60 Denmark Street
Kew 3101

3rd November 1976

The Honorable J. A. Rafferty MP
Minister of Transport
570 Bourke Street
Melbourne 3000

Sir
In accordance with the requirements of Section 128 of the Country Roads Board Act 1958 No. 6229, the Board has the honour to submit to you for presentation to Parliament the report of its proceedings for the year ended 30th June, 1976.

The Board thanks you, Sir, for your support and interest in its activities and wishes to place on record its appreciation of the continued co-operation and assistance of other State Ministers, Government departments, State instrumentalities and municipal councils.

The Board also pays tribute to the continued loyal co-operation and work done by its staff and employees throughout the year.

We have the honour to be,
Sir,
Your obedient servants

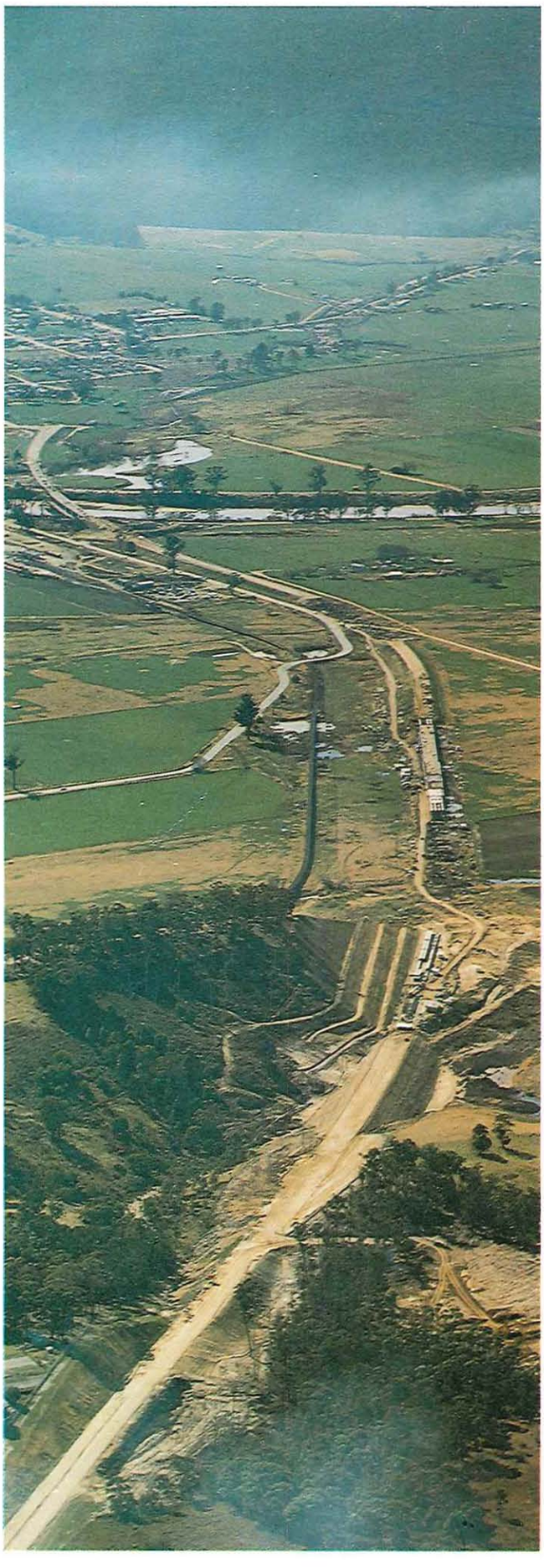
R. E. V. Donaldson
AASA (Senior), AIMA, FCIT, JP
Chairman

T. H. Russell
M.Eng.Sc., BCE, Dip.CE, CE, FIE Aust.
Deputy Chairman

W. S. Brake
BCE, CE, MIE Aust.
Member

N. L. Allanson
AASA (Senior), JP
Secretary

The Princes Freeway, Orbost. The Board's biggest State-financed rural project under construction during 1975-76, the $9 million Special Project will provide a freeway by-pass of Orbost and relief to persistent flood problems.



# Contents


It costs $4,000/kilometre to patch and reseal this . . .
. . . to achieve this
. . . if this is not done now . . .
. . . the pavement will fail . . .
. . . and costs $30,000/kilometre to reconstruct later.

# Review

## Crisis in road finance and road conditions

Continued steep increases in road construction and maintenance costs without matching increases in revenue caused a crisis point to be reached in road finance and road conditions during the year.

In terms of 1971/72 values, every dollar made available to the Board for road expenditure in 1975/76 was worth only approximately 58 cents. In financial year 1976/77 the 1971/72 value is expected to be approximately 51 cents.

The table below compares the actual funds received by the Board since and including financial year 1971/72 and their conversion to 1971/72 values. Road funds expended by the Melbourne & Metropolitan Board of Works prior to the transfer of its roading responsibilities to the Board on 1st July, 1974 have been included in the table for the purposes of realistic comparison.

| | | Funds received from | | | | Total funds received | | |
|---|---|---|---|---|---|---|---|---|
| | | C'wealth sources | | State sources | | | | |
| Year | Multiplier to convert to 71/72 values | Actual dollars | Amount in 1971/72 values | Actual dollars | Amount in 1971/72 values | Actual dollars | Amount in 1971/72 values | Accum. deficiency in 1971/72 values |
| | | $000's | $000's | $000's | $000's | $000's | $000's | $000's |
| 1971/72 | 1.0 | 49,820 | 49,820 | 63,823 | 63,823 | 113,643 | 113,643 | – |
| 1972/73 | .91 | 57,240 | 52,088 | 66,367 | 60,394 | 123,607 | 112,482 | 1,161 |
| 1973/74 | .79 | 66,119 | 52,234 | 69,717 | 55,076 | 135,836 | 107,310 | 7,494 |
| 1974/75 | .64 | 78,977 | 50,545 | 78,451 | 50,209 | 157,428 | 100,754 | 20,383 |
| 1975/76 | .58 | 91,342 | 52,978 | 92,153 | 53,449 | 183,495 | 106,427 | 27,599 |

The above table indicates that, in terms of 1971/72 values for each of the years shown, the accumulated deficiency in the funds available for roadworks for the period 1971/72 to 1975/76 is approximately $27m. In 1975/76 values, the accumulated deficiency is approximately $47m. As a result, road conditions are deteriorating. In some cases essential maintenance is not being carried out and scores of much needed improvements and new projects have had to be deferred.

Four major effects of these financial shortages are already evident to the travelling public, namely

—a lower standard of road surface and road condition over the State resulting from a lower incidence of reconstruction of worn out sections,

—extended travel times especially in urban areas as a result of the enforced postponement of much needed widening of existing arterial roads and the building of additional traffic arteries causing increased congestion on the roads,

—higher vehicle operating costs, and

—increasing use of residential streets because of the lack of capacity of arterial roads.

In the Melbourne urban area the growth rate of traffic during the year on particular roads ranged from between 4% and 10%. Travel time surveys indicated that 25% of the roads carrying 35% of the peak hour traffic had average travel speeds of less than 25 km/h (15 mph). Such low speeds were found not only on substantial lengths of inner city radial routes, but also on many sections of suburban circumferential routes such as Bell Street, Warrigal Road and Springvale Road.

In order to ease the severity of the present crisis and to ensure that Victoria would be in a position to take full advantage of the total funds available for road expenditure from the Commonwealth, the Board recommended during the year that the Government approve a 50% increase in motor car and trailer registration fees as from 1st July 1976 and that such increases be made available directly to the Board without diversion to other funds or authorities.

## Matching Commonwealth Grants for roads

The Commonwealth Roads Grants Act fixes for each year a 'quota' of expenditure to be made on roads by each State from its own resources. The achievement of the quota over the three year period ending 30th June 1977 is necessary for each State to qualify in full for the total amounts of the Commonwealth grants to be made under the National Roads Act, the Roads Grants Act and the Transport (Planning and Research) Act. Failure to expend an amount at least equal to the overall quota would require a State to pay to the Commonwealth the amount of any shortfall against the quota or such lesser sum as the Commonwealth Treasurer determines.

At 30th June 1976 the three year quota for Victoria is $297.9 million. Unless there are further sums made available to the Board from State sources during financial year 1976/77, a shortfall against the quota of approximately $13 million is likely to eventuate.

An increase in motor registration fees of approximately 15% as from 1st July 1976 would have been necessary to meet the State's shortfall in quota expenditure.

## Road needs of the community

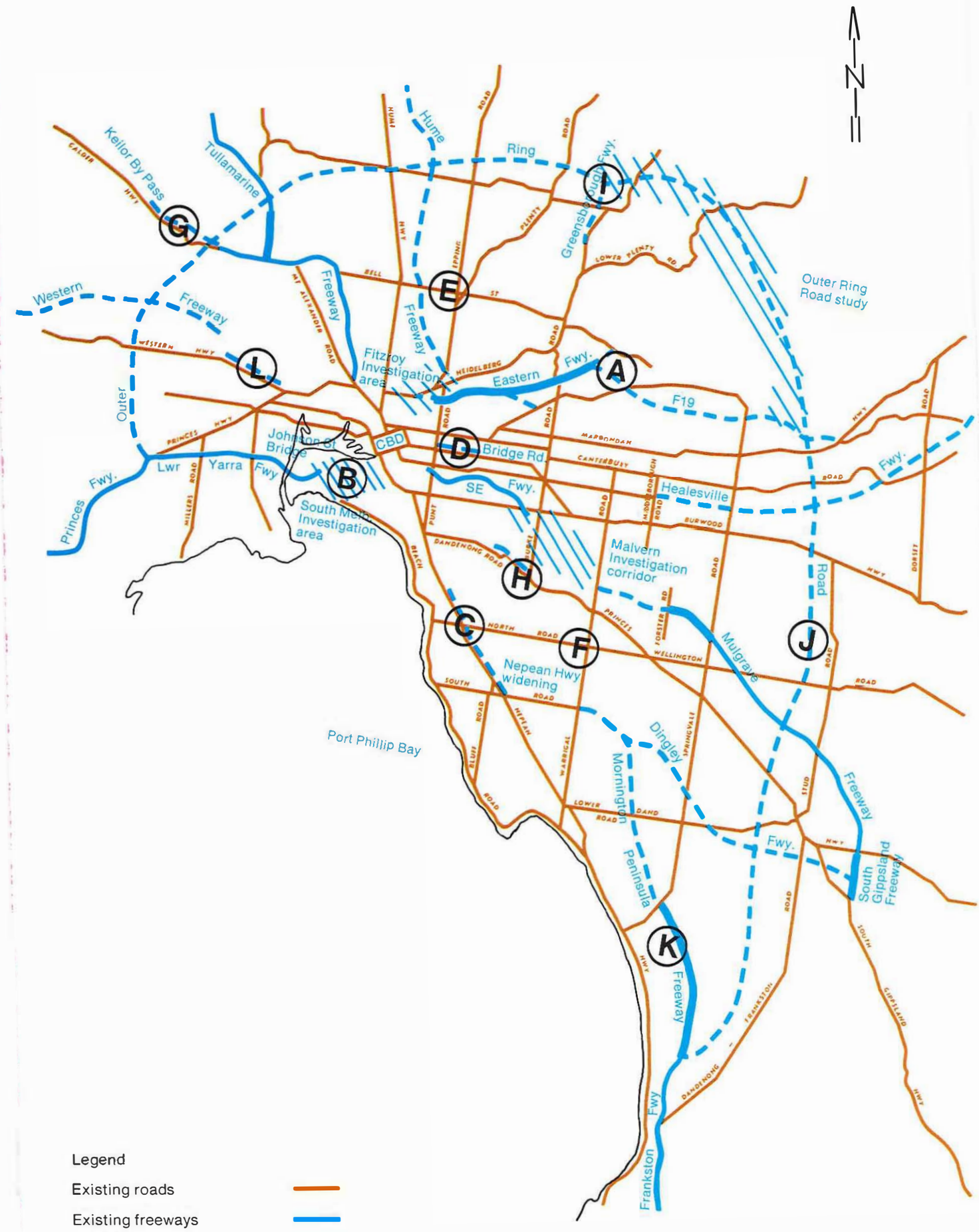
Population densities in the metropolitan area have changed significantly over the past 15 years. In the inner areas the population has either decreased or remained static whereas a large increase in population has occurred in the developing areas to the east and south-east. During this 15 year period the population in the Melbourne Statistical Division has increased from 1.98 million people to 2.66 million people.

The need for roads in both metropolitan and rural areas is directly related to the size and location of the population as well as the associated business, commercial, industrial and social activity.

The fact that there is one motor vehicle for every 2.5 persons in Victoria is an illustration of how the community generally is dependent upon motor vehicles.

**Metropolitan Melbourne:**

**Urgent road needs**



Even though problems such as accidents, exhaust emissions and the effect on the environment are recognized, their existence is not likely to diminish the dependency on the motor car or reduce the road needs of the community. Neither are the problems insurmountable. Efforts are being made by vehicle manufacturers to make safer vehicles with less air and noise pollution and road designers are endeavouring to ensure that roads serve the community with optimum efficiency and safety and without detriment to the natural environment.

In the Board's view the immediate road needs of the community are:

1. *in rural areas, the replacement of deficient bridges and the reversal of the deterioration of roads by a programme of works that will enable progressive improvement of the road system.*
   There are approximately 8,000 bridges and major culverts on rural roads in the State. Of these approximately 1,200 are on declared State highways, tourists' roads and forest roads under the direct control of the Board. Nearly half of the remaining 6,800 structures on main roads and unclassified roads under the care and management of municipal councils are deficient in structural adequacy, road geometry or hydraulic capacity to such an extent that they need to be urgently replaced. Such a programme would require the expenditure of approximately $150 million in financial year 1975/76. Only $2.5 million could be devoted to this task by the Board.
   The length of sealed roads in rural areas is 54,732 kilometres. A modest annual maintenance resealing and reconstruction programme would cost $42 million. Only $6.9 million was expended on this work in 1975/76. The lack of adequate maintenance programmes causes accelerated deterioration of road surfaces and costly remedial measures. Resealing costs approximately $4,000 per kilometre and extends the life of a reasonably sound pavement by approximately seven years. If adequate resealing is not carried out when required the cost of reconstruction in a few years time would cost approximately $20,000 per kilometre for an unclassified road, approximately $30,000 per kilometre for a main road and $60,000 per kilometre for a State highway;

2. *the provision of an adequate arterial road system in the Melbourne metropolitan area.*
   The present Melbourne metropolitan arterial road system is already heavily overtaxed as indicated by the travel times referred to earlier. Severe congestion is occurring and has forced vehicles on to residential streets. In many outer metropolitan areas weekend traffic on arterial roads exceeds weekday traffic.

Some examples of major projects which should be commenced to provide urgently needed improvements to the urban arterial road system are:

**A** The extension of the Eastern Freeway to Doncaster Road, North Balwyn.

**B** The construction of Freeway F9 as an extension of the Lower Yarra Freeway from West Gate Bridge to Kingsway, South Melbourne.

**C** The widening of the Nepean Highway from Elsternwick to Moorabbin.

**D** The widening of Bridge Road, Richmond between Church Street and Hoddle Street.

**E** The widening of Bell Street in Preston.

**F** The widening of North Road between Ormond and Huntingdale.

**G** The construction of the Calder Freeway, Keilor Section to bypass the township of Keilor.

**H** The widening of the Princes Highway East between Caulfield and Malvern.

**I** The construction of a section of Freeway F5 near Greensborough.

**J** The construction of the Scoresby Freeway between Ringwood and Dandenong.

**K** The extension of the Mornington Peninsula Freeway northerly from Dromana and from Eel Race Road to Springvale Road, Chelsea.

**L** The widening of the Western Highway between the Princes Highway West at Footscray and Ashley St., Braybrook.

In addition to the above major projects many other traffic engineering improvements such as channelised intersections, turning lanes, bus bays and minor widenings need to be carried out to improve the carrying capacity of existing roads;

3. *adequate provision for buses.*

The community relies heavily on bus transport as a means of travelling to and from work in the morning and evening peak periods. In the metropolitan area of Melbourne Government Buses alone carry 22 million passengers, a large proportion of whom travel twice daily between their home and work centre or between home and the railway station. The provision of adequate road capacity to cater for buses is an increasingly important factor in assisting the mobility of the community.

The Board also needs to have the financial resources to purchase now, land required for the community's road needs in the foreseeable future. These needs are evident in new growth areas where development should ideally occur in the knowledge of and in conformity with the community's future road requirements.

## Motor registration fees

Motor registration fee revenue provided the Board with approximately 44% of its total funds available for expenditure on roads in 1975/76. The level of registration fees is therefore a significant factor in the funds available to satisfy the community's road needs. Although motor registration fees were increased by 35% in February 1975, cost increases alone since then support a further increase. The following table indicates that registration fees and drivers' licence fees represent only approximately 3.3% of the cost of operating a Holden Kingswood Sedan and that this percentage has dropped from 3.5% in 1974.

| Element of cost | 1974 | 1976 |
|---|---|---|
| Motor registration fee and drivers' licence fee | 3.5% | 3.3% |
| Third Party Insurance and Comprehensive Insurance | 13.9% | 15.9% |
| Maintenance (parts and labour) | 14.9% | 18.2% |
| Fuel | 24.5% | 18.4% |
| Interest and depreciation | 43.2% | 44.2% |
| Totals | 100% | 100% |

A 50% increase in motor registration fees would mean an increased cost to the average car owner of less than 50 cents per week.

On a State by State comparison the following table indicates the recent patterns of movement in registration fees since 1967 for a Holden Kingswood Sedan type vehicle with 32 power units and 25 weight units.

| Date | NSW | Vic | Qld | SA | WA | Tas |
|---|---|---|---|---|---|---|
| December 1967 | $26 | $31 | $37 | $30 | $29 | $33 |
| December 1968 | $26 | $34 | $37 | $30 | $29 | $33 |
| December 1969 | $26 | $34 | $37 | $30 | $29 | $33 |
| December 1970 | $26 | $34 | $37 | $30 | $29 | $33 |
| December 1971 | $26 | $34 | $37 | $35 | $29 | $33 |
| December 1972 | $39 | $34 | $37 | $35 | $29 | $33 |
| December 1973 | $39 | $34 | $37 | $35 | $29 | $33 |
| December 1974 | $43 | $34 | $37 | $44 | $47 | $35 |
| December 1975 | $43 | $46 | $51 | $44 | $47 | $52 |
| March 1976 | $43 | $46 | $51 | $59 | $62 | $52 |

The table indicates that Victorian registration fees were the second highest in Australia up to 1970 but since that date have fallen to second lowest with a margin considerably below the highest.

## Accidents and safety

The Board shares the concern of the community about the accident frequency on roads. Apart from the tragic loss of life and the human suffering which are caused by road accidents, the economic cost is estimated on an Australia-wide basis to be between $500 million and $1000 million per annum or about 2% of the gross national product. Fortunately, the number of persons killed and injured in road accidents in Victoria is not rising as fast as motor vehicle registrations are increasing. Accurate significant statistics such as types of vehicles involved in accidents, the nature of accidents, locations, weather conditions, road conditions and times are all essential for the proper diagnosis of the factors influencing road accidents.

In urban areas dual carriageway roads with no direct access from adjoining properties or side roads which are the essential characteristics of freeways have accident rates between one-third and one-sixth of those for conventional arterial roads.

Providing safe conditions for traffic is one of the Board's prime responsibilities. Some of the accident counter measures employed by the Board are:

—the provision of a properly planned hierarchy of roads to meet the functional requirements of the community;

—the efficient design and construction of roads to ensure maximum visibility, a minimum of curvature, a smooth alignment consistent with the topography of the area, adequate lane widths and adequate shoulder widths;

—the provision of channelised intersections;

—the provision of wide medians to separate opposing flows of traffic and to alleviate headlight glare;

—the provision of traffic control devices such as traffic control signals, separate right hand and left hand turn lanes;

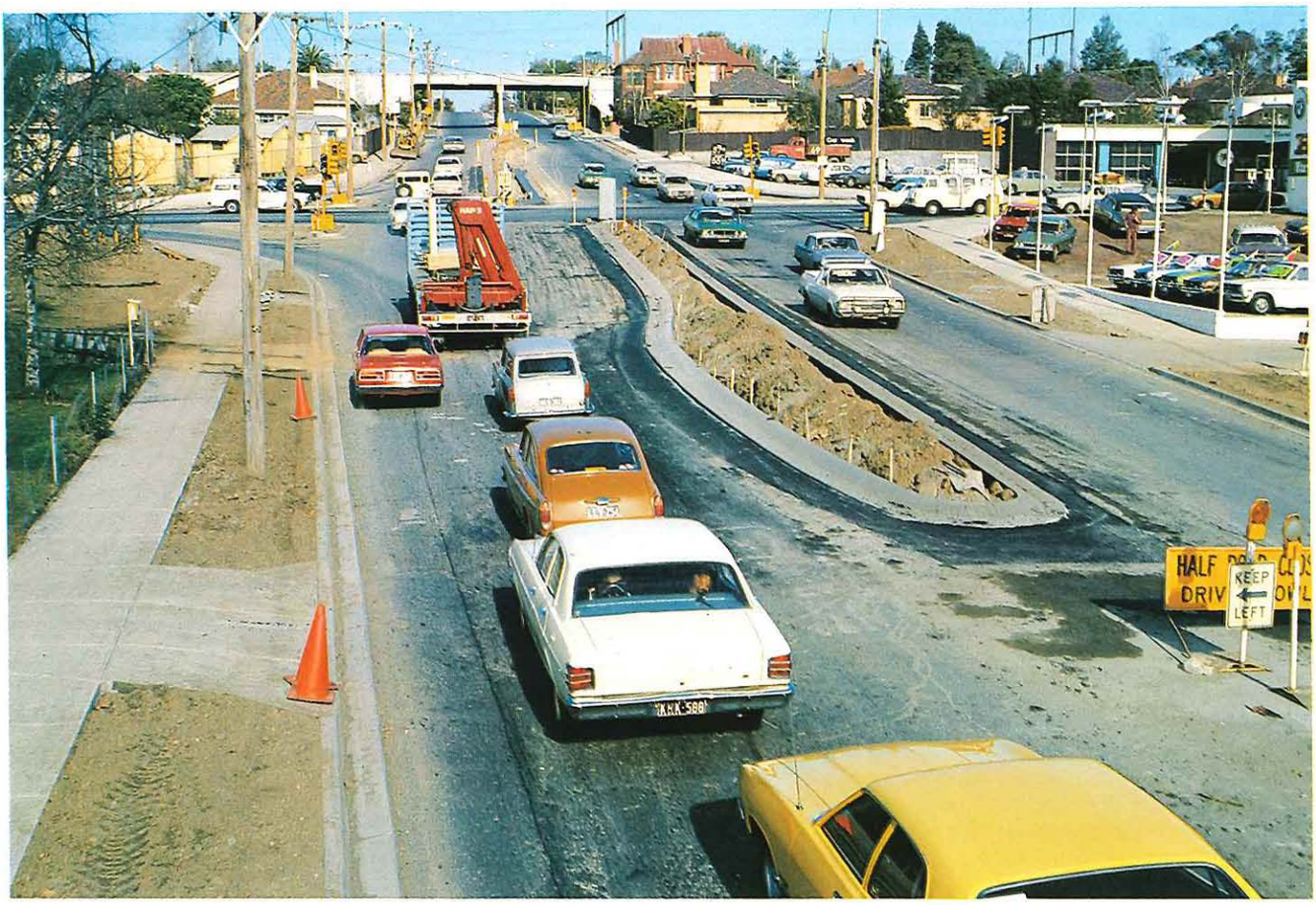
—the provision of adequate street lighting;

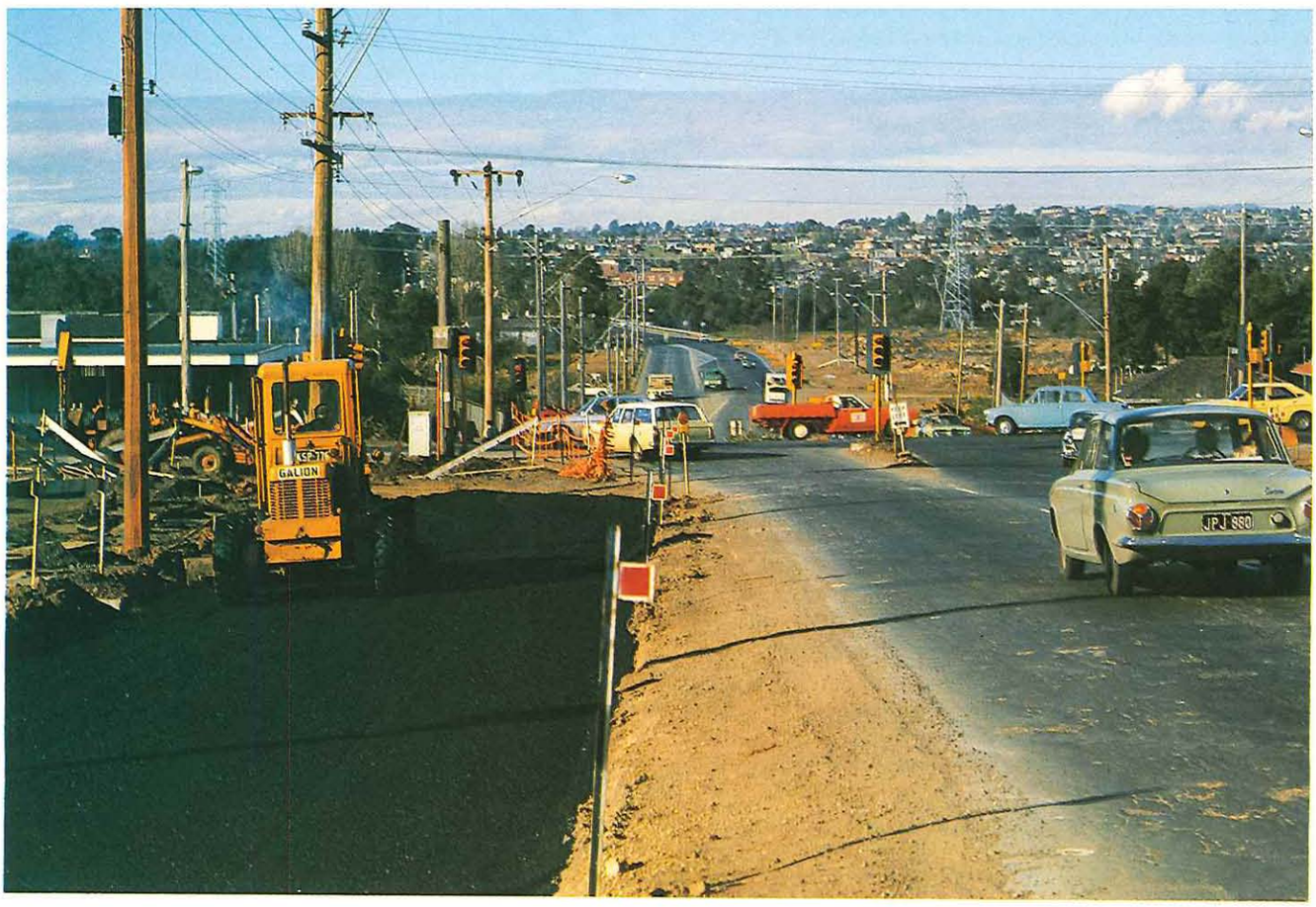
—the reduction of roadside hazards;

—adequate provision for pedestrians including the construction of overpasses or underpasses across arterial roads at strategic locations;

—the identification of accident locations with a supporting road condition analysis as a guide to the implementation of corrective measures.

Intersection improvements provide safer roads. Top, Lower Heidelberg Road and Banksia Street, Heidelberg; Below, Maroondah Highway and Elgar Road, Box Hill.



Official opening of Hume Freeway, Wallan-Broadford section.

## Report on roads in Australia, 1975

In December 1975 the Commonwealth Bureau of Roads released its report entitled 'Report on Roads in Australia, 1975'. The purpose of the report was to assist the Commonwealth Government, particularly in its consideration of financial assistance to the States for roads in the period 1976/77-1980/81.

The recommendations made in the report included suggested increases in the Commonwealth grants to the States for roads in 1976/77, being the last year covered by the current legislation and also the levels of grants to the States for roads in the period 1977/78 to 1979/80. The report also suggested that when introducing the legislation for the period 1977/78 to 1979/80 the Commonwealth Government should indicate the probable level of grants for 1980/81 as contained in the report.

The Bureau's report was the result of a comprehensive and detailed evaluation of the road needs throughout the State and provided sound justification for public investment in roads.

The Board agrées with many of the recommendations contained in the report, but there are some aspects with which the Board does not agree, namely:

—the report shows too strong a desire for the Commonwealth to be involved in matters which are clearly the responsibility of the States, eg. in project planning, and in the allocation of available financial resources to roads most in need of improvement. This is especially so when the recommended Commonwealth contributions are less than one-third of the estimated cost of the proposed total road programme in Victoria for the five years 1976/77 to 1980/81;

—Victoria is the only State where the recommended State Government contribution to roads exceeds the recommended Commonwealth grants over the five year period;

—the recommended adherence to nine road grant categories inhibits the preparation of balanced road programmes and imposes unnecessary administrative burdens;

—the planning of individual projects other than National Highways should be a State responsibility free of Commonwealth legislative constraints. The recommended requirements for programme submissions and approvals are cumbersome and unnecessary, particularly in the categories of urban local roads and rural local roads which are far removed from national policy interests;

—for administrative convenience all Commonwealth grants for roads should be included in one Act, not three as at present and as proposed;

—there is no recommendation which would permit portion of the proposed grants for urban arterial, urban local and rural arterial roads to be expended on maintenance.

—the recommended provisions for expenditure on rural roads are most inadequate in view of the high traffic volumes which these roads carry in Victoria.

Existing Commonwealth road legislation expires on 30th June, 1977, and so far draft legislation for the ensuing three years has not been made available to the States. There will therefore be less than twelve months' notice of the grants to be made under Commonwealth statute for the years 1977/78, 1978/79 and 1979/80. The Board believes that such a short period is most inadequate for planning the State's continuing works programmes and suggests that a six year financial expectation overlapping in three year periods would be more realistic and effective in financial planning.

## Hume Freeway, Wallan-Broadford section

The $35 million Wallan to Broadford section of the Hume Freeway was officially opened on 3rd May, 1976, by the Premier of Victoria, the Hon R J Hamer, ED, MP.

This work was the biggest single construction project carried out by the Board since its inception in 1913, and is the longest section of freeway opened at the one time in Victoria. The new freeway route between Wallan and Broadford crosses the Great Dividing Range 120 metres lower than the old highway route at Pretty Sally and by-passes the towns of Wallan, Kilmore and Broadford.

The project involved the construction of 34 km of four-lane freeway from south of Wallan to north of Broadford, with associated structures and access roads, as part of the Board's long term construction programme to improve the Hume Highway to freeway standard between Melbourne and Wodonga.

## Western Freeway, Myrniong section

The 5.9 km section of the Western Freeway at Myrniong was opened by the then Minister of Transport, the Hon E R Meagher, CBE, ED, on 3rd October, 1975.

At a cost of $3.28 million, the Myrniong project involved the construction of dual carriageways by-passing the township of Myrniong to the south and interchanges with the existing Western Highway at each end of the project. Bridge structures at these interchanges were constructed to carry Western Highway traffic over the freeway.

The location of the freeway was through undulating areas largely devoid of natural timber. The designed curves of the freeway blended with the natural features of the countryside without interference to distant vistas or horizon lines. With the completion of this section of the Western Freeway, more than 80 km of the 100 km between Melbourne and Ballarat have been reconstructed with dual carriageways.

## Emergency services

The Board introduced a 24 hour emergency telephone service on metropolitan freeways during the year. The emergency telephones are connected to a switchboard located in the Board's Head Office at Kew. The freeways concerned are the Tullamarine Freeway (16 telephones), South Eastern Freeway (12 telephones), and the Lower Yarra Freeway (14 telephones). Six telephones on King's Street Bridge and approaches and three telephones on Queens Way at St. Kilda junction are also connected to the switchboard.

The telephonist receiving the emergency telephone call has two-way radio link with the road patrolmen so that road conditions can be restored to normal as quickly as possible. Contracts have also been entered into by the Board with local towing organizations to enable drivers in difficulties to move their vehicles from the freeway. The service is free to the motorist.

Approximately 500 calls each month have been received since the service began. About 25 per cent of the calls received have been from motorists who have run out of petrol.

Arrangements are being made for connection to the H.O. switchboard of the emergency telephones to be installed on the Mulgrave Freeway and the Eastern Freeway.

Top. One of the two major projects completed during 1975-76, the Western Freeway, Myrniong Section.

Below. An average 500 calls for assistance per month are received through the Board's free emergency service.

# Finance

After deducting the cost of collecting revenue received under the Motor Car Act, the total funds available to the Board during the year, including the allocation from the Roads (Special Projects) Fund, was $188,450,522. The funds were derived from:

| | |
|---|---|
| State sources | $95,660,904 |
| Commonwealth sources | 92,132,390 |
| Balance brought forward from year 1974/75 | 657,228 |
| | $188,450,522 |

## Receipts

The Board's receipts were obtained from the following main sources:

**State sources:**

—Motor registration fees:
Fees payable on the registration and re-registration of motor vehicles and trailers less the costs of collecting the fees (excluding metropolitan omnibus registration fees and the specified proportion of registration fees paid to the Roads (Special Projects) Fund).

—Registration number plate fees:
Fees payable for the provision and/or replacement of number plates less the costs of providing the plates and collecting the fees.

—Examiners' licence fees:
Fees payable by persons licensed to conduct motor car roadworthiness examinations, less cost of collection of the fees.

—Authorized log book fees:
Fees payable for the purchase of log books less the cost of providing the books and collecting the fees.

—Learner driver permit fees:
Seven-eighths of the permit fee and the permit extension fee payable by applicants for and/or holders of learner driver permits less seven-eighths of the cost of collection of the fees (one-eighth less one-eighth cost of collection is paid to the Drivers' Licence Suspense Account).

—Motor car drivers' licence fees and tractor drivers' licence fees:
One-eighth of the fees payable for the issue of drivers' licences less one-eighth of the cost of collecting the fees (one-half, less one-half cost of collection, is paid to the Consolidated Fund; one-quarter, less one-quarter cost of collection, is paid to the Municipalities Assistance Fund; one-eighth, less one-eighth cost of collection, is paid to the Drivers' Licence Suspense Account).

—Motor driving instructors' appointment and testing fees:
Fees payable by candidates for motor driving instructors' licences, less cost of collection of the fees.

—Motor driving instructors' licence fees:
One-quarter of the fees payable for the issue of motor driving instructors' licences less one-quarter of the costs of collection of the fees (one-half, less one-half cost of collection, is paid to the Consolidated Fund; one-quarter, less one-quarter cost of collection, is paid to the Municipalities Assistance Fund).

—Unregistered vehicle permit fee:
A fee for the issue of a permit to use an unregistered motor car or trailer on a highway for a period of not more than 7 days, less the costs of collection of the fee.

—Proprietorship notification fee:
A fee payable with notification by a proprietor of a motor car or trailer of repossession of the item under a hire purchase agreement, bill of sale or like instrument, less the costs of collection of the fee.

—Fines imposed under the provisions of the Country Roads Act.

—All moneys received under Part II of the Commercial Goods Vehicles Act (tonne kilometre tax).

—Municipal payments on account of main road works.

—Special moneys appropriated by Parliament.

—Loan money.

—Allocation from Roads (Special Projects) Fund.

—Drivers' licence testing fees:
Seven-eighths of $4 of the fee payable for the test of proficiency of candidates for motor car drivers' licences less seven-eighths of the cost of conducting the test and collecting the fee (one-eighth of $4 less one-eighth cost of collection is paid to the Drivers' Licence Suspense Account) and the amount of each fee above $4 is paid to the Consolidated Fund.

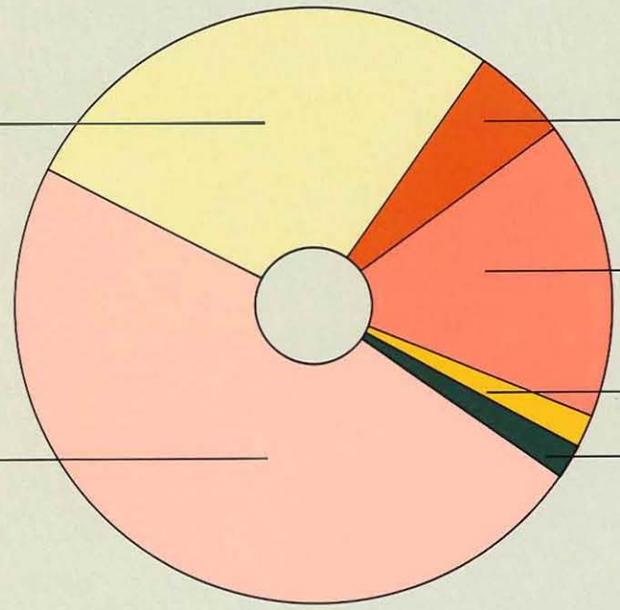
**Commonwealth sources:**

—Receipts under the National Roads Act 1974, Roads Grants Act 1974, and Transport (Planning and Research) Act 1974.

