MAIN ROADS

JOURNAL OF THE DEPARTMENT OF MAIN ROADS

NEW SOUTH WALES

MAIN ROADS

Issued Quarterly by and with the Authority of the Commissioner for Main Roads.

Vol. XXV, No. 1. *September*, 1959 *Price: Two Shillings.*

CONTENTS

Additional copies of this journal obtainable from the—

Department of Main Roads,
309 Castlereagh Street, Sydney, New South Wales, Australia.

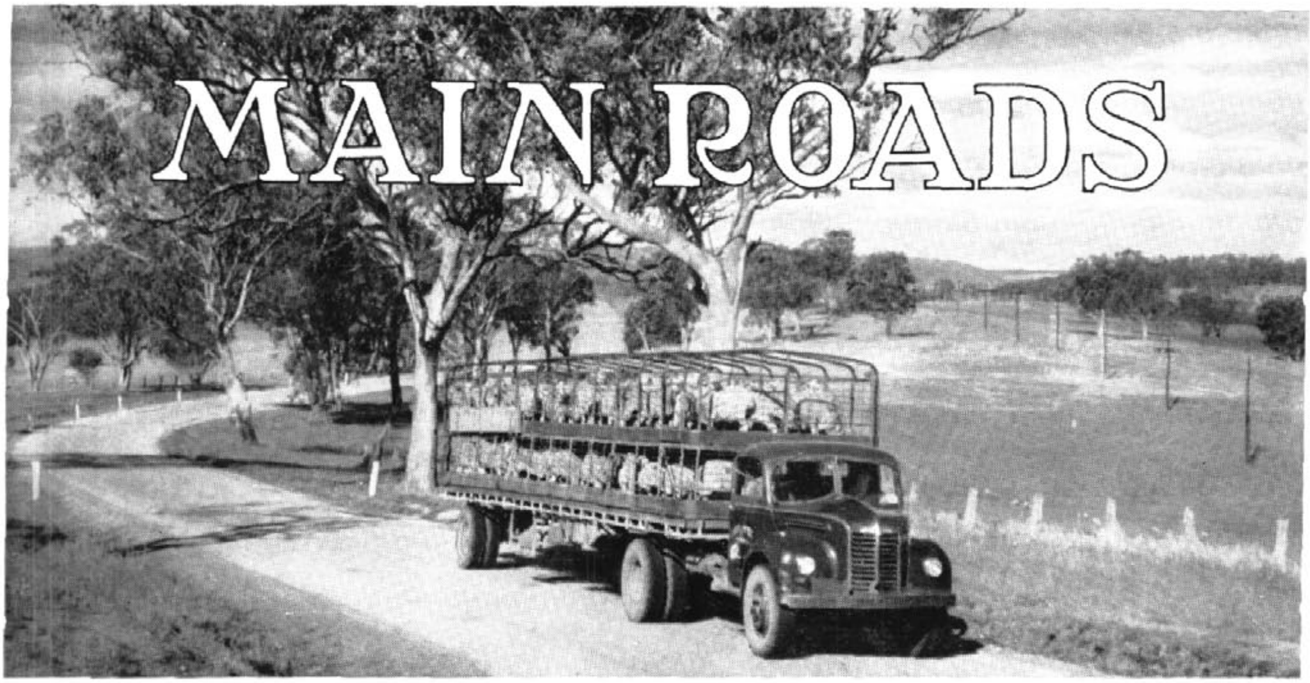
Box 3903 G.P.O. Telephone: B 0933. Telegrams "Mainroads" Sydney.

Annual Subscription, 8/–; Post Free.

Cover Page

Looking north towards Mudgee from Stoney Pinch on the Lidsdale–Mudgee Trunk Road

Next Issue: December, 1959.



Vol. XXV, No.1 *SEPTEMBER*, 1959 1

A Plan for Good Roads

An address by H. M. Sherrard, Commissioner for Main Roads, New South Wales, to the Good Roads Convention, held by the Australian Roads Federation, at Bondi, New South Wales, on 19th August, 1959.

THE STAGE WE HAVE REACHED IN ROAD PLANNING

THE title "A Plan for Good Roads", selected by the Federation, might lead to the expectation that this address will describe a clear-cut plan for the further development and financing of Australia's road system. Any such plan, to be convincing to Governments and to the road users who mainly will pay for it, must be based on indisputable facts, and on reasonable deductions drawn from those facts. The facts regarding Australia's roads have not yet been fully marshalled and analysed in sufficient detail to permit of the preparation of a convincing plan. This address therefore will be confined to describing what is meant by a plan for good roads, and to indicating how the plan should be prepared if it is later to win public acceptance and be put into effect. In addition, I shall comment on traffic distribution and growth, and on needs and progress on Main Roads in New South Wales.

*73344—1

Although Australia is a new land, it is also an advanced country. Planning for good roads in Australia thus does not need to start at the grass roots, as it would in a less advanced country.

Nevertheless, in order to make quite clear how far Australia is advanced already in road planning, I shall first describe the stages in road planning which would be required in a less advanced country.

Say it is required that a road system be planned for a primitive country, how would we go about it? First, we would study the distribution of its population and its resources. Then we would start planning arterial roads on a map in such a way as to link up the towns, and also link the sites of major resources. We could estimate from past experience in other similar countries as to the total mileage of road which would likely to be required ultimately per square mile, and we could take between 10 per cent. and 20 per cent. of this figure as the mileage of arterial roads which should be provided. All desirable road connections might not be practicable on account of topographical limitations. The next step would be to establish suitable administrative and financial arrangements, in order to be able to build and maintain the arterial roads, or as many of them as seemed necessary at this stage, and later also to develop the subsidiary roads. Finally, we would have to establish engineering organisations capable of carrying out the work to be done. Such are the logical first stages in road planning in a primitive country. In earlier years planning assistance of this type was given by the United States Government to some Central and South American countries. Latterly, somewhat similar aid in road planning has been given by the United States to some Asian countries. The United States aid to Turkey is typical, where it has included organising a modern highway engineering department, and assisting in training of engineers, foremen, plant operators and plant mechanics, or of establishing means for their training.

Now, we in Australia have long passed this stage. Technically and administratively in respect of roads we are a well-advanced country.

We ensure that we do not lag technically by various means. For example, we utilise the services of people of high technical training. We constantly engage in research and experiment. We play an active part in ensuring that high standards of training are available to students. We frequently send persons overseas to study latest road developments there. We closely follow the overseas technical press. Regarding our road administration, the entire road network of our States is the responsibility of well established and soundly based State and local bodies provided with funds or with the means to raise funds for road purposes. Contractors are available who are both willing and capable of building roads.

The arterial road network of New South Wales, and I consider that this applies to all or most Australian States, is clearly defined, and has been established and adjusted over many years and after much study. The mileage of the entire network of arterial and subsidiary roads of New South Wales appears to be reasonably adequate to meet needs. The construction of completely new roads to assist in rural development, *i.e.*, roads never built before, averages in New South Wales only about 100 miles a year, and even if this figure were doubled, it would still be small in relation to the total mileage of roads in the State (about 120,000 miles), so that it is apparent that this State is reasonably well roaded in respect of mileage of roads.

In the Commonwealth of Australia as a whole, while there is some variation in the road administrative systems in the various States, broadly they are all organised on somewhat similar lines, and have reached comparable stages of road development. Further, there is a common outlook among the States in respect of roads, and a basis for co-operation, as a result of the continued work over the years of the national association or "Conference" of the Australian State Road Authorities.

If we compare our Australian set-up with that in another federal country, the United States, we will observe, however, that there are two striking differences between the two countries. First, in the United States, the federal government shows a positive and continuous interest in road development and expresses this interest through a special road administrative agency, namely the Bureau of Public Roads. As a result of its interest in roads, the United States Government has ensured, for example, that an adequate United States national arterial road system will be created, and not just a series of State road systems, each primarily aimed at serving State needs. The second big difference between the United States and Australia in respect of road administration is the well-known position regarding petrol tax which, in the United States, is collected mainly by the States and forms the principal source of revenue for their main road systems, whereas in Australia this field of taxation is closed to the States, thereby preventing the establishment by the States in Australia of a logical financing scheme for main roads.

The situation then is that in Australia we have already carried our planning a considerable way, in that we have established our road system, we have classified its components so that we can distinguish which are the roads of greater importance and which of lesser importance, we have set up administrative and financial systems to maintain and improve our roads, and we have established technical and road-building facilities capable of designing and constructing whatever is needed. We have observed, however, that our administrative and financial system is lacking in certain respects when compared with that of the United States. In my view, it is these differences from United States practice which lie at the root of our road problem in Australia today, because it is abundantly evident that we lack both—(*a*) the interest of the Commonwealth Government in roads, and (*b*) the regular and adequate revenue drawn from road users necessary to give the good roads. It is, in my opinion, essential to correct this position in order to produce good roads in Australia.

But what is the road problem in Australia; how can we identify it?

THE BASIS OF A SOUND PLAN

What do we mean by "good roads"? Do we mean a bitumen surface to everyone's gate, in both city and country? Do we mean construction of expressways to avoid all the congestion which occurs in and near the larger cities? Do we mean that all arterial roads in the country should be wider, and straighter, and safer? Do we mean providing expressways to link all Australia's capital cities on the mainland?

If we mean that our plan should provide all these things, then I may as well say at once that such a plan is impossible of attainment, and we would be wasting our time advocating it. It would be impossible to achieve because the real need for such a plan could not be established. If we can learn one thing about road development from the United States, it is that the funds to provide better roads will be made available by the community only when the need for road improvement, and the benefits which will follow from it, can be described convincingly by facts and figures. We can learn also, from United States experience, that any plan for road progress must be founded not on vague dreams of Australia's possible future greatness, but on intelligent estimates of future traffic, determined from studies of traffic flow and trends in traffic and population growth.

Any worthwhile plan has to be realistic; it has to be based on a complete knowledge of the relevant facts; and the arguments presented in the plan have to be such as to convince those who study it that the plan is both practicable and necessary.

HOW TO GO ABOUT DEVELOPING A PLAN FOR GOOD ROADS

What we mean then by "good roads" is roads which are constructed appropriately to the nature and volume of the traffic which they are going to be called on to serve.

To prepare a plan to secure good roads, the first step necessary is to identify what is lacking in existing roads and to find out what it is going to cost to provide what is lacking. Then it is necessary to estimate the extra funds required to meet the assessed needs. Then a programme must be prepared placing the needed works in order of priority. Finally a practicable scheme of finance must be evolved which will supply funds sufficient to carry out the needed works within a reasonable time.

The hardest part yet remains to be accomplished—namely selling the plan to the public and to governments. Yet we have seen how the American people have been sold a vast plan for Interstate Highways, and we have seen in post-war years one American State after another adopting with full public support a progressive highway plan and proceeding to provide finance to implement it. California, with a population comparable with that of Australia, is an excellent example of this. How has this been achieved? Broadly by two means—first, the national leadership which has come from the U.S. Bureau of Public Roads, and second, the careful determination of real needs in such a way that the facts and the conclusions from them are unassailable. The U.S. Bureau of Public Roads has been insistent over the years that assessment of needs must be based on knowledge of relevant facts.

The facts have been collected in the United States by means of "needs studies". These have not always been carried out under the control of road authorities, but often by independent organisations who can in no way be accused of bias or self-interest. The most prominent such organisation has been the Automotive Safety Foundation. The American State and local road authorities have co-operated in all cases, and in particular have carried out surveys and otherwise collected data needed for the reports. Needs studies cover the condition of the roads, the traffic they carry, the standards to which they should be built, the cost of construction and maintenance, and the existing sources of revenue. The report prepared on a needs study analyses the facts collected, and presents recommendations as to the action required which, inevitably, is action to provide additional funds. Usually the report is supplemented by a popular edition, well illustrated with maps and diagrams, suitable for public consumption.

The undertaking of comprehensive needs studies is a big task, and it has never yet been attempted in Australia in the detail commonly practised in the United States. Nevertheless, several efforts have been made during post-war years by Australian State Road Authorities in combination to supply figures as to the funds required to meet Australian road needs. The most publicised of such figures was that published by the Committee on Transport Economic Research of the Australian Transport Advisory Council in its report on costs of road transport in Australia. This gave Australia's road needs, in 1956, as requiring the expenditure of £318,000,000 over the following ten years extra to what would be available from revenue arrangements existing at the time when the estimate was prepared. This represented only about a 25 per cent. increase in the current rate at spending, so could not be regarded as extravagant.

Figures of this nature soon get out of date, and a new combined effort is now being made by Australian State Road Authorities to make a fresh assessment on the basis of more extensive studies and with the co-operation of many local governing Councils. This new assessment of needs will not be done with the degree of detail common to American studies, but it will, nevertheless, be made the most reliable assessment to be produced in Australia hitherto. The work is now actively in progress in New South Wales, where the Department of Main Roads is not only surveying needs on Main Roads in relation to future traffic, but is also surveying traffic and local road needs in a series of typical country Council areas.

When the results of these investigations eventually come to hand from all States, and are published, support of the Australian Roads Federation and of all other road user organisations will be essential if tangible results are to follow.

ECONOMIC BENEFITS OF ROADS

In order to assist in supporting the case for good roads, the Department of Main Roads has set aside an officer to work under Professor Blunden at the University of New South Wales, where he is conducting research into what the Americans call "cost-benefit" analysis, which means assessing the benefit in money value which is secured by carrying out various kinds of road improvement. It is hoped by this means to produce verifiable information which will demonstrate as clearly as possible that "good roads don't cost, they pay", both in country and city.

SOME TRAFFIC ASPECTS WHICH AFFECT NEEDS

While, therefore, I cannot give you an exact plan for good roads in Australia, because all the necessary facts are not yet available, there is no reason why I should not describe some of the traffic facts, and express the needs on Main Roads in New South Wales as I judge them to be.

Studies in overseas countries have shown that 50 per cent. of the road mileage of a country carries 95 per cent. of the vehicle-miles of travel, and 20 per cent. of the road mileage carries 80 per cent. of the vehicle miles of travel. The arterial roads of a country usually comprise from 10 to 20 per cent. of its total road mileage, and it will be apparent therefore that the improvement of the arterial roads must be the prime concern of any road improvement programme, because each pound so expended gives a bigger return in traffic service than can be obtained in any other way. Other roads should also be improved appropriate to the traffic they carry.

In New South Wales the average traffic on Main Roads is estimated to be at least twelve times the average traffic on side roads. It is estimated that Main Roads in New South Wales carry about 75 per cent. of all vehicle-miles of travel.

Roads exist to serve traffic, and traffic arises from people. Thus the more people in any area the more traffic there is.

The nature and extent of future traffic flow will be influenced by a number of factors, including the following:—

(1) Population increase, and the fact that the majority of newcomers from overseas appear to settle in the cities.

(2) The continuous increase in Australia in the number of vehicles per 1,000 persons.

(3) The continuous increase in the average annual amount of petrol consumed per vehicle.

(4) The ability of modern motor trucks and buses to provide relatively cheap transport over long distances.

(5) The replacement of trams by buses in cities.

It is estimated that total traffic on New South Wales roads will increase by about 35 per cent. in the next five years. On some roads the increases will be greater, and on others will be less. For example, traffic on a side road serving a group of wheat farms is unlikely to increase greatly during the next five years because there will likely be no increase in the number of people served by the road or in the volume of wheat produced. On the other hand, arterial roads at the outskirts of Sydney have a present rate of traffic increase of about 15 per cent. every year on account of the expanding nature of the city, and so in five years the traffic on them will likely increase by more than 50 per cent.

Some State Highways in inland areas are not carrying their proper share of the traffic on account of their primitive condition, as a result of which traffic takes other but longer routes. Some lengths of State Highways carrying heavy vehicles are avoided by light traffic on account of the paved width being undesirably narrow, and because facilities for overtaking on hills are not yet provided. The diversion of traffic from the most direct route also occurs to some extent in the metropolitan area, for example, where Main Roads are congested and require widening.

Traffic information available leads to the general conclusion that the greatest percentage increase of traffic in the years immediately ahead will be on the principal radial and circumferential Main Roads in and near the metropolitan area, Newcastle and Wollongong, and on the principal country State Highways, particularly those from Sydney towards Melbourne and Brisbane.

Substantial but lesser traffic increases are likely on many of the remaining Main Roads in the metropolitan, Newcastle and Wollongong areas, and on many Main Roads in the country, especially where the development of industry or business is proceeding, or where rural land is becoming more intensively used, *e.g.*, in new irrigation areas.

Traffic increases on side roads, whether rural or urban, will likely be smaller, except where housing or industry, or closer land settlement or intensive land use, or mining or forestry is being expanded.

NATURE OF MAIN ROAD NEEDS IN NEW SOUTH WALES

The nature of needs on Main Roads in New South Wales may be described broadly as follows:—

Country Main Roads

(1) Construction of new bridges in place of those which are worn out, too narrow, or otherwise hazardous to traffic, and construction of new bridges at sites where no bridge at present exists, including a number of large streams where ferries are operated.

There are over 4,000 bridges on the Main Roads system of New South Wales, including over 2,500 of timber. A careful study of the condition of bridges generally has shown that 100 new bridges per annum are required to keep abreast of deterioration.

Approximately 25 per cent. of the total expenditure of the Department of Main Roads, New South Wales, is at present concentrated on the maintenance and construction of bridges.

(2) Bitumen surfacing, including reconstruction. Based on traffic needs, a reasonable target is considered to be 1,000 miles of new bitumen surface per annum for a period of ten years. (To reach in ten years' time a position equivalent to that already attained in Victoria, would

alone require about 800 miles of new bitumen surface a year. Both to catch up and then to keep abreast with Victoria would require over 1,000 miles of new bitumen surface a year, so it will be seen that a target of 1,000 miles per year is not unreasonable.)

To reconstruct and bitumen surface only the 2,700 miles of State Highways in New South Wales not yet dealt with is estimated to cost about £22,000,000.

(3) Providing a gravel surface on some 3,000 miles of Main Roads in western areas which have at present only an earth surface.

