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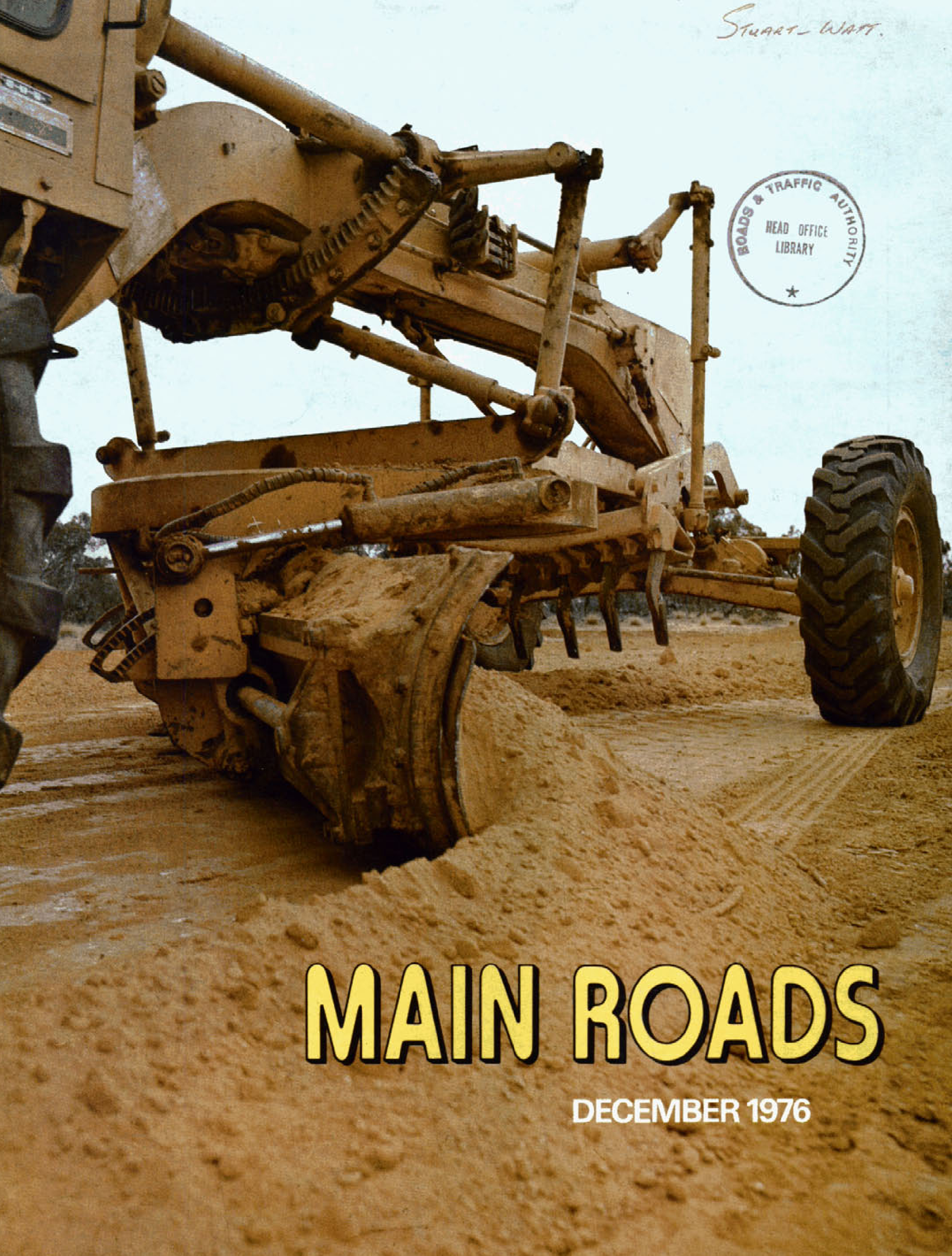
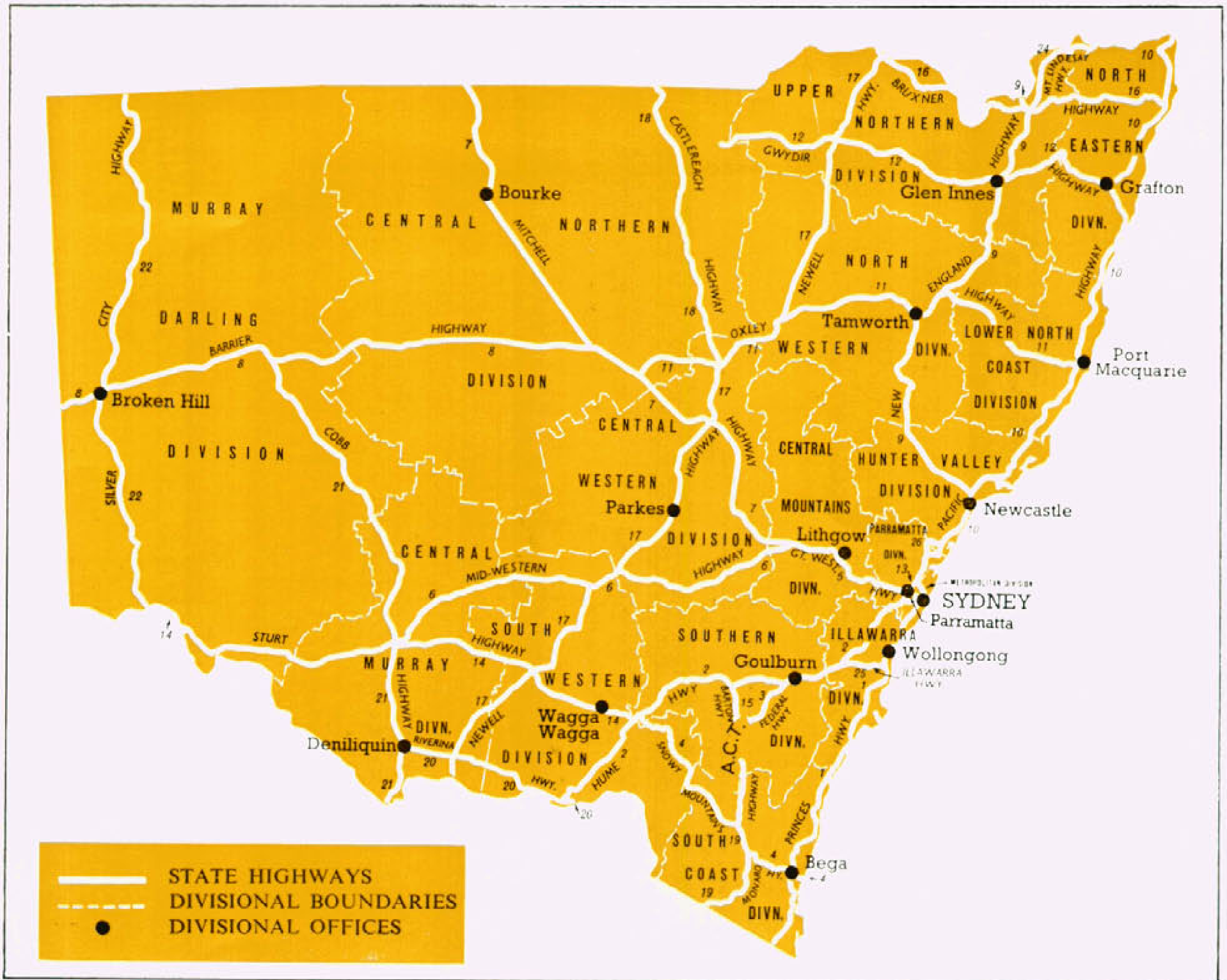


MAIN ROADS

DECEMBER 1976



New South Wales

Area—801 428 km²

Population as at 30th June, 1976—4 776 258

Length of Public Roads—208 804 km

*Number of Motor Vehicles registered as at 30th December, 1976—2 203 300**

** This figure has been obtained from the Australian Bureau of Statistics. It should be noted that, due to the exclusion of certain categories of vehicles (such as tractors and trailers), etc., this figure is considerably lower than the statistics published prior to December, 1974, which were obtained from the New South Wales Department of Motor Transport.*

ROAD CLASSIFICATIONS AND LENGTHS IN NEW SOUTH WALES

The lengths of roads within various classifications and for which the Commissioner for Main Roads was responsible as at 30th June, 1976 were:

Freeways	114
State Highways	10 476
Trunk Roads	7 080
Ordinary Main Roads	18 317
Secondary Roads	285
Tourist Roads	395
Developmental Roads	3 608
Unclassified Roads	2 480
TOTAL	42 755 km

MAIN ROADS

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CONTENTS

Front cover: Getting the low-down on roadworks on the Cobb Highway (see also centre colour pages).

Back cover: From low-down to high up. This aerial view shows reconstruction being undertaken to improve the route of the New England Highway through the Moonbi Ranges, 25–30 km north of Tamworth.

ROAD SPACE

There is an immediate need for more road space in New South Wales especially in urban areas during peak travel times.

At 30th June, 1976 the length of roads in the Main Roads System in New South Wales was 42 755 kilometres and there were 2 203 300 registered motor vehicles. If *all* of these vehicles suddenly drove onto the Main Roads System *at the same time* there would be one vehicle every 19·4 metres.

Among this vast number of registered vehicles, there are many commercial vehicles whose legal length is up to 15 metres and they require a greater amount of road space to manoeuvre than the motor car. So often criticised, these large commercial vehicles are an integral part of our everyday community life and are vital for the movement of goods from farm and factory to ship, rail or air. The space they occupy is balanced by the work they do.

However, there is not sufficient money available to provide the *ideal* amount of road space needed, for all the travelling we do in all the vehicles we own. It is also open to question whether it is within the capacity of the community at this time to afford to make more money available for more road space.

It follows that the maximum use must therefore be wrung out of the existing road space, especially in urban areas. This is being done by reconstructing roads to provide more traffic lanes within the road reserve and by the application of traffic management techniques.

Traffic management techniques are many and varied. They include improving and channelising intersections, extending medians, providing co-ordinated signals systems, introducing clearways and major-minor road conditions (see article commencing on page 51).

A great deal of public money is invested in the construction of roads and the selfish attitude adopted by some road users of parking at the kerb on major arterial roads restricts the use of much needed traffic lanes. Adequate parking is always obtainable either in a nearby car park or at the kerb in a lightly trafficked street off the major road.

To control this misuse of valuable road space, which is provided for the *movement* of vehicles, parking restrictions are necessary. Twelve hour and twenty-four hour clearways are proposed for those roads in the Main Roads System which act as arterial routes and which carry heavy densities of commercial traffic throughout the day.

Major-minor (priority system) conditions on roads—together with other traffic management techniques—will also provide road users with some of that urgently needed road space. They will fill the void until the population and money are available to support a complete freeway system.

With the application of traffic management techniques through traffic will flow more freely on arterial routes and local streets will again revert to local use by nearby residents and visitors. Furthermore, the road user will benefit more from the money which he contributes by way of tax (see article on page 43) and which is invested in roads as communication links for all, not merely as parking areas for some●

$ + DMR / COUNCILS = ROADS

Main Roads and Local Government

A summary of the relationship between Local Government and the Department of Main Roads in the development and upkeep of the principal roads in New South Wales.

The Department's relationship with local government authorities has evolved over a long period, partly arising from Acts of Parliament and partly from a process of rationalising individual objectives. The development of this relationship has led to co-operative working arrangements aimed at achieving the best use of funds (which always fall short of needs).

Since colonial times different authorities have been responsible for the survey, design and construction of roads in New South Wales. These authorities included the Surveyor General's Department, the Royal Engineers, numerous Parish Road Trusts and a wide variety of individual contractors.

From the late 1850's the Department of Public Works undertook the task until 1907 when, as a result of the Local Government Act, the responsibility for roads and bridges was handed over to the shire and municipal councils. Under that Act the Minister for Local Government was empowered to classify roads as Main Roads and so render them eligible for financial assistance from the Government.

From 1912 onwards there were public demands for the establishment of a central road authority which could co-ordinate the inevitably disjointed works of so many councils, each with different standards and priorities.

The situation was summed up in an address by Mr P. Allan, Chief Engineer for National and Local Government Works, Department of Public Works, to the Institution of Civil Engineers in Sydney on 17th June, 1921:

"*When handed over to the various Shire Councils the principal country council roads were in reasonably good order, but the more important thoroughfares or National Highways have gradually fallen into so deplorable a state that their improvement and restoration to something approaching the condition they were in when transferred to the local authorities is fast becoming one of the most pressing problems with which the community will soon be called upon to deal.*"

A number of Bills were introduced into Parliament but they failed to gain sufficient support and were defeated or dropped. Finally in November, 1924, the Main Roads Act was passed to take effect on 1st January, 1925. The aim of the Act was to ensure satisfactory maintenance and progressive improvement of the Main Roads in the State.

This was to be accomplished by:

(a) setting aside for Main Roads purposes revenue from motor vehicle taxation to supplement revenue raised from rating on land by Councils; and

(b) establishing a central main roads authority to administer the expenditure of funds derived from motor vehicle taxation, and to co-ordinate, assist and supervise the work of councils on Main Roads.

A clear distinction was made in the Main Roads Act between the County of Cumberland (the area surrounding Sydney and some adjoining areas) and the country (the remainder of the State), each area with its own financial fund.

The Act was later amended in 1928 to provide for the classification of Main Roads into:

—State Highways,
—Trunk Roads, and
—Ordinary Main Roads

as improvements to the Main Roads System needed to be dealt with independently of local considerations.

The Department assumed full responsibility for all State Highways, in both the County of Cumberland and the country, and for all Ordinary Main Roads located within the County of Cumberland. The remaining classified roads continued to be the responsibility of the appropriate local government authority, which received financial assistance from the Department.

Councils contributed one-third of the cost of construction and maintenance works on Main Roads in the country and one-quarter on Trunk Roads (for bridge construction the contributions were one-quarter and nil respectively). Within the County of Cumberland, councils were required to pay a levy of 5/24ths cents in each dollar of unimproved capital value.

However, from 1st January, 1972 the Department has met the full cost of construction and maintenance works on all State Highways, Trunk Roads and Ordinary Main Roads. Councils still contribute 50 per cent of the cost of construction and maintenance on Secondary and Tourist Roads (with a few isolated exceptions).

From 3rd February, 1975, the Department was given responsibility (transferred from the Department of Public Works) for the distribution to councils of funds provided by the Commonwealth Government for works on unclassified roads.

PRESENT POSITION

At 30th June, 1976, there were 208 804 kilometres of public roads in New South Wales of which 42 755 kilometres were the responsibility of the Commissioner for Main Roads.

The following classifications of roads have been adopted in New South Wales.

State Highways—10 476 kilometres

The principal avenues of road communication between the coast and the interior, or throughout the State and connecting with such avenues in other States.

State Highways are maintained by the Department's own forces, except for 985 kilometres which are maintained by various councils.

Trunk Roads—7 080 kilometres

The secondary avenues of Main Road communication which connect the State Highways and, together with the State Highways, link the main regions of the State. Work on these roads is generally carried out by councils' work forces.

Ordinary Main Roads—18 317 kilometres

The network of Ordinary Main Roads connects towns and important centres of population with State Highways and Trunk Roads and with each other. Ordinary Main Roads, in conjunction with State Highways and Trunk Roads, effectively link all districts in the State.

Work on Ordinary Main Roads in the country is generally carried out by councils' work forces (except in a few isolated instances).

In the County of Cumberland, a substantial amount of the work on Ordinary Main Roads is carried out by the Department's work forces. However, councils maintain 417 kilometres of Ordinary Main Roads on behalf of the Department.