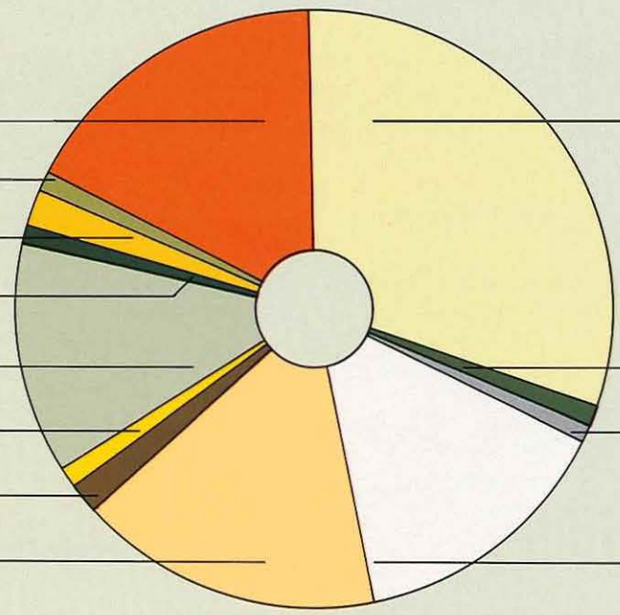
—Commonwealth grant for general employment purposes.

—Grant towards Traffic Engineering and Road Safety Improvements.

**Receipts 1975-76**




**Expenditure 1975-76**



The following table shows the funds available to the Board for the construction and maintenance of roads in 1975/76 compared with 1974/75.

| Item | 1974/75 | | 1975/76 | |
|---|---|---|---|---|
| | $ | $ | $ | $ |
| **Receipts from State sources** | | | | |
| Fees under the Motor Car Act less cost of collection | 41,984,641 | | 50,826,830 | |
| Less: Payment to: | | | | |
| —Interest and sinking fund | 2,688,496 | | 2,792,880 | |
| —Traffic authority fund | 375,375 | | 419,846 | |
| —Tourist fund | 750,749 | | 839,693 | |
| —Transport regulation fund | 621,528 | | 602,256 | |
| —M.M.B.W. (liability transferred under Act 8573) | | 37,548,493 | 371,447 | 45,800,708 |
| Commercial Goods Vehicle Act | | 10,037,593 | | 10,132,146 |
| Municipalities contributions | | 2,047,269 | | 2,232,860 |
| Loan funds | | 300,000 | | 325,000 |
| Special grant from State treasury | | 772,371 | | 427,000 |
| General receipts | | 1,247,398 | | 1,524,877 |
| Allocation from Roads (Special Projects) Fund | | 30,428,673 | | 30,192,191 |
| | | 82,381,797 | | 90,634,782 |
| Balance brought forward at 1st July | | 831,610 | | 657,228 |
| | | 83,213,407 | | 91,292,010 |
| **Receipts under Commonwealth grants** | | | | |
| Regional employment development scheme | | 133,583 | | 701,864 |
| Traffic engineering and road safety | | 172,217 | | 129,616 |
| General employment purposes | | 3,000,000 | | 1,500,000 |
| | | 3,305,800 | | 2,331,480 |
| **Receipts under National Roads Act 1974** | | | | |
| National highways | | 18,920,000 | | 23,200,000 |
| **Receipts under Road Grants Act 1974** | | | | |
| Urban arterial roads | | 35,890,000 | | 42,590,000 |
| Urban local roads | | 1,670,000 | | 3,200,000 |
| Rural arterial roads | | 4,150,000 | | 5,660,000 |
| Rural local roads | | 13,160,000 | | 11,750,000 |
| Minor traffic engineering and road safety improvements | | 640,000 | | 1,610,000 |
| | | 55,510,000 | | 64,810,000 |
| **Receipts under Transport (Planning & Research) Act 1974** | | 1,241,000 | | 1,790,910 |
| Total funds available for expenditure by the Country Roads Board | | 162,190,207 | | 183,424,400 |
| Less: | | | | |
| Expenditure on planning and research | 2,204,749 | | 3,662,713 | |
| Capital expenditure (plant, workshops, offices, etc.) | 2,589,526 | | 1,547,473 | |
| Salaries, operating a/cs and other admin. expenditure | 21,431,592 | 26,225,867 | 22,931,701 | 28,141,887 |
| Funds available for construction and maintenance of roads and bridges | | 135,964,340 | | 155,282,513 |

## Expenditure

Expenditure in the form of cash payments during the financial year amounted to $180,288,216 leaving balances of $8,162,306 to be carried forward into financial year 1976/77.

The following table shows expenditure incurred by the Board, including that from the Roads (Special Projects) Fund, in the years 1974/75 and 1975/76.

| Item | 1974/75 | 1975/76 |
|---|---|---|
| | $ | $ |
| Construction and maintenance of roads and bridges | 135,307,111 | 147,120,207 |
| Capital expenditure (plant, workshops, offices, etc.) | 2,589,527 | 1,547,473 |
| Planning and research | 2,204,749 | 3,662,713 |
| Salaries, operating accounts and other administrative expenditure | 21,431,592 | 22,931,701 |
| Statutory payments to Traffic Authority Fund, Transport Regulation Fund and Tourist Fund | 1,747,652 | 2,233,242 |
| Interest and Sinking Fund payments | 2,688,496 | 2,792,880 |
| Total | 165,969,127 | 180,288,216 |

## Sharing the costs of roadworks

The Country Roads Act provides that no more than one-half of the amount expended from loan funds and one-third of the amount expended from the Country Roads Board Fund on main roads during the preceding financial year shall be apportioned between the various municipalities benefited thereby. The Act also provides that the amount apportioned to a council in respect of expenditure charged to the Country Roads Board Fund may be reduced where the cost of maintenance is excessive due either to motor traffic not of local origin or to timber traffic. The revenue, valuation, and rating of the municipality and its financial obligations for loan expenditure on permanent works are taken into account in deciding the level of contribution by a council.

In September 1975 expenditure on main roads in financial year 1974/75 was apportioned in accordance with the Country Roads Act, resulting in the following distribution of expenditure other than Loan Fund expenditure:

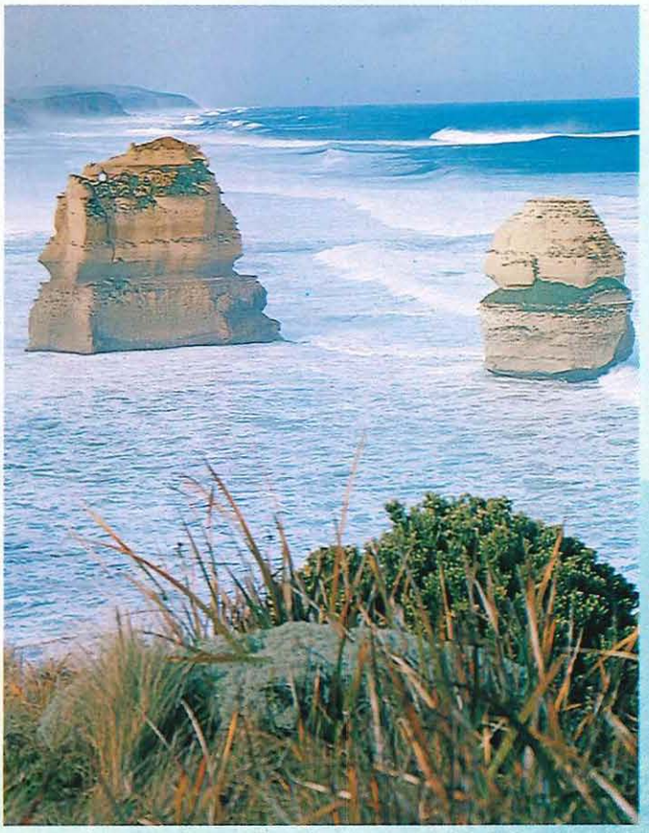
| | |
|---|---|
| Expenditure from Country Roads Board Fund | $13,886,756 |
| Expenditure from Commonwealth funds | 5,368,715 |
| Expenditure from proceeds of ton/mile tax (Commercial Goods Vehicles Act) | 4,294,743 |
| | $23,550,214 |

Amount of Country Roads Board Fund expenditure apportioned to councils $2,208,090

Within the limit of funds available, the Board made allocations to municipal councils for works on unclassified roads. The expenditure incurred from the allocations made by the Board in financial year 1975/76 compared with 1974/75 was as follows:

| | 1974/75 | | 1975/76 | |
|---|---|---|---|---|
| | CRB | Council contribution | CRB | Council contribution |
| | $ | $ | $ | $ |
| Patrol maintenance | 2,200,195 | 937,103 | 2,195,180 | 974,530 |
| Construction, reconstruction and other maintenance | 18,928,299 | 4,642,896 | 22,035,733 | 5,475,677 |
| Total | 21,128,494 | 5,579,999 | 24,230,913 | 6,450,207 |

Municipal councils were not required to contribute towards the cost of works involving an expenditure during the year of $89,051,000 on State highways, freeways, tourists' roads and forest roads (including expenditure from the Roads (Special Projects) Fund).



Roads are the vital link to Victoria's many tourist attractions. Background, Mt. Buffalo in Autumn; Inserts: Top, the southern coast; Below top, snow clearing in winter; Below, new Rest Area on the South Australian-Victorian border.

# The declared road system

The total length of roads declared or proclaimed in Victoria under the Country Roads Act was 23,893 km as at 30th June, 1976.

| '000s kms | 0 2 4 6 8 10 12 14 16 18 20 22 24 |
|---|---|
| State Highways | 7,108 |
| Freeways | 220 |
| Tourists' Roads | 825 |
| Forest Roads | 1,060 |
| Main Roads | 14,680 |
| Total length of declared road system | 23,893 |

## State Highways

State highways are the principal arteries forming interstate connections and links between the larger centres of population in the State. Some State highways in Victoria form part of the National Route system of highways with uniform route numbering throughout Australia. The Board bears the full cost of both construction and maintenance works required to meet the needs of through traffic. The total length of State highways was 7,108 km.

The total expenditure of $30,972,000 on Victoria's 32 State highways during the year included an amount of $2,181,000 made available from the Roads (Special Projects) Fund.

Appendix 1 includes a list of State highways declared by the Board, and details of the more significant works completed during the year on State highways are given in Appendix 2.

The Hume Highway/Freeway and the Western Highway/Freeway have been declared by the Commonwealth Minister for Transport as national highways under the provisions of the Commonwealth National Roads Act. These declarations permitted funds made available under the Commonwealth National Roads Act to be spent on the Hume Highway/Freeway and the Western Highway/Freeway. During the year $15,052,000 from Commonwealth sources and $4,699,000 from State sources was spent on these two State highways/freeways.

## Freeways

A freeway is a road having dual carriageways with no direct access from adjoining properties and side roads. All crossings of a freeway are by means of overpass or underpass bridges, and traffic enters or leaves the freeway carriageway by means of carefully designed ramps.

The Board bears the total cost of all work on freeways.

The total expenditure of $54,983,000 on freeways during the year included an amount of $20,224,000 made available from the Roads (Special Projects) Fund.

The table in Appendix 1 lists the freeways constructed by the Board and opened to traffic. The significant works completed during the year are shown in Appendix 2.

## Tourists' roads

Tourists' roads proclaimed under the provisions of the Country Roads Act provide access to places of special interest to tourists, both in summer and winter. The Board bears the full cost of works required to cater for the needs of through traffic. In general the works are carried out under the direct supervision of the Board's staff.

Details of the more significant works carried out on tourists' roads during the year are listed in Appendix 3.

The table in Appendix 1 lists the tourists' roads proclaimed under the provisions of the Country Roads Act.

## Forest roads

Forest roads proclaimed under the provisions of the Country Roads Act are situated within or adjacent to any State forest or in areas which are considered by the Board to be timbered, mountainous or undeveloped. The Board bears the full cost of works required to cater for the needs of through traffic, with approximately half the work carried out on these roads being undertaken by municipal councils on behalf of the Board.

Appendix 3 lists the more important works completed during the year. The table in Appendix 1 lists the forest roads proclaimed under the provisions of the Country Roads Act.

## Main roads

Main roads are roads linking centres of population with other centres or with areas of industry, commerce, or settlement. Generally main roads are constructed and maintained by municipal councils to the satisfaction of, and with financial assistance from the Board. In some cases, at the request of the council and with the approval of the Minister, works are carried out under the direct supervision of the Board's staff.

A summary of the more important works on main roads completed during the year is given in Appendix 4.

## Unclassified roads

Roads which are not included in the Board's declared and proclaimed road system are referred to as unclassified roads. These roads are the responsibility of municipal councils, but each year the Board provides financial assistance towards the cost of construction and maintenance works, generally in accordance with priorities allotted by municipal councils.

Municipal contributions are determined at the time the allocation is made, and are based on many factors including the nature, extent, and location of the particular work and the financial position of the municipality concerned.

A list of the more significant works on unclassified roads carried out during the year with financial assistance from the Board appears in Appendix 5.

# Planning for the future in the metropolitan area

## Major road improvements

The Board made further progress during the year in the development of a plan outlining major road improvements needed to improve conditions for motorists in the metropolitan area of Melbourne.

Three major projects have emerged as having the highest priority for immediate construction, viz.:

—the easterly extension of the Lower Yarra Freeway;
—the widening of the Nepean Highway between Cochrane Street, Elsternwick, and South Road, Moorabbin;
—the extension of the Eastern Freeway from Bulleen Road to Doncaster Road, North Balwyn.

A brief description of these projects and the reasons for their high priorities are as follows:

**Easterly extension of Lower Yarra Freeway (Freeway F9)**

The easterly extension of the F9 Freeway from Graham St. together with the completion of the West Gate bridge and the Johnson Street bridge will provide improved connections to the western suburbs, by-passing the city centre to the south. The route of the freeway extension generally follows the existing Melbourne Metropolitan Planning Scheme main road reservation, passing through industrial areas to the west of the Port Melbourne railway, and predominantly commercial sites nearer Kingsway.

The disruptive effects to property along the freeway route have been minimized by the planning scheme reservation, and the prevalence of Crown licences and Crown leases.

For people in the western suburbs, the new route will mean greatly increased ease of access to the community facilities south of the city, including the National Gallery, Botanic Gardens, the Domain, and the Sidney Myer Music Bowl. The link will attract through traffic and therefore draw traffic away from residential streets in the western suburbs and South Melbourne and Port Melbourne.

Eight traffic lanes at ground level will be provided from Graham Street to Johnson Street. From Johnson Street the freeway will be elevated to east of Kingsway, with a basic six lane configuration. Beyond Kingsway there will be an arterial road connection along Grant Street to St Kilda Road. Interchanges will be provided at Graham Street, Port Melbourne, and at Johnson Street and Kingsway in South Melbourne. Connection to Sturt Street and Power Street will provide access to Alexandra Avenue.

**Environmental study: Freeway F9**

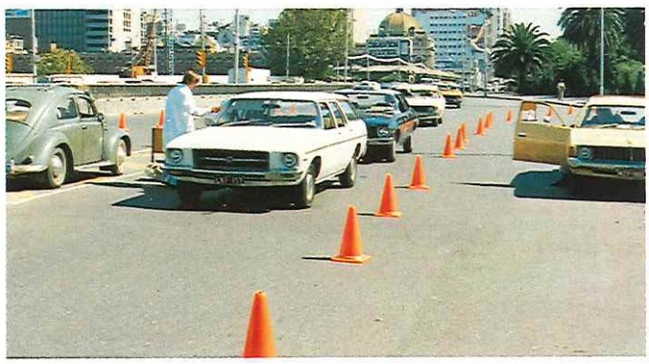
A land use and environmental study was commenced with the following objectives:

—to consolidate local traffic management proposals prepared by councils and designed to protect areas susceptible to future traffic intrusion, so that area-wide effects can be evaluated;
—to formulate suggested guidelines for the future development along the F9 corridor; and
—to assess the impact of the F9 route.

The parties involved in the study include:

—The Country Roads Board
—South Melbourne Council
—Port Melbourne Council
—The Emerald Hill Liaison Committee
—The Housing Commission of Victoria
—The Melbourne and Metropolitan Board of Works
—The Town and Country Planning Board
—The Ministry of Transport
—The Ministry of Conservation
—The Environment Protection Authority
—The Centre for Environmental Studies, Melbourne University


During February and March, 1976, the Board carried out an extensive traffic survey in the St Kilda, South Melbourne, Port Melbourne and Melbourne areas. The results of this survey will assist in the detailed design of the freeway and provide background information for the environmental study.



**Nepean Highway**

The section of the Nepean Highway between Cochrane Street, Elsternwick, and South Road, Moorabbin, is a bottleneck on this major access road through the southern suburbs. The construction of dual carriageways on this section will substantially assist motorists and also benefit nearby residents by reducing traffic volumes on other roads in the vicinity.

At present about 27,300 vehicles use the Elsternwick-Moorabbin section of the highway between 7 am. and 7 pm. each weekday. During the same period the parallel section of Beach Road carries in excess of 15,500 vehicles.

The project will provide dual carriageways each containing four lanes for traffic in each direction plus a service road, where needed along the eastern side.

**Eastern Freeway—extension from Bulleen Road to Doncaster Road**

The extension of the Eastern Freeway from Bulleen Road to Doncaster Road, a distance of approximately 2.7 km, will further improve access to the expanding eastern suburbs. In addition, it will remove traffic from local residential streets.

The route generally follows the road reservation along the Koonung Creek valley in the Melbourne Metropolitan Planning Scheme. Dual carriageways each with two traffic lanes are proposed for construction.

Present indications are that because of financial constraints it will not be possible to construct the extension of the Lower Yarra Freeway, the widening of the Nepean Highway, and the extension of the Eastern Freeway at the same time and it will be necessary to programme construction of these three projects to suit the finance available.

Part of the section of Nepean Highway to be widened, looking north towards the city.

Other major projects for which planning will be continued are:

**Mulgrave Freeway–extension from Forster Road to Warrigal Road**
Extension of the Mulgrave Freeway from Forster Road to Warrigal Road will substantially improve the freeway's effectiveness. The existing Mulgrave Freeway easterly from Springvale Road provides a by-pass function of Dandenong for traffic destined for the Latrobe Valley and Gippsland. The Princes Highway East through the Latrobe Valley is one of the most heavily trafficked rural highways in the State, and a substantial portion of this traffic is generated in the metropolitan area.
Completed works and extensions of the freeway from Springvale Road to Forster Road, Mount Waverley, will cost in the vicinity of $40 million.
Studies are being undertaken on the need for a road connection from the Mulgrave Freeway at Warrigal Road to the South Eastern Freeway at Tooronga.

**Dandenong Road, Malvern (Princes Highway East)**
Dandenong Road between Glenferrie Road and Burke Road is the last remaining single carriageway section between the St Kilda Junction and Dandenong. In 1975 a traffic survey recorded 26,000 vehicles per day passing through this bottleneck section of the Highway.
The work planned by the Board to provide dual carriageways will improve traffic flow along Dandenong Road, and improve the various intersections along the length.

**Bridge Road, Richmond**
The Board has developed three alternative widening schemes to remove the bottleneck in Bridge Road, between Punt Road and Church Street.
The plans were forwarded to the Richmond City Council which has indicated its preference for the scheme favoured by the Board, being to provide a similar width of road to Bridge Road east of Church Street. A final scheme has not yet been recommended to the Government.

**Greensborough Freeway**
The Greensborough Freeway, north from Watsonia, will provide a by-pass of the Greensborough shopping complex for through traffic and provide access to the developing residential areas around Diamond Creek.
Works currently under way will lower the railway under Watsonia Road and Grimshaw Street, and eliminate three railway level crossings.

**Hume Freeway (Craigieburn to Eastern Freeway)**
Traffic destined for the Hume Highway from the metropolitan area, especially the eastern suburbs, is creating environmental and traffic problems in the inner and northern suburbs. The solution to the problem is neither simple nor cheap, and the sociological town planning, environmental, economic and engineering issues will need to be resolved in conjunction with all parties affected.

**Calder Freeway (Keilor Section)**
A freeway by-pass of Keilor township will remove traffic from the Keilor commercial centre and assist residents, shoppers and through traffic. The by-pass will join the Niddrie Section of the Calder Freeway and serve the developing areas of Melton and Sunbury and traffic destined for Bendigo.

**Western Highway–Braybrook**
The construction of dual carriageways is needed on the Western Highway between the Princes Highway West and Ashley Street to provide adequately for the average 20,000 vehicles during daylight hours.
The Western Highway is the main western outlet from the metropolitan area.

## Road planning studies

The road planning function of the Board is an essential and highly sophisticated operation, involving all of the many diverse skills required to reach a compatible balance between the community's desire for mobility and its various other needs. The staff of the Board's Environmental Studies Section brings together the sociological, economic, town planning and engineering expertise in evaluating and formulating future road proposals. Specially trained officers in the Board's service, together with specialised equipment, are also able to provide technological advice on pollution, noise, landscaping and general environmental matters.
Four significant road planning studies in which the Board was involved were carried out during the year, and are described below.

**Eastern Corridor study–Bulleen to Ringwood**
In January 1976, the Government approved the recommendations of the Eastern Corridor Study drawn up by a Management Group of representatives of the Country Roads Board, Melbourne and Metropolitan Board of Works, Ministry of Conservation, Ministry of Planning and the Ministry of Transport.
The Management Group, with the assistance of consultants, carried out a comprehensive study of the eastern corridor transport needs, covering a wide range of options and transport possibilities to cater for present and future needs.
Some of the recommendations were:
- the extension of the Eastern Freeway to Doncaster Road as a four lane arterial road. This would reduce traffic on Thompsons Road and Manningham Road and lessen the infiltration of traffic through neighbouring residential areas;
- the co-ordination of traffic signals on the Maroondah Highway through the Ringwood area to improve traffic flow;
- the construction of a road along the Bushy Creek drain in the Melbourne Metropolitan Planning Scheme secondary road reservation to connect Springfield Road and Belmore Road, Box Hill;
- the reservation of land for the future extension of Reynolds Road from Templestowe to the Maroondah Highway via Wonga Road and Plymouth Road, Croydon North;
- the railway level crossing eliminations programme should continue along the Ringwood railway line to improve north-south traffic movements.

The Management Group also concluded that:
- investigations have shown that a six lane freeway from the Eastern Freeway, at Doncaster Road, to the proposed

Scoresby Freeway, at Maroondah Highway, Ringwood, plus a six lane arterial road by-pass of Ringwood, is warranted, as part of a long term solution. The route would best be located generally within the existing Planning Scheme Reservation, along the Koonung and Mullum Mullum Creeks;

—arterial road discontinuities exist between Mont Albert Road and Barkers Road at Burke Road and between Blackburn Road and Surrey Road at Blackburn. They are not major urban projects and while they are not specifically recommended, the study did recommend that their priorities should be reviewed.

**Western Highway Corridor–Melbourne suburbs**

Various freeway and arterial road options in Melbourne's western suburbs were the subject of traffic studies during the year. The studies are being carried out by the Board's Road Planning Division and the Joint Road Planning Group, comprising officers of the Ministry of Transport, Melbourne and Metropolitan Board of Works and the Country Roads Board.

The two major options for linking the Western Freeway into the suburban road network are a northern route near St. Albans and a southern route to the south of Ardeer. No choice has yet been made between the two alternatives, as the strategic implications are still being assessed.

**Eastern Freeway–Western approaches**

The study into the effects and impact of the Eastern Freeway on the cities of Collingwood, Fitzroy and Melbourne was completed by the consultant firm Llewelyn-Davies Kinhill Pty. Ltd., under the direction of a Steering Committee composed of representatives from the three municipal councils concerned, the Ministry of Transport and the Board.

The consultant used extensive data supplied by the Board and the councils, and in addition collected other data relating to social characteristics, air pollution, traffic noise levels and business and economic activity, to enable an assessment of the environmental, social and transport effects of the Eastern Freeway in the study area.

The study involved assessing the effects from the date of opening the Eastern Freeway in 1977 up to the mid 1980s of:

—four alternative developments for the western end of the freeway, viz.: a T Junction of 4, 6 or 8 lanes along Alexandra Parade;

—a possible new arterial road connection from the freeway to the Park Street-Brunswick Road corridor, in the medium term (up to 1985);

—a possible Hume Freeway F2 connection to the Eastern Freeway, in the long term (beyond 1985).

The consultant was required to make recommendations on measures to minimize adverse effects and to ameliorate any unavoidable adverse effects. In addition, during the progress of the study, the consultant was instructed to carry out an assessment of the conditions which would have prevailed if the freeway had not been built. Following consideration of the consultant's report by all interested organizations and the public, the Steering Committee will make its recommendations.

**Outer Ring Corridor**

A study was commenced into the strategic significance of a new transport route around the main built-up area of Melbourne. The findings of the study, into what is known as the Outer Ring Road, should be known late in the 1976 calendar year.

The consulting firm of P. G. Pak Poy and Associates Pty. Ltd. and a number of sub-consultants have been retained for this study. The consultants are being supervised by the Road Planning Liaison Committee consisting of representatives of the Board, the Ministry of Transport and the Melbourne and Metropolitan Board of Works. The comments of other transport authorities are also being obtained.

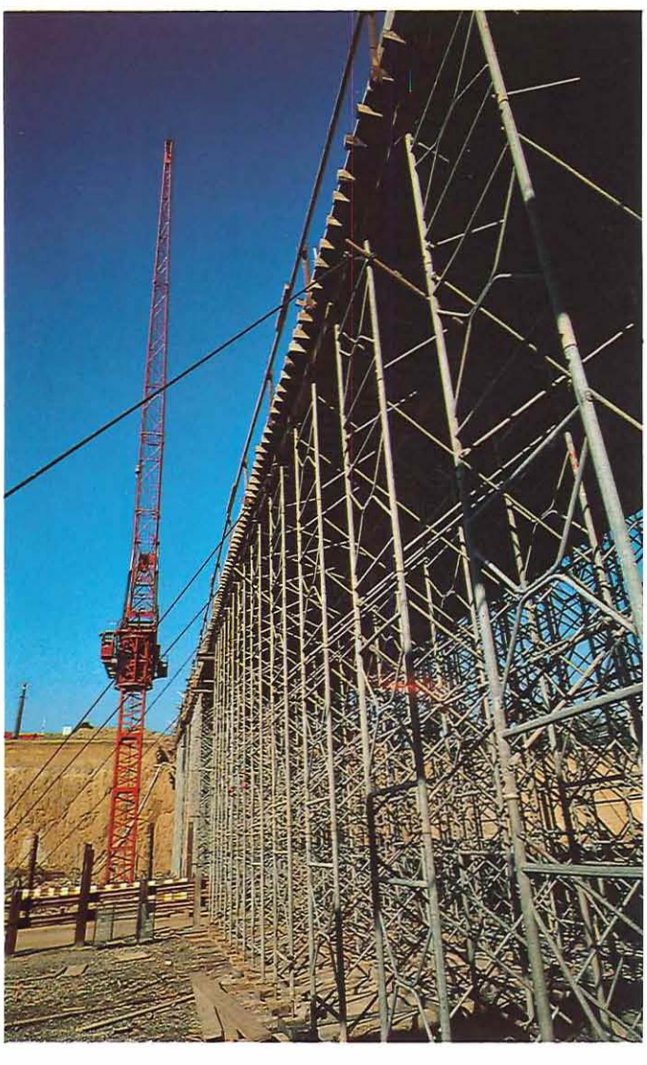
In the Melbourne Metropolitan Planning Scheme a main road reservation has existed for a number of years, connecting the Princes Highway at Brooklyn with Greensborough Road at Diamond Creek via a circular route passing through Sunshine, Broadmeadows and Thomastown. A similar reservation exists connecting the Maroondah Highway west of Ringwood, southwards through Scoresby and Springvale to Frankston.

These planning scheme reservations make provision for a circular route around the built-up area of Melbourne, except for a section between Diamond Creek and Ringwood. A preliminary examination of the desirability of connecting these reservations indicates that a route crossing the Yarra Valley and through an area of environmental significance would be necessary.

The first step has been to study the strategic implications of the construction of an outer ring transportation facility on the future growth of Melbourne. The study has therefore been expanded to examine the strategic effects of constructing alternative types of transport facilities such as a freeway, an arterial road and/or public transport facilities in the outer ring corridor.

Bridge Road, the Board has developed three widening proposals, which are under consideration.

The Eastern Freeway, Collingwood to Bulleen Section, under construction.



# Road construction and maintenance

Mulgrave Freeway under construction, west of Blackburn Road.

## Construction of freeways and dual carriageway roads

Again the Board's construction programme was severely hampered because of limited finance. Notwithstanding this the Board was able to complete the construction of 46 km of additional dual carriageways on freeways and State highways during the year. This increased the total length of dual carriageways on freeways, State highways and main roads to 649 km.

In addition to the Hume Freeway (Wallan to Broadford Section) and the Western Freeway (Myrniong Section) referred to in the Review section of this Annual Report, the more important dual carriageway projects completed or in progress during the year were:

### Urban

**Eastern Freeway**

The construction of the Eastern Freeway between Hoddle Street, Collingwood, and Bulleen Road, Bulleen, a distance of nine kilometres, continued during the year. This section of the freeway will be generally of eight lane capacity, with a ten lane capacity between the Merri Creek and the Chandler Highway interchange. The central reservation is designed to cater for a fixed rail public transport system to serve the East Doncaster area. The Yarra Bend Park and Clifton Hill Railway overpasses were opened to traffic during the year and work on the remaining bridge structures and the freeway carriageways progressed satisfactorily. The freeway is expected to be opened to traffic late in 1977. The total cost for this first section of the Eastern Freeway is estimated to exceed $80 million.

**South Gippsland Freeway**

Construction works continued on the southerly extension of the South Gippsland Freeway from the Princes Highway East to the South Gippsland Highway at Hampton Park. The first stage of this 3.7 kilometre section of freeway, connecting to the existing Mulgrave Freeway, is expected to be opened to traffic late in 1976.

**Mulgrave Freeway**

Work progressed on the construction of 3.5 kilometres of the Mulgrave Freeway between Springvale Road, Mulgrave, and Forster Road, Mount Waverley. This section of freeway is expected to be opened to traffic early in 1977. The Stanley Avenue overpass of the freeway at East Oakleigh was opened to traffic in December, 1975. Construction proceeded on the freeway carriageways and bridge structures at Ferntree Gully Road, Blackburn Road and Forster Road.

**Tullamarine Freeway**

Work associated with the upgrading to freeway standard of Lancefield Road adjacent to the Essendon Airport commenced. A pedestrian overpass at Vaughan Street was completed in late June, 1976, and temporary traffic signals were installed on Lancefield Road near Parer Street. A pedestrian overpass at Bristol Street was almost completed. Work on the upgrading of Lancefield Road, esti
available.

Mulgrave Freeway bridge over Ferntree Gully Road.

mated t

Mahoneys Road, Campbellfield to Thomastown.

Hume Freeway, Violet Town to Baddaginnie.

**Greensborough Freeway**
Work progressed on a $4.5 million road-rail project to abolish three railway level crossings in Watsonia. Road over rail overpasses at Watsonia Road and Grimshaw Street were commenced as part of the overall works associated with the freeway.

**Princes Freeway (Geelong Road)**
Work progressed on the widening of the Princes Freeway to three lanes in each direction from the Lower Yarra Freeway to the Maltby By-pass Road near Werribee, a distance of 12 kilometres. The project is estimated to cost $4.1 million. The first section from the Lower Yarra Freeway to Point Cook Road was completed late in 1975.
The Princes Highway West is also being widened to three lanes in each direction between McDonalds Road and the Old Geelong Road, Brooklyn. This work is scheduled for completion in October 1976, and is estimated to cost $550,000.

**Nepean Highway, Mentone**
Work was completed in September, 1975, on the widening of the Nepean Highway to three lanes in each direction between Centre Dandenong Road, Cheltenham, and Lower Dandenong Road, Mentone. The widening of this section of the highway cost $1.3 million.

**Mahoneys Road**
The construction of three lane, dual carriageways in Mahoneys Road between the Hume Highway, Campbellfield, and High Street, Thomastown, continued. The sections from the Hume Highway to Phillip Street, Reservoir, and from High Street to the Central Creek were opened to traffic. Work on the remaining section between Phillip Street and the Central Creek is expected to be completed early in 1977. The total cost of the project is estimated to be $3.5 million.

**Johnson Street Bridge, South Melbourne**
Work progressed on the Johnson Street Bridge over the Yarra River to link the proposed F9 freeway with Footscray Road. Satisfactory progress was achieved with the construction of the bridge cylinder foundations 46 metres deep and the construction of the necessary approach roads. The project is expected to be completed late in 1978.

**Mornington Peninsula Freeway**
Construction continued on a section of the Mornington Peninsula Freeway between Springvale Road, Keysborough, and the Frankston Freeway at Seaford. The new freeway, running parallel to Wells Road, will improve access to the bayside suburbs and the holiday resorts on the Mornington Peninsula. The Board expects to open a section of the new work from Frankston Freeway to Eel Race Road during October, 1976, by constructing a temporary connection to Wells Road.
A 1975 traffic survey recorded 20,000 vehicles travelling along Wells Road and Nepean Highway during daylight hours. The new freeway will cater for a large number of these vehicles.

Johnson Street Bridge, South Melbourne.

## Rural

**Hume Freeway, Violet Town–Baddaginnie**
Work began on the construction of a section of the Hume Freeway between Violet Town and Baddaginnie. A second carriageway is being constructed adjacent to the existing highway over a distance of 10 kilometres. The formation of earthwork progressed satisfactorily and the project is scheduled for completion in mid 1977 at an estimated cost of $3.8 million at 1976 prices.

**Hume Highway, Wodonga**
Work on widening the Lincoln Causeway between Wodonga and the State border at the Murray River was substantially completed during the year. The project included the widening of four bridges and the connecting causeways to provide two lanes for traffic in each direction. The estimated cost of the project is $1.6 million.

**Western Freeway, Ballan**
Construction commenced on a nine kilometre section of freeway by-passing the township of Ballan. This freeway will provide two lanes for traffic in each direction and will connect the Pykes Creek and Gordon sections of the Western Freeway. Earthworks and bridge construction progressed satisfactorily and the work is scheduled for completion in 1978 at an estimated cost of $8 million at 1976 prices.

**Princes Highway East**
Work was completed on the Princes Highway East through the township of Beaconsfield to provide two lanes for traffic in each direction. The provision of dual carriageways will continue between Beaconsfield and Officer. Further to the east work progressed on the provision of dual carriageways between Morwell and Traralgon. This work involves the construction of a second carriageway for a distance of 9.3 kilometres, the reconstruction of 5.5 kilometres of the existing carriageway and the construction of a second bridge across Waterhole Creek.
The
cost of $2.25 million at 1976 prices.

**Princes Freeway, Drouin to Warragul Section**
Preliminary works began on the construction of the Princes Freeway, by-passing the townships of Drouin and Warragul, a distance of 15 kilometres. Dual carriageways will be provided on a two kilometre section of the existing Princes Highway to form part of a freeway interchange two kilometres east of Drouin.
The project is scheduled for completion in 1982 at an estimated cost of $31 million at 1976 prices.

**Bellarine Highway**
Duplication of the Bellarine Highway between Christies Road and Bawtree Road, near Leopold, was completed during the year. The project covered 1.7 km and cost $245,000.

# Contracts

**Contracts under the Board's supervision**

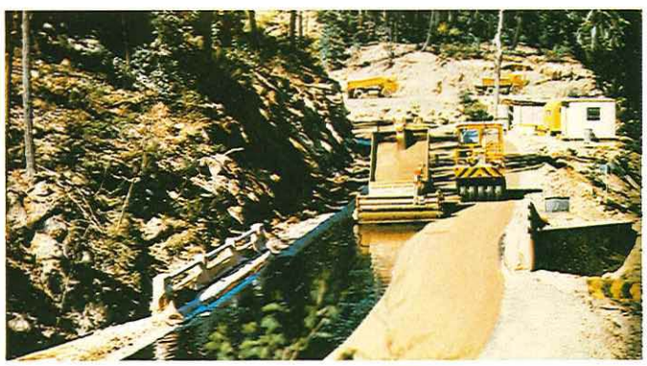
The value of new contracts awarded during the year reflected the reduced funds available for construction work. The price adjustment clauses introduced by the Board in financial year 1974/75 has met the objective of reducing tendering risks which were inherent in fixed price contracts being performed during the present inflationary climate.

