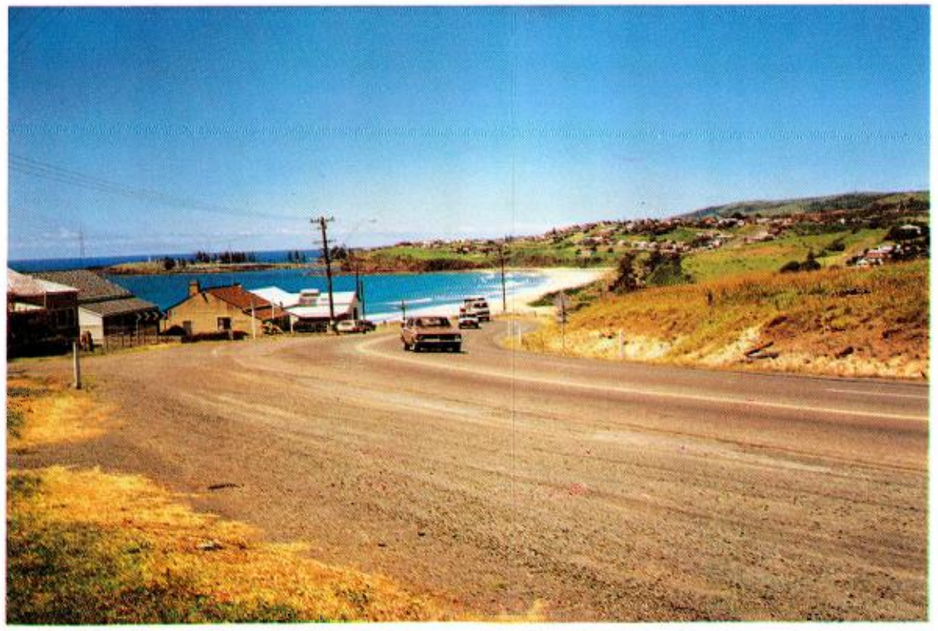
Dames & Moore : 13605-004-70

PHOTOGRAPH 5·1 : PRINCES HIGHWAY AND KIAMA GOLF COURSE - LOOKING SOUTH FROM GOLFERS PARADE.



PHOTOGRAPH 5·2 : PRINCES HIGHWAY - LOOKING NORTH FROM NEAR OXLEY AUENUE.

PHOTOGRAPH 5·3 : PRINCES HIGHWAY - LOOKING SOUTH NEAR OXLEY AVENUE.



PHOTOGRAPH 5·4 : PRINCES HIGHWAY, BOMBO BEACH AND KIAMA - LOOKING SOUTH NEAR COMMISSIONERS LANE.

TABLE 5.7

DESCRIPTION OF NOISE MONTIORING SITES
(Refer Figure 5.8)

| SITE | LOCATION |
|---|---|
| 1a | Seven metres from road on grass surface outside gate to farm house |
| 1b | Five metres from road on grass surface |
| 2 | Fifteen metres from Princes Highway on grass surface |
| 3 | Three metres from edge of quiet suburban street on high ground above the Princes Highway. Princes Highway is located at the base of cliff and is not visable from sampling point. |
| 4 | Fifteen metres from road on grass surface. |
| 5 | Fifteen metres from road on hard surface in open lot. |

Sites 2, 4 and 5 were located adjacent to the Princes Highway and traffic noise dominated the acoustical environments of these locations.When traffic flow was low (see for example Site 2 for the twenty- minute period commencing 2.48 am when there were 10 cars) noise levels were correspondingly low, $L_{A90}$ levels were as low as 31.3 dB(A). The highest $L_{A90}$ level was 56.5 dB(A) at Site 5 (approximately 15m from the road) for the 20-minutes commencing 8.06 am.

### 5.6.2 Air Quality

No measurements of air quality were made for this study. Adjacent to the Princes Highway exhaust odours were present and based on traffic flows it is clear that carbon monoxide, oxides of nitrogen and hydrocarbons and lead would be present. However experience in Australia suggests that air pollution from traffic only reaches problem levels on much busier roads and in areas where traffic flows are slow and street canyon effects are important.

# 6.0 DESCRIPTION OF PREFERRED ROUTE

## 6.1 ROUTE DESCRIPTION

The section of Princes Highway under study is north of Kiama and commences at the Bridge over the Minnamurra River at Minnamurra and travels 4.5 km to Bombo. The Highway passes through the northern suburbs of Kiama, which include Minnamurra and Kiama Downs. The Highway route is discussed in greater detail in Section 5.4.

The main features of the existing Highway are as follows:

- 2 lane road with unsealed shoulders:
- The Kiama Golf Course on the east, traversed by Federal Street:
- The Minnamurra River and backwater on the west;
- The densely vegetated cliff on the east including residential dwellings;
- Public oyster leases in the backwater:
- 8 local street intersections on the east (including Federal Street);
- 2 local street intersections on the west;
- Gainsborough Estate, a developing residential area:
- Residential dwellings on both sides of the Highway from Oxley Avenue to Bombo;
- Recreation areas;
- Abandoned and operating quarries at Bombo.

Some sections of the Highway have two-lane carriageways, widening to three-lanes in other sections. The alignment and line-of-sight in some sections is inadequate considering the present volume and type of traffic, and the terrain traversed. The proposed route alignment and widening is shown in Figure 6.1.

The proposed widening of the Highway from the Minnamurra Bridge to Oxley Avenue requires the duplication of the existing bridge over the Minnamurra River. The location for the new bridge is on the eastern side of the existing bridge.

The widening will encroach on the existing truck and car stopping area on the western side of the Highway and the intersection at Trevethan Street will require upgrading.

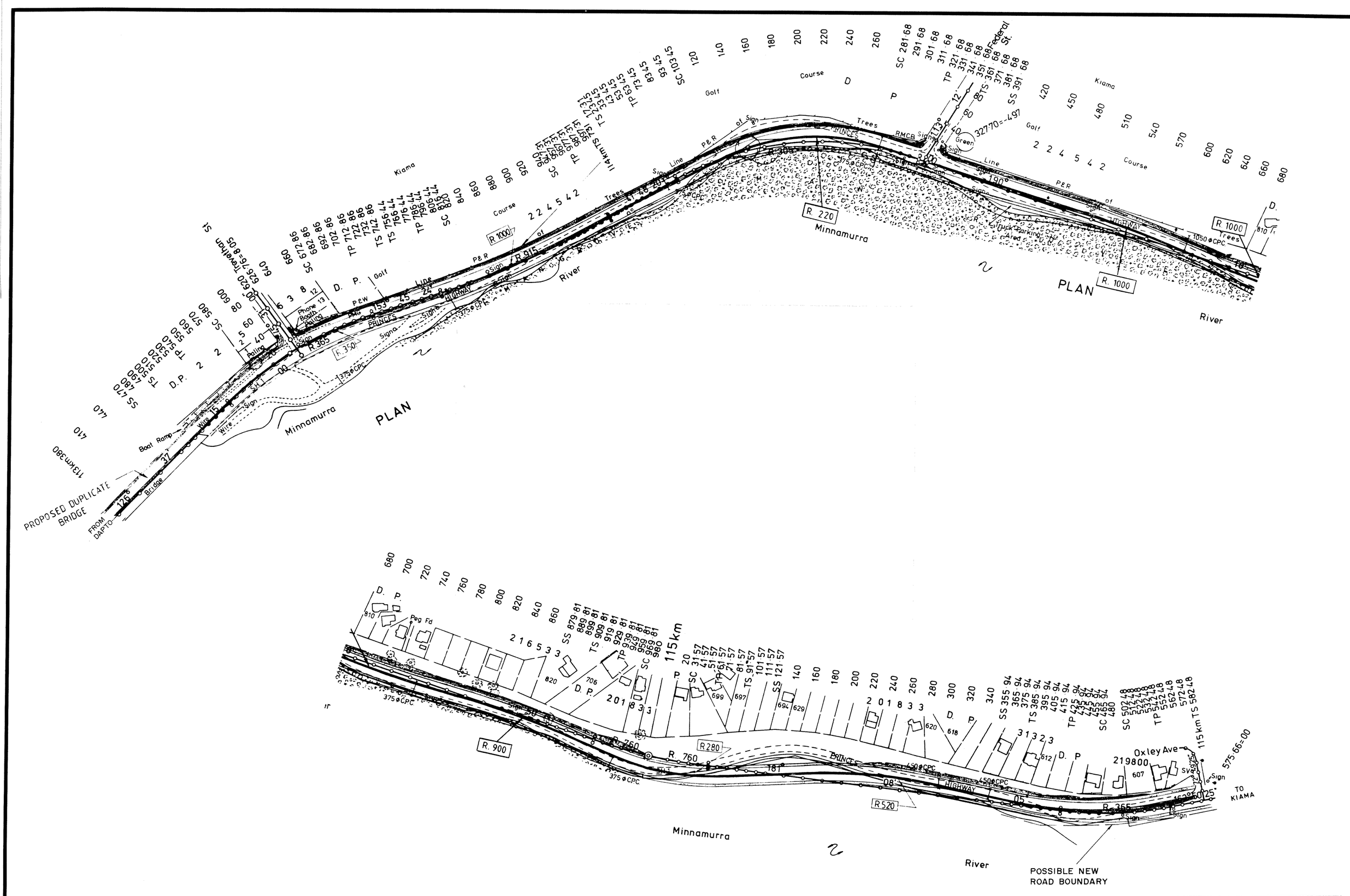
The Highway parallels the western boundary of the Kiama Golf Course for almost 1 km. To maintain the proposed alignment and widening a small portion (40 $m^2$) of the Golf Course must be acquired. This acquisition will not affect the Golf Course or the players' game. The area is indicated at 113 km 880 on Figure 6.1. The Federal Street intersection will be upgraded allowing turning movements in all directions.

Areas of earthworks required to accommodate the Highway widening commence approximately 60 m from the truck parking area on the western side of the Highway and extend the length of the Highway as it parallels the River.

Two major areas of fill are required. The first area is opposite the southern end of the Golf Course where the maximum fill width is 10 m from the edge of the river bank. The second area is the backwater of the river. The proposed filling has a width of 30 m into the backwater, for approximately 300 m. These areas are indicated on Figure 6.1 at 114 km 620 and 115 km 160 respectively.

The major areas of excavation are at 114 km 680, south of the Golf Course and 115 km 220, opposite the backwater. The basalt cliff, requiring excavation, is covered with dense vegetation which will require removal. Residential houses are located on top of the cliff line. The new road boundary will be moved approximately 18 m closer to the house-block boundaries on Samuels Lane near the Golf Course, and 6 m closer to house-block boundaries on Oxley Avenue, at the closest points. In some locations, the road boundary moves away from house block boundaries, for example, the area opposite the backwater.