Developmental Roads—3 608 kilometres

Roads not previously constructed but which, if constructed would serve to develop a district or any area of crown or private land by providing access to a railway station or shipping wharf or to a road leading to them. There is also provision for individual works, e.g., a new bridge on an isolated unconstructed length of road, to be proclaimed a Developmental Work.

All Developmental Roads are located in the country and are maintained by councils' work forces. The Department meets the full cost of the construction of these roads and works but does not contribute to maintenance costs.

Secondary Roads—285 kilometres

Certain roads within the County of Cumberland may be declared by the Commissioner for Main Roads to be Secondary Roads. A Secondary Road is one which carries a substantial volume of through traffic and gives relief to a Main Road.

Secondary Roads are all located in the County of Cumberland and are maintained by councils' work forces.

Tourist Roads—395 kilometres

These are roads which serve the tourist industry. Work on these roads is generally carried out by councils' work forces (with a few isolated exceptions).

Motorways

Motorways are roads or lengths of road in respect of which the Commissioner has, following proclamation as a Motorway under the Main Roads Act, direct control over the means of access. The aim is to provide a limited access road and to prevent traffic from crossing the Motorway boundaries at points other than those where special provision is made for traffic to enter or leave the road.

Toll Works

Certain works designed to provide for the easier movement of road traffic between Sydney and Newcastle or Sydney and Wollongong may be proclaimed under the Act to be Toll Works. Moneys received from tolls or charges are required to be applied, in the first place, towards the cost of repairing and maintaining the Toll Work and the collection of tolls and charges. Secondly, toll receipts are also applied towards the cost of constructing the Toll Work (including land acquisitions) and the repayment of loans in connection therewith.

The term "Freeway" is not included in the Main Roads Act, but was adopted by the Standards Association of Australia to describe a highway for through traffic with full control of access and with provision for separation of all cross traffic by bridging.

Unclassified Roads—166 049 kilometres

Unclassified roads are those which are not classified under the Main Roads Act. Most of them are Local Roads in terms of Commonwealth Government legislation.

Work on Local Roads is generally carried out by councils' work forces, with the exception of 2 480 km in the Unincorporated Area of the Western Division, which are maintained by the Department.

WORK PRIORITIES

In determining priorities for improvements to roads in the Main Roads System, regard is paid to safety, structures, road capacity and geometry, economic considerations and miscellaneous needs. The co-ordinated planning and uniformity of road communications in an integrated network of arterial and connecting roads is developed on a regional basis without regard to local government boundaries.

Within the County of Cumberland many Main Roads are of multi-lane construction and of high capacity. They extend through a number of local government areas and carry a heavy volume of inter-regional urban traffic.

Priorities for the progressive improvement of all State Highways and Ordinary Main Roads in the County of Cumberland are determined by the Department.

In the country each council is requested to submit periodically a list of priorities for construction works on classified roads under its control. The Department's Divisional Engineer examines council's priorities and, if necessary, discusses them with council to arrive at a mutually acceptable sequence of works. Council's priorities are generally accepted. Priorities for improvement works on unclassified roads are determined by the councils concerned.

FUNDS

The Department prepares annual construction programmes for the various categories of roads and for bridges within the County of Cumberland and country areas. Funds are allocated on the basis of total needs and, within all categories, with regard to the balanced development of the Main Roads System throughout the State.

Funds for works on Trunk and Ordinary Main Roads are made available to councils in keeping with their accepted priorities. However, in order to assist councils in maintaining a stable work force on classified roads, the Department takes into account the desirability of allocating funds of a similar amount each year. Where major works are required construction is spread over a period of two or three years.

Funds for the construction of local roads are provided by the Commonwealth Government under the Roads Grants Act, 1974 and distributed by the Department.

In respect of Rural Local Roads, councils submit annual works programmes to the Department and funds are distributed as

- ☆ direct grants to shires and municipalities for expenditure on road works in accordance with a formula and apportioned partly on a needs basis (having regard to area, population and existing road systems).
- ☆ bridge subsidies (usually 50 per cent), to assist councils to replace substandard bridges or provide new ones.
- ☆ flood damage restoration in instances not declared natural disasters and where additional financial assistance is not provided.

In the case of Urban Local Roads, councils submit their annual works programmes to the Local Government Association in the first instance. Funds are apportioned having regard to the length of road and population in each local government area.

GENERAL MATTERS

The administration of the Department of Main Roads is decentralised into 16 geographical divisions, each of which comprises a grouping of local government areas. Each division is administered by a Divisional Engineer who is responsible, among other things, for the supervision of works undertaken by councils on behalf of the Department, the examination of their proposals and general liaison on all road matters. The Divisional Engineers and their staffs have achieved a close working relationship with local government councils, enhanced by living in the area and experiencing the same conditions as councils.

Almost invariably councils' employees are engaged on works on both classified and unclassified roads and as at 30th June, 1976, there were approximately 3 124 council employees working on Classified Main Roads.

Generally, councils use their own plant and equipment on roadworks and are reimbursed the cost by a hire rate. Hire rates are fixed to compensate councils for the purchase price of equipment, interest on capital and other charges such as major repairs, overhauls and the renewal of tyres, tubes and batteries. This ensures that under normal circumstances, councils should not be operating equipment at a loss. Wages of the operator, cost of fuels and servicing and other actual costs are charged direct to the jobs on which the equipment is engaged.

With the introduction of the Commonwealth Aid Roads Act, 1969, and the Roads Grants Act and National Roads Act of 1974, further classifications of roads have been introduced. These in turn are related to nine functional classifications adopted by the National Association of Australian State Road Authorities. There are, however, no clear and unqualified relationships between the three classification systems and consequently, within the County of Cumberland area there are some Rural Roads and in the country area there are some Urban Roads.

The hierarchy of road classifications used in New South Wales has been proved over the years to be a simple workable arrangement for the distribution of funds and the establishment of priorities.

Funds distributed to councils during 1975–76 were spent on the following classifications.

Classified Main Roads ..	$44·25M.
Rural Local Roads ..	$21·60M.
Urban Local Roads ..	$ 4·11M.
MITERS (Minor Traffic Engineering and Road Safety Improvements)	$ 0·58M.
TOTAL ..	$70·54M.

Funds for the construction and maintenance of classified Main Roads are provided from State revenue received from motor vehicle taxation and road maintenance charges and from grants provided by the Commonwealth Government under the National Roads Act and Roads Grants Act, 1974.

Funds for rural and urban local roads and MITERS are provided by the Commonwealth Government under the Roads Grants Act, 1974.

The expenditure of almost $71 million in a financial year by the State's 230 shire and municipal councils represents a very significant proportion of the total funds available for expenditure on road and bridge works in New South Wales●

More Pedestrian Overbridges

Although the provision of special facilities for pedestrians to cross Main Roads is primarily a matter for the consideration of the municipal or shire council concerned, this Department has contributed to the cost of, and has constructed, various pedestrian bridges over Main Roads, on the ground that the separation of pedestrians and vehicular traffic improves road safety and the flow of traffic. The Department generally accepts responsibility for the design and construction of footbridges because of its broad experience in bridge building.

The Department is aware that pedestrians prefer open structures like bridges rather than subways, despite the fact that subways usually involve less climbing. The Department endeavours to satisfy this public preference despite the frequent cost advantage of building a subway instead of an overbridge. It is important that *grade separation* structures for pedestrians (whether bridge or tunnel) are readily accepted and used by the public if they are to be worth the high cost involved.

It is apparent that pedestrians prefer ramped approaches to the main span of an overbridge, rather than stairways which are more difficult for the elderly and for mothers with prams. Unfortunately, ramps take up more of the footpath area, which is often congested in the vicinity of footbridges. The design problems associated with footbridges are made more complex by the need to provide for existing and future public utility services under the footpaths, as well as for adequate and economical foundations for the structure.

Some examples of footbridges constructed by the Department in the past twelve years are listed below.

- ☆ Over Victoria Road (Main Road No. 165) near Gladesville Bridge in 1964.
- ☆ Over the Princes Highway (State Highway No. 1) at Sylvania in 1967.
- ☆ Over the Warringah Freeway (F1) at North Sydney in 1968.
- ☆ Over the Sydney–Newcastle Freeway (F3) at Cowan in 1968.
- ☆ Over the Southern Freeway (F6) at Wollongong in 1969.
- ☆ Over Warringah Road (Main Road No. 328) at Frenchs Forest in 1969.
- ☆ Over Beecroft Road (Main Road No. 139) at Epping in 1970.
- ☆ Over the Pacific Highway (State Highway No. 10) at Kororo in 1971.
- ☆ Over Parramatta Road (State Highway No. 5) at Sydney University in 1972.

Details of these structures were given in articles in the March, 1971 issue of "Main Roads", Vol. 36, No. 3, pp. 66–8, 80–1.

More recently, the Department has completed the construction of six footbridges at Linley Point, Picton, Rydalmere, Kings Cross, South Hurstville and Auburn. It is at present constructing a footbridge at Mt Kuring-gai.

Linley Point

On 16th December, 1965, the Tarban Creek Bridge was opened to traffic, bringing into full use the first short section of the North Western Freeway. The Tarban Creek Bridge provided a direct connection between the Gladesville and Fig Tree Bridges and provided a favourable alternative route for some traffic which would otherwise use Sydney Harbour Bridge to reach the northern suburbs.

Traffic counts in 1966 on Burns Bay Road, Lane Cove (Main Road No. 166), which forms the northern approach to the Fig Tree Bridge, indicated that the traffic volume was approximately 30 000 vehicles per day, with a peak total flow in both directions nearing 3 000 vehicles per hour. Consequently, it was very difficult for pedestrians to cross the carriageway on this section of Burns Bay Road as few breaks in the traffic flow occur during peak periods.

A marked pedestrian crossing with traffic lights was rejected as a solution, because it would check traffic flow. Other proposals considered were a subway beneath the Fig Tree Bridge and a pedestrian overbridge. The last solution was adopted.

The bridge is constructed of steel box girders and tapered box columns. Pedestrians walk on the top plate of the deck girder, which has a 25 mm wearing surface of asphaltic concrete. Steel grille handrailing is welded to the top of the box girders. Access to the bridge from Burns Bay Road is by stairs only, there being no room for ramps, particularly on the eastern side where a rock face stands adjacent to the footpath. The stairs are of steel boxed beams with prestressed concrete tread planks. Carborundum strips are set in these planks to prevent slipping. Overall length of the footbridge is 30 m and the width between railings is 1·52 m. The minimum vertical clearance above Burns Bay Road is 5·70 m. The supporting columns are founded on short bored piles, 380 mm in diameter and up to 2·13 m in length. There are four piles at each column and each is set 610 mm into hard sandstone.

The Department designed and erected the bridge and fabricated the steelwork at its Central Workshop, Granville. Since all steel components were prefabricated, work on the site was restricted to the concrete foundation footings and girder assembly by site welding. The main girder was brought to the site complete with handrailings and wearing course, and had been pre-painted at Central Workshop. It was erected in the early hours of the morning and delay to traffic was reduced to a minimum.

The bridge was opened on 26th November, 1973, and the total cost was approximately $80,000.

Picton

A similar footbridge to the one at Linley Point (without the access structure) was designed by the Department for erection over the Main Southern Railway Line at Picton (between Picton Avenue and Argyle Street). The provision of this bridge has allowed the Department to close the footway that previously ran beside the busy Hume Highway as it passed through the subway under the railway line at Picton. The closing of the footway has in turn allowed the Department to undertake to widen the roadway through the subway and thus provide better clearance for vehicles negotiating the sharp turn at the southern approach.

The bridge is 18·3 m long, 1·5 m wide and the bottom of the deck is 5·8 m above the railtracks. The complete bridge span was brought to the site on a railway truck and lifted onto the foundations by railway cranes. The structure was opened for use on 23rd December, 1974.

Rydalmere

At Rydalmere, a footbridge has been built over an on-loading ramp leading from Kissing Point Road (Main Road No. 574) to the southbound lanes of the North Parramatta By-pass (County Road No. 5037). It connects the footway on the new Kissing Point Road overbridge to Macquarie Boys High School. (The new overbridge carries Kissing Point Road across the By-pass.) This arrangement allows school buses to use the existing facilities and for school pupils to walk to and from the buses without crossing the path of vehicular traffic which is moving onto the By-pass.

The footbridge is a simply supported prestressed concrete slab, 16·77 m in length and with a clear width for pedestrians of 2·15 m. It is built to a vertical curve of 75 m radius, is on a straight alignment and has a minimum vertical clearance of 5·18 m above the loading ramp. The deck is prestressed, using eight 35 mm diameter high tensile alloy steel rods for post-tensioning. The slab rests on an elastomeric (rubber) strip bearing at each abutment, which consists of a reinforced concrete retaining wall founded on sandstone.

Both the Kissing Point Road overbridge and the footbridge were built at the same time, so as to allow unimpeded traffic facilities on completion. E. M. Moore Pty Ltd constructed the footbridge for the Department at a cost of approximately $30,000. It was opened on 12th September, 1975. A brief article and map of the North Parramatta Traffic Relief Route (By-pass) appeared in the December, 1973 issue of "Main Roads", Vol. 39, No. 2, p. 55.

Kings Cross

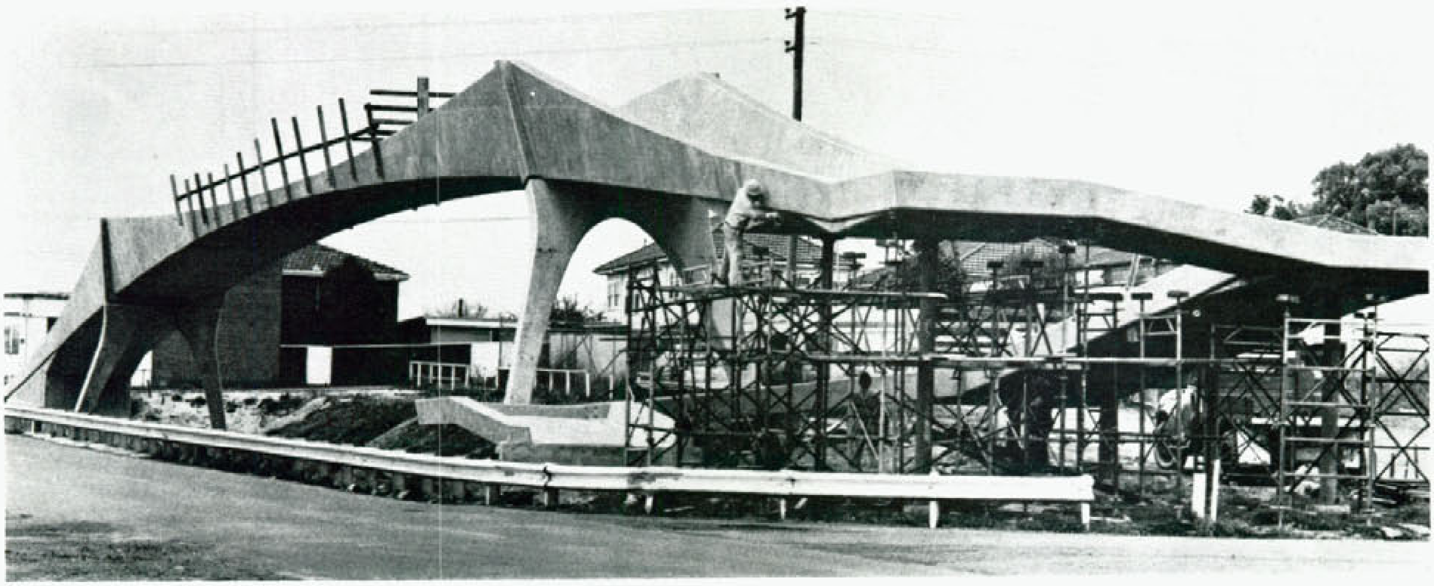
Articles on the design and construction of the Kings Cross Road Tunnel have already appeared in the September, 1972 (Vol. 38, No. 1, pp. 18–22) and December, 1975 (Vol. 41, No. 2, pp. 34–8) issues of "Main Roads". The road tunnel was, of course, designed to streamline traffic flow to and from the eastern suburbs but, at the same time, provisions were included for pedestrians whose routes would be altered due to the tunnel's construction. For example, the road bridges at each end of the tunnel (i.e., at Victoria Street and Craigend Place) have a footway leading to the adjacent streets.