(4) Strengthening and widening and generally improving the earlier constructed bitumen surfaced State Highways, especially where pavements have deteriorated. (There are some 500 miles in this category at present.) Provision of third lanes on hills. Increase of sight distance where needed.

(5) Complete construction or reconstruction to modern standards of some lengths of important roads situated in especially rough or mountainous country, and thus of an especially costly nature. Examples are the new road under construction between Grafton and Glen Innes, and the Sydney-Newcastle road.

(6) Road widening and construction of additional Main Roads at both Newcastle and Wollongong to meet rapidly growing traffic needs and reduce existing congestion.

(7) Elimination of a number of railway level crossings.

Metropolitan Main Roads

(1) The replacement of bridges which are worn out or insufficient in width, and the provision of new bridges at sites not previously bridged. A number of these bridges will be of major size.

(2) The rebuilding of worn-out carriageways.

(3) The widening of suburban pavements out to full width between kerbs where not already done.

(4) The widening, sometimes duplication, of carriageways on principal arterial roads in outer metropolitan areas.

(5) The reconstruction and channelising of major intersections.

(6) Elimination of a number of level crossings.

(7) The paving of road strips formerly used for tram tracks.

(8) Land acquisition—(*a*) to enable wider roads to be provided, and (*b*) to make possible the later development of freeways.

(9) The construction of lengths of freeway where other and cheaper means of eliminating congestion have been exhausted.

NEED FOR AN INTERSTATE HIGHWAY SYSTEM

As well as considering State needs, New South Wales has also given special consideration to Interstate road needs, and has advocated the systematic improvement of those highways which serve to link the principal population centres of the Commonwealth. This proposal has been fully described in a brochure published earlier this year and widely distributed. Broadly it is a scheme to give road communication throughout Australia disregarding State borders, and it was inspired both by the obvious need, and by the conception of a National Interstate and Defence Road System which has been adopted in the United States. Improvement of the Australian interstate road links would give a tremendous boost to Australian economic development, as well as making it much easier for Australians to know their own country. At present, northern and western Australia are virtually cut off from eastern and southern Australia in respect of roads. Six State road plans do not successfully add up to a national road plan, because naturally State needs are the basis of each State plan.

The proposed Australian interstate road network has a mileage of 17,500 miles. Of this, slightly more than half already has a bitumen surface. Much of the mileage without a bitumen surface is already improved to various stages. If we assume that on the average it would require £12,000 per mile to finally construct and bitumen seal this remaining mileage, the bulk of which is in fairly flat country but situated in remote areas, we arrive at a figure of about £100,000,000 to secure an Australia-wide bitumen surfaced primary or principal road network.*

WHAT IS BEING ACCOMPLISHED

All the emphasis in this address has been on needs, and how to determine them in order to prepare a logical plan for the development of good roads. However, although road improvement is often disappointingly slow, nevertheless progress is being made in New South Wales as in other States, and there has been a general acceleration in New South Wales during recent years, which contrasts with the slow progress in the immediate post-war and inflationary period.

In the country, on Main Roads, about sixty new bridges are being built each year, between 400 and 500 miles of new bitumen surface are being built each year, special emphasis being placed on inland areas, and about 80 to 90 miles of old bitumen surfaced Main Road are being strengthened and rebuilt each year. A new highway is being built over a length of 74 miles through mountainous country linking the northern

* The figure given in the brochure by the Department of Main Roads, New South Wales, of £350,000,000 to construct the entire network of 17,500 miles provided for bringing all parts of it to the standard required by traffic growth for some years ahead, and involved considerable expenditure in widening and otherwise improving existing fully constructed bitumen surfaced roads, in addition to the reconstruction and bitumen surfacing of all other roads included in the proposed system and estimated here to cost £100,000,000.

tablelands and the north coast, between Glen Innes and Grafton, and extensive relocations are in progress or authorised on both the Pacific Highway (between Karuah and Bulahdelah) and the Prince's Highway south of Eden. The Department of Main Roads also has a large length of the Canberra to Bateman's Bay Trunk Road under construction. Of the bridges built since the war, a considerable number are of the larger variety. Within recent weeks two further large country bridges were opened to traffic, namely at Casino and at Forster, another is approaching completion over the Macleay River at Kempsey. Tenders have just been accepted for a large bridge to replace the ferry over the Hastings River near Port Macquarie, and for a large prestressed concrete bridge over the Mann River at Jackadgery on the new route of the Gwydir Highway. Plans are in hand for the early construction of other large bridges in the country, including a bridge over the Richmond River on the Pacific Highway near Ballina, over the Richmond River at Lismore, over the Clyde River at Nelligen, over the Towamba River on the Prince's Highway at Kiah, and over the South Arm of the Hunter River at Newcastle.

In the metropolitan area the principal emphasis on Main Roads has been placed on widening the road pavements on the principal Main Roads, especially the State Highways, on channelising intersections in order to give easier and safer traffic flow, on installation of median strips in wide roads to give increased safety both to vehicles and to pedestrians, and on construction of bridges. New wider bridges have been provided during recent years at Iron Cove, at The Spit, at Liverpool and at Lansdowne. Two additional lanes have been added to the Sydney Harbour Bridge. A contract has been let for a wider bridge over Cook's River at Tempe. A contract has been let for a magnificent six-lane arch bridge across the Parramatta River at Gladesville, the clear span of which will be greater than that of any concrete arch bridge yet built. Tenders are shortly to be invited for a wider bridge over the Lane Cove River at Fig Tree, and for a new bridge over the Parramatta River at Silverwater. Plans are also in hand for new wider bridges over Middle Harbour at Roseville, and over the Lane Cove River at De Burgh's Bridge, tenders for both of which should be invited within the next twelve months.

Finally, I must refer to the Cahill Expressway and its extension now in hand, and to the published intentions of the Government regarding the commencement of part of the Warringah Expressway, and of part of the Western Distributor, which is the overhead road projected along the western side of the city.

CONCLUSION

Although good progress is being made, there is a tremendous lag to be overtaken in New South Wales in both city and country on account of the lack of progress during the war years and the small progress in some of the post-war years. In addition, we have the tremendous growth of traffic to provide for, and in particular, the increasing use of the roads by heavy vehicles.

Economic losses brought about by inadequate roads adversely affect the standard of living of the whole community, and make it more difficult for Australia to compete with overseas countries.

I shall end by again referring to United States experience in respect of road improvement, and quote to you some words of the late Thos. H. MacDonald, former Chief of the United States Bureau of Public Roads, who said on one occasion in reference to the United States, as follows:—"We were not a wealthy nation when we began improving our highways . . . But the roads themselves helped us create a new wealth, in business and industry and land values. . . . So it was not our wealth that made our highways possible. Rather, it was our highways that made our wealth possible."

Fellowship in Highway Engineering at University of New South Wales

The University of New South Wales has announced receipt of an offer from the Vacuum Oil Coy. Pty. Ltd. to provide £1,000 per annum for three years for a Fellowship in Highway Engineering. The grant is designed by the Company to provide an incentive for graduates in Civil Engineering to continue their studies, and to encourage an increasing number of well trained engineers to enter the field of modern highway engineering. It is understood that the Fellowship will be open to Civil Engineering graduates (Bachelors) from all Australian Universities.

Some Large Bridges Recently Opened on Main Roads

THREE important new bridges on Main Roads in New South Wales were opened recently. On the 4th June, 1959, the Hon. J. B. Renshaw, M.L.A., Minister for Local Government and Minister for Highways, opened a bridge over the Castlereagh River at Mendooran, on Main Road No. 205. On the 9th July, 1959, the Minister opened a bridge over the Richmond River at Casino, on State Highway No. 16 and on the 18th July, 1959, the Premier, the Hon. J. J. Cahill, M.L.A., officially opened a bridge over the Wollomba River between Forster and Tuncurry on Main Road No. 111.

Bridge over the Castlereagh River at Mendooran

A description of this new bridge was given in the article "Some Recently Completed Bridge Works on Main Roads" which appeared in the June, 1959, issue of "Main Roads".

Bridge over the Richmond River at Casino

The first bridge built over the Richmond River at Casino was erected in 1876. It was a timber structure 410 ft. in length with a carriageway 18-ft. wide, and was replaced in 1909.

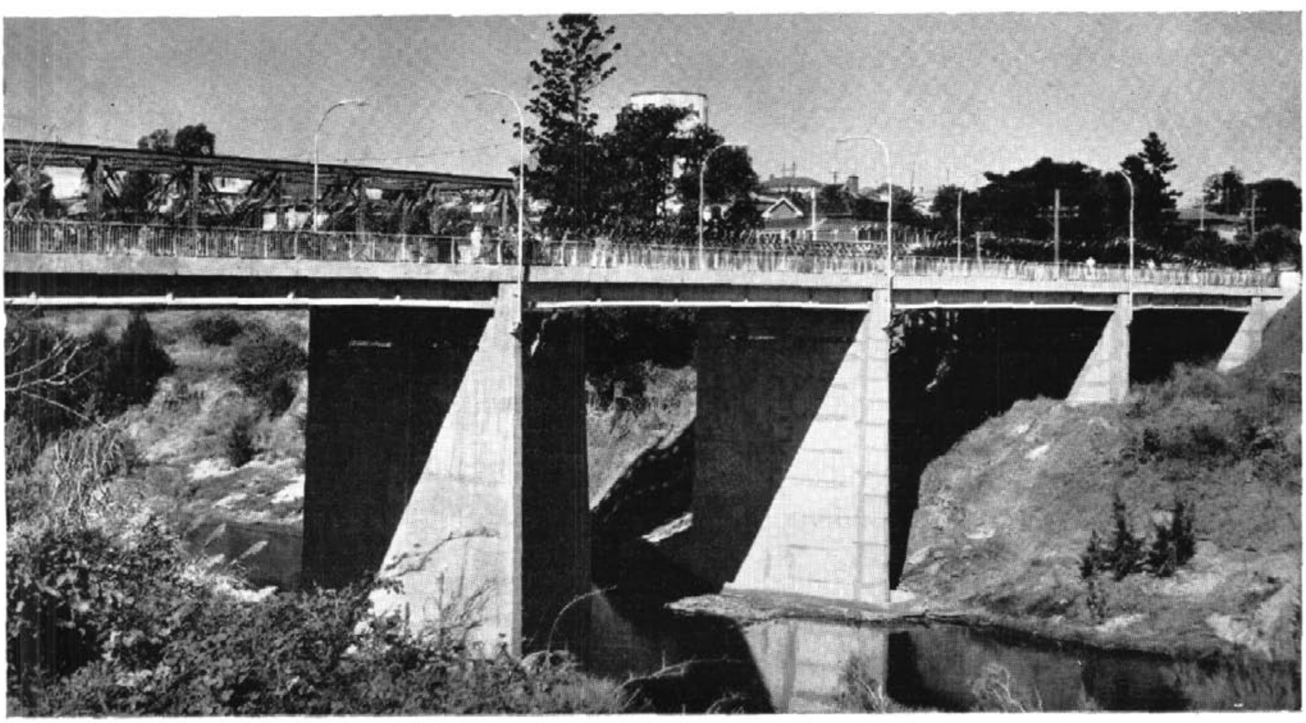
The second bridge comprised eight timber beam approach spans and one steel truss span giving an overall length of 475 ft. This bridge was severely damaged by floods in the Richmond River in February, 1954, when two piers were swept away causing the collapse of three approach spans into the river. Pending the construction of a new bridge, the damaged structure was made trafficable by the use of Bailey bridging equipment.

The new bridge is 482-ft. long and was built by the Department of Main Roads by day labour. It consists of three spans, each 100-ft. long, over the main channel of Richmond River, flanked by a 75-ft. span and a decked abutment at each end.

The main spans consist of prestressed concrete girders, each weighing 30 tons. The girders were cast and prestressed in a casting yard adjoining the site and were placed in position on the piers by means of gantries and trollies, the latter being supported by Bailey bridging equipment over the river. These 100-ft. girders are the longest prestressed concrete spans yet erected by the Department of Main Roads.

The carriageway is 24-ft. wide and there are two footways, each 7 ft. 6 in. in width.

The new bridge over the Richmond River at Casino.



New bridge over the Wollomba (or Wallamba) River connecting Forster and Tuncurry.

The piers and the southern abutment were constructed in reinforced concrete directly on rock foundations. The northern abutment is supported by piles driven to rock level. Each pier consists of three columns which are connected by web walls to prevent debris lodging between the columns in time of flood.

The cost of the bridge will be approximately £205,000 and is being met by the Department of Main Roads. The approaches to the bridge were constructed by the Casino Municipal Council on behalf of the Department at a cost of approximately £13,000.

The new bridge, in common with the two preceding bridges at the site, is known as "Irving Bridge", after an early settler.

Bridge over the Wollomba (or Wallamba) River between Forster and Tuncurry

The new bridge over the estuary of the Wollomba River (or Wallamba River as it is more commonly known locally), links the two towns of Tuncurry and Forster on either side of the river, and takes the place of a vehicular ferry.

At the site of the bridge there is a deep channel adjacent to each side of the crossing, with a sand island, mainly formed by dredged material, between the two channels.

The design prepared by the Department of Main Roads comprised separate steel and concrete bridges on reinforced concrete piles across the two channels, connected by a causeway across the sand island. Clearance for small vessels using the channels was provided for by introducing a crest vertical curve into the longitudinal grade line over each channel. One span of the bridge on the Tuncurry side was so designed that it could be converted to an opening span at a later date, if necessary.

When tenders were invited, tenderers were given the alternatives of tendering for two separate bridges as designed, for a single bridge of similar design connecting the two shores and omitting the causeway, or for two separate bridges or a single bridge in prestressed concrete, provison for the possible future opening span over the Tuncurry channel being required in each case.

A tender for the construction of a single prestressed concrete bridge from shore to shore to the tenderer's design was accepted by the Department. The successful tenderer was John Holland Constructions Pty. Ltd., Oakleigh, Victoria.

The new bridge is 2,074-ft. long and consists of 47 prestressed concrete girder spans each 42 ft. 6 in. long and one steel span 76-ft. long over the main channel on the Tuncurry side of the crossing.

One prestressed beam was made available by the Contractors for testing before the casting of the remaining beams commenced and the result of the test was satisfactory. In all, 376 beams were cast, at the rate of two beams per day, using steel forms. During the hot weather water for curing was prevented from evaporating by covering the beams with plastic covers. From the casting yard the beams were loaded on to barges by a 5-ton stiff-legged derrick crane, towed to the site and placed in position by a similar crane travelling along the previously completed spans.

The roadway deck is 7-in. thick, reinforced at top and bottom with welded wire mesh.

The plate girders in the 76 ft. steel span are 40-in. deep with flanges 16-in. wide. The steelwork was fabricated by C. J. Greedy Pty. Ltd., Maitland, as subcontractors to the bridge Contractor. The steelwork was sandblasted and metal coated before erection.

The design provided for the driving of 346 prestressed concrete piles and these were manufactured in Sydney by Concrete Industries (Australia) Ltd., as sub-contractors to the bridge Contractor, and were transported by road to the bridge site.

To determine the length of piles required 12 test piles were driven at approximately 200-ft. intervals along the length of the bridge.

Across the two channels the piles were driven from floating plant but an ordinary pile rig supported on falsework was used across the shallow length where the floating plant could not be used. On the sand island the piles were unloaded by a gantry over a loading bay and transported on bogies on a rail track to their respective positions.

The piles as driven vary in length from 28 ft. to 57 ft., the average length being approximately 40 ft. The total length of piles driven is approximately 15,000 lin. ft.

The contract time for the completion of the bridge was 140 weeks and the structure was completed early. The cost of the bridge was approximately £345,000.

The cost of the work is being shared by the Department of Main Roads and the Councils of the Shires of Stroud and Manning.

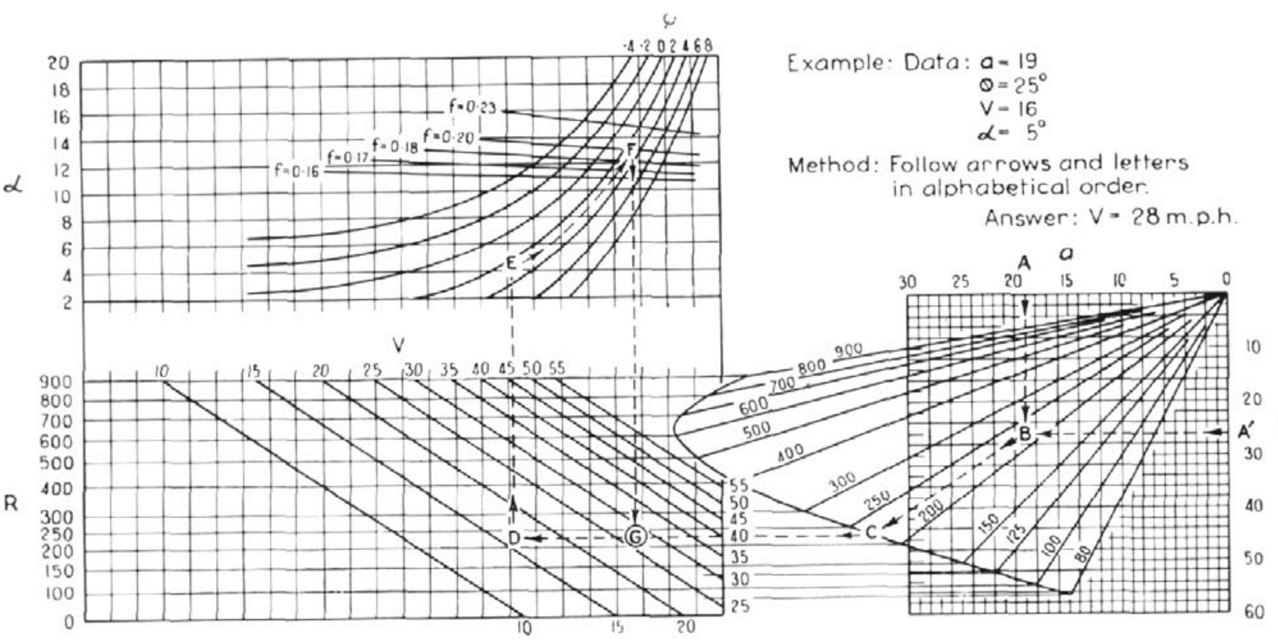
Erection of Advisory Speed Signs at Curves

THE Department of Main Roads has recently erected advisory speed signs on a section of State Highway No. 2 (Hume Highway) between Camden and Berrima as a trial and is proposing to study their effect on traffic, speeds and accident rates, before considering whether or not to adopt advisory speed signs more widely.