Details of the types and numbers of contracts entered into during the year showing their respective values together with a comparison with those awarded in 1974/75 are shown in the following table.

**Contracts under councils' supervision**

During the year the Board approved the acceptance by municipal councils of 156 tenders for a total amount of $7,525,247 for road and bridge works for which the Board allocated funds in whole or in part. In financial year 1974/75, 198 tenders were approved for a total amount of $8,305,962. The Board also approved the use of 63 municipal contracts for the supply of materials for works partly financed from funds provided by the Board compared with 77 last year.

| | 1975/76 | | 1974/75 | |
|---|---|---|---|---|
| Type of contract | No. of contracts | Value $ | No. of contracts | Value $ |
| Road construction– | | | | |
| 1. Over $1M | – | | – | |
| 2. $100,000 to $1M | 3 | 590,390 | 2 | 1,313,472 |
| 3. Under $100,000 | – | | 1 | 33,000 |
| Supply of road-making materials | 134 | 4,825,667 | 88 | 2,931,605 |
| Bituminous treatment and supply of materials | 62 | 10,024,524 | 45 | 4,009,145 |
| Bridge construction– | | | | |
| 1. Over $1M | – | | 3 | 16,503,382 |
| 2. $100,000 to $1M | 7 | 2,715,629 | 7 | 1,317,133 |
| 3. Under $100,000 | 5 | 325,689 | 19 | 1,127,179 |
| Components and Fabricated Steel | 22 | 1,169,859 | 20 | 1,124,517 |
| Construction Equipment | 16 | 665,055 | 16 | 1,011,737 |
| Divisional Facilities | 2 | 65,724 | 7 | 287,535 |
| Stores | 13 | 1,600,676 | 12 | 2,096,800 |
| Miscellaneous Services | 28 | 1,131,060 | 29 | 2,210,014 |
| Total | 292 | $23,114,273 | 249 | $33,965,519 |



Sprayed bituminous surfacing.

## Bituminous surfacing

Bituminous surfacing is an important part of road construction and maintenance work. It confers the following benefits to the road user:

—Provides a dust free, skid resistant, non-glare surface over a long period.

—Reduces the tractive effort required by a vehicle travelling on the road.

—Provides and maintains good road-riding qualities.

Bituminous surfacing work is broadly classified into two main types:

—*The sprayed type* of bituminous surfacing is normally provided by spraying a bituminous binder from a mobile sprayer and immediately covering it with a layer of uniformly spread aggregate which is compacted by rolling.

—*The plantmix type* of bituminous surfacing is normally provided by spreading a layer of material with a mechanical paver. The most commonly used type of plantmix is 'asphalt' which consists of a mixture of aggregate and bitumen. Asphalt is produced at a fixed plant and is mixed, spread and compacted while hot.

Plantmix.

The total length of bituminous surfacing, including both sprayed work and plantmix work, completed during the year amounted to 4371 km at an approximate cost of $19,700,000. The Board's 17 mobile bituminous surfacing units, together with plant owned by municipal councils and contractors, completed 4201 km of sprayed work at a cost of approximately $13,560,000.
Contractors operating from fixed asphalt plants completed 170 km of plant mix work on densely trafficked roads at a cost of approximately $6,144,000 using 302,000 tonnes of asphalt.
The lengths of the various types of work completed during the year were:
125 km of sealing widened pavements,
39 km of initial sealing on dual carriageways,
597 km of restoration of sealed coats on reconstruction sections,
516 km of final sealing on initial treatments,
2383 km of maintenance retreatments,
265 km sealed on behalf of other State and municipal authorities, and
446 km of extensions to the bituminous sealed road system of the State including 66 km of roads declared or proclaimed under the Country Roads Act.

The following quantities of materials were used by the Board or by contractors during the year on bituminous surfacing works:

| Material | Quantity |
|---|---|
| Bitumen for sprayed work | 29,000 tonnes |
| Bitumen for asphalt | 16,000 tonnes |
| Aggregate for sprayed work | 249,800 cubic metres |
| Aggregate for asphalt | 210,000 cubic metres |
| Other bituminous materials for sprayed work and maintenance | 11,000 tonnes |

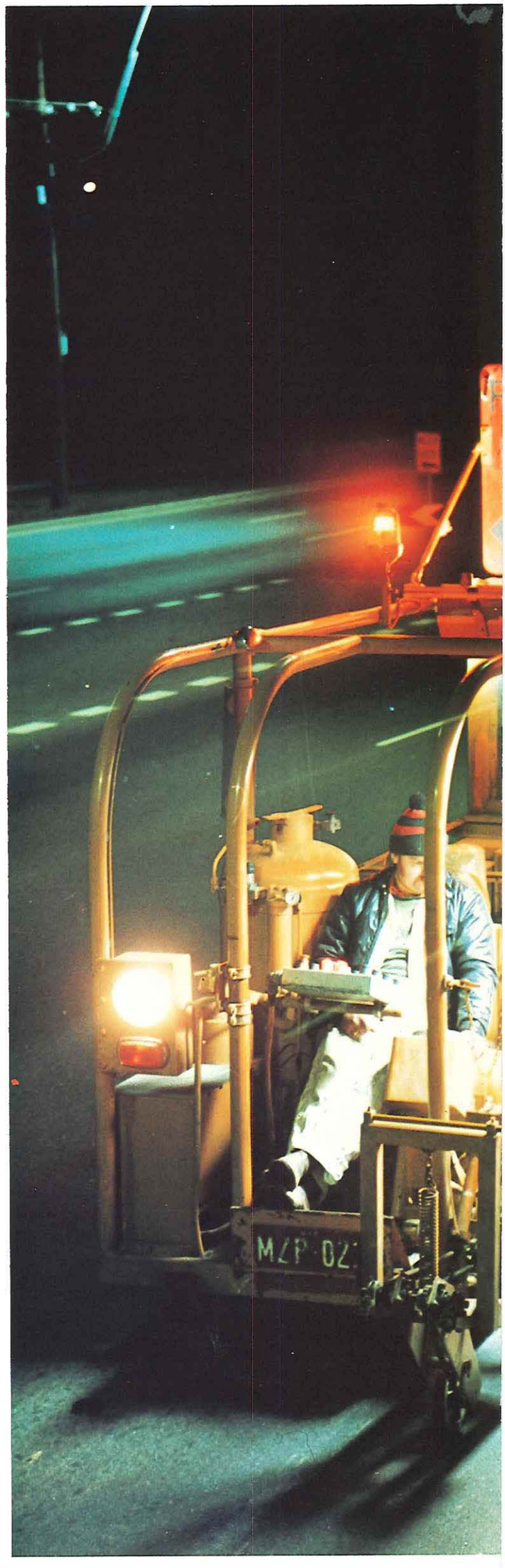
The total length of sealed roads in the Board's declared or proclaimed road network is 21,779 km or 92% of the total length of declared or proclaimed roads.

## Linemarking

The flexibility of the Board's linemarking operations was significantly increased during the year by the production of a new linemarking machine especially designed to meet the requirements of the METCON pavement markings.
The new machine was completely developed and built at the Board's central workshop at Syndal to provide the high degree of manoeuvrability required. The linemarker can repaint up to 200 approaches to intersections in a single eight-hour shift, using a specially developed paint which includes reflective glass beads. The cost of repainting an approach to an intersection has been reduced from $15 to less than $7.
The length of linemarking maintained during the year by the Board's linemarking machines was as follows:

| | |
|---|---|
| State highways and freeways | 7419 km |
| Other CRB declared and proclaimed roads | 5309 km |
| Unclassified roads | 1515 km |

The total expenditure incurred on linemarking was $758,923, of which $105,252 was spent maintaining the markings




associated with METCON. This expenditure reflected an increase in the unit cost of approximately 25% due to the increased costs of labour and materials. The unit costs were:

| | 1975/76 | 1974/75 |
|---|---|---|
| Cost per km of standard stripe of 3 m-9 m gap | $22.30 | $16.08 |
| Cost per km of solid stripe of 75 mm | $39.50 | $31.17 |
| Cost per sq. metre of other pavement markings | $4.25 | $4.00 |

**Raised reflective markers**

Raised reflective markers were laid on the Hume Highway, Princes Highway West and Calder Highway during the year. A total 29,241 markers were laid at a cost of $66,380 during the first year of a two-year programme. The markers, designed for freeway use, have substantially improved night driving visibility on the highways.

## Land purchase

One of the pre-requisites to the construction of new roads and widening existing road reserves is the purchase of the necessary land. During the year the Board paid compensation and costs amounting to $16,022,000 to 661 owners of land. Under the provisions of the Country Roads Act the Board is required to make full compensation for the value of land taken or used and for all damages sustained. The main principle adopted by the Board in the assessment of compensation is to ensure as far as possible that the owner is placed in the same financial position after the purchase of land as prior to the purchase.

In order to prevent hardship accruing to owners of property affected by future road works, it is necessary for the Board in some cases to purchase properties well ahead of the time they are required for road construction purposes. These properties are then rented or leased until road construction is imminent.

The table below shows the expenditure incurred in land compensation during 1975/76.

| | Commonwealth road category | | | | | | |
|---|---|---|---|---|---|---|---|
| CRB road classification | National highways | Urban arterial roads | Urban local roads | Rural arterial roads | Rural local roads | Export roads | Totals |
| | $'000 | $'000 | $'000 | $'000 | $'000 | $'000 | $'000 |
| Freeways | 382 | 9,556 | – | 697 | – | – | 10,635 |
| State highways | 99 | 735 | – | 613 | – | – | 1,447 |
| Tourists' roads | – | 3 | – | 13 | 2 | – | 18 |
| Forest roads | – | – | – | – | 5 | – | 5 |
| Main roads | – | 1,194 | – | 239 | 70 | – | 1,503 |
| Unclassified roads | – | 627 | 107 | – | 158 | 1,522 | 2,414 |
| Totals | 481 | 12,115 | 107 | 1,562 | 235 | 1,522 | 16,022 |

The table below shows the number of land purchase transactions completed and the amount of compensation paid over the last five years.

| | 1971/72 | 1972/73 | 1973/74 | 1974/75 | 1975/76 |
|---|---|---|---|---|---|
| Number of land purchase cases settled | 977 | 865 | 864 | 923 | 661 |
| Compensation and associated costs paid by the Board | $5.14m | $10.07m | $11.71m | $19.34m | $16.02m |
| Reimbursement to councils for the purchase of land for unclassified roads | $0.33m | $0.46m | $0.88m | $0.53m | $0.73m |

The Board engages independent qualified valuers to assist in the assessment of compensation. The valuers are required to furnish a current market valuation of land, buildings and other improvements required for road purposes, and also where only part of a property is purchased, the amount of any compensation which should be paid for the reduction in value of the balance of the property due to the Board's works. In order to assist owners to submit claims for compensation, the Board permits owners to obtain a valuation from a valuer of their own choice at the Board's cost.

Other types of expenses incurred by the owner which are taken into account by the Board in assessing the amount of compensation to be paid include legal costs for the discharge of mortgages; legal costs incurred in the actual transfer to the Board of the land concerned and production of the relevant titles; removal costs; costs involved in the transfer of a telephone; other necessary incidental expenses relating to the owners' reinstatement in another home.

Of the $16.02 million expended during the year, $6.55 million was spent in purchasing properties from owners who demonstrated that they were incurring hardship due to the Board's future road proposals. The Board received $1,275,378 from 645 rented residential or commercial properties and 209 separate areas of vacant land. During the year, 23 separate areas of surplus land were sold for $467,905, 17 residential properties surplus to requirements were sold for $508,690 and 39 houses were sold for removal for $90,390.

# Bridges

## Construction of new bridges

The limited funds available during the year greatly reduced the Board's capacity to commence the construction of new bridges under the direct supervision of the Board's staff and to provide finance for bridgeworks under municipal supervision. Seventy-eight new bridges estimated to cost $11,700,000 were commenced compared with 103 in 1974/75 estimated to cost $13,635,000 and 143 in 1973/74 estimated to cost $14.750,000.

The following table gives a comparison between the number and estimated cost of bridge projects begun in 1975/76 and those for the preceding financial year:

| Description | 1974/75 | | 1975/76 | |
|---|---|---|---|---|
| | No. | Est. cost | No. | Est. cost |
| New bridges under the supervision of the Board's staff | 40 | $11,500,000 | 37 | $9,970,000 |
| New bridges under municipal supervision with financial assistance from the Board | 63 | $2,135,000 | 41 | $1,695,000 |
| Total bridges commenced | 103 | $13,635,000 | 78 | $11,665,000 |

Plans were completed for a further 13 bridges estimated to cost $4.9 million but the construction of many of these will need to be deferred owing to lack of funds.

## Major bridges completed in rural areas

Some of the major bridges completed in rural areas during the year under the direct supervision of the Board's staff included:

—Hume Highway–Wodonga-Albury Section (Lincoln Causeway): The four existing bridges on the Lincoln Causeway were widened to provide dual carriageways.

—Princes Freeway–Gunns Gully Interchange–City of Moe: A three span prestressed concrete beam and reinforced concrete bridge 81 m long by 9.1 m between kerbs.

—Great Ocean Road–Sherbrook River Bridge–Shire of Heytesbury: A four span precast high strength U-slab and reinforced concrete bridge 44 m long and 8.5 m between kerbs over the Sherbrook River near Port Campbell.

—Pyrenees Highway–Patterson's Bridge at Forest Creek–City of Castlemaine: Part reconstruction and widening of Patterson's Bridge in Castlemaine to 27 m long by 8.5 m between kerbs plus two 1.8 m footways using precast reinforced concrete beams and reinforced concrete.

—Princes Highway East–Cann River Bridge–Shire of Orbost: A six span prestressed concrete beam and reinforced concrete bridge 121 m long by 9.8 m between kerbs over the Cann River at Cann River.

—Pyrenees Highway–Bet Bet Creek–Shire of Talbot and Clunes: A three span prestressed concrete beam and reinforced concrete bridge 46 m long by 8.5 m between kerbs over the Bet Bet Creek at Bung Bong.

Some of the larger bridges completed during the year under municipal supervision with financial assistance from the Board were:

—Rowe's Bridge–St. Arnaud Creek–Carapooee-Gower East Road, Shire of Kara Kara: A single span precast reinforced concrete slab bridge 10.6 m long and 6.2 m between kerbs.

—McCallum's Bridge–Sutherland's Creek–Anderson's Road, Shire of Corio: A three span precast reinforced concrete slab bridge 32.4 m long and 8.7 m between kerbs.

—Broken River–Ackerly Avenue–City of Benalla: A four span precast reinforced concrete slab bridge 37 m long and 8.5 m between kerbs.

—Latrobe River–Walhalla Road–Shire of Narracan: A five span prestressed concrete beam and reinforced concrete bridge 92 m long and 9.75 m between kerbs.

—Dwyers Creek–Victoria Valley Road–Shire of Dundas: A two span precast reinforced concrete slab bridge 21.9 m long and 9.4 m between kerbs.

## Metropolitan bridges and overpasses

Amongst the larger bridges in the metropolitan area completed during the year under the direct supervision of the Board's staff were:

—Pascoe Vale Road–City of Broadmeadows: A two span prestressed concrete beam and reinforced concrete bridge 60 m long and 18.9 m between kerbs plus one 1.8 m footway over the railway line at Jacana, together with an adjacent pedestrian subway.

—Mahoneys Road–Merri Creek–Cities of Broadmeadows and Preston: A three span prestressed concrete beam and reinforced concrete bridge 52.2 m long and 11 m between kerbs plus two 1.2 m wide kerbs.

—McIntyre Road-Rail Overpass–North Sunshine–City of Sunshine: A four span steel girder and reinforced concrete railway overpass 62 m long and 17.1 m between roadway kerbs plus one 1.8 m footway.

—Hyde Street–Stony Creek–City of Williamstown: A three span precast reinforced concrete slab bridge 34 m long and 14.64 m between kerbs plus two footways 2.7 m and 2.1 m wide.

—Stanley Avenue–Mulgrave Freeway–City of Waverley: A two span prestressed concrete box girder overpass structure 79 m long and 8.5 m between kerbs plus two 1.8 m footways.

New bridge over Bet Bet Creek, Pyrenees Highway.

## Grade separated pedestrian crossings

The Board is involved in the construction of grade separated pedestrian crossings as outlined below:

1. the construction of pedestrian overpasses over freeways or other important arterial roads to improve pedestrian access to areas on either side of the road;
2. the replacement of at-grade school crossings on heavily trafficked roads with pedestrian overpasses or underpasses under the scheme introduced by the Victorian Government in 1965. The scheme provides for:

—applications for subsidies to be submitted to the Board by municipal councils;

—priorities to be decided by the Board and the Road Safety and Traffic Authority in conjunction, taking into account traffic volume, average speed, number and age range of children crossing, and the type of road;

—the total costs of approved crossings to be shared equally between the State Government (Treasury), the Transport Fund and the municipal council;

3. assistance to municipal councils on request in the preparation of plans and specifications and supervision of construction in cases where the Council pays the whole cost of construction.

The following crossings were constructed by the Board during the year:

**Restoration of pedestrian access:**

—Vaughan Street-Lancefield Road–City of Keilor: A three span prestressed and reinforced concrete beam overpass 60.3 m long by 1.8 m wide.

—Bristol Street-Lancefield Road–City of Keilor: A two span prestressed and reinforced concrete beam overpass 83.8 m long and 1.8 m between handrails.

—Jacana Rail Overpass–Pascoe Vale Road–City of Broadmeadows: A reinforced concrete subway through the approach bank to the railway overpass 24.6 m long and 3.1 m internal width.

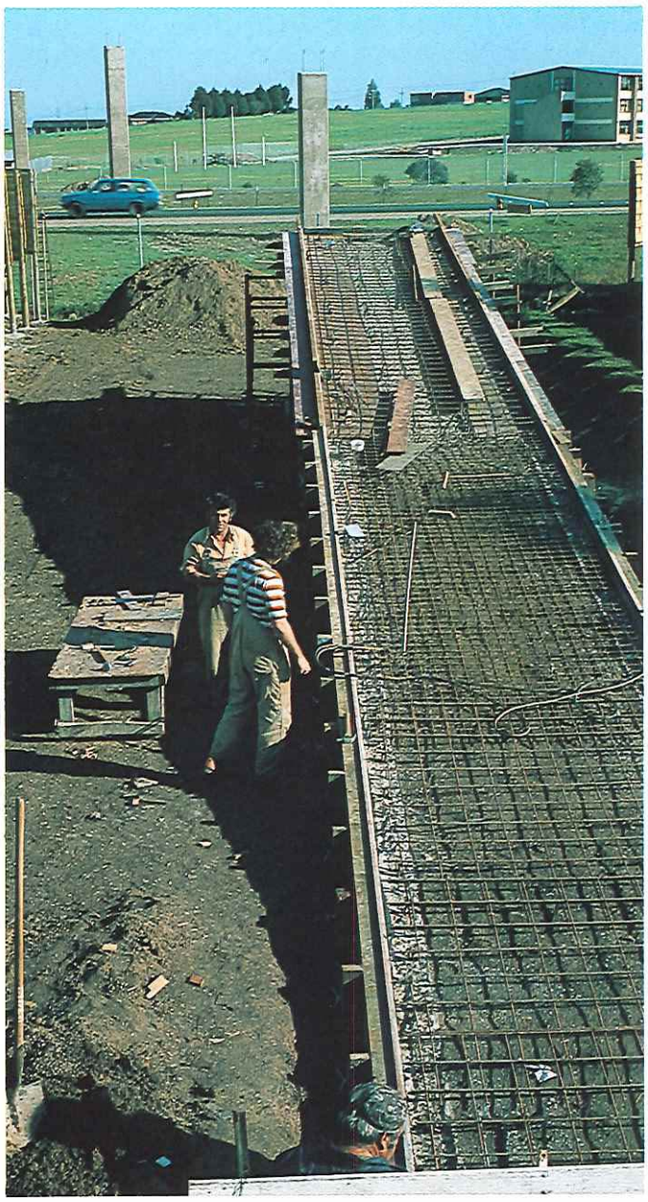
**Grade-separated crossings to serve schools**

Eighteen structures have now been constructed under the Victorian Government's scheme which calls for the financing of the grade separations on the basis of ⅓ Government, ⅓ Board and ⅓ Council. Overpasses completed during the year under the scheme were:

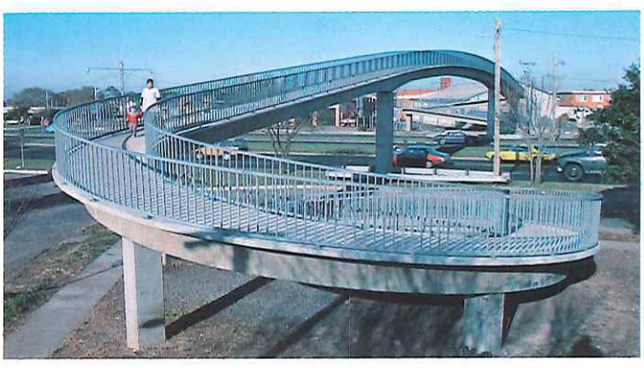
—Dandenong Road at Hornby Street–Cities of Prahran and St. Kilda: A three span prestressed and reinforced concrete beam overpass 59 m long by 1.8 m between handrails.

—Princes Highway East at Gordon Avenue–City of Oakleigh: A three span prestressed concrete beam and reinforced concrete overpass 68.6 m long and 1.9 m clear width between handrails.

Pedestrian overpass under construction, Mulgrave Freeway.



Completed pedestrian overpass, Princes Highway East at Gordon Avenue, Oakleigh.



# Other projects and activities

Construction started on a major level crossing elimination project at Camp Road. Broadmeadows.

## Elimination of railway level crossings

In 1954 the State Government established the Level Crossings Fund with a view to providing finance to assist with the elimination of dangerous railway level crossings. Contributions were made by the Board and the Victorian Railways towards the cost of projects. Since then 62 road overpasses, or underpasses, at a cost of more than $36 million have been constructed to eliminate dangerous railway level crossings.

Since 1st July 1974 the full cost of this work has been charged to the Transport Fund.

Between 1970 and 1974, 419 motor vehicle accidents occurred at railway level crossings in Victoria and as a consequence 114 persons were killed and 536 persons injured. These figures compiled by the Australian Bureau of Statistics–Victorian Office, show that of the 419 accidents, 175 occurred at railway level crossings without a train being involved. The remaining 244 involved trains and 146 of these occurred at unguarded level crossings.

The following projects were completed by the Board during the year:

—a road-over-rail overpass on the Princes Highway at Colac. More than 5,000 vehicles and 14 trains used the old level crossing daily.

—a road-over-rail overpass to carry Melbourne Road over the Newport/Sunshine railway at Spotswood. More than 11,000 vehicles and 40 trains used the old level crossing daily.

Work was commenced on the following projects during the year:

—a road-over-rail overpass in Camp Road, Broadmeadows. The project also includes improvements to the Camp Road/Pascoe Vale Road intersection. The project is estimated to cost $3.7 million at 1976 prices and the overpass is expected to be opened to traffic in late 1977. Associated roadworks at Pascoe Vale Road intersection are expected to be completed in late 1978.

—as part of the Greensborough Freeway project two new road-over-rail overpasses estimated to cost $4.5 million will result in the elimination of three railway level crossings on the Hurstbridge railway line at Watsonia. The overpasses are scheduled for completion early in 1978.

In addition the Board carried out design work on the following projects during the year:

—a road-over-rail overpass to carry Latrobe Terrace over the Melbourne/Geelong railway line in Geelong. The project is estimated to cost $6.2 million at 1976 prices but no firm construction programme has been scheduled.

—a road-over-rail overpass at Weerite, 185 kilometres to the west of Melbourne to carry the Princes Highway over the Warrnambool/Port Fairy railway line. This project is estimated to cost $630,000 at 1976 prices, and work is expected to commence late in 1976. The project is expected to be completed in early 1978.

## National Parks roads

Once again the State Government provided loan funds amounting to $100,000 repayable by the Board for expenditure on roads and associated purposes in or near National Parks.

Allocations were made by the Board after consultation with the National Parks Service for maintenance and other works in or near:

—Brisbane Ranges National Park in Bannockburn Shire
—Bulga National Park in Alberton Shire
—Cape Schanck National Park in Flinders Shire
—Captain James Cook National Park in Orbost Shire
—Ferntree Gully National Park in Sherbrooke Shire
—Fraser National Park in Alexandra Shire
—Glenaladale National Park in Bairnsdale Shire
—Hattah Lakes National Park in Mildura Shire
—Kinglake National Park in Eltham and Whittlesea Shires
—Lind National Park in Orbost Shire
—Little Desert National Park in Dimboola Shire
—Lower Glenelg National Park in Portland Shire
—Mount Buffalo National Park in Bright Shire
—Mount Eccles National Park in Minhamite Shire
—Mount Richmond National Park in Portland Shire
—Organ Pipes National Park in Keilor City and Bulla Shire
—Port Campbell National Park in Heytesbury Shire
—Tarra Valley National Park in Alberton Shire
—The Lakes National Park in Rosedale Shire
—Wilsons Promontory National Park in South Gippsland Shire
—Wyperfeld National Park in Karkarooc Shire

The works consisted of construction and sealing of access roads to and roads within National Parks, parking areas and the maintenance of roads and parking areas already constructed. The works were carried out either by the Board or the local municipal council concerned.

The Government has made loan funds totalling $1,297,000 available for these purposes since 1st July 1963.

## Roads of tourist interest

The State Government increased its usual allocation of $200,000 to an amount of $225,000 for expenditure on roads of a tourist nature other than roads proclaimed as tourists' roads under the provisions of the Country Roads Act. The loan funds are repayable by the Board.

Allocations for particular projects were again made by the Board after consultation with the Ministry of Tourism. The total amount made available by the Government since 1960 is $3,219,000. Applications for financial assistance from these funds far exceed the amount available for expenditure.

Completed level crossing elimination project, Princes Highway West, Colac.

Control of heavy traffic, an important function of the CRB.

The Board is required to make an annual payment into the Tourist Fund amounting to two per cent of the amount credited to the Country Roads Board Fund in the previous year from receipts under the Motor Car Act. An amount of $839,693 was paid during the year. The Tourist Fund is administered by the Ministry of Tourism.

## Municipalities Forest Roads Improvement Fund

The Municipalities Forest Roads Improvement Fund was established in the State Treasury in 1955 for the purpose of assisting municipal councils in the improvement and protection of roads adjacent to State Forest areas to facilitate the extraction of forest produce. An amount of $125,000 was authorized to be contributed to the Fund by the State Government during the year increasing the actual contributions to $735,000 since the inception of the Fund.
Once again the Board's Divisional Engineers combined with the appropriate Forests Commission Officers to determine the priorities of eligible works. Allocations for particular works were made by the Board with the agreement of the Forests Commission.
The limited funds available from the Fund only enable grants to be made for the most urgent works. Unsatisfied applications for funds totalled approximately $400,000.

## Control of heavy traffic

To provide safer conditions for road users and to protect road surfaces, it is necessary for the Government to impose statutory limits on the weight, width, height and length of vehicles and their loads. The Board is the authority responsible for issuing permits for the movement of vehicles and loads exceeding the legal weight, height, length and width on:

—roads declared or proclaimed under the provisions of the Country Roads Act; and

—a journey which includes unclassified roads in two or more greater metropolitan municipalities as defined in the Motor Car Act.

The number and types of permits issued during the year compared with those issued during financial year 1974/75 are shown below:

| | 1974/75 | 1975/76 |
|---|---|---|
| Single trip permits issued | 26,760 | 22,959 |
| Annual permits issued | 3,833 | 4,040 |
| Total number of permits issued | 30,593 | 26,999 |

The decrease in the total number of permits issued results mainly from a reduction in the applications to transport structural items for the building industry.
The number of offence reports submitted was 9,556, an increase of 1,356 (16.5%) as compared to last year.
Of the above reports, 8,846 or 92.6% were successfully prosecuted. Total fines and costs resulting from the above cases amounted to $785,807 which was paid into Consolidated Revenue.

## Thirty-second conference of municipal engineers

The thirty-second conference of municipal engineers was held in the Board's theatrette on 23rd and 25th March 1976. The conference concluded with technical tours of the Mulgrave and South Gippsland Freeways and the Port Melbourne area on 26th March. The Chairman of the Board, Mr R. E. V. Donaldson, was the Conference Chairman. Approximately 260 attended, including the municipal engineers of most Victorian municipalities, municipal engineers from Tasmania, civil engineers from State Government Departments and State Instrumentalities and senior CRB engineers.
The morning sessions consisted of the presentation of papers and panel discussion. The first topic was 'Commonwealth Roads Legislation', the speakers and panel members being: Mr M. J. Pawsey, City Engineer, Berwick, Mr R. J. Nuttall, Shire Engineer, Avoca, Mr N. S. Guerin, the Board's Deputy Engineer in Chief, and Mr R. G. Cooper, the Board's Chief Accountant.
The second topic was 'Some Environmental Aspects of Road Design–Landscaping and Roadside Development'. The Chairman of the panel was Dr R. G. Downes–Director of Conservation, Ministry of Conservation. The other speakers and panel members were: Professor K. J. Polakowski, University of Michigan, Dr J. H. Willis, formerly Assistant Government Botanist, Mr A. Mitchell, Chairman, Soil Conservation Authority, Mr E. V. C. Adamson, Natural Resources League, and Mr G. P. Edwards, Senior Land Management Officer, Department of Crown Lands and Survey.
Other papers and addresses covered a wide range of engineering and technical interests. Mr S. C. Derwent, University of New South Wales, spoke on selected aspects of communication, Mr W. A. Adams, City Engineer, South Melbourne, on 'Traffic Problems in the Inner Metropolitan Area', Mr M. J. Pawsey, City Engineer, Berwick, on 'Pavement and Line Marking–Use of Thermoplastic Material' and Mr C. A. Ackehurst, Special Project Engineer, City of Waverley (formerly City Engineer, Bendigo), on 'Old Gold Mining Town, Conversion to a Provincial City'.
Contributions by CRB engineers included the measurement and control of traffic noise; the NAASRA Economics of Road Vehicle Limits Study, Outdoor Advertising Regulations and new mechanical plant.
The Board expresses its thanks and appreciation to the Local Government Engineers' Association of Victoria for its assistance in planning the Conference, to the contributors of papers and speakers at the Conference, and to the West Gate Bridge Authority and Melbourne Harbor Trust who made their facilities available for the technical tour.

Municipal engineers inspect the Johnson Street Bridge project during their annual conference.

## Visits to municipalities

Each year the Board Members make official visits to a number of municipalities throughout the State. This has been the practice since 1913 when the first Board toured the State to decide which roads should be main roads.
Most municipalities in Victoria are visited at approximately six yearly intervals. These visits include a tour of the municipality's roads, in company with Councillors and council officers, and discussions on local road problems. These visits provide the Board Members with important information about road conditions and developments.
During the year the Board made official visits to 36 municipalities: the Shires of Alexandra, Arapiles, Broadford, Bulla, Daylesford and Glenlyon, Goulburn, Hampden, Healesville, Kaniva, Kilmore, Lowan, Melton, Minhamite, Mortlake, Newstead, Oxley, Seymour, Tullaroop, Upper Yarra, Walpeup, Winchelsea, Woorayl and Yackandandah; the Borough of Koroit; the Town of Camperdown; and the Cities of Altona, Brighton, Castlemaine, Caulfield, Footscray, Geelong, Geelong West, Horsham, Maryborough, Malvern and Newtown.
The Board also met representatives of councils in the Dandenong Division at a meeting in the Nunawading Town Hall to discuss road finance.
The Board places on record its appreciation of the assistance given by all Councillors and municipal officers during these visits.

## Deputations

The Board is always prepared to discuss matters of common interest with representatives of councils or other official bodies. These discussions provide a useful channel of communication between the Board and local administration.
During the year the Board received 29 deputations of which 20 were from municipal councils and the remainder from municipal associations and commercial interests. The principal subjects raised were the general inadequacy of road grants to meet the State's road needs, the allocation of road funds to municipal councils by the Board, land acquisition, contracts and freeway planning.

## National Association of Australian State Road Authorities

The National Association of Australian State Road Authorities (NAASRA) is an organisation consisting of the Heads of the road authorities of tne six States and the Commonwealth Department of Construction which is the road constructing authority for the territories administered by the Commonwealth Government. The aims of NAASRA may be briefly stated as providing uniformity of practice in road and bridge design construction and operation, improved road construction methods and the production and updating of technical manuals to establish standard practices throughout Australia.

The Association also collects and disseminates statistical information relating to traffic, the types and standards of roads, and road finance. The information collected is used in the formulation of national road policies. Meetings of the Authority are normally held at six monthly intervals.
During the year meetings of NAASRA were held as follows:
—54th (Annual Meeting)–Hobart 17-18/11/75 attended by Mr R. E. V. Donaldson, Chairman
—Special Meeting–Canberra 21/1/76 attended by Mr R. E. V. Donaldson, Chairman
—Special Meeting–Melbourne 7/4/76 attended by Mr R. E. V. Donaldson, Chairman, Mr T. H. Russell, Deputy Chairman, and Mr W. S. Brake, Board Member
—55th (Intermediate Meeting)–Melbourne attended by Chairman, Deputy Chairman and Member.

There are a number of specialist committees within NAASRA. Eight of these assist the Principal Technical Committee, which plans and organises the technical work of the Association. The Board's representative on the P.T.C. is Dr K. G. E. Moody, Engineer in Chief.
The financial and administrative functions of the State Road Authorities are covered by the Secretarial and Accounts Committee, the Board's representatives on this Committee being Mr N. L. Allanson, Secretary and Mr R. G. Cooper, Chief Accountant. Additional specialist committees are formed for specific tasks. For example, a NAASRA Sub-Committee is carrying out a feasibility study on the establishment of a data bank system for the storage and processing of data provided by State Road Authorities. Other committees cover a wide field of study, including legal matters, training, transportation planning, programme budgeting, roadside development, pavement testing, national and inter-regional routes and the preparation of technical and general information.
The joint work of the State Road Authorities through these Committees ensures co-ordination of effort, uniformity of approach and a pooling of experience in road and bridge planning, design, construction and maintenance. A National study is being undertaken with the objective of producing guidelines suitable for use by State Road Authorities for establishing appropriate maintenance standards; costing of maintenance work and overall management of maintenance operations.

**Economics of road vehicle limits study**

During the year NAASRA continued and completed its Study of the Economics of Road Vehicle Limits. The objective of the Study was to provide a means of determining the most appropriate legal limits for road vehicles which could be applied nationally or in particular regions. The Study considered all the consequences of varying such limits, so that an optimum balance can be achieved between the advantages to the community from changes in the limits and the full cost to the community of providing for these changes. The main factors considered were: vehicle operating costs; road and bridge construction and maintenance costs; limits on finance for roads; enforcement; uniformity of limits; road safety; special needs of transport users; the effect caused by noise, exhaust emissions and vibration on the environment; effects on other transport modes; and community demand for transport.
Mr T. H. Russell, the Board's Deputy Chairman, was Convener of the Steering Committee for the Study which was carried out by a study team drawn from the State Road

Authorities and ARRB. The study team leader was Mr A. T. Fry, a senior engineer on the Board's staff. The study team consisted of personnel experienced in transport planning, structures, economics and systems analysis. Although the bulk of the data was obtained from State Road Authorities, the views and assistance of individuals and organisations in the transport field was obtained.

## Australian Road Research Board

The Australian Road Research Board was established in 1960. The Board of Directors includes the Heads of the State Road Authorities, the Secretary of the Commonwealth Department of Construction, the Secretary of the Commonwealth Department of Transport, and the Executive Director of ARRB. The Chairmanship of ARRB rotates annually amongst the Directors. Mr R. E. V. Donaldson was Chairman of ARRB from 14th May, 1975, to 19th May, 1976.

The members of the Australian Road Research Board meet twice a year to consider management and policy matters and to review the progress of research projects. Meetings attended by Mr R. E. V. Donaldson were held in Hobart on 19th and 20th November, 1975, and in Melbourne on 19th and 20th May, 1975. Several of the Board's engineers are members of ARRB technical or specialist committees.

Up to 10% of the ARRB's annual expenditure is borne by the Commonwealth Department of Construction and the remainder is shared by the six State Road Authorities on the percentage basis adopted by the Commonwealth Government in making grants to the States under the Commonwealth Roads Grants Act 1974. The major objective of the Board is to co-ordinate, encourage and arrange continuing research into problems associated with roads and traffic in Australia.

