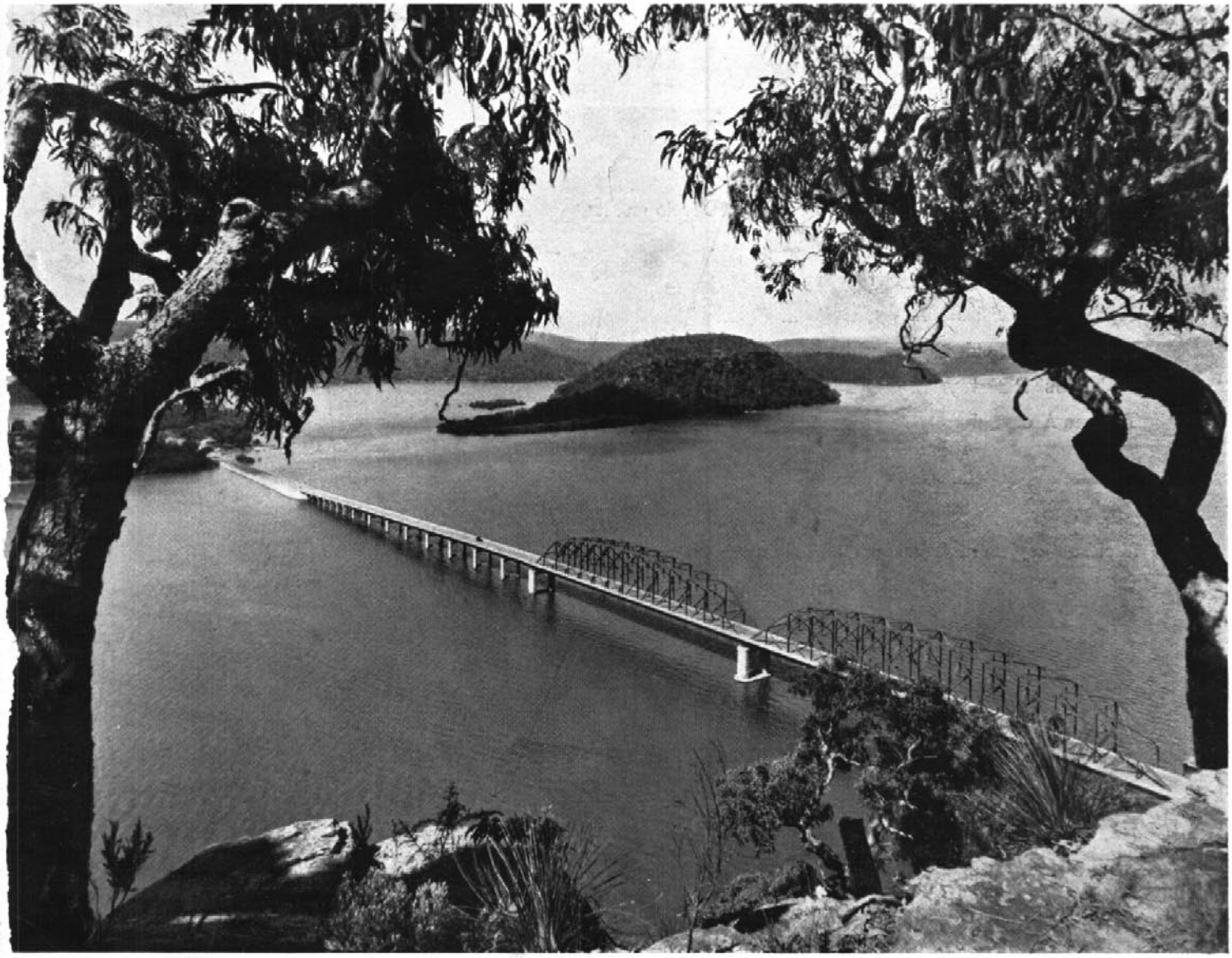
MAIN ROADS

A Record of the activities of the
Department of Main Roads, N.S.W.



The recently completed bridge over the Hawkesbury River at Peat's Ferry on State Highway No. 10—Pacific Highway—between Sydney and Brisbane.

SEPTEMBER **1946**

MAIN ROADS.

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Main Roads

FOREWORD

By The Hon. M. O'Sullivan, M.L.A., Minister for Transport.

In view of the urgent necessity of devoting all resources to the war effort, the journal *Main Roads* issued quarterly in pre-war years by the Department of Main Roads was discontinued. With the return of peace there is a need to keep the public, who provides the funds, fully informed of the activities of the Department and the progress being made in the improvement of roads and in the methods of construction and maintenance. Arrangements have consequently been made for publication of the journal to be resumed.

With the war, road improvement ceased and maintenance was greatly reduced. There is much leeway to be made up and the Department of Main Roads, in co-operation with Councils, has a big task ahead in reorganising road activities. Shortage of skilled manpower and of plant and materials is affecting immediate progress, but these drawbacks are being overcome gradually. With the foundations soundly laid the public can look forward with confidence to a return to pre-war rate of improvement without an undue lapse of time.

So that all who may desire can watch progress, *Main Roads* is commended to their attention. Good roads are essential for the welfare and prosperity of practically every person, and the road industry in the form of public investments in roads and in public and private road transport is by far the largest single industry in Australia and merits the closest interest of all.

In conclusion, I desire to place on record my deep regret at the loss sustained by the State in the sudden death on the 1st August last of the Commissioner, Mr. David Craig, just as this issue was ready for the press.

The Hon. M. O'Sullivan, M.L.A., Minister for Transport.

*33640—1

Mr. Craig had occupied the position of Commissioner for Main Roads since the 17th March, 1941, and had given many years of wonderful service to New South Wales, particularly during the war years when he was also responsible for the carrying out of many highly important works associated with the defence of Australia for the Commonwealth Government.

I also wish to extend my best wishes to Mr. A. E. Toyer, B.E., who has been appointed to succeed Mr. Craig as Commissioner for Main Roads for a term of seven years.

The late

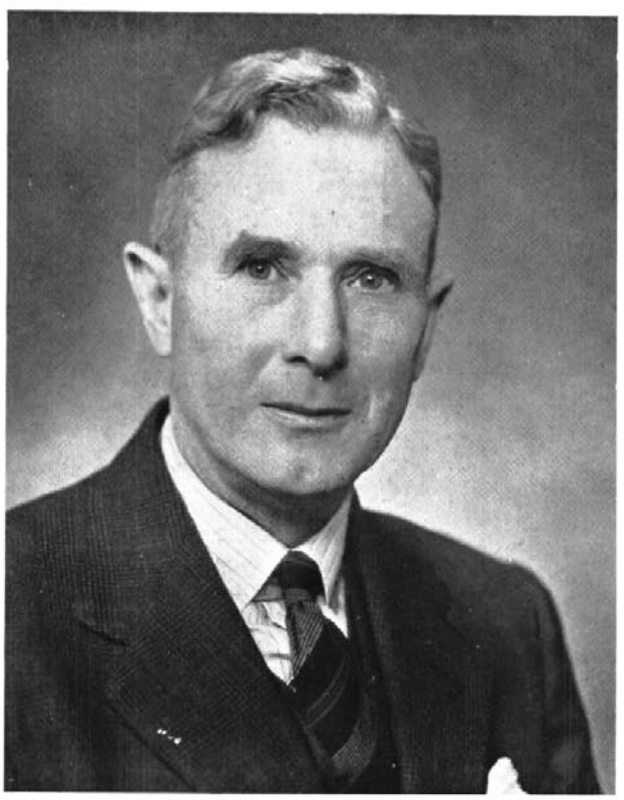
DAVID CRAIG

M. Inst. C.E. : M.I.E. Aust.

Commissioner for Main Roads
17th March, 1941 to 1st August, 1946.

By the death of Mr. David Craig, at his office, on the afternoon of 1st August, 1946, the Department and the State lost a leader in Public Service, one who had unstintingly applied his outstanding abilities to great tasks without counting the cost to himself.

Commissioner during the most difficult years of the war, he was intimately associated with the defence works which the Department carried out in this State, in northern Australia and on certain Pacific Islands.



The late Mr. David Craig.

In the words of the Hon. W. J. McKell, Premier of New South Wales, "Mr. Craig had given valuable service to Australia at a most critical period in its history." That service took its toll but, working on, he died whilst still planning the years beyond the Victory for which he had striven.

A man of vision and wide human sympathies, this Scottish civil engineer was profoundly interested in all the problems of his adopted land, and brought to their discussion the informed, penetrating and kindly common sense that made him a respected colleague and a revered chief.

Firm in the belief that meeting and discussing in a spirit of sincere co-operation could achieve satisfactory solutions, Mr. Craig was ever easy of access and ready with just decision and helpful advice. Travelling much, seeing for himself, calling on Councils, stopping to speak to contractors and workmen, he sought only to "get on with the job."

* * * * * * * * * * *

Born in Paisley, Scotland, on 29th September, 1883, Mr. Craig received his early training at the Technical College in that town, and then at the Royal Technical College, Glasgow, whose certificate in Civil Engineering he held. Afterwards he was employed as a cadet with a Consulting Engineer in Glasgow, and later as Assistant Engineer with a firm of Public Works Contractors engaged on railway and bridge construction in Britain. In 1910 he came to Australia and joined the Construction Branch of the Victorian Railways Department as Assistant Engineer. He remained in this service from 1910 to 1923 except for the period between 1916 and 1919 when he returned to Great Britain to engage under the Ministry of Munitions on war works which included railways, buildings and the construction of concrete barges and tugs. Whilst with the Victorian Railways Department he was resident Officer-in-Charge of the first section of the Bairnsdale to Orbost Railway. Later, he was Inspecting

Engineer for the whole of the construction of this line and subsequently for a number of branch lines, including the Morwell Brown Coal line and a section of the line from Moama to Balranald. In 1923 Mr. Craig left the Victorian Railways to become Chief Engineer and later Director of the Australian business of Messrs. Armstrong, Whitworth Pty. Ltd., public works contractors.