Advisory speed signs are designed to be erected in conjunction with curve-warning signs. The speeds indicated on the signs are of an informative nature only and have no regulatory significance.

Advisory speed signs have now been used for some years in several of the States in the United States

Fig. 1.



Values of "f" to be used with graph.

α \ V	10	15	20	25	30	35	40	45	50
2	·20	·18	·17	·16					
4	·23	·19	·18	·17	·16	·16			
6		·20	·18	·18	·17	·16	·16		
8		·20	·19	·18	·17	·17	·16	·16	
10		·20	·19	·18	·18	·17	·17	·16	·16
12		·23	·20	·19	·18	·18	·17	·17	·16
14			·20	·19	·18	·18	·17	·17	·17
16			·20	·20	·19	·18	·18	·17	·17
18			·20	·20	·19	·18	·18	·17	·17
20			·23	·20	·19	·18	·18	·17	·17

SAFE SPEEDS ON CURVES

computed from

$$V^2 = \frac{4528 \cdot 72a}{\Theta} \tan(\phi - \rho + \alpha)$$

Where V is speed in m.p.h.

a is arc length in $\frac{1}{1000}$ mile.

Θ is angle of deflection in degrees.

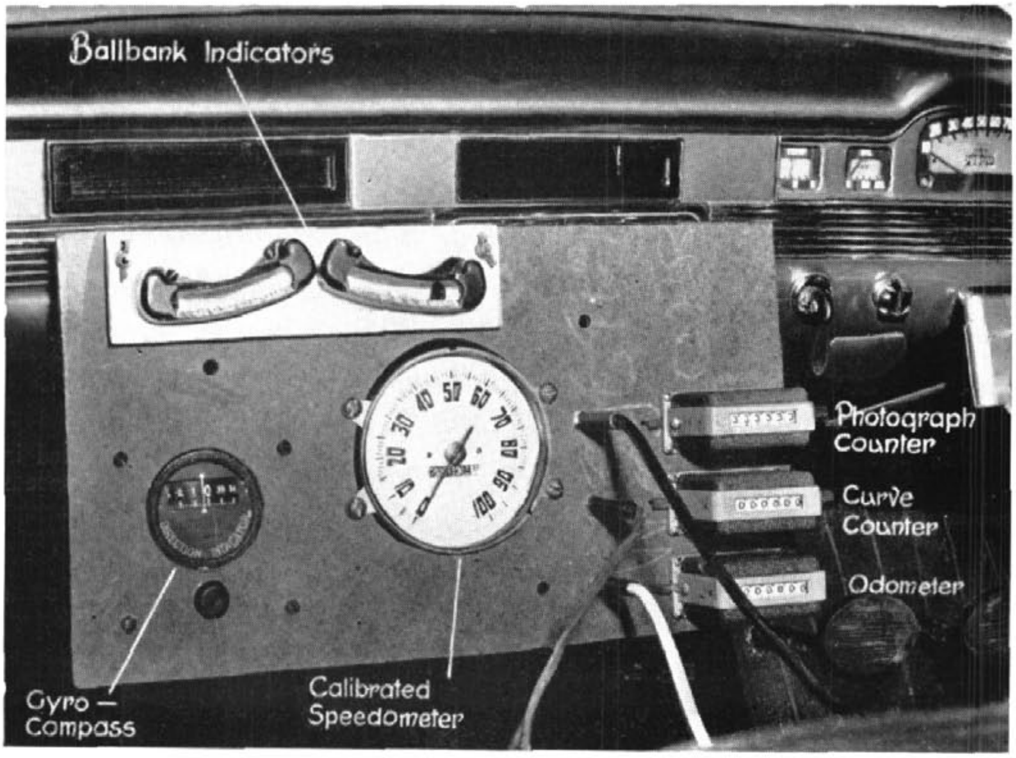
φ is angle of superelevation in degrees.

ρ is body roll (assumed constant at 2°).

α is ball bank angle in degrees.

R is radius of curve in feet.

f is fricton factor.



Instrument panel in survey car.

and are also being used to some extent in New Zealand.

The advisory speed is defined as the highest speed at which the driver and passengers do not experience discomfort when cornering in a vehicle in satisfactory road-worthy condition. This speed is lower than the speed at which the vehicle will normally skid and there is thus a margin of safety in the advised speed, although this is sufficiently high for an average motorist not to want to exceed it. It is a "safe" speed for the curve.

The method adopted by the Department of Main Roads in assessing the "advisory" speed closely follows a method developed in the United States* but the methods and conclusions have been slightly modified as a result of experiments conducted locally.

From experiments and theoretical calculations, based on the American report, the Department has developed the graph shown in figure 1.

In the method adopted a survey car is fitted, as illustrated, with a ball-bank indicator, or calibrated speedometer incorporating an accurate odometer, and a gyroscopic compass. The arc length and deflection angle, the maximum ball-bank reading and the vehicle speed at which this occurs are observed and figure 1 is used to calculate the advisory speed. This enables advisory speeds to be determined quickly and accurately by experiment, without reference to construction plans, which, for older roads may not be available.

*"Marking Highway Curves with Safe Speed Indications", Moyer and Berry, Highway Research Board Proceedings, 1940.

The major criticism levelled against the use of advisory speed signs is that, due to variations in makes of car, road-worthiness and the ability of the driver, the "safe" speed on any one curve may vary significantly with circumstances.

In general, these criticisms are not quantitatively significant. Data collected in the United States indicated that body roll on the range of vehicles tested varied between 1° 25′ to 2° 25′ at speeds up to 50 m.p.h. Differences in body roll could contribute a variation of less than 3 m.p.h. in "safe" speed. Similarly, differences in the steering properties of various vehicles have been shown to have a negligible effect on "safe" speeds.

The ability of drivers to handle vehicles when cornering is more unpredictable but the advisory speed is well below the maximum speed at which it is possible to corner, using all the tricks of the race circuit. Even the most unskilled driver should be able to corner safely at speeds in the vicinity of those indicated.

The only times when the indicated speed would not be reliable are when ice forms on the road, or the pavement becomes slick or is slippery when wet.

The section of the Hume Highway on which the advisory speed signs have been erected for trial is not subject to icing and there are no curves where the pavement is known to be slick. In any case, however, action would normally be taken to eliminate slick pavements, and driving under conditions of snow and ice is so different from normal driving that the normal signposting cannot be considered applicable.

Explanatory sign at commencement of trial section of advisory speed signs.

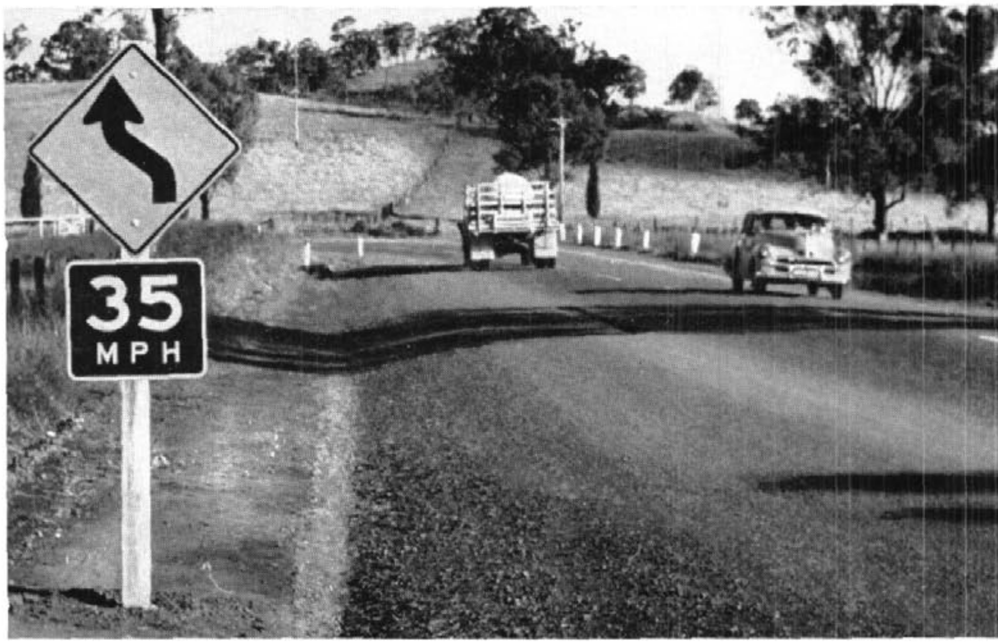
In considering the size, shape and colour to be used for the signs, test signs of various types were made up and tested under both day and night conditions. The present size and colour (rectangular board 21 in. x 18 in. with white "series E" retro-reflective numerals on a matt black background) was chosen as providing the most legible message both by day and by night. The use of rectangular signs with white legend on a black background also prevents confusion with route markers and regulatory speed limit signs, and being different in colour and shape from warning signs it has an attention attracting value on a par with that of the warning sign.

The advisory speed signs bear speed values ranging by 5 m.p.h. increments up to 45 m.p.h. and are used at all curve and turn symbol signs as well as "winding road" legend signs. The standard sized speed sign is also used in conjunction with the oversize "curve" and "turn" warning signs which are used in certain locations.

Advisory speed signs have been used only at curves on the open road having a determined speed of up to 45 m.p.h. whilst in built-up areas, 25 m.p.h. is the maximum posted speed, *i.e.*, a speed sign is not erected on a curve which may be safely negotiated at a speed at or above the legal speed limits.

In general, curves with "safe" speeds greater than these figures would not be provided with standard

Typical advisory speed sign in conjunction with right-hand curve warning sign.



Advisory speed sign in conjunction with reverse curve warning sign.

warning signs, though in special cases, curve warning signs without advisory speed signs may be used. For example, a curve with a speed value of 35 m.p.h., just inside a built-up area at the end of a long straight, would not be provided with an advisory speed sign, although a standard curve warning sign might be warranted.

Prior to the erection of the advisory speed signs on the trial length, approach speeds of vehicles were checked on various curves and these will again be checked after the signs have been in position for some time. Accident figures are available for this section of road and these will be compared with accident figures over a similar period after the erection of the signs. If the signs prove sufficiently beneficial, consideration will be given to similar speed signing on other sections of the State Highway system.

From the information available and the experience to date, it is considered that these signs are proving helpful, particularly at night and to strangers unfamiliar with the length of road concerned.

Sydney Harbour Bridge Account

Receipts and Payments for the financial year ended 30th June, 1959

Receipts	£	*Payments*	£
Road tolls	892,882	Cost of collecting road tolls	108,870
Contributions—		Maintenance and minor improvement	142,387
Railway passengers	145,483	Payment of loan charges	267,070
Omnibus passengers	17,581	Provision for traffic facilities	14,458
Rents from properties	24,382	Administrative expenses and miscellaneous charges	10,404
Miscellaneous	1,898	*Conversion of tramway area to roadway	824,699
		Miscellaneous	4,950
	£1,082,226		£1,372,838

* Capital expenditure financed principally from revenue available during the year; the remainder from accumulated surplus revenue.

The Public Road, its Origin and Development

THROUGHOUT the ages, roads and the uses to which they have been put have exercised a profound influence upon the path of history. In their earliest form they were the tracks beaten by prehistoric men and animals to water and shelter. As settlements developed, tracks became established between settlements to provide means for communication and for the interchange of goods.

Archaeological records exist which indicate that as long ago as 5,000 B.C. some paved roads were in use in Egypt and Babylonia. A trade route crossing Afghanistan, Persia and Arabia was in regular use by caravans in 3,000 B.C. The most clearly determined of the prehistoric long distance trade routes were those across Central Europe which were used by traders in amber, important deposits of which were located along the Baltic Coast.

The word "road" with its present meaning first came into use during the early part of the 17th century. It is derived from an old English word "ridan" meaning "to ride". This gave rise to "rad" which passed, in time to "raid" and then "road". There is some uncertainty as to the original application of the word but it is generally accepted that when first used it applied to the track ridden on.

Care of the Roads in England

Until 1555 care of the roads in England had been based up on the "trinoda necessitas", the three-fold required service of the tenant whereby every occupier of land had laid upon him the duty of repelling an enemy; the construction of fortifications; and the repair of roads and bridges.

In 1555 an Act was introduced into the English Parliament, in the reign of Queen Mary, which specified that the "Constables and Church Wardens of every Parish shall, yearly upon the Tuesday or Wednesday in Easter week, call together a number of parishioners and shall then elect and choose two honest persons of the Parish to be Surveyors and Orderers, for one year, of the works for amending of the highways in their Parish." Four days in each year were set aside on which the parishioners were called upon to report for work on the roads and to provide the necessary tools, draught animals and vehicles. Those who failed to report were penalised.

The 1555 Act was re-affirmed and made permanent by an Act of 1562 in the reign of Queen Elizabeth I and by this Act the yearly period of Statute Labour was increased from four days to six. These Acts were later modified but the Statute labour laws remained in force in England until 1835.

Until early in the 18th Century, care of the roads in England was the responsibility of the Boroughs and Parishes and as a result of this most of the through roads were incompletely developed and some were almost entirely neglected. With the advent of stage coaches a delegated administration in the form of Turnpike Trusts was created in an attempt to improve the situation then existing. The trusts were empowered to charge tolls for the use of the roads they maintained and to apply the revenues so raised to road purposes. The trusts continued until the end of the 19th Century when the principle of general taxation for road purposes was introduced.

Road Control in New South Wales

Upon the foundation of New South Wales in 1788, all land throughout the Colony became Crown land and responsibility for the construction and care of the roads rested upon the Governor. To extend settlement, grants of land were made to private persons and these lands could be traversed only by permission of the owner. Certain recognised tracks had, however, been in use by the public since the first years of the Colony and in 1833 an Act of Council made provision for the opening of roads through the freehold of alienated lands.

In 1828 Governor Darling had instructed the Surveyor-General, Major (later Sir Thomas) Mitchell to divide the country into Counties and "Hundreds" (areas of about 100 square miles) and to sub-divide these into parishes in each of which land was to be reserved for public roads. The Act of 1833 required that the reserved roads be surveyed and delineated on a plan and when proclaimed were to be maintained at the public expense or at the charge of the parish or parishes through which they passed. Those roads which had been in general use prior to the passing of the Act were listed in a schedule as being those which would be under the care of the State. These were the forerunners of the present system of Main Roads. The passage of a "Parish Roads Act" in 1840 entitled land owners to elect Road Trusts which were empowered to levy rates and collect tolls for road purposes and road trusts were appointed at Sydney and at Newcastle and vested with responsibility for maintaining and improving the roads in their respective areas.

An Act of 1842 provided for the election of District Councils which, amongst other duties, were also authorised to make and maintain roads. The Councils did not prove satisfactory and in 1848 they were abolished. In their place, the Municipalities Act of that year provided for the establishment of Municipal Councils to whom was given the care of all public roads, bridges, ferries, etc., in their areas. These also were authorised to collect tolls or levy a rate for the purpose. In that year too a "Main Roads Management Act" was passed which transferred to the Government, responsibility for a number of "main roads" which were listed in the Act and which previously had been under the control of Road Trusts or District Councils. Necessary funds for upkeep were provided from consolidated revenue and from the proceeds of toll collections. The toll system was abolished in 1877.

The provisions of the various Acts relating to the opening of roads were more or less superseded when a Public Roads Act came into force in 1897. This, however, was repealed in 1902 when an Act to consolidate the Acts relating to the opening, closing, altering and improvements of the roads was passed.

Legislation was enacted in 1906 by means of which the whole of the eastern and central divisions of the State, excluding the existing municipalities, were divided into Shires to be controlled by elected Councils. These were empowered to levy rates on the unimproved value of land to provide funds for road construction and other public works or services. This legislation repealed previous Acts relating to the old Municipalities.

Under the new Act—the "Local Government Act of 1906"—the main highways then in existence were classified as "Main Roads" and were included in the definition of "Public Roads" together with certain other roads proclaimed or dedicated under any Act dealing with public roads, or under the Crown Lands Act, and in certain circumstances roads provided through private lands by private individuals. As a result practically all roads in the eastern and central divisions of the State were placed under the care, control and management of the Local Governing authorities. At that time, on account of the building of railways the principal Main Roads of the State had largely lost their earlier significance and the future potentialities of the motor vehicle were not yet realized. The Act of 1906 was subsequently replaced by the Local Government Act of 1919 which defines what is meant by the term "public road", by stating that public roads include—

"(*a*) any road dedicated as a public road by any person, or

(*b*) notified, proclaimed or dedicated as a public road under the authority of any Act."

As motor traffic increased in volume and range, attempts were made by various Governments to secure the passage of legislation providing for the centralisation of authority for the care and management of the main roads. The first attempts did not succeed but in 1924 the "Main Roads Act" was passed which provided for the establishment of a Main Roads organisation now known as the Department of Main Roads and controlled by a Commissioner for Main Roads. The Department of Main Roads is vested with funds, drawn mainly from road users, and is charged with responsibility for the construction and maintenance of State Highways in the country; for all Main Roads in the County of Cumberland; and with joint financial responsibility with the local governing authorities, for the care of all other main roads in the State.

Use of the Public Roads for Transport Purposes

The primary purpose of roads has always been to facilitate the movement of men and goods. At first travel was, of necessity, on foot and later on the back of an animal or in some rude form of conveyance. Later it became the business of public bodies or companies to provide vehicular transport. The introduction of stage coaches and wagons in France and England, early in the 15th Century, was the first step towards the establishment of the great public transport systems which now are so important a feature of the modern State.