From Oxley Avenue to Bombo, the Highway generally travels through residential areas with houses fronting the Highway. On the western side of the Highway new houses have been constructed and are under construction in the residential subdivision area called the Gainsborough Estate. The only access to the Estate, at present, is



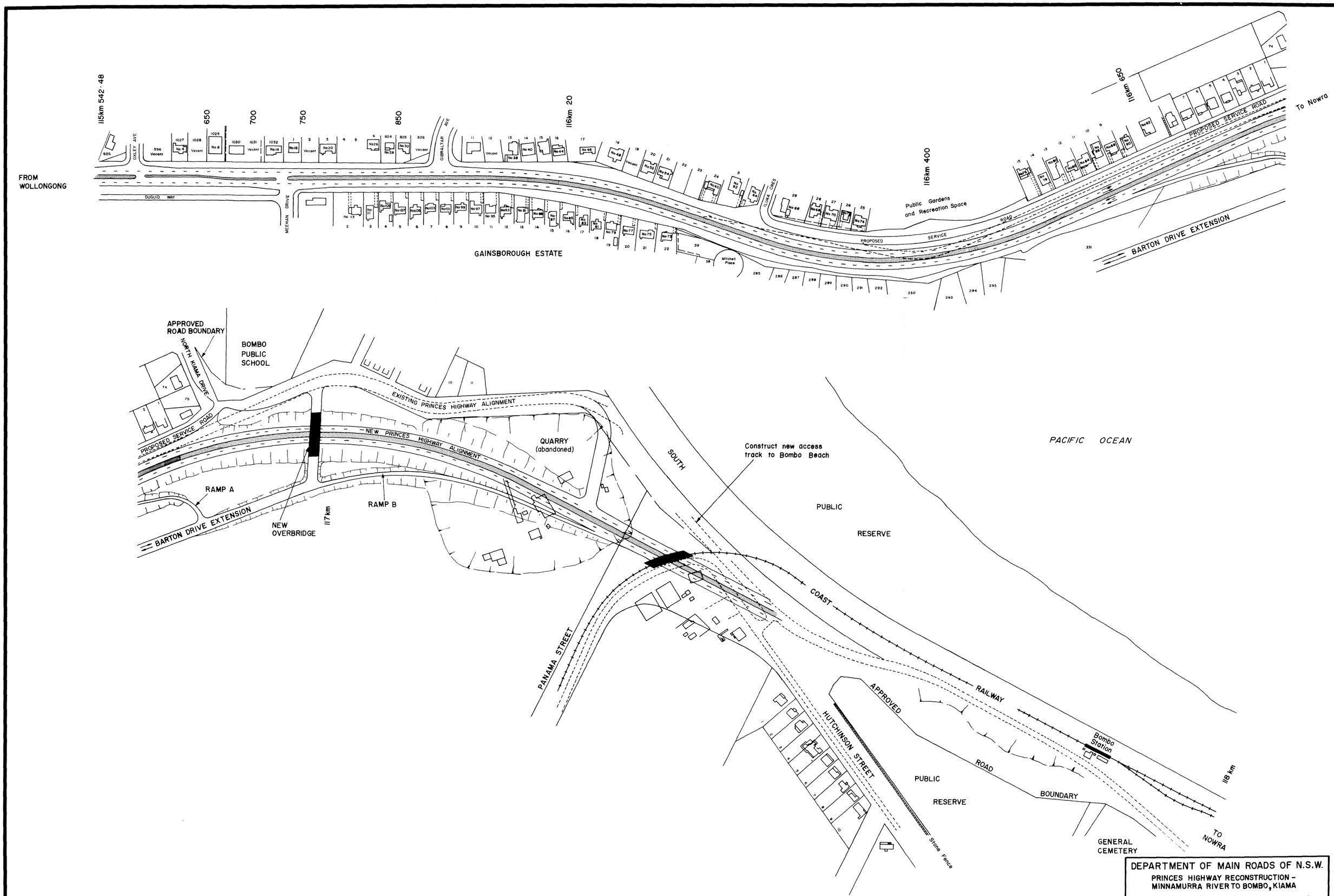

DEPARTMENT OF MAIN ROADS OF N.S.W.

PRINCES HIGHWAY RECONSTRUCTION - MINNAMURRA RIVER TO BOMBO, KIAMA

**PROPOSED HIGHWAY RECONSTRUCTION**

**FIGURE 6·1a**

Dames & Moore: 13605-004-70




DEPARTMENT OF MAIN ROADS OF N.S.W.

PRINCES HIGHWAY RECONSTRUCTION – MINNAMURRA RIVER TO BOMBO, KIAMA

# OXLEY AVE TO BOMBO

FIGURE 6·1b

Dames & Moore : 13605-004-70

from Meehan Drive. The intersection is approximately 200 m south of Oxley Avenue on the west.

The proposed widening of the Highway generally follows the existing alignment, allowing footways and wide median strips in areas where there are residences and pedestrians who may cross the Highway. Medians narrow in areas where intersections are designed to allow right hand turn bays.

Fill will be required along the strip of land adjacent to Dugid Way (a service road parallel to the Highway). Its intersection is on the northern side of Meehan Drive. The land required is currently zoned as open space - existing recreation. It will be replaced by fill which can be revegetated. From Meehan Drive to the Gibraltar Avenue intersection, the proposed reconstruction includes footways on both sides of the carriageway and a 4.6 m median. A break in the median is not proposed at Gibraltar Avenue. To allow for the new road alignment and widening, frontages of properties on the western side of the Highway from Meehan Drive almost to the Iluka Crescent intersection will require acquisition. They are Nos. 73 - 115 Princes Highway (Lots 1 to 22). The majority of the fibro cottages on these properties belong to Department of Housing (Housing Commission). This section will also require earthworks adjacent to Nos 73 - 97 Princes Highway (Lots 10 to 22).

On the eastern side of the Highway along this section, some cutting and replacement of the footpaths and driveways to houses will be required. This will affect Nos. 38-64 Princes Highway.

The intersection at Iluka Crescent will be redesigned, denying access to the Highway. A service road is proposed adjoining Iluka Crescent to allow access to houses that currently front the Highway. The service road will join Iluka Crescent and North Kiama Drive.

South of Iluka Crescent, minor acquisitions will be required from Nos. 72 and 74 Princes Highway (Lots 25 and 26) to accommodate the proposed footpath on the eastern side of the service road.

The proposed new road boundary on the western side of the Highway also intrudes into a narrow strip of public garden and recreation space adjacent to Gainsborough Estate and a property in the Gainsborough Estate. The area and the property will need to be acquired.

The Highway also traverses another area of public garden and recreational space of which a minor acquisition is required. This area is known as Iluka Reserve. The aquisition of the land is not expected to adversely affect the reserve area or its function. The area is required for fill to accommodate the proposed service road.

A crib wall will be required for approximately 50 m on the road boundary opposite an area of vacant land adjacent to the Iluka Reserve. A footpath is proposed for this section of Highway widening which includes an area of cut through for a proposed ramp. The ramp will join the Barton Drive extension (from Gainsborough Estate) to the Highway.

The proposed Barton Drive extension traverses land zoned 7(d) - Rural, Environmental Protection - Scenic and 4(c) - Light Industrial. The light industrial area includes a disused quarry.

The environmental protection area is cleared pasture land and extends west, its width varying from 200 m to 400 m. The zoning to the north of this area is residential and to the south - industrial.

The construction of the Barton Drive extension and its ramp onto the Highway will significantly change the land use of the area.

The Barton Drive extension is intersected to the south by the proposed overbridge. The overbridge will allow east-west access from residential areas on either side of the Highway and access to and from the Highway for residents of these areas. The Highway reconstruction requires excavation of the area and filling of the disused quarry to maintain the proposed alignment. A ramp joining the Highway and the Barton Drive extension for traffic travelling north is also proposed. The existing Highway alignment will be maintained on the eastern side of the new carriageway for access. Footpaths are planned for the overbridge and the Barton Drive extension. The required earthworks and

construction will significantly change the existing views from houses in this vicinity that front the Highway. However, landscaping and revegetation in the median that separates the proposed service road from the Highway will assist to obscure views of the Highway.

## 6.2 PROJECT DESCRIPTION

The proposal under consideration is widening the Princes Highway from the existing two lane road to four lanes. This includes improved alignment of some sections of the Highway for driver safety reasons. The widening also requires earthworks in the vicinity of the River, the cliff opposite the River, and the abandoned quarry north of Bombo.

### 6.2.1 Design Considerations

In developing the detailed design for the proposed widening of the Highway, consideration has been given to such factors as volume and type of traffic, terrain to be traversed, existing facilities, natural resources, effects on the physical and social environments, planning for the area and future needs, standards of adjoining sections of Highway, and estimated costs. Having regard to these basic aspects, design specifications were developed for determining the design speed, alignment, maximum grade, width and nature of the pavement and formation. A detailed geotechnical investigation was undertaken to confirm the technical feasibility of the proposed alignment considering both the rock cuts and embankments of the River.

To ensure traffic flow and minimum traffic conflict situations, a traffic management plan has been developed for long term traffic requirements.

Highway standard design will apply on the 4.5 km of new alignment between the Minnamurra River and Bombo.

### 6.2.2 Design Elements

Since the primary function of the Highway is to cater for long distance traffic, commuter and local traffic, it is being designed to be a safe yet high speed, four lane, dual carriageway, with shoulders for broken down vehicles, and control of access from intersections.

The reconstruction from Minnamurra River to Bombo will provide an improved alignment with dual 7.0 metre pavement, nominal 3.0 metre sealed shoulders. For safety reasons, the northbound and southbound traffic streams will be kept apart with a median strip.

An overbridge and interchange is proposed for the area on Bombo hill. This will involve two ramps, one to access the Highway for traffic travelling from the west to the north, the other from the Highway to the overbridge. The overbridge proposed is 46 m long.

**Median, Sealed Shoulders and Footways**

The upgraded road will contain median strips (1.8 to 4.6 metres wide) not only to segregate the traffic but also to provide safety for any pedestrians crossing the road. The medians will be wider in areas where pedestrians are known to cross the road and at intersections allowing right turn bays for south bound traffic. Narrower medians will ensure minimum acquisition of land and these will be reduced to the minimum of 1.8 metres beyond the influence of road junctions and where there are not likely to be any pedestrians.

A sealed shoulder will be provided for cars that breakdown, and where guard rails are warranted it will be necessary to place the face of the rail 0.3 m behind the future kerb line and provide 0.6 m from the face of the rail to the edge of the formation. For example, where the road follows the river, guard rails will be replaced. The purpose of guard rails is to protect the driver from going over embankments.

A footway will be provided from Minnamurra Bridge parallel to the Golf Course on the eastern side of the Highway. No allowance has been made from south of the Golf Course to Oxley Avenue. Footways will be provided on both sides of the Highway between Oxley Avenue and Iluka Crescent. South from Iluka Crescent, a footway is proposed adjacent to the service road on the eastern side only. A footway is also proposed for the overbridge and either side of the Barton Drive Extension which accesses the overbridge.

**Culverts and Drainage**

Where culverts exist, they will be replaced to suit the new road work. They will have a slight increase in capacity as a small increase in runoff is expected due to the widened road. The culverts and drains will be concrete and drains through cuttings concrete lined. Open table drains will be replaced by kerb and gutter including normal gully pits connected to stormwater pipes.

**Earthworks**

As shown on Figure 6.1, the proposed widening and realignment of the Highway will require cutting and filling of various lengths of roadway. The most significant areas are the cliff face on the east of the Highway, filling the Minnamurra River opposite the cliff on the west, and the changed road design on Bombo hill.

The following figures are considered close approximations for quantities of material that will be required for earthworks in the vicinity of the river.

Cut 37,500 $m^3$
Fill 34,700 $m^3$

Of the fill, approximately 10,300 cubic metres will be placed in the river below Mean High Water Level. The remaining 24,400 cubic metres will be above Mean High Water Level or on dry land, and used for road grading purposes.

From Oxley Avenue to Bombo the total earthworks is approximately 78,000 cubic metres. This is largely to fill the quarry area at Bombo to support the proposed new Highway alignment and access ramps.

The type of equipment likely to be used during the construction includes the following items: D10, D9, D8, and D6 bulldozers, 631 Scraper, tracked and wheeled truck loaders, hydraulic hammers, 15- and 16-tonne trucks, 8/9 and 15-tonne tippers, compressors and water carts. The equipment is used during the various road construction operations required to widen the road.

**Cut Design**

The proposed excavations of the basalt cliff rock will be cut vertically along the naturally occuring vertical joints in the rock.

For cuts in rock up to 4.0 m high, the cut will be designed as a single vertical batter. A bench will be incorporated between the toe of the slope and the pavement to catch any debris that may fall from the face during service. An intermediate bench will be incorporated in cuts higher than 4.0 m to catch any debris that may fall from the upper vertical batter. A typical cross section and longitudinal section through the cut, designed in this way, is shown on Figure 6.2. These incorporate benches 2.5 m wide. Inclusion of a bench of this width, in the manner illustrated, will allow periodic cleanup of the intermediate bench using mechanical equipment accessing the bench from road level.