In February, 1928, he joined the staff of the Main Roads Board of New South Wales (afterwards the Department of Main Roads) as Engineer in charge of Country Construction, and was promoted to Chief Engineer (Country) in May of the same year. He continued in this position until March, 1937, when he was appointed Deputy-Commissioner during the absence of the Commissioner (Mr. H. H. Newell, C.B.E.) on special duties overseas. Mr. Newell returned in October, 1937, and three weeks later Mr. Craig was appointed Assistant Commissioner. In March, 1941, he became Commissioner and filled this arduous office until his untimely death at the age of 62.

Mr. Craig's extra-Departmental but official posts included a Vice-Presidency of the Road Safety Council of New South Wales, Membership of the State Traffic Advisory Committee, and, in 1945, Chairmanship of the Committee set up by the New South Wales Government to report on a proposal for the development of a deep-sea port to serve the northern part of the State. The report presented by this Committee was described in Parliament as "monumental," and "doing great credit to Mr. Craig as Chairman and to those associated with him."

In 1934 Mr. Craig visited the Continent and Great Britain and represented the Commonwealth Government at the Seventh International Road Congress, Munich.

He was a Member of the Institution of Civil Engineers (London), a Member of the Institution of Engineers, Australia, a Councillor of the Australian Regional Group of the Institute of Public Administration, and a Member of the Town and Country Planning Institute of New South Wales.

* * * * * * * * * * * *

A life trained for service ended in service before it had given all it wished; but the faithful work of the engineer stands, and the example of modesty, understanding and industry is with us.

OFFICIAL OPENING OF WAKEHURST PARKWAY.

Ald. J. Anderson, Mayor of Manly; Mr. E. D. Darby, M.L.A.; Mr. H. M. Sherrard, Asst. Commissioner for Main Roads; Mr S. A. Storey, M.L.A.; Mr. F. Laws, Metropolitan Engineer, Department of Main Roads; Clr. W. L. Harris, President, Warringah Shire; Hon. W. J. McKell, M.L.A., Premier of New South Wales; the late Mr. D. Craig, formerly Commissioner for Main Roads; Hon. M. O'Sullivan, M.L.A., Minister for Transport; Mr. L. A. Robb, Official Secretary to the Governor of New South Wales; Mr. A. E. Toyer, Commissioner for Main Roads.

The Effect of the War on Main and Developmental Roads Fund

The revenue available to the Department of Main Roads, New South Wales, for expenditure on Main and Developmental Roads is derived principally from taxes levied on motor vehicles and on petrol, and the proceeds of each of these taxes were considerably reduced by the impact of the war. The number of registered motor vehicles in New South Wales dropped from 329,219 in August, 1939, to a minimum of 266,829 in October, 1942; the rates of Motor Taxation were lowered by approximately 20 per cent. in May, 1942, following the imposition of severe restrictions on the use of petrol, and at the same time the petrol restrictions resulted in revenue from the petrol tax receding from £1,229,230 in 1939-40 to as low as £440,031 in 1942-43, while the State Government voluntarily decided not to collect Petrol Tax from the Commonwealth Government for a portion of the year 1943-44 when receipts from that source were only £143,958. While there has been some recovery recently, due to the easing of petrol restrictions and increasing vehicle registrations, revenues are still well below 1939-40 level; the 20 per cent. reduction in the rates of Motor Vehicle Taxation imposed in May, 1942, is still effective; motor vehicle registrations at the end of June, 1946 were only 325,643, and petrol restrictions, even though in a modified form, still apply.

The revenue received by the Department from Motor Taxation and Fees and from Petrol Taxation dropped from £3,348,000 in 1939-40 to a minimum of £1,902,000 in 1943-44, while a recovery to £2,898,000 was experienced for 1945-46. The figures for the year 1939-40 and each of the succeeding years were as follows:—

	£
1939-40	3,348,000
1940-41	3,150,000
1941-42	2,479,000
1942-43	2,084,000
1943-44	1,902,000
1944-45	2,382,000
1945-46	2,898,000

Motor vehicles were steadily increasing in number each year prior to 1940, and as it is generally acknowledged that this trend would have continued but for the war, it is clear that the above figures alone do not serve to show the full effect of the war on the funds available for expenditure on Main and Developmental Roads. The average annual increase of registered motor vehicles in New South Wales for the three years ended the 31st December, 1938, was 7.87%, and a reasonably conservative view is taken in assuming that the annual increase from 1939-40 to 1945-46 would have been 6%. By applying this rate of increase to the year 1938-39 as a base year and allowing for factors which affected revenues and which were not connected with war conditions, it is estimated that the loss of revenue from motor and petrol tax during the war years amounted to £12,572,000, as follows:—

YEARS 1939-40 TO 1945-46.

Year.	Actual Revenue.	Revenue which would have been received but for intervention of the war.	Loss of Revenue.
	£	£	£
1939-40.....	3,348,000	3,530,000	182,000
1940-41.....	3,150,000	3,850,000	700,000
1941-42.....	2,479,000	4,082,000	1,603,000
1942-43.....	2,084,000	4,326,000	2,242,000
1943-44.....	1,902,000	4,640,000	2,738,000
1944-45.....	2,382,000	4,979,000	2,597,000
1945-46.....	2,898,000	5,269,000	2,371,000
	18,243,000	30,676,000	12,433,000

The loss of £12,433,000 is made up of:—

Motor Tax, Fees, etc. ..	£6,748,000
Petrol Tax	£5,685,000

The full measure of the reduction of work done on the roads is not disclosed by the above figures, however, as rising costs during the war period resulted in a lesser unit of work being carried out for the expenditure of the same unit of money, and this rise in unit costs was not accompanied by an increase in the unit rates of revenue. Apart from wages increases, substantial increases in camping allowances and other privileges have been made to employees. Most other items of expense increased and a most notable example is the cost of bitumen which rose from a little over £8 per ton in 1938-39 to nearly £25 per ton in 1942, although it is now priced at just under £19 per ton. An examination of the cost of carrying out road works at the present time compared with 1938-39 discloses the following percentage increases:—

	%
Maintenance work	31
Construction of roads	36
Construction of bridges ..	50

The overall increase is dependent on the amount spent on the different types of work, but in the Department's case the figure for 1945-46 is 33%. The percentage increases quoted did not, of course, apply to the whole of the war years, but by the establishment of the appropriate percentages for each year and then by the application of these to the Department's expenditure from "revenue" funds on the maintenance and construction of roads and bridges each year, it is estimated

that the value of the loss in the quantity of work done from 1939-40 onward due to rises in costs over those obtaining in 1938-39 amounted to £2,633,000 at the end of 1945-46.

It will be seen that the total reduction of expenditure on the Main and Developmental Roads due to war conditions is estimated to be over £15,000,000, as follows:—

	£
Reduction of Revenue	12,433,000
Reduction of volume of work due to increased unit cost of works done	2,633,000
	15,066,000

Further reductions of expenditure occurred during the war years with the virtual cessation of special works, such as Unemployment Relief and Loan Works, financed with funds provided from Governmental sources, but as against this some money was allocated by the Commonwealth and State Governments for expenditure on roads of strategic importance from a defence point of view and which, it is reasonable to assume, would not have been allocated for this purpose but for the war.

The question arises as to whether there are any factors which serve to offset the loss in expenditure in improvement and construction works of some £15,000,000 on the State's Main and Developmental Roads system due to war conditions. In this regard it might be put forward that the reduction of traffic caused by the decrease in the number of registered motor vehicles and the restriction in the use of vehicles on account of petrol rationing should have resulted in a lessening of the liability against Main Roads Funds. That, however, is not the case except to a minor extent. The most potent agent in the deterioration of road pavements and bridges and culverts generally is not traffic, but the element of time. So far as the effect of traffic on roads is concerned, it is the heavier vehicles which cause the greatest damage. There was only a small decrease in the number of these vehicles (lorries) registered during the war, while the number in use at present is nearly 20% in excess of the number at the outbreak of war. The incidence of petrol rationing also was not nearly so great for lorries as for the lighter vehicles. Added to this is the fact that there was a considerable use of the roads by Commonwealth military vehicles in respect of which there is no contribution of Motor or Petrol Taxation and which vehicles do not appear in the quoted number of motor vehicles in the State, as they are not registered in the ordinary way. Many of these military vehicles were heavy lorries and trailers, the use of which added appreciably to the road maintenance bill of the State.

The moneys available to the Department are paid by Statute into three separate Funds, being:—

County of Cumberland Main Roads Fund from which is met the cost of approved work on proclaimed Main Roads in and near the Metropolitan Area of Sydney (excluding the City of Sydney).

Country Main Roads Fund from which is met the Department's contribution towards the cost of approved work on proclaimed Main Roads in the State, but outside the County of Cumberland.

Developmental Roads Fund from which is met the cost of approved construction work on proclaimed Developmental Roads throughout the State.

The distribution between the three Funds of the loss to the roads system of £15,066,000 due to war conditions previously referred to is as follows:—

	£
County of Cumberland Main Roads Fund	3,152,000
Country Main Roads Fund ..	10,730,000
Developmental Roads Fund ..	*1,184,000
Total	£15,066,000

*As a part offset against this amount, the sum of approximately £290,000, representing Loan charges, was borne by Consolidated Revenue from 1942-43 to 1945-46, so that the net loss of money available for expenditure on Developmental Road Works was £894,000.