At the eastern end, where the approach to the tunnel is through a cutting, it would have been impractical and dangerous to allow pedestrians to cross the tunnel approaches. Consequently, it was decided to place a footbridge right across Kings Cross Road, the tunnel approaches and Craigend Street, to connect Roslyn Street with Oswald Lane.

The footbridge, which was designed by the Department, has two main spans (each 34·3 m) and two curved approach ramps. The overall length along the bridge centreline is 123 m, with a 1·82 m clear width for pedestrians. The main deck structure comprises two solid precast and prestressed concrete slab sections, joined to a post-tensioned concrete cantilevered hollow box section supported by the central pier. The central pier is also of post-tensioned concrete and is fixed to the underlying sandstone by means of rock anchors. All other piers and ramps are of reinforced concrete.

During construction, the cantilevers were propped prior to the precast sections being erected. These precast sections were then supported directly from the cantilevers, and the concrete joints between the precast sections and cantilevers were then poured in place to make the superstructure continuous.

Peter Verheul Pty Ltd manufactured the two precast concrete girders and the Department's own forces carried out the construction of the bridge. It cost $230,000 and was completed shortly before the Kings Cross Road Tunnel was opened on 15th December, 1975.

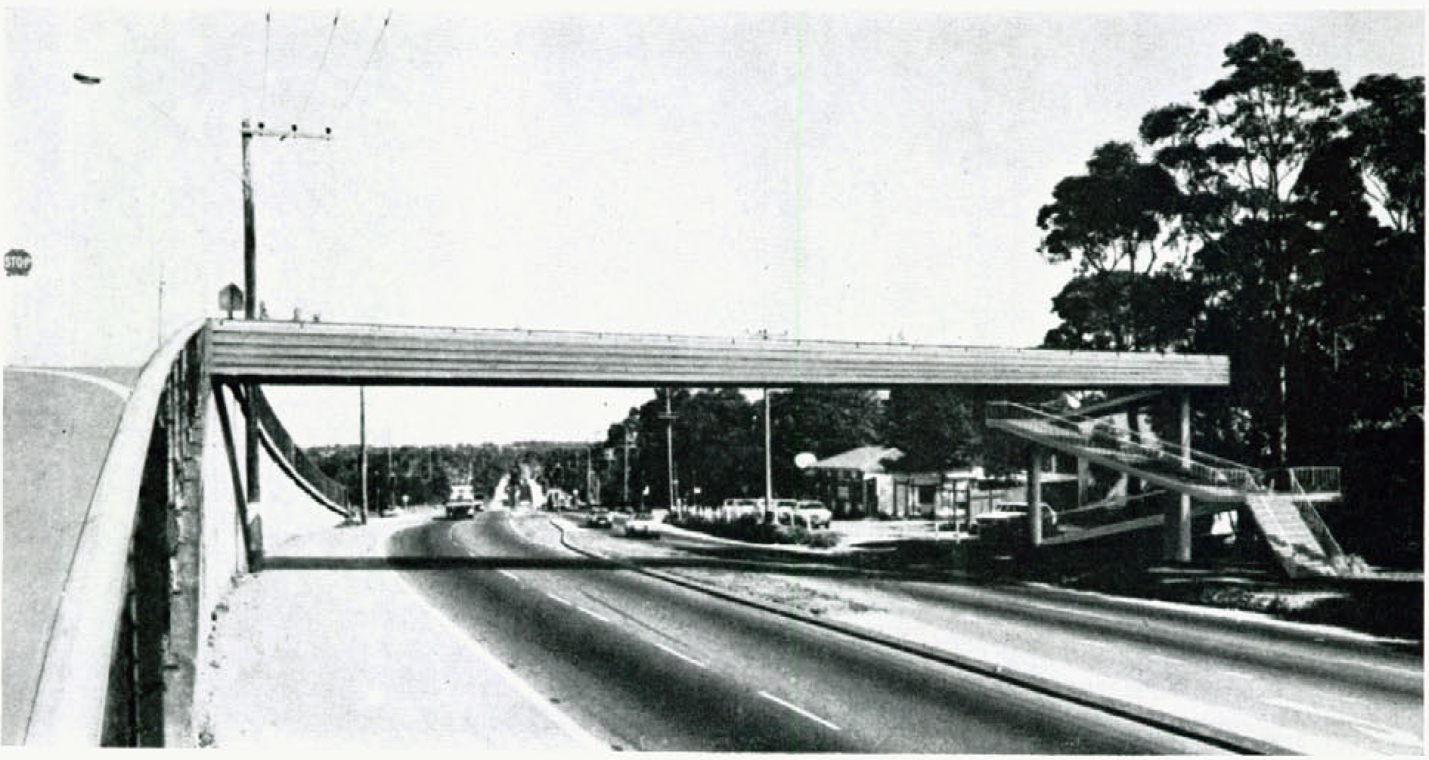


Top: This overbridge crosses the southbound loading ramp from Kissing Point Road onto the new North Parramatta By-pass and provides access for students moving to and from the high school in the background.

Above: Looking like the skeleton of some huge dinosaur, this new footbridge will eventually span a busy section of the Western Freeway at Melton Street, Auburn. This view with falsework and without handrailing was taken in September, 1976.

Above: An artist's impression of the recently completed structure spanning busy King Georges Road at South Hurstville.

Below: Looking into the future to see what the pedestrian overbridge across the Pacific Highway at Mt Kuring-gai railway station will look like when completed (facing south).



South Hurstville

An overbridge has just been built for pedestrians wishing to cross the increasingly heavily trafficked King Georges Road (Main Road No. 315) which forms part of Ring Road 3—a major circumferential route. Of primary concern was the safety of pupils attending South Hurstville Public School. Previously, there was a pedestrian crossing with traffic lights near the corner of King Georges Road and Maher Street, but a survey by the School's Parents and Citizens' Association showed that there were many violations of the signalled traffic halts during the morning and afternoon peak crossing periods for school children.

The design prepared by the Department provided for a central 19·20 m long suspended span of prestressed, precast concrete to be lifted into place when minimum disruption to traffic would occur. Consequently, King Georges Road was closed and traffic diverted around the site between 6 a.m. and 10 a.m. on Sunday, 17th October, 1976, while the centre span was erected. This span was then post-tensioned, using eleven 35 mm diameter high tensile alloy steel rods.

The suspended span is supported by 4·57 m long reinforced concrete cantilevers of varying depth. The two anchor piers were post-tensioned, using four 32 mm diameter high tensile alloy steel rods. Rock anchors were used to connect these piers to the underlying rock and to extend 2·74 m into solid rock.

The overall length of the structure is 88·74 m with a deck width of 1·85 m. The ramps are of reinforced concrete slab construction with both curved and straight sections and have a total length of 60·39 m. The foundations are cast-in-place reinforced concrete piles bearing on hard shale and sandstone.

Because the school buildings at the southern end of the footbridge are very close to the roadway, it was necessary to *sweep* the footbridge away from the building by means of a curved ramp.

The successful tenderer was E. M. Moore Pty Ltd, with a contract price of $155,000. Work commenced early in 1976 and the footbridge was opened on 8th December, 1976.

Auburn

The Melton Street pedestrian overbridge, in the Municipality of Auburn, is part of the Western Freeway project (Homebush to Clyde section). An article (with map) on this length of freeway appeared in the March, 1975 issue of "Main Roads", Vol. 40, No. 3, pp. 82–7. The footbridge was designed for the Department by Messrs Rankine and Hill, consulting engineers, and will allow pedestrians to cross over the new Freeway from Deakin Street to Adderley Street.

The design selected was for a continuous structure of reinforced and prestressed concrete, with sloping frame piers and a clear central span 44·3 m long over the Freeway, the minimum vertical clearance being 5·33 m. The overall length of the structure along the centreline is 117·96 m and the deck width is 2·13 m. For prestressing, four post-tensioned cables were provided, two of which were stressed to 1 420 kN and the other two to 1 910 kN.

The Adderley Street approach ramp of reinforced concrete slab spans is on a straight alignment with the main span, while the Deakin Street approach ramp is rectangular in plan and has a length of 49·56 m. The slope of both ramps is 1 in 8.

It is interesting to note that in days gone by, soldiers were instructed to break step when crossing bridges. The rhythm of their march was similar to *cyclic loading*, the effects of which could lead to the collapse of the bridge. The *cyclic loading* effect may act in sympathy with the *natural frequency* of the bridge, reinforcing it and giving a much greater amplitude of vibration. Messrs Rankine and Hill investigated the amplitude of vibration of the footbridge under *cyclic loading*, using a computer programme. It was found that there could be vibration induced under load (such as a group of people crossing the footbridge in step) but there would not be enough to cause any danger to either the bridge or the people using it.

Construction of the overbridge by the Department's own forces began in early 1976 and was completed in December, even though the section of Freeway beneath it will not be in use for some time yet.

Mt Kuring-gai

It is necessary for residents and school children who live west of the main northern railway line at Mt Kuring-gai to cross the Pacific Highway in order to reach the railway station and schools in the area. This section of the Highway carries about 36 000 vehicles a day and the risk of pedestrian injury has increased with traffic growth.

Examination of aerial photographs confirmed that most settlement on the western side was concentrated near Nyara Road. A number of proposals for marked pedestrian crossings and traffic lights were considered, but a footbridge was accepted as giving the best solution with regard to pedestrian safety and traffic flow.

Since there is already a road bridge across the railway line near Nyara Road, it was decided that a footbridge could easily be connected to this and so avoid the necessity for a ramp on the eastern side. On the western side, commuters moving to Mt Kuring-gai railway station will approach the overbridge along an existing path. School children will particularly benefit from this footbridge as it is being built where they now have to cross the busy Highway under police supervision.

The approach ramp on the western side posed a problem, since a reasonable gradient of 1 in 8 would necessitate a ramp 43 m in length if laid straight out. In order to overcome this, the ramp was planned in a rectangular pattern, with three inclines, and extended to 48·8 m. For more active, agile pedestrians, a short flight of steps will be provided to give a short-cut to the landing at the top of the first incline.

The overall length of the bridge, along the centreline, will be 80·79 m, with a 31·7 m main span. The width of the deck will be 1·5 m.

The design, prepared by the Department, includes post-tensioned concrete segmental girders for the main span. There will be three different types of segments used, one of which will have a mass of 10·5 tonnes and the other two 9·0 tonnes. The girders will also form the parapet walls, the floor being supported between them. The floor system will be cast-in-place reinforced concrete on a formwork of asbestos cement sheets, which will be left in position. The columns and ramps will be reinforced concrete with spread footings founded on rock.

To add interest to the structure and to avoid a heavy appearance, the outer sides of the girders will be cast using rough-sawn timber formwork and a series of horizontal fins will be formed across the girders by the thin strips of concrete left between adjacent form boards.

A tender of $83,000 from the Hornibrook Group was accepted by the Department in August, 1976, for construction of the bridge and the contract time for completion is 40 weeks.

Yesterday's Styles . . .

The photographs on pages 39 and 40 highlight the more pleasant designs to which pedestrian structures are now built. The older overbridges at Arncliffe and Auburn are not as handsome but they still do their job of providing safe access across busy urban thoroughfares, especially for students of the nearby schools. Some details about these two earlier overbridges may be of interest, for comparison with the current construction styles described above.

Both bridges were built and have been maintained by this Department although they were originally paid for by the Department of Road Transport and Tramways. More recently, until the recent transfer of traffic management responsibilities, the Department of Motor Transport was financially responsible for their upkeep.

☆ Arncliffe

This overbridge crosses the Princes Highway, just south of the Forest Road (Main Road No. 168) turnoff, at Arncliffe Public School. It was built in 1933 for only £435 0. 7. ($870)—plus £1 14. 6. for land—and was the Department's first venture into providing this type of pedestrian facility.

The bridge was designed within the Department and built partly by "day labour" (i.e., using the Department's own workforce) and partly by contract (Australian Iron and Steel Co. Ltd). It is 24·4 m long and has a main steel truss span with timber decking. The footway is 2·5 m wide and the minimum vertical clearance above the roadway was originally 4·6 m but this has subsequently been increased to 5·3 m.

☆ Auburn

This overbridge crosses the Great Western Highway (Parramatta Road) at Auburn North Public School—just west of Melton Street and not far from Silverwater Road (Main Road No. 532). It was designed by the Department and constructed in 1940 by W. B. Dawes, Builder, of Auburn at a total cost of £1,411 19. 4. ($2,824).

The structure is similar to the one at Arncliffe, being 24·6 m long and 2·4 m wide. The steel truss span originally had a timber decking but this was replaced with a steel one in 1971. The original vertical clearance of 4·6 m was also increased to 5·3 m when the structure was raised in 1965.

In this conservation-conscious age, it is interesting to note that the original construction contract specified that the builder "*shall not damage the Western Australia flowering gum tree situated at the western end of this bridge site in the school grounds*" ●

Right: This pedestrian overbridge over the Princes Highway at Arncliffe was the first one ever built by the Department back in 1933.

Below and bottom right: The slim lines of the footbridge over Burns Bay Road at Lane Cove (below) contrasts dramatically with the bulky, cluttered look of the 1940 bridge over Parramatta Road at Auburn.

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NEW SECRETARY

Mr N. B. Herrick

On 27th September, 1976, Mr C. A. Gittoes retired as Secretary of the Department, a position which he had held for over 2½ years since 5th February, 1974. Mr Gittoes joined the Main Roads Board as a junior clerk on 11th March, 1929 and rose to the highest administrative position in the Department. He served under all seven Commissioners for Main Roads during a remarkable 47½ years of service (outlined in the March, 1974 issue of "Main Roads", Vol. 39, No. 3, p. 92).

On 28th September, 1976 Mr N. B. Herrick was appointed Secretary of the Department, to succeed Mr Gittoes.

Mr Neville Herrick joined the Department as a junior clerk on 30th November, 1936. In the ensuing 40 years, Mr Herrick has worked in many areas of the State.

During the war years, he served for approximately 12 months in the Australian Army and later transferred to the RAAF, where he served for a period of almost 4½ years.

Returning to the Department in 1945, Mr Herrick spent several years in Head Office in various sections of the Accounts Branch and from 1949 to 1954 he worked in the country, principally at Yass.

Mr N. B. Herrick

After his return to Head Office, he held the position of Senior Clerk at the Department's Central Workshop, Granville. He then spent four years as an Accounts Inspector, inspecting the work of clerical officers in the Department's country offices.

Later on, Mr Herrick occupied positions in the Costs Section, Metropolitan Divisional Office, and Correspondence Section before being transferred to the position of Officer-in-Charge, Weight of Loads Section in 1964. He was appointed to the position of Senior Examiner of Claims in 1968 and then as Industrial Officer in 1970, before being appointed Assistant Secretary in February, 1974.