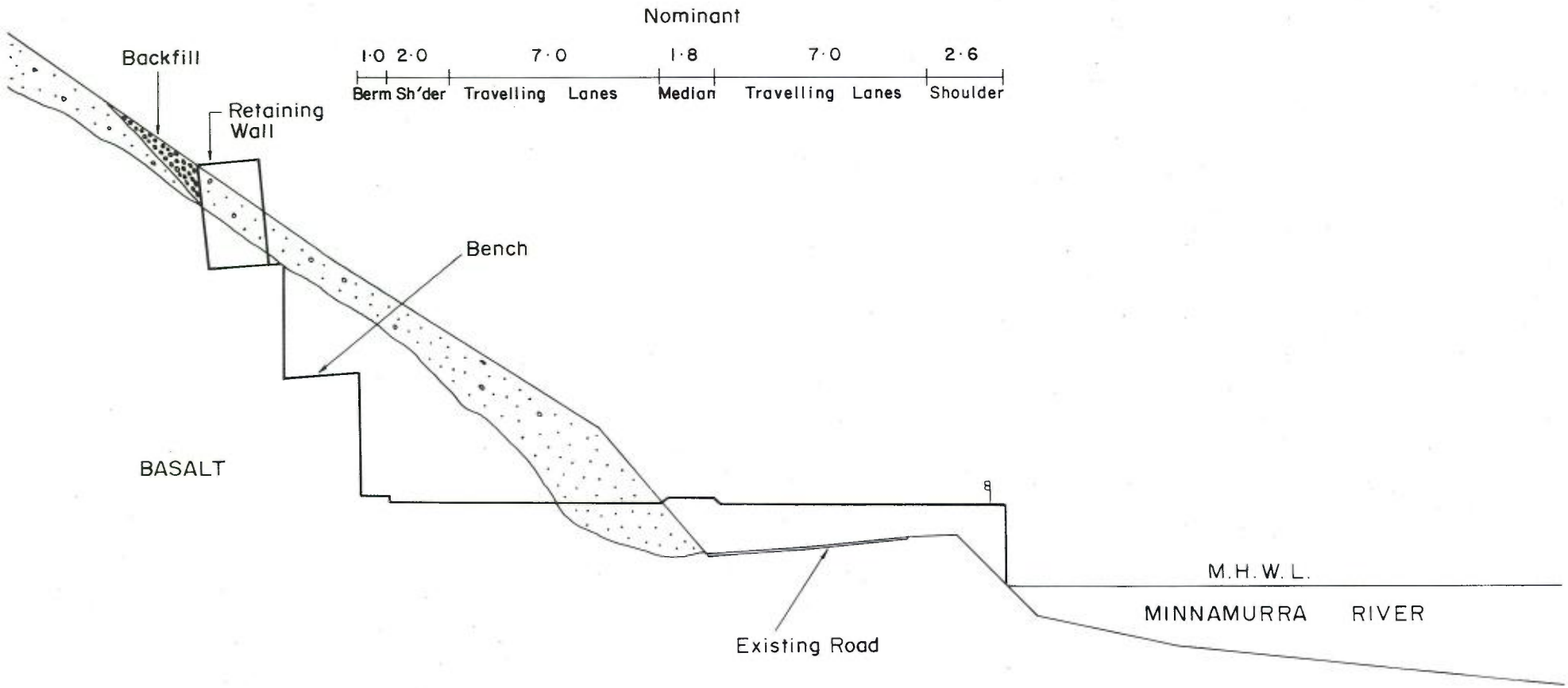
Provided excavation of the vertical batters is performed carefully, very little degradation and spalling of the cut surface is to be expected in the long term; maintenance and cleanup requirements for the slope will be minimal.

**Slopewash Support**

The thickness of slopewash overlying bedrock varies from about 0.0 m to 1.75 m and may be locally thicker, see Figure 6.3.

This material will be supported by a small gabion wall founded on rock at the top of the rock cut. This will retain the slopewash material, minimise disruption of the existing vegetation on the slope and allow effective revegetation of the backfill surface behind the wall.

In most circumstances, this wall will be no higher than 2.0 m. However, due to variations in the slopewash thickness and/or existing slope angles, this may locally increase. Gabions will be filled using basalt excavated from the rock cut. Backfill behind the wall will be placed loose to minimise the lateral earth pressures developed. Adequate drainage behind, and through, the wall will be provided to minimise the risk of water pressure build up. Depending on the backfill used, a filter fabric layer may be required behind the gabions




DEPARTMENT OF MAIN ROADS OF N.S.W

PRINCES HIGHWAY RECONSTRUCTION - MINNAMURRA RIVER TO BOMBO, KIAMA

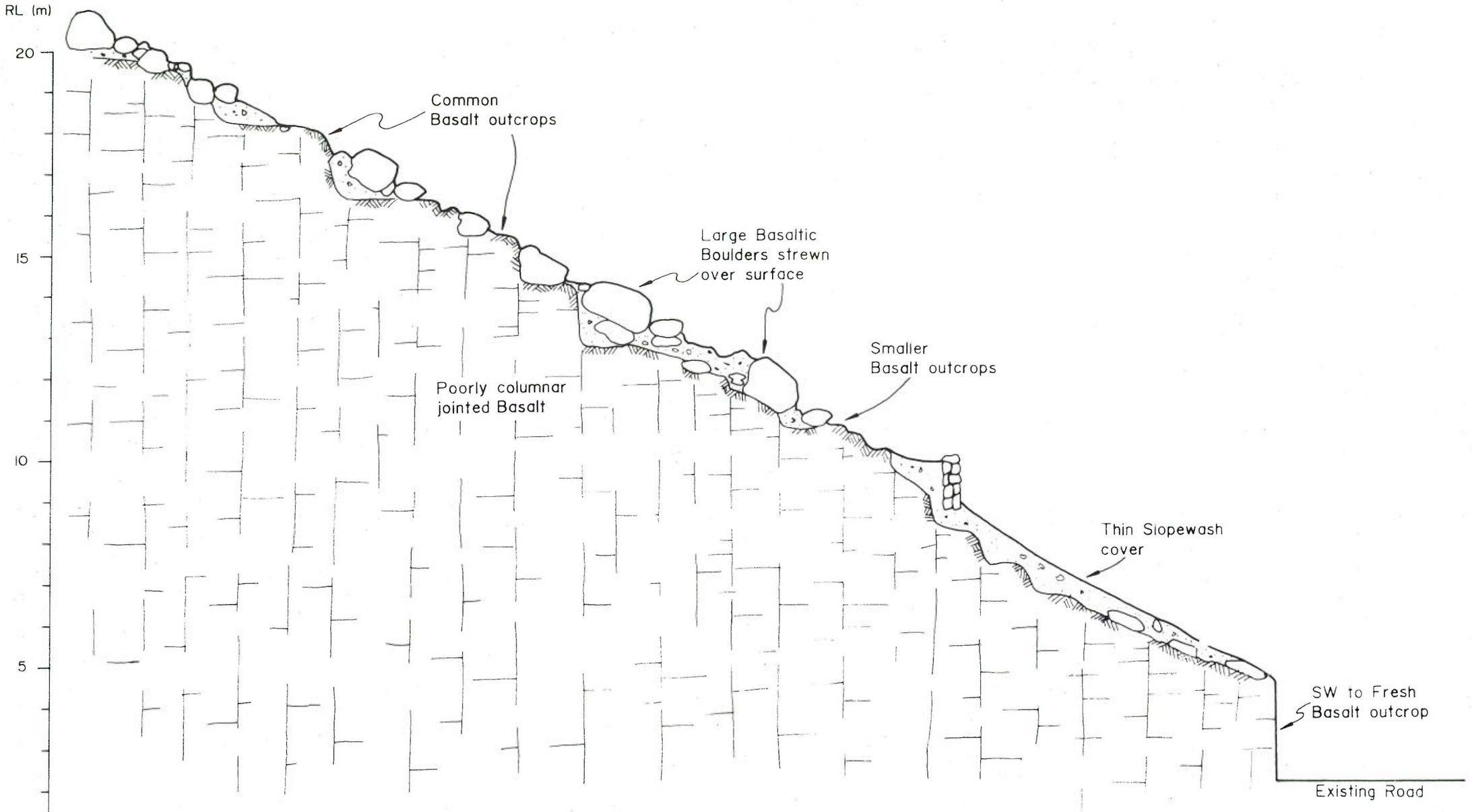
**LONGITUDINAL SECTION**

**FIGURE 6·2**

Dames & Moore : 13605-004-70

EAST

WEST

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DEPARTMENT OF MAIN ROADS OF N.S.W.

PRINCES HIGHWAY RECONSTRUCTION-
MINNAMURRA RIVER TO BOMBO, KIAMA

**SLOPEWASH SUPPORT – 115·018 km**

**FIGURE : 6·3**

Dames & Moore : 13605-004-70

to minimise the infiltration of fines from the backfill into the gabions themselves.

Many large boulders, up to 1.6 m across, occur at the ground surface around chainage 115.018 km and, less frequently, elsewhere. Most were towards the top of the slope and appeared stable.

**Excavation Methods**

Because of the jointed nature of the rock, a small percentage of the required rock excavation may be possible using heavy ripping equipment. However, this approach is not feasible for all the required rock excavation and so blasting will be required. Presplit blasting techniques will be employed and every effort will be made to minimise disturbance to the rock mass left forming the cut face. Further details of blasting are discussed in Section 7.0, and Working Paper E.

Given the jointed nature of the rock, only relatively light charges will be required to break the rock mass along pre-existing joints. If this is done, it is likely that the majority of the blocks produced will lie within the 0.15 to 1.00 $m^3$ range.

**Embankment Construction**

The proposed embankments will be constructed without any pretreatment or regrading of the river bed surface. A cross-section is shown on Figure 6.4.

A study has been carried out of the geometric and structural design of the vertical walls required to provide the proposed road alignment. The report of this study is included in Working Paper J. It includes an evaluation of the various wall types and examines in detail the preferred option, a reinforced earth wall.

The geotechnical investigation (Dames & Moore, 1984) disclosed that the river bottom along the western edge comprises clean, loose to medium dense sands and gravels overlying bedrock. The proposed embankment would not pose any stability problems for this foundation.

A reinforced earth wall would be composed of precast concrete facing panels and steel reinforcing strips placed in layers with backfilling. Select granular fill is used to obtain the necessary friction between the reinforcement and the fill. The durability of the wall in a marine environment is ensured by providing a corrosion allowance in the reinforcement.

Four sections of wall would be required along the proposed route, totalling 1,320 metres in length. Of this about 960 metres would have a toe level above or at Mean Water Level. Construction uses prefabricated components and is quick. Along those sections of wall, above or at Mean Water Level, construction would be programmed in the dry, such that panels would be erected, reinforcement fixed and part backfill placed around low water level. The rising tide can submerge the works without damage. Further backfilling at successive low tides raises the fill until the design level is reached.