Apart from the question of this loss, the impact of war conditions on the financial position of the three Funds has been different in each case. A substantial cash balance has accumulated in the County of Cumberland Fund. The Country Fund has been kept solvent, but there is little ready cash available in the Fund to meet the cost of the considerable volume of works, including deferred maintenance now required to be carried out. The only source of revenue (Motor Taxation) available to the Developmental Roads Fund was eliminated in 1942 and has not yet been restored, so that recourse has been temporarily made to Government Loan Funds for the purpose of financing work to a minor degree on Developmental Roads. The position in regard to each of the Funds is dealt with in detail below:—

COUNTY OF CUMBERLAND MAIN ROADS FUND.

The ordinary revenue of this Fund amounted to about £1,000,000 each year prior to the war and the approximate annual disbursements were as follows:—

	£	%
Maintenance and improvement work	275,000	27.5
Construction and road widening work	500,000	50.0
Loan Charges	200,000	20.0
Other	25,000	2.5
Total	£1,000,000	100.0

It will be seen that no less than half a million pounds a year, or approximately half the revenue of the Fund, was spent on construction and road widening works before the war. Works of this nature were necessarily curtailed under war conditions. Maintenance expenditure has continued at much the same rate since the outbreak of war. Due to the fact that a fair proportion of the outstanding Loans have been redeemed during recent years the annual payments on account of Loan charges have shown a marked decline. The average

annual disbursements from "revenue" funds (as distinct from funds provided for special purposes) during the war years for comparison with the pre-war expenditure shown above and also the minimum expenditure in any one year were as follows:—

	Average expenditure 1940–41 to 1945–46.	Minimum expenditure in any one year.
	£	£
Maintenance work	249,000	195,000 (1942–43)
Construction and road widening work	187,000	104,000 (1943–44)
Loan Charges	107,000	67,000 (1945–46)
Other Charge	20,000	10,000 (1942–43)
Total	563,000	433,000 (1942–43)

Receipts decreased to an average of £791,000 per annum during the war years, but the decrease of expenditure was greater, principally because of the curtailment of the relatively large proportion of the revenue of the Fund normally spent on construction and road widening work. The net result is that the cash balance grew from £43,087 at the end of 1938-39 to an amount of £1,261,000 at the end of 1945-46. There is ample work required to be done within the County of Cumberland in the interests of road traffic and on which the accumulated cash balance will be expended now that man-power, plant and materials are becoming available. Major works in hand or contemplated within a measurable period include the replacement of the large bridges at Iron Cove, Gladesville, Fig Tree and the Spit. Although road widening works are not at present being proceeded with to any extent in view of the undesirability of demolishing buildings during the present housing shortage, the Department is commencing the expenditure of considerable funds on the acquisition of properties in anticipation of the actual widening works being put in hand when the housing position becomes less acute. Some of the road widening works contemplated as soon as circumstances permit are Oxford Street, from Paddington Town Hall to Bondi Junction; Victoria Road in Balmain and Drummoyne, from White Bay to Gladesville Bridge; Military Road, Mosman, from Cremorne Junction to near Spit Junction; Pacific Highway from Crow's Nest to St. Leonards Railway Station, and from Boundary Street, Roseville, to Treatt's Road, Lindfield; and Prince's Highway from Forest Road to Spring Street, Rockdale.

COUNTRY MAIN ROADS FUND.

The normal pre-war revenue of £2,450,000 of the Country Roads Fund was spent approximately as follows:—

	£	%
Maintenance and improvement work	1,225,000	50
Construction work	1,000,000	41
Loan charges	150,000	6
Other	75,000	3
Total	£2,450,000	100

The reduction of expenditure dictated by war conditions was effected in the country principally by limiting construction works to those essential to maintain road service, such as the replacement of worn-out bridges. The degree of maintenance work carried out during the war was governed not so much by requirements as by the resources available. The result is that there has been left a legacy of long lengths of worn surfaces in need of reconditioning.

The following was the average annual expenditure of "revenue" moneys from the Country Fund during the war years for comparison with the pre-war figures quoted above and also the minimum expenditure incurred in any one year. It is to be remembered that, apart from the figures shown, higher costs during the war years resulted in a reduction of the volume of maintenance and construction work done during those years compared with the pre-war years.

	Average expenditure 1940–41 to 1945–46.	Minimum expenditure in any one year.
	£	£
Maintenance work ...	1,224,000	925,499 (1942–43)
Construction work ...	322,000	196,000 (1942–43)
Loan Charges	195,000	182,000 (1945–46)
Other	69,000	32,000 (1942–43)
Total ... £	1,810,000	1,348,000 (1942–43)

The feature of higher costs of carrying out works has an important bearing on the finances of the Country Main Roads Fund. Maintenance and improvement expenditure before the war accounted for over £1,200,000 per annum. In order to carry out the same volume of work, the expenditure now required will be of the order of £1,600,000. To this figure there needs to be added at least £100,000 required for the next several years to restore road surfaces to pre-war standards. When £300,000 is also added to cover the cost of loan and other fixed charges, it will be seen that a total of about £2,000,000 will be required to meet what might be termed inescapable commitments. Based on the assumption that petrol restrictions will be lifted and that the current 20% reduction in the rates of Motor Taxation will be restored, it is estimated that the amount to be received from "revenue" funds will average £2,500,000 in each year during the next few years, so that only £500,000 of this will be available for construction works compared with £1,000,000 per annum before the war. The effect of present higher costs must also be borne in mind in this connection. A large portion of the amount of £500,000 must be used for the construction of new bridges and replacement of existing bridges. The amount which will be left for expenditure on road construction and improvement works will thus be very small.

Short of the provision of further revenues to the Fund, the only course open if new road improvement works are to be undertaken to any extent is for money to be borrowed for that purpose. The narrow margin,

however, between revenue and inescapable commitments makes it clear that the additional loan liability that can safely be incurred is limited to comparatively small annual amounts.

DEVELOPMENTAL ROADS FUND

With the reduction of Motor Taxation effected in 1942, the revenue of the Developmental Roads Fund ceased. The cash balance in the Fund at the time, amounting to some £70,000, was used to complete works then in hand and to finance the cost of subsequent urgent works. This money was all committed by the end of 1944-45 and, in view of the pressing need to carry out a number of works on Developmental Roads in order to assist primary production, Government loan funds totalling £50,000 were obtained from the State Government during 1945-46. The financing of works on Developmental Roads from Loan Funds can be regarded as a temporary measure pending the anticipated restoration of the reduction in the rates of Motor Taxation effected in 1942 when approximately £130,000 per annum of "revenue" money will again become available for Developmental Road works.

GENERAL.

Based on the estimated annual increase of 6% in the number of motor vehicles registered as previously quoted, it will be another five years before the same volume of road works can be carried out as in the pre-war year 1938-39, because of increased costs. A period of twelve years will therefore have elapsed from the commencement of the war before the same rate of progress as then prevailed can be achieved.

PAYMENTS FROM THE ROAD FUNDS FOR THE PERIOD 1st JULY, 1945, TO 30th JUNE, 1946.

	Amount paid.
County of Cumberland Main Roads Fund:—	£
Construction of Roads and Bridges	263,401
Cost of Acquisition of Land for Road Widening	14,691
Maintenance of Roads and Bridges	302,694
Interest and Repayment of Loans	79,746
Other Expenditure	150,728
Total	£811,260

Country Main Roads Fund:—	£
Construction of Roads and Bridges	436,960
Cost of Acquisition of Land for Road Widening	4,230
Maintenance of Roads and Bridges	1,511,899
Interest and Repayment of Loans	199,272
Purchase and Repair of Plant and Motor Vehicles	373,095
Other Expenditure	112,422
Total	£2,637,878

Developmental Roads Fund:—	£
Construction of Roads and Bridges	30,076
Other Expenditure	1,015
Total	£31,091

Summary All Funds:—	£
Construction of Roads and Bridges	730,437
Cost of Acquisition of Land for Road Widening	18,921
Maintenance of Roads and Bridges	1,814,593
Interest and Repayment of Loans	279,018
Purchase and Repair of Plant and Motor Vehicles	373,095
Other Expenditure	264,165
Total	£3,480,229

Note: The figures in this statement are subject to audit.

Roads in the Scheme of Reconstruction and Development

Modification of Paper originally read at Meeting of Institute of Public Administration.

By the late DAVID CRAIG, M.Inst.C.E., M.I.E.A., Commissioner for Main Roads.

The following quotation from a technical pamphlet issued in Britain by the Institution of Highway Engineers will serve as an introduction to this article:—

> "The road system of any country is the basis of all development and re-development planning, and is, in fact, the foundation on which the state of society is built and on which further progress depends . . .
>
> "The main requirements of the re-planned Highway system are that it should provide a means of safe, speedy, cheap and comfortable transportation of people and goods between main centres of population and industry, wherever they now exist or where they will ultimately exist under the basic National planning scheme."

The existing road system of New South Wales has been gradually developed during the 160 years of the life of the State. Taken by and large, the construction and improvements effected during the period have kept pace reasonably well with road traffic demands.

The introduction of road motor vehicles at the beginning of the present century brought in a new era of road requirements. Road transport increased rapidly, particularly after the 1914-1918 war. To meet the needs of the community, a Government Main Roads Authority has been set up in most countries or States in the world.

In New South Wales the Main Roads Board, consisting of a President and two full-time Members, was created in 1925 and seven years later the form of control was altered to the Department of Main Roads, with a Commissioner and Assistant Commissioner in charge.