Public road transport in New South Wales may be said to date from 1818 when a coach began to ply between Sydney and Parramatta. By 1824 regular daily coach services were operating between Sydney and the principal centres of settlement and in 1839 a fortnightly overland mail was established between Sydney and Melbourne. The discovery of gold in New South Wales in 1851 created a demand for the carriage of men and supplies to and from the goldfields and as settlement extended more and more coach services were inaugurated until by 1895 a net-work of road transport services covered the greater area of the State.

The growth of the metropolis created a need for some form of metropolitan public transport and a bus service was started by a private operator in about 1857. This venture was not successful and it was taken over by a company which provided a regular bus service between the city and the eastern suburbs. A government owned public transport service commenced operations in Sydney in 1861 and was maintained by means of horse drawn trams. Steam, cable and electric trams followed, and later motor buses.

The extent to which the public roads of the State are used by individuals for transport purposes cannot be precisely determined but a measure of such use may be obtained from the fact that at the 30th June, 1958, 941,693 motor vehicles of all types were registered in New South Wales. In a report to the Transport Advisory Council, its Transport Economic Research Committee estimated that during one year (1954-55) road transport in Australia moved 220 million tons of freight.

Functions of the Public Road

In a "Treatise on Roads" published in 1838 its author, Sir Henry Parnell, said that when society had attained a high degree of industry and wealth, so many persons, and so great a volume of goods, are set in motion that the construction of roads to provide safe and rapid transport becomes a matter of greatest importance, and it was, therefore, one of the most important duties of government to enact such laws and provide such means as were necessary for the construction and maintenance of good roads throughout the territory under its authority.

The demands of road traffic since the treatise was written have developed to an extent which could not have been envisaged at the time of its publication. If good and safe roads were a matter of importance more than a century ago, how much more are they an imperative necessity today!

The public road, in fact, is one of the great fundamental institutions of mankind. It provides the framework within which economic development is built; it is the primary channel for all trade and commerce and is a factor in modern life without which organised society, as at present known, would be impossible.

Material for this article was obtained from—

The Mitchell Library.

The Public Library of New South Wales.

"The King's Highway"—Sidney and Beatrice Webb.

"The Story of the Roads"—C. G. Hartman.

"The Story of the Road from the Beginning"—J. W. Gregory.

"The Road Goes On"—C. W. Scott-Giles.

S.G.P.

Changes in Traffic Line Marking Practice

TWO important changes were made recently in the Department's centre line marking practice These were:—

(1) a change in the colour of lines; and

(2) the addition on some lengths of glass beads to improve night visibility of lines.

1. Colour of Lines

White paint instead of yellow is now being used by the Department of Main Roads for marking all "broken" traffic lines on Main Roads. Where centre lines are to be continuous or "unbroken" over a length they will be marked with yellow as at present.

A number of factors have influenced the Department in making the change. Four of the Australian States use a white line and it is desired to achieve Commonwealth-wide uniformity. However, by retaining yellow for the unbroken line the contrast in colour emphasises the meaning of the lines as prescribed in the Motor Traffic Regulations.

The unbroken yellow indicates the lines which are not to be crossed, except in specified circumstances. They also assist in warning of conditions where particular care is needed. Broken white indicates the lines which are provided principally to guide traffic and which may be crossed when it is safe to do so.

The use of two colours in this way for traffic line marking is in accordance with the practice now recommended by the American Association of State Highway Officials and it has been adopted by the majority of the States in the United States of America.

Before making the change, a length of traffic line marking using white for broken lines and yellow for unbroken lines was under trial for some weeks on the Prince's Highway between Heathcote and Sublime Point, and following inspection of the trial length the Police Department concurred in the proposed changes.

Some time will elapse before the "broken" white centre line can be marked on all Main Roads throughout the State, and generally it will be introduced progressively as the existing line marking becomes due for repainting.

2. Reflectorization of Lines

To improve visibility at night, the Department is now providing reflectorized traffic lines on Main Roads. This is being done by the application of minute glass beads to the paint used for line marking. The glass beads reflects the light from the headlamps of motor vehicles and give the line a luminous appearance at night.

Reflecting traffic lines have already been provided on the Prince's Highway between Sylvania and Nowra, the Pacific Highway between Roseville and Hexham, the New England Highway between Hexham and Maitland, the Great Western Highway between Parramatta and Bathurst, and the Hume Highway from Warwick Farm to the junction with the Federal Highway south of Goulburn and also on some of the main roads in the Sydney Metropolitan area.

Glass beads have been used in traffic line marking in the United States for some years. Early tests of the application of glass beads to line-marking paints in New South Wales were unsuccessful as the paints then in use were not suitable to hold the beads. Suitable paints were later developed.

The glass beads, which are spherical in shape, range from one-hundredth to one-fiftieth of an inch in diameter, and are dropped by the marking machine on to the freshly painted line at the rate of one pound of beads to every 50 feet of line.

Northern approach to Sydney Harbour Bridge showing the two additional traffic lanes (on left)

Additional Traffic Lanes on Sydney Harbour Bridge

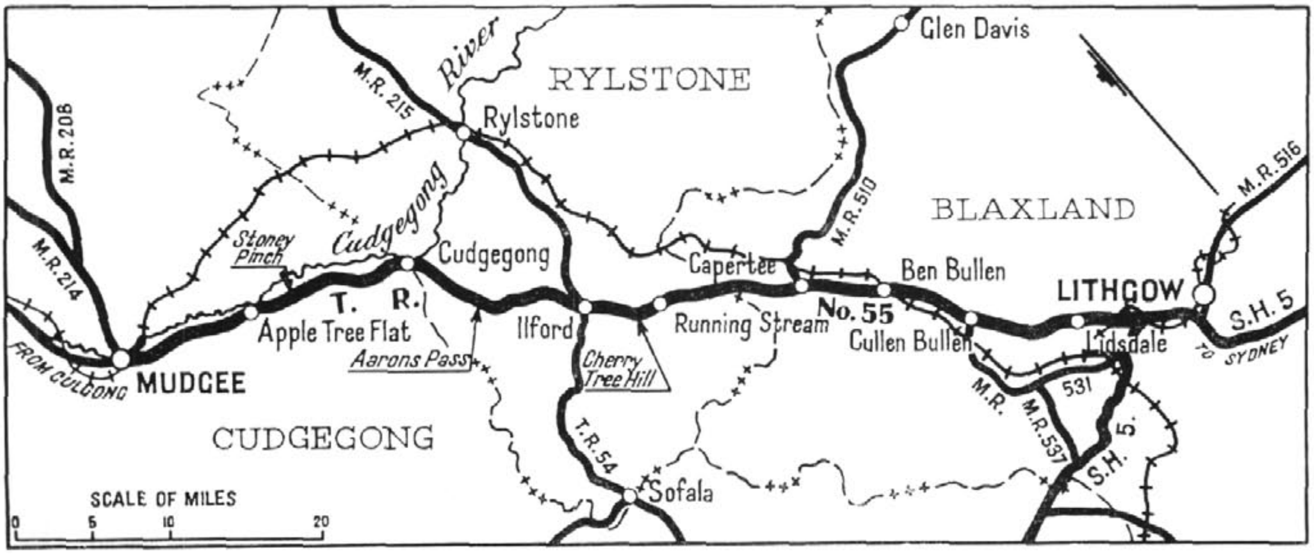
ON the 2nd July, 1959, the Hon. J. B. Renshaw, M.L.A., Minister for Local Government and Highways, officially opened for road purposes the two extra lanes on the Sydney Harbour Bridge. These lanes have been made available through the conversion of the area formerly used for tramway purposes to roadway.

Conversion of the tramway area for road purposes involved several major works. On the bridge structure, a deck suitable for vehicular traffic was provided on the main arch and approach spans, a total length of 3,750 feet. On the northern approach the tramway station at Milson's Point was removed and, to give access to the new traffic lanes, a new roadway was constructed along the former tramway tracks approaching the bridge, and a ramp was built from the road at the eastern side of the bridge to the site of the former tramway station.

At the southern end, a ramp was constructed to carry road traffic over the entrances to the tramway tunnels leading to Wynyard Station, and a bridge was built over the west-bound traffic lanes of the Cahill Expressway.

Toll gates were erected on each of the two new road approaches on the northern side, as there was insufficient room for the gates on the southern approach.

The work was carried out by the Department of Main Roads, partly by contract and partly by day labour. The work commenced towards the end of June, 1958, and was originally expected to be completed by the end of August, 1959, the estimated cost being £1,250,000. The work was completed two months earlier than forecast, and the cost was £250,000 less than had been anticipated. These favourable results can be attributed to the co-operation and efficiency of the staffs and employees of the Department of Main Roads and of the various contractors, to generally good weather conditions during the work, and to the provision for a "penalty or reward" clause in the contract for decking the main arch and approach spans.



Locality sketch—Trunk Road No. 55—Lidsdale–Mudgee.

Reconstruction and Bitumen Surfacing of Trunk Road No. 55 Between Lidsdale and Mudgee

RECONSTRUCTION and bitumen surfacing of Trunk Road No. 55 between Lidsdale (near Lithgow) and Mudgee was completed in December, 1958. This section traverses the Shires of Blaxland, Rylstone and Cudgegong and is 69.34 miles in length.

Trunk Road No. 55 leaves the Great Western Highway at Marrangaroo, 4½ miles from Lithgow, and passes northwards through the villages of Lidsdale, Cullen Bullen, Ben Bullen, Capertee and Cudgegong and the towns of Mudgee, Gulgong and Coolah, terminating at Mullaley on the Oxley Highway.

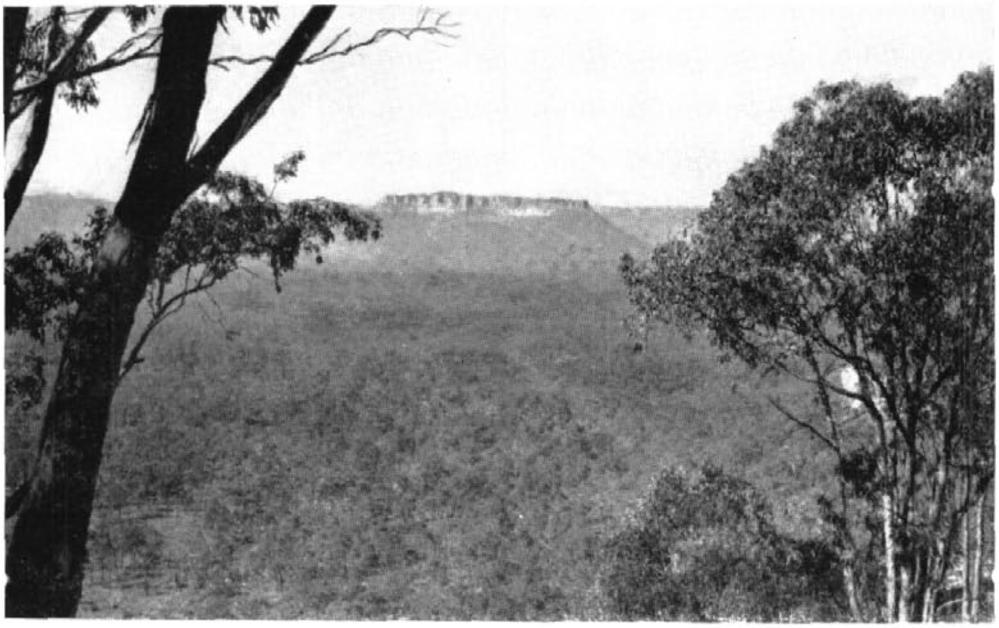
In 1946, the Lidsdale—Mudgee section of this road had a gravel surface throughout except for a short length of bitumen surfacing 3½ miles long at the Mudgee end, and short lengths in the villages of Cullen Bullen and Capertee. The road traverses high and hilly country, the highest point being at Cherry Tree Hill, 3,600 feet above sea level. Due to the nature of the country there were many steep grades and winding sections of alignment, and the formation was generally narrow and inadequately drained. These factors and the lack of suitable culverts in some parts made maintenance costly and difficult.

The development of open cut coal mining and other heavy haulage, as well as increased general traffic, created a need for improved travelling conditions on this road. Aerial photographs of the road obtained by the Department of Main Roads, showed that whilst long deviations were not required, some major works would be necessary. The Councils concerned were not in a position to undertake the major works needed in a reconstruction programme and, in any case, were having difficulty in coping with the maintenance required under the conditions existing. In view of the urgent need for improvement, arrangements were made between the Department of Main Roads and the Councils whereby the Department of Main Roads would accept responsibility for the reconstruction of the road from Lidsdale to Mudgee, and for its maintenance during construction, subject to a fixed annual contribution by each of the Councils during this period. In the case of Rylstone and Cudgegong Councils' areas, it was arranged that the Department would take over the control of the road and works on it as from the 1st January, 1946, until such time as the reconstruction work had been completed. Later, somewhat similar arrangements were made with the Blaxland Shire Council except that the road works were done by the Council and bridges by the Department.

Blaxland Shire (7.85 miles to 33.44 miles from Lithgow)

In 1948, reconstruction and bitumen surfacing of the length from Lidsdale to Ben Bullen was carried out by Blaxland Shire Council by day labour.

About the same time the Department of Main Roads commenced the construction of a reinforced concrete bridge over the Cox's River. This bridge was 22 feet wide between kerbs and had six spans of a total



The Capertee Valley from the Lidsdale–Mudgee Trunk Road.

length of 230 feet. Following this work, Jew's Creek Bridge, also a reinforced concrete structure, was constructed. This structure was also 22 feet wide between kerbs, had four spans and a total length of 150 feet.

The length from Ben Bullen to the Rylstone Shire boundary, excluding a length of 1.3 miles at Capertee Crown where heavy earthwork was involved, was reconstructed by Council and sealed in 1953 and 1954. Gravel for the pavement on this section was obtained from the "overburden" at an open cut coal mine near Ben Bullen. Formation and pavement widths of 26 feet and 18 feet respectively were adopted as for the previous section.

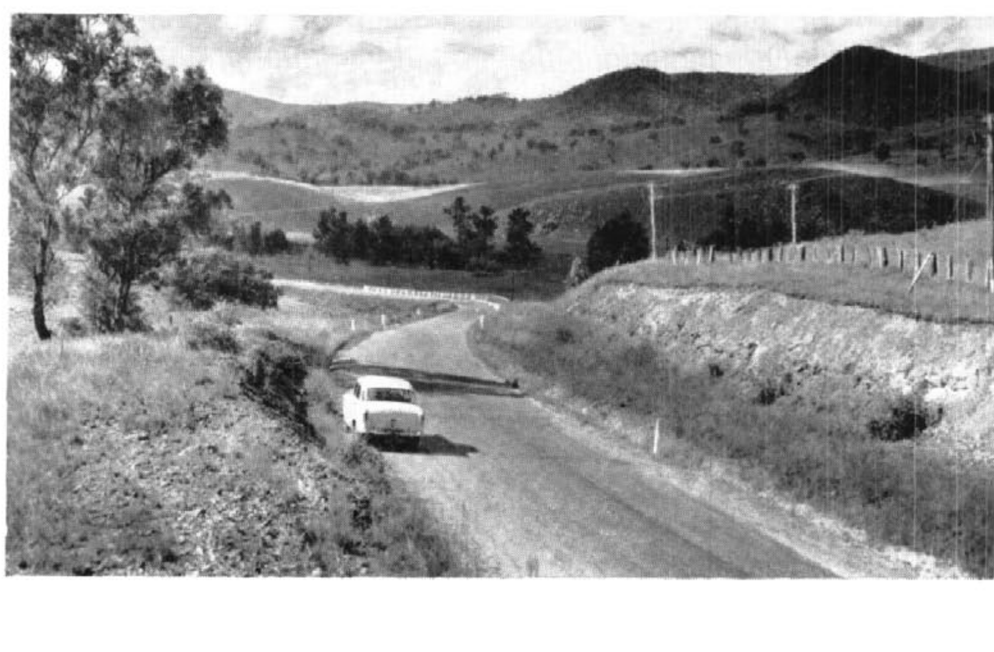
The length of 1.3 miles at Capertee Crown where the road crossed a mountain range had steep grades and winding alignment. A detailed survey was made and plans were prepared by Council providing maximum grades of 9 per cent. and minimum curves of 600 feet radius. The total earthworks amounted to 31,000 cubic yards. The work was completed early in 1958, thus completing the full length in Blaxland Shire Council's area.

Rylstone and Cudgegong Shires (33.44 miles to 77.20 miles from Lithgow)

Upon taking over control of the lengths in these Councils' areas on the 1st January, 1946, the Department of Main Roads first established a small maintenance organisation, which was controlled from the Department's Local Office already existing at Bowenfels.

In 1951, the Department carried out some reconstruction and surfacing for a length of 3 miles between the northern side of Cherry Tree Hill and Ilford, and between then and 1954 reconstructed an additional length of about 3 miles in short lengths in both Ryl-

Typical view on the Lidsdale–Mudgee Trunk Road.



Looking north along the reconstructed road from Stoney Pinch Cutting.

stone and Cudgegong Shires where the work could be done at low cost, thus giving the maximum benefit for the expenditure.

In the meantime the Department had critically examined the whole length and carried out surveys over the greater part. Until 1954 all work on the road done by the Department had been controlled from the Department's Local Office at Bowenfels, but as more extensive construction work was undertaken a Local Office was established at Running Stream, 4 miles north of the Blaxland Shire boundary.

Work proceeded progressively northwards from the Blaxland Shire boundary, each length being sealed as completed. When the work in Rylstone Shire was nearing completion and a start had been made in Cudgegong Shire, the Local Office was moved north to Apple Tree Flat, 12 miles south of Mudgee.

The Local Office and depot were staffed with an engineer, and at times with an assistant also, a foreman and three clerks. Living quarters, mess huts, offices and stores were made up from weatherboard huts, 16 feet x 14 feet, which could be transported bodily on trucks. A workshop fitted with equipment for servicing and repairing plant was established at the depot.