There was co-operation between the CRB and ARRB during the year in several areas of practical road research, for example:

—CRB staff laid test sections of ARRB experimental bituminous mixes on the Princes Highway.
—Compaction measurements were taken on sections of the ARRB/CRB experimental sections on the Burwood Highway.
—ARRB compaction equipment was used by CRB staff to prepare experiments for nuclear density measurements.
—Tests were carried out on the Eastern Freeway and the Hume Freeway, with the co-operation of the CRB, in the determination of as-constructed-roughness on bituminous-concrete and other finished surfaces.
—In a Quality Control project (Dimensional Tolerances in Construction) lift thickness measurements were taken on the Western, Hume, South Gippsland and Mulgrave Freeways.
—ARRB Instrumentation Section is developing electronic equipment for road surveys and for white line marking for the CRB.
—CRB freeway construction projects were used by ARRB in the development of a new testing device for measuring construction quality.
—Investigation of calibration procedures for pendulum friction tester and on procedures for polished stone value testing.
—ARRB conducted vibration measurements from pile driving for the CRB, on the Mulgrave Freeway and supplied equipment for measurements at Johnson Street Bridge site.
—Evaluation of foam bitumen stabilised crushed rock was made, using deflection and in-situ stress-strain measuring instruments.

Grants are made to Universities for specific projects where particular facilities and specially skilled research staff are available.

With the growing pressures on resources, both financial and physical, the Australian Road Research Board will have an increasingly important role to play in developing low cost road construction techniques and in making the optimum use of scarce roadmaking materials. For this reason the Australian Road Research Board is now placing greater emphasis on documentation of its findings and thus the information gained is more readily available to practising engineers both within and outside the State Road Authorities.

To further assist the Australian Road Research Board in this wider sphere, the National Association of Australian State Road Authorities has recommended to the Commonwealth Government that ARRB become a member of International Road Research Documentation (IRRD).

## Co-operation with Army Reserve (CMF) – 25 years involvement

The CRB has co-operated with the Australian Army in sponsoring Reserve units of the Royal Australian Engineers for 25 years. The units are the Headquarters 22 Construction Regiment and 107 Plant Squadron (Heavy).

The Commanding Officer of the Regiment is Lt. Col. G. R. Hunt ED, who is the Board's Project Engineer for the Hume Freeway (Wallan-Broadford) project. Thirteen members of the Board's staff are officers of the unit.

The highlight of the 1975 year was the annual camp at Puckapunyal in October, where the unit celebrated its 25th anniversary. About 120 personnel of the Board attended the camp. In addition to the training of recruits, the principal training activities were demolitions, water supply, infantry minor tactics and range shooting.

## Personnel

The Board's personnel numbers as at 30th June, 1976, were as follows:

| | |
|---|---|
| Technological staff (professional) | 634 |
| Technical staff | 530 |
| Administrative staff | 755 |
| Supervisory staff – Field | 170 |
| – Depot | 75 |
| Clerks of works | 98 |
| Construction and maintenance personnel | 1,986 |
| Workshop and depot personnel | 597 |
| | 4,845 |

**Staffing**

Staff positions which became vacant during the year as a result of resignations and retirements were not filled unless the need for a replacement could be clearly justified.

No cadetships were offered at the end of the 1975 academic year and no graduates were recruited. The recent changes to the Superannuation Act are expected to encourage more officers to retire at the age of sixty.

In line with the State Public Service and the Commonwealth Public Service the Board decided that as from 1st January, 1976, the Higher School Certificate or equivalent would be the minimum requirement for new officers appointed to Administrative Officer positions.
Proposals were being developed towards the end of the financial year for the introduction of Flexible Working Hours. A committee including representatives of each of the Staff Associations conducted a feasibility study and formulated preliminary proposals.

**Apprenticeships**
During the year the Board engaged twenty-one new apprentices in the trades of motor mechanics (14), automotive electrics (1), structural steel fabrication (1), carpentry (2), gardening (1), electrical mechanics (1) and painting and decorating (1). The new gardening apprentice is being trained at the Eastern Freeway where a considerable amount of landscaping and roadside development work is being undertaken.
Sixteen of the new apprentices represented the Board's normal intake and five were engaged with financial assistance from the Commonwealth Government.
The total number of apprentices in training at 30th June, 1976 was:

| | |
|---|---|
| Motor mechanics | 45 |
| Structural steel fabrication | 4 |
| Carpentry and joinery | 8 |
| Painting and decorating | 2 |
| Cooking | 2 |
| Electrical mechanics | 3 |
| Automotive electrics | 2 |
| Gardening | 1 |
| | 67 |

**Industrial relations**
The Board's wages and salaries costs in 1975/76 increased by 8% over the previous year. This compares with an increase of 34% in 1974/75 when the full impact of the 1974 wage explosion was experienced. The introduction of Wage Indexation principles in April 1975 was welcomed by the Board as a means of slowing down the rate of wage increases.
With wage increases generally restricted to quarterly adjustments, the activities of Staff Associations and Unions were more concerned with improving various allowances and conditions.
During the year the Board was involved in several arbitration cases including a new National Building Trades Construction Award and a new classification structure and increased salaries for Cost Clerks.

**Training**
More than two hundred members of the staff took advantage of the Board's study leave scheme during the year to further their educational qualifications thereby improving their promotional prospects and gaining special skills and knowledge important to the Board's work.
The Board's extensive in-service training programme provided courses based on the needs of the various work areas. Training courses covered such subjects as traffic engineering, road and freeway design, project management, computer methods, management skills, supervision, letter writing, responsibilities of patrolmen and overseers, materials, quality control and legislation.
Relevant external training courses, lectures, conferences and symposia were attended by selected staff, thus ensuring that the Board's staff is aware of latest trends and information in their fields of work. Particular officers attended the Australian Administrative Staff College, the Summer School of Business Administration at the University of Melbourne, the Traffic Planning and Control Course and the Government Administrative Staff Course at the University of New South Wales.

During the year the following personnel retired after substantial service with the Board:

| | | | Years of service |
|---|---|---|---|
| Mitchell, R. | Overseer | Benalla Division | 44 |
| Baade, R. E. | Engineering assistant | Bairnsdale Division | 40 |
| Whiteley, C. J. | Leading hand carpenter | Ballarat Division | 39 |
| Avery, T. | Patrolman | Geelong Division | 37 |
| Emonson, L. P. | Foreman | Mechanical Sub-Branch | 35 |
| Kline, J. K. | Plant inspector | Mechanical Sub-Branch | 35 |
| Gall, M. R. | Overseer | Major Projects Division | 34 |
| Penna, F. C. | Leading hand fitter | Bendigo Division | 33 |
| Ramus, E. C. | Stock control clerk | Central Stores | 33 |
| Baldwin, A. F. | Patrolman | Traralgon Division | 32 |
| Christopher, L. R. | Divisional accountant | Bendigo Division | 29 |
| Clarke, D. C. | Fitter | Mechanical Sub-Branch | 28 |
| Crosthwaite, C. A. M. | Traffic officer | Geelong Division | 28 |
| Freeman, C. H. | Painter | Mechanical Sub-Branch | 28 |
| Murphy, L. T. | Welder | Mechanical Sub-Branch | 28 |
| Strachan, P. | Patrolman | Traralgon Division | 28 |
| Williams, F. E. | Administration officer (personnel) | Personnel Section | 28 |
| Bilney, C. G. | Foreman | Geelong Division | 27 |
| Joseph, J. L. | Patrolman | Ballarat Division | 27 |
| Kilpatrick, T. J. | Patrolman | Benalla Division | 27 |
| McLachlan, R. | Superintendent of works | Geelong Division | 27 |
| MacKenzie, J. R. | Purchasing officer | Central Stores | 26 |
| Conley, P. J. | Leading hand fitter | Geelong Division | 25 |
| Gooch, G. J. | Administrative officer | Metropolitan Division | 25 |
| Hunter, T. D. | Traffic controller | Ballarat Division | 25 |
| Morris, H. E. | Administrative officer | Central Stores | 25 |
| *Dyer, R. R. | Contracts & acquisition claims officer | Claims Section | 24 |
| James, L. J. | Patrolman | Traralgon Division | 24 |
| Mellington, L. W. | Storeman | Ballarat Division | 24 |
| *Walker, A. T. | Patrolman | Warrnambool Division | 24 |
| Bailey, M. L. | Administrative officer | Major Projects Division | 23 |
| Balfour, F. G. | Foreman | Ballarat Division | 23 |
| Hyder, T. W. | Overseer | Benalla Division | 23 |
| Lavery, L. | Overseer | Ballarat Division | 23 |
| Nicholson, S. S. | Assistant purchasing officer | Central Stores | 23 |
| Carnegie, R. G. | Employment officer | Personnel Section | 22 |
| *Abley, W. E. | Traffic controller | Benalla Division | 21 |
| Barnett, E. | Load checker | Ballarat Division | 21 |
| Crocker, A. | Truck driver | Ballarat Division | 21 |
| Fogarty, M. J. | Cost clerk | Metropolitan Division | 21 |
| Hoerauf, H. F. | Senior draftsman | Mechanical Sub-Branch | 21 |
| Coverdale, H. S. | Truck driver | Warrnambool Division | 20 |
| De Jong, P. J. | Administrative officer | Bridge Sub-Branch | 20 |
| Foley, D. J. | Truck driver | Warrnambool Division | 20 |
| Martin, L. J. | Construction & maintenance worker | Bendigo Division | 20 |
| Matzner, E. | Senior design engineer | Bridge Sub-Branch | 20 |

*Deceased

# Appendix 1

## Lengths of State Highways, Freeways, Forest roads and Tourists' roads

As at 30th June, 1976

### State Highways

| Name | Route | Length (kilometres) |
|---|---|---|
| Bass | Lang Lang-Inverloch | 60.6 |
| Bellarine | Geelong-Queenscliff | 31.6 |
| Bonang | Orbost-NSW border near Delegate | 113.1 |
| Borung | Dimboola-Charlton | 123.3 |
| Burwood | Burwood-Ferntree Gully | 20.4 |
| Calder | Melbourne-Mildura | 560.1 |
| Cann Valley | Cann River-NSW border | 44.9 |
| Glenelg | Ballarat-SA border near Mt Gambier | 232.2 |
| Goulburn Valley | Eildon-Strathmerton | 225.4 |
| Hamilton | Geelong-Hamilton | 231.0 |
| Henty | Portland-Lascelles | 346.1 |
| Hume | Melbourne-NSW border near Albury | 246.6 |
| Kiewa Valley | Bandiana-Mt Beauty | 78.7 |
| Loddon Valley | Bendigo-Kerang | 123.7 |
| Maroondah | Melbourne-Mansfield | 184.6 |
| McIvor | Heathcote-Bendigo | 44.2 |
| Midland | Geelong-Ballarat-Bendigo-Shepparton-Benalla-Mansfield | 416.0 |
| | Morwell-Port Welshpool | 78.9 |
| Murray Valley | Corryong-Hattah | 738.5 |
| Nepean | Melbourne-Portsea | 88.8 |
| Northern | Kilmore-Echuca | 142.5 |
| Omeo | Bairnsdale-Tallangatta | 282.2 |
| Ouyen | Ouyen-SA border near Pinnaroo | 130.7 |
| Ovens | Wangaratta-Bright | 76.2 |
| Princes (East) | Melbourne-NSW border near Genoa | 485.7 |
| Princes (West) | Melbourne-SA border near Mt Gambier | 391.7 |
| Pyrenees | Elphinstone-Ararat | 147.5 |
| South Gippsland | Dandenong-Yarram-Sale | 254.4 |
| Sturt | Mildura-SA border near Renmark | 113.6 |
| Sunraysia | Ballarat-Calder Highway | 340.0 |
| Warburton | Lilydale-Warburton | 34.6 |
| Western | Melbourne-Serviceton | 376.4 |
| Wimmera | Apsley-St Arnaud | 222.2 |

### Freeways

| Name | Section | Length (kilometres) |
|---|---|---|
| Calder | Keilor | 2.8 |
| | Elphinstone | 2.7 |
| Frankston | Catron Street to Beach Street | 4.6 |
| Hume | Craigieburn to Kalkallo | 8.3 |
| | Beveridge | 3.2 |
| | Wallan-Broadford | 34.8 |
| | Broadford to Tallarook | 15.5 |
| | Chiltern | 21.3 |
| Lower Yarra | Bertie Street to Graham Street | 0.3 |
| | Williamstown Road to Princes F'way | 5.1 |
| Midland | Yinnar | 9.6 |
| Mornington Peninsula | Dromana to Rosebud | 8.4 |
| Princes | Mulgrave | 12.4 |
| | Moe to Haunted Hills | 16.2 |
| | Laverton | 12.8 |
| | Lara | 24.4 |
| | Maltby | 10.2 |
| | Dartmoor | 3.0 |
| South Eastern | Anderson Street to Tooronga Road | 6.8 |
| South Gippsland | Whitelaw | 3.8 |
| | Princes Freeway to Princes Highway | 1.4 |
| Tullamarine | Flemington Bridge to Melbourne Airport | 19.6 |
| Western | Deer Park to Melton | 13.3 |
| | Bacchus Marsh | 8.7 |
| | Pentland Hills | 11.0 |
| | Pykes Creek | 5.7 |
| | Gordon | 10.8 |

### Forest roads

| Name | Municipalities | Length (kilometres) |
|---|---|---|
| Bairnsdale-Dargo | Avon and Bairnsdale Shires | 20.8 |
| Bealiba-Moliagul | Bet Bet Shire | 9.0 |
| Beech Forest-Mt. Sabine | Otway Shire | 12.6 |
| Benambra-Corryong | Omeo, Tallangatta and Upper Murray Shires | 76.5 |
| Benambra-Limestone | Omeo Shire | 14.3 |
| Bendoc-Orbost | Orbost Shire | 20.9 |
| Brookville | Omeo Shire | 15.8 |
| Bruthen-Buchan | Tambo Shire | 36.5 |
| Buchan-Ensay | Tambo Shire | 19.8 |
| Bullumwaal-Tabberabbera | Bairnsdale Shire | 30.3 |
| Carrajung-Woodside | Alberton Shire | 17.7 |
| Dargo | Avon Shire | 74.8 |
| Dean Marsh-Lorne | Winchelsea Shire | 24 0 |
| Drummond-Vaughan | Daylesford and Glenlyon and Newstead Shires | 20.9 |
| Epsom-Fosterville | Huntly Shire | 21.2 |
| Forrest-Apollo Bay | Otway Shire | 22.4 |
| Greendale-Trentham | Ballan and Kyneton Shires | 23.8 |
| Heyfield-Jamieson | Mansfield and Maffra Shires | 145.5 |
| Inglewood-Rheola | Korong Shire | 17.3 |
| Kimbolton | Strathfieldsaye Shire | 13.5 |
| Lavers Hill-Cobden | Heytesbury and Otway Shires | 46.7 |
| Meredith-Steiglitz-Maude | Bannockburn Shire | 20.7 |
| Murrungower | Orbost Shire | 21.3 |
| Portland-Nelson | Portland Shire | 38.6 |
| Red Knob | Tambo Shire | 6.7 |
| Tatong-Tolmie | Benalla Shire | 36.3 |
| Walhalla | Narracan, Mansfield and Upper Yarra Shires | 110.7 |
| Warburton-Woods Point | Healesville, Upper Yarra and Mansfield Shires | 103.4 |
| Warrowitue | McIvor Shire | 16.5 |

# Appendix 2

## State Highways and Freeways

Significant works completed during financial year 1975/76

**Tourists' roads**

| Name | Municipalities | Length (kilometres) |
|---|---|---|
| Acheron Way | Healesville and Upper Yarra Shires | 35.4 |
| Alpine | Bright and Omeo Shires | 83.0 |
| Arthur's Seat | Flinders Shire | 8.1 |
| Bogong High Plains | Bright and Omeo Shires | 66.7 |
| Cameron Drive | Gisborne and Newham and Woodend Shires | 4.3 |
| Donna Buang | Healesville and Upper Yarra Shires | 34.0 |
| Gipsy Point | Orbost Shire | 2.4 |
| Grampians | Ararat, Dundas and Stawell Shires and Stawell Town | 69.5 |
| Great Ocean Road | Barrabool, Winchelsea, Otway, Heytesbury and Warrnambool Shires | 207.2 |
| Mallacoota | Orbost Shire | 22.5 |
| Mount Abrupt | Ararat and Mount Rouse Shires | 24.8 |
| Mount Buffalo | Bright Shire | 39.0 |
| Mount Buller | Mansfield Shire | 25.5 |
| Mount Dandenong | Sherbrooke and Lillydale Shires | 21.8 |
| Mount Victory | Arapiles, Stawell and Wimmera Shires | 30.7 |
| Marysville-Woods Point | Healesville Shire | 18.9 |
| Otway Lighthouse | Otway Shire | 12.9 |
| Phillip Island | Bass and Phillip Island Shires | 23.4 |
| Silverband | Stawell Shire | 9.1 |
| Sydenham Inlet | Orbost Shire | 21.6 |
| Wartook | Wimmera Shire | 3.5 |
| Wilson's Promontory | South Gippsland Shire | 31.0 |

**Bass Highway**
—Bass Shire
Construction of a new alignment west of Bass township including a bridge over the Bass River and approaches.
Replacement of a timber bridge at Bourne Creek and approaches.
Replacement of a timber bridge over Bridge Creek.

**Bellarine Highway**
—Bellarine Shire
Construction of a dual carriageway between Christies Road and Bawtree Road, near Leopold.

**Calder Freeway**
—Keilor City
Construction of the Southern Service Road from Tunnecliffe Avenue to Curly Hill.

**Calder Highway**
—Bendigo City
Reconstruction including curve improvement between Violet Street and Forest Street.

—Mildura Shire
Construction of an additional carriageway through Irymple for a length of 0.5 km, including the realignment of a railway level crossing and the channelization of intersections.

—Walpeup Shire
Reconstruction and sealing of 2.3 km north of Ouyen.

**Frankston Freeway**
—Frankston City
Roadworks associated with the Seaford Road interchange.
Construction of the Klauer Street overpass of the freeway.

**Glenelg Highway**
—Glenelg Shire
Reconstruction and realignment of 4.0 km west of Casterton to provide a sealed pavement of 7.4 m wide.

**Goulburn Valley Highway**
—Numurkah Shire
Reconstruction of 1.2 km north from Saxton Street, Numurkah.

—Shepparton City
Widening to provide turning lanes at Wanganui Road, north of Shepparton.

**Hamilton Highway**
—Bannockburn Shire
Reconstruction and widening of 2.7 km west of Inverleigh.

—Hampden Shire
Reconstruction of 3.1 km to provide a sealed pavement 7.4 m wide.

**Henty Highway**
—Wimmera Shire
Reconstruction and sealing of 2.2 km at Dooen.

**Hume Freeway**
—Broadford Shire and Kilmore Shire
Construction of 34 km of dual carriageways each 3.7 m wide, with associated structures from south of Wallan to north of Broadford.

**Hume Highway**
—Euroa Shire
Reconstruction of 2.3 km north of Euroa to provide a sealed pavement 7.4 m wide.

—Wangaratta City
Reconstruction of 2.4 km of dual carriageway between One Mile Creek and Ford Street.

—Wodonga City
Construction of a dual carriageway along 2.5 km of Lincoln Causeway including the duplication of 4 bridges between Wodonga and Albury providing 2 by 7.4 m wide carriageways.

**Kiewa Valley Highway**
—Yackandandah Shire
Realignment of 0.4 km including the installation of 1.2 m armco pipes at Deep Creek, north of Tawonga.

**Loddon Valley Highway**
—Gordon Shire
Reconstruction and drainage improvement of 4 km south of Durham Ox.

**Maroondah Highway**
—Box Hill and Nunawading Cities
Reconstruction of Middleborough Road intersection.

**Midland Highway**
—Bannockburn Shire
Reconstruction and widening of 1 km near Meredith.
Construction of a dual carriageway in Church Street, Geelong.

—Morwell Shire
Deviation of 20.11 km from south of Yinnar to the Princes Highway, east of Morwell.

—Waranga Shire
Reconstruction of existing pavement east of Stanhope from 83.6 to 85.3 km.

**Mornington Peninsula Freeway**
—Flinders Shire
Construction of Kangerong Avenue overpass and approaches.

**Murray Valley Highway**
—Rutherglen Shire
Widening and resheeting 1.3 km west of Rutherglen to provide a sealed pavement of 7.4 m wide.

**Nepean Highway**
—Frankston City
Construction of a duplicate bridge over Kananook Creek including intersection treatment at Gould Street and Overton Road.

—Flinders Shire
Widening from Elizabeth Avenue to Weeroona Street, Rye.

—Moorabbin and Mordialloc Cities
Widening to six lanes from Centre Dandenong Road to Lower Dandenong Road.

**Northern Highway**
—McIvor Shire
Reconstruction and resheeting between Tooborac and Heathcote.

—Huntly Shire
Reconstruction of existing pavement for 1.5 km between Elmore and Rochester from 167 km to 168.5 km.

**Omeo Highway**
—Bairnsdale Shire
Reconstruction of 1.1 km to provide a sealed pavement of 7.4 m wide and widening the Cherry Tree Creek culvert at Sarsfield.

—Omeo Shire
Construction of 0.7 km of approaches for a new bridge over the Haunted Stream to provide a sealed pavement 7.4 m wide.

—Tallangatta Shire
Construction of 2.5 km between Tallangatta East and Noorongong to provide a sealed pavement of 7.4 m wide.

**Princes Freeway East**
—Moe City
Construction of the interchange at Gunns Gully, east of Moe.

—Morwell Shire
Construction of the interchange at Hernes Oak, west of Morwell.

**Princes Freeway West**
—Altona City and Werribee Shire
Widening to six lanes from Lower Yarra Freeway to Kororoit Creek Road.

—Werribee Shire
Provision of 6 lanes between the Lower Yarra Freeway and the Maltby Bypass Road.
Construction of the Little River interchange.

**Princes Highway East**
—Bairnsdale Town
Construction of a dual carriageway for a length of 0.7 km.

—Dandenong City
Construction of pedestrian bridge over Dandenong Creek.

—Orbost Shire
Construction of a new bridge 121 m long and 9.8 m wide over the Cann River together with the necessary approaches and stream protection works.

—Pakenham Shire
Construction of duplicate carriageways through Beaconsfield from Cardinia Creek to west of Pink Hill.
Construction of a duplicate bridge over Cardinia Creek.

—Tambo Shire
Reconstruction of 2.1 km near Johnsonville to provide a sealed pavement 7.4 m wide.

**Princes Highway West**
—Hampden Shire
Reconstruction of 2.2 km east of Terang to provide a sealed pavement 7.4 m wide.

# Appendix 3

## Tourists' roads and Forest roads

Significant works completed during
financial year 1975/76

**Pyrenees Highway**
—Avoca Shire, Talbot and Clunes Shire and Tullaroop Shire
Construction of a 3 span reinforced concrete bridge 46.02 m long and 8.53 m wide between kerbs over the Bet Bet Creek, Bung Bong.

—Castlemaine City
Reconstruction of Pattersons Bridge over Forest Creek.

**South Gippsland Highway**
—Cranbourne Shire
Deviation at Hampton Park between Hallam Main Drain and south of Cairns Road.

**Sturt Highway**
—Mildura City
Widening 8.0 km to provide a sealed pavement 6.2 m wide and resealing west of Lake Cullulleraine.

**Sunraysia Highway**
—Birchip Shire
Resheeting, widening and sealing 3.9 km north-west of Birchip.

—Donald Shire
Reconstruction of 1.9 km of a flood damaged section, south of Donald.

**Tullamarine Freeway**
—Keilor City
Essendon Airport Interchange.
Construction of the Vaughan Street pedestrian overpass.
Essendon Airport Interchange.
Construction of the main outfall drain from Lancefield Road.

**Western Freeway**
—Bacchus Marsh Shire and Ballan Shire
Construction of 5.9 km of dual carriageway 3.7 m wide with associated structures bypassing the township of Myrniong to the south.

**Western Highway**
—Ararat Shire
Widening and resheeting 1.4 km at Langi Ghiron to provide a sealed pavement 7.3 m wide.
Widening and resheeting 1.2 km east of Dobie to provide a sealed pavement 7.3 m wide.

—Ararat Shire and Ripon Shire
Widening and resheeting 1.6 km at Middle Creek to provide a sealed pavement 7.3 m wide.

—Dimboola Shire
Reconstruction of 1.5 km from Dimboola Hospital to Rainbow Road Junction.

—Kaniva Shire
Regrading, resheeting and sealing 1.5 km, east of Merwyn Swamp.

—Lowan Shire
Widening and resheeting 2.8 km west of Nhill.

**Forest Roads**
—Bruthen-Buchan
Reconstruction and sealing of 2.6 km including a new deviation and a culvert at Harris Creek.

**Tourists' roads**
—Great Ocean Road
Construction of a new bridge over Sherbrooke River 43.5 m long and 8.5 m wide between kerbs together with the necessary approaches.

# Appendix 4

## Main roads

Significant works completed during
financial year 1975/76

—Bellarine Shire
Geelong-Portarlington Road–Duplication of 0.6 km.

—Broadmeadows City
Pascoe Vale Road–Construction of a road over rail overpass at Jacana.

—Cranbourne Shire
Baxter-Tooradin Road–Reconstruction of existing pavement 5.0-6.2 km.

—Croydon City
Mt Dandenong Road–Intersection treatment at Dorset Road.

—Dandenong City
Cheltenham Road–Duplication of 0.6-1.2 km.

—Doncaster and Templestowe City
Doncaster Road–Duplication from Elizabeth Street to Pine Way.

—Dundas Shire
MacArthur-Penshurst Road–Reconstruction and sealing of 3.3 km north-east of MacArthur to provide a sealed pavement 6.2 m wide.

—Eltham Shire
Eltham-Yarra Glen Road–Reconstruction of 1.7-2.3 km.

—Flinders Shire
Mornington-Dromana Road–Reconstruction of 1.1-1.5 km.

—Footscray City
Napier Street–Duplication from Moreland Street to Hyde Street.

—Hampden Shire
Parlington Road–Reconstruction and sealing of 5.0 km, north-west of Camperdown to provide a sealed pavement 7.4 m wide.

# Appendix 5

## Unclassified roads

Significant works completed during financial year 1975/76

—Hastings Shire
Mornington-Tyabb Road–Reconstruction of 5.8-7.7 km.

—Knox City
Wellington Road–Reconstruction from Stud Road-Summit Road.
Wellington Road–Construction of new bridge over Dandenong Creek.

—Korong Shire
Bendigo-St Arnaud Road–Reconstruction from 7.2 km to 11.4 km to provide a sealed pavement 7.3 m wide.

—Lillydale Shire
Olinda-Monbulk Road–Reconstruction of 1.6-3.2 km.

—Mansfield Shire
Mansfield Main Road–Construction at approaches and a 2 span reinforced concrete bridge, 3.17 km east of Mansfield.
Mansfield-Whitfield Road–Reconstruction and realignment of 1.6 km from Tolmie to shire boundary.

—Morwell Shire
Morwell-Thorpdale Road–Reconstruction of 0.3 km from Hazelwood Road to Jane Street with channelized intersection treatment at Hazelwood Road.

—Myrtleford Shire
Happy Valley Road–Reconstruction and realignment of 2.1 km.

—Oakleigh City
Warrigal Road/North Road intersection.
Flaring of the intersection and improved channelization.

—Otway Shire
Beech Forest-Lavers Hill Road–Reconstruction and realignment of 2.0 km.

—Pakenham Shire
Nar Nar Goon-Longwarry Road–Reconstruction of 7.4-10.6 km.

—Portland Shire
Dartmoor-Hamilton Road–Reconstruction and sealing of 3.4 km, north-east of Dartmoor to provide a sealed pavement 6.8 m wide.

—Sherbrooke Shire
Belgrave-Hallam Road–Construction of 1.9-3.5 km.

—South Gippsland Shire
Falls Road–Construction of a 2 cell 5.4 m corrugated multi plate culvert at Fish Creek.

—Springvale City
Springvale Road–Duplication of 6.4-10.8 km.

—Upper Yarra Shire
Healesville-Koo-wee-rup Road–Reconstruction of 5.1-6.5 km.

—Yackandandah Shire
Dederang Road–Reconstruction and initial sealing of 4.2 km.

—Bairnsdale Shire
Wy-Yung-Calulu Road–Construction of a new 3-span concrete bridge over Boggy Creek.

—Benalla City
Ackerly Avenue–Construction of a reinforced concrete bridge and approaches at Broken River.

—Berwick City
Heatherton Road–Reconstruction east from Power Road.

—Buln Buln Shire
Longmores Road–Reconstruction and realignment of 0.7 km between Yarra Junction-Noojee Road and Main Neerim Road, Noyook.

—Corio Shire
Steiglitz Road–Construction of a 3-span bridge 27.8 m long and 7.3 m wide between kerbs over Sutherlands Creek.
Andersons Road–Construction of a reinforced concrete bridge 31.8 m long to provide a sealed pavement 8.8 m wide.

—Cranbourne Shire
Finsbury Road–Reconstruction from South Gippsland Highway to Cross Road.

—Croydon City
Eastfield Road–Reconstruction from the Pass to Pleasant Road.

—Dandenong City
Kirkham Road–Reconstruction easterly from Chandler Road.

—East Loddon Shire
Pyramid-Yarraberb Road–Reconstruction of existing pavement to provide a sealed pavement 6.8 m wide.

—Eltham Shire
Cottlesbridge-Strathaven Road–Construction of bridge over Diamond Creek.

—Flinders Shire
Eastbourne Road–Construction from Rosebud-Flinders Road to Elonera Avenue.

—Footscray City
Francis Street Underpass–Reconstruction and widening from Ballarat Street to Buninyong Street.

—Frankston City
Boundary Road–Construction from Robinsons Road to Willow Road.

—Keilor City
Matthews Avenue–Reconstruction from Dromana Avenue to Mascoma Street.

—Knox City
Underwood Road/Hastings Avenue–Construction of a deviation at Boronia shopping centre.

—Korumburra Shire
Timms Road–Construction of 1.8 km and 3.5 m single cell corrugated multi plate culvert at Little Pheasant Creek, Toowong North.

—Minhamite Shire
Condah-MacArthur Road–Reconstruction and widening of 3.3 km, east of Condah to provide a sealed pavement 6.8 m wide.

—Mortlake Shire
Woolongoom Road–Construction of a 3-span bridge 32.4 m long to provide a sealed pavement 6.3 m wide over Hopkins River, north-west of Ellerslie.

—Morwell Shire
Mountain Hut Road–Reconstruction and realignment of 4.7 km, south-west of Yinnar-Driffield Road.

—Oakleigh City
Blackburn Road–Duplication from Princes Highway East to Duerdin Street.

—Omeo Shire
Swifts Creek East–Construction of a 3-span concrete bridge 61 m long over Tambo River.

—Oxley Shire
Milawa-Glenrowan Road–Construction of a 3-span reinforced concrete bridge over King River.

—Pakenham Shire
Tynong-Bayles Road–Construction of a new bridge over the Bunyip River at Cora Lynn.

—Pyalong Shire
Pyalong-Seymour Road–Reconstruction and realignment to provide a sealed pavement 6.8 m wide.

—Shepparton City
Archer Street–Reconstruction and sealing between Westmoreland Crescent and Channel Road.

—Tallangatta Shire
Kurrajong Road–Resheeting of 3.8 km.

—Tambo Shire
Snowy River–Installation of a culvert and the construction of the necessary approaches at Red Soil Creek.

—Warragul Shire
Endeavour Street–Construction of a 4 cell reinforced concrete box culvert at Hazel Creek.

—Warrnambool Shire
Wallaston Road–Reconstruction and realignment of 3.5 km to provide a sealed pavement 6.1m wide.

—Williamstown City
Melbourne Road–Elimination of a level crossing at Spotswood.

# Appendix 6

## Special projects

| Project No. | Description of project | Progress of work |
|---|---|---|
| 24 | Eastern Freeway–Construction of a multi-lane freeway from Alexandra Parade, Collingwood to Thompsons Road, Camberwell. | Work continued over the entire length of 9 km during the year. |
| 25 | Johnson Street Bridge over the Yarra west of Spencer Street Bridge. | Work continued on the bridge and the associated roadworks are well advanced. |
| 33 | Princes Highway East–Construction of a new bridge over the Snowy River at Orbost and realignment of approaches. | Bridgeworks are well advanced and roadworks are continuing. |
| 40 | Princes Freeway–Construction of a second carriageway between Moe and Hernes Oak. | Both the Hernes Oak and the Gunns Gully interchange were completed during the year. |
| 41 | Princes Freeway/Princes Highway–Construction of dual carriageways between Morwell and Traralgon. | Duplication is complete to the outskirts of Morwell. Work within Morwell will proceed to complete the whole project. |
| 42 | Bass Highway–Improvements from Lang Lang to Dalyston. Including interchange with South Gippsland Highway. | All works are now complete, including the bridges over Bourne Creek and Bridge Creek at Dalyston. |
| 43 | Princes Freeway, Bypass of Drouin and Warragul. | Preliminary construction work commenced on the Princes Highway interchange with the freeway between Drouin and Warragul. |
| 44 | Tullamarine Freeway–Construction of diamond interchange with Essendon Airport and conversion of Lancefield Road to Freeway. | Construction of two pedestrian overpasses at Vaughan Street and Bristol Street associated with the project. |
| 46 | Omeo Highway–Omeo to Mitta Mitta. | Reconstruction of a 1.15 km section between Omeo and Lightning Ridge is well advanced. |
| 47 | Calder Highway–Harcourt to Bendigo. | Reconstruction of the Calder Highway and Midland Highway intersection and realignment of the Calder Highway through Harcourt was completed through the year. |
| 49 | Goulburn Valley Highway–Trawool. Construction of a new bridge and realignment of approaches. | Construction of the bridge is well advanced and preliminary work on the approaches has been done. |

# Appendix 7

## Motor Registrations

Registrations under the Motor Car Act during the year 1975/76 totalled 2,116,874, an increase of 5.5% over the total for the previous year.

| Vehicle | Financial year 1974/75 | | Financial year 1975/76 | | Increase |
|---|---|---|---|---|---|
| *Private* | | | | | |
| New | 138,210 | | 130,205 | | |
| Secondhand: | | | | | |
| Re-registered | 44,048 | | 52,535 | | |
| Renewed | 1,289,832 | 1,472,090 | 1,365,540 | 1,548,280 | 76,190 |
| *Commercial and hire* | | | | | |
| New | 17,706 | | 17,461 | | |
| Secondhand: | | | | | |
| Re-registered | 4,653 | | 5,432 | | |
| Renewed | 127,079 | 149,438 | 130,578 | 153,471 | 4,033 |
| *Primary producers' trucks and tractors* | | | | | |
| New | 3,969 | | 3,223 | | |
| Secondhand: | | | | | |
| Re-registered | 2,912 | | 2,735 | | |
| Renewed | 80,736 | 87,617† | 82,190 | 88,148* | 531 |
| *Licences under the Motor Omnibus Act* | | 826 | | 848 | 22 |
| Trailers | | 251,630 | | 279,897 | 28,267 |
| Motor cycles | | 44,753 | | 46,230 | 1,477 |
| Totals | | 2,006,354 | | 2,116,874 | 110,520 |

†Includes 45,228 no-fee tractors
*Includes 45,258 no-fee tractors

# Appendix 8

## Statement of receipts and payments

for year ended 30th June 1976 (Adjusted to nearest dollar)

Country Roads Board

| | | Country Roads Board Fund | Loan Funds |
|---|---|---|---|
| **Receipts** | | | |
| Balances as at 1st July 1975 | | 616,605 | |
| Motor Car Act 1958 (No. 6325) | | | |
| Motor Car Registration Fees | 56,605,989 | | |
| Drivers Licence Fees | 1,442,700 | | |
| Drivers Licence Testing Fees | 437,199 | | |
| Trailer Registration Fees | 1,602,267 | | |
| Learner Drivers Permit Fees | 192,155 | | |
| Examiners Licence Fees | 7,832 | | |
| Sale of Log Books | 12,375 | | |
| Motor Driving Instructors Licence– Appointment and Testing Fees | 1,770 | | |
| Motor Driving Instructors Licence Fees | 3,640 | | |
| | 60,305,927 | | |
| Less: Cost of Collection | 9,479,097 | 50,826,830 | |
| Municipalities Contributions | | | |
| Permanent Works–Main Roads | 100,969 | | |
| Maintenance Works–Main Roads | 2,131,891 | 2,232,860 | |
| Fees–Commercial Goods Vehicles Act No. 6222– Road Maintenance A/c | | 10,132,146 | |
| Public Works and Services Act No. 8779 | | 427,000 | |
| Fines–Country Roads Act No. 6229 | | 2,996 | |
| General Receipts | | 1,521,881 | |
| State Loan Funds–Act No. 6229 | | | 325,000 |
| Allocation–Roads (Special Projects) Fund | | | |
| Commonwealth Grants | | | |
| National Roads Act 1974 | | | |
| Roads Grants Act 1974 | | | |
| Transport (Planning & Research) Act 1974 | | | |
| Traffic & Road Safety Improvement | | | |
| Commonwealth Employment Scheme 1975 | | | |
| Regional Employment Development Scheme | | | |
| | | $65,760,318 | 325,000 |
| **Payments** | | | |
| Road Expenditure | | | |
| Main Roads | –Construction and Reconstruction | 9,296,406 | |
| | Maintenance | 4,999,663 | |
| | Road Maintenance A/c–Act No. 6222 | 5,147,059 | |
| State Highways | –Construction and Reconstruction | 2,639,792 | 325,000 |
| | Maintenance | 5,907,367 | |
| | Road Maintenance A/c–Act No. 6222 | 4,393,015 | |
| Freeways | –Construction and Reconstruction | 3,169,966 | |
| | Maintenance | 863,872 | |
| | Road Maintenance A/c–Act No. 6222 | 592,072 | |
| Tourists' Roads | –Construction and Reconstruction | 206,039 | |
| | Maintenance | 1,235,317 | |
| Forest Roads | –Construction and Reconstruction | 474,342 | |
| | Maintenance | 750,564 | |
| Unclassified Roads | –Construction and Reconstruction | 7,641,061 | |
| | Maintenance | 572,021 | |
| Contribution to Melbourne & Metropolitan Tramways Board–Tram Tracks Reconstruction | | 200,000 | |
| Metropolitan Bridges | | 1,935 | |
| State Intersection Control (STATCON) Programme | | 107,440 | |
| Murray River Bridges and Punts | | 227,653 | |
| Traffic Line Marking | | 816,201 | |
| Statutory Payments | | | |
| Interest and Sinking Fund | 2,792,880 | | |
| Traffic Authority Fund | 419,846 | | |
| Tourist Fund | 839,693 | | |
| Transport Regulation Fund | 602,256 | 4,654,675 | |
| Planning & Research | | 1,846,180 | |
| Residual Liability for Loan Funds–Metropolitan Bridges, Highways and Foreshores Act No. 8573 | | 371,447 | |
| Capital Expenditure | | | |
| Plant Replacement and Additions | 1,234,046 | | |
| Buildings, Workshops, etc. | 313,427 | 1,547,473 | |
| Management and Operating Expenditure | | 4,922,887 | |
| | | $62,584,447 | 325,000 |
| Balances available to the Board as at 30th June 1976 | | $3,175,871 | |

**Auditor-General's Certificate**

The accounts of the Country Roads Board for the year ended 30th June 1976 have been audited. In my opinion, the above Statement of Receipts and Payments fairly presents in summary form the transactions during that period.