It is almost axiomatic that under stable conditions most people are not conscious of the effect of roads on the life of the community. However, as the proportion of car-owning populace rapidly increased road consciousness developed. This was particularly the case in New South Wales between 1919 and 1935, but by 1939, when substantial improvement had been effected to roads generally and the rate of increase in the number of motor vehicles had substantially declined, people again began to take roads for granted.

With the end of the war road consciousness again exercises a strong influence on roads policy. This arises out of two main factors: (1) The low condition of the roads resulting from the transfer of plant and experienced men to urgent defence works or to the fighting services, and (2) the need for roads in the post-war development of the State.

In order to get a general picture of the road position in New South Wales some statistical information is of interest. Altogether there are 126,058 miles of roads of which 27,336 miles are cleared only and 36,425 miles in their natural condition, leaving 62,297 miles of improved roads, or roughly half the total length. Out of the 62,297 miles of improved roads fully 7,000 miles are in the Western Division (*i.e.*, west of the Lachlan and the Barwon Rivers), leaving about 55,000 miles in the Central and Eastern Divisions. Of this mileage 19,939 miles are proclaimed Main, Secondary or Developmental Roads which come under the administration of the Department of Main Roads.

Practically the whole of the cost of construction of roads in New South Wales has been borne out of revenue funds or from Government grants. There is little capital expenditure on which interest and sinking fund has to be raised. Statistics giving the cost of roads and bridges are not available but, on a conservative estimate, the total would not be less than £120,000,000. This represents a very substantial asset to the State.

The following were the motor vehicle registrations in New South Wales since 1910:—

1910— 4,374
1920— 41,310
1930—251,348
1939—329,219 (peak)
1942—266,829 (minimum).
1946—325,043 (30th June)

The population in 1939 was 2,764,780, so that there was then one registered vehicle to every 84 persons.

It can be anticipated that with the return of peace the number of motor vehicles will again rise rapidly and within ten years may readily reach the total of 500,000. Thereafter the rate of increase will probably be only a fraction above the rate of increase of the population.

With the exception of roads in the vicinity of or through the cities, roads in 1939 carried under 1,000 vehicles per day and generally of the order of from 10 to 200 with a registration of 329,219 motor vehicles. Even, therefore, with an increase to 500,000 vehicles the number of vehicles on roads would be well within the carrying capacity of any road with a 20 ft. pavement or so. Roads, however, carrying concentrated traffic require to be dealt with as a specific problem.

The carrying capacity of one lane of traffic may vary from 300 or 400 vehicles per hour to as many as 1,500. It is generally assumed, however, that if traffic reaches 2,000 to 3,000 per day in one direction then consideration should be given to duplication of the road if free movement of various types of vehicles is to be maintained. When traffic was at its peak the average number of motor vehicles passing over the Sydney Harbour Bridge reached approximately 20,000 daily. At peak hours the number was approximately 3,000, and the bulk was in one direction of three lanes or 700 per lane.

That is a short outline of the general road position in New South Wales. Now for a few notes on the Main Roads Administration.

The Main Roads Department exercises control over all Governmental activities in connection with main road works. These activities embrace works on Main and Developmental Roads throughout the State, all roads in the unincorporated portion of the Western Division and proclaimed national works, principally bridges and ferries, which were constructed from Government funds.

The Department co-operates with the Municipal and Shire Councils in the work of constructing and maintaining a well-organised system of main highways, with the primary object of developing the lands in the State, feeding the railways with traffic, giving the primary producers access to markets, and providing facilities for modern motor through traffic.

Public roads, except those within the City of Sydney, may be proclaimed as Main Roads upon the recommendation of the Commissioner. The most important classes of Main Roads are: (1) the State Highways, which form the principal avenues of road communication between the coast and the interior or throughout the State and connect with similar avenues in other States; (2) Trunk Roads, which are the secondary avenues, forming with the State Highways the framework of a general system of intercommunication throughout the State; (3) ordinary Main Roads, which are those not classified as Highways or Trunk Roads. Any road, not being a Main Road, may be proclaimed as a Developmental Road if it will help to develop a district, and in 1936 provision was made for the declaration of developmental works, *i.e.*, works carried out on portion of a road. The whole or part of the cost of construction of Developmental Roads and works may be provided from a fund created in the Main Roads Act for the purpose.

There are altogether 17,104 miles of Main Roads, 2,757 miles of Developmental Roads and 78 miles of Secondary Main Roads within the State, excluding the Western Division. Secondary Roads are all within the County of Cumberland.

The terms of the Main Roads Act require that the moneys of the Main Roads Department be kept in separate funds—(1) the County of Cumberland Main Roads Fund for Metropolitan Main Roads, *i.e.*, those in the County of Cumberland which, for the purposes of the Act, is deemed to include the Municipalities of Katoomba and Blackheath, and the Shire of the Blue Mountains; also small sections of the Bulli, Colo and Blaxland Shires added in 1929; (2) the Country Main Roads Fund; (3) the Developmental Roads Fund.

The income of the two Main Roads Funds is derived chiefly from (*a*) the proceeds of taxes on motor vehicles; (*b*) grants from the Federal Government; (*c*) contributions by Municipal and Shire Councils; (*d*) loan moneys appropriated for the Main Roads.

The resources of the Developmental Roads Fund were derived mainly from State loan appropriations until the end of 1939, and later from a share of motor taxes.

The proceeds of the motor tax with the exception of a small proportion paid into the Public Vehicles Fund are distributed amongst the Road Funds. The Developmental Roads Fund receives, as from 1st December, 1939, one-ninth of the total proceeds (*i.e.*, the additional yield obtained by an increase of 12½% in the rates on the date mentioned), and is required to pay annually £5,000 to the County of Cumberland Main Roads Fund, and £52,000 to the Country Main Roads Fund. Of the balance (less the amount paid to the Public Vehicles Fund) the tax on vehicles owned by residents of the Metropolitan road district is apportioned in equal shares between the two Main Roads Funds, and the Country Main Roads Fund receives the tax on motor vehicles registered in the country.

Following restrictions on motoring and as a war measure the 12½% increase in motor taxation was eliminated together with a further percentage to make the total deductions approximately 20%. There is thus no payment direct from revenues into the Developmental Roads Fund at present.

The Councils in the Metropolitan road district, except the City of Sydney, may be required to contribute to the County of Cumberland Main Roads Fund at a rate not exceeding ½d. in the £ of the unimproved capital value of ratable property. The maximum rate was fixed at ½d. in the £ for the years 1925 to 1932 inclusive, and then reduced to 7-16d.

Contributions by country Councils to the Country Main Roads Fund depend upon the amount expended on the Main Roads. Usually contributions by country Councils are not paid to the Department's funds, as in the case of Metropolitan Councils, but are applied directly in meeting the Councils' share of the cost of works.

The Main Roads Funds are expended on the construction and maintenance of Main Roads in the respective districts, and on administrative expenses and loan charges, including interest, exchange, sinking fund and management.

In the Metropolitan district, where the levy on Councils is compulsory, the whole cost of construction and maintenance of Main Roads is paid from the funds of the Main Roads Department, but the actual work may be done by the Councils.

In the country districts assistance in respect of road works may be granted by the Department to the Council of any area through which the Main Road

passes, and the Council may be required to contribute part of the cost of the work as prescribed by the Act. The Councils may pay a greater proportion of the cost than is prescribed, or in special circumstances, the whole cost of any particular work may be paid from the roads funds, or the cost may be advanced to be repaid by the Councils.

The proportion of the cost of works on country roads borne by the Department of Main Roads varies with the class of roads. The Department pays the whole cost of works on State Highways; three-quarters in respect of Trunk Roads and two-thirds for ordinary Main Roads. Additional assistance is granted for bridge construction, namely, the whole cost of bridges over 20 ft. span on Trunk Roads and three-fourths on ordinary Main Roads.

The cost of constructing Developmental Roads and works is borne in full by the Main Roads Department but, upon completion, local Councils are required to maintain them in satisfactory condition.

Apart from the assistance granted by the State Government for the construction and upkeep of roads, the Commonwealth Government under the Federal Aid Road Agreement pays to the States for a period of ten years, as from 1st July, 1937, 3d. per gallon on petrol imported and 2d. per gallon on petrol locally refined. The proceeds of a ½d. per gallon on petrol may be applied to road and other works connected with transport, and the Commonwealth Government may require one-twelfth to be expended upon the maintenance of roads giving access to Commonwealth properties.

The year 1939-40 can be taken as the last normal year so far as the Income and Expenditure of the funds of the Main Roads Department are concerned. Details are as follows:—

Income.	£
Motor Taxes, Fees, etc.	2,119,268
Contributions by Councils	232,491
State Appropriation for specially authorised works	1,016,133
Federal Appropriations, Petrol Tax	1,229,230
Federal Appropriations for Defence Works	295,200
Miscellaneous	70,683
Total	£4,963,005

Expenditure.	£
Construction	2,727,159
Maintenance	1,577,013
Loans—	
Repayment and Sinking Fund	174,316
Interest	184,771
Exchange and Management	24,752
Administrative Expenses	108,078
Miscellaneous	341
Total	£4,796,430

It will be noted that the main sources of Revenue are motor and petrol taxes. The motor tax is collected by the State and the petrol tax by the Commonwealth. The two combined is the toll which the motor vehicle owner pays for the use of the road; in other words, the principal user of the Main Roads pays directly for their minor improvement and maintenance. To that extent, therefore, the contribution by the Commonwealth cannot be regarded as a grant in aid of the upkeep of roads but rather that the Commonwealth is the most convenient authority to collect from the motorist, through a petrol levy, a fee for each mile he travels. The amount so collected being handed over to the authority responsible for the upkeep of the roads. From the motor vehicle owner's point of view he pays a fixed amount plus an amount for every mile travelled, and this practice is very sound in principle.