On these works, which extended over four years, an average of about forty men, mostly recruited locally, was employed. The plant used varied to some extent depending on the class of work in hand at the time, but generally comprised one ¾-cubic yard excavator, four heavy tractors, two medium tractors, five scrapers ranging from 6 to 12 cubic yards, two heavy powered graders, one light grader, five compressors, rollers and sundry small plant. In addition, utility trucks were used for supervision, and one or two departmental vehicles for general purposes. For general

Reconstructed road approaching Mudgee.

haulage, including gravelling operations, hired trucks were used.

On many sections it was necessary first to prepare contour plans and locate deviations before final surveys were made. The major obstacles and inadequacies were where ridges and ranges of hills had to be crossed.

The road throughout the Shires of Rylstone and Cudgegong was built to 50 m.p.h. standard with minimum radius curves of 800 feet excepting that in a few cases such as at Cherry Tree Hill and at Stoney Pinch grades of up to 10 per cent. were adopted. Two 600 feet curves were also used at Cherry Tree Hill. The formation and pavement widths are 26 feet and 18 feet respectively.

In the reconstruction only one new bridge was built, namely at Cunningham's Creek, where a reinforced concrete structure of four 18 feet spans was provided. Many reinforced concrete box culverts were built up to four cells 10 feet x 6 feet, and at Stoney Pinch a corrugated steel pipe 165 inches in diameter and 140 feet long was built with 25 feet of filling over the top of the culvert. The ends of this pipe culvert were shaped to suit the fill, and were protected against scour by grouted pitching on the adjoining slopes. Near Mudgee, on a length which had previously been built and bitumen surfaced, there were five causeways where traffic was blocked in times of heavy rain. These were all replaced with reinforced concrete box culverts.

The total quantity of earthworks was 295,000 cubic yards. The largest cutting was at Stoney Pinch, and contained 36,000 cubic yards, of which about half had to be blasted. The country traversed varied and included granite, limestone, sandstone and shale. In some cases the material could be ripped with heavy tractors, but particularly in the lower layers much blasting had to be resorted to.

As the road crosses many minor ranges of hills these provided the main difficulties and heavy work. The major sections concerned were at Cunningham's Creek, Aaron's Pass, south of Cudgegong village, Limestone Creek, Stoney Pinch and Martin's Hill.

The pavement depths were determined by testing of sub-grade samples in the Divisional Laboratory. Suitable granite gravels were located towards the northern end of Rylstone Shire, but there was a scarcity of suitable gravels in other areas, and at the Mudgee end local gravels had to be stabilised with sand. Where the hauls were not long or the gravel costly the full width of the formations was gravelled, but in other places the pavement was constructed to 20 feet and sealed 18 feet.

Compaction of fillings was done by sheepsfoot and pneumatic tyred rollers assisted by construction equipment and traffic, and in order to allow for some subsequent settlement, particularly in heavy earth fills, sand seals were used as a temporary measure and retained in service for up to two years. Any irregularities which had then developed were corrected prior to final sealing.

The sand seals referred to above were carried out by applying .20 gallon of fluxed bitumen per square yard with the percentage of kerosene flux 10 per cent. greater than would be the case for normal aggregate flush seals. The sand used was the coarsest available, generally granitic sand. The rate of application of sand was about one cubic yard to 120 square yards, and additional sand was added as necessary to maintain a full cover for a period of up to ten days. The sand seals showed no tendency to bleed, and had a grey coloured surface of non-skid qualities.

When aggregate seals were applied direct to the pavement primers were not used, but water emulsion made from about 1½ drums of emulsion to 800 gallons of water was applied generally in about two applications, and this treatment was found to be satisfactory in holding the pavement for a few months, but when protracted wet weather occurred it was sometimes necessary to reshape the pavement afresh.

Sealing was done with 80-100 bitumen and crushed limestone aggregate supplied by local contractors. These contractors had only small plants and set them up solely for the Department's requirements. As they would have had difficulty in disposing of sizes not usually required, the whole product of the crusher from ¾-inch down, but excluding dust, was used by sealing some sections with ¾ inch and others with ½ inch and using the ⅜ inch and 3/16 inch material for a second aggregate cover. The spraying of the bitumen and spreading of the aggregate were carried out by the Department's organisation.

Road Traffic Surveys on Main Roads

General

In order to make it possible to provide Main Roads which will best serve their purpose, it is essential in many cases that the nature, volume and objectives of traffic be known. Such information is obtained by carrying out traffic surveys.

The two types of traffic survey most commonly used are those involving either the recording of the nature and volume of traffic, or ascertaining the origin and destination of traffic.

The recording of the nature and volume of traffic passing any place may be done manually, or the volume may be recorded by automatic counters. Usually automatic counters are actuated by an air switch which receives impulses as vehicles pass over a pneumatic tube stretched across a road. The automatic counter records the numbers of axles which pass across the tube and these are adjusted subsequently to make allowance for multi-axled vehicles. Automatic traffic counters may be installed permanently to obtain continuous traffic data (see Figure 1) or temporarily to

Figure 1.

obtain information to assist in dealing with a particular problem (see Figure 2).

Some of the automatic traffic counters in use on Main Roads in New South Wales have been designed and manufactured by the Department of Main Roads, while others are of either American or British commercial origin.

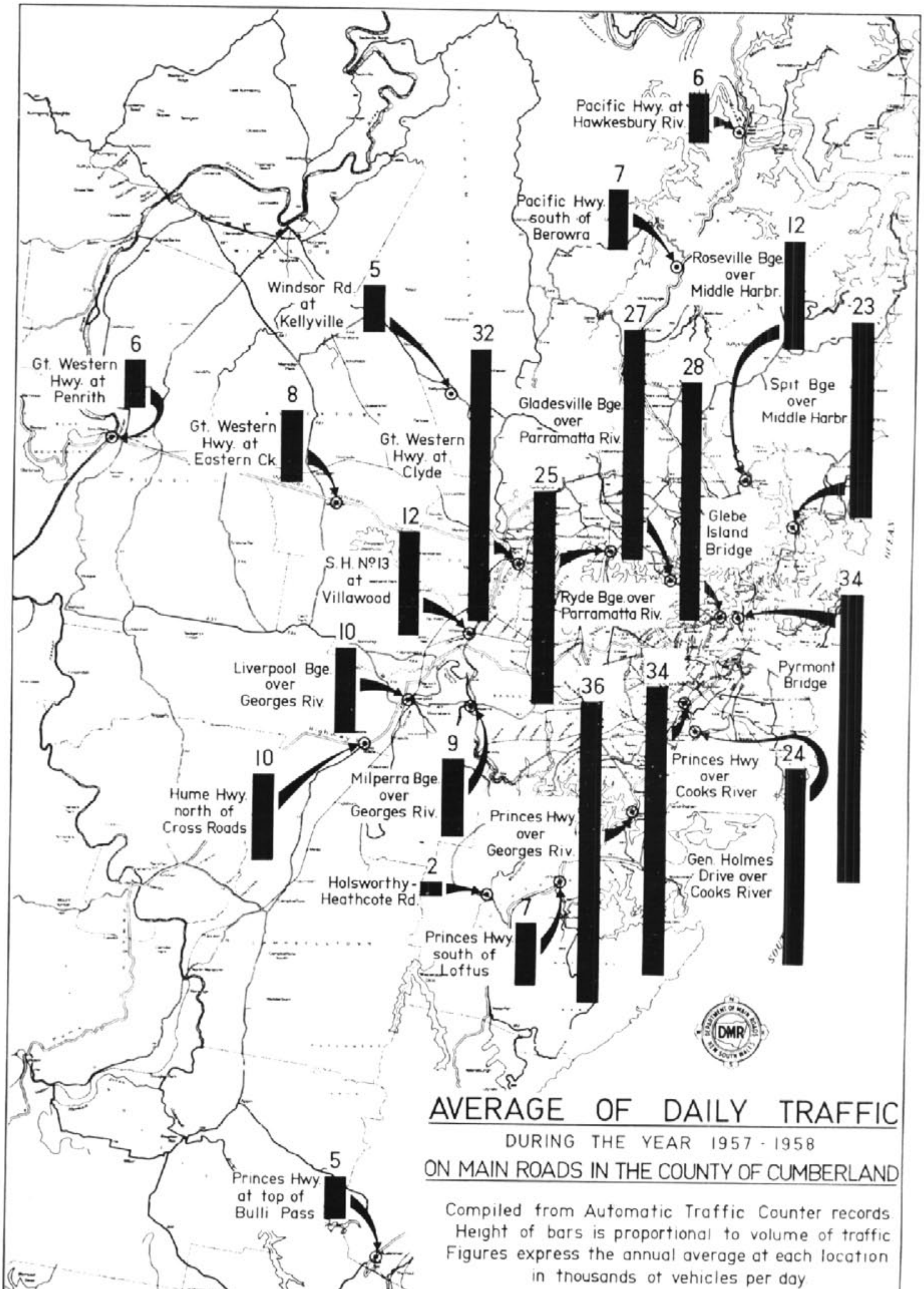
When a traffic volume survey is carried out manually, the types and sizes of vehicles are recorded, but when counting is carried out automatically it needs to be supplemented by manual counts if a classification of vehicles is required.

An "origin and destination" survey is used when the need arises for more comprehensive traffic data than is obtained by a simple count of traffic. For example, a count of traffic using various roads may not reveal the requirements of traffic because when traffic facilities are inadequate or unsuitable, some traffic may be forced to follow routes which are neither suitable nor logical. In such cases, therefore, it is necessary to obtain data showing both where traffic is coming from and where it is proceeding to.

Origin and destination studies are essential for planning new facilities or making large scale alterations to traffic movement. Such surveys are generally carried out in connection with specific problems and are planned to obtain all the information required for the solution of those problems. On the other hand, traffic

Figure 2.

Figure 3.


6
Pacific Hwy. at Hawkesbury Riv.
7
Pacific Hwy. south of Berowra
12
Roseville Bge. over Middle Harbr.
5
Windsor Rd. at Kellyville
32
27
23
6
Gt. Western Hwy. at Penrith
8
Gt. Western Hwy. at Eastern Ck.
Gt. Western Hwy. at Clyde
Gladesville Bge. over Parramatta Riv.
28
Spit Bge over Middle Harbr
25
12
S.H. Nº13 at Villawood
Glebe Island Bridge
Ryde Bge. over Parramatta Riv.
34
10
Liverpool Bge. over Georges Riv.
36
34
Pyrmont Bridge
10
Hume Hwy. north of Cross Roads
9
Milperra Bge. over Georges Riv.
Princes Hwy over Cooks River
24
Princes Hwy over Georges Riv.
2
Holsworthy-Heathcote Rd.
Gen. Holmes Drive over Cooks River
7
Princes Hwy south of Loftus
DMR
AVERAGE OF DAILY TRAFFIC
DURING THE YEAR 1957 - 1958
ON MAIN ROADS IN THE COUNTY OF CUMBERLAND
5
Princes Hwy at top of Bulli Pass
Compiled from Automatic Traffic Counter records.
Height of bars is proportional to volume of traffic.
Figures express the annual average at each location in thousands of vehicles per day.

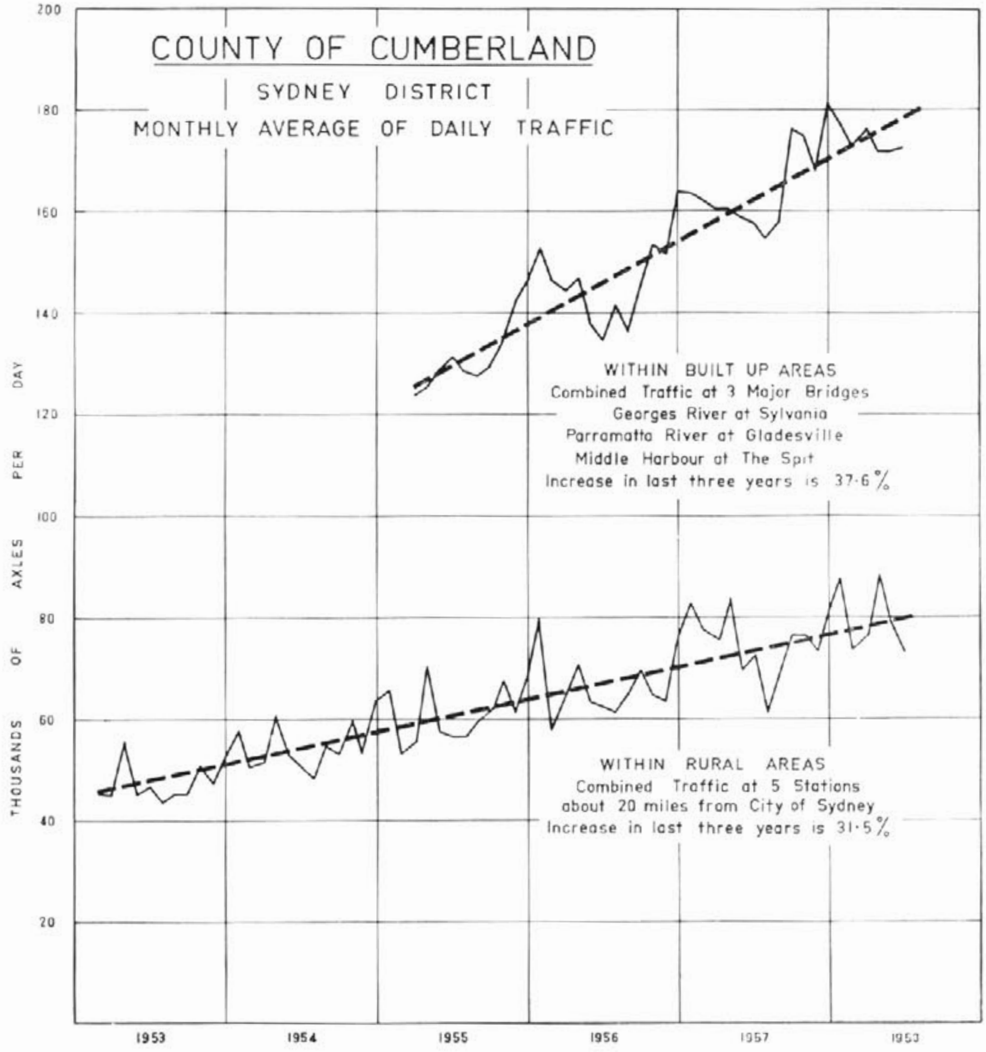


Figure 4.

volume data are required for many purposes and it is necessary that surveys of this type should be continued year by year so that data are kept up to date.

An origin and destination survey was made on the Sydney Harbour Bridge in March, 1957, the results of which are reported in "Main Roads" for September, 1957. In that case, the object of the survey was to obtain information in advance to assist in determining the most satisfactory arrangements for dealing with the altered movement of traffic which would result from the bringing into use of the Cahill Expressway.

More recently, on behalf of the Transport Economic Research Committee of the Australian Transport Advisory Council, the Department of Main Roads conducted origin and destination surveys at a number of points in the country on Interstate Highways.

In order to obtain and have available at all times traffic volume information of as accurate a nature as possible, the Department of Main Roads has a special group engaged in the collection of this information, comprising field staff equipped with automatic traffic counters and office staff for management of the surveys and the analysis and presentation of the data obtained. This is supplemented by permanent continuously operating traffic volume counters installed on Main Roads at 43 locations throughout the State.

County of Cumberland

In the County of Cumberland, recent traffic surveys carried out by the Department of Main Roads have been mostly by means of automatic traffic counting stations supplemented by peak-hour manual traffic counts to obtain information to assist in dealing with particular problems.

The Department of Main Roads has permanent automatic traffic counters operating continuously at 22 locations on Main Roads in the County of Cumberland. At these 22 locations, over 100,000,000 vehicle journeys were recorded during the year ended 30th June, 1958. Fig. 3 indicates the locations of the stations and shows graphically the average daily traffic at each station. It will be seen that the station which recorded the highest daily average traffic is that located at the bridge over George's River on the Prince's Highway, where the average reached 36,000 vehicles per day. There are, however, other Main Roads in the County of Cumberland carrying higher traffic volumes than this. The most heavily trafficked road appears to be the Bradfield Highway, which includes the Sydney Harbour Bridge, where the average daily traffic in 1958 was 65,000 vehicles.

At some locations the continuous record extends over a sufficient period to show the trends in traffic growth, both within the built-up areas and beyond. Fig. 4 shows the combined traffic on three important routes within built-up areas, and also the combined traffic on five major radial routes at about 20 miles from Sydney. It will be seen that over the past three years the combined volume of traffic at the three points within the built-up area increased by 37.6 per cent., while the combined volume of traffic at the five locations increased by 31.5 per cent. During the same three years, motor vehicle registrations in New South Wales increased in total by 21.5 per cent. The rate of increase in registrations within the County of Cumberland is not known precisely, but it is believed to be approximately the same as for the State as a whole.