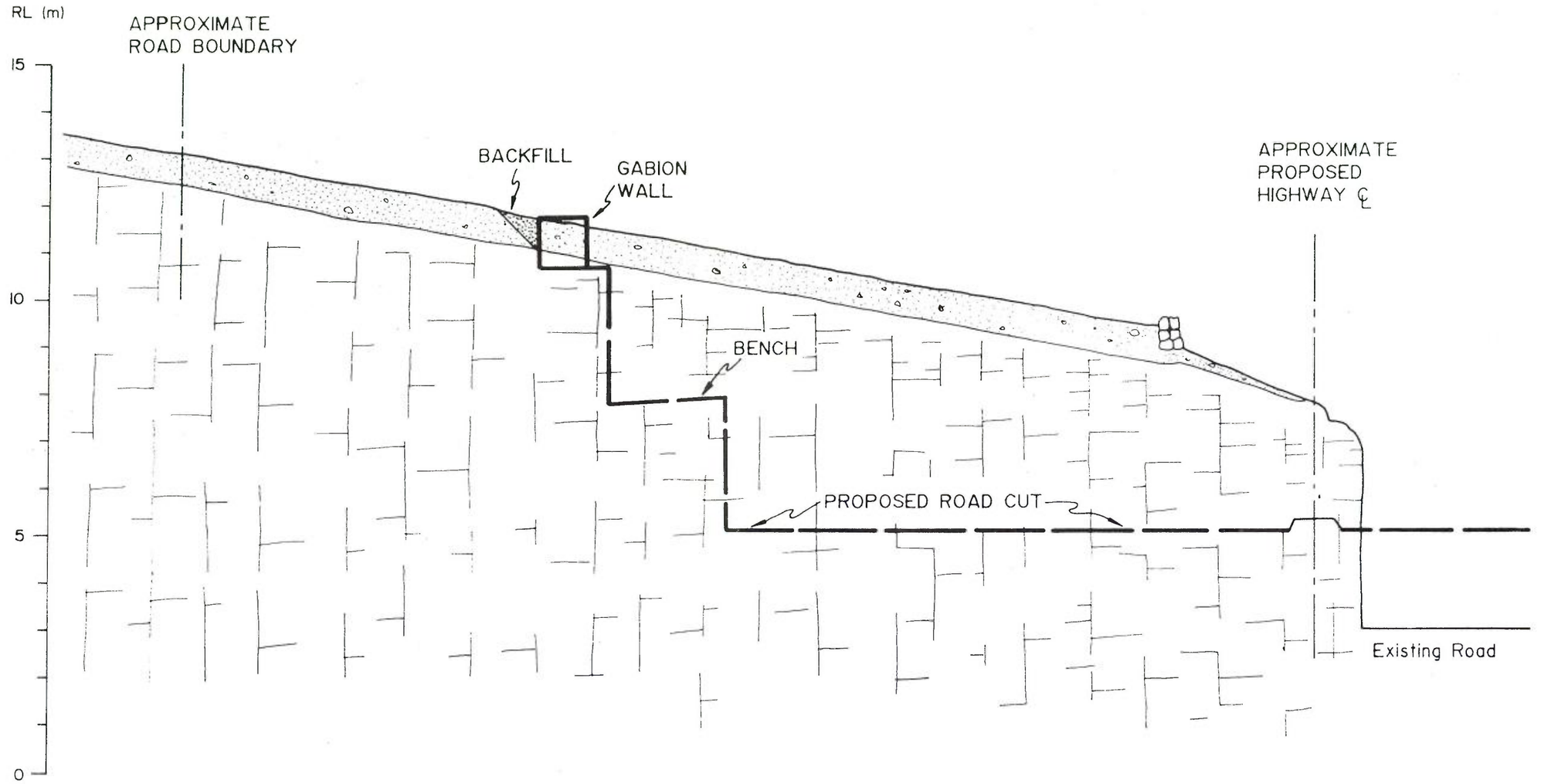
The remaining sections of wall totalling 360 metres would have a toe level below Mean Low Water Level. To enable construction in the wet, a layer of course aggregate would be placed along the line of panels and screeded level to provide a base. The panels are then erected and reinforcement and fill placed until the height is above water level. At that stage construction would proceed normally.

Along the section of the wall which intrudes into the backwater, a wall would be required on both sides of the road for a short distance. On the eastern side, this will comprise a fill batter rather than the reinforced wall.

**Source of Rockfill For Embankments**

The majority of the rockfill material required for the embankments, including armour, will be available from the rock cuts excavated on the eastern side of the road.

The fines fraction of the slopewash material is considered unsatisfactory for embankment construction and will be hauled to waste. All basalt to be excavated from the cuts is suitable material




SCALE 1:100 H & V

DEPARTMENT OF MAIN ROADS OF N.S.W.

PRINCES HIGHWAY RECONSTRUCTION -
MINNAMURRA RIVER TO BOMBO, KIAMA

**CROSS SECTION – 114·688 km**

**FIGURE : 6·4**

Dames & Moore : 13605-004-70

and may be used provided that the overall grading of the rockfill employed is satisfactory.

The grading of the rock likely to be produced from the cuts will be dependent on the blasting techniques employed. However, the majority of the blocks coming from the cut will be broadly rhombic in shape and will mostly range in volume from 0.15 to 1.0 $m^3$ - with an average block size of approximately 0.5 $m^3$. Occasional blocks in the range of 2.0 - 8.0 $m^3$ should also be expected.

Acceptable rockfill may be limited to a maximum block size of about 1.5 $m^3$ with the material used being broadly well graded below this upper limit. Thus, oversize blocks will be either broken up prior to use as rockfill or armour or hauled to waste. Additional sand and gravel-sized material may have to be imported to supplement deficiences in the grading of the rock coming from the cuts.

### 6.2.3 Staging

It is proposed to construct the 4.5 km length of dual carriageway highway from Minnamurra River bridge to Bombo in such a manner so as to minimise disruption to existing traffic flows. It is proposed that two lanes will always be maintained to allow the free flow of traffic, except for short periods. Construction methods will be tailored to suit the needs of the area as discussed above. One of the more complicated areas of the construction work is in the vicinity of the Minnamurra River.

A conceptual plan of construction in this section is to fill a portion of the river and move the road (and traffic) allowing room to excavate the cliff except for two sections, 114 km 900 to 115 km 30 and 114 km 670 to 114 km 800, where the cliff will be excavated first for fill ensuring that the existing road is not undermined. This would continue in a staged process commencing near Oxley Avenue and progressing north to the bridge. Work on the cliff area will be completed as quickly as possible. This section of the road is expected to be completed in under two years. The section from Oxley Avenue to Bombo is included in the DMR five year rolling programme (country) for commencement in 1986/87. Funds have been allocated over a three year plan with completion in 1988/89.

Hours of construction will be 7.30 am to 4.00 pm, Monday to Friday excluding public holidays. However this may vary to avoid peak traffic periods.

### 6.2.4 Landscaping and Treatment

Site clearing will be limited to the minimum necessary for access outside the area to be occupied by the earthworks, plus a small number of stockpile areas for topsoil and base materials. Any remaining timber and shrubs within the Highway reserve will be preserved.

The most densely vegetated area is the cliff face on the eastern side of the Highway opposite the river. It is anticipated that most vegetation will be removed to allow excavation and road construction.

On the western side of the road, the most predominant features are the mangrove stands and a large Morton Bay fig tree near the Federal Street intersection. Much of this vegetation will be removed. Further details are outlined in Section 7.0.

The trees lining the edge of the Kiama golf course will largely be preserved with the exception of a small area that is encroached upon from the road widening.

Construction requirements include provision for the works to be kept clean and tidy as they proceed, and to remove regularly from the site rubbish and surplus material arising from the execution of works. As soon as practicable after completion of the works, all buildings, workshops, temporary works, construction plan and equipment used on the site will be removed.

Landscape work will be one of restoration by encouraging regeneration of indigenous species. This will be particularly rigorous in the area of the excavated cliff where areas for replanting will be limited, and at other bare surfaces. Areas where earthworks have been undertaken will be grassed and revegetated as quickly as possible to minimise soil erosion and interruption to visual and scenic quality for the road construction. Further details are outlined in Section 7.0.

### 6.2.5 Crossings and Traffic Management

Ten intersections will require redesigning to cater for the new traffic patterns in conjunction with the proposed traffic management scheme. These intersections are Trevethan Street, Federal Street, Oxley Avenue, Meehan Drive, Gibraltar Avenue, Iluka Crescent, North Kiama Drive, Commissioners Avenue, Darion Avenue and Panorama Street. Figure 6.5 shows the locations and designs of the proposed new intersections.

At Trevethan Street, no restriction will be placed on traffic movements. Both left and right turns will be available. Traffic turning right will be able to shelter in a right hand turn bay when travelling from south to east.

At Federal Street there will be no restrictions. All traffic movements will be available. The sea gull island treatment has been designed to suit semi-trailer traffic. This allows shelter on right hand turn from the south and right hand turn to the north. Traffic on the Highway need not be synchronized for drivers leaving Federal Street. It is intended to be a collector road for the residential area.

At Oxley Avenue a sheltered right hand turn bay will be available for traffic travelling from south to east. The right turn out of Oxley Avenue to the north will be denied. The denial is part of the traffic management proposal.

Meehan Drive, from Gainsborough Estate, will allow right turns for traffic travelling from the north including a right hand turn bay. Right hand turns to the south will be denied.

The intersection at Gibraltar Avenue will be restricted to left turns only for traffic travelling south and no median break is proposed.

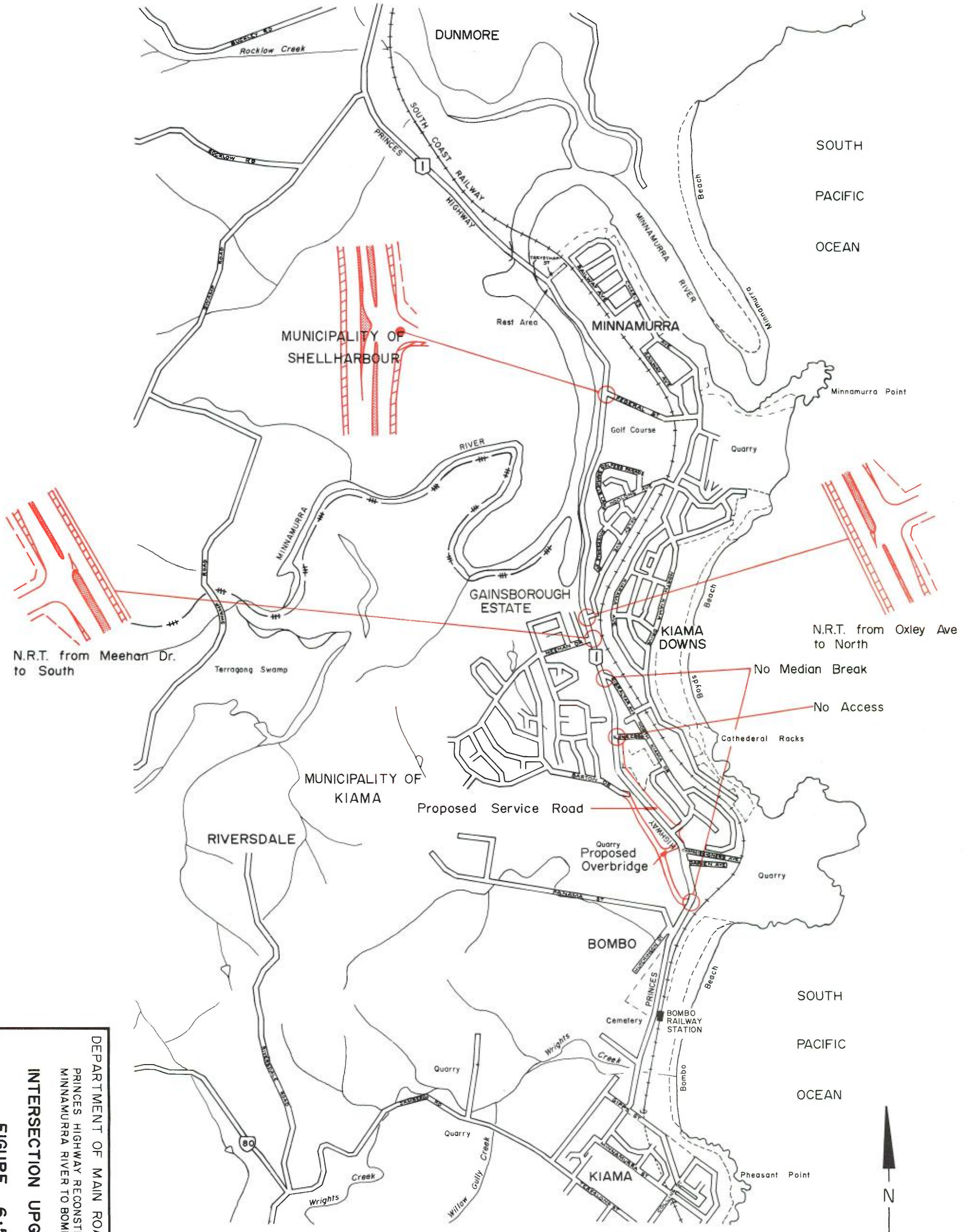
Access to the Highway from Iluka Crescent will be denied. It is proposed that a service road connect Iluka Crescent and the North Kiama Drive intersection on the eastern side of the Highway allowing access to dwellings that currently front the Highway.