The payment of the motor tax, together with the 3d. per gallon petrol tax, is a measure of the contribution of the owner of a motor vehicle to the cost of improvement and maintenance of roads. The owner of a 30-cwt. car which travels 12,000 miles per annum consuming, say, one gallon of petrol every 15 miles, pays one-fifth penny (1·5d.) per mile in petrol tax and almost exactly the same amount in motor tax or a total of two-fifths penny (2·5d.) per mile travelled. The owner of a 5-ton truck which travels 12,000 miles per annum, consuming one gallon to 6 miles, pays one-half penny (½d.) per mile in petrol tax and in motor tax practically the same amount, or a total of 1d. per mile travelled or about one-fifth penny (1·5d.) per ton mile. These rates cannot be regarded other than very reasonable.

The fact that the Department of Main Roads has a regular income which can be estimated well ahead of the time when it is required for expenditure has enabled the Department to prepare annual programmes of maintenance, improvement and construction with the certainty that funds will be available to meet the cost. These programmes of works are based on the progressive and systematic improvement of the main roads system, and I think all will agree that much was achieved in this direction during the comparatively short period of 14 years from the inception of the Main Roads Board in 1925 up to the outbreak of the war in 1939.

With the foregoing as a background, Roads in the Scheme of Reconstruction and Development may now be considered.

TYPES OF ROADS.

In the older closely-settled countries road builders have for some years turned their attention to the construction of express motor roads between specific centres, on which local traffic is not permitted, and with few connections. Intersecting roads are designed so that all traffic will pass over or under the express motor road. Such roads permit of fast motor traffic passing with the minimum of delay and inconvenience and the maximum safety between the terminal points. Italy and Germany perhaps led the world in this direction, but in both countries the construction of such motorways was probably well ahead of civil requirements. Some British authorities have recently recommended the construction of 2,826 miles of similar roads in Britain.

The traffic in Australia, however, between any two large centres of population is still well within the capacity of improved existing roads, so that the construction of special fast motor roadways could not be justified. At the same time it may become necessary to make provision now for some lengths of this type of road in the vicinity of or through Sydney or Newcastle if expensive resumptions are to be avoided in future.

Long distance traffic in Australia will therefore continue for many years on what are sometimes described as "Mixed Traffic Roads." The raising of these roads to a good standard throughout has been the objective of the Department of Main Roads. With the interruptions due to the war the work will require to be tackled with increased energy as a reconstruction measure.

Road works will fall into three main categories:—

(1) Intensive maintenance and improvement of existing roads to bring them up to the 1939 condition.

(2) Construction of lengths of main roads to raise the alignment, grading and pavement to the design standard for the road. Such lengths may either be on the existing location or on a deviation.

(3) Construction of roads to assist the development of the State. These may fall into two groups—

(*a*) Developmental Roads and works under the Main Roads Act.

(*b*) Special road works to assist in the development of the primary and secondary industries in a district.

In all cases roads include bridges.

With regard to (1) intensive maintenance and improvement of existing roads has automatically been reverted to as plant and experienced men become available.

In connection with (2) much new construction still remains to be done to bring the main roads system up to modern standards. This work has been going on since the creation of the Main Roads Board in 1925 up to the limits of available funds. The work involves clearing, forming, realigning, regrading, construction of pavement, culverts and bridges inclusive of elimination of ferries and railway level crossings and the building of safety into Main Roads as far as practicable. The rate of progress of these works depends at present on availability of suitable men and on securing necessary plant and materials.

In the case of (3) (*a*) developmental roads and works will proceed with funds provided under the Main Roads Act. This, however, will take care of rural development of a minor nature only.

In the case of (3) (*b*) much will depend on the general policy adopted for the development of the State.

BRIDGES.

In addition to renewing worn-out bridges on Main Roads the Department has pursued a policy of eliminating ferries by the construction of bridges in lieu thereof, and also of eliminating dangerous railway level crossings by the construction of bridges or subways. The average number of bridges constructed in normal times would be of the order of 70 or 80 per annum. During the war the number did not exceed 10 or 12. There is consequently a substantial amount of leeway to be made up as a result of war conditions.

In the Metropolitan area two large bridges require to be renewed. One is over Iron Cove, for which a contract has been let, and the other is over Middle Harbour at The Spit. A contract has also been let for the construction of a large bridge over the Hunter River at Hexham. In addition, many smaller bridges throughout the State have reached the end of their useful life and have had to be propped up to keep them serviceable over the war period.

Altogether, the construction of not less than 100 bridges per annum can be undertaken for some years as part of a reconstruction programme, in order to keep pace with essential renewals as well as with very desirable new bridge works. While normally many of the older timber bridges would be reconstructed in concrete and steel, a fair number may be renewed in timber in order to expedite the work and spread the use of various kinds of materials.

DESIGN STANDARDS.

The principle adopted in the design of important routes is first to select a design speed based on the importance of the road and of the topography. Sections of uniform design speed are made as long as possible. The usual design speed is 50 miles per hour with reductions to 40 and 30 miles per hour where the cost of construction to the higher speed would be out of proportion to the amount of traffic on the road.

The provision of suitable width, alignment and grading with ample visibility at road connections is necessary to facilitate the safe passage of traffic. Other safety features are, the benching or cutting back of the side-slope when road is in cutting; the defining of the edge of the formation by erection of white painted posts; the marking of a centre line and the erection of warning signs.

There is still a big task in building all these features into existing roads, and much work can be done as part of reconstruction measures in connection therewith.

PAVEMENTS.

The total mileage of roads in the rural part of the State with traffic exceeding 100 vehicles per day is not very high. Therefore from the traffic point of view costly pavements cannot be justified. Concrete and bituminous surfaced roads have largely been confined to roads in the vicinity of closely-settled areas and to the State Highways. However, there is another phase of the condition of road pavements apart from the load they carry which has to be taken into consideration and that is the regular ravelling of water-bound surfaces by fast-moving traffic and the consequent dust nuisance. While the provision and maintenance of a bituminous surfaced pavement may not

be economically justified where traffic is well below 100 vehicles per day, nevertheless the extra cost involved may be justified on account of the greater comfort and safety provided. To reduce the cost on low traffic roads a width of 10 ft. or 12 ft. of bituminous surface is sometimes adopted. When bitumen and tar are obtainable at anything like pre-war prices, then a very large programme of bituminous surfacing of road pavements can be undertaken in the reconstruction period and in the subsequent development of the State.

AMENITIES.

Another phase of modern road improvement is the preservation of existing amenities and their provision where non-existent. This usually takes the form of preservation of trees within the road boundaries or in its vicinity; the planting of suitable trees and shrubs and the provision of suitable parking places for vehicles. In addition, an attempt has been made to control the display of hoardings within sight of the roads. Again, these matters will have the fullest consideration when planning post-war road works.

EMPLOYMENT

Fears are sometimes expressed that the discharge of men from the Fighting Forces and the closing down of munition factories of one kind and another will make available large numbers of men who cannot be immediately absorbed into peace-time industries. While programmes of public capital works should undoubtedly be planned to meet any emergency which might arise, these should not be put in hand to forcibly employ labour if such labour can be utilised profitably in established industries and works. In other words, works planned to meet an emergency in the volume of employment should not become competitors for man-power.

Whether large post-war works will be organised on the basis of the employment of properly trained skilled operators equipped with up-to-date mechanical plant, or whether such works will be regarded as simply providing employment for the maximum number of unskilled men will be a measure of the success (or failure) of the implementation of a policy of full employment. There is ample work to be done in Australia for generations ahead to keep every able-bodied man fully employed at a task he is properly trained to fulfil. Full employment will have a hollow meaning if we do not see that the opportunity is created for everyone accordingly.

FINANCE.

The amount of money required to finance road works will depend on the rate of progress ultimately decided upon. This in turn will depend on the volume of public works it will be necessary to put in hand to implement the promise of full employment. Generally it should be practicable to finance all intensive maintenance and minor improvement work arising out of reduction or postponement of such work due to war conditions, from revenue funds. Some of the major improvement work and all new construction work will have to be financed either from Government free grants or from loan funds.

Much has been done by the Department of Main Roads in co-operation with Councils in the improvement of roads, but only a small return is obtained in many areas from the expenditure incurred owing to the low volume of traffic. It is clear that rural reconstruction and development must more and more be considered on a regional basis and in conjunction with industrial development to bring about a rapid and substantial increase in the population of Australia. To this end preliminary action has been taken by Regional Development Committees set up by the State Government to carry out a survey of all the resources within their respective regions, *i.e.*, mineral, agricultural, pastoral, timber, water, etc., as well as of existing facilities for transport and communication, and to make separate studies to determine what industries should be encouraged to provide for the maximum use of these natural resources. Preparation of a comprehensive regional plan for the area embracing all activities and providing for the works and services required for the development of primary, secondary and tertiary industries within the area should ultimately be practicable. If this is ultimately achieved then all road improvement and development within any given area would be carried out to conform with that plan.

SYDNEY HARBOUR BRIDGE ACCOUNT.

Income and Expenditure for the Period 1st July, 1945, to 30th June, 1946.

Income.

	£
Road Tolls	225,353
Contributions—	
Railway Passengers	136,440
Tramway Passengers	18,955
Omnibus Passengers	6,593
Rent from Properties	8,819
Miscellaneous	62
	£396,422

Expenditure.