Mr Herrick is an Associate of the Australian Society of Accountants●

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INCREASE IN MOTOR VEHICLE TAX

On 23rd September, 1976 the Minister for Transport and Highways, the Hon. Peter Cox, M.L.A., announced that motor vehicle taxation rates (i.e., the tax levy and weight tax) in New South Wales would increase by 33⅓ per cent as from 1st November, 1976.

Registration charges which motor vehicle owners pay in addition to the tax levy and weight tax are a registration fee ($10) and a compulsory third party insurance premium (about $83 for a private car in Sydney). It has subsequently been announced that third party insurance rates will rise by 12 per cent as from 1st January, 1977.

The average tax increase is about $11. For example, in the case of a Holden Kingswood, an average family car, the taxes have increased by $11.45 from $34.65 to $46.10. With the registration fee and third party insurance premium, the total cost of annual registration for a Holden Kingswood has risen from $127.65 to $139.10. This is still almost $20 less than the cost of registering a similar car in Victoria.

Mr Cox explained that the State Government previously received $90 million annually from motor vehicle taxation. The current increase will add approximately $30 million to its annual revenue (yielding about $19 million in the remaining part of the current financial year) and all such receipts will be used for road and bridge construction. Motor vehicle tax had not previously been increased since 1st January, 1972 and, in the meantime, road construction and maintenance costs have risen substantially.

Mr Cox said that without the increase 1 500 people, comprising employees of the Department of Main Roads as well as of councils and contractors undertaking roadworks on behalf of the Department, would lose their jobs. Failure to take some remedial measures would have had severe repercussions in country areas in particular. The closure of three country works offices seemed inevitable and substantial reduction in the labour force at forty-two other works offices would have had to be made. He continued . . .

"The Department has been forced not to replace employees who resign. As well, it has cut back, re-organised and postponed essential construction works in an attempt to balance its budget."

Speaking in Parliament on 14th October, 1976 during the second reading of the Motor Vehicles (Taxation) Bill, which he had introduced earlier, Mr Cox made the following statement.

"I reiterate that the 1975 report on roads in Australia by the Commonwealth Bureau of Roads recommended that $54 million be made available to the State during the 1976–77 financial year to offset cost escalation. Instead, only $11·3 million was allocated to New South Wales. Moreover, to qualify for the full $11·3 million, New South Wales must increase expenditure on roads from its own resources by about 9 per cent. The Bureau's report recommended also a road programme for this State totalling $1,952·8 million for the five years commencing 1st July, 1976. Although it has had the report for some time, so far the Commonwealth has given no indication of its attitude to the Bureau's recommendation.

The report shows further that the ratio of road grants to motor fuel tax revenue has been steadily declining. For the year ended 30th June, 1970, the Commonwealth Government received $291 million in revenue from motor fuel taxes and 66 per cent of this amount was returned to the States in the form of road grants. In 1973–74, $635 million was received by the Commonwealth from fuel taxes but only 50 per cent was returned to the States."●

ELEVATION OF BRIDGE

NEW BRIDGE NEAR BRAIDWOOD

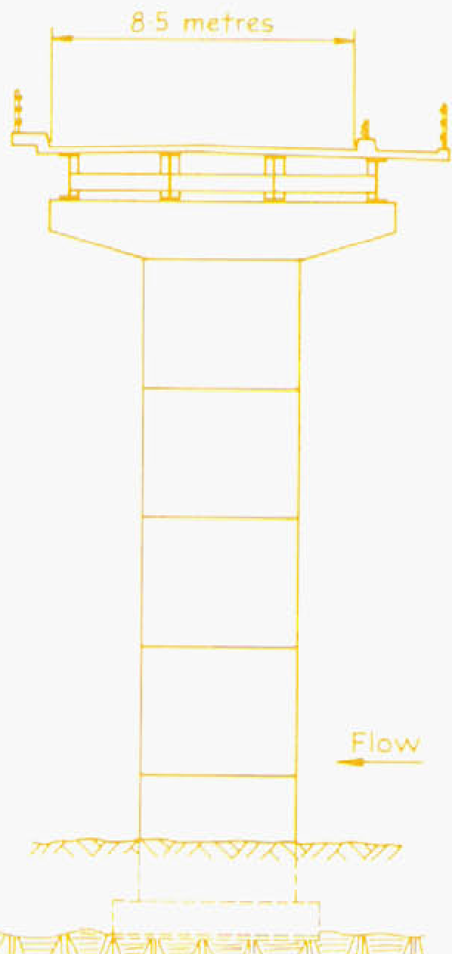
The Shoalhaven River is crossed by Trunk Road No. 51 between Braidwood and Queanbeyan near Warri Trig Station, about 13 km northwest of Braidwood. Trunk Road No. 51 is the main route from Canberra and the nearby tablelands to the coast near Batemans Bay. The present traffic volume on the road is approximately 1 500 vehicles a day and its importance is increasing as Canberra grows and tourism develops.

The Department has just completed building a new bridge at Warri to replace the old one built in 1892. The new bridge was officially opened by the Commissioner for Main Roads, Mr A. F. Schmidt, on Friday, 19th November, 1976, at a function organised by the Tallaganda Shire Council.

The old Warri Bridge consisted of five 27·5 m long timber truss spans and a single 9 m timber beam span. The deck was 5 m between kerbs. The bridge was, in its time, a fine example of the later McDonald truss principle. It is one of two truss principles which were evolved in the late 1800's by Mr John A. McDonald, an eminent engineer with the N.S.W. Department of Public Works. This form was introduced by that Department in 1886 for spans of 18·8, 22·9 and 27·4 metres (i.e., 65, 75 and 90 feet). It was a double principal truss (with double suspension bolts) consisting of timber top and bottom chords, timber diagonals and vertical steel tie rods

General Description of the New Bridge

The new bridge is located approximately 150 m downstream from the previous bridge. It is 190 m long and about 19 m above the river bed. The new bridge is on a sag vertical curve and is both longer and higher than the old structure. The greater height is required not only to provide a good vertical alignment for the road, but also to accommodate the backwaters from the proposed Welcome Reef Dam (to be built by the Metropolitan Water Sewerage and Drainage Board as part of their Shoalhaven Water Scheme), approximately 50 km downstream from the site.



CROSS SECTION

The new bridge has seven spans, the two end spans being 21·7 m long and the five intermediate spans being 29·2 m. The bridge has an overall width of 11·5 m and provides a two-lane carriageway 8·5 m wide, a footway of 1·5 m and a safety kerb of 0·6 m. Steel railings are provided along the outer edges of the bridge and a corrugated steel guardrail separates the footway and the carriageway.

The superstructure consists of continuous steel plate girders with a reinforced concrete deck. The piers and abutments are of reinforced concrete and are supported on spread footings founded either in decomposed granite (the abutments and Pier 1) or on granite bedrock (Piers 2 to 6).

The main factor determining the length of the bridge was the height of the abutments which were 8 m and 10 m. The height of the bridge favoured the use of light prefabricated steel girders in order to avoid both the high cost and high falsework for cast-in-place concrete construction. The cost of cranes for the erection of precast concrete girders was also avoided. The proposal to use steel girders was endorsed by the isolated nature of the site which is a considerable distance from the nearest major town where ready-mixed concrete is available.

Design of Superstructure

The steel plate web girders are 1·12 m high and are continuous for their full length. The 180 mm reinforced concrete deck slab is designed to act compositely with the girders by means of stud-welded shear connectors on the top flanges of the girders.

The girder webs are of 12 mm plate and do not require intermediate stiffeners. The flanges of the girders, 355 mm wide for the top and 280 mm for the bottom, are of constant width throughout and vary in thickness between 16 mm and 32 mm to suit the *bending moment* requirements.

Three different grades of steel with improved notch ductility (AS 1204 grades 250 LO, 300 LO and 350 LO) were specified in the design of the girder flanges. However, it was later found that the small quantity of grade 300 LO steel could not be rolled in Australia and grade 350 LO was substituted for this intermediate grade. The web plates and all other steelwork on the bridge are of grade 250 LO steel.

Detailed consideration was given during the early stages of the design to the possible methods of erecting the steel girders. The height of the bridge, and the uneven rock-strewn river bed, would have presented problems for conventional erection of falsework. It was decided that launching of the girders from the embankments at the abutments was the most likely method of erection and, consequently, the detailed drawings for the bridge were based on this method of construction.

Construction Techniques

Launching the girders involved constructing a length of the approaches at both abutments to approximately 1·5 m below the designed road level. Shop-fabricated lengths of girders, 12·2 m to 16·9 m in length, were then assembled to the correct longitudinal profile and spliced on the approach embankments. On completion of a sufficient length of girder, it was moved out over the abutment and across the piers. Further girder sections were spliced on at the abutment end and the girder was launched further—until the girders from both sides of the river met at the quarter point of Span 4.

To provide lateral stability during launching, the four girders were launched in pairs. The bracing between each pair of girders was provided at approximately 7·3 m spacing by universal beam cross girders which formed part of the final design. A launching nose was required at the leading end of the girders to raise the deflected leading end up onto each pier. The length of the launching nose was not critical, as it was not required to reduce bending stresses in the cantilevered position of the girder.

As most of the field splicing of the girder segments took place in convenient working conditions on the embankments, it was decided to use welded splices. This facilitated the movement of the bottom flange splices across the rollers used for the launching. The only bolted splices in the girders were in Span 4, where the leading ends of the girders launched from the two abutments met and were to be spliced in mid-air. In addition, all cross girder connections were bolted connections.

The design required that a number of restrictions be placed on the sequence of casting of the concrete deck, in order to control the stresses in the steel girders. The length of the deck was divided into 13 sections by mandatory construction joints 6·4 m either side of the piers. The sections over the piers could not be cast until both adjacent midspan sections had been cast and had cured for a minimum of six days.

Two views showing construction of the new bridge as at April, 1976.

The Abutments and Provision for Expansion

Both abutments are reinforced concrete and are of the spill-through open-buttress type. They are founded either 1 m into decomposed granite or 150 mm into hard granite.

The fully continuous superstructure is anchored to the lower abutment by fixed steel bearings. The higher abutment has therefore to accommodate the total temperature movement of the superstructure. Accordingly, sliding bearings were required at this point and neoprene pot/PTFE disc bearings of the "Pot-Glide" variety were specified. These bearings and the steel and neoprene finger-type deck expansion joint at the abutment have to accommodate an overall movement of $\pm$ 65 mm.

To minimise impact on the steel girders at the abutments, 3 m long concrete approach slabs have been provided in the design.

Details of Piers

The piers consist of single columns of constant 3·65 x 0·9 m rectangular cross-section, with cantilevered headstocks. All the piers are founded on spread footings on granite bedrock, with the exception of Pier 1 which is founded in decomposed granite. The overall heights of the piers vary from 12·5 m to 20·2 m above foundation level.

All the piers with the exception of Pier 1 are required to flex with temperature movements of the deck and are provided with fixed steel bearings. Pier 1, being the shortest and least flexible pier and having to accommodate the greatest deck movement, supports the superstructure through expansion bearings similar to those at the higher abutment.

Summing it up

Construction of the bridge was let by contract to Pearson Bridge Pty Ltd at a tender price of $838,667.

The contractor adopted the Department's suggested launching method for the erection of the steel girders and no difficulties were experienced with the site-welding of the girder splices (which were all accepted after ultra-sonic inspection with a minimum of subsequent repair). The girders were mounted on a series of simple rail trolleys on the bank and gently pushed out over the river by means of a bulldozer. Temporary steel rollers, fitted with vertical guide rollers, were used at the abutments and piers.

The approximate quantities of materials used in the new bridge were:

Steel girders	220 tonnes
Concrete	1 050 cubic metres
Reinforcing steel	194 tonnes

* * * * * *

The new Warri Bridge is located on a picturesque reach of the Shoalhaven River which has become a popular swimming and picnic spot for Canberra and Queanbeyan residents. Upstream from the bridge there is a considerable expanse of sand on a sweeping bend of the river, and downstream the bed and banks are formed by granite rock outcrops.

It's a pretty place, so next time you're in the area why not stop for a while and take a longer look at the bridge, from a different angle instead of merely a brief glance through your windscreen.

Briefly about . . . Braidwood

Braidwood is the centre of a pastoral and agricultural district but it is starting to attract attention as a fine example of an early Australian town. Many of its buildings are good examples of early Australian architecture largely Georgian and Victorian in style. In Wallace Street many buildings feature the old traditional over hanging footpath awnings with long, wide verandahs above.

The State Planning and Environment Commission is supporting a plan by Tallaganda Shire Council to preserve Braidwood as an historic town. The Council's plan is to preserve old buildings with statutory controls, but still provide for future growth.

Gold was discovered nearby in 1852 and the town expanded rapidly between 1860 and 1890. Over 100 years ago, in 1866, Bailliere's New South Wales Gazetteer described Braidwood as follows.

"*There is one steam flour mill in Braidwood, also 3 tanneries, all in work. The district is both agricultural and pastoral, goldmining, chiefly alluvial, being also carried on to a great extent in the neighbourhood. The nearest diggings are those at Jembaicumbene, 7 miles S.; Major's creek, 9 miles S.S.W.; Bell's creek, 10 miles S.; and Araluen, 18 miles S.S.W. There are also diggings at different points on the Shoalhaven river. The whole of the above-named places are mining townships or villages; there are, however, no means of communication with them except by travelling on horseback, the mails being carried in that manner. The township of Nelligen lies 35 miles E.S.E., to which place a coach runs twice a week, and Goulburn 60 miles N.N.W., to which coaches run every day except Sunday. With Sydney, 180 miles N.N.E., the communication is either to Nelligen by coach, and thence by steamer, or by coach, via Goulburn, to Picton, and thence by rail. Braidwood has a post and money order office, a telegraph office, and a court house and gaol. The quarter sessions, petty sessions, and small debts courts for the district, are held in Braidwood. There is a good hospital for the relief of the destitute sick in the district, a literary society, and a dramatic club; also a Bible society, a Masonic lodge . . . an Oddfellows' lodge . . . and two well conducted newspapers, the Braidwood Dispatch and the Braidwood News;*" (seven insurance company offices and nine hotels are then listed).

"*The surrounding country is undulating, and consists of a fine agricultural district, the soil being especially suited to the growth of wheat, although, for the last two years, the rust has committed fearful damage on that article of produce. Braidwood itself is a flourishing town, doing a good amount of business, it being the principal town in the southern gold field district, and supplying the whole of the surrounding country with stores . . . The population numbers about 1,000 persons.*"

Hopefully, Braidwood will once again become a flourishing town—displaying and preserving a valuable part of our heritage—while the roads and bridges nearby (as at Warri) will be much better than before●

NEW BRIDGE NEAR BRAIDWOOD

THESE VIEWS SHOW THE CONSTRUCTION OF A NEW BRIDGE — NOW COMPLETED — AT A VERY PICTURESQUE SPOT ON THE SHOALHAVEN RIVER AT WARRI

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MEN AND MACHINES

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New South Wales is a big State and it is a big task to provide roads throughout its length and breadth. But, as most travellers know, you can't go far in this State without coming across *men and machines* involved in road reconstruction, widening or bituminous surfacing. And, as well, there is a lot more going on out of view of passing motorists — where new deviations are being built on better alignments.

In case you haven't stopped lately to watch these *"magnificent men in their familiar machines"* (especially the D.M.R. Rosehill Red ones), here's a selection of photographs of some of them — from out west and southwest.