Country

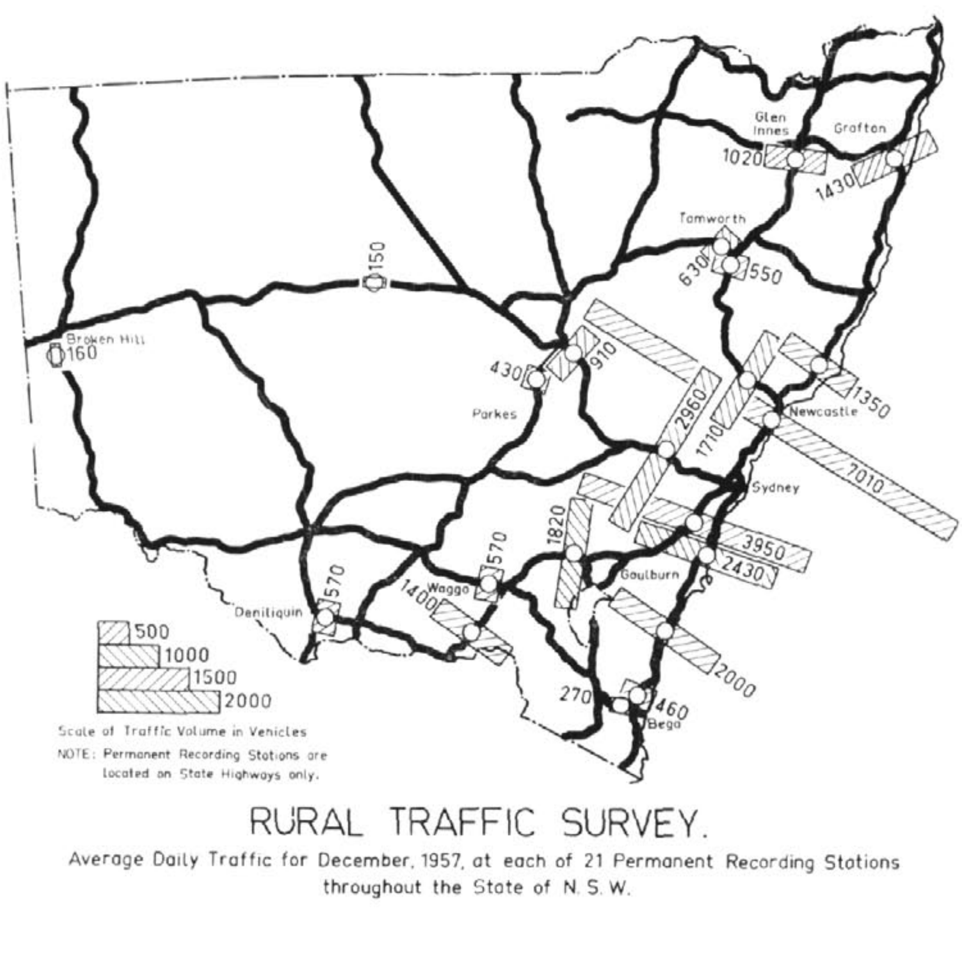
A comprehensive traffic survey of principal Main Roads in the country was commenced by the Department of Main Roads in February, 1956. Prior to that date, surveys had been undertaken only at irregular intervals. By June, 1958, representative figures had been obtained on all State Highways except for some sections in the far western part of the State where the traffic volume is less than 50 vehicles per day.

Since the survey was commenced, traffic counts have been taken at 1,146 locations. The majority of these counts were by means of automatic traffic counters installed for a period of 7 days and the remainder were manual classification counts, usually over twelve hour periods between 7.00 a.m. and 7.00 p.m.

In addition to the short duration counts already mentioned, continuous counts are being taken at 21 permanent automatic recording stations on State Highways. The locations of these stations is shown in Fig. 5 which also shows diagrammatically the average daily traffic for December, 1957. The counters at these stations are read twice weekly.

The monthly average daily traffic during the year ended 30th June, 1958, compared with the average

Figure 5.



RURAL TRAFFIC SURVEY.

Average Daily Traffic for December, 1957, at each of 21 Permanent Recording Stations throughout the State of N. S. W.

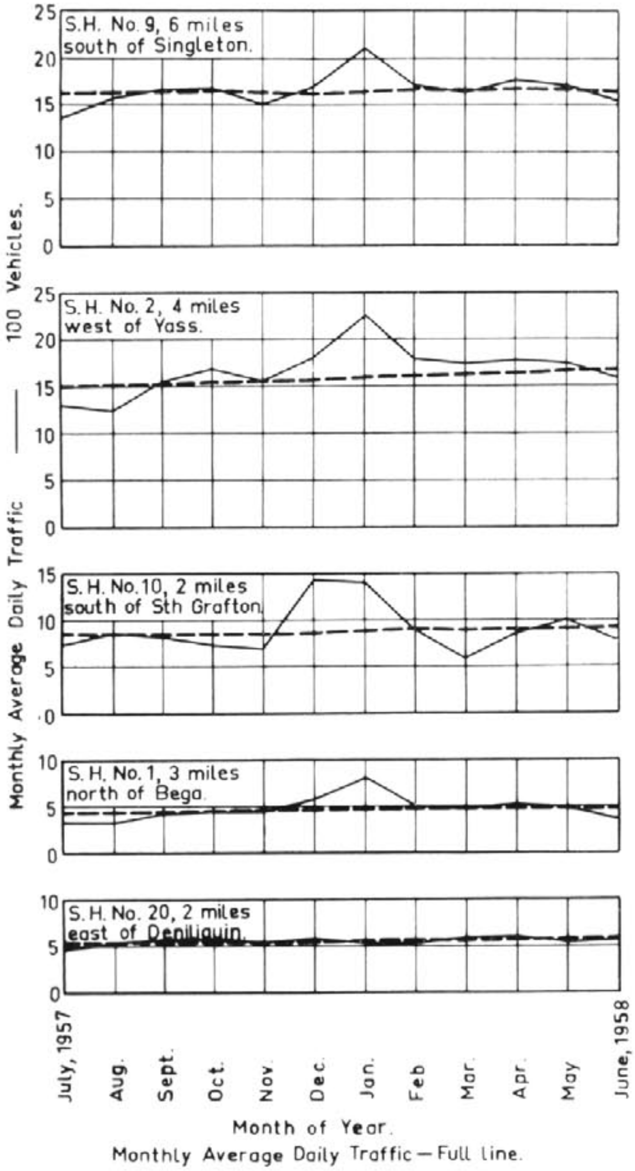


Figure 6.

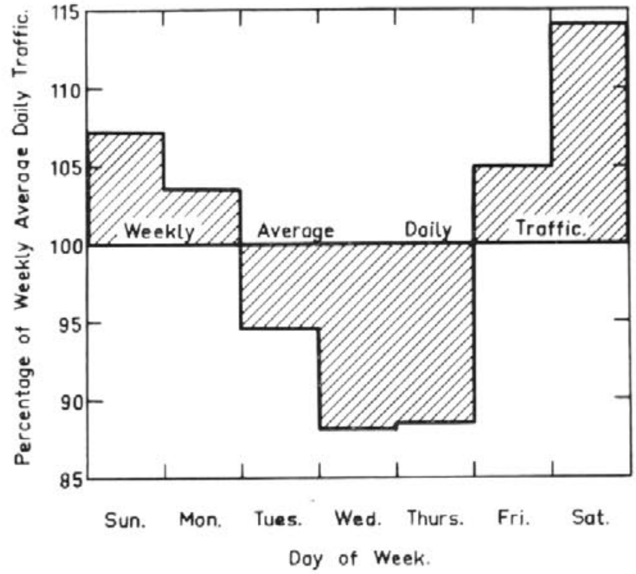


Figure 7.

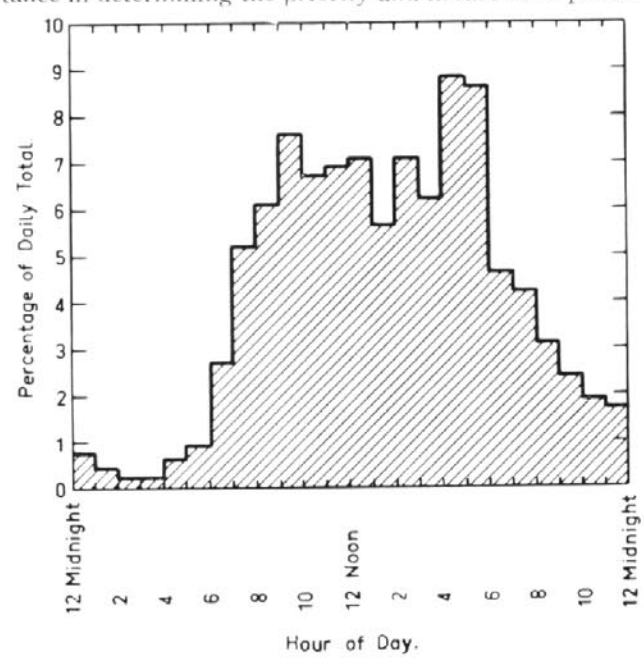


Figure 8.

daily traffic for the preceding twelve months at five of the permanent recording stations is shown in Fig. 6.

Quarterly classification counts, over periods varying from 24 hours to 14 days, are carried out each year at the following four stations—

(i) Pacific Highway (State Highway No. 10) at junction with Trunk Road No. 90—2 miles south of Taree.

(ii) Trunk Road No. 90 at junction with Main Road No. 111—5 miles south of Stroud.

(iii) Snowy Mountains Highway (State Highway No. 4) at junction with Main Road No. 286 —4 miles west of Cooma.

(iv) Hume Highway (State Highway No. 2) at junction with Trunk Road No. 56—5 miles west of Yass.

Typical variations which may occur in traffic volumes on different days in one week are shown in Fig. 7. Fig. 8 shows typical hourly variations which may occur in traffic volumes during a single day.

The information obtained from this data is of assistance in determining the priority and nature of improvement works including bituminous surfacing, widening, provision of third lanes on hills for slow moving vehicles and the strengthening of pavements. It can also assist in determining the most suitable time for carrying out repairs to roads and bridges when part of the roadway must be closed to traffic. Knowledge of present traffic volumes and traffic trends is essential in predicting future traffic needs and for long range planning of road improvements.

Soils and Rocks in Road Construction in New South Wales

PART IV: ROCKS—DESCRIPTIONS OF THE MAIN TYPES SUITABLE FOR ROADWORK, THEIR OCCURRENCE AND USE

THE three previous articles in this series were published in the June, 1956, September, 1956, and June, 1957, issues. Parts I and II dealt with the occurrence, classification and test results of the principal soils of New South Wales which are important as road foundations. Part III covered the use of rock as a road-making material, the qualities desirable for particular types of construction and the tests used by the Department of Main Roads in assessing these qualities. Part IV deals with the descriptions of the main types of rock suitable for roadwork, their occurrence and their use, having regard to their quality as determined by the tests outlined in Part III.

General Uses of Rock

The principal uses of rock as a road-making material in New South Wales are in the following types of work: "gravel" type pavements from shale and soft rocks, sandstone pavements, fine crushed rock and macadam pavements or courses, bituminous concrete, cover aggregate for bituminous surface treatment, and aggregate for portland cement concrete for pavements, bridges and other structures.

Rocks commonly available for roadwork in New South Wales include basalt, dolerite, andesite, granite, porphyry, rhyolite, sandstone, limestone, shale, conglomerate, quartzite, river gravel and slag. The generalised geological map of New South Wales, opposite, indicates broadly the areas where these rocks (or groups of rocks) are usually found.

A. Igneous Rocks

Basalt

From the road engineering viewpoint, basalt is the principal volcanic rock. It is a fine-grained, compact, basic*, aphanitic** rock, dark in colour, containing plagioclase and augite as the common constituents, frequently having also magnetite and olivine, and not uncommonly having olivine as the principal ferromagnesian silicate. Although generally dense, it sometimes exhibits vesicular structure.

Basalt occurs in widely scattered areas along the eastern half of New South Wales as shown in Fig. 1. It is usually hard, tough and dense with good resistance to wear and good shape on crushing. However, cases have been noted of apparently sound rock containing secondary minerals which soften or disintegrate in water, this property being detected by the "Plate" Test. Many basalts show a tendency to strip from bitumen in the presence of water and may require the use of an anti-stripping agent or precoating to overcome this defect. Several cases of "polishing" of basalt aggregate have been observed. Polishing results in reduced resistance to skidding when a road is wet.

Sound basalt aggregate can be used for all classes of roadwork, but careful consideration should be given to the use of vesicular basalt, as this material is likely to break down under weathering and traffic.

Gravels produced from the natural weathering of basalt are often poorly graded and high in clay content and hence not satisfactory for pavement construction. However, several instances occur of basalt injections which have undergone breaking down into small pieces upon cooling, producing materials of satisfactory base course quality.

Dolerite

Dolerite is a fine to medium-grained basic, igneous rock containing minerals similar to those in basalt. Dolerite is not widespread in New South Wales, but generally is hard and tough, although not as dense as basalt. It has stripping tendencies similar to basalt; no cases of "polishing" have come under notice. Dolerite is suitable for use in most roadwork requiring a hard rock. A considerable proportion of the crushed stone used in the Sydney area is dolerite.

Partially weathered dolerite, while being reasonably hard, does not produce a satisfactory proportion of the finer fractions and thus to use it in a fine crushed rock or "gravel" type pavement may require the addition of other material. By comparison, volcanic breccia (e.g., from St. Marys) produces a material, when the partially weathered rock is crushed, which can be used satisfactorily for graded aggregate constructions.

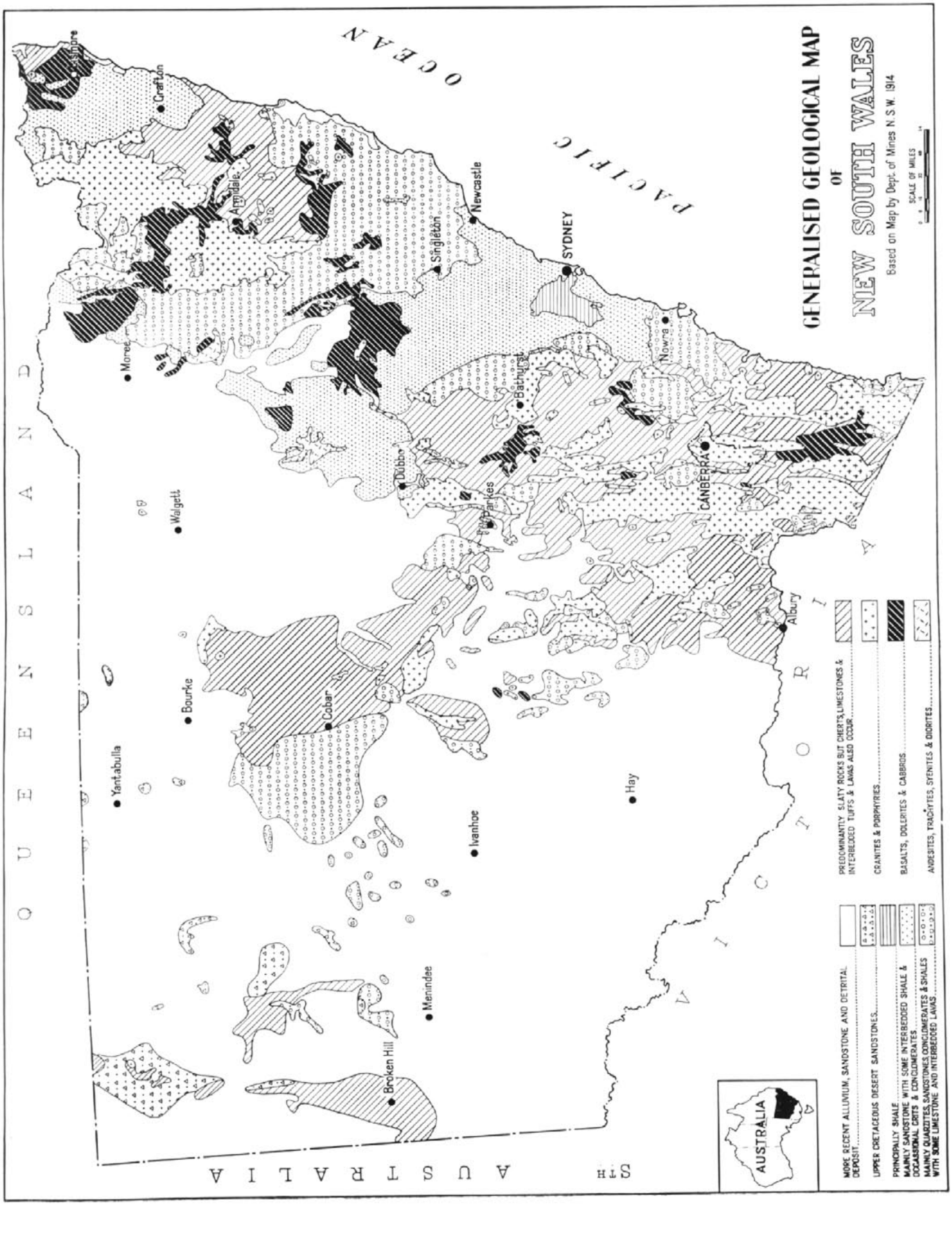
As is the case with basalt, extreme care should be exercised in the use of gravels produced from the weathering of dolerite, as they are usually very clayey and hence unsuitable for pavement construction.

Andesite

This is a compact aphanitic rock, frequently with individual large crystals of plagioclase, somewhat lighter in colour than basalt, and intermediate in composition between basalt and granite. Andesite is suitable for use in most classes or roadwork, but almost invariably strips from bitumen and tests should always be carried out to determine this property.

* Basic = having a silica content of less than 52 per cent.

** Aphanitic = with mineral crystals indistinguishable to the naked eye.


GENERALISED GEOLOGICAL MAP
OF
NEW SOUTH WALES
Based on Map by Dept. of Mines N.S.W. 1914
SCALE OF MILES
PACIFIC OCEAN
QUEENSLAND
VICTORIA
STH AUSTRALIA
AUSTRALIA
Grafton
Armidale
Newcastle
Singleton
SYDNEY
Nowra
Moree
Bathurst
Dubbo
Parkes
CANBERRA
Walgett
Albury
Bourke
Cobar
Yantabulla
Hay
Ivanhoe
Menindee
Broken Hill
MORE RECENT ALLUVIUM, SANDSTONE AND DETRITAL DEPOSIT
UPPER CRETACEOUS DESERT SANDSTONES
PRINCIPALLY SHALE
MAINLY SANDSTONE WITH SOME INTERBEDDED SHALE & OCCASIONAL GRITS & CONGLOMERATES
MAINLY QUARTZITES, SANDSTONES, CONGLOMERATES & SHALES WITH SOME LIMESTONE AND INTERBEDDED LAVAS
PREDOMINANTLY SLATY ROCKS BUT CHERTS, LIMESTONES & INTERBEDDED TUFFS & LAVAS ALSO OCCUR
GRANITES & PORPHYRIES
BASALTS, DOLERITES & GABBROS
ANDESITES, TRACHYTES, SYENITES & DIORITES

Granite

Granite is the principal course-grained igneous rock. Granites found mostly in New South Wales are so-called acidic† rocks and contain quartz, felspar and mica or hornblende. Other representatives of this group, e.g., diorite, might contain biotite mica and sometimes augite. Granite has a brittle and crystalline structure and possesses fair to good resistance to abrasion. Sound granite is durable and resistant to weathering. Its shape when crushed is generally not as satisfactory for use in roadworks as that of finer grained rocks, particularly in relation to mechanical interlock. It has generally poor resistance to stripping from bitumen and requires the use of anti-stripping agents.