	£	£
Cost of Collecting Road Tolls		11,320
Maintenance and Minor Improvements		32,588
Administrative Expenses		1,000
Loan Charges—		
Interest	270,000	
Exchange	36,700	
Sinking Fund	67,000	
Management Expenses	1,070	
		374,770
Miscellaneous		927
		£420,605

Note: The figures in this Statement are subject to adjustment upon completion of accounts for the year.

Work in the Northern Territory, 1940-1944.

During the war years the Department of Main Roads was called upon to carry out a very large amount of work which was primarily intended to fulfil military requirements. Much of the work was executed in locations at some distance from the Department's usual area of operations. A considerable proportion even in New South Wales, was construction of a type in which the Department's organisation was not particularly experienced, but to which it proved readily adaptable.

Activities in the period 1940-45 included construction and maintenance of roads, aerodromes and subsidiary works in Norfolk Island, New Caledonia, Queensland and the Northern Territory of Australia, as well as works outside the Department's normal sphere in New South Wales.

Works executed in the Northern Territory have considerable strategic and peace-time value and the present article is confined to a general description of these. Future issues of "Main Roads" will contain articles describing the Department's wartime works in other areas.

GENERAL DESCRIPTION OF THE NORTHERN TERRITORY.

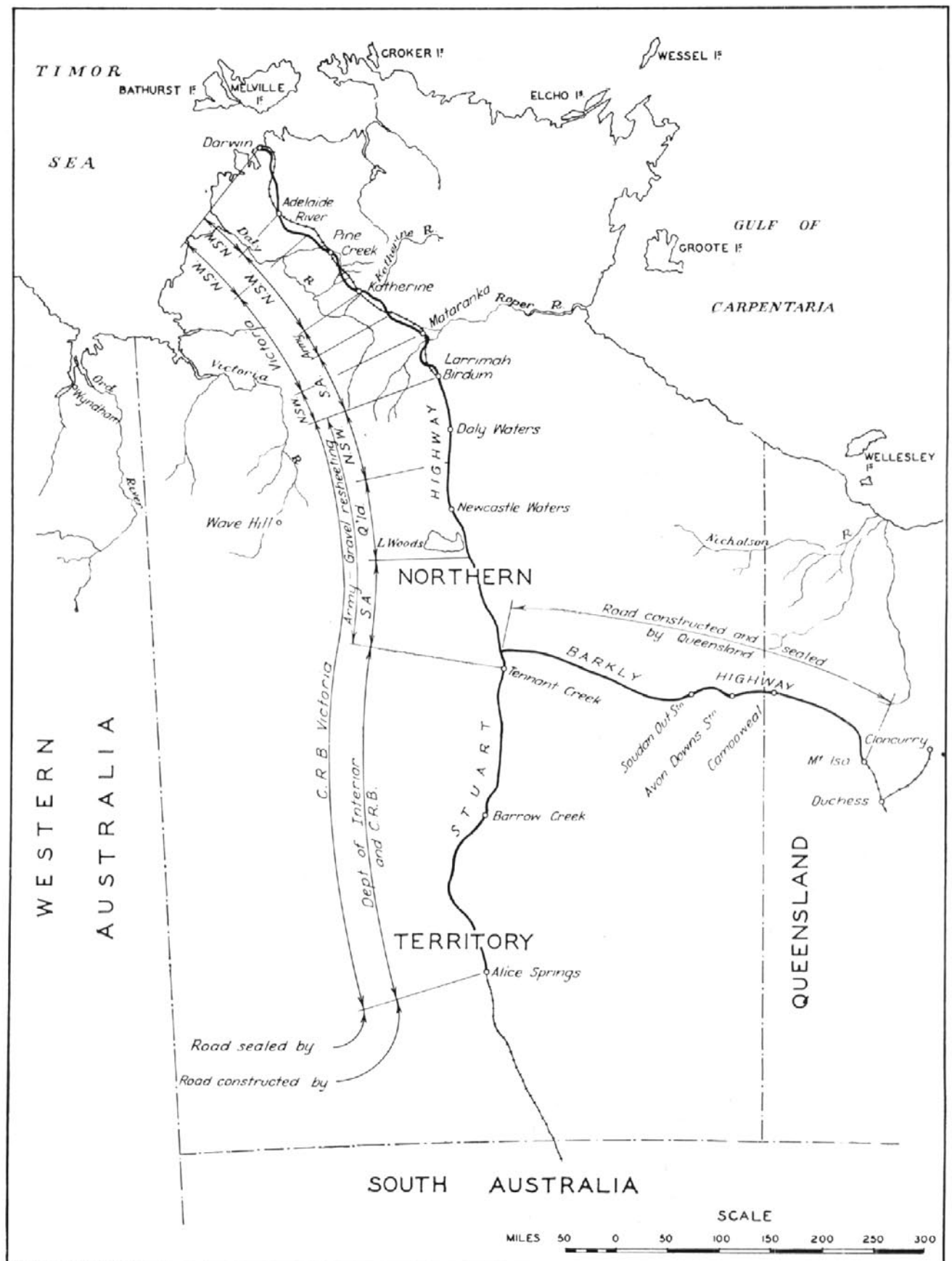
For a proper understanding of the value of the work carried out, an appreciation of pre-war conditions in the Territory is required.

Darwin, with a population of 5,000, was the principal transport inlet and outlet. Communication with other States was mainly by sea, with a limited amount of air travel. The North Australia railway extended from Darwin 330 miles southwards to Birdum and one train a week on this light 3 feet 6 inches gauge line provided a sufficient service for the scattered cattle stations and the small mining settlements. There were small townships on the railway at Pine Creek, 156 miles south of Darwin, and Katherine 220 miles south, with smaller centres at Adelaide River, Brock's Creek, Grove Hill, Ferguson and Mataranka. There were no made roads for more than a few miles from Darwin. In the more northerly area of the Territory, the infrequent travellers used tracks which followed the same general line, year after year, but which were so overgrown by grass each wet season that they were difficult to find and follow in the dry. Such tracks linked up the cattle stations and mining settlements, and connected the Darwin-Birdum area with far distant centres (*e.g.*, Wyndham, W.A., Daly Waters, Tennant Creek, Alice Springs, and centres in the Gulf country to the east). In the south of the Territory, Alice Springs, the terminal of the railway from South Australia (and 980 miles from Adelaide), was the main centre. Communication in radiating directions from Alice Springs was by bush track but, even before the war, a well established road of natural earth and gravel carried regular traffic from Alice Springs to Tennant Creek, a centre of fairly extensive mining operations.

Darwin-Adelaide River Road before Construction.

Constructional work and travel by road vehicles on natural tracks, particularly in the northern section of the Territory, is controlled by climatic conditions. The tropical wet season extends from September to about the end of March, its main incidence being in December, January and February. In the wet season 50 to 70 inches of rain can be expected at points between Darwin and Pine Creek, gradually reducing to about 30 inches at Daly Waters and tapering off more or less uniformly to 6 to 8 inches at Alice Springs. Individual falls of up to 11 inches in four to five hours are not uncommon and rainfall intensities are generally high. Falling on dry country which has received no rain for the preceding six to nine months, the early storms are readily absorbed, and do not affect activities for any lengthy period, but the effect is cumulative. By the end of December, most activities (particularly north of Pine Creek) are seriously handicapped. The saturation of the ground increases until the climax of the

Ant Hill near Larrimah.


TIMOR SEA
BATHURST I.
MELVILLE I.
CROKER I.
WESSEL Is.
ELCHO I.
Darwin
Adelaide River
Pine Creek
Katherine R.
Katherine
GULF OF CARPENTARIA
GROOTE I.
Mataranka
Roper R.
Larrimah
Birdum
Daly Waters
HIGHWAY
Victoria
Ord
Wyndham
River
Wave Hill
Newcastle Waters
L. Woods
NORTHERN
WELLESLEY Is.
Nicholson R.
Road constructed and sealed by Queensland
BARKLY HIGHWAY
Tennant Creek
Soudan Out Stn
Avon Downs Stn
Camooweal
Cloncurry
Mt Isa
Duchess
STUART
Barrow Creek
C.R.B. Victoria
Dept of Interior and C.R.B.
Army Gravel resheeting
N.S.W.
Q'ld
S.A.
TERRITORY
Alice Springs
WESTERN AUSTRALIA
QUEENSLAND
Road sealed by
Road constructed by
SOUTH AUSTRALIA
SCALE
MILES 50 0 50 100 150 200 250 300

wet season occurs, usually in the latter half of February or early in March. By that time, the many swamps are full, the ground is full of soaks and springs, and many streams are flooded. Even works intended to resist these conditions are heavily taxed, and wheeled travel, except on made roads, is out of the question. During the rains, bamboo grass covers most areas in a thick crop, and, by the end of the wet season, reaches up to 14 feet in height. As the rains ease off, the ground surface dries fairly quickly, the grass is beaten down by the last storms (the "knock-em-down" rains) and, gradually, soaks dry up and watercourses become fordable again. By May, tracks are dusty, and, a month or so later, water supplies are scarce in the lower rainfall areas to the south.

Throughout the year maximum shade temperatures in the south are persistently high, sometimes reaching 120°F. in the summer. The humidity is generally low, except after occasional storms when it may be as high as 70% with shade temperatures of about 100°F. Usually the temperature falls appreciably at night and affords a welcome relief to otherwise trying conditions. In the north, the climate is typical of tropical coastal areas, with higher humidity and lower temperatures.

NOTE.—Any reader who desires further information under this heading is referred to a symposium of five papers published in the July, 1941, issue of the Journal of the Institution of Engineers, Australia, under the title "The Darwin Overland Road." In the first of these papers, the Commissioner for Main Roads, N.S.W. (the late Mr. D. Craig) has included a more detailed description of the country, particularly of the area between Alice Springs and Birdum.