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—IN ACTION

1. Reconstruction and widening of the Sturt Highway, 17 to 29 km east of Balranald.
2. A 13 650-litre capacity water tanker working on the same section of the Sturt Highway.
3. A self-propelled scraper at work on the Barrier Highway, just east of Broken Hill.
4. Rollers used for compaction during reconstruction of the Cobb Highway just south of the Barrier Highway, near Wilcannia.
5. Spreading gravel onto hot bitumen during reconstruction of the Newell Highway, 7 km north of Finley.
6. Near Broken Hill, this mobile hammer mill — or "rockbuster" — is used to reduce large rocks to a usable size.

6

Towards Greater Safety and Smoother Traffic Flow

Pedestrian overbridge on Burns Bay Road at Linley Point.

"Give way" signs are a feature of the priority system for roads.

Traffic management responsibilities involve the Department in a wide variety of activities which are vital to the continued safety and convenience of road users.

These activities include

- the provision of pedestrian overbridges — see article commencing on page 37 — and
- a priority system for roads — see article commencing on the page opposite.

A Priority System for Roads

What, where, why, when, how?

For a long time, traffic authorities in New South Wales (and indeed, throughout Australia) relied solely on the *give-way-to-the-right* rule to regulate traffic at intersections. This applied on all types of roads, from multi-lane highways to quiet residential streets. But gradually the growth of our cities and increasing traffic brought about a need for change in the system.

Traffic congestion problems and accidents at individual locations have called for specific controls, such as "give way" signs and traffic signals. These factors also contributed to the change made in 1974 to the meaning of "stop" signs (whereby drivers facing a "stop" sign have now to give way to traffic on both their left and right before moving off—instead of only on their right as previously specified).

As traffic has increased, it has spread from the crowded Main Roads network and filtered through large areas of our minor street system, disrupting the *amenity* of otherwise quiet residential areas and generating a multitude of small, difficult and dangerous trouble spots. Local government and State traffic authorities alike have to face up to both sides of this problem—that is, to bring efficiency back to the Main Roads System and *amenity* back to our residential and recreational areas.

A major technique now employed to reduce traffic problems is the priority road system. Although used extensively in other countries, the priority road system is relatively new to New South Wales and to other States of Australia. As with most innovations, many of the objectives and principles involved have not been well understood. Unfortunately, misconceptions and an air of uncertainty are still common.

The priority road system was among the traffic management activities for which the Department of Main Roads took over complete responsibility on 1st July, 1976, when it had transferred to it the road activities of the Department of Motor Transport. This followed the setting up of the new Traffic Authority of New South Wales on 1st June, 1976 (under the Traffic Authority Act) and a number of associated changeovers in organisational arrangements (see article in September, 1976 issue of "Main Roads", Vol. 42, No. 1, pp. 8–10).

This article is based on a leaflet originally produced by the Department of Motor Transport and is intended to explain the rationale of the priority road system and to dispel some of the misapprehensions about them.

WHAT IS THE PRIORITY SYSTEM?

The priority system is one in which all intersections are controlled by either traffic signals or by "give way" or "stop" signs on all approaches except that on which the major flow occurs.

In this system traffic on the minor road has to give way to all traffic already on the major road, whether the major road traffic is on its right or on its left.

The only exception is at traffic lights, which are, of course, designed to share the "right-of-way" between the streams of traffic using both major and minor roads.

WHERE WILL THE SYSTEM EXTEND?

Eventually, the complete road network will be changed to the priority system. Initially, the arterial road system (including State Highways, Ordinary Main Roads and Secondary Roads as well as other arterial roads which carry significant traffic volumes) will be converted. Until suitable arrangements can be made, priority conditions will not be introduced, even on major roads, in areas where access from side streets would otherwise become impossible.

It is hoped that local residents, as well as other regular users of the affected side streets, will accept a small measure of inconvenience (perhaps involving some short detours) in order to enjoy the increased safety which the priority conditions can bring to both local and through traffic.

WHY DO WE NEED THE SYSTEM?

Smooth flow and the absence of *turbulence* are the essential ingredients of safe and efficient traffic movement. Motorists who demand their *right-of-way* when cutting into or across heavy traffic create danger, congestion and a not unreasonable reaction of frustration when they bring long lines of fast-flowing traffic to a sudden halt.

Far too many selfish motorists have in the past taken advantage of the *give-way-to-the-right* rule by choosing a route to bypass traffic signals or "give way" signs (which have been erected for their own and others' protection) and aiming to rejoin the major road on the right of the main traffic flow.

In so doing, they filter through back streets, carrying the traffic safety, noise and pollution problems away from the Main Roads (where they can best be controlled) and introducing them into quiet residential suburbs. This generally means also disturbing environmentally sensitive areas such as parks, playgrounds and schools.

To cater for the multitude of essential journeys made along our streets by day and night, we need an efficient road system which incorporates a hierarchy of roads, ranging from freeways to residential routes. (See article entitled "Traffic Flow—Fact and Fallacy" in the December, 1974 issue of "Main Roads", Vol. 40, No. 2, pp. 38–46). We must make the best use of the existing assets and this means extracting the maximum capacity from the whole Main Roads System, without destroying the quality of our living and recreation areas.

The objectives of the priority system are to keep major traffic flows moving along the major routes and to avoid the intrusion of through traffic into residential streets. The priority system supplements the proposed freeway network by increasing the capacity of existing Main Roads.

WHEN WILL THE SYSTEM BE INTRODUCED?

In 1972, an initial trial of the priority road system was introduced on Victoria Road (Main Road No. 165) which was designated a "priority road" by special signs. This trial proved a success in reducing accidents and increasing flow on this arterial route. However, it was found that the system of "give way" signs, "stop" signs and traffic signals, coupled with some closure of medians opposite side streets, achieved the result, with little or no contribution from the special designation of "priority road". In later signposting, the use of a sign (by name or symbol) to indicate the major route has been discontinued.

As a consequence, conversion of arterial roads to the priority system proceeded and many of our major urban routes (e.g., Victoria Road, Parramatta Road and Canterbury Road) have been operating successfully under priority conditions for some years. Shorter sections of many other roads, ranging from State Highways to unclassified (but nevertheless important) traffic routes, are similarly returning benefits in smoother and safer travelling conditions. By the end of 1976 the Sydney arterial road network had been substantially converted to priority road conditions.

Although much work has already been undertaken, the amount and cost of the planning, signposting and signalling work involved makes it impossible to implement the whole priority system overnight. The areas where both the need and the benefit are greatest will be tackled first. In general, urban Main Roads (such as State Highways, Ordinary Main Roads and Secondary Roads) in Sydney, Newcastle and Wollongong will be given the highest priority for conversion and then the rural Main Roads network. The conversion of unclassified roads will follow.

HOW IS THE PRIORITY SYSTEM PLANNED AND INTRODUCED?

The concept of a priority system is international and other States in Australia have introduced or are introducing similar systems. The application of this concept to New South Wales and the guiding principles behind this have been developed in the past by the Traffic Advisory Committee (which comprised representatives of the Police Department, Department of Motor Transport, Department of Main Roads, Planning and Environment Commission and Public Transport Commission). Such policy-making is now the responsibility of the new Traffic Authority of New South Wales.

The detailed planning and implementation of priority conditions in specific areas is now planned and scheduled by the appropriate Departmental Divisional Office, in consultation with the local shire or municipal councils. Councils are formally advised of the programmes prepared by the Department and, wherever major objections are made to details of this programme, consultations are arranged prior to proceeding to implementation.

The fundamental strategy employed in this planning is that safe and reasonable access must be available to the arterial system at all times. Where it is necessary to guarantee this, traffic signals are planned for introduction at appropriate locations.

However, signals cannot be provided everywhere and, as previously indicated, a measure of delay and inconvenience in joining the major traffic stream may occur in some cases. Old travel habits will sometimes need to be changed. Balanced against the increased safety and improvement in traffic conditions in residential and recreational areas, this seems a reasonable price to pay.

SOME OTHER QUESTIONS . . . AND ANSWERS

☆ How will we recognize a road on which priority conditions apply?

The presence of "give way" signs on side streets is underlined by broken white lines painted across the entrances of those streets at their junction with the major road. The line is unbroken adjacent to a "stop" sign. This is the system that has worked well in the United Kingdom for many years.

☆ Don't priority road conditions lead to excessive speeds on major routes?

Surveys have shown conclusively that time savings achieved on major roads where priority conditions apply come from reduced delays at minor intersections, not from excessive speeds.

☆ What about pedestrians?

Pedestrians are most at risk in unstable and *turbulent* traffic streams. Priority road conditions help to smooth these streams. Nevertheless, particular attention is paid to pedestrian problems when planning the necessary control measures. Furthermore, facilities to help pedestrians to cross Main Roads are automatically included where traffic signals are installed.

☆ Don't the extra traffic lights needed cause more delays anyway?

Modern traffic signals are very sensitive to fluctuations in traffic flow and are much more effective in reducing delays than before. Additionally, where necessary, groups of signals are being co-ordinated to provide less interruptions to the movement of peak traffic.

☆ What is the proof that the priority road system works?

Accidents on Victoria Road fell by 10 per cent in the year after priority road conditions were introduced in 1972. Priority road conditions and co-ordinated traffic lights on Parramatta Road have reduced 1975 levels of congestion and delay to below those occurring in 1971, notwithstanding greatly increased volumes of traffic! Similar results are being achieved throughout the road network where priority conditions have been introduced. To such benefits can be added the bonus advantage of encouraging through traffic to remain on the Main Roads network and stay out of residential streets●

SYDNEY HARBOUR BRIDGE TRAFFIC

1 000 MILLIONTH VEHICLE!

In June, 1976 the 1 000 millionth vehicle crossed the Sydney Harbour Bridge. The first 500 million crossings took over 33 years while the second 500 million took less than 11 years.

These "*mind-boggling*" numbers of vehicles introduce some interesting traffic facts about the Sydney Harbour Bridge, particularly when we compare some statistics from 1932 (the year it was opened) and from 1975.

☆ In 1932 the annual average daily traffic volume (in both directions) was of the order of 10 900. In 1943 with a wartime shortage of vehicles and petrol rationing, there was a drop in traffic to about 8 600 vehicles a day.

In 1975 the annual average daily traffic volume (in both directions) was of the order of 145 350 vehicles.

☆ If all the vehicles crossing the Sydney Harbour Bridge on an average weekday were parked end to end along the Hume Highway they would reach from Sydney to Melbourne.

☆ In 1932 there were 211 896 motor vehicles registered in New South Wales. In 1976 there were 2 623 887 motor vehicles registered in New South Wales.

☆ The growth in motor vehicle population between 1932 and 1976 is about 12·4 times.

The growth in the annual average daily traffic on the Sydney Harbour Bridge over the same period is about 13·3 times.

☆ In 1975 the average *peak-hour* traffic volume (in both directions) was 13 470—that is, almost four vehicles each second—and far more than the average *daily* volume in 1932.

☆ The highest number of vehicles crossing the Sydney Harbour Bridge in 1975 was 177 680 on Friday, 5th December, 1975.

☆ In 1932–33 a total number of 3 980 000 motor vehicles crossed the Sydney Harbour Bridge (in the first full year of its operation).

Vehicular crossings during 1975 totalled 52 906 000—of which 27 224 000 were northbound and 25 682 000 southbound.

☆ On average one vehicle crossed the Sydney Harbour Bridge every 6/10ths of a second throughout 1975●

THE ROADMAKERS

—A Valuable Historical Document

Earlier this year, the Department's long-awaited book "The Roadmakers—A History of Main Roads in New South Wales" was published. Judging from the sales response and from letters of appreciation, the problems encountered in researching and compiling the detailed information included in the book—and seeing it through its design and production—was well worth while.

Six thousand copies of the book were printed and copies are still available at $15 each (plus postage*). But, if you want one, don't hesitate—as only about 250 are left.

The book begins back in 1788 and traces development from the twisting tracks of the early settlers to the wider, straighter, stronger, smoother highways and freeways, which form such an essential part of our mobile society's transport needs.

It describes the first rough attempts at road and bridge building, the frequent setbacks caused by flooding rains, the gradual growth in the major lines of communication, the outstanding guidance of Governor Lachlan Macquarie, the contribution of Surveyor General Sir Thomas Mitchell, and the worthwhile work of less familiar roadmakers such as the illiterate William Roberts.

Changes in the control of road and bridge works are traced through to the Department of Public Works and the changeover to local government responsibility in 1906. The movements leading up to the establishment in 1925 of the Main Roads Board as the new central road authority are recorded.

The major part of "The Roadmakers" is focused on the forty year period (from the early 1930's to the early 1970's) during which the Department of Main Roads has been responsible for rapid and widespread improvements to the network of Main Roads throughout the State.

With over 400 black and white illustrations (including over 20 maps) and over 30 colour illustrations, this book presents a remarkable pictorial panorama and brings together, for the first time in one volume, an excellent visual record of almost 200 years of vital, but often unrecognised, public service. It contains 352 pages and includes extensive appendices, references and notes, a bibliography and a useful index●

* *Postage rates for the book, with a protective cardboard box, are 98 cents within the Sydney Metropolitan Area and $1.40 elsewhere within New South Wales.*

* *Alternatively, copies of the book may be obtained by calling at the Public Relations Section, Third Floor, Head Office, between 8.30 a.m. and 4.30 p.m.*

STATEMENT OF RECEIPTS AND PAYMENTS

RECEIPTS

Motor vehicle taxation
Charges on commercial vehicles under the Road Maintenance (Contribution) Act, 1958
Levy upon Councils in accordance with Section 11 of the Main Roads Act, 1924
State Government Loans—Repayable
Loan Borrowings under Section 42A of the Main Roads Act, 1924
State Treasury Advance—Repayable
Contributions by Councils towards maintenance and construction of Main and Secondary Roads
Contributions by other departments and bodies towards maintenance and construction of Main and Secondary Roads
Commonwealth/State Government Grant for Relief of Unemployment
Commonwealth/State Government Grant for restoration of flood damage
Sydney Harbour Bridge Account for freeway approaches
Transport (Planning and Research) Act, 1974
National Roads Act, 1974
Roads Grants Act, 1974
Commonwealth Government Grants
Other

Total Receipts

PAYMENTS

Construction and reconstruction of roads and bridges
Construction and maintenance of local roads
Land acquisition
Maintenance and minor improvements of roads and bridges
Restoration of flood damage (Proclaimed National Disasters)
Purchase of land and buildings for works operations
Administrative expenses
Purchase of land and buildings for administration
Planning and research
State Treasury Loans—
    Sinking fund payments
    Interest, exchange, management and flotation expenses
Loan Borrowings under Section 42A of the Main Roads Act, 1924—
    Repayment of principal
    Interest
Other

Transfers to reserve for loan repayments
Net transactions of operating and suspense accounts

Total Payments

* Includes Unclassified Roads in the unincorporated area of the Western Division, Developmental Roads and Councils Local Roads taken over from the Public Works Department on 1st February, 1975.