North Kiama Drive will be extended and access to the Highway relocated further south to adjoin the new Highway alignment. The existing Highway alignment is part of the North Kiama Drive extension. Right hand turns at this intersection will be denied. A bridge over the Highway is proposed to connect North Kiama Drive and the proposed extension of Barton Drive. Barton Drive is an existing road in the Gainsborough Estate residential area that is proposed as access to the Highway.

The Barton Drive extension will accommodate left hand turns onto the Highway for traffic travelling north, and a ramp up to the proposed new bridge for traffic travelling from the south. The overbridge and associated ramps will allow traffic movement to either the east or the west of the Highway.

The proposed traffic management plan allows for traffic flow in an east-west direction as well as the predominant north-south movement which currently exists. The proposed plan reduces the number of conflict points that occur at existing intersections.

There is no proposal to install traffic signals at any intersections. Congestion problems only occur on a limited number of days per year, mostly during school holiday periods and long weekends. Traffic lights would restrict traffic flow under normal conditions and would be a potential hazard to fast moving traffic.




DEPARTMENT OF MAIN ROADS OF N.S.W.

PRINCES HIGHWAY RECONSTRUCTION - MINNAMURRA RIVER TO BOMBO, KIAMA

**INTERSECTION UPGRADING**

**FIGURE 6·5**

Dames & Moore : 13605-004-70

# 7.0 POTENTIAL ENVIRONMENTAL IMPACTS AND PROPOSED SAFEGUARDS

The potential environmental impacts of the proposed Highway reconstruction are assessed in this section. The major areas of impact are the terrestrial, aquatic, social, transportation and atmospheric environments. There will be no impact on the historical and archaeological aspects of the environment.

## 7.1 TERRESTRIAL

### 7.1.1 Landform and Soils

The existing Princes Highway corridor has already modified the terrain and landscape. The proposed earthworks will result in changes to the cliff and the river along the section of road parallel to the Minnamurra River.

The other area of significant landform modification is at Bombo where the abandoned quarry will be filled and part of the hill excavated to accommodate the proposed overbridge and realignment of the Highway.

Some other small areas of excavations and filling will be required to accommodate the Highway widening and realignment. However these areas will not create a significant impact.

The Highway widening will affect a small area of the Kiama Golf Course. The soil on the Golf Course is prone to wind erosion. Erosion maps of the general area show no appreciable erosion but there are minor areas of sheet erosion around Bombo. A rockfall has also occurred near the quarry.

In general the favourable climatic conditions allow vegetative methods to be used as an effective control for most forms of surface soil erosion. (See Section 6.2.5 on restoration and landscaping.)

The advice of the Soil Conservation Service will be sought at the time of construction to ensure that restoration techniques are employed which are effective in minimising and controlling erosion. Few areas are recognised as worthy of special attention.

### 7.1.2 Land Use

The Highway widening and realignment will effect narrow sections of properties adjacent to the Highway. These affects have been minimised by ensuring that the proposed corridor falls largely within the Arterial Road zoning defined in the Kiama Municipality LEP No. 5.

The areas that will be encroached upon include a $40m^2$ area of the Golf Course, a narrow strip of zoned open space area on the western side of Duguid Way, the frontages of properties 73-115, 38-64, and 72-74 Princes Highway, and the Iluka Reserve. The encroachment of the Highway in these areas is not expected to significantly affect the use of these properties. While some acquisition of land will be required, driveways and access points will be reconstructed to ensure minimal disturbance to residents.

The proposed widening will involve excavation of the basalt cliff opposite the Minnamurra River with the road boundary moving approximately 18 m closer to house block boundaries on Samuels Lane. This will not involve any curtailing of the existing residential use.

The proposed Barton Drive extension traverses land zoned scenic environmental protection and light industrial land. At present the land involved is not actively utilised. It will need to be rezoned for road purposes.

### 7.1.3 Vegetation

**Impact on Estuary and Saltmarshes**

Direct impacts of constructing a second bridge over the Minnamurra River will be minimal. On the northern shore, the approach carries vegetation which may largely owe its limited extent and composition to the construction of the existing bridge as well as past clearing. On the southern shore, the alignment is cleared and there should be minimal spillover of embankment into the small wetland area between the existing road bridge and the railway bridge. By ensuring that embankments do not extend beyond the current river bank, hydrological changes

which might result in changed patterns of inundation and subsequent alteration in the composition of saltmarsh should be minimal.

Embankment into the river is discussed in Section 7.2.

**Impact on Terrestrial Vegetation**

The regrowth on the existing road's western verge would be partially lost. The fig and other rainforest species scrubs on the eastern cliff face would be completely lost. Existing housing blocks may eventually be cleared to their boundaries, leaving little, if any vegetation between the road and house-block boundaries.

Revegetation of the cliff face is proposed where possible. The gabion wall and stepped vertical rock-face will allow re-establishment of shrubs and trees. However, the density of vegetation is not expected to be similar to the existing growth, because of the proposed stepped vertical rock face and installation of gabion walls reducing the total area available for plant restoration.

## 7.2 AQUATIC ENVIRONMENT

The proposed reconstruction and widening of SH1 could have a number of detrimental impacts, if the proposal were to result in a deterioration in water quality or changes to the existing erosion/sedimentation patterns. The selection of Scheme E as the preferred route causes significantly less encroachment into the river mangroves than Scheme A.

**Water Quality**

Water quality in the Minnamurra estuary is good, as would be expected of an uncontaminated estuary. At times of low river flow the water is well mixed to the upstream boundary of the study area, although a weakly developed freshwater layer can appear during the outflowing tide.

Sediments on the channel bottom and exposed flats are predominantly sands. Muddy sands occur in seagrass beds, and muds within the

mangroves and the sheltered areas. Because of the generally sandy sediments, the effects of the proposed Highway reconstruction on water quality will be limited to an increase in turbidity during the construction phase. Turbidity in the Minnamurra estuary is naturally quite variable, with high turbidity levels occurring during flood flow and strong tidal currents. These turbidity increases are significant only for their potential to impact biota.

The river bottom along the western edge of the proposed road comprises relatively clean, loose to medium dense sands and gravels overlying bedrock.

The proposed construction of the river embankment, utilizing a vertical reinforced earth wall as described in Working Paper J, will result in minimum disturbance to the river bottom. The wall will be erected over about 960 metres (73% of the total length of Highway adjacent to the River) in the dry as the toe will be above Mean Water Level. Consequently there will be little disturbance to the river sediments.

Along the remaining 360 metres where the toe is below Mean Water Level, a layer of coarse aggregate will be placed along the line of the reinforced earth panels and screeded level to form a base. Deposition of this material will cause some disturbance to silt and sediment, but once laid in position, the remainder of the construction activities will not cause disturbance to the river bed. The nature of the river deposits are such that they will settle soon after disturbance.

The use of a reinforced earth wall was selected from five alternative wall structures, as the best to minimise disturbance to the river channel.

**Hydrology**

Currents within the studied section result from tidal action, with the contribution from river flow being insignificant except when in flood.

The range of current velocities observed during spring tide were 0-25 cm/sec on the flood tide and 0-22 cm/sec on the ebb tide. These are relatively low velocities.

Computer modelling of the Minnamurra estuary (detailed in Working Paper D) showed that current velocities in periods of low river flow would increase by about 10% as a result of the Scheme A reconstruction of SH1. It is expected to be lower with the construction of Scheme E. Under maximum flood flow, using data for an estimated 20 year flood, combined with an ebbing spring tide, maximum current velocities would increase from approximately 150 cm/sec to approximately 170 cm/sec. This would have resulted in some additional erosion and sediment transport but is unlikely to significantly change existing overall sediment transport patterns.

Flood levels would also be raised upstream of the development with maximum increases in flood levels being around 4 cm. These increases in peak flood velocities and levels were considered to be a significant impact, and a variety of options were considered to reduce or eliminate this impact. The effects of Scheme E, involving the use of vertical walls from the roadway into the river (instead of 1:1.5 batter) were tested using the computer model. The model predicted that current velocities and flood heights would be mid-way between those determined for the 1:1.5 batter and the undeveloped case. However further modelling predicted that in the worst possible scenario, flood levels and current speeds would be relatively similar to the 1:1.5 batter case for flood events in the order of one in 20 years return interval.

It should be noted that significant changes have taken place over time to the alignment of the Minnamurra River channel. Stabilization works have been carried out on the sand spit to the east of the Bridge. Rapid erosion is currently taking place of the river bank adjacent to the bend just upstream of the proposed filling. The intrusion of the proposed roadway has been minimised by the adoption of a vertical reinforced earth wall instead of an embankment into the river. Road reconstruction is not expected to significantly affect these processes but no long term monitoring of changes has been undertaken.

**Aquatic Biology**

Some organisms will be destroyed or removed during the construction phase. The aquatic organisms of the Minnamurra estuary could also be

affected by increased turbidity or by changes to erosion/sedimentation patterns during peak flood flow.

An embankment or vertical reinforced earth wall into the river is proposed for most of the road alignment south of 113 km 800 m. This will directly remove approximately 5% (approximately 0.13 ha) of the main stand of mangrove, and part of the scattered mangrove stands south of 114 km 800 m. The effects of silting on the mangroves depends on the extent of silting. Minor and short duration silting may have no discernible impact whereas silting which results in infilling or raising the ground level by more than a few centimetres is likely to result in mangrove death in affected areas.

Mangroves, and in particular Avicennia marina, which forms a dense collection of pneumatophores (aerial roots), are quite resistant to erosion. Where accretion occurs mangroves will be quick to recolonise, depending on tidal range. If conditions are suitable, seagrasses may colonise accreted areas. The seagrasses are reasonably resistant to erosive forces (particularly those generated by tidal currents) as long as they remain in a healthy condition. A combination of increased siltation and erosion pressure would be highly detrimental.

The design of the reinforced earth wall and the construction method proposed will ensure that silt and sediment movement during construction is minimised. This will not affect other sections of the mangrove stands. Long term effects due to changes in the stream flow patterns will be gradual and will not have a significant effect on the existing stands. They may however affect a recolonisation of disturbed areas.

Construction of the Highway is not expected to significantly alter the existing hydrological or sediment transport patterns, and therefore no signficant impacts on the wetland communities are anticipated except for those stands directly affected by construction. It should be recognised, however, that estuaries are dynamic, and that the distribution of wetlands changes naturally over time, as the morphology of the estuary changes.

Increased flood flow during extreme events (i.e. 1 in 20 year or greater floods) is expected to cause slightly increased erosion, and

would probably remove additional seagrass. Because of the long interval between such floods, the normal cycle of seagrass growth is expected to be resumed after a recovery period.

Increased turbidity has the following effects on the major groups of organisms present:

- Oysters - increased silt loads result in a gradual decline of oyster condition and may cause death.

- Fish - silt has numerous effects on fish of which gill clogging and disruption of migratory behaviour are considered to be important;

- Seagrasses - large quantities of silt smother seagrasses and reduce photosynthetic efficiency by settling on the leaves.