Granites are not extensively used as aggregates for road-making. However, gravels derived from natural weathering of granite are extensively used for flexible pavement construction; some granite gravels, however, contain a high clay content and these should not be used. Granite gravels with a high mica content should be avoided, because mica, due to its flakiness, makes packing of the particles difficult with a resultant adverse effect on field compaction procedures. These gravels are readily detected in laboratory testing and usually have a high liquid limit.

Porphyry

This igneous rock contains phenocrysts, i.e., large mineral crystals, usually of quartz or felspar, in a fine groundmass. It is intermediate in grain size between basalt and granite, and is hard and durable. Its resistance to stripping from bitumen is similar to that of granite. It is not extensively used as aggregate for road-making, but as is the case with granite, gravels derived from natural weathering find use in flexible pavement construction. Gravels derived from porphyry often give material of superior quality to the detrital gravels.

Rhyolite and Syenite

Rhyolite is an acidic, aphanitic to glassy rock of volcanic origin, usually light coloured, sometimes with phenocrysts of quartz and felspar. It corresponds in chemical composition to granite and quartz-porphyry. It is suitable for most classes of roadwork, but has not been extensively used due to its comparatively limited occurrence in New South Wales. Gravels derived from natural weathering are similar to granite gravels, but are free from mica and frequently are deficient in sand sizes.

Syenite consists predominantly of felspar (usually orthoclase) with subordinate amounts of hornblende, mica, etc., but with little or no quartz. Its qualities and uses are similar to Rhyolite.

B. Sedimentary Rocks

Sandstone

Sandstone is a variable material composed of water-worn grains of sand cemented together by one of the following: (*a*) carbonate of lime; (*b*) oxide of iron; (*c*) silica; (*d*) clay. The sandstone group of rocks includes also siltstone, grit, conglomerate, and greywacke, depending on the grain size of the fragments.

Due to their granular composition and the variable nature of the cementing material members of the sandstone group are generally unsuitable for use in a number of classes of roadwork, e.g., for bitumen-aggregate mixtures, cover aggregate for bituminous surface treatment and aggregate for portland cement concrete. However, they may be used in pavement construction, particularly as base courses, in the absence of more suitable materials or for economy.

Because of the composition and variable hardness of the members of the sandstone group, the usual tests for soils and gravels do not apply. They may be evaluated for use in pavement construction by a crushing test on soaked material. Sandstone pavements depend on the wedging and bedding of large pieces, assisted by the jamming and friction of the smaller pieces and sand in the voids and not on the stability of a graded matrix, formation of which is prevented by the granular composition.

The resistance to weathering is variable depending on the cementing agent. It is usual to check this property in the laboratory if there is any suspicion of poor resistance to weathering.

Conglomerate

Conglomerate consists of rounded and water-worn material of different sizes, ranging from pebbles up to large boulders, embedded in a matrix of finer material (mostly sand). These are usually made up of the more resistant varieties of minerals and rocks that may have travelled some distance from their original source and the rock pebbles may be derived from original igneous or sedimentary rocks, or their equivalent metamorphic ones. Silicious pebbles are probably the most common found in conglomerates.

Conglomerates are entirely aqueous in origin and usually exhibit more or less characteristic stratified or bedded structure, which is apt to be less distinct in the coarser types. They usually mark the lowest member of a sedimentary series and are of widespread occurrence among sedimentary rocks.

Conglomerate varies in hardness depending on the type of matrix and the effect of deposition circumstances. It is extensively used for pavement construction, mostly without the need for crushing and screening in the quarry.

Limestone

This is the principal member of the calcareous group of rocks resulting from the chemical deposition of Calcium Carbonate or from the accumulation of the remains of shells, corals, etc. A wide variety of texture exists, varying from very fine-grained to sugary or coarse texture (e.g., marble). This difference in texture is reflected in results obtained in the Los Angeles

† Acidic = having a silica content of more than 65 per cent., showing free quartz crystals.

Abrasion Test and accounts for losses varying between 18 and 42 as shown in the table in Part III of this series. Limestone has generally good resistance to weathering and is unique in that it has generally very good affinity for bitumen. Whilst it usually yields a well-shaped aggregate, it sometimes tends to wear quickly, resulting in the formation of a slippery pavement.

Limestone may be used in all classes of roadwork. It also finds use, when crushed to a fine dust, as a filler in fine crushed rock and macadam pavements and bituminous mixtures.

There are other rocks containing Calcium Carbonate which are allied to limestone and which in some instances may be used as bitumen surfacing aggregate and for pavement construction, e.g., dolomitic limestone, travertine, and nodular limestone ("Kunkar").

Gravel produced from secondary limestone is used for pavement construction in some inland areas, although in some instances it requires stabilising (e.g., with coarse sand) to produce a gravel suitable to receive a bitumen surface.

Another member of the limestone group, gypsum (called "Kopi" in its powdered form) can, when mixed with an appropriate proportion of loam, produce a road surface for light traffic in areas of low rainfall.

Shale

This is the principal member of a group of rocks referred to generally as soft rocks. Other rock in this category, include mudstone, phyllite, slate, mica schist, breccia, tuff and chert. These are usually harder than shale. The principal use of shale in pavement construction is by in-situ breakdown to a well-graded "gravel" under the action of construction plant. Some of the harder varieties, however, may require crushing prior to use in pavement construction.

It is necessary with shale and other "soft rocks" to determine carefully in the laboratory the amount of weathering which is likely to occur (i.e., by an Accelerated Weathering Test) and whether the material is of suitable hardness, i.e., hard enough to withstand abrasion but not so hard as to resist breakdown under construction plant. Careful determination of adverse constituents is also necessary, e.g., excess of mica in phyllite and mica schist.

C. Metamorphic Rocks

Quartzite

Quartzite is a hardened sedimentary rock (e.g., an altered standstone). It is hard and tough, but does not possess the cementitious properties that some other rocks do (e.g., basalt) for use in fine crushed rock or macadam pavements. Quartzite has a tendency to strip from bitumen in the presence of water, but this can be corrected by the use of suitable anti-stripping agents. No cases of "polishing" have been detected. Quartzite finds use in most classes of roadworks.

An interesting material in this category is a quartzite stringered gypsum from a deposit near Mullumbimby. It breaks down under rolling to a satisfactory grading but has a low maximum dry compressive strength. Despite this, it has given good service to date as a pavement material and this is attributed to good mechanical interlock.

There are a number of other metamorphic rocks which find use in pavement construction. Typical of these are phyllite, slate, mica schist—however, these materials usually require similar construction technique to shale and they have thus been dealt with in that section.

River Gravels and Sands

Extensive deposits of river gravel occur along the major streams of New South Wales. Deposits show a wide variation in composition and size, depending upon rock types, topography and climate. They become progressively finer and sparser as the distance from the Great Dividing Range increases, particularly in the western part of the State.

River gravels may consist of quartz, quartz porhyry, basalt, etc., whilst metamorphic rocks are fairly common. They are generally hard and durable but usually contain a certain proportion of soft and absorbent pieces, which may not adversely affect the loss determined by the Los Angeles Test, but which may show up if the Los Angeles Test is carried out on material representing the weakest 10 per cent. of the sample. River gravels almost invariably tend to strip from bitumen in the presence of water, but are usually satisfactory when anti-stripping agents are used. No cases of "polishing" have been observed.

River gravels are extensively used throughout New South Wales as aggregate for bitumen surfacing and also in cement concrete. Some use is also made of these materials for pavement construction, e.g., when mixed with loam as binder to form a "gravel" type pavement.

River sand finds use in stabilising naturally occurring gravels which are deficient in the sand fraction for pavement construction and as fine aggregate for cement concrete.

Slag

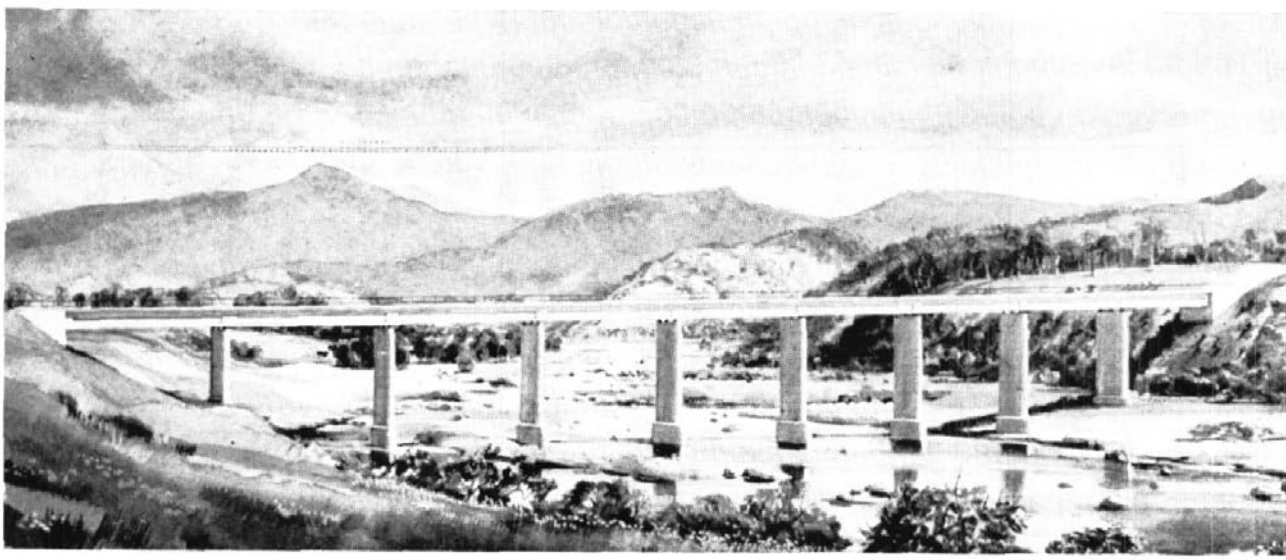
Large quantities of blast-furnace slag are continuously produced from Steelworks at Newcastle and Port Kembla, whilst there is a large stockpile of slag at the site of the old blast furnaces at Lithgow. Considerable use has been made of crushed and screened slag for roadworks, as pavement material for macadam type pavements, as cover aggregate for bitumen surfacing work, and to a lesser extent for bitumen-aggregate mixtures and portland cement concrete.

Crushed slag varies considerably, not only as between different sources but also in the material produced at any one source. It usually consists of a mixture of stony, vesicular and glassy pieces. The former are reasonably hard and tough, but the vesicular pieces are somewhat softer and the glassy pieces are brittle. The Los Angeles loss on these two latter varieties of slag is usually greater than that of the stony pieces and of the whole sample. As they are often present in comparatively large proportions, the Los Angeles Test carried out on material representing the weakest 10 per cent. of the sample often causes the sample to be outside specification limits. Crushed blast furnace slag is generally well-shaped with little tendency to "strip" from bitumen or "polish" under traffic.

At some of the old copper mining and smelting areas of the State there are dumps of slag which have needed only loosening (by power shovel) and screening to produce a good cover aggregate for bitumen surface treatment.

New Bridge over the Mann River at Jackadgery

Tender Accepted



An artist's impression of the bridge.

A contract has recently been entered into between the Department of Main Roads and Messrs. Thiess Bros. Pty. Ltd. for the construction of a bridge across the Mann River about 31 miles east of Grafton on the new route of the Gwydir Highway now under construction. The contract price for the construction of the bridge is £226,114 4s. 9d., the contract time for completion being 78 weeks.

The bridge was designed for the Department by G. Maunsell & Partners, Consulting Engineers of London and Melbourne. It will have an overall length of 926 feet made up of seven spans of 105 feet and two shore spans of 95 feet 6 inches. The width of the carriageway between kerbs is 24 feet and the kerbs have been widened to two feet on each side to serve as refuges for the occasional pedestrians using the bridge.

The superstructure will consist of prestressed concrete girders with a reinforced concrete roadway cast in situ.

The piers are intended to be built with precast prestressed concrete outer shells, which will be filled with reinforced concrete supported on steel driven piles.

The Mann River is a tributary of the Clarence River on the North Coast. At the bridge site the river flood height is 50 feet above the normal water level shown in the illustration.

Tenders Accepted by Department of Main Roads

The following tenders (in excess of £3,000) were accepted by the Department of Main Roads during the three months ended 30th June, 1959.

Work or Service	Name of Accepted Tenderer	Amount
		£ s. d.
State Highway No. 2 Hume Highway. Shire of Holbrook. Cement modification of gravel pavement between 35·62 m. and 38·28 m. south of Tarcutta.	Stabilisers Ltd.	8,228 0 0
State Highway No. 10. Pacific Highway. City of Newcastle. Construction of bridge over Ironbark Creek at Hexham.	L. Delatorre	49,206 12 2
State Highway No. 10. Pacific Highway. Shire of Stroud. Supply and delivery of 2,400 cu. yds. of crushed aggregate to 2·4 m. north of Karuah.	Frost Constructions Pty. Ltd. ...	4,530 0 0
State Highway No. 17. Newell Highway. Shire of Jerilderie. Supply and delivery of aggregate between 13·6 m. and 20·0 m. north of Jerilderie.	Berrigan Quarries Pty. Ltd. ...	4,803 15 2
Shire of Wentworth. Trunk Road No. 68. Reconstruction of bridge over Rufus River at outlet from Lake Victoria.	Handley, Liardet and Briggs ...	7,878 0 0
Municipalities of Drummoyne and Hunter's Hill. Main Road No. 165. Construction of bridge over the Parramatta River at Gladesville.	Reed and Mallik Ltd., and Stuart Bros. Pty. Ltd.	2,365,289 0 0
Shire of Muswellbrook. Main Road No. 208. Construction of bridge over Goulburn River at Sandy Hollow.	Giovenco Constructions Pty. Ltd.	97,300 1 4
Shires of Illabo and Gundagai. Construction of bridge over Murrumbidgee River at Tenandra.	Elweld Pty. Ltd.	31,053 12 3
Supply and delivery of 80/100 penetration residual bitumen during the period 1st July 1959, to 30th June 1960.	Shell Co. of Australia Ltd. ...	140,861 13 4 (estimated)
Supply and delivery of 80/100 penetration residual bitumen during the period 1st July, 1959, to 30th June, 1960.	Bitumen and Oil Refineries (Aust.) Ltd.	199,738 15 0 (estimated).
Supply and delivery of up to 350,000 gallons of Petroleum Tar during the period 1st July, 1959, to 30th June, 1960.	Bitumen and Oil Refineries (Aust.) Ltd.	26,400 0 0 (estimated).

Main Road Funds

Receipts and Payments for the financial year ended 30th June, 1959

Heading	County of Cumberland Main Roads Fund	Country Main Roads Fund
	£	£
Receipts		
Motor Vehicle taxation (State) ...	1,630,237	6,520,947
Charge on heavy commercial goods vehicles under Road Maintenance (Contribution) Act, 1958 (State).	477,022	1,908,089
Receipts from Road Transport and Traffic Fund ...	....	190,831
Petrol taxation paid to the State by the Commonwealth Government ...	1,162,785	4,559,466
Receipts under Commonwealth Aid Roads (Special Assistance) Act, 1957 ...	138,200	552,797
From Councils under Section 11 of Main Roads Act and for cost of works ...	1,326,927	....
Miscellaneous ...	101,462	95,578
Total Receipts ...	£4,836,633	13,827,708
Payments		
Maintenance and minor improvement of roads and bridges ...	937,358	4,910,516
Construction and reconstruction of roads and bridges ...	2,138,705	6,825,927
Land acquisition ...	298,992	73,050
Administrative expenses ...	174,505	531,242
Loan charges—Payment of interest, exchange, management and flotation expenses...	....	190,789
*Miscellaneous ...	972,768	1,259,291
Total Payments ...	£4,522,328	13,790,815

* Includes transfers to Special Purposes Accounts for purchase of road plant, motor vehicles and other assets, and for the provision for special works.

Tenders Accepted by Councils

The following tenders (in excess of £3,000) were accepted by the respective Councils during the three months ended 30th June, 1959.