B. Hamilton, Auditor-General, 27th October 1976

| Roads (Special Projects) Fund | National Roads Act 1974 | Roads Grants Act 1974 | Transport (P&R) Act 1974 Sections 7 & 8 | C'wealth Traff. & Rd. Safety Improve. Trust A/c | C'wealth Employ. Scheme 1975 | Regional Employ. Dev. Scheme | | Total |
|---|---|---|---|---|---|---|---|---|
| | | 15,000 | 25,623 | | | | | 657,228 |
| | | | | | | | 50,826,830 | |
| | | | | | | | 2,232,860 | |
| | | | | | | | 10,132,146 | |
| | | | | | | | 427,000 | |
| | | | | | | | 2,996 | |
| | | | | | | | 1,521,881 | |
| | | | | | | | 325,000 | |
| 30,192,191 | | | | | | | 30,192,191 | 95,660,904 |
| | 23,200,000 | | | | | | 23,200,000 | |
| | | 64,810,000 | | | | | 64,810,000 | |
| | | | 1.790,910 | | | | 1,790,910 | |
| | | | | 129,616 | | | 129,616 | |
| | | | | | 1,500,000 | | 1,500,000 | |
| | | | | | | 701,864 | 701,864 | 92,132,390 |
| 30,192,191 | 23,200,000 | 64,825,000 | 1,816,533 | 129,616 | 1,500,000 | 701,864 | | 188,450,522 |
| 1,021,476 | | 6,257,117 | | 21,371 | | 36,869 | 16,633,239 | |
| | | | | | | | 4,999,663 | |
| | | | | | | | 5,147,059 | 26,779,961 |
| 2,181,152 | 2,722,187 | 9,709,675 | | 100,390 | 1,050,473 | 141,937 | 18,870,606 | |
| | 1,089,917 | | | | 341,311 | 369,440 | 7,708,035 | |
| | | | | | | | 4,393,015 | 30,971,656 |
| 20,223,729 | 10,871,145 | 18,861.872 | | | | 77,400 | 53,204,112 | |
| | 310,398 | | | | | 12,288 | 1,186,558 | |
| | | | | | | | 592,072 | 54,982,742 |
| | | 292,400 | | 406 | 13,109 | 6,305 | 518,259 | |
| | | | | | | | 1,235.317 | 1,753,576 |
| | | | | 190 | | | 474,532 | |
| | | | | | 95,107 | 21,700 | 867,371 | 1,341,903 |
| 1,470,351 | 3,883,809 | 11,995,413 | | 7,259 | | 22,323 | 25,020,216 | |
| | | 4,015,159 | | | | 13,602 | 4,600,782 | |
| | | | | | | | 200,000 | 29,820,998 |
| | | | | | | | | 1,935 |
| 316,142 | | | | | | | | 423,582 |
| | | | | | | | | 227,653 |
| | | | | | | | | 816,201 |
| | | | | | | | | 147,120,207 |
| | | | | | | | | 4,654,675 |
| | | | 1,816,533 | | | | | 3,662,713 |
| | | | | | | | | 371,447 |
| | | | | | | | | 1,547,473 |
| 4,979,341 | 4,322,544 | 8,706,929 | | | | | | 22,931,701 |
| 30.192,191 | 23.200,000 | 59,838.565 | 1,816,533 | 129.616 | 1,500,000 | 701,864 | | 180,288,216 |
| | | 4,986,435 | | | | | | 8,162,306 |

R. G. Cooper, Chief Accountant, 21st October 1976

# Appendix 9

## Loan Liability

as at 30th June 1976

Country Roads Board

| | Main roads etc. | Developmental roads | Total |
|---|---|---|---|
| | $ | $ | $ |
| **Permanent works** | | | |
| Main roads | 16,730,322.16 | | 16,730,322.16 |
| State highways | 18,629,304.20 | | 18,629,304.20 |
| Freeways | 3,000,000.00 | | 3,000,000.00 |
| Tourists' roads | 227,316.44 | | 227,316.44 |
| Forest roads | 2,167.89 | | 2,167.89 |
| Developmental roads | | 12,851,515.09 | 12,851,515.09 |
| Discount and expenses | 745,738.03 | 584,137.03 | 1,329,875.06 |
| **Total amount borrowed** | 39,334,848.72 | 13,435,652.12 | 52,770,500.84 |
| **Less redemption of loans** | | | |
| Redemption funds | 170,438.11 | 1,292,772.73 | 1,463,210.84 |
| Main roads sinking fund | 571,376.76 | | 571,376.76 |
| Developmental roads sinking fund | | 110,166.02 | 110,166.02 |
| State loans repayment fund | 3,479,591.38 | | 3,479,591.38 |
| National debt sinking fund | 8,332,035.71 | 7,868,212.35 | 16,200,248.06 |
| Consolidated fund | 30,309.19 | | 30,309.19 |
| | 12,583,751.15 | 9,271,151.10 | 21,854,902.25 |
| **Loan Liability at 30th June 1976** | 26,751,097.57 | 4,164,501.02 | 30,915.598.59 |

# Appendix 10

## Works executed on behalf of Commonwealth and State Government authorities

for the year ended 30th June 1976 (Adjusted to nearest dollar)

| Departments | Description of works | | Expenditure |
|---|---|---|---|
| **Commonwealth** | | | |
| Department of Housing and Construction<br>Department of Construction | Access roads to various Commonwealth establishments | | 12,438 |
| **Victoria** | | | |
| Housing Commission | Overpass at Riggall Street, Broadmeadows City | 36,984 | |
| Lands and Survey Department | Reconstruction of Dunmoor Road, Glenelg Shire | 483 | |
| Melbourne and Metropolitan Board of Works | Roadworks in connection with Cardinia Reservoir, maintenance of Marysville-Woods Point Road | 14,800 | |
| Ministry of Tourism | Additional snow clearing on the Alpine Road to Mt Hotham | 24,126 | |
| Ministry of Transport | Grade separated level crossing projects, etc., charged to the Transport Fund | 1,803,965 | |
| | Grade separated pedestrian crossings charged to State Treasury, Municipalities and Transport Fund | 319,833 | |
| Premier's Department | Roadworks in connection with Wonderland and Sundial Roads, Stawell Shire | 300 | |
| Rural Finance and Settlement Commission | Roadworks in Commission land settlement areas throughout the State | 22,051 | 2,222,542 |
| State Treasury | Kings Bridge–sundry expenditure less proceeds of rental of properties acquired in connection with construction of Kings Bridge | 15,457 Cr. | |
| State Treasury | Improvements to various roads adjacent to State Forests to facilitate the extraction of timber and charged to Municipalities Forest Roads Improvement Fund | 53,878 | |
| State Treasury | Restoration works on roads and bridges damaged by floods | 6,430,460 | 6,468,881 |
| | | | $8,703,861 |

# Appendix 11

## Engineer in Chief's Report

Country Roads Board
Melbourne

The Chairman

I submit herewith my Report for 1975/76. The report deals with those activities within the Engineer in Chief's Branch which are considered to be of general and special technical interest.

K G Moody
Engineer in Chief

# Section A: Bridge Sub-branch

## 1. Construction Division

**Fabrication of steel girders using high yield strength steel**

The fabrication of steel girders for the Goulburn River Bridge at Trawool on the Goulburn Valley Highway in the Shire of Seymour has been of interest because the flanges of the girders consisted of high yield strength steel which, apart from some small girders on the Lower Yarra Crossing, was being used by the Board for the first time on long span girders since the problems that occurred with the high yield steel on King Street Bridge. The girders were up to 34 metres in length.

The steel specified for the girders was normal use grade 250 with the exception of the flanges which was specified as grade 350 LO high yield strength steel.

All steel of this quality was tested by the Materials Research Division to ensure compliance with the specification.

A welding procedure using the submerged arc process with preheating to 75°C was devised and test plates of full penetration butt welds were prepared. Ultrasonic inspection, metallographic examination (see macro specimen Plate 1), hardness, mechanical, impact, bending, drop weight and chemical tests were carried out on the weld material.

The procedure proved satisfactory and was adopted.

Similarly, a procedure was adopted for fillet welding, joining the web to the flange (Plate 2 shows macro specimen of fillet weld). All of the butt welds in the flanges and web were tested by ultrasonic method.

Also, tests were taken on the friction welded stud shear connections to the 350 grade flange steel and it was found that good results were obtained without preheating.

Cracking occurred in some welds during the first runs with the submerged arc because of differential shrinkage in the weld metal. Flattening the profile of the weld bead eliminated the problem. Otherwise, no problems outside those normally associated with welding occurred. Repairs were required to approximately 7 per cent of the welds. Faults were mainly lack of side fusion, slag inclusions and porosity. The percentage of repairs with standard structural grade steel is usually in the order of 4-5%.

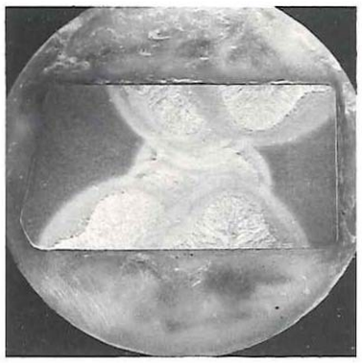


Plate 1: Full depth butt weld in AS1204 – Grade 350 LO Plate magnification 1.5 polished and etched section.

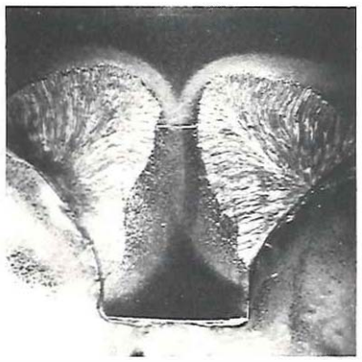


Plate 2: Section through fillet weld test plate.

**Yarra bridges – Eastern Freeway, Kew**

This project requires the construction of twin bridges, each of five spans on a 45° skew over the Yarra River. Construction is being carried out over a period of two years under direct management utilizing direct labour and the resources of fourteen separate contractors. The total estimated cost of the work is $4.6 million.

Contracts have included on-site construction of sixteen 5 ft diameter cylinder piles socketted into Silurian mud-stone for the river piers and off-site work including supply of steel cylinders, prestressed concrete I-beams, bearings, concrete, beam stressing, pile preloading, steel diaphragm girders and temporary beam support falsework.

The Board's precast yard at Syndal has produced reinforced concrete piles, and beam segments and parapet units have been produced at the Board's Bendigo precast yard. The design was adapted to convenient and economical construction, and special steel falsework and moulds have facilitated the speed of construction.

Some technical aspects of particular interest are:

a. Steel formwork moulds

1. *Pier columns*. The cross sectional dimensions of the column are 20 ft x 3 ft and these are cast in 10 ft lifts with a feature recessed joint in the concrete top and bottom of each cast. This joint houses the only formwork ties required for the two moulds in use.
   Each mould, comprising two halves, has a fully assembled weight of 8 tons and will be used thirty-two times on this site. The frequency of concrete casts averages one every four days.

2. *River pier pile caps*. The concrete dimensions of a river pier pile cap are 26 ft x 6 ft x 4 ft. A special steel mould, fabricated in two halves and weighing 8 tons, is being used to cast the eight pile caps in the water, the upper surface of the cap being about 1 ft above low water level. The mould is lowered over two cylinder piles, a steel ring placed around each of the piles to partially seal the over-sized hole in the mould base. a false floor of concrete 6 in thick is tremmied in underwater and allowed to set for 24 hours before the water is pumped out and the cap constructed.

b. Temporary beam support falsework
   Factors such as the 40 ft spacing between the two columns of each pier, the weight of beams and site conditions, necessitated an elaborate temporary beam support system. The system consists of 12 in x 12 in universal columns bearing on the concrete pile caps, supporting steel trusses and steel girders.
   The falsework remains in position until the deck and diaphragm beam above is cast and cured. Sand jacks were incorporated in the trusses to facilitate lowering prior to stripping.

c. Prestressed concrete beam placement
   Where access is suitable, large cranes are being employed for beam erection. A Bailey launching truss was used to place the thirty 120 ft x 45$^{T}$ beams for the central span of each bridge.

Plate 3: (above): Overall view of the Yarra River bridges construction site.

Plate 4: (left): Yarra River bridges – Construction of river pier columns and pile cap using steel formwork moulds.

Plate 5 (above): Completed pile sections with female couplings.

Plate 6 (left): 'Herkules' male and female couplings.

d. Permanent deck soffit steel formwork
As the bridge has a deck surface area of approximately 40,000 sq ft an alternative to conventional deck soffit formwork was investigated.
For three of the five spans of each bridge a 1.0 mm thick, high tensile galvanized steel sheet, ribbed for strength, is being used between the beams as permanent shuttering.
The major advantages in using such a product are that stripping of forms and beam staining are eliminated, and it offers considerable savings in construction costs by way of reducing labour and time factors.

**'Herkules' patented reinforced concrete piles**
'Herkules' patented precast concrete piles have been used in foundations of several major structures.
The 'Herkules' concrete pile was developed in Sweden around 1960. It consists of precast sections joined together insitu by means of a mechanical locking joint. Although several shape types are available overseas, the Australian agents market only hexagonal section piles and splice couplings.
A standard 'Herkules' section consists of a concrete section of very high strength, reinforced with high yielding reinforcing steel, with an impact resistant male and female coupling at alternate ends of the section.
The longitudinal reinforcement used in the sections is cold worked stress relieved grade 410C deformed steel rod of minimum yield strength of 410 MPa. Concrete cylinder 28-day compressive strengths of 50 MPa, together with a minimum tensile strength of 6 MPa, were specified.
The joint itself comprises two steel fittings (male and female) connected by the use of a bayonet type coupling. Dowels threaded into the end plates of the fittings fix the fittings to the precast section and prevent severance of end plates. Fittings conform in size and shape to the precast section.
Sections of 12.5 metres and 6.25 metres in length with a hexagonal shape 300 mm side to side of hexagon were manufactured for the Orbost project. However, in view of the high cost of the patented coupling, as many sections as practicable were made with either the Board's standard driving head or a standard toe at one end of the section replacing 'Herkules' male or female coupling.
The first section of pile is driven to leave about 1 metre of pile above ground, with the female fitting on top of this section. The next section is then lifted onto the top of the bottom section with the male fitting fixing onto the female section. The joint is locked by turning the male end into the female part by the use of a very large wrench lever, and then fixing with two locking pins. The normal 3-man pile driving crew can effect the coupling of the two sections within five minutes.
Because of the high cost of the patented joints, the manufacturing costs of 'Herkules' piles are some 25 per cent higher than long prestressed concrete piles, however they have been found to offer advantages which more than compensate for this higher initial cost as:
—the longest length used (12.5 metres) is suitable for most types of pile rigs available, and pre-boring is eliminated on long piling in most cases;
—piles can be quickly extended by adding 12.5 or 6.25 metre sections;
—breaking back prestressed piles more than 3 metres provides difficult and costly jointing to crossheads, whereas the 'Herkules' sections wherever broken back provide the same reinforcement for joining on;
—they are easier to transport than long prestressed piles;
—compared with steel piles they provide greater frictional resistance, particularly in wet clays and silts, and they eliminate the problem of field welded splices with the consequent downtime of the pile rig and crew whilst joints are being made.

Approximately 1900 metres of 'Herkules' pile section were driven at the Orbost project. With the obvious advantages of such systems, it can be expected that increasing use will be made of this kind of pile in the future.

## 2. Design Division

**Eastern Freeway – Yarra river bridges test loading of foundation cylinder piles**
The twin five-span Yarra river bridges are each 138 metres long and 25 metres wide continuous over the intermediate piers. The piers are supported on cylinder piles embedded in Silurian mudstone.
The cylinder piles at pier 3 on the eastern side of the river are founded in a fault zone in the highly to moderately weathered Silurian mudstone. The rock within the fault zone was particularly poor and extremely variable: joint frequencies 20 to 30 joints per metre were common, and joints were often slickensided or sheared.
Two test cylinder piles were constructed and loaded to failure to ascertain whether it was practicable to construct cylinder piles in the severely fractured rock, and the settlement which could be expected at the required design loadings.
The tests indicated that cylinder piles could be incorporated into a suitable foundation system. It was also demonstrated that, although relatively large settlements occurred under the first application of load, the behaviour under subsequent loading was more nearly elastic. Further, it was established that the cylinder piles in the fault zone should be drilled and cast under water in order to minimize the risk of collapse of the fractured rock.
The design of the superstructure required that settlement of cylinder piles be limited to no more than 5 mm. Because of the variable ground conditions, and the possibility of significant settlements occurring under initial loading, it was decided to proof load all cylinder piles to 6,700 kN or 1.5 times the design dead load.

The proof loading system comprised one rock anchor placed in a 300 mm diameter duct located in the centre of each cylinder pile (see Figure 1). A stressing jack bearing directly on each cylinder pile was able to apply load increments of 2200, 4400 and 6700 kN. During the first loading cycle each increment of load was maintained for a period of 30 minutes and the maximum load was maintained for a period of 20 hours. The results of the earlier tests suggested that the cylinder piles should not settle more than 0.25 mm during this 20-hour period if long-term creep settlement was to remain within acceptable limits. One of the cylinder piles was instrumented with resistance strain gauges so that the load distribution along the socket could be determined. The strain gauges were welded to short lengths of reinforcing bar in the laboratory and then tied to the main reinforcing cage before being lowered into the socket. The results of these tests are shown on Figure 2.

The load distributions indicate that, at the design load of 4400 kN, about 1100 kN is taken in end bearing, 2100 kN in side shear in the rock socket, and the remaining 1200kN by the bedding of the steel casing into the rock surface.

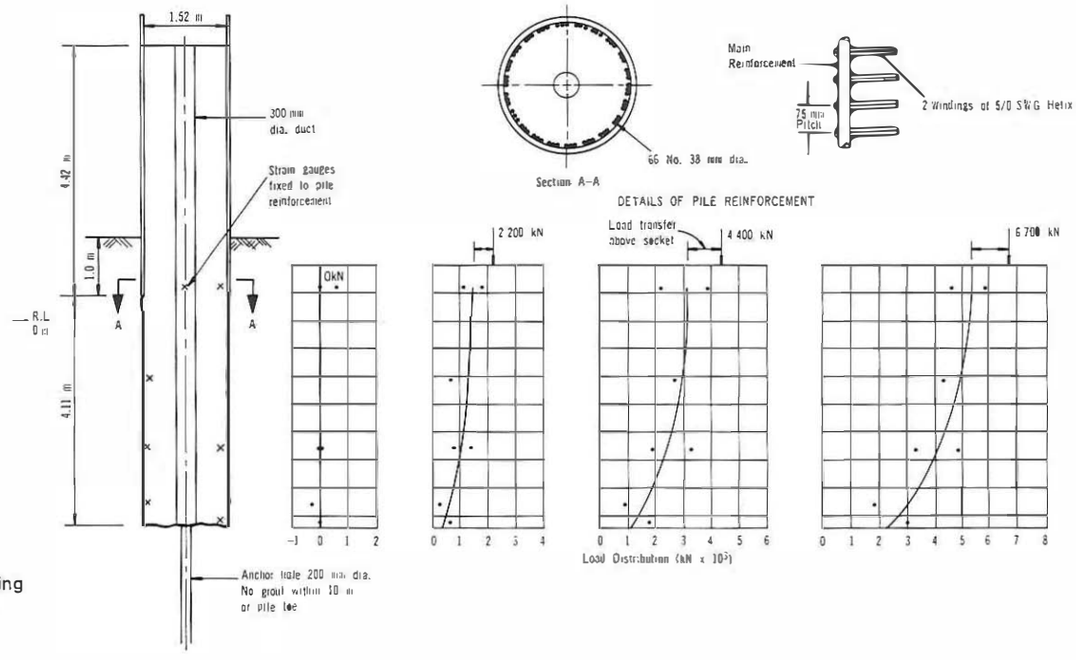



Figure 1: Eastern Freeway, Yarra river bridges–proof loading of cylinder 6, load distribution.

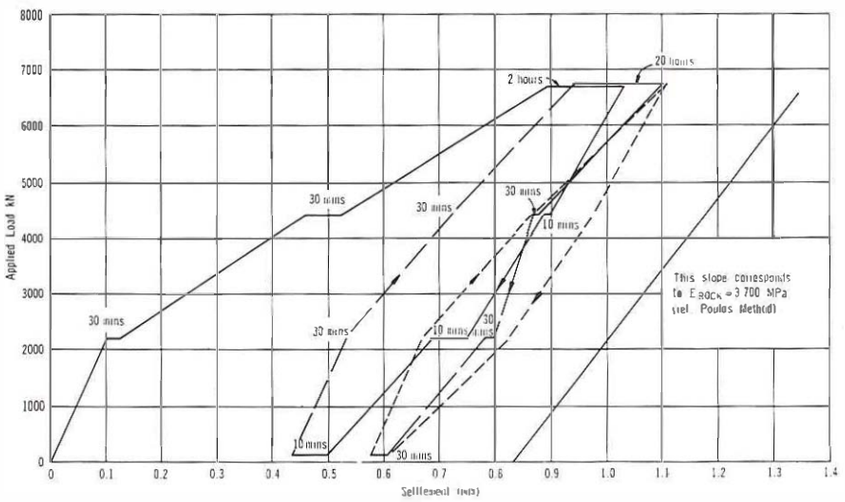



Figure 2: Eastern Freeway, Yarra river bridges–proof loading of cylinder 6, load settlement curve.

# Section B: Mechanical Sub-branch

**Priority intersection marker**

The introduction of the METCON priority intersection system has resulted in a considerable increase in roadmarking activity.

Initially, the painting of 'Stop' and 'Give way' lines at intersections was undertaken by hand but a machine has now been developed to carry out this function.

It is expected that this machine will perform work valued at $120,000 per year.

Following discussions with appropriate officials, 'Stop' and 'Give way' lines are now placed more on the through carriageway than in the side street. Nevertheless, numerous light poles, traffic signs and other obstructions adjacent to kerbs still impair access for mechanized painting of these lines. For this reason, a double folding outrigger or arm has been developed for carrying the paint guns. Both folding sections are electrically interlocked in the working position and may be retracted by the operator, but will automatically retract if an obstruction is encountered.

The driver's seat, steering wheel, pedals and instrument console assembly may be extended or retracted. When extended, the driver is seated directly behind the inner gun and is in the best position to line up the work. However, if fixed in this position, the machine would often have to be driven off course to clear obstructions. Instead such obstructions are generally cleared by the driver retracting his seat temporarily.

The machine has three wheels. The single front wheel is mounted in a ball race turntable which is rotated by a hydraulic system connected to the driver's steering wheel. The turning radius is about 2.5 m and this allows the machine to operate where there is only limited clearance before striking an obstruction.
The machine is powered by a V8 petrol engine, accurately governed to 1750 rpm, which is connected by a propeller shaft to an axle assembly incorporating a complete hydrostatic transmission, including a differential action, reduction gearing and brakes.
The machine is equipped with an axle mounted hydrostatic transmission controller which is moved by an electric motor coupled to a potentiometer. The driver's foot pedal is coupled to a second potentiometer. These potentiometers form part of a balanced bridge. This means that any movement of the operator's foot pedal produces a corresponding movement of the controller which permits the selection of any forward or reverse speed.
The more sharply defined lines required for this work have been obtained by adopting an airless atomization system of paint spraying. Apart from the improved definition, the change from an air-atomized system to an airless system reduces overspray paint loss by about 17%, creates less pollution and maintains a cleaner machine. Although the benefits of the airless atomization system have been appreciated for some time, the change has been deferred because of the unavailability of suitable commercial equipment. Therefore, the Board has developed and made most of the equipment used on this machine.
In the past, the Board has used gravity discharged glass beads for retro-reflection of the painted line. The position at which the beads initially reached the line, under this system, was affected by vehicle and wind speeds and, as such, was somewhat variable. On the longer lines this presents no problem, but on the shorter lines used in the METCON system more accurate bead placement was required. Therefore, a compressed air bead discharge system was adopted and the beads projected from their dispenser with a definite velocity. This bead stream is aimed to hit the painted line immediately behind the paint spray.
A fifth wheel cycling device is provided and the method of operation is:

—The machine is driven up to the end of a centre line.
—The gun operator zeros the indicating head of the cycling device.
—The machine reverses for a short distance, stops and then approaches the work at the pre-selected painting speed.
—At the approach to the first line, the gun operator presses the 'Paint' switch and painting starts automatically in the correct position and paints the desired broken line.
—At the approach to the centre of the side street, the gun operator presses either the 'Give way' or the 'Stop' switch and the second half of the line is painted in the desired pattern.

Because this machine operates at night when there is minimum traffic, it is provided with generous working and sign illumination. Considerable effort has been directed to ensuring that its operation was acceptably quiet, and this result appears to have been achieved.

**Snow blowers**
The Board's snow clearing work has been mainly performed by three Model 1500 Rolba Snow Blowers. These are fully imported machines of European origin and, as purchased, are not completely satisfactory for use in Victorian conditions. Their deficiencies have included inadequate performance and control and excessive maintenance costs. A series of modifications, as described below, have overcome these deficiencies and changed these snow blowers into efficient and economic machines.
The basic fault with the machines was that the original mechanical transmission could not provide a sufficiently low speed, and when the machine was headed into a heavy snow bank overloading of the cutter/blower system resulted. To overcome this problem, the operator was forced to reduce engine speed to such a degree that he lost control of some auxiliary functions. He was also forced to 'ride the clutch' causing excessive wear and increased maintenance costs. This problem has been overcome by replacing the clutch and mechanical transmission with an infinitely variable hydrostatic transmission, which allows the operator to select any speed from maximum forward to maximum reverse, including particularly any creep speed that is appropriate for the conditions. A consequent change in the weight distribution has also improved the handling characteristics of the machine.
Overloading the cutter/blower system also caused excessive wear and maintenance of the clutch in that system. This clutch has been replaced by a torque converter, which allows the operator to select a creep speed that is more appropriate for the continuously varying load.
These large 14 tonne pneumatic tyred machines have only a 3.5 m wheelbase and consequently tend to pitch longitudinally when in operation. This makes it difficult for the operator to clear snow to a consistent minimum depth without damaging the road surface. This deficiency has now been overcome by mounting the cutting head on hydraulically supported wheels which keep the cutting head at a constant height above the road surface regardless of the pitching of the vehicle.
Because embankments adjacent to roads in snow areas are often covered with snow, it was not unusual for the snow feeding spirals to catch and jam on an isolated rock or other obstruction.
To protect the machine from damage, the cutter/blower drive is provided with shear pins which break when the load is excessive. The pins would break several times each day and, since shear pin replacement is slow in the snow conditions, this represented a serious loss of snow clearing capacity. A guard ring has now been added to the outboard ends of the snow feeding spirals and this has dramatically reduced the incidence of shear pin breakage and time lost in this way is no longer significant.
As originally equipped, snow could only be discharged from the machine in a direction at right angles to the machine's direction of travel. Because the discharged snow also contains stones and other foreign bodies, this restriction on the direction of discharge was dangerous and sometimes resulted in damage to adjacent buildings. The machines have now been provided with fully rotating discharge chutes which are driven by a hydraulic motor. The operator can now discharge snow in any chosen direction.
While the Rolba Snow Blowers are appropriate for areas of heavy snowfall, the Board also uses graders in some areas which commonly have lighter snow falls. These graders are equipped with special front mounted blades for snow clearing. However, these machines are not completely satisfactory in restricted areas, particularly car parking sites. To improve their performance in these areas, a small snow blowing attachment which takes the place of the normal blade has been designed and fitted. The attachment can be fitted in ten minutes. This attachment has been evaluated during the 1976 snow season and found to be satisfactory. Although the Board maintains a continuous surveillance of new products, there appears to be no snow clearing equipment which is superior to these improved machines.

# Section C: Planning Sub-branch

## 1. Road Planning Division

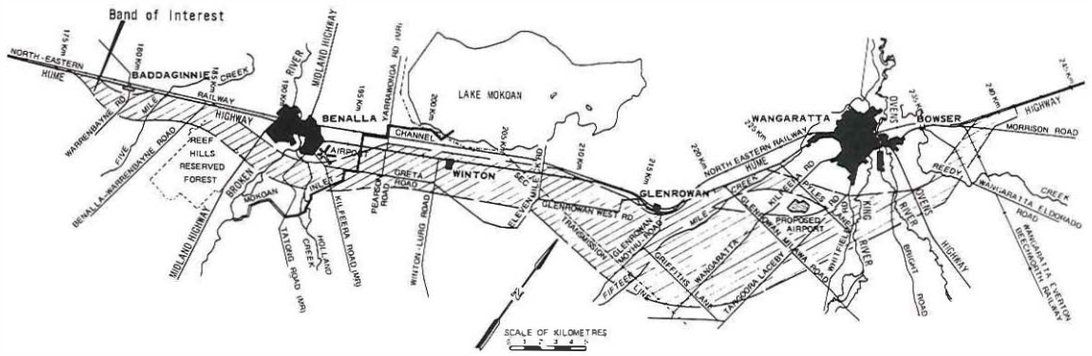
**Rural investigations**
The major emphasis in rural planning studies has been in determining the most appropriate manner in which a future freeway can be developed generally along the Hume Highway Corridor between Craigieburn and Wodonga. This work forms part of the National Highways programme.
A comprehensive study was carried out for the corridor as a whole to broadly determine existing information, identify ranges of practical solutions, estimate financial and physical resource requirements and form a basis for investigation of specific projects. Investigations were then undertaken on specific projects with planning investigations being co-ordinated by the Road Design and Planning Sub-branches.

Firm proposals have been developed for most of the routes. Studies still under way include:

—Euroa By-pass: alternative routes to the north or south of the township are being investigated.

—Benalla and Wangaratta By-passes: this section is discussed in more detail later in the report.

Figure 3: Band of Interest for the Baddaginnie to Bowser Section of the Hume Freeway.




The practice of conducting an overall corridor appraisal which sets the framework for subsequent project investigations has been found to be a most valuable aid in guiding detailed studies.

The practices and procedures adopted in the planning process are continually under review. As a new step in the rural investigation process, a Band of Interest was defined for the 65 km section of the Hume Freeway between Baddaginnie and Bowser, including the by-passes of Benalla and Wangaratta (see Figure 3). This has been done to allow all affected authorities to be advised of the Board's interest in the area well in advance of the stage where a favoured route can be recommended and discussed with relevant councils, landowners and other authorities.

The definition of a Band of Interest has been found to be of assistance in obtaining inputs from the above groups and facilitating consideration of land use, topographical, geological, hydraulic and geometric and economic factors.

A number of alternative routes are being investigated within the Band of Interest. A progress report will be issued to all authorities summarizing the major alternatives investigated and indicating those routes which should be discarded from future investigations. This will effectively reduce the Band of Interest from a broad band to one or two relatively well defined routes which will be the basis for future studies.

**Urban investigations**

The issues involved in seeking satisfactory and appropriate solutions to urban road-based transportation problems are complex. Over the past financial year, significant progress has been made on the following projects:

a. Eastern Corridor Study–Bulleen to Ringwood

In January 1976 the Government approved recommendations proposed from the Eastern Corridor Study. The study was carried out under the direction of a Management Group comprising representatives of the Country Roads Board, Melbourne and Metropolitan Board of Works, and the Ministries of Conservation, Planning and Transport.

The Management Group engaged consultants and sub-consultants and, with the assistance of staff of the authorities, carried out a comprehensive study of the transport requirements of the corridor, with appropriate consideration of environmental, sociological and economic factors.

Some of the major recommendations were:

—Action should be taken to extend the Eastern Freeway to Doncaster Road generally within the existing Planning Scheme reservation.

—The existing main road reservation should be retained and amended where necessary to provide for a six-lane freeway from Bulleen Road to join the Scoresby Freeway reservation at Ringwood. Provision should be made for a six-lane arterial road to by-pass Ringwood linking the freeway reservation with the Maroondah Highway.

—Several planned short-term improvements should be implemented.

Work has been continuing on the above tasks.

b. Freeway F9–Graham Street to St Kilda Road

Preliminary investigations were carried out for the development of an improved road link generally between the West Gate Bridge and St Kilda Road with connections to the Johnson Street Bridge and Kingsway.

Generally, the project will provide an eight-lane freeway between Graham Street and Kingsway and an arterial connection along Grant Street to St Kilda Road. The freeway section will then be elevated between Johnson Street and just east of Kingsway.

The route follows generally along the existing Planning Scheme reservation passing through industrial areas to the west of the Port Melbourne railway, and predominantly commercial sites nearer Kingsway.

Current planning provides for interchanges at Graham Street in Port Melbourne, and at Johnson Street and Kingsway in South Melbourne. A comprehensive traffic survey and socio-economic/environmental studies are currently being undertaken as part of the detailed planning in this area.

The socio-economic/environmental studies involve close liaison with the South Melbourne and Port Melbourne City Councils together with other authorities and groups with interests in the area. The studies will consider traffic management proposals developed by the Councils' and Board's staff, with a view to identifying areas susceptible to traffic intrusion and assessing the consequences and benefits of traffic management strategies.

It is also intended to assess the potential effects of construction of the freeway and develop suggestions and guidelines to assist in planning future development along the F9 corridor.

**Project evaluation**

Over recent years there has been a significant increase in the complexity of data used in transportation planning.

In selecting the most appropriate solutions consideration must be given to the social and environmental consequences of a proposed course of action as well as the engineering and economic factors.

A systematic approach is essential in assembling and presenting the full range of relevant data. The various evaluation techniques which have been developed around the world to cope with this problem have been summarized in Technical Report No. 61, 'Project Evaluation: The State Of the Art', for application in the Board's investigations.