for the Year ended 30th June, 1976

County of Cumberland Fund	County Fund	Commonwealth Fund	Total 1975–76	Total 1974–75
$	$	$	$	$
24,830,204	61,124,099		85,954,303	83,506,708
4,053,555	16,214,221		20,267,776	20,769,493
104,468			104,468	135,903
	7,250,000		7,250,000	2,000,000
5,000,000	3,000,000		8,000,000	8,000,000
	6,000,000		6,000,000	
674,269	456,707		1,130,976	435,735
132,543	986,709		1,119,252	624,959
146,270	202,409		348,679	511,566
	13,223,400		13,223,400	8,267,000
6,711			6,711	3,039
		1,597,079	1,597,079	1,240,843
		49,200,000	49,200,000	35,200,000
		83,605,370	83,605,370	72,354,998
				42,000
1,449,671	452,972		1,902,643	1,861,786
36,397,691	108,910,517	134,402,449	279,710,657	234,974,030
13,940,757	43,742,077	84,988,602	142,671,436	116,955,082
		21,332,098	21,332,098	9,915,798*
4,359,405	2,034,533	11,385,838	17,779,776	21,586,234
13,899,619	39,397,011	7,026,856	60,323,486	50,463,485
	13,181,743		13,181,743	7,094,557
481,541	451,010	160,813	1,093,364	798,715
3,412,915	6,087,460	4,269,746	13,770,121	12,804,004
277,688	853,576		1,131,264	552,563
229,718	357,718	1,639,295	2,226,731	1,975,547
21,120	215,263		236,383	220,914
239,590	1,305,457		1,545,047	1,191,276
208,308	307,050		515,358	410,511
1,009,322	1,311,638		2,320,960	1,883,528
221,915	754,852		976,767	1,078,365
38,301,898	109,999,388	130,803,248	279,104,534	226,930,579
206,287	175,538		381,825	24,375
1,193,206	403,487 *Cr.*		789,719	4,409,948
39,701,391	109,771,439	130,803,248	280,276,078	231,364,902

HUME HIGHWAY CORRIDOR STUDY

A RETROSPECTIVE SUMMARY

On 8th November, 1824 Captain William Hovell, R.N. recorded in his journal:

"*As we found it impossible to proceed any further in that direction, without endangering the lives of both man and beast, and perhaps to no purpose, I proposed that we should return to the 5¼ mile to attempt a passage over the range west from us, and to endeavour to get 50 to 60 miles in a westerly direction and when circumstances would admit to make southwardly. . . . I should have observed that all the mountains that I have seen or gone over are mere hillocks, when compared with those we have seen today.*"

That day the Hume and Hovell party was in the Tumut–Batlow area. Hovell's proposal led them westerly (to where the route of the Hume Highway is now located) and then in a southerly direction to the Murray River. Their route subsequently developed as the main southern road through New South Wales to the settlement at Port Phillip (see historical article in June, 1948 issue of "Main Roads", Vol. 13, No. 4, pp. 122–6—available in reprint form). During the next one hundred and fifty years it was never seriously proposed that the main route between Sydney and Melbourne should pass further east, through the mountainous terrain near Tumut and Batlow. There had been suggestions from time to time that it should be relocated further west.

In July, 1974, the Department was asked by the Transport Planning Division of the Commonwealth Bureau of Roads if it would co-operate in undertaking a "Hume Highway Corridor Study". The Bureau recommended that the route of the National Highway between Goulburn and Albury–Wodonga should not be designated until the possibility of an alternative route in a corridor passing closer to Canberra was examined (see reference to National Highways in March, 1975 issue of "Main Roads", Vol. 30, No. 3, pp. 66–7). The Department's task was to investigate a "straight line" route passing through Collector, Murrumbateman, Tumut and Batlow to Holbrook.

The Bureau's specification for the study divided the work into seven "jobs" as follows.

1—Data Collection
2—Population and Land Use Forecasts
3—Travel Forecasting
4—Sociological Investigations
5—Bio-Physical Investigations
6—Economic Investigations
7—Highway Location and Design

The Department immediately informed the Bureau that the draft specification was "*based on the assumption that a suitable location, east of the Hume Highway, exists for a high standard road*". The Department's view was that "*first priority should be given to the study of the general engineering feasibility of a possible route*".

This proposal was not accepted on the grounds that, in the limited time available, the Bureau considered that the studies outlined in the specification must proceed simultaneously. The Department's contribution was therefore to "*undertake any necessary field surveys, preliminary design and cost estimation aspects of each route alternative considered, together with any roadside interview studies in the field*" as well as "*to obtain other necessary information which is available from other State Departments, such as air photographs, maps, etc*". The Department's work was then to locate the cheapest route, of acceptable standard, through the mountains.

The obvious programme was to:

☆ define the road standard to be attained;
☆ define the area within which the road must lie;
☆ map and study this area; and
☆ apply the standards to the terrain to locate and grade the most economical alignment through the area.

Road Standard

As the Commonwealth Government appeared to be seeking a route to supersede the Hume Highway, it was desirable that the road standard for the "straight line" highway, in curvature and grading, should be comparable with the standard adopted in construction work on the Hume Highway over the past ten years. At the outset, it was obvious that this would mean long lengths of tunnels, viaducts and extremely high costs.

Though termed a "straight line" highway, it seemed that the road envisaged by the Government would be comparable to European highways, such as the Italian autostradas. Such highways traverse mountainous terrain and are quite steep and curved compared with Australian and American freeways. The design standards for the highway (now laid down as the National Highway Standards) specified maximum grades of 5% and 7%, with maximum lengths of such grades of 1 000 metres and 700 metres. It was apparent that, even with the adoption of these maximum lengths of grades, it would still be impossible to get out of some of the valleys without very long lengths of tunnelling. The horizontal alignment was to be limited to curves with a radius of 1 000 metres.

It therefore appeared that horizontal alignment for the "straight line" highway would be comparable with the existing Hume Highway and its proposed deviations, while vertical alignment would be decidedly inferior, and probably not up to National Highway Standards.

Mapping Problems

When identifying the general boundaries of the area under study, the Bureau provided a map indicating a corridor which diverged at Tumut, with one route going via Batlow and Rosewood to Holbrook, and the other going via Adelong and Yaven Creek to Little Billabong (see map on page 59).

The terrain of this study area was not covered by mapping at a suitable scale to properly assist in road location. The Commonwealth Bureau of Roads (through the Division of National Mapping) arranged for the Central Mapping Authority of New South Wales to carry out mapping of standard 1:25 000 ten metre contour sheets. Time did not permit such mapping to be precision drawn, and it was used as pencil roughs.

The Department normally uses two metre contours at a scale of 1:2 000 for road location purposes. The ten metre contours at a scale of 1:25 000 are not as useful for this purpose, but being the only alternative, they had to be used. As is well known, the use of too large a contour interval often causes earthworks to be seriously under-estimated in quantity.

Procedures

While much had been made of environmental factors (in the fields of sociology, zoology and botany) as controlling influences in the selection of the "straight line" route, it was apparent that these factors could best receive consideration after (and if) the engineering and economic feasibility of the route had been proven. However, it was necessary to assess the geological environment of the general area as a control on route location. This involved knowing what materials would be encountered in cuts and fills and how they would behave. It also meant knowing what road building materials might be found within a reasonable distance of the route. For these reasons a geological assessment was made after a land and air reconnaissance survey was carried out.

In order to supplement the 1:25 000 pencil line mapping, and thereby facilitate location, barometric control levels (indicating altitude) were taken both on the ground and from the Department's helicopter.

By using the helicopter's altitude as a fixed height or base line, a radar distance meter was used to supplement the navigational instruments in the aircraft and to measure the distance from the base line to the land surface. This operated as a check on the ground barometric readings.

Pairs of aerial photographs were obtained and viewed stereometrically to give a three dimensional effect in order to allow examination of the shape of the terrain.

Using all these sources of information, a number of control points for location were identified. These control points included major bridge sites (for crossings of the Goodradigbee, Murrumbidgee and Tumut Rivers), tunnel locations and ridge crossing points. Within the horizontal alignment constraints of the National Highway Standards, and limiting the maximum grading to 7 per cent but without limiting the lengths of grades, the apparent most economical horizontal lines and gradings were identified and plotted. Two lines and gradings via Batlow and via Adelong were identified.

Cost of Improving the Hume Highway

As the proposed "straight line" or "mountain" route was claimed by its advocates not only to be shorter than the Hume Highway between Sydney and Melbourne (specifically between Goulburn and Holbrook) but also to be comparable economically with improvements to the existing Highway, it was necessary to extract for comparison the details of costs for equivalent improvements on the relevant lengths of the Highway. The Department had never intended to make a full access-controlled freeway of the whole of the Hume Highway, as the extra cost would unduly draw money away from other more needed works. However, it does intend to provide such a facility as far south as Mittagong (see articles on the South Western Freeway in the September, 1976 issue of "Main Roads", Vol. 42, No. 1, pp. 2–4). From there to Albury a high standard dual carriageway highway, with some access control, would be provided.

In order to make a comparison with the "straight line" route (which was apparently intended to be of freeway standard all the way) it was necessary to add on to the estimated costs for planned improvements to the Hume Highway approximate amounts to represent both the interchanges (which would be needed at about 16 km intervals) and the service roads (which would permit the closing of access directly onto the highway pavement). Figures of up to $350,000 per interchange and up to $25,000 per kilometre were used for this purpose.

The shortest length of the Hume Highway which could be used for comparison with both variations of the "straight line" route was between the existing grade-separated interchange with the Federal Highway at Yarra (just south of Goulburn) and the southern end of a proposed Holbrook bypass. This represented a length of approximately 283 kilometres along the existing Highway and the proposed deviations which were then either currently under construction or not yet commenced. The existing comparable length of the Hume Highway was 295 kilometres. The estimated cost to bring this length of Highway to freeway standard was $140,810,000, or an average cost of $498,000 per kilometre. This included the cost of such current works as the new Gundagai Bridge and the dual carriageway work between Yass and Bowning.

An important factor in considering the economic feasibility of the "straight line" highway was that whether or not it was constructed, much of the estimated $140,810,000 would still need to be spent on the existing Hume Highway. This would be in order to provide a suitable standard of road for the traffic which now uses it and would continue to use it.

Cost of the "Straight Line" Highway

The length of the proposed Batlow route was 269·7 km. Along this route tunnels totalling 2 500 metres in length (at an estimated cost of $62,500,000) and major high bridges totalling 3 170 metres in length (at an estimated cost of $63,400,000) would be required. Cuttings would be up to 80 metres deep and 1 300 metres long, while fills would be up to 50 metres high and 1 000 metres long. The total estimated construction cost (including tunnels and bridges) was calculated to be $507,555,000.

On the Adelong (Yaven Creek) route, which would join the Hume Highway south of Little Billabong, the comparable length was 263·6 km. Tunnelling on this route would be 5 400 metres long over four lengths, and the total estimated cost was $672,175,000.

In general terms, the lengths and costs compared as follows.

Road	*Length*	*Estimated cost*	*Estimated cost per km*
	km	$	$
Hume Highway	283	140,810,000	498,000
"Straight Line" via Batlow	269·7	507,555,000	1,882,000
"Straight Line" via Adelong (Yaven Creek)	263·6	672,175,000	2,550,000

For paving the "straight line" highway, it was assumed that the same type of pavement would be adopted as is proposed for deviations on the Hume Highway. This consists of a selected sub-base, 30 cm thick, lime stabilised, topped by 15 cm of fine crushed rock, also stabilised. The top surface consists of 5 cm of asphaltic concrete with a light flush seal. For the Hume Highway this was then estimated to cost $176,000 per kilometre.

While this same unit cost might be assumed for the lengths from Collector to Wee Jasper Creek and from Rosewood to Holbrook, higher prices needed to be allowed over the lengths from Wee Jasper Creek to Rosewood and from Adelong to Little Billabong. Over these latter lengths, there is a scarcity of rock suitable for crushing for road pavement materials. A unit cost of $208,000 per kilometre was therefore accepted.

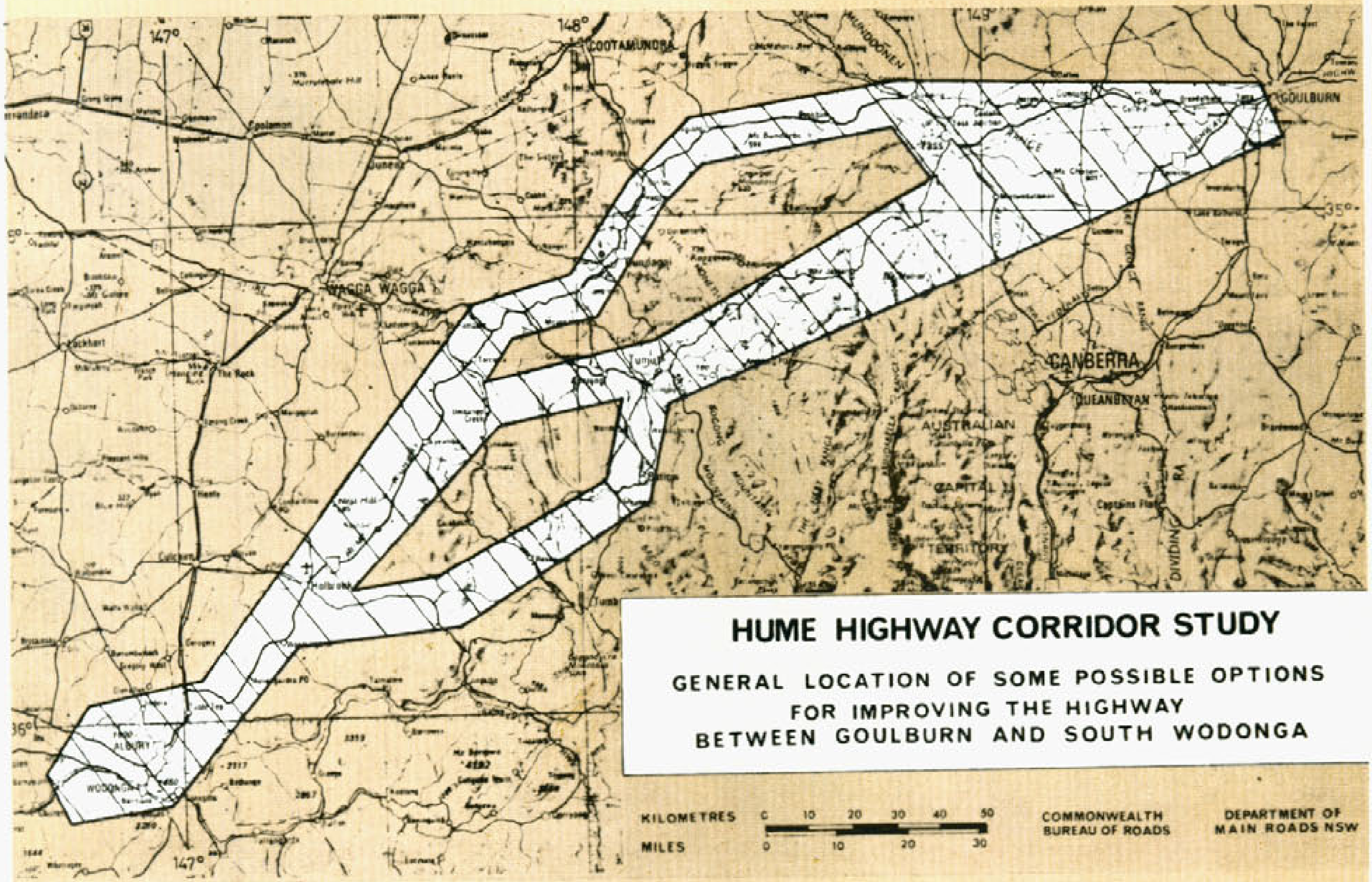
The material encountered in the cuttings in many instances would require special batter treatment, and this was allowed for in the estimate.

Unit costs for excavation purposes varied over different sections and the unit costs of large structures were calculated on the costs of similar structures built by the Department. The unit costs of tunnels were based on advice from the Commonwealth Bureau of Roads and recorded United States experience.

Influence of High Costs

It became necessary occasionally for departures to be made from National Highway grading and curvature standards in order to prevent the production of an alignment which would be impossible to finance. The following examples illustrate such alignment and grading controls.