These organisms are adapted to continually changing turbidity levels. As the levels of turbidity generated during construction will be minimised due to the adoption of a reinforced earth wall, no adverse impacts are anticipated.

## 7.3 SOCIAL

### 7.3.1 Community Impacts

Although the existing Highway is perceived by the local community as a barrier separating the suburbs on the east and west of the Highway, it is expected that with the implementation of the proposed traffic management scheme, the barrier effect will be reduced. Access to and from the Highway will be safer, easier, and traffic flow interruptions along the Highway will be reduced. Widening of the Highway will not significantly affect traffic flow from east-west as an overbridge is proposed near Bombo to remove crossing traffic from the Highway. Impacts of construction are discussed in Section 7.4.

Access will be maintained to all houses fronting the Highway and wide median strips provided in areas where pedestrians may cross the carriageway.

### 7.3.2 Tourism and Recreation

The boat launching ramp on the eastern side of the Minnamurra Bridge will be relocated to maintain access to the river at that location. The access ramp adjacent to the public oyster lease will be demolished and not replaced, however pedestrian access will be maintained.

Encroachment of the Highway onto the Golf Course will not be significant and will not affect its use. The DMR would undertake any necessary adjustments to the boundary fence affected by the development. Increases of traffic along Federal Street (which traverses the Golf Course) are not expected to be such as to increase the disruption to use of the Golf Course.

Land acquired from Reserves adjacent to the Highway will not affect their present use.

## 7.4 TRANSPORT

The duplication of the Princes Highway between the Minnamurra River and Bombo will have a number of transport impacts in both the short and long term.

The major short term impacts will result from traffic disruption created during the construction phase. The nature of the existing corridor and the proposed road development will result in disruptions as existing Highway lanes are temporarily removed from service.

Discussions with DMR representatives indicate that the complete removal of sections of the Highway from service will be minimal. The construction programme will be developed to ensure that new lanes are constructed before existing lanes are removed from service. Some periods of road closure can be anticipated such as when blasting is occurring. However closures will be planned for times when traffic demand is low. Both daily peaks and holiday peak times will be avoided. The timing and duration of such closures will influence the level of short term impact.

The upgrading of the Princes Highway and the associated traffic management programme will affect existing road facilities and traffic patterns in the North Kiama area. As stated in Section 2.0, substantial residential development in the northern areas of Kiama has led to an increase in local traffic as a result of commuter traffic between Wollongong and interaction with various facilities in Kiama including the town centre. The duplication of the Highway will provide adequate road facilities to accommodate the existing and projected traffic needs.

The growth in traffic volumes on the Princes Highway could increase vehicle conflicts at the intersection of residential streets with the Highway. The proposed Highway design and traffic management programme, which has been developed as part of the overall project, will improve the traffic flow along the Highway as well as access in the residential areas adjacent to the Highway in the long term.

Northbound traffic from the Minnamurra and Kiama Downs areas will have access to the Highway via Federal Street and the proposed northbound merge lane associated with the overpass at North Kiama Drive (see Figure 6.1, Section 6). The removal of right turns on to the Highway from Oxley Avenue and Gibraltar Avenue will concentrate northbound and morning commuter traffic from these residential areas onto Federal Street and North Kiama Drive. Provision of an overpass and northbound merging lane will improve traffic conditions at the North Kiama Drive intersection. Slight increases in traffic will occur along Federal Street by the prevention of right turns out of Oxley Avenue. Intersection surveys at Oxley Avenue identified this movement to be very low (refer Table 5.4.2) and the additional traffic on Federal Street will not significantly affect existing traffic conditions. The volume of right turn traffic out of Gibraltar Avenue is higher and consequently the removal of this movement will force slightly more traffic onto either North Kiama Drive or Federal Street. However, the existing street network indicates that the majority of this traffic would be redirected along North Kiama Drive to the overpass and northbound merging lane.

The removal of the right turn out of Meehan Drive onto the Highway will alter traffic patterns within the Gainsborough Estate. Barton Drive

will become the main route for traffic from Gainsborough Estate to the Kiama town centre altering its present function from local access to a distributor route catering for Gainsborough traffic.

Although original subdivision plans did indicate Barton Drive as a second access road for the Estate, and the carriageway is capable of catering for the proposed increase in traffic, the potential traffic conditions may differ from those originally perceived by residents, especially along the affected road. Based on surveyed traffic movements of the intersection of Meehan Drive and the Princes Highway and potential traffic generated by the Estate when it is fully developed, traffic in the vicinity of 3,700 vehicles a day could be expected to use some section of Barton Drive to gain access to and from the Highway.

Traffic patterns within the Gainsborough Estate will also be altered by the continued development of the area. The volumes of traffic generated by the Estate will depend on facilities developed locally and the population characteristics of the residents. Provision of shopping facilities within the Estate would reduce the demand for trips to the Kiama business centre and consequently the volume of traffic that would use Barton Drive for access to the Highway and the town centre. Continued growth in the working age group will ensure growth in commuter traffic to Wollongong and would increase pressure on Meehan Drive if it remained the only access point. The establishment of a second access point at Barton Drive will provide a more even traffic distribution during peak periods as commuters residing in southern areas of the Estate use this route. However, due to the existing uncertainties of traffic patterns associated with the Gainsborough Estate, ongoing traffic monitoring programmes are seen as important to ensure the proper implementation of the traffic management programme.

Although the proposed upgrading of the Princes Highway will provide a carriageway capable of accommodating higher volumes of traffic, works associated with this upgrading, such as intersection improvements and the overpass at North Kiama Drive, will improve traffic conditions and reduce the number of conflict points between through traffic and local traffic. This will be achieved as a result of turning and merging

lanes at intersections as well by the realignment of the existing Highway through both the Minnamurra Bends and Bombo Hill sections.

Problems already exist along Federal Street and at the railway underpass. The proposal will not improve this situation. Problems on Federal Street are seen as being the result of a conflict of uses with the road and the Golf Course, an inadequate road facility under the railway line, and local traffic demand from residents in the Minnamurra area.

The overpass adjacent to North Kiama Drive will provide a link between residential areas either side of the Highway for both vehicular and pedestrian traffic. There is some pedestrian movement between the communities, fronting onto either side of the Highway. This movement across the Highway will need to cross additional lanes and volumes of traffic. Pedestrian movement will, however, be assisted by the provision of a median strip which will provide a safe area during the crossing. Pedestrians will only need to watch for traffic from one direction during each stage of the crossing.

## 7.5 VISUAL ENVIRONMENT

### 7.5.1 Viewshed

An interpretation of maps and field study was used to delineate a viewshed of the proposed route. The results were used to identify locations from which the existing Highway can be seen, and views experienced by road users.

Locations identified where the Highway can be seen are as follows:

- The Minnamurra River users;
- Trevethan Street/Highway intersection;
- Charles Avenue, adjacent to the railway and overlooking the golf course;
- Golfers Parade, overlooking the golf course;
- Samuels Lane and Hoolong Avenue, adjacent to the Highway;
- Oxley Avenue/Highway intersection;

- Duguid Way, Gainsborough Estate;
- Residences fronting the Highway from Oxley Avenue to Bombo;
- Residences located along Riversdale Road and west of Bombo can see the sections of the Highway from a distance;
- Residences located south of Bombo Beach;
- Residences at the intersection of North Kiama Drive.

Views from some of these locations are often indirect and interrupted by existing vegetation, other constructions and houses. Road users impressions gained of the area are largely dependent on the speed of traffic flow.

### 7.5.2 Visual Assessment

The scenic quality of the existing landscape of the road corridor will change as a result of reconstruction of SH1. From Minnamurra Bridge, the general visual impression gained at present is of a tree-lined roadway described by local residents as a "gateway" to Kiama. The most predominant visual features are the densely vegetated cliff and the mangroves lining the river with a background of river views.

The Minnamurra River provides an aesthetically attractive surrounding to this section of Highway. The somewhat hazardous nature of the road restricts the opportunity for enjoying these views while driving. Truck stopping areas are used for viewing the river. However, only the area closest to the Minnamurra Bridge provides an unrestricted view of the river as mangroves obscure views at other locations.

The visual impact of the reconstructed Highway in many locations will be insignificant. From locations such as Trevethan Street, Charles Avenue and Golfers Parade the reconstruction will upgrade the Highway and intersections, resulting in a more structured road corridor.

The major visual impact of the road widening from the Bridge to Oxley Avenue will be the loss of the vegetation along the roadway, resulting from the excavation of the cliff and filling of the river. This will be noticeable to several groups of people including road users, local residents on top of the cliff, and river users.

Road users will experience a changed scenic quality along the road corridor, and local residents and river users will lose much of the screening effect of the trees that currently screen the Highway. From a road users point of view the cliff will initially appear as an exposed basalt surface. This will change after a period of time. However, the vegetation cover will never be as dense as existing vegetation due to the changed structure of the cliff face.

Some vegetation screening of the Highway will remain along the boundary of the Golf Course. Road users will have a better line of sight along the Highway as a result of the realignment, ensuring a safer journey.

It is not expected mangroves will be purposefully re-established along the river banks where filling has occurred. Removal of some mangroves will enhance road user views of the adjacent wetland and the distant mountains of the Jamberoo Valley which are currently obscured or not visible.

From Oxley Avenue to Bombo the Highway reconstruction will be beneficial from the road users and local residents view point. The widening will have a "tidying up" effect, particularly along the section from Oxley Avenue to Iluka Crescent, where the existing corridor varies in width from two to three lanes.

The road widening will alter the corridor alignment in the vicinity of the hill above Bombo. This will not adversely affect any local residents in the close vicinity of the Highway as the proposed road alignment is further west than the existing carriageway, away from the houses. However, residents who live at the southern end of Bombo Beach will have a full view of the works during the construction phase, but for a limited time period. Exposed surfaces will be revegetated when construction works are completed, returning the area to a more visually harmonious landscape.

The effect of the road reconstruction on distant views will be largely due to the removal of vegetation on the cliff, exposing a bare surface. This will be reduced as revegetation occurs.

The proposed service lane from Iluka Cresent to North Kiama Drive will provide an area on which trees or shrubs can be grown to screen views from residences along the Highway. A comprehensive landscaping programme will be developed which will included screening views of the Highway where necessary and the use of landscaping measures as the excavation and road construction proceeds.

The exposed basalt cliff is not expected to be able to support the same density of vegetation that exists at present, due to the shape and reduced quantity of soil cover. However, with careful landscaping treatment the resultant landform can be made to be visually pleasing, with vegetation grown where possible. Loose material and soil on benches will be planted.

The construction of the roadway and its realignment on Bombo hill will change the existing visual environment. Earthworks will be required in this location to fill the abandoned quarry for the proposed Highway realignment. Other work required includes excavation of material for the roadway and construction of a road bridge over the Highway. The exposed bare earth surfaces that will occur at this location can be revegetated to reduce the visual contrast. The long term visual effect of the road will be its changed alignment, the new overbridge and the Barton Drive access ramps.

The overall visual impact of road reconstruction will be to reduce some of the natural "Gateway to Kiama" impression of the area which local residents interviewed in the course of the study find attractive and characteristic of the area. The irregular pattern of trees and shrubs, mangroves and a winding river bank will be replaced by the more regular form of the widened roadway and river banks. The opportunities available for landscape treatment along the roadway will be used for this purpose.

## 7.6 ATMOSPHERIC

### 7.6.1 Noise

Some noise will be generated during the construction phase by heavy earth moving machinery. This will cause some temporary inconvenience,

lasting no more than a few months at any location. Working hours will normally be confined from 7.30 am to 4 pm, which is within the SPCC guidelines set for permissible hours of construction. The SPCC guidelines are:

Monday to Friday : 0700 - 1800 hours
Saturday : 0700 - 1300 hours

Traffic flow information is presented in Section 2. The upgrading of the road will not in itself generate increased traffic but traffic is expected to grow at rates similar to those over the past few years. If all other factors remained the same, this would cause noise levels to increase progressively. Such an increase in unlikely to be noticed by local residents, but it should be noted that the increase will be occurring on top of levels which are already high. For Sites 2, 4 and 5, noise levels are at times already above 68 dB(A) for $L_{A10,18hour}$ levels at 1 m from the facade of the residence. The level of 68 dB(A) has been adopted as this is the noise level below which noise attenuation measures are considered by the Department to be unwarranted, in relation to the upgrading of existing major roads, where the present noise levels are already high.