The report outlines the basic principles underlying project evaluation, the main evaluation methods and proposes a recommended evaluation framework.

One of the major principles highlighted in the report is that evaluation does not simply take place at the end of a study.

Evaluation tends to be an iterative process that should be considered as taking place continuously throughout a study as major issues emerge and are clarified.

Application of these principles and a systematic manner have already assisted in determining the most appropriate course of action in the investigations noted above.

## 2. Environmental Studies Section

In 1975 the Environmental Studies Section was created in the Planning Sub-branch. The Section includes engineers, sociologists, a town planner and an economist, together with assistants and support staff.

The functions of the Section are to:

—undertake environmental studies for planning investigations,
—extend studies to the design, construction and operation stages as required,
—provide specialist advice on other phases of the Board's activities when required,
—develop techniques and procedures commensurate with the scale and nature of the Board's activities.

The creation of the Section was the Board's response to the community attitude that not only should the broad effects of roads on the environment be considered but the results of this work should be properly documented. The Section assists in the planning, design, construction and operation of road facilities.

In recent times, the Commonwealth and Victorian Governments, by either legislation or direction, have required that all authorities proposing major public works should consult with and receive a clearance from the relevant department charged with the protection of the environment. In attempting to avoid the pitfalls of overseas legislation, the process of publishing and examining information on the environmental aspects of proposals has been informal. Thus, the emphasis has been on meeting the spirit of environmental assessment rather than formalized procedures. The procedures adopted within the Board in meeting this requirement have varied depending on the nature of the project under consideration.

Environmental studies related to the upgrading of the Nepean Highway between Elsternwick and Moorabbin, the provision of a new route for the Hume Freeway from south of Seymour to north of Avenel, and to the Eastern Corridor, have been completed.

On the Nepean Highway, examination of a number of options with significantly differing effects was undertaken, however before proceeding to a final decision a public display was held at the Brighton Town Hall. In this display all options were shown, together with a summary of consequences of each.

In the process of selecting the most suitable location for the by-pass of Seymour on the Hume Freeway, a total of five alternative locations was examined to assess their effect on the social, physical and economic structure of the areas.

After the public display of the Statement of Environmental Considerations prepared by the Section, the Ministry for Conservation in its final summation stated—'Many of the adverse consequences noted for all routes were much less pronounced in the case of the favoured route. Further, in many instances, remedial action could be more effectively accomplished'.

A significant input was made by the Section to environmental aspects of the Eastern Corridor Study. This involved a programme of public consultation in the assessment of a number of alternatives in the Corridor ranging from the no-build option to an eight-lane freeway from the current terminal of the Eastern Freeway to the Maroondah Highway in Ringwood. Ultimately, after consideration of both engineering and environmental aspects, a six-lane freeway was recommended. Detailed work on definition of the right-of-way is currently in progress.

The F9 Environmental and Land Use Study which encompasses the Cities of South and Port Melbourne and a small section of St Kilda is in progress. The overall purpose of the study is to assess the impact of the future freeway and its traffic, and to ensure that opportunities which the new facility may present for improving the environment are identified.

Three specific objectives of the study are to:

—aggregate local traffic management proposals prepared by councils and designed to protect areas susceptible to future traffic intrusion, so that system effects can be evaluated;
—formulate suggested guidelines for the future development along the F9 Corridor; and
—assess the impact of the F9 route.

This study, which is expected to be completed in late 1976, is being co-ordinated by the Section.

The Commonwealth Minister for Transport has requested the Board to provide an environmental clearance for various projects on the current Works Programme. The method of approach adopted has been to include a senior member of the Assessment Branch of the Victorian Ministry for Conservation in discussions on each job in the programme. The discussions have been led by the respective Divisional Engineers, or their nominated representatives, and each item has been explored to establish whether likely environmental consequences or possible public controversy has been adequately considered. While some of the larger items have been the subject of major studies, agreement has readily been obtained to the majority of the programme.

# Section D: Road Design Sub-branch

## 1. Plans and Surveys Division

**Photogrammetry**

The Department of Crown Lands and Survey has introduced procedures through the State Advisory Mapping Committee to standardize large-scale maps on a set of basic scales with unified sheet format size, paper size and a unique indexing system, whereby map information may be related, stored and retrieved. The basis of this system is the Australian Map Grid, supplemented by the State Prime Rectangle Grid.

Photogrammetric mapping surveys undertaken recently have been integrated into the State Prime Rectangle Grid system. No extra cost is incurred in mapping prime rectangle oriented sheets as against stereomodel mapped sheets. The same area which would have been mapped by stereomodel project mapping can be mapped by prime rectangle type mapping, and for some projects part only prime rectangle map sheets need be prepared to satisfy the Board's mapping requirement.

The co-operation of all State authorities concerned with mapping has resulted in major time and cost savings in photogrammetric mapping in the metropolitan area. Further investigation in the conversion of double model photogrammetric map sheets to prime rectangle map sheets was done during the year.

Orthophotography has been converted to orthophotomaps on an experimental basis by combining orthophotographs obtained from the Board's PP08 Orthophoto instrument with graphical mapping, thus obtaining a photographic base map with detail and contours superimposed.

**Road design data processing**

The RIDGE (Roadway Integrated Design and Geometry) system reported in the 62nd Annual Report has now been installed and is fully operational. Further improvements have been made to facilitate:

—Contour plotting of natural terrain surfaces and designed roadways. This function will allow consideration of landscape and environmental effects of design.
—Resheet design for control of pavement surfacing problems. This facet of RIDGE was used extensively on the Hume Freeway (Wallan-Broadford section).
—Curvilinear horizontal alignment design.

Training sessions have been conducted to familiarize staff at Head Office and Regional Divisions in systems usage. The level of design usage is as follows:

| | |
|---|---|
| Urban and rural freeways | : 60% |
| Urban and rural arterial roads | : 25% |
| Other rural roads | : 10% |
| Miscellaneous road design | : 5% |

City Council to investigate the impact of the Eastern Freeway on the City of Melbourne. The resulting study by consultants Llewelyn Davies Kinhill Pty Ltd investigated the environmental, social and transport effects of the Eastern Freeway at its western terminal. The study was directed by a Steering Committee composed of Councillors representing the Cities of Collingwood, Fitzroy and Melbourne, the Country Roads Board and the Ministry of Transport. A Technical Committee was established to advise the Steering Committee on technical aspects of the study.
The Traffic Engineering Division has been actively involved in this study by providing detailed estimates of traffic using the Eastern Freeway, expertise in the fields of data collection, traffic design and planning of alternatives, and the joint supervision of the consultant on behalf of the Steering Committee.

3. *Mulgrave Freeway.* During the year, an investigation into the approach roads at the western end of the Mulgrave Freeway was completed.
Detailed distributions of expected traffic flows were assessed by the Division and consequent road improvements and intersection improvements designed in association with Metropolitan Division and the councils. The investigations also established that, in addition to the short-term arterial road improvements required when the freeway opens to Warrigal Road, a new major road connection between Mulgrave Freeway and the South Eastern Freeway would provide a better long-term solution to traffic problems and arrest deterioration of the environment in this corridor. Because of the need for proper consideration of the requirements for drainage, recreation, transport and various urban service facilities within this corridor, the Board has proposed that a series of studies be carried out in parallel by the appropriate authorities, with co-ordination and direction provided by broadly-based Steering and Technical Committees.

b. Traffic control systems.
The concept of traffic control has changed markedly over recent years. Individual sites requiring signalisation can, in many cases, no longer be considered in isolation in that the interaction of all individual intersections with adjoining intersections must be considered. This is especially true along major arterial roads where traffic flow can be considerably improved, especially in regard to travel time delay, by co-ordination of successive traffic signals along the route. There are two basic methods available to control co-ordinated signals: a fixed time system which relies on historical data and changes co-ordination patterns by time of day, e.g. morning peak, off-peak, evening peak, or a dynamic system responsive to traffic flows in varying the co-ordination patterns. The fixed time system has proved to be useful to a limited extent in achieving optimum co-ordination, but substantial improvement can be achieved by dynamic traffic responsive systems.
Currently, the Board operates several different types of co-ordinated systems, of which two examples are:

1. *Kingsway, South Melbourne.* In Kingsway, South Melbourne, six simple fixed time signals are linked to give progression. The individual controllers provide three fixed phasing patterns on dials driven by small electric motors: one for morning peak, one for evening peak, and one for off-peak. The controllers also have a radio receiver tuned to the radio-controlled Melbourne City Council traffic control system which sends out synchronising pulses to keep the signals in step, and also selects the dial appropriate to the time of day. This system has been in operation for about 15 years.

2. *St Kilda Road, St Kilda.* The dynamic system in St Kilda Road, St Kilda, immediately south of the St Kilda Junction, involves co-ordination of eight intersections which are linked by cable and connected to a master controller and mini computer (see Plate 9) located approximately at the mid-point of the route.
Information is transmitted to the computer from 107 traffic detectors placed along the route to record traffic, pedestrian and tram volumes. The computer analyses this information and determines the signal settings to achieve optimum conditions for the movement of road vehicles and trams along the route, and minimum delay to pedestrians.

c. Systems being planned
1. *The Eastern Freeway approach roads.* Three further systems are being planned in association with the Eastern Freeway and its approach roads (see Figure 5). The three routes are Hoddle Street from the Eastern Freeway to the Victoria Street/Albert Street intersection, Alexandra Parade from Hoddle Street to Lygon Street, and Chandler Highway from the Eastern Freeway to Willsmere Road. The design for these three facilities is currently in progress following studies which determined the most economical method of linking and controlling these three systems.
The basic options studied were:
—to link each of the systems individually by cable along their length and to run them on a fixed time basis;
—to control each system with an individual computer in a similar fashion to the St Kilda Road, St Kilda, route; or
—to use one single computer to control all three systems.

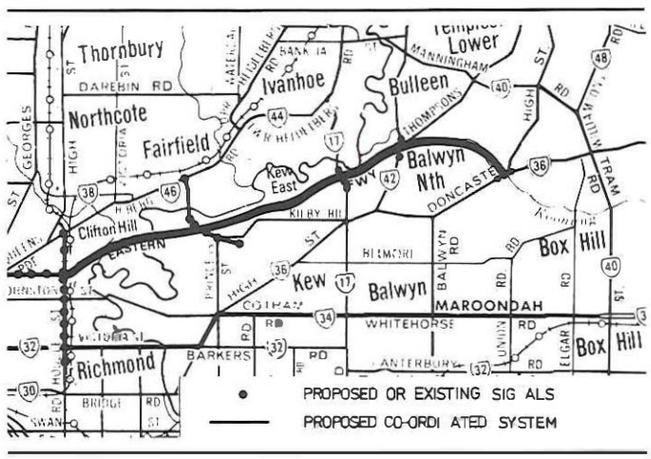
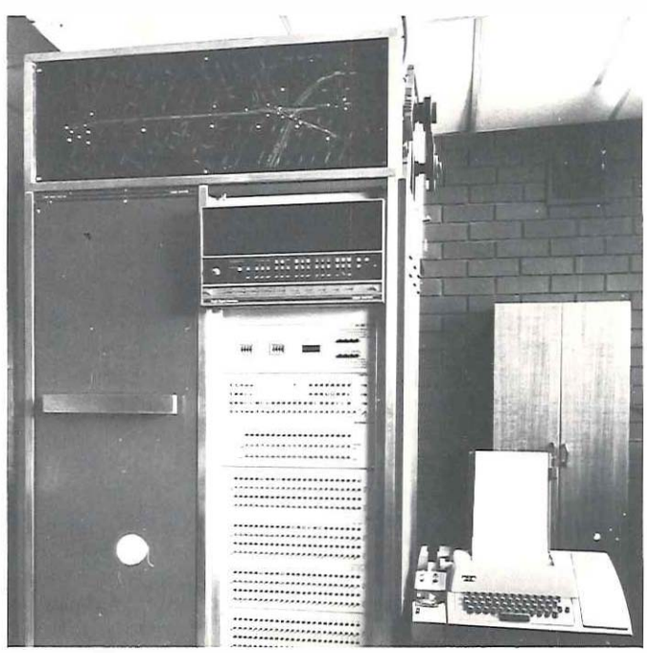



Figure 5: The Eastern Freeway co-ordinated signal systems.

Plate 9: St Kilda Road Computer Installation. The mini-computer is located at the top right-hand corner of the installation with the master controller to the left and the input-output interconnections to both traffic signals and traffic detectors below. A mimic display mounted on top of the installation monitors the operation of the system and the teletype shown on the right is used for operator contact with the mini-computer.



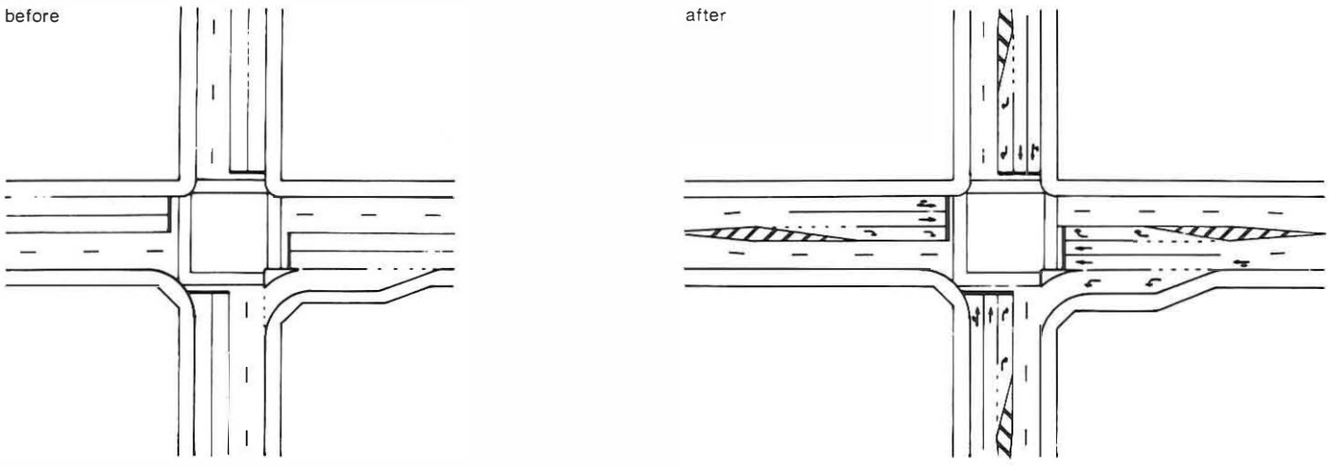



Figure 6: Barkers Road/Denmark Street intersection before and after treatment.

The studies indicated that, whilst a fixed time system is the cheapest system to install and operate, variations in traffic along the route and by time of day will probably require a dynamic system of control. It was also found that a single computer controlling all three individual systems would be the most economical, as it would cater for traffic counting and have the flexibility for future expansion as required. The design of the system currently under way envisages an initial installation operating on a fixed time mode but being readily capable of development to a traffic responsive mode as the traffic situation demands and the availability of finance permits.

2. *Other systems.* A fully traffic-responsive co-ordinated system has been designed for the main route via the Johnson Street Bridge from City Road, South Melbourne, to Dudley Street, West Melbourne, which carries heavy industrial traffic and is complicated by the high proportions of turning movements, and the presence of two railway level crossings serving the port facilities. The system will control seven intersections.

Investigations are in progress on another system on the Maroondah Highway through Ringwood with the objective of improving the level of service through the main commercial area of Ringwood where high volumes of cross traffic and pedestrian movements result in severe congestion during week-day peak periods and to undue delay to recreational traffic at weekends.

Investigations are also in progress into the co-ordination of traffic signals along a section of the Nepean Highway between Elsternwick and Moorabbin which is planned for widening in the near future.

**Important recent tasks**

a. Improving traffic flow and safety

The improvement of traffic flow and safety on roads either in association with major area or corridor investigations or as an individual project can be effected in many cases without incurring high costs. The aim of such improvements is to increase the efficiency of the existing road system, in particular to minimize any undue delays along a route to minimize conflict between vehicles in the traffic stream. Measures which have been implemented to reduce traffic delays and improve safety include:

—channelization and flaring at intersections,
—provision of exclusive lanes for turning traffic at intersections,
—provision of linked signal systems,
—provision of special signal systems,
—provision of special signal phases for turning traffic,
—elimination of railway level crossings,
—introduction of clearways,
—provision of bus bays,
—provision of signalized pedestrian crossings,
—provision of tram safety zones.

One of the most common sources of delay in urban areas is the blockage, by right turning vehicles, of the inner lanes of four-lane undivided roads at signalized intersections.

Plate 10: Maroondah Highway–Middleborough Road improvements.

Treatments to allow separate right-turn storage lanes to alleviate this problem usually require flaring of the approaches and, in the case of the more important intersections where severe problems exist, land acquisition is often required. These large-scale improvements, such as that at the Maroondah Highway/Middleborough Road intersection (see Plate 10), are expensive, and therefore very few can be constructed each year.

At many intersections along roads with 46 ft to 48 ft carriageways within a one chain reserve it is possible by reducing lane widths to provide a right-turn lane without widening the right-of-way. In association with the City of Hawthorn, a low cost treatment in Barkers Road at Denmark Street was investigated and the treatment shown in Figure 6 was developed (see also Plate 11). Jiggle bars and raised reflective markings have been used to supplement and reinforce the pavement markings.

Plate 11: View of improved Barkers Road/Denmark Street intersection looking east along Barkers Road.

Before and after studies indicated that delays to westbound through vehicles in the peak direction have been halved (see Table 1), whilst the number of vehicles turning right has increased by about 50%.

**Table 1:**
Barkers Road/Denmark Street intersection–comparison of operating conditions before and after treatment

| | Travel speed in kerbside lane *(km/hr) | Travel speed in central lane *(km/hr) | Total volume in kerbside lane (v p h) | Total volume in central lane (v p h) |
|---|---|---|---|---|
| Before | 10.7 | 9.6 | 870 | 610 |
| After | 19.2 | 18.0 | 870 | 820 |

* Average peak speed between Glenferrie Road and Denmark Street (800 m).

The estimated construction and annual maintenance cost of the treatment is $1,000 with an annual benefit of $50,000 attributable to reduced delays giving a benefit/cost ratio of about 50.
The treatment has been regarded as very successful and has now also been constructed on the Denmark Street approaches of the intersection.

b. Traffic accident reduction.
The Traffic Engineering Division in conjunction with the Computer Section is developing a system which will be used to analyse accident patterns, identify abnormally hazardous locations, assist in establishing the need for improvements, and subsequently check on the effectiveness of improvements.
Typical of the former are investigations into the effect of regulatory and warning signs at rural intersections. Preliminary results have confirmed that certain types of cross intersections are not suited to standard signing and delineation treatments and, where practicable, should be converted to staggered 'T' intersections, or roundabouts where appropriate.
The Division has also carried out a number of studies to determine the effectiveness of various minor traffic engineering measures in improving road safety, and reducing the number of accidents. These have included studies of individual intersections, as well as a study of an 80 kilometre length of the Princes Highway East.

c. Traffic signals at individual intersections.
The need to improve road safety and the introduction of the METCON and STATCON priority road programmes has increased the demand for signalization of intersections.
The aesthetics, safety and economy of traffic signal installations have been a matter of concern, and preliminary investigations into joint use of public lighting poles and traffic signal pedestals and the combination of public lighting poles and traffic signal mast arms have been completed.
Responses from electricity supply authorities to the concept of joint use have been favourable, and a number of installations have been completed with good results.
Locations where joint use poles have been used include:
—Mulgrave Freeway–Blackburn Road Interchange
—Maroondah Highway–Middleborough Road
—Western Highway–Gillies Street, Ballarat
—Charing Cross, Bendigo
—Lancefield Road–Mascoma Street–Dromana Avenue

**Normal duties**

a. Street lighting.
The amendment to the Country Roads Act in 1971 which established the Street Lighting Committee and provided for the sharing of street lighting costs on State highways between the Board, the electric supply authority and the municipality concerned was extended by a further amendment in 1973 to include declared main roads.
The Street Lighting Committee has adopted Australian Standard CA19 Part 1–1964 as the minimum standard for cost-sharing installations which existed at the time of the legislative amendments becoming effective, and Australian Standard AS1158 Part 1–1973 as the minimum standard for cost-sharing new installations and improvements to existing substandard installations. The Committee also established lighting standards for channelised intersections and isolated rural intersections.
Since the introduction of the cost-sharing arrangements, lighting on a total of approximately 127 km of State highways and 42 km of main roads has been accepted for cost-sharing. The total expenditure on annual tariff is approximately $171,800, and approximately $179,500 has been expended on capital costs associated with new installations and improvements to substandard existing installations.
Improvements to lighting technology are being introduced and a notable example is the scheme installed on the Princes Highway in the City of Springvale (see Plate 12). This scheme incorporates 250 W high pressure sodium lamps in semi cut-off lanterns mounted 12.5 m above the carriageways on a central line of columns spaced at 58 m in the median of the highway. The layout which makes the most efficient use of this type of lantern involves fewer columns than other types and provides better lighting than the minimum code requirement. The general appearance of the scheme is most satisfactory and "in scale" with the highway.
Another example of improved technique is the lighting system being installed on the Eastern Freeway (see Plate 13). This scheme incorporates clusters of 400 W high pressure sodium lanterns mounted on high masts at heights ranging from 18 m to 44 m, but predominantly at 36 m. The masts are centrally mounted in the median at approximately 116 m spacing and incorporate lantern raising and lowering gear to permit maintenance at ground level.
During the year a training course in Street Lighting was conducted in association with the State Electricity Commission. The detailed notes for the course form an excellent manual of administration, design, operation and maintenance of street lighting work in Victoria.

b. Traffic signs and devices.
The Traffic Engineering Division is responsible for the general development and oversight of standards and practices in the use of traffic signs and devices by the Board, and for the preparation of signing schemes for major new facilities. The following significant developments in standards and practices occurred during the year:

1. Publication of Australian Standard 1742-1975, the Manual of Uniform Traffic Control Devices Part 1. This manual, to which major contributions were made by the Division through its NAASRA representation on the Australian Committee on Road Devices, comprises a modern comprehensive standard for practically a full range of road signs, pavement markings and delineation devices, and has resulted in several changes in Board practices to the National Standard. Typical of these changes are:
—Greater use of symbols on signs as illustrated:
—New colour coding for certain types of sign, e.g. white legend on 'standard green' background for large direction signs, blue background for motorists' services signs, and brown background for tourist signs.

2. Production of a comprehensive guide for the signing of tourist drives and features of tourist interest. The guide has been prepared in response to a continuing high demand for this type of sign, and incorporates a white-on-brown colour scheme for the signs and the tourist route marker for the signing of tourist drives. A similar guide for the signing of motorists' services (including signs on freeways) is in the course of preparation.

3. Production of a standard map of destinations to be used on direction signs on State highways. The map is aimed at simplifying the task of selecting destination names for use on signs and to obtain consistency of message for through traffic along any particular route.
From time to time circumstances are noted in the road system where standard signing is not adequate, and special solutions must be devised. One such case is the Elgar Road approach to Doncaster Road involving the use of diagrammatic symbols which has resulted in substantially improved operation at the intersection (see Plate 14).

Plate 12: Street lighting installation on the Princes Highway East in the City of Springvale.

Plate 13: High mast lighting installation on the Eastern Freeway.


Plate 14: Elgar Road approach to Doncaster Road.

Figure 7: Sign W5-20 Slippery Road.

Figure 8: Sign W6-3 Children.

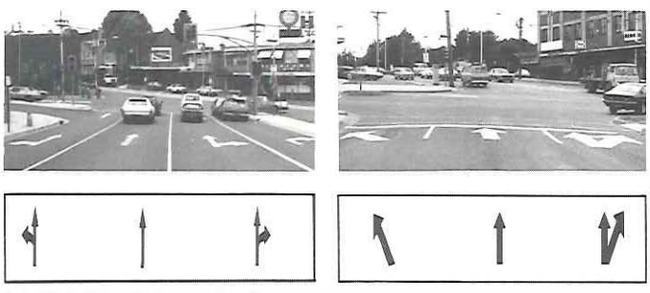


Figure 9: The photographs show a motorist's view of the new (left) and old (right) pavement arrows. The actual shape of the arrows is shown below the photographs.

c. Traffic linemarking.

The Division is responsible for the painting and maintenance of traffic lines and pavement markings on most of the Board's declared road system, including the technical oversight of small units attached to Regional Divisions. It operates three large highway striping machines and a number of smaller units engaged on intersection and allied work. In all, a work force of some forty plant operators is employed, with an annual expenditure in excess of $1 million.

The Division is also responsible for the maintenance and development of standards and practices for line and pavement marking, and some recent developments in this field are:

1. The manufacture of a mechanised unit for placing raised pavement markers. This truck mounted equipment meters, mixes and dispenses mixed epoxy adhesive for the markers, thereby reducing the installation time and allowing the use of rapid set adhesives. This is an advantage when laying markers under traffic or in cold weather. The unit will be used for the installation of new markers as required and for the routine maintenance of existing installations.

2. The use of long-life pavement marking materials at urban intersections. Thermoplastic and two-part polymer materials have been used on stop lines and pavement arrows at a number of intersections on declared roads in the Melbourne area.

The Board is continually improving the type of pavement markings used to convey a message to the driver. Pavement arrows at intersections, for example, have recently been altered to conform with the latest Australian Standard. The new arrows, illustrated in comparison with the old style arrows in Figure 9, have been shown from research conducted by the Australian Road Research Board to be more readily interpreted by the driver and therefore more effective. They are also less costly to install and maintain.

d. Delineation.

Consideration is currently being given to means of improving delineation of rural roads for night travel. The Board has a policy of using edge lines at points of some hazard such as rural intersections, narrowing of pavement and formation, and road sections subject to fog conditions, etc. To date, only limited use has been made of long lengths of edge lines, generally along freeways and selected lengths of high volume rural State highways.

It has not been possible to determine the advantages of edge lining from an examination of accident statistics or road maintenance costs, but it is recognised that road users react favourably to their presence. Other means of improving delineation, including the use of raised reflective pavement markers and high performance guide post delineators, are being applied. The current programme of laying the raised reflective pavement markers involves approximately 1,000 km of rural State highways – the programme is now about half complete. Following the satisfactory field trials of high performance guide post delineators by the Materials Research Division, it is likely that these will soon replace conventional delineators in a number of locations on State highways, which will further enhance night-time delineation and guide drivers in adverse weather conditions.

As improved delineation is costly, criteria such as traffic volume, road capacity, and relative hazard at particular locations, are considered before installation. To assist in gaining a better understanding of delineation needs of drivers, the Australian Road Research Board is currently conducting research in this field. The research project will be monitored by the Traffic Engineering Division through its representative on the Human Factors Committee of the Australian Road Research Board.

# Section E: Urban Projects Sub-branch

**Eastern Freeway**

The major construction work undertaken by the Urban Projects Sub-branch during the year was the continued work on the Eastern Freeway, Collingwood to Bulleen, and, in view of changing community attitudes to freeways in the metropolitan area, particularly close attention has been given to achieving aesthetically pleasing treatment on this section of the Eastern Freeway. Over 200,000 trees, shrubs and ground cover plants will have been established on this 9 kilometre section and adjacent areas when the freeway is opened in 1977. The planting includes species which will blend with adjacent river banks and the flood plain, and faster-growing varieties have been included to give an early effect.

Features of landscaping treatments include the planting of thick vegetative screens close to residential areas and control of erosion on unstable batters. The work included the restoration of Kew and Latrobe golf courses, involving the construction of 60 temporary and permanent tees, fairways and greens, and the construction of new ovals and facilities in Yarra Bend National Park.

The landscaping tasks have been carried out by a direct labour force of about fifteen men under the supervision of two qualified horticulturists.

Part of the restoration work has involved a new type of treatment of an urban creek, namely Glass Creek in the City of Kew. The treatment was developed after discussions with the drainage authority (Melbourne and Metropolitan Board of Works), local groups and Kew City Council (see Plates 15 & 16).

Plate 15: Glass Creek before restoration.

Plate 16: Erosion control treatment on the banks of Glass Creek.

The treatment involved:

—construction of a retarding basin to dissipate energy from a 10 ft diameter pipe outfall;

—regrading of the channel over 0.7 km from about 1 in 200 to 1 in 1000 by a series of low weirs;

—establishment of rock work on the creek banks at bends to control erosion and to give a pleasing natural appearance: over 4000 cyds of boulders were used in this work; and

—re-vegetation of the whole area of 5 hectares.

Close participation by all relevant authorities and members of the public engendered a feeling of confidence in the treatment which has been approved by the authorities which will be responsible for the maintenance of the creek.

# Section F: Works Sub-branch

## 1. Asphalt Division

**Extent of work**

Table 2 shows that 4371 km of all types of bituminous surfacing work was completed in 1975/76 compared with 4636 km in 1974/75. Although the length of roadway treated decreased by 265 km the area treated has increased by approximately 500,000 $m^2$.

In 1975/76 the length of sealed pavement on the Board's declared system was increased by 66 km and the length on unclassified roads by 380 km as shown in Table 3.

Reconstruction of existing sealed pavements and the restoration of the seal coat amounted to 366 km of the declared system, 1.5% of the sealed length compared with 2.1% in 1974/75 and 2.1% in 1973/74.

Retreatment on declared roads amounted to 1584 km, 6.7% of the sealed length, compared with 5.8% in 1974/75.

**Table 2:**
Bituminous surfacing work completed

| Category of road and plant used | 1974/75 | | 1975/76 | |
|---|---|---|---|---|
| | | Km | | Km |
| Work on roads to which the Board contributed funds | | | | |
| a) CRB declared roads | | | | |
| Board's plant | 1899 | | 2066 | |
| Municipal plant | 130 | | 132 | |
| Contractor's plant | 387 | | 242 | |
| | | 2416 | | 2440 |
| b) Unclassified roads | | | | |
| Board's plant | 1610 | | 1339 | |
| Municipal plant | 178 | | 152 | |
| Contractor's plant | 204 | | 175 | |
| | | 1992 | | 1666 |
| Sub-total | | 4408 | | 4108 |
| Work done for other Authorities by Board's plant (No Board contribution) | | | | |
| Municipalities | 212 | | 259 | |
| State Instrumentalities | 15 | | 5 | |
| Commonwealth Works | 1 | | 1 | |
| | | 228 | | 265 |
| Total | | 4636 | | 4371 |

**Table 3:**
Bituminous surfacing work on various road categories
(On roads to which the Board contributed funds during 1975/76)

| Type of work | State Highways | Freeways | Tourists' and forest roads | Main roads | Total Board's decl. system | Unclassified roads | Totals |
|---|---|---|---|---|---|---|---|
| | Km | Km | Km | Km | Km | Km | Km |
| Initial treatments: | | | | | | | |
| *Extensions to sealed system* | | | | | | | |
| Sprayed work | 1.10 | 13.86 | 3.10 | 29.10 | 47.16 | 368.94 | 416.10 |
| Plant mix work | | 17.21 | 0.40 | 1.19 | 18.80 | 10.65 | 29.45 |
| *Reconstruction of lengths of previously sealed pavements* | | | | | | | |
| Sprayed work | 117.05 | 3.40 | 9.92 | 212.24 | 342.61 | 209.79 | 552.40 |
| Plant mix work | 6.04 | 0.85 | 0.25 | 16.39 | 23.53 | 20.64 | 44.17 |
| *Widening of existing sealed pavements* | | | | | | | |
| Sprayed work | 29.02 | 2.16 | 2.30 | 23.93 | 57.41 | 60.88 | 118.29 |
| Plant mix work | 3.54 | | | 2.09 | 5.63 | 1.36 | 6.99 |
| *Duplication of existing sealed pavements* | | | | | | | |
| Sprayed work | 16.85 | | | 4.90 | 21.75 | 1.24 | 22.99 |
| Plant mix work | 3.86 | | | 5.86 | 9.72 | 6.32 | 16.04 |
| *Final seal* | | | | | | | |
| Sprayed work | 120.37 | 46.01 | 14.60 | 135.54 | 316.52 | 178.04 | 494.56 |
| Plant mix work | 3.40 | 3.27 | | 6.72 | 13.39 | 8.37 | 21.76 |
| Retreatments: | | | | | | | |
| Sprayed work | 731.52 | 19.30 | 41.64 | 759.21 | 1551.67 | 780.21 | 2331.88 |
| Plant mix work | 12.23 | 4.58 | | 15.74 | 32.55 | 18.85 | 51.40 |
| Total | 1044.98 | 110.64 | 72.21 | 1212.91 | 2440.74 | 1665.29 | 4106.03 |

**Types of work**

Sprayed work (initial treatments and retreatments) was again the principal type of work, amounting to 96% of the total length of the work.

The plant mix work completed in 1975/76 was 170 km, i.e. 4% of the total distance and 8% of the total area. The 1975/76 expenditure on plant mix works was equivalent to 31% of the total expenditure on bituminous surfacing. For the plant mix work a total of 302 068 tonnes was supplied and spread by contractors.

**Costs of work**

The average unit costs for sprayed work done by the Board's 17 bituminous surfacing units are shown in Table 4. The average overall cost of all types of sprayed work was 54.6 cents per square metre compared with 47.8 cents in 1974/75, an increase of 14%. The average cost per tonne for asphalt supplied and laid was approximately $20.00 per tonne in the Melbourne and Geelong areas and approximately $29.50 per tonne in country areas. The average cost per tonne for all areas was $20.34 compared with $17.35 in 1974/75.

**Table 4:**
Average costs of sprayed bituminous surfacing done by CRB plant
(On roads to which the Board contributed funds during 1975/76)
(Costs in cents per square metre)

| Item | Nature of work | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Square metres costed | ITP & S* Size 13 | | ITP & S Size 10 | | ITP & S S.7 & sand | | Primer-seals | | IT Two-application seal only | | ITSO** & reseals S.16 & over | | ITSO & reseals Size 13 | | ITSO & reseals Size 10 | | ITSO & reseals S.7 & sand | |
| | 766394 | | 705641 | | 14590 | | 1269436 | | 7569 | | 4617 | | 3090408 | | 8738809 | | 6385919 | |
| | Cents | % | Cents | % | Cents | % | Cents | % | Cents | % | Cents | % | Cents | % | Cents | % | Cents | % |
| Material | 45.4 | 50.7 | 39.1 | 50.8 | 33.6 | 52.2 | 27.3 | 46.9 | 53.1 | 62.1 | 34.4 | 56.2 | 35.6 | 53.7 | 27.6 | 52.1 | 23.3 | 53.8 |
| Stores | 3.0 | 3.4 | 2.4 | 3.1 | 2.8 | 4.3 | 2.0 | 3.4 | 3.6 | 4.2 | 1.8 | 3.0 | 2.1 | 3.2 | 1.5 | 2.8 | 1.4 | 3.2 |
| Plant hire | 16.2 | 18.1 | 14.8 | 19.2 | 11.9 | 18.5 | 11.1 | 19.0 | 10.8 | 12.6 | 12.4 | 20.3 | 10.7 | 16.1 | 9.0 | 16.9 | 7.4 | 17.1 |
| Labour | 24.9 | 27.8 | 20.7 | 26.9 | 16.1 | 25.0 | 17.9 | 30.7 | 18.0 | 21.1 | 12.5 | 20.5 | 17.9 | 27.0 | 15.0 | 28.2 | 11.2 | 25.9 |
| Total | 89.5 | 100 | 77.0 | 100 | 64.4 | 100 | 58.3 | 100 | 85.5 | 100 | 61.0 | 100 | 66.3 | 100 | 53.0 | 100 | 43.3 | 100 |

*Indicates 'Initial Treatment Prime & Seal'

**Indicates 'Initial Treatment Seal Only'

**Materials**

a. Aggregate.
The total quantity of covering aggregate used was approximately 210 200 cubic metres on sprayed work done by the Board's plant and 49 600 cubic metres on sprayed work done by municipalities and contractors. Table 5 sets out the average prices of aggregates over the last five years and shows that the average price in 1975/76 was $1.88 per cubic metre higher than the average price in 1974/75.

b. Bitumen.
The Board purchased 28 963 tonnes of bitumen by contract with four marketing companies at a cost of $2,912,000.

**Table 5:**
Average price of aggregate for bituminous surfacing (In roadside stacks)

| Material price per cubic metre | 1971/72 | 1972/73 | 1973/74 | 1974/75 | 1975/76 |
|---|---|---|---|---|---|
| | $ | $ | $ | $ | $ |
| Screenings | 6.74 | 7.01 | 7.39 | 9.31 | 11.19 |
| Gravel | 6.50 | 6.76 | 6.53 | 9.24 | 11.36 |
| Sand | 2.05 | 2.64 | 3.68 | 3.06 | 5.23 |
| Average price all aggregates | 6.54 | 6.83 | 7.08 | 9.13 | 11.01 |
| Scoria | 4.46 | 5.10 | 4.49 | 5.38 | 6.51 |

Plate 17: Hume Freeway–Wallan to Broadford. General view of sealing in progress.