- ☆ West of Murrumbateman, the line had to deviate north to avoid tunnelling through the Mt Boambolo range of hills.
- ☆ The crossing of the Murrumbidgee River, about 5 km above Taemas, had the problem of being at a geological fault line, but any significant move away would have resulted in major rock excavation.
- ☆ The only feasible route to climb out of the Goodradigbee Valley towards Tumut was up Wee Jasper Creek. Despite long lengths of tunnelling and high bridging, this could neither be provided straight nor at a National Highway Standard grading.
- ☆ A *saddle* had to be selected to cross Honeysuckle Range without obviously excessive rise and fall. Between Yaven Creek and Oberne Creek there is a range rising more than 300 metres above the creek beds, which are only about 10 km apart. For reasons of economy, this range would have had to be tunnelled at its narrowest width.


HUME HIGHWAY CORRIDOR STUDY
GENERAL LOCATION OF SOME POSSIBLE OPTIONS
FOR IMPROVING THE HIGHWAY
BETWEEN GOULBURN AND SOUTH WODONGA
KILOMETRES 0 10 20 30 40 50
MILES 0 10 20 30
COMMONWEALTH BUREAU OF ROADS
DEPARTMENT OF MAIN ROADS NSW
COOTAMUNDRA
GOULBURN
WAGGA WAGGA
CANBERRA
QUEANBEYAN
AUSTRALIAN
CAPITAL
TERRITORY
DIVIDING RA
ALBURY
WODONGA
The Rock
147°
148°
149°
35°
36°

HUME HIGHWAY CORRIDOR STUDY continued

One possibility which would have created a unique problem was that, in tunnelling through some limestone areas, caves might have been encountered, which would have necessitated underground bridging. If undertaken, this would be the first time anywhere in the world that such a feat had been achieved.

MORE COSTS AND TIMING

The allocation for construction for all National Highways in New South Wales for the three years from 1974 was \$112,900,000. This amount was calculated to be barely sufficient to complete construction of the South Western Freeway between Cross Roads (near Liverpool) and Mittagong. Completion of Hume Highway dual carriageway work then in hand between Mittagong and the Federal Highway junction at Yarra (just south of Goulburn) was estimated to cost another \$50,000,000.

It was estimated that if all the National Highways money allocated to New South Wales for the five years from 1974 to 1978 were spent on the Hume Highway south of Liverpool, there would still be insufficient funds to finance the work from there to the Federal Highway junction. Continuation of dual carriageway conditions south to Albury, generally along the existing route of the Hume Highway, would cost an additional \$165,000,000. Without information on the future funding of National Highways, it appeared likely that it would take at least ten years' funds to provide a dual carriageway road from Sydney to Albury—generally along the existing route of the Hume Highway.

If the "straight line" highway were to be built between Goulburn and Holbrook, there would be little opportunity for "staging" (i.e., construction in convenient length sections). Virtually the whole length, whether via Batlow or via Adelong, would need to be constructed in one stage before traffic could be allowed to use it. As outlined above, some \$507 million or \$672 million respectively would need to be spent to complete these routes. Even if the State's *entire* allocation of funds were spent on the "straight line" route (at the rate of \$112,900,000 for three years), it would take 14 or 18 years, respectively, to finish.

The greatest need for improvement of the Hume Highway is where traffic volumes are largest, where there is only one carriageway at present, and where the alignment and grading are inferior. These three factors are primarily found over the length between Sydney and Goulburn, and not the length between Goulburn and Albury. It is therefore logical that the Department should complete its current work, extending southwards from the Sydney end, before any mammoth tasks south of Goulburn are commenced.

TIME AND DISTANCE

The proposed "straight line" route descended into and rose out of the Murrumbidgee River Valley, the Goodradigbee River Valley and the Tumut River Valley, and reached an altitude of about 1 000 metres in the vicinity of Batlow. This indicated that heavy commercial vehicles would most likely prefer to use the existing Hume Highway because it is flatter. In contrast, many tourists would presumably prefer the more mountainous route because of its scenic interest.

Light vehicles travelling between Canberra and Melbourne could save distance by joining the "straight line" route near Murrumbateman, and travelling on it to its junction with the Hume Highway at Little Billabong or Holbrook. This could save up to 45 kilometres in distance, at the expense of increased rise and fall.

Traffic between Canberra and Tumut would obviously use the "straight line" route. If this traffic is primarily that to be served in this area, it could be that the Hume Highway should be developed generally along its existing route, while an improved road (not a freeway) is developed between Canberra and Tumut.

CONCLUSION

The obvious general conclusion of the Department's part of the "Hume Highway Corridor Study" was that the Hume Highway should be reconstructed along or in the vicinity of its present route and any alternative route to the east should not be built.

At some time in the future there will be a need for a better direct connection between Canberra and Tumut. This could be achieved by the construction of a road from the A.C.T. boundary near Belconnen via Wee Jasper to Tumut, generally along the route recommended in a joint study (undertaken in the 1960's) by the National Capital Development Commission and the Department●

The Department's "Hume Highway Corridor Study" is sub-titled—"a brief report on a preliminary investigation for the location of a high standard road in difficult country—December, 1974". It contains more information than is included in this article—such as geological and topographical conditions, maps and appendices. A copy of the Study is available for perusal in the Department's Library, 5th Floor, Head Office.

Also available for perusal is "A Technical Evaluation of the Comparative Benefits of the Alternative Routes via Brindabella and via Wee Jasper" published in 1968 following the joint NCDC–DMR project on "A Road Connecting Canberra and Tumut".

AUSTRALIAN ROAD RESEARCH BOARD

ARRB

The Australian Road Research Board (ARRB) is the focal point of road research in Australia. Regularly it undertakes, arranges and prescribes road and road transport research over a comprehensive range of subjects. With equal vitality the Board disseminates the results of that research to appropriate organisations and to the scientists, engineers and associated specialists involved with the design, location, construction, upkeep and use of roads.

The need for a national research centre was realised by NAASRA (the National Association of Australian State Road Authorities) who founded the Board in 1960. In 1965 ARRB's future was firmly endorsed when it was registered as a non-profit making company to be developed independently and financed continually by Australia's Federal and State Government Road Authorities.

From a modest research programme of specially selected subjects costing less than $200,000, the ARRB budget has grown to more than $2·5 million in 1976–77 for the undertaking of road and road transport research, and dissemination of information from this research.

Regularly guiding and reviewing ARRB policy is a Board of Directors comprised of the executive heads of the sponsoring road authorities (see list below). In support are various advisory groups and specialist committees representative of the current professional, commercial and educational thought within the community. A number of technical committees have been formed, experienced in Bituminous Surfacings, Road Pavements, Human Factors, Local Government Engineering, Traffic Engineering, and Transport Planning.

All research is controlled and most of it is conducted at the Australian Road Research Centre at Vermont in Victoria. But since its inception the Board has sponsored and continues to support research conducted at universities and other centres.

Complementing a research programme that currently covers some 50 aspects of road development, upkeep and use, are the information services of ARRB. Broadly defined, these serve to advance road engineering science by publishing and distributing reports, papers and articles of road research and practice, and through regional symposia and national conferences encourage the valuable exchange of information between road research scientists, practising engineers and managers, and associated specialists.

Of all conferences conducted by the Board, the ARRB Conference is regarded as the most important, creating as it does an invaluable source of Australian and overseas roading information and literary reference in the published Proceedings. For example, the Seventh ARRB Conference in Adelaide in 1974 involved over 1 000 delegates in discussions of 126 papers.

ARRB contributes and receives road and road transport research information at an international level by sending its senior scientists overseas to attend major conferences, and regularly exchanges information with principal road research organizations throughout the world. Equally, overseas experts are attracted to Australia by the Board's conference. Twenty-six countries were represented in 1974.

As well as maintaining a unique library of road information the Board has developed a computer-based index to Australian road and road transport literature. Updated quarterly and cumulated annually, this Australian Road Index offers instant bibliographic reference to provide librarians and researchers (in Federal, State, Local Government and private spheres) with a current-awareness aid genuinely Australian in content.

ARRB also has a very active technical services group who serve as consultants and developers of mechanical and electronic aids to modernise road engineering techniques and processes.

Under its charter, ARRB is able to expand and serve flexibly the material and conceptual needs of the Australian road industry, and is an essential organisation in a developing continent with unique climatic, topographic and demographic features.

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Administration

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EIGHTH ARRB Conference

The Eighth ARRB Conference was held at the University of Western Australia, Perth, from 23rd to 27th August, 1976.

The Conference featured over 130 papers (eight by Departmental authors) at 33 sessions. As usual, Local Government played a significant part and one session was devoted to this aspect of road research. As all papers had been circulated in preprinted form they were taken as read. Hence, the chief objective of the Conference was to allow concise and effective contributions on important features of the papers. The general principles for discussion were . . .

☆ to allow as many contributions as possible,

☆ to adequately cover the papers in the session,

☆ to present as many points of view as possible without useless controversy or waste of time,

☆ to introduce new ideas and show practical implications,

☆ to test the accuracy and importance of the views expressed by authors, and

☆ to finish with concise written contributions for publication.

The following list of the session subjects and the papers is given in full in order to highlight the wide-ranging variety of interesting proposals and experiences which were discussed at the Conference.*

STREETS NOT ROADS

— Towards Better Residential Streets
— Residential Streets from the Point of View of the Householder
— Road Safety Guidelines for Town Planning
— Residential Streets: Alternatives to the Conventional
— Traffic Management Schemes For Existing Residential Street Layouts on the Grid System
— Planning for the Street and Road Systems in the City of Berwick
— "Slow Ways" for Transport

MATERIALS

— Stress History Effects in Base Course Materials
— Bitumen Stabilisation of a Calcareous Aeolinite
— Soil Characterisation using a Repeated Loading Cubical Triaxial Apparatus
— Bituminous Materials for Maintenance Patching
— A Development in Road Marketing Materials—Formed In Situ Plastic Raised Pavement Markers*

QUALITY CONTROL

— An Impact Testing Device for In Situ Base Course Evaluation
— The Allocation of Quality Control Resources in the Supervision of Road Works
— Pavement Construction Standards and Tolerances
— The Use of Quick and Non-Destructive Measurement Methods in the Quality Control of Roads
— Factors to be considered in the Drafting of Compaction Specifications for Soils.

AGGREGATES

— The Resilient Behaviour of a Granular Material under Repeated Loading
— Evaluation of Basalt from Deer Park, Victoria, as an Aggregate for Concrete: A Progress Report
— Synthetic Aggregates for Road Surfacings
— Analysis of a Questionnaire on the Service Performance of Crushed Rock and Aggregate

NAASRA MAINTENANCE

— The NAASRA Study of Road Maintenance Standards, Costing and Management

MAINTENANCE AND PLANT MANAGEMENT

— An Economic Analysis of Factors Influencing Road Maintenance Costs
— An Information System for Plant Management
— The Development of Road Maintenance Management in Tasmania
— Road Maintenance Logistics—A Theoretical Approach
— The Operator—The Unknown Factor in Considering Plant Operating Costs

MOISTURE MOVEMENT AND CONTROL

— Toward Economic Small Catchment Drainage Design
— Plastic Pipe for Subsoil Drainage*
— The Influence of Soil Properties on the Wetting-up of Earth Structures
— Factors Influencing Moisture Changes in Pavements Constructed on Expansive Clay Subgrades
— Soil Moisture Content as Related to Atterberg Limits and Relative Humidity*

COMPACTION AND EARTH STRUCTURES

— Impact Rolling—A New Compaction Technique
— Stabilisation of Rock Batters Using Dowels
— Strength of Reinforced Soil
— Compaction of Sand in Thick Lifts

STRUCTURES

— Design of the Bridge over the Murrumbidgee River at Gundagai*
— Analysis of Multi-Cell Box-Girder Bridges Using Fully Compatible Finite Elements
— Bridge Live Loads for Limit State Design
— A Simple Algorithm for Computing Load Distribution in Multi-Beam Bridge Decks
— Analysis of Continuous Highway Box Bridges with Intermediate Stiffening
— A Folded Plate Approach to the Analysis of Box-Girder Bridges

FOUNDATIONS

— A Vibrating Wire Borehole Inclinometer*
— The Prediction of Settlement of Spread Footings on Partially Cemented Sands
— Lateral Earth Pressures Exerted by Compacted Granular Materials
— Field Evaluation of Pile Settlement Interaction and the Elastic Method

SURFACING AND SKIDDING

— Developments in the Design of Bituminous Plant Mixes
— The Effect of the Combined Aggregate Grading on the Voids Properties and Laboratory Stability of Bituminous Concrete*
— The Skid Resistance of Steelworks Slags as Road Surfacing Stone
— Design and Use of Asphalt Mixes
— The Design of Sprayed Single Seals

— Design and Use of Open-Graded Friction Course Asphalt for Road Surfacing
— A Comparison between Conventional Methods of Skid Resistance Evaluation and a Photogrammetric Method
— The Development and Evaluation of a fine Grained Bituminous Mix to Maintain High Frictional Resistance Under Adverse Conditions*
— Surfacing Treatments for Bituminous Concrete for High Speed Traffic
— Techniques for Achieving Non-Skid Pavement Surfaces
— The Relation Between Road Surface Texture, Friction and Abrasion of Tyre-Tread Rubber

PAVEMENT DESIGN
— Some Aspects of Upside-Down Pavement Design
— Functional Pavement Design for Container Terminals
— The Potential Use of Expansive Cement-Concrete in Highway Engineering*
— Theoretical Analysis of Pavement Edge Infiltration and Drainage

PAVEMENT PERFORMANCE
— Performance of Newly Constructed Full Depth Foamed Bitumen/Crushed Rock Pavements
— Some Roads in the Horsham Area—A Performance Survey
— Testing of the Shape of Roads
— Seasonal Variations in Flexible Pavement Deflections in South Western and North Eastern New South Wales*

TRAFFIC GENERATION
— Traffic Generated by Major Hospitals
— Analysis of Mode Choice and Location of Queensland University Students
— The Role of Systematic Segmentation in Studies of Traveller Behaviour
— Characteristics of Road Travel in Queensland 1973
— Effect on Traffic Patterns of the Collapse of the Tasman Bridge
— A Model of Inter-City Motor Travel Estimated by Link Volumes

TRAFFIC OPERATIONS
— Vehicle Conspicuity at Night
— Driver-Vehicle Behaviour on Intersection Curves During Day and Night
— Vehicle Speeds on High Standard Curves
— Short Count Annual Average Daily Traffic Estimation
— Optimal Control of Isolated Traffic Signals
— Traffic Engineering Measurements by Time Lapse Cinematography from a Moving Vehicle
— Three Traffic Signal Control Philosophies Applied to an Arterial Traffic System
— Deceleration Bed Tests of Dune Sand*
— A Freeway Traffic Study (South Eastern Freeway—Melbourne)
— The State Intersection Control Programme (STATCON)
—Conflict Resolution on Main Road Segments at the Introduction of a Priority Road Programme
— Perception of Road Rules and Priorities at the Introduction of a Priority Road Programme
— A Study of Merging at Urban Grade-Separated Interchanges
— Analysis of Free Speeds

GEOMETRIC DESIGN
— Tangents Method for Road Picture Construction
— Digital Mapping in the South Australian Highways Department
— Highway Engineering Surveys by Electronic Tacheometry—Cost and Quality Benefits for the Engineer
— Further Progress in Photogrammetric Research and Development for Highway Purposes in New South Wales*