Noise impact assessment has been undertaken on the basis of traffic volumes as they are expected to be by the year 1995. At this time maximum traffic flow along the upgraded road is expected to be 28,150 vehicles per day of which 11.5% are expected to be heavy vehicles. The design speed of the road is 80 km/hr. This level of traffic is the design capacity of the proposed upgraded road. Using this information and information on the road gradients the expected $L_{A10,18hour}$ levels have been estimated for several representative areas along the route. The representative areas are the same locations that were selected for the noise survey.

The procedure for estimating noise levels follows that outlined by the Department of Environment (DOE United Kingdom), as amended by the National Association of Australian State Road Authorities for Australian conditions.

The following sections examine the impacts in more detail for specific areas.

**Noise Monitoring Site 2 (Trevethan Street Intersection)**

The road is flat in this area. Present $L_{A10,20min}$ levels at 15 m from the road range from 47 to 78 dB(A). The DOE method of predicting traffic noise levels gives an $L_{A10,18hour}$ level of 74 dB(A). At present the facade of the closest residence is approximately 23 m from the road and a paling fence provides some reduction in noise levels at the house. The upgraded road will bring two lanes of southbound traffic closer to the residence and the distance between the edge of southbound road and the residence will be reduced to approximately 10 m. The 68 dB(A) $L_{A10,18hour}$ level will be exceeded unless mitigating measures such as the erection of an acoustic barrier or the imposition of speed restrictions are applied.

**Noise Monitoring Site 3 (Samuels Lane on cliff)**

The road is flat in this area. Present$L_{A10,20min}$ levels at Site 3 (approximately 50 m away from, and 20 m above the present road and hidden from the present road by a steep cliff) ranged from 45 to 56 dB(A). The DOE prediction method estimates an $L_{A10,18hour}$ level of 74 dB(A) at 10 m. The shielding afforded by the cliff can be estimated by comparing noise levels measured at Sites 2 and 3. After making appropriate allowance for the different distances between the monitoring points and the road at the two sites, the estimated noise reduction due to shielding by the cliff and vegetation is 17 dB(A). Thus the expected $L_{A10,18hour}$ noise level from the upgraded road would be 52 dB(A), which is well within the design level and no adverse noise impacts are anticipated for this area.

**Noise Monitoring Site 4 (Corner of Oxley Avenue)**

The road in this area has a slight (1.4%) upward gradient in the southerly direction. Present $L_{A10,20min}$ levels range from 54 to 72 dB(A) at 15 m from the road. At present, the facade of the closest residence is approximately 15 m from the edge of the road. The

upgraded road will reduce this distance to approximately 10 m. The DOE prediction method gives a $L_{A10,18hour}$ level of 75 dB(A) at 10 m. This is 7 dB(A) above the design level. Approximately 60 residences in this area (between 100 m north of the junction of Oxley Avenue and the Princes Highway and the junction of Iluka Crescent and Princes Highway) would be affected by noise levels which are predicted to exceed the 68 dB(A) level if no mitigation measures are adopted.

**Noise Monitoring Site 5 (South of Iluka Cresent at Iluka Reserve)**

The road in this area has, and will have, a steep (approximately 10%)down-gradient in a southward direction followed by a similar up -gradient. Present $L_{A10,20min}$ noise levels range from 64 to 73 dB(A) at 15 m from the road. The DOE prediction method estimates that future $L_{A10,18hour}$ levels will be 76 dB(A) at 10 m. The new road would be approximately 15 to 20 m from the building facades. Thus expected $L_{A10,18hour}$ levels will be approximately 75 to 73 dB(A), which again would be above the 68 dB(A) level. Twenty-three residences between the junction of Iluka Crescent and the Princes Highway and approximately 30 m south of the junction of Darien Avenue and the Princes Highway would be affected.

**Summary**

Between 80 and 90 residences adjacent to the proposed upgraded road will experience noise levels from traffic in excess of the 68 dB(A) level at the traffic volumes predicted for 1995. There is little opportunity to mitigate this problem by changing the road alignment (except possibly at the southern end of the route where the situation could be improved for 20 residences). The only practical mitigating measures for most of the affected residences could be the use of earth mounds, acoustically opaque fences or speed restrictions.

### 7.6.2 Air Quality

Neither of the options will lead to unacceptable air quality impacts and because of new pollution control equipment and regulations applying to Australian cars and fuel from 1986, it can be expected that carbon monoxide and lead levels will fall in the next decade.

### 7.6.3 Vibration

As is discussed in Working Paper E, providing blasting activities fall within the standards outlined, vibration and overpressure will avoid building damage and discomfort to local residents.

## 8.0 ENERGY STATEMENT

It is estimated that over the two year construction period, completion of the proposed scheme will result in the following use of fuel construction equipment:

Diesel - 500,000 litres
Petrol - 70,000 litres

Road user savings will be realised in liquid fuel consumption when the proposed widening and the By-Pass road are completed, through the reduction of delays during peak periods, such as school holiday periods and long weekends.

## 9.0 CONCLUSIONS

This Environmental Impact Statement has been prepared for the Department of Main Roads, NSW for the proposed widening and reconstruction of the Princes Highway from the Minnamurra Bridge to Bombo, north of Kiama.

The reconstruction is required to relieve traffic conditions that exists on the Highway at present and to cater for growth in local traffic as the northern suburbs of Kiama expand.

It is considered that all relevant factors have been taken into account in the selection of the preferred route, and that sufficient alternative routes have been evaluated to represent the range of options available. The preferred route is considered to provide a satisfactory balance between environmental and practical considerations.

The proposed construction and maintenance techniques are considered to include all measures that might reasonably be taken to minimise environmental impact. The most important impacts of proceeding with the proposal will arise from the excavation and filling of the section of Highway adjacent to the Minnamurra River and associated wetland and the Highway realignment on Bombo hill. Excavation of the cliff is required on the eastern side of the Highway and filling into the River on its eastern Bank on the western side of the Highway. Both the loss of vegetation and the visual impact of the road widening will be significant in some sections. The impact of changed hydrological patterns and sediment movement have been reduced by selecting a route which minimises as far as practicable intrusions into the river and by the proposed construction of a vertical reinforced earth wall. The visual impact of the Highway realignment on Bombo hill will be reduced by sympathetic landscaping and restoration of surfaces.

Other potential impacts from reconstructing and widening the existing Highway, including soil erosion, clearing of vegetation, changing the hydrological characteristics of the Minnamurra River and biota, will be minimised where practicable and are generally considered not to be significant. Consideration will be given to the reduction of noise levels for residents adjacent to the Highway by the construction of earth mounds or acoustically opaque barriers.

Having regard to the need for an upgraded road and the measures outlined in this document to reduce its environmental impact, it is considered that the resultant environmental consequences of proceeding with the proposed reconstruction of the Princes Highway are acceptable and that the project should be approved for construction.

## 10.0 REFERENCES

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Jamberoo Valley Regional Environmental Study (1985), Rural Land Evaluation Manual (1981)

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Leigh, J., Briggs, J. & Hartley, W. (1981)
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Register of the National Trust

Soil Conservation Service of NSW (May 1985)
Land Resources Survey, Kiama Municipality.

Williams, J.B. & Harden, G.J. (1979)
Rainforest trees and shrubs. A field guide to trees and shrubs of rainforests in New South Wales and south-eastern Queensland using leaf features. Botany Department, University of New England, Armidale.

Note : All Working Papers can be found in a separate document available from the DMR.

# ANNEX A

## DIRECTORS REQUIREMENTS

New South Wales Government

# Department of Environment and Planning

Remington Centre
175 Liverpool Street, Sydney 2000
Box 3927 G.P.O. Sydney 2001
DX 15 Sydney

Telephone (02) 266 7111 Ext 7134

Contact J. Shields

Our reference 83/3814

Your reference EP 1/236.13

The Secretary,
Department of Main Roads,
309 Castlereagh Street,
SYDNEY. N.S.W. 2000 00

Attention: Mr. Potter.

Environmental Impact Assessment - State Highway No. 1 - Princes Highway, Municipality of Kiama, Reconstruction between Minnamurra River and Oxley Avenue, 113.38 km. to 115.57 km. South of Sydney.

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Thank you for your letter dated 29th August, 1984 which indicated that you are consulting with the Director with regard to the preparation of an environmental impact statement for the above project.

2.Under the provisions of Kiama Local Environmental Plan No. 5, roadworks which constitute widening, realignment or relocation of State Highway No. 1 would require development consent under the Environmental Planning and Assessment Act, 1979. Those roadworks involving the construction, reconstruction, improvement, maintenance or repair of the highway do not require development consent and hence fall within the ambit of Part V of the Act. This Department notes your views that an environmental impact statement (E.I.S.) is warranted following your review of environmental factors. It would be appropriate for an environmental impact statement covering all roadworks under consideration to be submitted to Kiama Shire Council in support of the development applications for those proposed roadworks which require development consent.

3.The basic requirement for an environmental impact statement that relates to an activity referred to in Section 112(1) of the Environmental Planning and Assessment Act, 1979, is that it shall be prepared in accordance with Clauses 57 and 58 and bear a certificate required by Clause 59 of the Environmental Planning and Assessment Regulation, 1980.

4.The Director requires that you should take into account the matters specified in the attachment to this letter. These matters are to be adequately addressed in the environmental impact statement, and should be taken into account in the determination of the proposal. This should also be appended to the E.I.S. for the information of the reader.

✓ BOLJ 8/10
EEM 9/10.
Mr Potter.

.../2

5.Further, the National Parks and Wildlife Act contains legislation requirements for the preservation of relics and aboriginal places. The advice of the National Parks and Wildlife Service should be sought on the need for a professionally conducted aboriginal archaeological survey for inclusion in the EIS and on the appropriate manner for carrying out such a survey.

6.Where matters are likely to come within the scope of legislation relative to air, water and noise control as administered by the State Pollution Control Commission, the views of the Commission should be sought. Further, if aspects of the proposal would significantly affect agricultural land or agricultural industry, the views of the Department of Agriculture should also be sought and appropriately addressed in the environmental impact statement.

7.In view of the potential impacts of the proposed roadworks on the Minnamurra estuary, the views of the State Fisheries Division of the Department of Agriculture and the National Parks and Wildlife Service should be sought, especially in relation to ecologically significant wetlands and estuarine species.

8.When you have prepared an adequate environmental impact statement for the subject proposal, as determining authority, you should then proceed with the matter in accordance with sections 112 and 113 of the Act and place the documents on public exhibition. The procedures for public display that are to be followed by the proponent and determining authority are as in clauses 60 to 64 of the Environmental Planning and Assessment Regulation, 1980.

9.At such time as copies of the completed environmental impact statement are forwarded to The Secretary, it would be appreciated if two additional copies of the environmental impact statement could be forwarded to the Department, as well as details of the period of public exhibition and proposed public display locations. Should any submissions be made during the period of public exhibition, it is advised that such submissions should be forwarded to The Secretary and in the event of issues of interest to the Department being raised in any submissions received, we will advise you accordingly.

10.Should you require any further information regarding this matter, please do not hesitate to contact us again.

Yours faithfully,

jshields 28/9/84

J.D. Shields
Assessments Branch.
As Delegate for the Director.