**Increase in price of bitumen**
During the financial year the price of bitumen increased by $12.48 per tonne from $89.92 to $102.40 per tonne.

**Surface enrichment seals**
A light application of bituminous material, with or without a fine aggregate cover, applied to the surface to increase the binder content of an existing seal is designated a surface enrichment seal. In the present financial restrictions there is an application for a surface enrichment seal, particularly on low traffic density sealed roads (less than 100 vpd).
The aims of such a seal are to:
—Extend the life of the existing seal before a normal reseal is necessary.
—Stop or reduce the stripping of aggregate.
—Seal minor cracks existing in a sealed pavement.

Some successful trials have been carried out in the Shire of Grenville using cutback bitumen without cover aggregate on lightly trafficked roads. The cutback bitumen used consisted of 100 parts of R90 bitumen and 8, 14 or 30 parts of power kerosene, applied at application rates varying from 0.40 l/m² to 1.08 l/m². The 0.8 l/m² was the most promising result. Cost is about one-third of a normal size 7 reseal.

**Sealing of Hume Freeway, Wallan-Broadford**
In accordance with the Board's surfacing policy for rural freeways the Hume Freeway between Wallan and Broadford was given a surface seal. The bituminous surfacing units from Ballarat, Bendigo and Geelong Divisions carried out the work (see Plate 17).
As the various lengths of the pavement were prepared for sealing, either a size 7 primerseal or size 7 prime and seal was applied followed by a size 10 final seal.
The total length of two-lane dual carriageway was 34.4 km. The work of applying the final seal on the through lanes, shoulders and ancillary roads on a total area of 883 500 square metres involved the spraying of 966 000 litres of bitumen and the spreading of 8100 cubic metres of size 10 and size 7 aggregate.
The designed binder rates of application were based on the volume of traffic expected after opening. As the work was done under construction traffic only, the seal was subject to very little traffic for a period of from several days to several months. Therefore rubber-in-solution (2% by mass of rubber) was incorporated in the binder for the final size 10 seal on the through lanes to assist with the initial adhesion of the aggregate until it is compacted under traffic. A total of 55 150 litres of rubber-in-solution was used at a cost of $22,150.
The total cost of the final seal was $446,800.

**Experimental rubberised seals**
There is a need for a relatively cheap thin flexible surfacing to prevent entry of water into cracked pavements thus prolonging the life of the pavement. In normal circumstances some of these pavements would have been reconstructed or resurfaced with relatively thick layers of asphalt, but the present financial constraints preclude such treatments. Application of a surface seal coat incorporating rubber, in the form of natural rubber, synthetic rubber or reclaimed rubber, in the hot bitumen binder is envisaged as a possible means of treating cracked pavements. The experimental sections listed below have been placed to assess the suitability of the various treatments. All sections have performed satisfactorily to date, but it is expected that it will be two years before any difference in performance of the various binders will be evident.

a. The following experimental sections were sprayed on the Princes Highway East at Hallam between December 1975 and March 1976 over a cracked pavement. Most of the major cracks had been filled with rubberised emulsion and sand prior to resealing. Traffic is about 16,000 vehicles per 12 hours.

**Table 6**

| Section No. | Carriageway | Location | Residual binder average application rate (l/m²) | Rubber additive (% by mass) | Aggregate size (mm) |
|---|---|---|---|---|---|
| 1 (plates 18 and 19) | From Melbourne | 36.83-36.94 slow lane only | 1.62** | 15 parts re-claimed rubber-tyre retread buffings*** | 10 |
| 1A (Control) | From Melbourne | 36.83-37.22 36.94-37.22 (slow lane) | 1.24 | Nil | 13 |
| 2 | From Melbourne | 37.22-37.50 | 1.19 | 2% natural rubber added in a solution form | 13 |
| 3 | From Melbourne | 37.50-37.78 | 1.19 | 4% natural rubber added in a solution form | 13 |
| 4 | From Melbourne | 37.78-38.04 | 1.11 | 4% synthetic neoprene rubber added as a latex | 13 |
| 5 | From Melbourne | 38.04-38.34 | 1.24* | Nil | 10 |
| 6 | To Melbourne | 37.36-37.50 slow lane only | 2.00** | 15 parts reclaimed rubber-tyre retread buffings | 10 |
| 7 | To Melbourne | 35.73-36.22 | 1.13**** | 4% synthetic rubber in bitumen emulsion | 7 |

*Board-produced primerbinder used consisting of 100 parts R90 bitumen/25 parts power kerosene and 1% of adhesion agent by volume.
**Bitumen/rubber mix.
***All passing 1.18 mm and 34% passing 600 mm sieve.
****Anionic bitumen emulsion 65% bitumen content; 4% Styrene-butadiene rubber (SBR) by mass.

b. On the Princes Highway West near Lara between 49.50 km and 51.89 km on the Geelong-bound carriageway a size 10 rubberised seal was placed in April 1976 over a cracked pavement. Major cracks had been filled with rubberised emulsion and sand prior to the reseal. Traffic is about 10,000 vehicles per 12 hours. The binder consisted of 100 parts by mass of R90 bitumen with 15% by mass of reclaimed rubber tyre buffings of grading consisting of 100% passing 1.18 mm sieve and 56% passing 600 sieve. Application rate of the bitumen rubber mix varied between 1.83 l/m² and 2.28 l/m².

c. On the South Gippsland Highway near Cranbourne the following sections were given a size 10 reseal in April 1976 on the east-bound carriageway:

**Table 7**

| Location (km) | Binder type + additive (% by mass) | Application rate of binder (l/m²) |
|---|---|---|
| 43.64-43.92 | SP1000 primerbinder | 1.40 |
| 43.92-44.15 | R90 bitumen + 2% synthetic neoprene rubber added as a latex | 1.11 |
| 44.15-44.26 | R90 bitumen + 2% natural rubber added in a solution form | 1.09 |

The existing seal was badly cracked and had little patching prior to the reseal being applied. Traffic is 7600 vehicles per 12 hours.

d. On the Murray Valley Highway Section 3–Kerang the following sections were placed over a badly crazed pavement in May 1976. The cracks had not been treated prior to the reseal (see Plate 20). The traffic volume is 850 vehicles per 12 hours:

**Table 8**

| Location (km) | Binder type + additive (% by mass) | Application rate of binder (l/m²) | Aggregate size (mm) | Aggregate application rate m²/m³ |
|---|---|---|---|---|
| 94.16-94.20 | R90 bitumen–control section | 0.90 | 7 | 108 |
| 94.20-94.30 | R90 bitumen–with 13% rubber buffings | 1.18 | 7 | 97 |
| 94.30-94.40 | R90 bitumen with 13% rubber buffings | 1.76 | 10 | 85 |
| 94.40-95.04 | R90 bitumen with 2% natural rubber added in a solution form | 1.06 | 10 | 100 |
| 95.04-95.16 | R90 bitumen–control section | 1.07 | 10 | 102 |

Plate 18: Princes Highway East–cracks in existing seal on Section 1 prior to the bitumen/rubber mix binder (100/15) size 10 reseal.

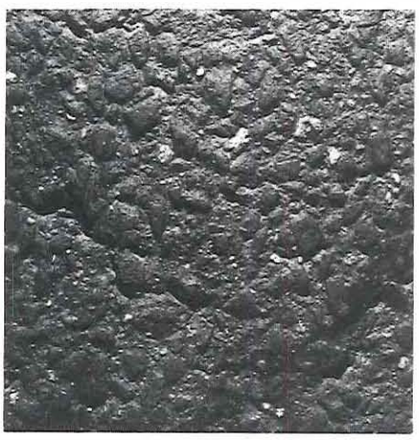
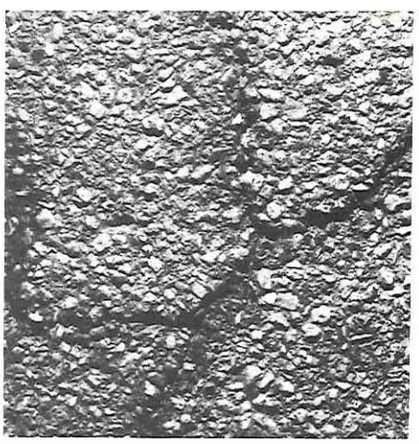


Plate 19: Princes Highway East–same location as in Plate 18 three months after the application of bitumen/rubber mix binder (100/15) size 10 reseal.

Plate 20: Cracks in existing seal on section 94.2 km-94.3 km of the Murray Valley Highway prior to the bitumen/rubber mix binder size 7 reseal.



**Bitumen/rubber buffings type seal**

The practice of incorporating rubber buffings in the binder has been developed with success in Phoenix, Arizona during the last 5-6 years. In Phoenix, up to 25 parts by mass of fine reclaimed rubber is added to 100 parts by mass of bitumen but with Victorian conditions and plant it has been found that 100 parts of mass of bitumen to 15 parts by mass of rubber buffings is the maximum workable proportion. The rubber buffings from tyre retreading plants have been obtained at very small cost, and have been added to the hot bitumen in the sprayer just prior to spraying. The only variations from normal spraying practice have been to raise the temperature of the binder from about 185°C to about 220°C and increase the manifold pressure by 25 per cent above that normally used. This type of seal treatment shows considerable promise for the following reasons:

—The seal has been placed with high binder application rates, in very hot weather in extremely heavy traffic conditions, and has performed very well.

—There is very strong initial adhesion of stone compared with normal R90 binder. This is of assistance when placing reseals under very difficult traffic situations.

—An excellent textured surface is achieved due to a reduction in the tendency of stone to flatten to its least dimension under traffic compaction. The textured surface has good water drainage characteristics which presents an excellent skid resistance surface for difficult traffic situations provided aggregate of high polished stone value is used.

—Cost is about 30% above a normal size 10 reseal and about half the cost of a thin asphalt resurfacing.

—Normal Board sealing equipment can be used.

—The rubber buffings do not completely dissolve in the bitumen at the temperatures sprayed and the suspended rubber buffings in the bitumen result in a tough elastic sticky material. In this regard the bitumen/rubber buffings mixture (100/15) when heated to about 230°C shows promise as a material for filling wide cracks in pavements.

In addition to the above, there is a significant environmental benefit in the successful recycling of a waste product—the worn out rubber tyres.

Over the next 1-2 years, it is proposed to encourage industry to set up suitable plant to produce rubber buffings or granulate to the desired grading from old tyres. Natural rubber-in-solution (RIS) has been used by the Board for many years as a rubber additive to the bitumen binder mainly to assist in initial retention of the aggregate. The price of the granulated rubber is likely to be such that the unit cost of this material will be approximately 5% of the present cost of RIS. This cost benefit means that much greater percentages of rubber granulate can be economically added. It also overcomes the other problem with RIS that the amount of cutter prohibits the percentage by mass being greater than about 4%. The following improvements in technique will be examined:

—Incorporation of up to 25% by mass of rubber granulate in the binder.

—Construction of trial sections of thin open graded asphalt mixes followed by a size 10 surface seal containing 15-25% of rubber granulate. It is expected that this type of treatment will be effective for regulating rough or crazed, but basically sound, pavements.

—Development of plant to incorporate and mix the rubber granulate in the sprayer.

—Development of suitable test methods and equipment to measure the improvement in the elastic properties of the bitumen/rubber granulate binder. Following development of appropriate tests, it will be necessary to set quality control criteria.

—Construction of trial sections with different aggregate sizes, rubber gradings and binder contents to determine the influence of these factors. It appears that the bitumen/rubber granulate binder is less temperature susceptible than normal bitumen binder and much higher rates of application of binder can be used without the risk of the surface flushing. This could lead to extended seal life.

—Development of the bitumen/rubber granulate material as a crack and joint filler and possibly as a membrane sealant.

—Development of a slurry process to apply the bitumen/rubber granulate binder and aggregate for patching very crazed areas of pavement.

**Coarse textured wearing course asphalt**

The Australian Road Research Board has been developing an asphalt mix which will have adequate density and stability and provide a coarse surface texture for maximum skid resistance.

In May 1976 size 10 and size 13 ARRB experimental mixes were placed on the Princes Highway East at Beaconsfield (Melbourne-bound carriageway), along with typical size 10 and size 13 CRB wearing course asphalt in accordance with Figure 10.

Figure 10: Princes Highway East at Beaconsfield—layout of test sections of coarse textured wearing course asphalt.

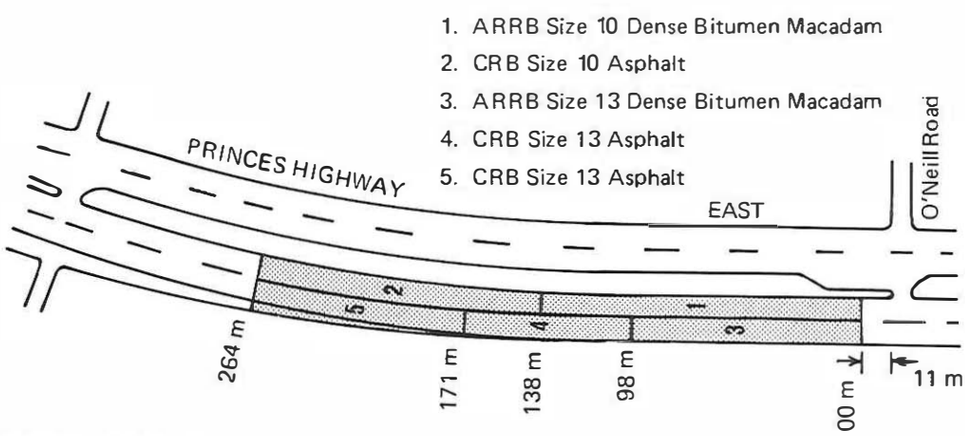



**Table 9**

Relevant details of the asphalt mixes are as follows:

| Mix | Grading of mix—percentage passing AS sieve (by mass) | | | | | | | | | | | % Bitumen | % Air voids | Stability kN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 19.0 | 13.2 | 9.5 | 6.7 | 4.75 | 2.36 | 1.18 | 0.60 | 0.30 | 0.15 | 0.075 | | | |
| CRB Size 10 | | 100 | 98 | 72 | 57 | 40 | 30 | 21 | 14 | 8 | 6.0 | 5.3 | 6.0 | 7.9 |
| ARRB Size 10 | | 100 | 99 | 72 | 53 | 36 | 30 | 24 | 17 | 12 | 9.0 | 5.75 | 3.2 | 8.5 |
| CRB Size 13 | 100 | 99 | 81 | 66 | 54 | 39 | 29 | 21 | 13 | 7 | 5.6 | 4.9 | 6.0 | 8.8 |
| ARRB Size 13 | 100 | 99 | 83 | 63 | 51 | 36 | 30 | 24 | 17 | 12 | 9.0 | 5.5 | 3.4 | 8.6 |

There is a close similarity in grading down to 1.18 mm sieve, but the ARRB mixes are then of finer grading using 5.0% added filler compared with 1.5% in the CRB mixes. The high proportion of filler gives a very dense mix with low air voids and therefore should have good durability. The CRB mixes were coarsened in 1972 to provide around 6% air voids to allow for traffic compaction and to avoid flushing and rutting under heavy traffic.
There were no difficulties in placing the mixes, although the ARRB mixes appeared to be slightly less workable. Surface texture measurements after completion of rolling, but before opening to traffic, gave the following results:

**Table 10**

| Section | Mix | Surface texture by sand patch method (mm) |
|---|---|---|
| 1 | ARRB Size 10 | 0.54 |
| 2 | CRB Size 10 | 0.54 |
| 3 | ARRB Size 13 | 0.54 |
| 4 | CRB Size 13 | 0.45 |

Skid resistance, texture depth measurement, cutting of cores and photographing the surface will be carried out at regular intervals to compare the different asphalt mixes.
Following a study of information available on a Swedish-developed gap graded asphalt containing rubber granulate (from discarded rubber tyres), laboratory testing is in progress by the Australian Road Research Board and the Country Roads Board. This coarse textured asphalt mix is claimed to have:
—High stability and therefore good resistance against permanent deformation and rutting.
—Good texture and therefore good winter drainage properties and skid resistance, provided aggregate of high polished stone value is used.
—Less risk of bleeding due to the reduced temperature susceptibility of the bitumen-rubber granulate binder.
—Enhanced noise suppression due to damping properties of the rubber granulate.
—Longer life due to the higher binder content and less air voids.
—Greater resistance to cracking than conventional asphalt due to elastic binder and presence of rubber granules in the mix.
—More resistance to abrasion.

If these properties are realised the material will have promise for use as an overlay on crazed pavements and in high stress situations.
It is proposed to place trial sections in the coming year to evaluate the mix.

**Experimental rubberised asphalt—Johnson Street Bridge and other projects**
The deviation of Lorimer Street, South Melbourne has been constructed as part of the Johnson Street Bridge Project. The pavement consists of 150 mm of cement treated crushed rock subbase, 230 mm reinforced Portland cement concrete base (construction joints at approximately 5 metre intervals) surfaced with 75 mm of asphalt. Experience with this type of pavement has shown that reflection cracks will appear through the asphalt surfacing at the construction joints after a few years' service.
In this instance synthetic rubber was added to the asphalt to increase the flexibility and toughness of the asphalt and reduce the rate at which cracking may occur. One carriageway was surfaced with the rubberised asphalt mixture.
The other carriageway was surfaced with normal asphalt, except that a harder Grade R65 bitumen binder was used to provide greater stability under the heavy commercial traffic that will use this road.
The synthetic rubber was added in the form of a latex to give a. 5% of rubber by mass of bitumen binder. The latex is an emulsion containing 20% rubber and 80% water. When added to the hot asphalt during mixing, the water component readily evaporates and good dispersion of rubber in the mix can be obtained.
Previous experiments of this nature have used natural rubber latex and a synthetic rubber/bitumen blend prepared in the refinery.
A short section of asphalt containing natural rubber was placed on the Princes Highway West at Norlane in April 1974 and was referred to in the 61st Annual Report. This is performing satisfactorily at this stage but remains under observation. A refinery prepared synthetic rubber blend was placed on the Princes Highway West in Malop Street, Geelong and was referred to in the 62nd Annual Report. This was not successful due to unexplained deterioration of binder during mixing.
The synthetic rubber was tried again under different conditions as research indicates that synthetic rubber is more stable than natural rubber at the temperatures used in asphalt manufacture (160°C approximately). There was no deterioration evident in the rubber placed in the asphalt used in Lorimer Street.
During the experimental work a polypropylene fabric was placed over several construction joints to ascertain whether this will assist in preventing or retarding the development of reflection cracks in the asphalt surfacing. The fabric was held in place by a heavily applied bitumen emulsion tack coat (see Plate 21) and then covered with a 75 mm thick layer of size 13 asphalt in two layers. It is estimated that it will be at least two years before any conclusions can be drawn as to the effectiveness of this treatment.

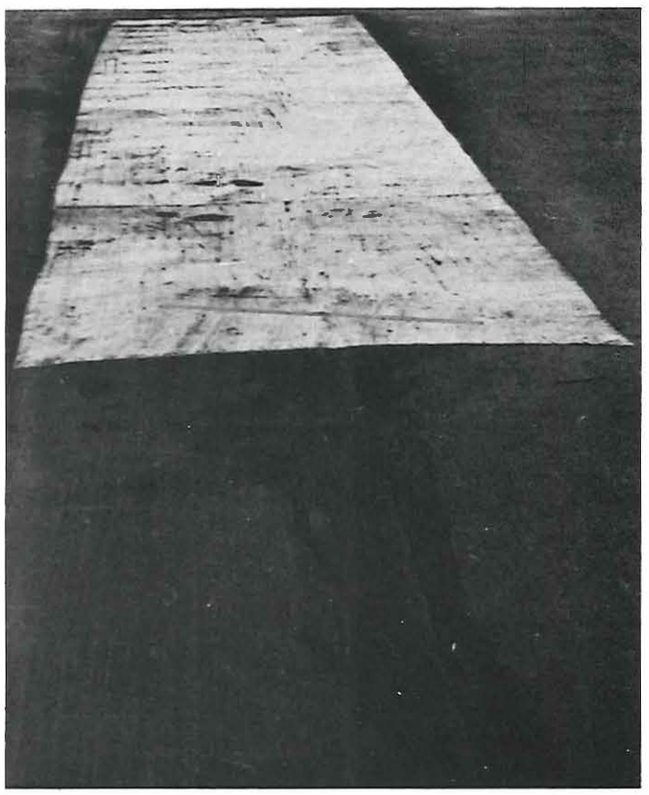


Plate 21: Transverse joint in concrete pavement filled with bitumen emulsion and sand and covered with polypropylene fabric prior to placing 75 mm of asphalt in two layers.

**Bitumen treated crushed rock**
Bitumen treated crushed rock, using a poorer quality crushed rock (Class 2A base, Standard Specification 812—crushed rock for base and subbase pavement) with 4% of bitumen, has been successfully used in a number of jobs. Cost is $3 to $5 per tonne less than conventional asphalt. A gravel equivalency factor of at least 1.5 can be adopted compared with 2.0 to 3.0 for conventional asphalt. The material can be mixed in conventional pugmill type or drum mixer plants and is usually grader spread on the road bed.

**Equipment**
a. Aggregate loaders.
In order to increase the loading rate, one of the Board's standard type aggregate loaders was fitted with additional elevator buckets. This prototype loader has operated very effectively under field test conditions. It has also been modified to take a spiral extension and a scraper extension. This will enable the larger standard metric dimensional aggregate stacks to be picked up in two passes of the aggregate loader thus ensuring a more efficient loading operation.

Plate 22: Aggregate loader showing the spiral and mouldboard extension.

b. Aggregate spreaders.
The Board's fleet of 3.0 metre rotating belt spreaders has provided excellent service over many years. However, owing to their age (average age 26 years) and constant usage over the years, the required high standard of aggregate spreading is difficult to achieve and the rate of spreading has been considerably reduced.
Accordingly, a prototype 'roll' spreader has been developed by the Mechanical Sub-branch. This aggregate spreader has been subject to field trials during the season and has produced a very uniform spread mat of aggregate. It also has the potential for improved spreading speeds by about 30%.

## 2. Materials Research Division

**Environmental studies**

Environmental considerations have always exercised an influence on road proposals but in recent years community interest has emphasised this aspect. Wherever required, skills and equipment have been developed in the Materials Research Division to allow environmental factors to be examined in a rational, scientific manner.

a. Monitoring for air quality.
Air pollution in the vicinity of roads is one of the environmental factors of interest in urban areas. Before changes are made in the road system, it is desirable to know the effects on air quality which will require the measurement of air quality under existing conditions, and the prediction of air quality under the proposed new conditions.
It has been proposed that World Health Organisation recommended limits on air pollutant levels be adopted in this State. Little is known of the detrimental effect of pollutants nor has much been done to establish the costs and benefits to the community of meeting these recommended levels, however, there is wide acceptance of the need to limit air pollution in urban areas.
To examine air quality in the vicinity of roads a vehicle has been equipped as an environmental analysis van with instruments to measure the concentrations of carbon monoxide, nitrogen oxides, hydrocarbons, ozone, airborne particulates and lead. Wind speed, wind direction, temperature and relative humidity will also be measured. The data obtained will be recorded on both magnetic tape and chart recorder, controlled by a digital data acquisition system.
The collection of data from both pollution monitors and meteorological sensors is controlled through a digital data acquisition system. This system scans all the channels once every 18 seconds, and at the end of three minutes computes the three minute average, recording this on an incremental cassette tape recorder. The pollutant levels are also continually recorded on a six pen chart recorder.
The programme for monitoring existing air quality will be carried out on a daily basis with the van operating for 12 to 13 hours a day between 6 am and 7 pm. These hours are chosen to cover both peak traffic hours and free flow traffic. From this data the existing pollution levels, and the dispersion patterns of the pollutants will be established. The prediction of future air quality will then be carried out.

b. Meteorological survey.
Meteorological surveys are an important part of air quality studies because atmospheric conditions determine how pollutants are dispersed. The surveys determine the frequency of occurrence of direction of the various winds, speed ranges and dispersion characteristics of the atmosphere. Surveys have been carried out in the Clifton Hill and South Melbourne-Port Melbourne areas.
For both studies, semi-permanent meteorological stations have been erected consisting of appropriate instruments mounted on a ten-metre high demountable column. The recorder operates for 28 days unattended, recording the wind speed and direction onto pressure sensitive chart paper.
From the charts obtained, wind speed, wind direction and atmospheric stability class are determined for each hour of the day. The atmospheric stability class, a measure of the dispersion characteristics of the atmosphere, is estimated from the range of the wind direction. This data is analysed statistically to determine the frequency of occurrence of the three factors.
From the studies to date two general conclusions can be drawn:
—Winds from the eastern quadrant are associated with stable conditions, conducive to pollution build-up; and
—Winds from the western quadrant are associated with unstable conditions, yielding good dispersion of pollutants.

c. Road traffic noise.
Road traffic noise is one of the environmental factors which must be assessed in relation to road proposals. Based on noise measurements in the vicinity of existing roads, and using traffic volume, composition of traffic and speed as the principal variables, prediction methods have been developed to estimate traffic noise. For a new road proposal, given that ambient noise levels have been determined prior to changes in conditions, the noise levels expected on completion of the new work can be predicted with acceptable accuracy.
There is still considerable controversy as to the significance of the various noise parameters and research is continuing in this field of activity.
During the year, the Board purchased a noise analyser to enable the field measurement and analysis of noise data to be carried out more conveniently than with previously used sound level meters (see Plate 23). The equipment monitors levels and automatically computes specified noise indices.

**Phytophthora Cinnamomi**

For a number of years there has been concern at the spread of the root fungus Phytophthora Cinnamomi through the State of Victoria. This pathogen, commonly known as Cinnamon Fungus, attacks and weakens the root system of plants and can be fatal to over 400 Australian native species and also to many introduced species. Plants are killed by a process sometimes known as 'die back' as the depleted root system is unable to maintain an adequate supply of nourishment to sustain growth.
Evidence suggests that roads, road vehicles and roadmaking plant can contribute to the spread of the fungus. This may occur when loads of soil or gravel are moved from one place to another or when soil particles which adhere to vehicles are transported to other localities. The fungus spreads more readily in moist conditions and, as such, its advancement along drainage lines is pronounced.
In order to assist in curtailing the spread of this fungus, a laboratory to test soils and gravels for the presence of Phytophthora has been established. A testing technique was developed by the Forests Commission, Victoria. The soil under test is examined initially by exposing eucalypt seedlings at the cotylodon stage to the risk of infection by the fungus. After four days the presence of the fungus can be detected, confirmed by microscopic examination of the sporangia.

**Comparison between Benkelman Beam and Deflectograph**

The Benkelman Beam and Deflectograph can both be used to measure pavement deflections although, in some situations, one method is more appropriate than the other.
On heavily trafficked highways requiring signing and traffic control, approximately 10 km of single traffic lane can be tested each day using the Deflectograph. With the Benkelman Beam, approximately 5 km of road can be tested in one day.
The nature of the operation of the two methods differs slightly. The Benkelman Beam measures the maximum and

Plate 23: Community noise analyser.

Plate 24: Phytophthora Cinnamomi Sporangia.

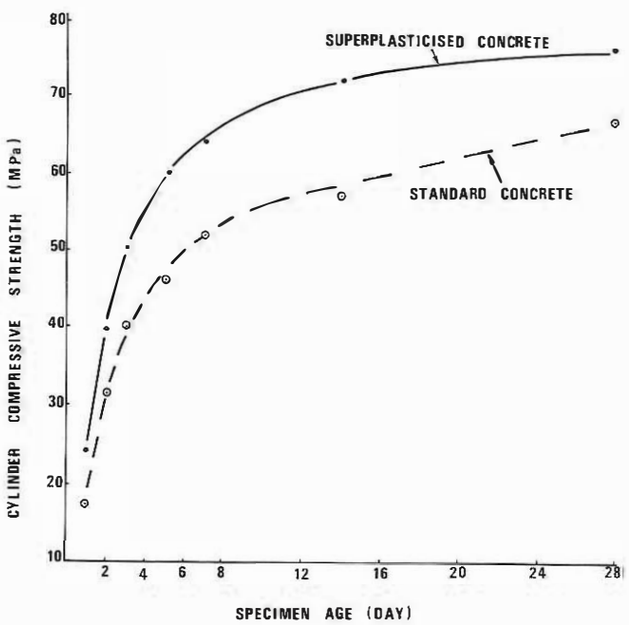



Figure 11: Strength development of concretes containing the superplasticising admixture.

final pavement deflections and uses the rebound deflection in assessing pavements. Its use is further discussed in Technical Bulletin No. 29. Because of its method of operation, the Deflectograph can only measure the maximum pavement deflections. The difference between the two methods is significant when the residual deflections are high or when the radius of curvature of the deflection bowl is large.

Correlation tests between the two methods are being undertaken. The work carried out by overseas authorities indicates that the correlation factor depends mainly upon the pavement composition.

| Type of pavement | | Ratio $\frac{\text{Deflectograph Deflection}}{\text{Benkelman Beam Deflection}}$ |
|---|---|---|
| TRRL (UK) | Unbound base with asphalt surfacing | 0.82* |
| | Bound base with asphalt surfacing | 0.78* |
| NIRR (South Africa) | Unbound base with thin surfacing | 0.96 |
| | Bound base with thin surfacing | 0.75 |

*The TRRL relationships are non-linear and do not pass through the origin. These ratios relate to a deflectograph reading of 50 x 10mm$^{-2}$.

**Superplasticising admixtures**

Two types of superplasticisers are available as additives to concrete mixes to improve workability. One uses a sulphorated melamine formaldehyde and the other a sulphorated naphthalene formaldehyde. The addition of these compounds to concrete results in flowing, self-compacting properties, which allows the water content in the mix to be substantially reduced, with a consequent increase in strength.

A recent study has been undertaken to assess the effects of a sulphorated melamine formaldehyde superplasticiser on the properties of concrete mixes typically used in Board works for high strength concrete.

A series of standard mixes was compared with mixes incorporating a fixed amount of the superplasticiser admixture. Both mixes were made to the same nominal slump. The results of tests indicated that the concretes containing the admixture have a much higher rate of gain of strength, with much higher strengths than the standard mixes (see Figure 11). The measurements have shown no significant differences in shrinkage behaviour, but it has been noted that the density of the compacted superplasticised concrete is slightly higher than the standard mixes.

Field trials have shown that mixer operators are able to judge workability, as measured by the slump test, with similar precision for both standard and superplasticised mixes. Results from field tests support the basic conclusions made from the laboratory investigation and suggest that there will be no major difficulties in using these types of admixtures. Superplasticising admixtures increase the cost of concrete by about $6 per cubic metre at the dose rate used in this investigation.

**Pavement markings**

Traffic linemarking and intersection marking carried out by the Board has traditionally used roadmarking paint with glass beads dropped onto the wet surface to improve night reflectivity. Specialised equipment has been developed to apply the markings.

In recent years, the rate of wear of pavement markings on heavily trafficked routes has increased markedly. The need to repaint at frequent intervals has over-taxed the means available for applying pavement markings, and has resulted in greatly increased costs for this service.

Thermoplastic roadmarking materials were first offered to the Board in the late 1960's as a long life alternative to paints They were rejected as an alternative repaint because their daytime visibility, stability and skid resistance was unsatisfactory and the current equipment was able to maintain the painted markings satisfactorily. The changed circumstances has led to a re-examination of these and other alternative roadmarking materials.

The skid resistance and wet night visibility of painted markings is unsatisfactory, and it was hoped that alternative materials might be superior in these aspects, however, it has been found that to obtain high skid resistance wet night visibility had to be sacrificed. Nevertheless, the alternative materials were extremely long wearing and good day-time visibility could be obtained if skid resistance similar to that of painted markings was accepted.

After about a year under traffic, estimates of life expectancy for test strips of some of the materials indicated that they would probably be more economical than painted intersection markings. Recently complete intersections have been marked with the new materials and more work is planned in the future.

Table 11 compares the properties and costs of the various materials tested. Some of the materials have satisfactory properties but are very difficult to handle and would therefore be unsuitable for widespread use. It is unlikely that the newer materials will replace paint for longitudinal linemarking, except on the most heavily trafficked urban roads.

**Corner-cube guidepost delineators**

Previous reports have referred to experimental installation of corner-cube guidepost delineators. The following tentative conclusions have been drawn from these experimental installations:

—The reflective performance of the corner-cube delineators was always better than the currently used reflective strip.

—The improvement was particularly apparent under adverse conditions when reflective strip delineators cannot be seen; and

—Vandalism would be a major problem in maintaining an installation of corner-cube delineators.

These tentative conclusions have been confirmed by continued observations and research work carried out elsewhere. Studies of threshold visibility of objects under night driving conditions and of the veiling effects of glare have enabled calculations to be made which show that the performance of reflective strip delineators is inadequate in commonly occurring glare situations but corner-cube delineators perform satisfactorily.

Over a three-year period, 50% of the total number of delineators installed were replaced using a special one-way 'theftproof' screw.

To determine the effectiveness of improved delineation in reducing night-time accidents, the statistics for night-time accidents reported in the three-year period prior to installation of corner-cube delineators and the three-year period after installation have been examined. The reduction was found to be statistically significant at the 80% level of confidence. Although 90% or 95% confidence limits are usually employed for 'conclusive' results in this type of accident study, the level achieved indicates that corner-cube delineators should be regarded as an aid to night-time driving which will tend to reduce accidents.

**Table 11:**
Comparison of properties and costs of pavement materials tested

| | Physical properties | | | | | Approx. costs | |
|---|---|---|---|---|---|---|---|
| Material | Approx. life in the urban situation (years) | Dry visibility | No pick-up time (min) | Bonding ability and stability | Polishing value (indicates skid resistance) | $/m² | $/m²/year |
| Paint (Intersection markings) | 0.3 | Satisfactory | 5 | Satisfactory | 35 | 5 | 16 |
| Paint (Linemarking) | 0.5 | Satisfactory | 5 | Satisfactory | 35 | 1 | 2 |
| Thermoplastic stick down sheeting (Intersection markings) | 5 | Varies with type of material. Present types are unsatisfactory | 0 | Varies with type of material. Some lift, crack, deform | 30-45 | 20 | 4 |
| Hot extruded thermoplastic (Intersection markings) | 5 | Newer materials satisfactory | 5 | Newer materials satisfactory | 30-40 | 13 | 2.60 |
| Hot sprayed thermoplastic (Linemarking) | 1 Longer life obtained if film thickness increased | Satisfactory | 0.2 | Satisfactory | 30-40 | 3 | 3 |
| Flame applied thermoplastic (Intersection markings) | 1 Longer life obtained if film thickness increased | Satisfactory | 0.2 | Satisfactory | 30-40 | 7 | 7 |
| Epoxy resin (Intersection markings) | 5 | Some yellowing | 60 | Satisfactory | 30 | 20 | 6 |
| Polymethyl methacrylate (Intersection markings) | 5 | Satisfactory | 20 | Satisfactory | 35 | 30 | 4 |

There is no material available which gives satisfactory wet visibility, particularly at night.

**Artificial aggregate**

The ideal road surfacing aggregate should be hard but resistant to polish, have an affinity for bitumen, and preferably be light in colour. Unfortunately, few naturally occurring rocks possess all of these desirable properties.

Natural gritstones (sandstone, siltstone) are known to resist polishing because of their mineral structure. They consist of small hard particles (quartz) bonded together by a softer material of silicon oxide or calcium oxide. The binding matrix must not be too soft (to avoid degradation) nor too hard (to avoid polishing) under traffic.

Board staff, working in conjunction with Council for Scientific & Industrial Research Organisation Division of Building Research, has developed an artificial ceramic type of road surfacing aggregate with favourable properties.

The material has a synthesised gritstone structure and is composed of common raw materials, including clay, limestone, whiting and silica, with particles of calcined bauxite to provide wear resistance. The resultant material after milling and mixing is pressed or extruded into the desired shape before drying and firing–thereby avoiding the wastage associated with crushing and screening to obtain the desired shape and size of aggregate.

Materials from many different sources have been tried and many different shapes and sizes of aggregate have been produced in experimental work to date. One of the most promising ceramic materials has been laid in a field trial in Wellington Street, Kew, to examine the performance of the aggregate under traffic (see Plate 25).

The estimated cost of the material is $25-$30 per tonne. Its use could therefore only be justified at selected locations.

Plate 25: Extruded artificial aggregate sealcoat.