THE STUART HIGHWAY.

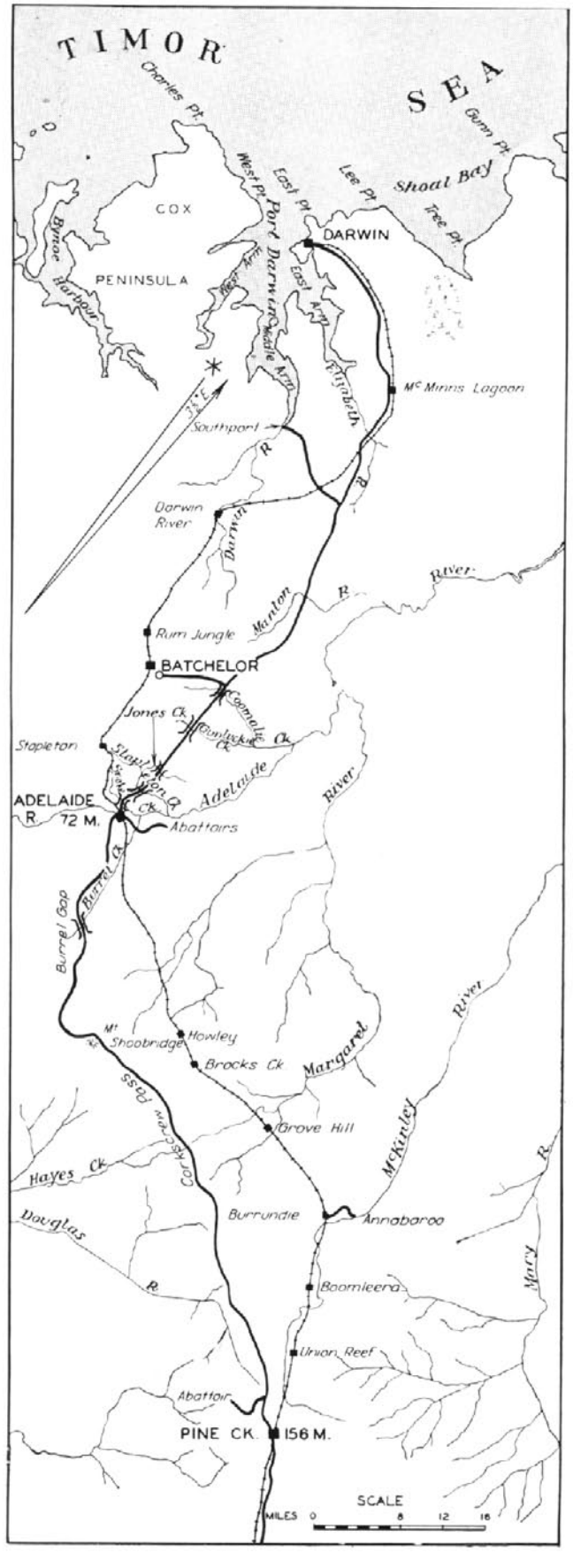
The most important work executed by the Department in the Territory was its share in the construction of the Stuart Highway, the road from Alice Springs to Darwin.

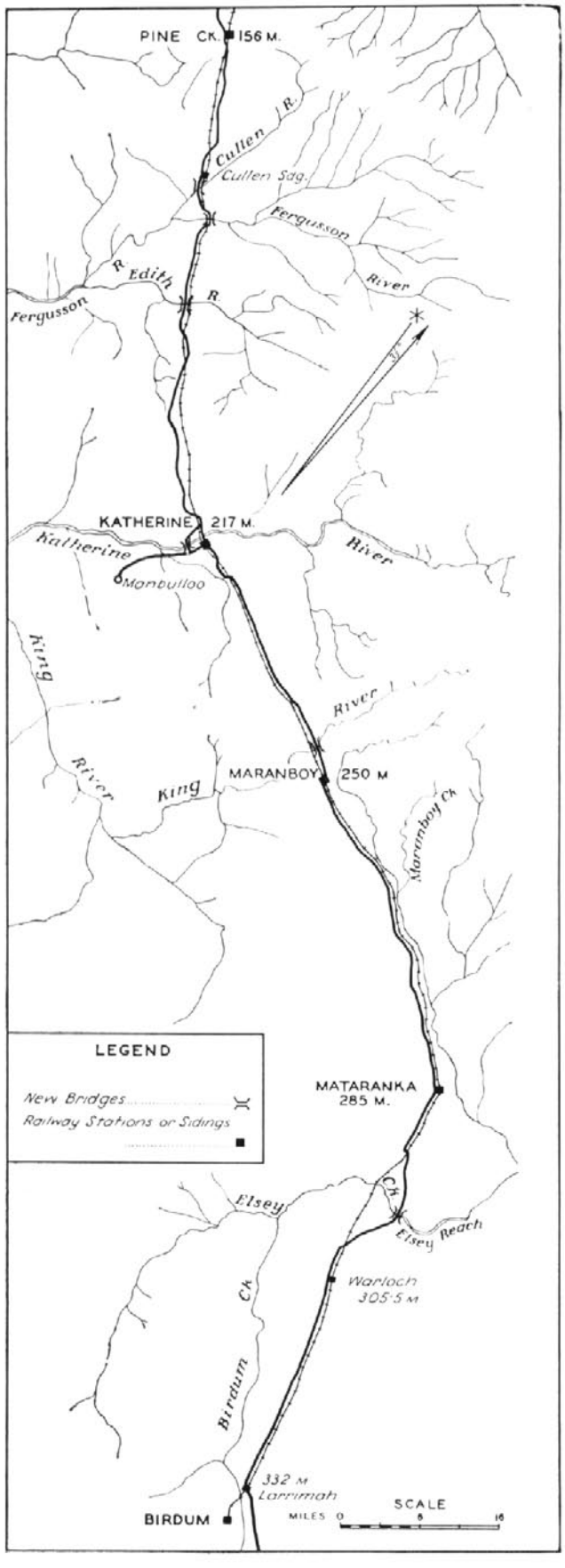
Before the war, land transport facilities existing between Adelaide and Darwin were:

Railway—Adelaide to Alice Springs (981 miles).
Formed Road—Alice Springs to Tennant Creek (314 miles).
Track (along the Overland Telegraph line)—Tennant Creek to Birdum (approximately 307 miles).
Railway—Birdum to Darwin (330 miles).

The Commonwealth Government decided in August, 1940, that an all-weather road should be constructed between Tennant Creek and Birdum, and, in order that the road would be available before the wet season, it was essential that construction be completed early in December. The State Governments of South Australia, Queensland and New South Wales were requested to undertake this work.

After a preliminary reconnaissance of the route, sections of the work were allocated to the three State Road Authorities. The section allotted to the Department of Main Roads, N.S.W. was the most northerly, from Dunmarra to Larrimah (4 miles north of





Burrell Gap near Hayes Creek.

Birdum) a length of approximately 86 miles. The location of the new road was determined by aerial reconnaisance and rapid ground survey. To meet military requirements, it was proposed that the work should be cleared, formed and drained, but that gravelling should be limited to bare necessities. On the Department's section it was found that gravel pavement, 16 feet wide and at least 3 inches thick was necessary over the whole length. The road was cleared 60 feet wide and formed to the Department's Class E flat country cross section over a width of 40 feet, with raised formation 24 feet wide across some areas of black soil. Construction commenced on 21st September, and was completed on 2nd December, 1940.

In this period of 66 working days 86.5 miles of road were constructed, a rate which had never previously been approached in Australia. A full description of this work, and of the lengths simultaneously constructed by the South Australian and Queensland Road Authorities, also is contained in the article published in the Journal of the Institution of Engineers Aust., for July, 1941.

At the end of construction a small maintenance organisation was retained until September, 1941, when the Department of the Interior assumed responsibility for future maintenance of the length.

In March, 1941, at the request of the Military Authorities the Department undertook a survey to determine the most suitable location for a road between Darwin and Larrimah to link with the section south

Formation, Larrimah-Dunmarra Section.

Completed Formation North of Manton River.

of Larrimah already constructed. A small survey party proceeded to the Territory and by mid-May it was able to report that the most suitable route between Darwin and Adelaide River was generally on the route of the existing track. The Department then provided an organisation for the construction of this length (4 m. to 72 m. southwards from Darwin) and completed the work before the next wet season. The clearing width of the old track (approximately 30 feet) was increased to an average of 60 feet throughout. Formation 26 feet wide was carried out with motor graders, except at bridge approaches and a number of short lengths of sidelong country (totalling approximately 5 miles). Gravel pavement was provided 18 feet wide, varying from a minimum depth of 4 inches to a maximum of 12 inches and low embankments composed entirely of gravel were placed across silt flats. A number of new culverts were constructed; existing culverts were lengthened and stone causeways were widened and improved. Bridges totalling 530 feet in length were erected over Coomalie, Gunluckie, Jones, Stapleton and Snake Creeks and Adelaide River, and the railway bridge at Elizabeth River was decked for road traffic. All bridges were built to the same general design of low level type with a 12 feet wide deck. As a supply of rolled steel joists and steel railway rails was available in the Northern Territory, bridges were built of these materials, supplemented with concrete and timber to the extent necessary.

While the construction work was in progress, investigation for a suitable location of the route from Adelaide River to Larrimah was continued, including an aerial photographic survey. This investigation was completed in September, 1941. Towards the end of December, the Department received advice that this section was to be undertaken on the basis of the Department constructing the length from Adelaide River (72 m.) to Katherine (217 m.) and bridges further south. The South Australian Department of Highways and Local Government was to complete the remainder of the road to Larrimah, but on arrival of the 2/1 Mechanical Equipment Coy., R.A.E., that unit took over the construction of the portion of this length between Katherine and Maranboy. The organisation established by the Department completed its share of the work by the end of 1942.