TRAFFIC CONTROL DEVICES
— Failsafe Requirements of Road Traffic Signal Equipment
— The Shape of Traffic Signal Arrows
— Effect of Level of Illumination, Stroke-Width, Visual Angle and Contrast on the Legibility of Numerals of Various Fonts
— Traffic Signal Facilities for Blind Pedestrians
— The Role of Advanced Electronic Components in Communicating with Moving Vehicles
— The Effects of Driving Demand and Roadway Environment on Peripheral Visual Detections

SAFETY
— The Hidden Pedestrian—An Aspect of Risk at Uncontrolled Crossings
— Further on the Effects of Co-Ordinated Traffic Signals Systems on Traffic Accidents
— Some Safety Considerations for Rural Intersections
— Commercial Vehicles: Weight and Dimensional Limits in Relation to Accident Experience
— Prediction of Motor Vehicle Occupant Fatality Trends Following Seat-Belt Wearing Legislation
— Levels of Safety in Accident Studies—A Safety Index
— Roadside Hazards and Lethal Side Impact for Belt Wearers
— The Victorian Road Accident Location System
— The Detection of Important Interactions Among Factors—A Useful Technique for Traffic Safety Research

PLANNING AND MANAGEMENT
— A Theoretical Framework for Planning Residential Areas
— Urban Land Use and Transport Policies
— Community Participation in Road Planning
— Improving Street Public Transport—Some Possible Solutions

TRANSPORT ECONOMICS
— Evaluation Procedures for Urban Arterial Road Projects
— Evaluation Procedures for Rural Road and Structure Projects
— Mathematical Programming as an Aid in Road Project Programming
— Programme Allocation by Simulation—An Alternative to Cost-Benefit Analysis

NAASRA ECONOMICS OF ROAD VEHICLE LIMITS STUDY
— The NAASRA Study of the Economics of Road Vehicle Limits—Features, Recommendations and Implementation

FREIGHT TRANSPORT
— The Control of Heavy Vehicle Loading on Bridges
— Estimation of Commercial Vehicle Operating Costs from Fleet Data
— Control of Overweight Vehicle Movements in New Zealand
— An Experimental Approach to Establishing Commercial Vehicle Operating Costs

DEMAND/LAND USE
— Some Empirical Findings on the Relationship Between Residential Density and Accessibility to Job Opportunities
— An Accessibility Approach to Trip Generation
— Analysis of Household Trip Production Rates
— Development of Disaggregated Behavioural Models—A Case Study of an Indian City

NOISE
— The Effects of Traffic Noise: South-East Freeway, Brisbane
— Traffic Noise and Residential Noise Criteria
— Observed and Predicted Traffic Noise Levels Around Road Junctions in the U.K.
— Traffic Noise—A Study of a Tyre/Road Noise Mechanism●

*Papers presented by Departmental authors are marked with an asterisk.

TENDERS ACCEPTED BY THE DEPARTMENT OF MAIN ROADS

The following tenders (in excess of $20,000) for road and bridge works were accepted by the Department for the three months ended 30th September, 1976.

Road No.	Work or Service	Name of Successful Tenderer	Amount
			$
State Highway No. 2	Hume Highway. Shire of Gundagai. Construction of new bridge over eastbound off-loading ramp. Gundagai Interchange 112·4 km west of Yass. Gundagai Deviation Bridge No. 5.	Siebels Concrete Pty Ltd	366,192.00
State Highway No. 5	Great Western Highway. City of Blue Mountains. Supply of up to 4 000 tonnes of 20 mm crushed rock for heavy patching at Woodford, 85 km west of Sydney and maintenance of area within County of Cumberland under control of Bowenfels Works Office.	Blue Metal and Gravel Ltd	32,280.00
State Highway No. 9 and Trunk Road No. 63	New England Highway and Trunk Road 63. Repainting of bridges at Aberdeen and Manilla.	KADA Painting Contractors Pty Ltd	88,673.80
State Highway No. 10	Pacific Highway. Shire of Hornsby. Construction of new pedestrian structure to cross Pacific Highway near Mt Kuring-gai Railway Station.	Hornibrook Group	83,000.00
Trunk Road No. 51	City of Queanbeyan. Construction of new bridge over Railway Line near Gilmore Road, Queanbeyan at the boundary with Australian Capital Territory.	White Industries Ltd	239,958.00
Secondary Road No. 2081	Municipality of Ryde. Construction of new bridge over Main Northern Railway Line between Rutledge Street and First Avenue, Epping.	Pearson Bridge (N.S.W.) Pty Ltd	837,378.00
Unclassified	City of Maitland. Surface preparation and painting of steelwork of Luskintyre Bridge over Hunter River, 2·1 km west of Lochinvar.	K.G.B. Painting Contractors (K. and G. Bradica Pty Ltd)	37,140.00
Various	North Eastern Division—Ballina area. Supply and delivery of up to 1 500 tonnes of hot mixed cold laid bituminous plant mix—1976–77 State Highways Maintenance and Improvement Programme.	Bitupave Ltd	32,235.50
Various	North Eastern Division. South Grafton area. Supply and delivery of up to 1 700 tonnes of hot mixed cold laid bituminous plant mix 1976–77 State Highways Maintenance and Improvement Programme.	Bitupave Ltd	51,013.00

TENDERS ACCEPTED BY COUNCILS

The following tenders (in excess of $20,000) for road and bridge works were accepted by Councils for the three months ended 30th September, 1976.

Council	Road No.	Work or Service	Name of Successful Tenderer	Amount
				$
Bingara	Rural Local Road	Construction of new bridge over Gwydir River at Cooringoora east of Bingara.	L. G. Rixon	85,347.68
Carrathool	Various Main and Rural Local Roads	Supply of aggregate.	Farley and Lewers Pty Ltd	34,225.80
Carrathool	Rural Local Road. Whealbah–Trida Road	Construction of new bridge over Middle Billabong Creek.	Nelmac Pty Ltd	59,621.79
Carrathool	Rural Local Road. Whealbah–Trida Road	Construction of new bridge over Conoble Creek.	Nelmac Pty Ltd	22,143.46
Dungog	Rural Local Road	Construction of reinforced concrete bridge over Sandy Creek 1·61 km from Main Road No. 101 at Wallarobba.	Geoffrey Stewart Constructions Pty Ltd	69,141.00
Monaro	Rural Local Road. Cooma to Braidwood Road	Construction of bridge over Numeralla River at Numeralla.	K. E. and S. Bottom	164,000.50
Walcha	Rural Local Road. Nowendoc Road	Construction of bridge over McLeods Creek.	M. Campese and R. Bruno	137,649.00

MAIN ROADS STANDARD SPECIFICATIONS

Note: Imperial drawings are prefixed by letter A, metric drawings by the letters SD, instructions are so described, all other items are specifications.

ROAD SURVEY AND DESIGN

	Form No.
Design of two-lane rural roads (Instruction—1964)	355
Data for design of two-lane rural roads (1973)	892 (Metric)
Flat country cross sections—bitumen sealed pavement (Instruction—1972)	A 6132
Plan and longsection—Two lane rural roads	SD 6215
Standard cross sections for bitumen surfaced two-lane rural roads (1973)	SD 6056

URBAN DRAINAGE

	Form No.
Concrete converter	A 1418
Concrete work other than bridges	738 (Metric)
Design of subsoil and subgrade drainage (Instruction—1973)	513 (Metric)
Gully grating (1969)	A 190
Gully pit with grating	A 1042
With kerb inlet only	A 1043
With grating and extended kerb inlet	A 1352
With extended kerb inlet only	A 1353
With grating for mountable kerb	A 4832
Kerb and gutter shapes (1975)	SD 6246
Perambulator ramp	A 3491
Vehicle gutter crossings (1974)	SD 6247
Waterway calculations for urban drainage (Instruction—1963)	371B

CULVERTS

(a) Cast in place reinforced concrete box culverts—

	Form No.
Box culverts with wearing surface	SD 6270
Single cell box culvert under fill from 1 m	SD 6271
Single cell box culvert under fill from 0·3 to 1 m	SD 6272
Multiple cell box culvert under fill from 1 m	SD 6273
Multiple cell box culvert under fill from 0·3 to 1 m	SD 6274

(b) Precast reinforced concrete box culverts—

	Form No.
Erection of precast concrete box culverts (1975)	138B (Metric)
Supply of precast concrete box culverts (1975)	138A (Metric)

(c) Pipe culverts—

	Form No.
Construction of concrete pipe culverts (1974)	25 (Metric)
Design of concrete pipe culverts (1974)	25A (Metric)
Headwalls for pipe culverts— Single row— 600, 750, 900 mm dia.	SD 139
375, 450, 525 mm dia.	SD 143
1 050 mm dia.	SD 172
1 200 mm dia.	SD 173
1 350 mm dia.	SD 174
1 500 mm dia.	SD 175
1 800 mm dia.	SD 177
Supply and laying of asbestos cement drainage pipes (1972)	861

BRIDGES

	Form No.
Concrete work for bridges (1976)	350 (Metric)
Data for bridge design (1973)	18 (Metric)
Delivery of precast concrete members to site (1975)	560 (Metric)
Erection of precast, prestressed concrete bridge units and planks (1975)	557 (Metric)
Erection of precast, prestressed concrete piles (1976)	558 (Metric)
Erection of precast, prestressed concrete bridge girders	561 (Metric)
Excavation for bridges (1974)	563 (Metric)
Extermination of termites in bridges (Instruction—1958)	326
Erection of structural steelwork (1975)	262 (Metric)
Manufacture of precast or cast-in-situ, prestressed concrete bridge members (1976)	556 (Metric)
Manufacture of elastomeric bearings for bridge units and girders (1967)	562
Preparation and pretreatment of metal surfaces prior to protective coating or painting—Method Selection Guide	1032 (Metric)
Prestressed concrete bridge drawings— (a) Prestressed concrete piles— 14 in octagonal—45 tons	A 4943
16 in octagonal—50 tons	A 4944
Reinforced concrete piles 35 and 45 tons (1963)	A 1207–8
Reinforced concrete piles (precast) for bridge foundations (1976)	564 (Metric)
Superstructure for bridges	568
Supply of high strength steel bolts (1976)	261 (Metric)
Supply of ready mixed concrete, for bridgeworks (1975)	895 (Metric)
Timber for bridges (1976)	140 (Metric)
Waterway diagram (0 to 200 acres)	A 26

BITUMINOUS SURFACES

	Form No.
Bituminous emulsions (cationic) (1973)	304 (Metric)
Bituminous emulsion (anionic) (1973)	305 (Metric)
Bituminous surfacing daily record (1974)	400 (Metric)
Bituminous surfacing job summary (1974)	1011 (Metric)
Cutback chart for bitumen seal coats (1973)	466 (Metric)
Performance requirements for mechanical sprayers	272 (Metric)
Sprayed bitumen surfacing (1974)	93 (Metric)
Sprayer loading slip (1974)	401 (Metric)
Supply and delivery of bitumen (1974)	337 (Metric)
Supply and spraying of bitumen (1973)	898 (Metric)
Supply and delivery of aggregate for use in bituminous plant mix (1975)	952 (Metric)
Supply and delivery of asphaltic concrete (1975)	953 (Metric)
Supply and laying of asphaltic concrete (1975)	612 (Metric)
Supply and laying of dense graded tar plant mix (1975)	954 (Metric)
Supply and delivery of dense graded tar plant mix (1975)	955 (Metric)
Supply and laying of open graded bituminous plant mix (1975)	956 (Metric)
Supply and delivery of open graded bituminous plant mix (1975)	957 (Metric)
Supply of prepared cutback bitumen for sealing purposes (1966)	740
Supply and delivery of cover aggregate for sealing and resealing with bitumen (1975)	351 (Metric)
Tar, supply and delivery (1976)	296 (Metric)
Tar for plant mix, supply and delivery (1976)	870 (Metric)

FENCING

	Form No.
Chain wire guard fencing—erection (1974)	144 (Metric) SD 149
Chain wire—supply—(1974)	132 (Metric)
Corrugated steel guard rail—supply—(1976)	SD 5595
Corrugated steel guard rail—erection (1976)	680 (Metric) SD 5829
Corrugated steel guard rail—anchor plates (1976)	SD 6264
Corrugated steel guard rail—steel posts (1976)	SD 6277
Delineators for attachment to guard rails (1976)	SD 6280
Drawings: Sheep fence (1974)	SD 494
Rabbit-proof fence (1974)	SD 498
Cattle fence (1974)	SD 1705
Floodgate (1974)	SD 316
"Manproof" pipe and chainwire boundary fence (1975)	611 (Metric) SD 6278
Post and wire fencing (1974)	141 (Metric)
Removal and re-erection of fencing (1974)	224 (Metric)
Tubular steel and hardwood post and rail fencing (1976)	143 (Metric) SD 6284
Warrants for use of guard fences (Instruction—1973)	246 (Metric)

FORMATION, INCLUDING EARTHWORKS AND RURAL DRAINAGE

	Form No.
Corrugated PVC subsoil drainage pipe (1972)	907 (Metric)
Earthworks and formation including surface drainage (1976)	70 (Metric)
Installation of lateral drains (1974)	1013 (Metric)
Shoulders and table drains (1973)	827 (Metric)
Standard rubble retaining wall (1941)	A 114
Standard mass concrete retaining wall (1959)	A 4934
Subsoil drains (1973)	528 (Metric)
Waterway calculations for bridges and culverts (1976)*	371A (Metric)

PAVEMENTS

	Form No.
Cement concrete pavement (1960)	A 1147
Construction of natural gravel or crushed rock road pavement (bitumen surfaced) (1975)	743 (Metric)
Construction or resheeting of natural gravel or crushed rock road pavement (not bitumen surfaced) (1975)	800 (Metric)
Preformed expansion joint fillers (1976)	610 (Metric)
Supply of natural gravel or crushed rock for road pavement (bitumen surfaces) (1975)	744 (Metric)
Supply of natural gravel or crushed rock for road pavement (not bitumen surfaced) (1975)	801 (Metric)
Supply of ready mixed concrete (1973)	609 (Metric)

ROADSIDE

	Form No.
Roadside fireplace (1974)	SD 4671
Roadside litter bin (1975)	SD 5841

TRAFFIC PROVISIONS AND PROTECTION

	Form No.
Control of traffic at Roads and Bridgeworks (1975)	121 (Metric)
Guide posts—supply (1973)	252 (Metric)
Guide posts—erection (1973)	253 (Metric)
Manufacture of warning signs (1971)	682
Motor grids—24 ft (1964)	A 5770
Plastic guide posts (1972)	880
Plastic traffic cones—supply spec. (1976)	1045 (Metric)
Roadmarking paint (1966)	671

CONTRACTS

	Form No.
Bulk sum tender form, Council contract (1966)	39
Bulk sum contract form, Council contract (1975)	38
Cover sheet for specifications, Council contract	342
Caretaking and operating ferries	498
General conditions of contract, Council contract (1976)	24B
Schedule of quantities (1966)	64

MANUALS *

Manuals, No. 1—Plant; No. 3—Materials; No. 4—Roadside Trees; No. 5—Explosives; No. 6—Bridge Maintenance; No. 7—Road Maintenance.

D.M.R. BOOKLETS

Guide to Main Roads Administration.
Duties of a Superintending Officer.

N.A.A.S.R.A. BOOKLETS

Guide to Publications and Policy of N.A.A.S.R.A.
List of current publications.

All standards may be purchased from the **Plan Room** at the Department's Head Office, 309 Castlereagh Street, Sydney. Single copies are free to Councils except those marked *. A charge will be made for sets of standards.

G 21363 D. West, Government Printer, New South Wales—1976