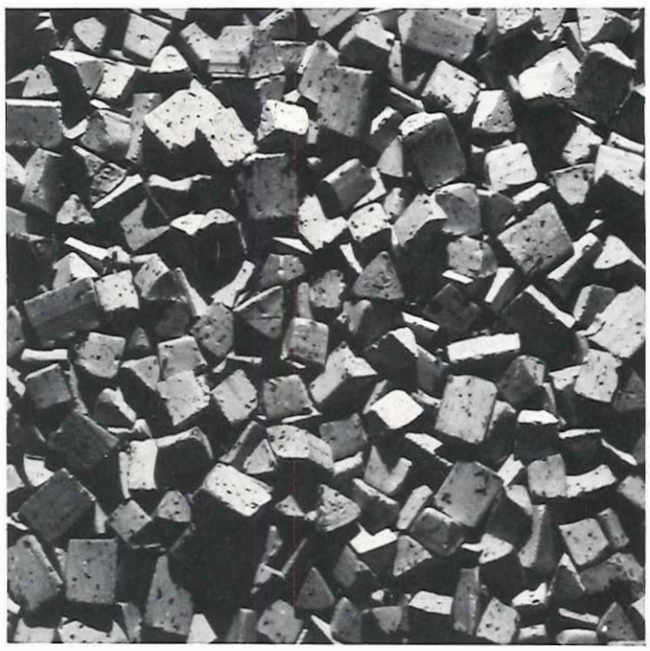


**Table 12:**
Typical properties of various aggregates

| | Property | | | | |
|---|---|---|---|---|---|
| | Aggregate impact value | Los Angeles abrasion loss | Polished stone value | Bitumen adhesion | Luminance factor |
| *Natural aggregates* | | | | | |
| Granite | | 28 | 43 | 35 | 0.18 |
| Quartz Porphyry | | 15 | 43 | 55 | 0.24 |
| Newer Basalt | | 23 | 48 | 56 | 0.03 |
| Older Basalt | | 15 | 41 | 69 | 0.08 |
| Scoria | | 21 | 60 | 56 | 0.07 |
| River Gravel | | 31 | 44 | 82 | 0.31 |
| Rhyolite | | 13 | 43 | 55 | 0.16 |
| *Artificial aggregates* | | | | | |
| Calcined phyrophyllite | 32 | | 45 | 90 | 0.60 |
| Artificial ceramic | 28 | | 60 | 74 | 0.34 |
| Desirable properties | 25 max | 32 max | 55 min | 50 min | 0.50 min |

**Study of a major landslip**

Landslips are not an uncommon phenomenon in Victoria and geologists and engineers spend a significant time in examining failures and potential failures. These slips are usually of minor significance but from time to time large and spectacular failures occur. A rotational slip of about 260 000 tonnes of material which occurred at Hanlon Parade, Portland in October 1975, is such a case. As shown in Plate 26, the road on a cliff top dropped about 10 metres, while in the adjacent sea at the base of the 30 metre high cliffs the toe of the slip heaved about 5 metres out of the water.

A site investigation prior to the massive failure using drilling and penetrometer probes defined a widespread deposit of a very plastic, weak clay (Maretimo Clay) at about sea level. This, together with sea erosion at the base of the cliffs, had created a condition of potential failure. The recommendation to unload the area by excavation could not be implemented before failure occurred.

**Drainage of cut batters**

Seven major cuttings in the Drouin and Warragul sections of the Princes Freeway will be up to 20 metres deep and the road level will be up to 15 metres below the natural ground water level. Cut batters have been designed with a slope of 2:1 but, even with this moderate slope, the factor of safety against failure will be inadequate, and lowering of the groundwater table is essential.

The most practicable means of lowering the groundwater table is by the installation of horizontal drains. To determine the length and spacing of drains, an electric analogue technique was applied. Figure 13(a) shows the flow net which would exist without and with horizontal drains, and Figure 13(b) shows the effect of varying the spacing and length of drains. On the basis of these studies, it was decided that drains 20 metres long at a spacing of 10 metres were appropriate.

Plate 26: View of the upper sections of the Hanlon Parade land slip.

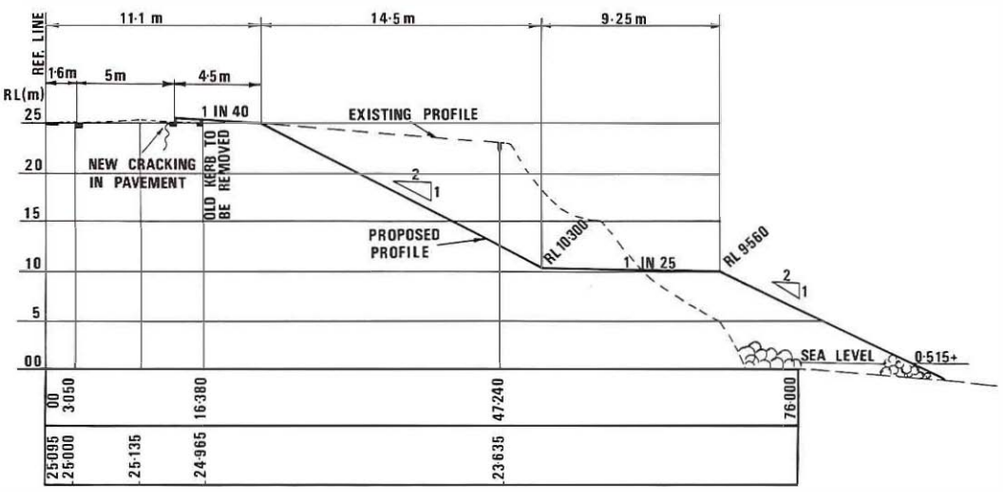



Figure 12: Proposed treatment of Hanlon Parade land slip.

Further cracking has since developed along Hanlon Parade during April 1976 and a slip of a further 500 000 tonnes of material is imminent.

To arrest this further failure, it has been recommended that the profile of the cliff be modified as shown in Figure 12. Excavation of 75 000 $m^3$ of material is required and 8500 tonnes of rock and gravel beaching will be required to protect this material from erosion.

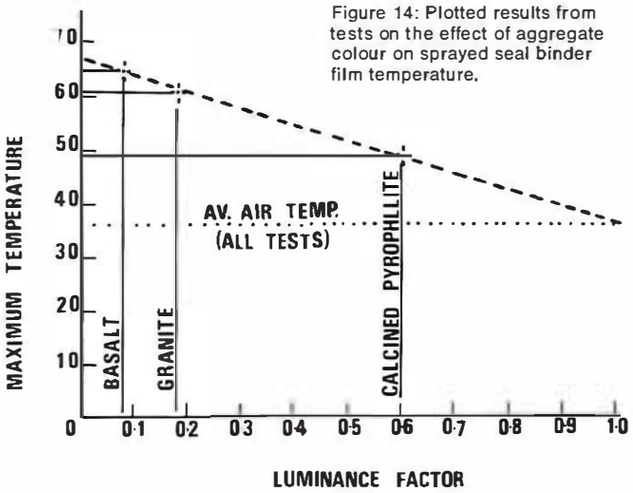



Figure 14: Plotted results from tests on the effect of aggregate colour on sprayed seal binder film temperature.

Test results showed that, whilst the air temperature above the seal was consistent (35°-37°C), the binder film temperatures attained were:

| | |
|---|---|
| Basalt | 64.7°C |
| Granite | 60.6°C |
| Calcined Pyrophyllite | 48.9°C |

It was found that plotting the maximum temperature attained in the binder film against the luminance factor of the aggregate (CRB Test Method 114.01), a straight line graph was obtained (see Figure 14) indicating that the heat reflecting properties of the material are similar to its light reflecting properties. Extension of the graph to a luminance factor of 0.0 (i.e. a perfect heat and light absorber) indicates a maximum temperature of 66.4°C, and extension of the graph to a luminance factor of 1.0 (i.e. a perfect diffuser of light and heat) indicates a maximum temperature of 36°C, which corresponds to the mean air temperature taken for all three tests. This in effect means that a perfect diffuser would reflect all heat and the temperature of the binder film would remain the same as the ambient air temperature.

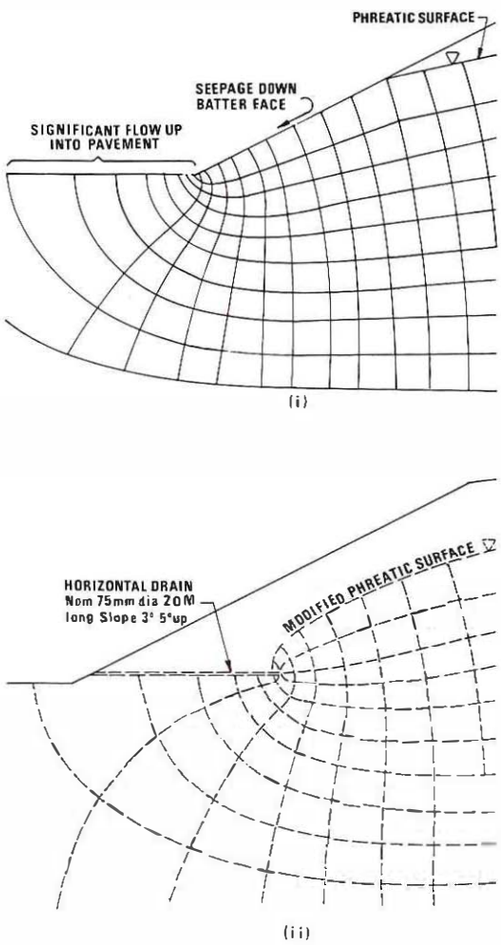



Figure 13(a): Flow net without drains (i), and with drains (ii).

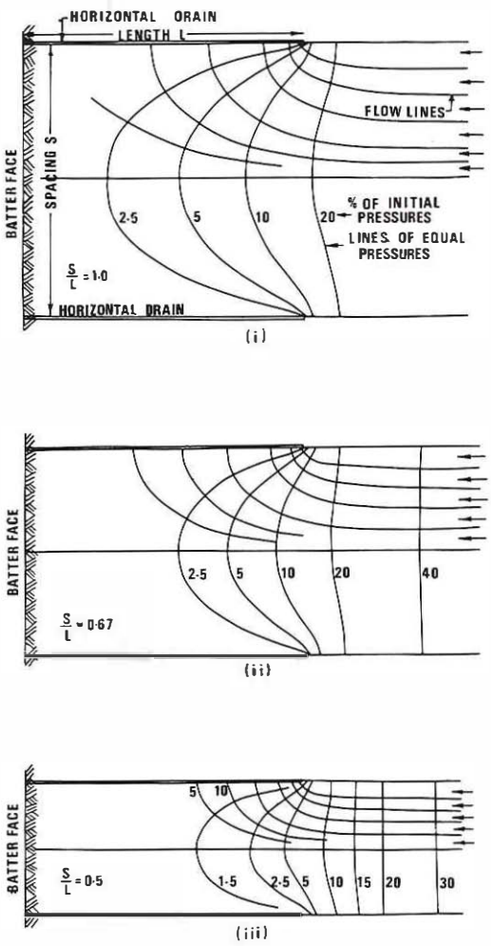



Figure 13(b): Effect of varying spacing and length of drain.

**Aggregate colour effect on road surface temperature**

The Division has conducted a study of the effect of aggregate colour on the temperature attained in the binder film of a sprayed seal. The testing was carried out in the laboratory with 'model' sealed pavements under standard infra red heating conditions.

Tests were carried out on a dark coloured aggregate (basalt), a light coloured artificial aggregate (calcined pyrophyllite) and an aggregate of intermediate colour (granite). The heating conditions and time were established to achieve a temperature of 64°C in the binder film of the basalt seal (this temperature was the maximum recorded at the surface of a black asphalt pavement in a three-year field study conducted by ARRB in Melbourne during 1965/68–ARR Journal Vol 3 No 9, March 1969). The same heating conditions were then used for the other two aggregate seals.

Overall, this relationship between maximum temperature and luminance factor means that an estimate of the likely maximum temperature to be encountered in the binder film, in service, can be made from the knowledge of the luminance factor of an aggregate:

$$\text{Maximum temperature in binder film (°C)} = 66.4 - (30.2 \times LF)$$

Very light coloured aggregates 'soil' under traffic use and some allowance would have to be made for this effect. Ideally, the 'in service' luminance factor of the aggregate would need to be known for the prediction of maximum temperature in the binder film.

Bitumen, in a sprayed seal, ages and ultimately fails through hardening due to oxidation. Some evidence exists that a 10°C increase in temperature will double the rate of reaction resulting in oxidation of the bitumen and similarly that a reduction of 10°C will halve the rate. Clearly, then, a light coloured aggregate with its attendant lower binder film temperature will serve to retard the bitumen oxidation process and increase seal life.

**Assessment of marginal base materials**

In the western and north-western areas of the State rippable sandstones have been used extensively in pavement construction as there are few alternative materials available. Traditional methods of assessment, including grading, plasticity, Los Angeles abrasion loss, etc., have not been useful in assessing the quality of these materials. The accepted practice has been to use the materials and to learn by experience which are satisfactory.

A recent investigation has been carried out to examine both satisfactory and unsatisfactory sections of road construction to see if any properties can be used to characterise good or bad performance. Results from this investigation have indicated that the Modified Triaxial Test may be able to provide a basis for assessment of marginal materials.

Materials sampled during the investigations from visually rated 'good', fair' or 'bad' pavements were often indistinguishable on the basis of the normal laboratory tests. Test results were averaged for each group and the averages compared. Sometimes there was no statistical evidence to show that the averages came from different populations. The differences in the averages as obtained from the Modified Triaxial Test were, however, very significant as can be seen from the table below:

**Table 13**

| Visual pavement rating | Number of results | Average compressive modulus (MPa) | Level at which differences in the average are significant (%) |
|---|---|---|---|
| Good | 5 | 86 | 99.9 |
| Fair | 7 | 52 | |
| Bad | 5 | 39 | 98.0 |

The test, first developed by the Texas Highways Department, differs from the normal triaxial test in that the lateral pressure is applied to the sample through a rubber membrane lining an open ended metal test cylinder and clamped over its ends. The membrane is inflated to the required pressure through an air valve in the side of the metal cylinder. A testing speed of 4 mm per minute is used. Three specimens are compacted and each tested at specified lateral pressures of 21 kPa, 41 kPa and 62 kPa. The compressive modulus is calculated for each specimen and the average of these is taken as the modulus of the material. Further information about the material is obtained from the failure envelope drawn tangent to the Mohr circles constructed for each lateral pressure.

The good statistical relationship for soft sandstones between laboratory test results and the visually assessed field performance is based on relatively few results. Further work is being carried out to confirm the relationship and to extend the conclusions to include other marginal materials.

**Pavement design–national highway standards**

The approved standards for design of national highways require pavements to be designed for a 9 tonne single axle load. This requirement is significantly different to the existing design criteria which is based on a single axle load of 8.2 tonnes.

The method of pavement design described in Technical Bulletin No 26 makes no allowance for variations in axle load, tyre pressure or axle configuration. If an increase in legal axle load is permitted, a reduction in pavement life must be expected if current methods of design are used. Conversely, to maintain the same life expectancy, the design method must be amended to allow for the greater damaging effect of the increased loads.

It is known that the thickness needed for a given life in any pavement under two distributions of traffic depends upon their relative destructive effects and is independent of the strength of the subgrade. The destructive effect is related by an expression of the form:

$K = (\frac{L1}{L2})^4$ K = relative destruction effect; L1, L2 = average destructive axle loads

Hence

$\frac{t_9}{t_{8.2}} = (\frac{L9}{L8.2})^4$ where $t_9$ = thickness required for 9.0 tonne design load; $t_{8.2}$ = thickness required for 8.2 tonne design load

The average destructive axle load is related to the design axle load in a complex manner which takes account of the spectrum of actual wheel loads. Application of these factors leads to the relationship:

$$t_9 = 1.1 t_{8.2}$$

The total thickness of pavements designed for national highway standards is therefore 10 per cent greater than that indicated in Technical Bulletin No 26.

**Asphalt compaction control by a nuclear device.**

Adequate compaction of asphalt is essential if the material is to perform satisfactorily as part of the pavement and have adequate durability. The compaction control method must provide rapid results so that corrective rolling can be undertaken while the asphalt mat is hot. Once the mat has cooled, further densification by rolling is not possible.

The control methods in current use rely on visual inspection counts of roller passes on the hot mat followed by post-mortem testing of 100 mm diameter cores cut from the cold mat.

Trials with the Troxler Model 2401 nuclear meter have shown that the instrument can give information of acceptable precision when a series of test results are averaged. In such investigations, two quarter minute readings are taken at four sites chosen at random in the area under test. Initial results indicate a precision better than ± 2% (at the 95% confidence limits) for the averaged area density determination. The time taken to provide this result is of the order of 10-12 minutes.

The study has shown that the main disadvantage with the nuclear meter is the lack of precision of individual density determinations. Even when working with a calibration chart for a particular asphalt mix, single density determinations can be relied upon to an accuracy of ± 4% at the 95% confidence limits.

**Foundation investigations**

a. Test pile programme–Snowy River Bridges.

The foundations for the Princes Freeway floodway bridges across the Snowy River flats at Orbost consist of piles driven through considerable depths of soft sandy silts to firmer strata.

A test pile programme for the floodway bridges has now been completed. A total of 15 steel H-section piles and a Herkules H-800 reinforced concrete pile were driven.

Ten of the steel piles were instrumented with electrical resistance strain gauges attached directly to webs and flanges. These gauges enabled a determination of the axial stresses in piles at various depths. Many gauges were damaged during pile driving operations. Also, moisture penetration into inter-pile section gauge lead wire joints invalidated readings from another group of strain gauges. Information from undamaged gauges and embankment settlement measurements has shown that downdrag at pier locations is negligible and is a problem only at the floodway bridge abutments. To minimise downdrag, bitumen coated composite piles have been used at abutments. The piles have not been coated for a length of 9 m from the toe to ensure adequate bearing capacity in lower supporting strata. The upper reinforced concrete section of piles will be bitumen coated to ensure that negligible load is transferred to the piles through the compacted embankment fill. Reinforced concrete sections extend below the level of fluctuation of corrosive groundwaters.

Two steel piles were proofload tested to twice the maximum axial design load of 700 kN.

Both test piles proved to be entirely satisfactory with respect to settlement at the maximum load level of 1400 kN applied to the pile heads. Elastic compression of the steel accounted for 80% to 90% of the total deflection of the pile heads.

Load shedding characteristics for the two piles were significantly different, the bitumen coated pile transferring a much greater proportion of the applied test load to the toe of the pile (Figure 15).
Knowledge obtained from these tests has provided a valuable understanding of the effect of a bitumen coating on pile axial load distribution with depth leading to the confirmation of a safe foundation design.

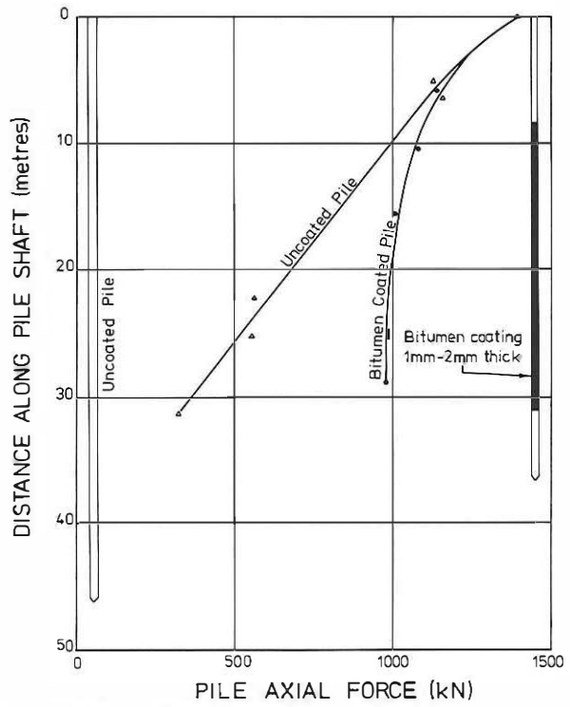



Figure 15: Axial load distribution in steel test piles.

b. Sand pile compaction at Orbost.
The northern abutment piles for the Snowy River Bridge at Orbost were to be 760 mm diameter cast in place and socketted one foot into bedrock. The specified method of construction required that the steel casing be withdrawn as the concrete was placed. During the casting of the first two piles the volume of concrete used was considerably in excess of the calculated volume required and it was deduced that large cavities had been formed in the foundation material while the steel casing was being driven (see Plate 27).
An extensive investigation was then carried out using the Cone Penetration Test to determine the extent and possible cause of the cavities. It was found that the cavities were confined to an area around the piles and that the underlying sands were loose to extremely loose.
To fill the cavities and
ment filling and the formation of more cavities during subsequent pile driving, the technique of compaction sand piling was adopted. This involved driving a steel tube (say, 400-500 mm diameter) with a closed end to a predetermined depth and then withdrawing the tube as sand is driven out at the bottom. This leaves a column of dense sand surrounded by densified sand.
Approximately twenty sand piles were installed at 2 metre centres at each abutment location using a 'Frankipile' piling rig. This machine was ideally suited to the task since the method of installation of the sand piles is similar to that for a conventional Frankipile. Four to five sand piles could be installed to a depth of 13 metres each day.

Plate 27: Cavities under the embankment.

c. Ground vibration near a sewer.
At the site of the new Johnson Street Bridge over the Yarra River, the Melbourne main sewer crosses the river founded in very soft silt. The sewer is approximately 80 years' old, and its structural condition is unknown, as it is surrounded by concrete. The foundation piles for the bridge consist of steel cylinders 4 ft 6 in in diameter which are embedded in the mudstone rock at depths of up to 140 ft and with rock sockets extending up to 30 ft further into rock. These cylinder piles for the bridge are adjacent to, and in some locations straddle, the 40 ft sewer easement.
To prevent damage to the sewer, the specification for the works prohibits the use of percussive methods in installing the steel cylinders. The contractor elected to install the cylinders by the oscillatory method using a Kato rig but, because of difficulties encountered in sealing the cylinders in bedrock, it has been necessary to permit limited percussion at that stage.
To check ground vibration and changes in pore pressure, and ground movement in the vicinity of the sewer during this process, geophones, piezometers and tiltmeters were installed at distances varying from 11 ft to 55 ft from a cylinder which was top driven using a 4 ton hammer falling 6 ft to 8 ft. The geophones capable of measuring 3 components of particle velocity and the piezometers were installed at 40 ft depth in the Coode Island silts coinciding with the sewer level and at 60 ft in Fishermens Bend silts which underlay the sewer.
Figure 16 shows that pore pressures of up to 6 KPa were developed in the Coode Island silt and therefore the sewer settlement from the dissipation of these pore pressures will be of the order of ½ in. Figure 17 shows a rapid attenuation of maximum particle velocity with distances from the test pile between 10 and 20 ft. Beyond that, there appears to be only slow decay.
In view of these results, which indicate that there is a risk of ground movement in the vicinity of the sewer, it has been decided to install more instruments to permit monitoring of ground movements during the installation of the piles for the river piers.

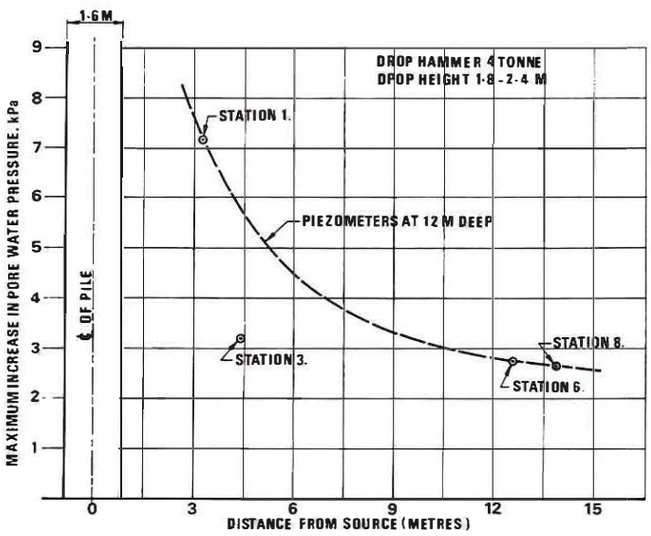



Figure 16: Increase in pore water pressure.

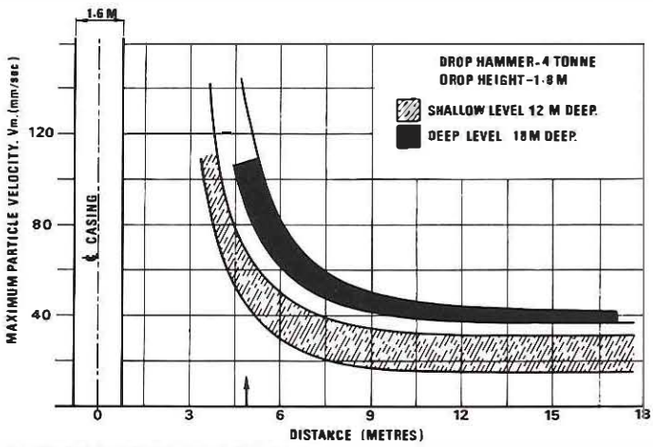



Figure 17: Maximum particle velocity.

d. Support for the Hiley formula.
Soils encountered along the Drouin and Warragul Sections of the Princes Freeway comprise uniform residual basaltic clays of stiff consistency. Laboratory tests indicated that concrete piles would need to penetrate the clays by about 26 m in order to sustain working loads of 350 kN. This proposition appeared inconsistent with the visual assessment of the clays which are quite stiff. To assess the position, test piles comprising one 355 x 355 mm reinforced concrete and one 254 x 254 mm H-pile were driven and test loaded. The results of the driving and loading shown in the table below indicate agreement with the Hiley Formula and confirmed the visual assessment. The clays concerned are fissured, and it is common for conventional triaxial tests to underestimate the strength of such clays because the fissures reduce the strength of a small triaxial test sample.

**Table 14**

| Pile | Depth (m) | Allowable Hiley capacity (kN) (F of S = 4) | Allowable capacity from load test (kN) (F of S = 4) |
|---|---|---|---|
| 355 x 355 mm R C | 13 | 320 | 350 |
| 250 UBP 84.8 | 13 | 235 | – |
| | 19 | 350 | 450 |

The load-settlement curve for the reinforced concrete pile is shown in Figure 18.
The concrete pile was successfully instrumented after driving was completed by grouting strain gauges into a duct which had been formed in the longitudinal centreline of the pile. The gauges indicated the distribution of load down the pile and the load reaching the pile toe. Figure 19 summarises the load distribution measurements for one of the load cycles. It is worth noting that at a load of 600 kN, ie. almost twice the allowable 350 kN, very little load is reaching the pile toe.

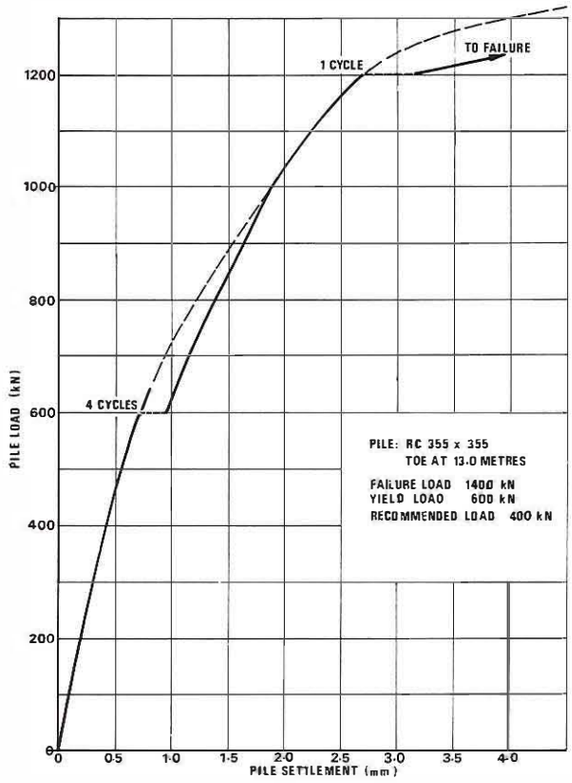
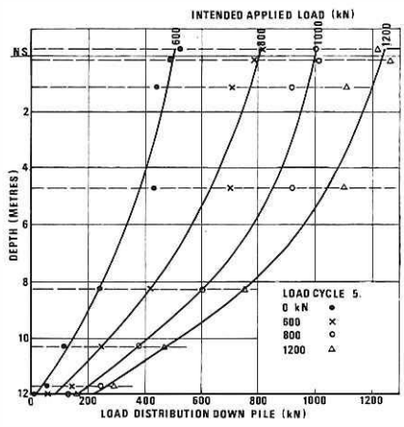



Figure 18 (left): Load settlement curve for the reinforced concrete piles.

Figure 19 (below): Load distribution of one of the load cycles.




# Section G: General

## 1. Computer Section

The installation of a new IBM 370/135 computer at Head Office to replace the IBM 1620 was completed in early August 1975. The new computer will enable the Board to centralise its computing on the one machine rather than use a variety of external service bureaux in addition to the IBM 1620. The capabilities of the new equipment will enable the Board to develop more computer-based applications and extend data processing facilities to Divisional Offices.
The installed computer equipment is as follows:
IBM 370/135 Central Processing Unit with 512K bytes of memory
4 Magnetic tape drives
4 Magnetic disc drives
1 Punched card reader at 1000 cards per minute
1 Card punch at 120 cards per minute
1 Line printer up to 1000 lines per minute
1 Paper tape reader at 120 characters per second
1 Paper tape punch at 120 characters per second
3 Keyboard terminals at 15 characters per second
1 Card reader/line printer terminal at 400 cards/line per minute
The terminals (3 keyboard terminals and 1 card reader/line printer terminal) enable computer processing jobs to be submitted to the IBM 370/135 from remote locations. The keyboard terminals are located in the Computer Section, Plans and Surveys Division and Bridge Sub-branch. The card reader/line printer terminal is located in the Methods Section for use by Methods Section, Plans and Surveys Division and Road Planning Division.
An investigation is currently being undertaken to examine the feasibility of installing a computer terminal in a regional division to provide access to a wide range of application programs on the new computer. Also, a feasibility study is being carried out to consider whether the Board should acquire an automatic graphical plotter.

During 1975/76 the major portion of the Computer Section's programming resources has involved the conversion of programs from the IBM 1620 and external computer bureaux to run on the IBM 370/135. This conversion is nearly complete.
The new computer is currently operating from 7.30 am to approximately 8.00 pm each working day, depending on the work load. Limited use is being made of the Board's computer by other bodies, including consultants and the Australian Road Research Board.

Major applications that are being processed on the Board's new computer include:

—the salaried staff payroll system;
—the allocations and expenditure system;
—the Roadway Integrated Design and Geometry (Ridge) System; and
—transportation planning systems.

All of these systems were previously processed or being developed on external bureaux computers. The installation of the Board's new computer has enabled these systems to be processed 'in house' giving a significant improvement in the computer users' productivity.

## 2. Safety

Details of the increases and decreases of accidents, the accident frequency rate and the days lost per million man-hours worked are shown in the following tables:

**Table 15:**
Accidents in the 1975/76 year compared with 1974/75

| Type of injury | 1974/75 | 1975/76 | Decrease | Increase |
|---|---|---|---|---|
| Back strains | 83 | 69 | 14 | – |
| Burns and scalds | 18 | 18 | – | – |
| Burns to eyes | 5 | 10 | – | 5 |
| Fatal injuries | 1 | – | 1 | – |
| Foreign body in eyes | 36 | 36 | – | – |
| Fractures | 18 | 24 | – | 6 |
| Head injuries | 17 | 18 | – | 1 |
| Lacerations and wounds | 63 | 71 | – | 8 |
| Miscellanous | 52 | 61 | – | 9 |
| Multiple injuries | – | – | – | – |
| Occupational diseases | 11 | 14 | – | 3 |
| Sprains and strains | 76 | 76 | – | – |
| Total | 380 | 397 | 15 | 32 |

**Table 16:**
Trend in accident frequency rate and the days lost per million man-hours worked

| | 1975/6 | 1974/5 | 1973/4 | 1972/3 | 1971/2 | 1970/1 | 1969/70 | 1968/9 |
|---|---|---|---|---|---|---|---|---|
| Total man-hours worked (million) | 8.55 | 9.06 | 8.75 | 9.05 | 9.08 | 8.97 | 8.76 | 8.42 |
| Lost time accidents | 397 | 380 | 315 | 355 | 314 | 294 | 369 | 375 |
| Accident frequency rate per million man-hours | 46 | 42 | 36 | 39 | 35 | 33 | 42 | 45 |
| Days lost (not including fatalities) | 2375 | 2222 | 1998 | 2051 | 2113 | 1794 | 2058 | 4113 |
| Resultant days lost per million man-hours | 277 | 245 | 228 | 226 | 233 | 199 | 235 | 491 |
| Number of fatalities | – | 1 | – | – | – | 1 | – | 3 |

The number of lost time injuries to Board's employees increased in two years 1975 and 1976 by 4.47% and the accident frequency rate per million man-hours increased by 9.52% against a decrease of 5.62% in man-hours worked.

## 3. Publications

**The following papers by officers of the Engineer in Chief's Branch were presented or published in the 1975/76 year:**

| | |
|---|---|
| 'Strut loads in a braced excavation in soft clay'.<br>Presented at the Second ANZ Conference on Geomechanics, July 1975. | P J Moore<br>University of Melbourne.<br>M C Ervin<br>Engineer<br>Materials Research Division. |
| 'Geometric features of rural freeways in Victoria, Australia'.<br>Presented at the 15th PIARC Congress in Mexico, October 1975. | R T Underwood<br>Chief Planning Engineer. |
| 'Road surfacing aggregates from ceramic raw materials'.<br>Published in the November 1975 edition of the Journal of the Australian Ceramic Society. | E Tauber<br>CSIRO Division of Building Research, Victoria.<br>H J Pepplinkhouse<br>CSIRO Division of Building Research, Victoria.<br>L W Middleton<br>CSIRO Division of Building Research, Victoria.<br>B L Phillips<br>Engineer<br>Materials Research Division. |
| 'Traffic control systems Why? How? and Who?'<br>Retiring Chairman's Address, Transportation Branch, Institution of Engineers Australia (Victorian Division), November 1975. | B J Negus<br>Design Engineer<br>Traffic Engineering Division. |
| 'Information to be obtained from Pile Loading Tests'.<br>Presented at the Insitu Testing for Design Parameters Symposium, Institution of Engineers Australia, November 1975. | H R Ellis<br>Engineer<br>Plans and Surveys Division.<br>A F Williams<br>Engineer<br>Materials Research Division. |
| 'Comments on the use of electrical friction Cone-Penetrometer'.<br>Presented at the Insitu Testing for Design Parameters Symposium, Institution of Engineers Australia, November 1975. | M C Ervin<br>Engineer<br>Materials Research Division. |
| 'The need for freeways'.<br>Presented at the Civ En Ex Seminar, March 1976, and published in the May 1976 edition of MEMO. | N S Guerin<br>Deputy Engineer in Chief. |
| 'A national road safety policy and its selective implementation'.<br>Presented at the Annual Conference, Institution of Engineers Australia, May 1976. | N S Guerin<br>Deputy Engineer in Chief.<br>B J Negus<br>Design Engineer<br>Traffic Engineering Division.<br>K C Hastings<br>Design Engineer<br>Traffic Engineering Division. |
| 'Workshop management'.<br>Presented at the Servicing the Modern Motor Vehicle Lecture Series, Society of Automotive Engineers Australia, May 1976. | M J Bailey<br>Central Maintenance Engineer (Mechanical). |

**Other publications in 1975/76 were:**

| | |
|---|---|
| Engineering Note No 110. | High Alumina Cement |
| Engineering Note No 111. | Removal of Graffiti from Surfaces |
| Engineering Note No 112. | Synthetic Cloths as Filter Mediums for Subsoil Drains |
| Research Memorandum No 22. | Investigation of a Post Tensioned Brick Lintel, by B J Weinberg B Eng (Civil), MIE Aust. |
| Technical Bulletin No 29. | Pavement Deflection Testing using the Benkelman Beam, prepared by P J F Mulholland BCE, M Eng Sc, MIE Aust. |
| Technical Report No 61. | Project Evaluation: The State of the Art, by G E Herbert BSc, Dip Ed. |
| Technical Report No 62. | Outline of an Air Quality Study in the vicinity of a proposed freeway section, by D J Ford B App Sc. |

## 4. Staff

As at 30th June 1976, the total staff in the Engineer in Chief's Branch was 1,318.

I thank all the staff for their conscientious work and loyal service to the Board.

K G Moody
Engineer in Chief