NEW SOUTH WALES DEPARTMENT OF ENVIRONMENT AND PLANNING

83/3814

ATTACHMENT TO LETTER OF ADVICE ON ENVIRONMENTAL IMPACT STATEMENT FOR STATE HIGHWAY NO.1 - PRINCES HIGHWAY, MUNICIPALITY OF KIAMA, RECONSTRUCTION BETWEEN MINNAMURRA RIVER AND OXLEY AVENUE, 113.38 KM TO 115.57 KM SOUTH OF SYDNEY

A comprehensive environmental impact statement should adequately cover all those matters provided in clause 57 of the Environmental Planning and Assessment Regulation, 1980.

These matters should be clearly and succinctly outlined in the text and where appropriate supported by adequate maps, plans, diagrams or other descriptive details to enable all concerned to gain a clear understanding of the full scope of the development and its likely impact on the environment.

The following particular matters should be included in its coverage :

1. Background Information

. Location of proposed WORKS .
. Broad nature and extent of works proposed; and
. Land tenure, boundaries, site details in relation to planning scheme zonings and any other land use constraints.

2. Objectives and justification of the project and its planned capacity and compatibility with the regional network of existing and any other proposed roads.

3. Description of the proposal including discussion of criteria used for determining selection of route and its form (e.g. either elevated or on ground). Specific information should include :

. Detail of the form and physical dimensions including heights and widths of structures and associated facilities.

. Details of cut depths and fill heights.

. Presence of median strips.

. Barriers to pedestrians.

. Alterations to means of access to adjoining properties.

. Resumptions required of existing development to accommodate the proposed WORKS .

. Construction problems envisaged.

. Staging of construction.

. Access arrangements during the construction phase.

. Alternative roads to be used by local and through traffic during construction.

. Details of lighting levels at nearby areas.

. Hours of operations for demolition/construction.

. Provision of animal creeps.

. Provision of stock dams.

. Location of construction materials and proposed routes of transport to the reconstruction length of road.

4. A full description of the existing environment sufficiently comprehensive and quantified to allow a proper assessment of impact to the level of anticipated influence. Aspects considered to include :-

. Geography, topography, geology, meteorology and geotechnical data.

. Noise and air quality (measured).

. Aesthetics.

. Utilities and communications.

. Buildings having architectural/heritage values.

. A summary of existing traffic levels and traffic flow patterns.

. Adjoining and nearby land uses.

. Provision of existing and proposed planning instruments.

5. Feasible alternatives to the proposal that have examined to service the objectives of the recommended proposal and the reasons for their rejection.

6. Assessment of environmental impact and environmental safeguards incorporated in the proposal to mitigate impact during the construction and operation of the proposed WORKS having regard for :

. Likely noise disturbance caused by the reconstruction of the roadway and by traffic operating on the completed roadway on any nearby residential and commercial buildings. A map depicting anticipated noise contour levels in relation to residences and inhabitants involved. Consideration should be given to both existing and proposed residential developments for such an analysis.

. Emission of air pollutants from vehicular traffic affected by the proposal, and their impact on the local and regional environment.

. Visual impact of the proposed roadway by both day and night taking into account the following effects of the proposed road :

- Scale in relation to any adjacent residential and commercial development.

- Appearance from nearby and afar.

- Lighting effect on existing and proposed residential/commercial buildings.

. Changes in journey length.

. Changes on community characteristics caused by severence.

. Effect on any commercial activity bypassed by the reconstructed road.

. Degree of severence of rural holdings.

. Effect of land lost on individual rural holdings.

. Effect on animal (fauna) movement.

. Impact on natural vegetation, particularly wetlands, mangroves and seagrasses.

. Effects on oyster leases.

. Effects on Minnamurra estuary in relation to water regime, tidal hydraulics, shore erosion and siltation and implications for estuarine species.

. Measures to enhance recolonisation of disturbed areas.

. Impact on nature reserves.

. Impact on historic buildings.

. Impact on flood plains.

. Impact on drainage patterns.

. Possible sedimentation/scouring of watercourses.

. Possible escape of water borne pollutants to the natural environment by way of accidental spillage of oils, greases and/or materials being carried by trucks.

. Sterilisation of minerals.

7. Any matters of specific interest to the responsibilities of the State Pollution Control Commission, Kiama Municipal Council and any other relevant authority.

8. Reference by suitable appendices to all relevant studies/ investigations dealing with traffic flow patterns, geotechnical, noise, air quality, ecology, planning etc. that are relevant to the proposed roadway.

# ANNEX B

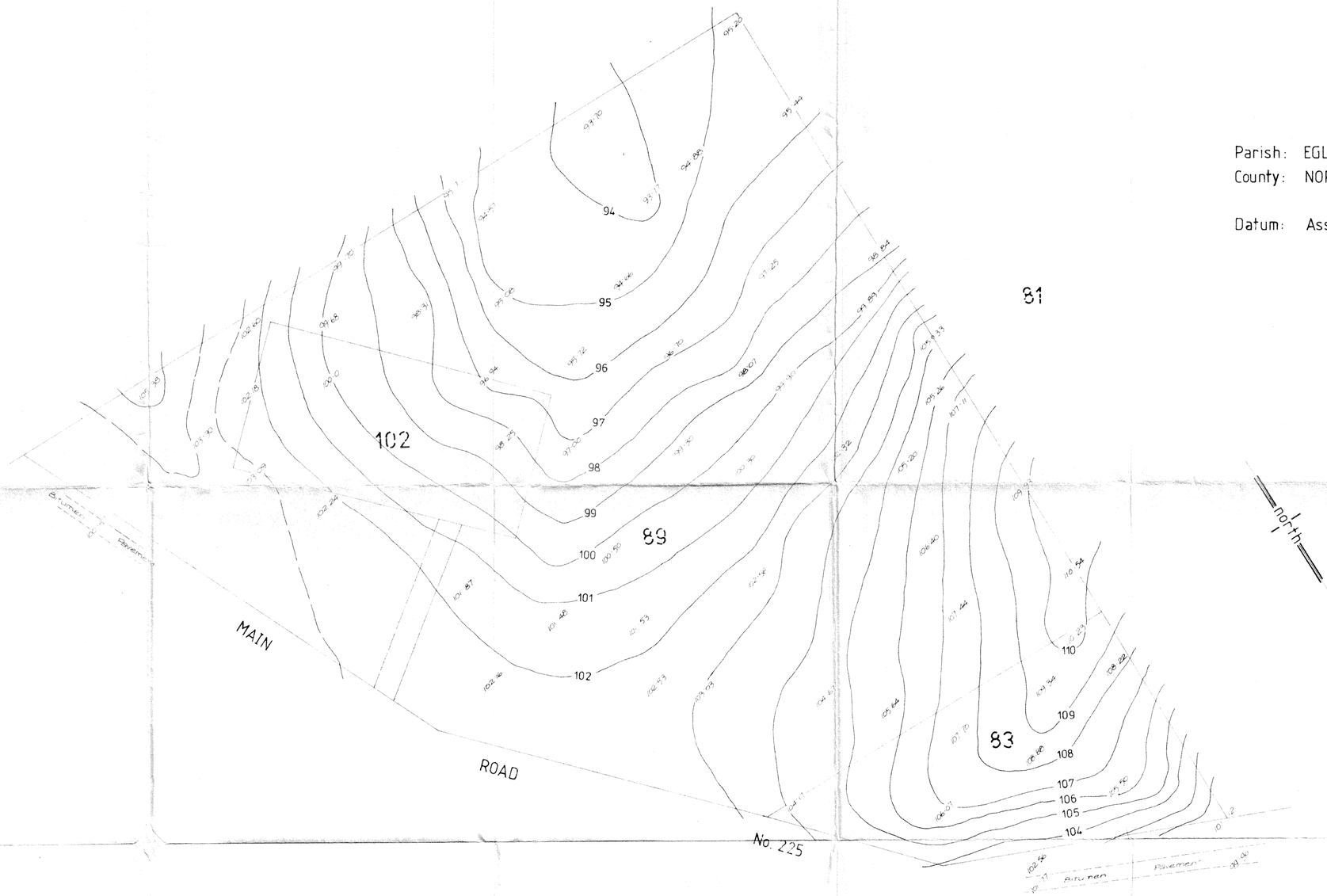
## STUDY TEAM

## STUDY TEAM

| | |
|---|---|
| **Study Director :** | Warren Atkinson |
| **Study Manager :** | Kerry Morrison |
| **STUDY COMPONENTS** | |
| **Land Resources :** | Lynn Bain<br>Melanie Cairns |
| **Biology :** | Bill Lane<br>Tim Fatchen<br>Lyle Vail<br>Duncan Leadbitter |
| **River & Estuarine Hydrology :** | Ian Irvine<br>Duncan Leadbitter<br>Lawson & Treloar Pty Ltd |
| **Noise & Vibration :** | Nigel Holmes<br>Wilkinson-Murray Consulting Pty Ltd |
| **Air Quality :** | Nigel Holmes |
| **Visual & Aesthetic Resources :** | Kerry Morrison |
| **Transportation :** | Doug Martin<br>Wilf Cramp<br>David Bostock |
| **Socio-Economics :** | Doug Martin |
| **History, Tourism, Recreation :** | Melanie Cairns |
| **Aboriginal Aspects :** | Jo Kamminga |
| **Community Aspects :** | Kerry Morrison |
| **Vertical Wall Investigation :** | Brown, Verge, Harris, Sutherland Pty Ltd |

Parish: EGLINGTON
County: NORTHUMBERLAND

Datum: Assumed




CONTOUR PLAN

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|---|---|
| JOHN HANCOCK & ASSOC.<br>TOWN PLANNING CONSULTANTS<br>Suite 3 24 Dane Drive Gosford | PROJECT: POR. 83, 89 & 102 Mangrove Mountain Road Somersby |
| | SCALE: 1: 1000 — DATE: October 1985 |

NEW SOUTH WALES DEPARTMENT OF MAIN EIS 453

Princes Highway Minnamurra River to Bombo Kiama

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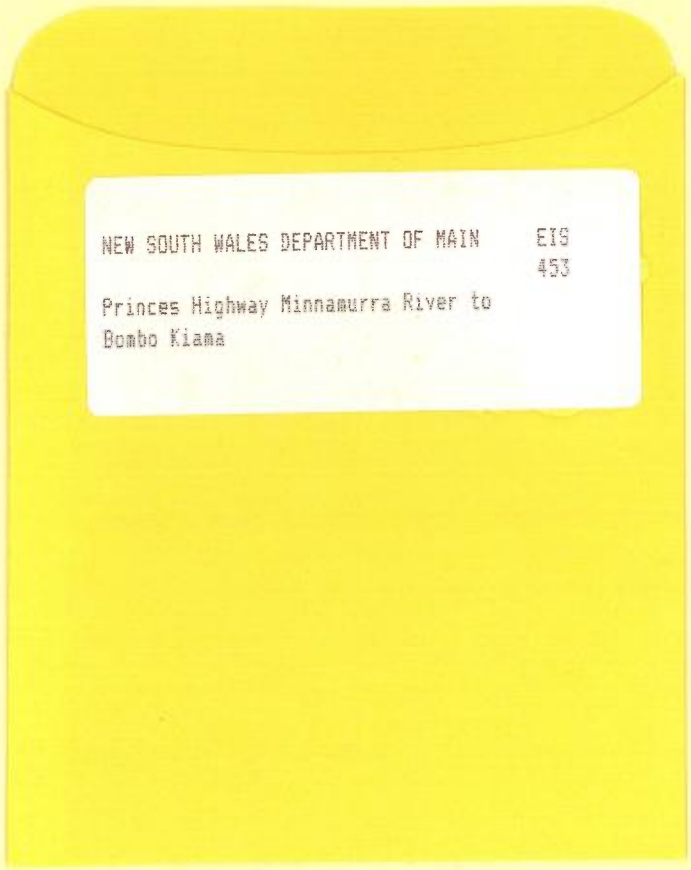
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Bombo Kiama