Council	Road No.	Work	Name of Accepted Tenderer	Amount £	s.	d.
Barraba S.	63	Reconstruction from 2·57 m. to 3·42 m. north of Barraba	C. T. Marshall	4,999	13	6
,, ...	360	Construction of bridge over the Horton River at Upper Horton.	Central Construction Co.	22,794	0	0
Bingara S. ...	63	Surfacing with Emulsion 24·8 m. to 29·1m. north of Barraba.	Construction Services Pty. Ltd.	5,114	6	6
Booiooroo S. ...	12, 16, 17	Bitumen Surfacing and Resurfacing various lengths totalling 182,698 sq. yds.	,, ,, ...	15,540	7	3
,, ...	17	Construction of a seven span R.C. bridge 165 ft. long over Gil Gil Creek at 24·01 m. north of Moree.	L. G. Rixon	15,770	16	0
Boree S. ...	61, 377	Bitumen surfacing 51,869 sq. yds. on various lengths between 26·57 m. and 40.1 m. west of Orange on Trunk Road 61 and 15,279 sq. yds. between 51·08 m. and 52·44 m. on Main Road 377 west of Orange.	B.H.P. By-Products Pty. Ltd.	4,176	10	9
Coolah S.	62	Construction of bridge over Coolah Creek at 0·3 m. south of Coolah.	A. Goor Pty. Ltd. ...	19,415	4	6
Coolamon S. ...	240, 243, 387, 398, 543	Supply and delivery of 13,840 cu. yds. of gravel to various locations. Average length of haul 4 m.	D. C. McCallum ...	3,710	15	0
Coonabarabran S.	17	Construction of 18 Pipe Culverts and Headwalls together with associated earthworks between 4·23 m. and 26·47 m. from junction with State Highway No. 11.	R. J. Hawkins	9,185	7	6
,, ...	129	Bitumen surfacing between 0·26 m. from Coonabarabran and the Ulamambri turn-off at 8.26 m.	Construction Services Pty. Ltd.	5,010	14	2
Demondrille S. ...	3096	Construction of a timber bridge over the Murrumbidgee River at Jugiong.	Central Construction Co.	17,386	0	0
Eurobodalla and Tallaganda S.	51	Construction of a 3 cell R.C. box culvert at 24·07 m. between Nelligen Creek and Mongarlowe River.	Stanley Constructions...	5,637	6	0
Murrurundi S. ...	358	Construction of R.C. box culverts at 7·2 m. and 7.49 m. from State Highway No. 9 near Willow Tree.	H. F. Eastoe	3,119	17	6
Namoi S. ...	72	Construction of R.C. box culverts at Tallamullen Creek 22·74 m. and 22·88 m. south of Narrabri.	Schmeide & Cook ...	12,027	0	0
Patrick Plains S....	181, 213	Bitumen surfacing of various lengths totalling 48,379 sq. yds.	B.H.P. By-Products Pty. Ltd.	4,333	13	0
,, ...	128, 181, 220, 213, 503	Supply and delivery to stockpiles of 1,699 cu. yds. of coarse aggregate and 1, 61 cu. yds. of fine aggregate.	D. H. Smith & Co. ...	5,652	11	3
,, ...	128, 181, 22[illegible], 503	Bitumen surfacing and resurfacing various lengths totalling 46,886 sq. yds.	B.H.P. By-Products Pty. Ltd.	3,964	4	5
Port Stephens S.	108	Construction of R.C. bridge over Tilligerry Creek ...	Thiess Bros. Pty. Ltd.	6,403	6	4
Sutherland S. ...	227, 2034	Bitumen Macadam resurfacing of 21,450 sq. yds. of Kingsway (Main Road 227) between Willarong Road and Jackaranda Road, and 2,800 sq. yds. on Lugarno—Sutherland Road (S.R. 2034).	Neuchatel Asphalte Co. (A/Asia.) Pty. Ltd.	10,460	8	10
,, ...	227	Bitumen Macadem resurfacing 5,900 sq. yds. on Port Hacking Road between Garnet Road and Bellingara Road and 7,600 sq. yds. on Kingsway between State Highway No. 1 and Gymea.	,, ,, ...	6,881	1	4
Tumbarumba S. ...	85, 282	Bitumen surfacing of various lengths totalling 45,936 sq. yds.	B.H.P. By-Products Pty. Ltd.	3,474	16	0
Tumut S. ...	85, 280	Bitumen surfacing of various lengths totalling 60,810 sq. yds.	,, ,, ...	3,873	4	10
Wakool S. ...	...	Win, load, haul and spread 27,536 cu. yds. limestone gravel and loam on Main and Trunk Roads in the Shire	J. C. Jones	4,613	5	0
,, ...	14	Supply and delivery of 41,580 gallons R.90 bitumen ...	Vacuum Oil Co. Pty. Ltd.	4,350	0	0
,, ...	14	Bitumen surfacing and resurfacing various lengths east of Balranald.	Emoleum (Australia) Ltd.	4,598	0	0
Waradgery S. ...	514	Shouldering and loaming of four sections between 2·6 m. and 36·5 m. west of Hay.	L. G. Jones	3,318	0	0
Wollongong G.C....	568, 581	Supply of up to 118,000 cu. yds. of filling between Link Road at 1·32 m. and Swan Street at 2·83 m.	Allied Constructions Pty. Ltd.	36,841	13	4
Yarrowlumla S. ...	51	Construction of R.C. bridge over Moura Creek	Golding Constructions Pty. Ltd.	6,406	0	0

MAIN ROADS STANDARD SPECIFICATIONS DRAWINGS AND INSTRUCTIONS

NOTE: Drawings are prefixed by letter "A", instructions are so described; all other items are specifications or forms. Year of revision, if within last 10 years, is shown in brackets.

Form No.

ROAD SURVEY AND DESIGN.

A 478 }
A 478A } Specimen drawings, country road design.
A 478C Specimen drawing, flat country road design.
A 478B Specimen drawings, urban road design.
A 1645 Stadia reduction diagram.
355 Design of two-lane rural highways. (Instruction.)
369 Design of urban roads. (Instruction.)
288 Design of intersections. (Instruction.) (1952.)
402 Design of acceleration and deceleration lanes. (Instruction.)
499 Design of kerb-lines and splays at corners. (Instruction.) (1952.)
A 1614 Widening at points of "A" sight distance.
A 83 Earthwork quantity diagram.
A 1640 Mould for permanent mark block.
Manual No. 2—Survey and design for main road works*
Policy for geometric design of rural roads—State Road Authorities*.

STREET DRAINAGE.

243 Integral concrete kerb and gutter and vehicle and dish crossing, and drawing. (A 134A.)
245 Gully pit and drawings: with grating (A 1042); kerb inlet only (A 1043); with grating and extended kerb inlet (A 1352) extended kerb inlet (A 1353), (1956).
A 190 Gully grating.
A 1418 Concrete converter.
A 3491 Perambulator ramp.
A 3536 Mountable type kerb with reflectors.

CULVERTS.

138 Pre-cast concrete box culvert (1957) and drawing: 12 in., 18 in., 24 in., and 30 in. high (A 3847).
206 Reinforced concrete culvert (1948) and instruction sheets. (A 304, A 305, A 306, A 359.)
A 1012–20 Single cell reinforced concrete box culvert: 6 in. to 1 ft. 3 in. (A 1012); 1 ft. 4 in. to 3 ft. (A 1013); 4ft. (A 1014); 5 ft. (A 1015); 6 ft. (A 1016); 7 ft. (A 1017); 8 ft. (A 1018); 9 ft. (A 1019); 10 ft. (A 1020); 11ft. (A 1020A); 12ft. (A 1020B).
A 1021–29 Two cell, reinforced concrete box culvert: 6 in. to 1 ft. 3 in. (A 1021); 1 ft. 4 in. to 3 ft. (A 1022); 4 ft. (A 1023); 5 ft. (A 1024); 6ft. (A 1025); 7 ft. (A 1026); 8 ft. (A 1027); 9 ft. (A 1028); 10 ft. (A 1029);
A 1031–36 Three cell, reinforced concrete box culvert: 6 in. to 1 ft. 3 in. (A-
A 1038 1031); 1 ft. 4 in. to 3 ft. (A 1032); 4 ft. (A 1033); 5 ft. (A 1034);
A 1040 6 ft. (A 1035); 7 ft. (A 1036); 8 ft. (A 1038); 9 ft. (A 1040).
25 Pipe culverts and headwalls, and drawings: single rows of pipes: 15. in. to 21 in. dia. (A 143); 2 ft. to 3 ft. dia. (A 139); 3 ft. 6 in. dia. (A 172); 4 ft. dia. (A 173); 4 ft. 6 in. dia. (A 174); 5ft. dia. (A-175); 6 ft. dia. (A 177); Double rows of pipes: 15 in. to 21 in. dia. (A 211); 2 ft. to 3 ft. dia. (A 203); 3 ft. 6 in. dia. (A 215); 4 ft. dia. (A 208); 4 ft. 6 in. dia. (A 207); 5 ft. dia. (A 206); 6 ft. dia. (A 213). Treble rows of pipes: 15 in. to 21 in. dia. (A-210); 2 ft. to 3 ft. dia. (A 216). Straight headwalls for pipe culverts: 15 in. to 24 in. dia. (A 1153) (1957).
A 1 Joint for concrete pipes.
A 142 Inlet sump for pipe culvert 3 ft. dia. or less. (1947).
139 Timber culvert (1950) and drawings, 1 ft. 6 in. high (A 427); 2 ft. (A 428); 3 ft. (A 429); 4 ft. (A 430); 5 ft. to 8 ft. high (A 431).
A 1223 Timber culvert 20 ft. roadway. (1949.)
A 3472 Timber culvert 22 ft. roadway. (1949.)
303 Supply and delivery of pre-cast reinforced concrete pipes.

BRIDGES AND FERRIES.

18 Data for bridge design. (1948.)
371 Waterway calculations. (Instruction.)
300 Pile driving frame, specification for 25 ft. and drawings for 50 ft. (A 209); 40 ft. (A 253); and 25 ft. portable (A 1148).
A 3693 Pontoon and pile driving equipment.
164 Timber beam bridge (1947) and instruction sheets, 12 ft. (A 3469); 20 ft. (A 70) (1949); and 22 ft. (A 1761) (1949).
326 Extermination of termites in timber bridges. (Instruction.)
350 Reinforced concrete bridge. (1949.)
495 Design of forms and falsework for concrete bridge construction. (Instruction.)
314 Regulations for running of ferries. (1955.)
A 4 Standard bridge loading. (Instruction.) (1957.)
A 26 Waterway diagram. (1943.)
A 1886 Arrangement of bolting planks. (1948.)
A 45 Timber bridge, standard details. (1949.)
A 1791 Timber beam skew bridge details. (1949.)
A 3470 } Low level timber bridge, for 12 ft. and 20 ft. between kerb. (Instruc-
A 3471 } tion.) (1949.)
A 1216 Running planks.
A 1207 Reinforced concrete pile—25 tons. (1945.)
A 1208 Reinforced concrete pile—35 tons. (1957.)
A 1621 Reflector strip for bridges.
Highway Bridge Design Specification of State Road Authorities.*

FORMATION.

70 Formation. (1955.)
528 Subsoil drains. (1957.)
A 1532 Standard typical cross-section.
A 4618 Flat country cross-section, Type A. 1955.
A 4619 Flat country cross-section, Type B. 1955.
A 4620 Flat country cross-section, Type C. 1955.
A 4621 Flat country cross-section, Type D. 1955.

Form No.
A 1101 Cross-section one-way feeder road.
A 1102 Cross-section two-way feeder road.
A 114 Rubble retaining wall.

PAVEMENTS.

71 Gravel pavement. (1949.)
228 Reconstruction with gravel of existing pavement.
254A Supply and delivery of gravel.
72 Broken stone base course. (1956.)
216 Telford base course.
68 Reconstruction with broken stone of existing pavement to form a base course.
257 Haulage of materials.
65 Waterbound macadam surface course.
230 Tar or bitumen penetration macadam surface course, 2 in. thick.
66 Tar or bitumen penetration macadam surface course, 3 in. thick.
125 Cement concrete pavement, and plan and cross-section. (A 1147.)
A 380 Galvanised iron strip for deformed joint.
A 381 Bituminous filler strip for transverse expansion joint.
493 Supply of ready mixed concrete.
266 Asphaltic concrete pavement.

SURFACE TREATMENT.

93 Surfacing and resurfacing with bitumen, tar-bitumen mixture, or tar. (1957.)
466 Fluxing of binders for bituminous flush seals and reseals. (Instruction.)
351 Supply and delivery of cover aggregate for bituminous surfacing work (1957.)
354 Road-mix resealing. (1949.)
397 Fluxing for tar road-mix reseal. (Instruction and chart.)
A 1635 Fluxing chart for bitumen road-mix reseal.
167 Resheeting with plant-mixed bituminous macadam by drag spreader. (1951.)

FENCING AND GRIDS.

141 Post and wire fencing (1947) and drawings: plain (A 494 . rabbit-proof (A 498); flood gate (A 316).
143 Ordnance fencing and drawing. (A 7.)
144 Chain wire protection fencing and drawing. (A 149.)
246 Location of protection fencing. (Instruction.)
224 Removal and re-erection of fencing.
A 1705 Plain wire fence for use in cattle country.
A 3598 Wire cable guard fence.

ROADSIDE.

A 1337 Concrete mile post, Type A.
A 1338 Concrete mile post, Type D.
A 1366 Standard lettering for mile posts.
A 1367 Timber mile post, Type B1.
A 1368 Timber mile post, Type B2.
A 3497 Timber mile post, Type B3.
A 2815 Concrete kerb mile block.
A 1420 Steel mould for concrete mile posts.
A 1381–3 }
A 1452–5 } Tree guards, Types A, B, C, D, E, F, and G.
Manual No. 4—Preservation of roadside trees.

MATERIALS.

296 Tar. (1949.)
337 Residual bitumen and fluxed native asphalt.
305 Bitumen emulsion. (1953.)
349 Light and medium oils for fluxing bitumen. (1948.)
A 27 Slump cone for concrete.
A 178 Mould for concrete test cylinder.
76 Design of non-rigid pavements. (Instruction.)
Manual No. 3—Materials.*

TRAFFIC PROVISION AND PROTECTION.

121 Provision for traffic (1954) with general arrangement (A 1323), and details (A 1325) of temporary signs. (1947.)
252 Supply and delivery of guide posts.
253 Erection of guide posts. (Instruction.)
A 1342 Temporary warning sign, details of construction.
A 1346 Iron trestle for road barrier.
A 1341 Timber trestle and barrier.

PLANT.

A 1414 Gate attachment for lorries with fantail spreader.
A 1450 Half-ton roller with pneumatic tyres for transport.
A 2814 Two-berth pneumatic tyred caravan.
A 2828 Multi-wheeled pneumatic tyred roller.
A 2976 Fantail aggregate spreader.
A 3530 Benders for steel reinforcement.
A 3547 Steel bar cutter.

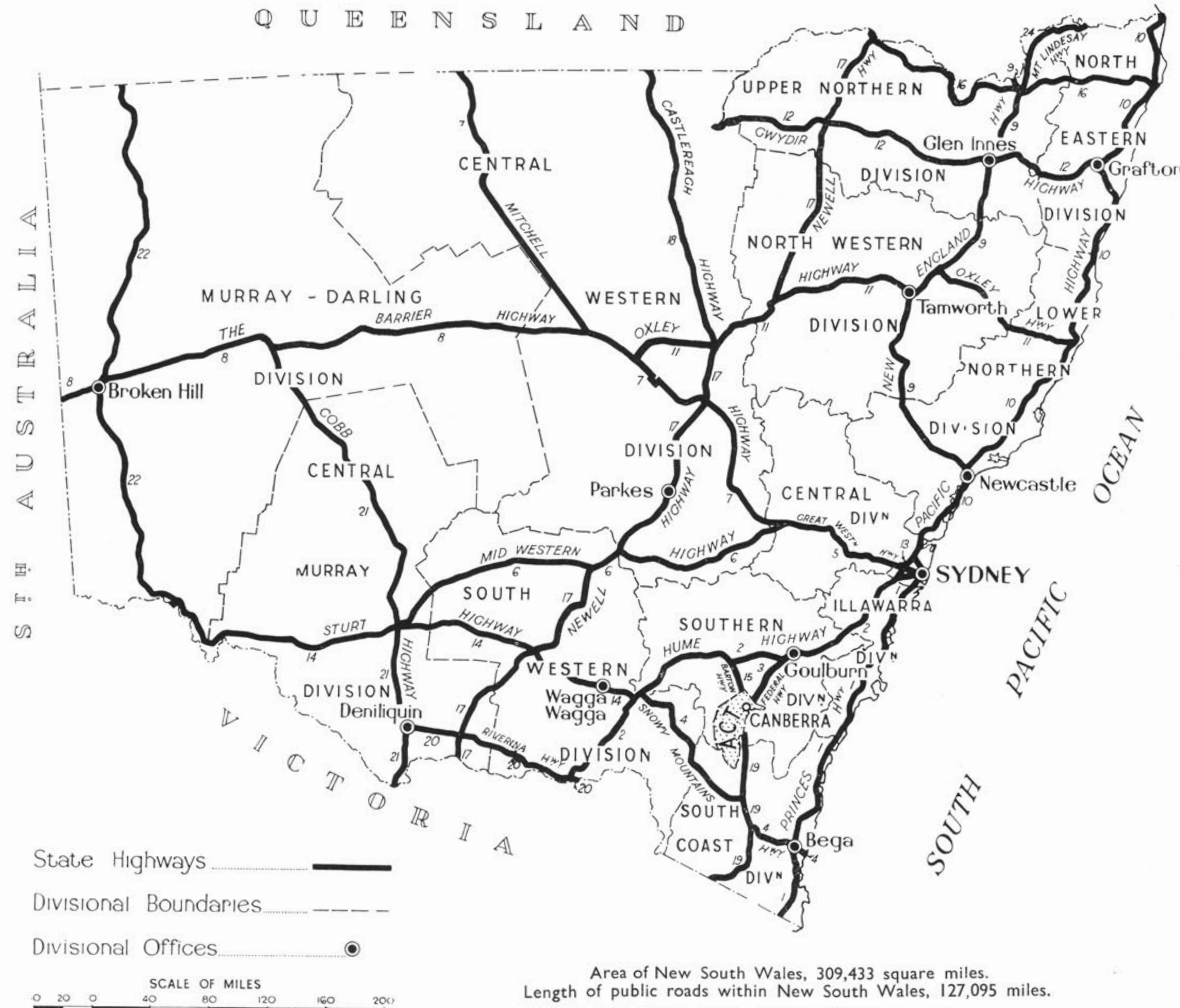
CONTRACTS.

24B General conditions of contract, Council contract. (1956.)
342 Cover sheet for specifications, Council contract. (1950.)
64 Schedule of quantities form.
39 Bulk sum tender form, Council contract. (1946.)
38 Bulk sum contract form, Council contract.
193 Duties of superintending officer. (Instruction.)
498 Caretaking and operating ferry.

All Standards may be purchased from the Head Office of the Department of Main Roads, 309 Castlereagh Street, Sydney. Single copies are free to Council except those marked *.

Sydney: V. C. N. Blight, Government Printer—1959

State Highway System of the State of New South Wales



Area of New South Wales, 309,433 square miles.
Length of public roads within New South Wales, 127,095 miles.

MILEAGE OF MAIN AND DEVELOPMENTAL ROADS, AS AT 30th JUNE, 1959.

State Highways	6,504
Trunk Roads	4,180
Main Roads	11,739
Secondary Roads (County of Cumberland only)	86
Developmental Roads	2,787
	25,296
UNCLASSIFIED ROADS, in Western part of State, coming within the provisions of the Main Roads Act	1,200
TOTAL	26,496