Ferguson River near Site of Bridge.

With the entry of Japan into the war in December, 1941, military needs required this length to be constructed firstly as a single lane dry weather track, and later developed to a full width all-weather road. The length 142 m. to 178½ m. (*i.e.*, north and south from Pine Creek, 156 m.) of the dry-weather "pioneer" track was constructed by the U.S. 808 Engineer Battalion, and maintained and improved by that unit until its departure from the area in July, 1942. On the completed work (a length of 145 miles) clearing was usually 1 chain wide. Formation was 26 feet in cuttings and 28 feet on embankments with cross sections similar to the previous work. Gravel in all cases extended over the full formation width with a slightly tapered cross section and was usually 6 inches deep. Over swampy ground and silt flats, gravel was placed up to 18 inches deep. Again a number of culverts and causeways were constructed. Bridges were all 12 feet between kerbs, and all except that across the Elsey River were of low-level type. Wherever possible, an alternative high level crossing was provided by decking and building approaches to an adjacent railway bridge. A schedule of the bridge works completed during 1942 is given below:—

Mileage from Darwin.	Crossing.	Length	Work.
miles.		feet.	
72	Adelaide River...	500	Decking railway bridge.
87	Burrel Creek ...	60	Concrete bridge on concrete piles, 2/30-feet spans.
172	Cullen River ...	140	Concrete bridge on concrete piers, 4/35-feet spans.
178	Fergusson River	88	Concrete bridge on existing concrete piers of abandoned railway bridge, 4/22-feet spans.
178	do do ...	420	Decking railway bridge.
187	Edith River ...	155	Concrete bridge on concrete piers, 4/35-feet and 1/15-feet spans.
215	Katherine River	700	Decking railway bridge.
217	do do ...	315	Concrete bridge on concrete piers, 9/35-feet spans, and low weir.
242	King River ...	60	Concrete bridge on steel piles, 2/30-feet spans.
242	do do ...	160	Decking of railway bridge.
290	Elsey River ...	540	High level concrete bridge on steel piles.

Coomallie Creek Bridge.

Adelaide River Bridge.

Edith River Bridge.

Katherine River Railway Bridge before decking for road traffic.

As part of the work of the 1942 organisation, the Department carried out maintenance of the length constructed in 1941 from Darwin to Adelaide River. Some improvements were effected and approximately 20 miles of bituminous seal coat were laid through the principal camps and alongside airstrips.

At the end of 1942 the Department was made responsible for the maintenance of the Stuart Highway from 4 m. to 332 m. south of Darwin. During 1943, in order to meet the needs of exceptionally heavy military traffic, extensive reconstruction and drainage works were carried out on the length Darwin (4 m.) to Adelaide River (72 m.) and the whole of this length was provided with a bituminous seal 20 feet wide. Traffic on this length was up to 2,000 vehicles per day, a large percentage of which were heavy lorries. The length from Mataranka (285 m.) to Larrimah (332 m.) was also sealed in this period. Maintenance by the Department of the highway from 4 m. to 332 m. south of Darwin was continued in 1944. Improvement works during 1944 included extensive drainage and gravel resheeting between Adelaide River (72 m.), and 114 m. and this length was later sealed 20 feet wide. In addition, various sections, totalling 36 m., between Darwin and Adelaide River were resealed.

During 1944 the Department's commitments ended and maintenance of the Stuart Highway was taken over by the Allied Works Council as follows.—

Maranboy (250 m.)–Larrimah (332 m.)—1st March, 1944.

Cullen River (174 m.)–Maranboy (250 m.)—1st May, 1944.

109 m.–Cullen River (174 m.)—1st July, 1944.

Darwin (4 m.)–109 m.—1st September, 1944.

When the Department's organisation was withdrawn in September, 1944, the Country Roads Board (Victoria) was proceeding with the bitumen surfacing (16 feet wide) of the length 114 m. to Mataranka (285 m.). This work filled the only gap still remaining unsealed in the whole length from Darwin to Alice Springs. The Country Roads Board had previously completed the sealing 16 feet wide, of the section Alice Springs to Larrimah. At that stage the Stuart Highway was in such condition that it could be expected to carry heavy traffic in practically all weathers.

AERODROMES.

Early in November, 1941, road work was interrupted so that the Department's forces could undertake higher priority work involved in gravelling and extension of the runways at the R.A.A.F. aerodrome at Darwin and at Batchelor. Work executed in 1941 was as follows:—

R.A.A.F. Aerodrome, Darwin.

Gravelling of existing formation on two runways and their extension. Gravel pavement 6 inches deep for 5,000 feet on one runway and 4,500 feet on the other.

Surfacing—Stuart Highway.

Batchelor Aerodrome.

Formation of extensions of two existing runways from 3,600 to 5,000 feet with gravel pavement 9 inches deep on extensions. Depth of gravel pavement of one previously existing 3,600 feet runway increased from 4 inches to 9 inches. It is of interest that the work at Batchelor was completed in the week preceding the attack on Pearl Harbour.

The change in the tactical situation signified by the first and heaviest raid on Darwin on 19th February, 1942, caused radical and immediate alterations in the programmes of all works authorities in the Territory. The construction of fighter strips became first priority work. The small D.M.R. force was the only constructional party adapted to such work then in the Darwin area and did the bulk of the work in the early weeks after the raid. Some aerodrome work had been included in the Department's commitments for 1942 but this was considerably increased, and work actually carried out was as follows:—

Darwin Civil Aerodrome.

Supply and spreading of gravel on runway extensions and taxiways. Some work was also done in forming of a runway extension, provision of culverts and repair of bomb damage.

Completed Road at Corkscrew Pass.

R.A.A.F. Aerodrome, Darwin.

Supply and delivery of gravel on taxiways and repair of bomb damage.

Roadside Strip, Sattler.

Clearing 9,000 feet by 150 feet wide. An area 5,200 feet by 100 feet was partly formed.

Roadside Strip, Livingstone.

Cleared and formed to the same dimensions as at Sattler. A gravel pit was also prepared.

Batchelor Aerodrome.

Trenching for protection of petrol and oil dumps. Clearing and gravelling of an extensive system of taxiways, and dispersal bays. Spraying runways with fuel oil to reduce dust nuisance. One of the main runways was surfaced with a bituminous seal coat (an area of 89,000 square yards.)

Roadside Strip, Pell.

Runway cleared, formed and gravelled to same dimensions as other roadside strips. Taxiways were also completed at this strip and all gravel pavement was sprayed with fuel oil.

Fenton Aerodrome.

Runway resheeted with gravel, and surfacing with bitumen on a total area of 90,000 square yards.

Roadside Strip, McDonald.

Aggregate crushed for sealing by R.A.A.F., and access tracks provided.

Manbulloo Aerodrome, Katherine.

Runways prepared for sealing and sealed with bitumen (an area of 85,700 square yards.)

In 1943 the Department's commitments in regard to aerodrome works were fairly heavy, but changes in the co-ordinating authority, and in strategical requirements, led to an appreciable reduction in these. Works actually carried out comprised:—

Long Aerodrome—Clearing, formation and gravel pavement.

Riding Aerodrome—Clearing and formation.

Frazer Aerodrome—Clearing only.

In 1944 the principal work put in hand was the reconstruction of the R.A.A.F. Aerodrome, Darwin, to take Superfortress (B29) heavy bombers. The Department was allotted a large share of this work. An idea of the extent of the construction can be gained from the quantities completed by the D.M.R. organisation as follows:—

Formation—1,003,000 square yards.
Gravel—261,000 cubic yards.
Scoop Drains—169,600 lin. feet.
Culverts—18,850 lin. feet.

Bituminous Surfacing:

Prime and Single Seal—878,800 square yards.
Prime and Double Seal—64,400 square yards.

Fenton Aerodrome—Resheeting prior to sealing.

The principal dimensions of this aerodrome on completion were:—

311° runway—10,000 feet long by 150 feet wide. Fighter strip (parallel to above).

5,000 feet long by 100 feet wide.

177° runway—5,600 feet long by 150 feet wide.

In addition to the work actually carried out by the Department's forces at R.A.A.F. Aerodrome in 1944, considerable assistance was given to Service units, both R.A.A.F. and U.S. Engineers, in connection with the tasks allotted to them at this aerodrome.

MISCELLANEOUS WORKS.

In 1940 construction work carried out by the Department was confined wholly to the Stuart Highway, but, in the following years, a considerable volume of other work required by service authorities was undertaken. A large proportion was in connection with aerodromes, as described above. The remainder can best be described as "Miscellaneous Works." Brief details of these are given hereunder:—

1941—

Adelaide River Military Depot—Excavation for ammunition bins. Clearing, forming and gravelling access roads (3¾ miles).

Batchelor Aerodrome—Truck servicing Tractor.

Leayner Swamp—Clearing pandanus swamp for field of fire (25 acres) in front of barbed wire defences.

Darwin Racecourse and East Pt.—Clearing scrub for field of fire (10 acres) in front of barbed wire defences.

1942—

Bomb Damage, Darwin—Repair of cratered roadways and aerodromes.

Southport Jetty, Port Darwin—Construction of access road, 9½ miles long, from Stuart Highway, at 29¾ miles to jetty.

Adelaide River Abattoirs—Construction of 5 miles of new road connecting the abattoirs with the Military Depot road system.

Fenton Aerodrome—Access roads, 6½ miles long, from Stuart Highway to aerodrome.

Burrundie-Annabaroo—Formed road, 2¾ miles long, from Burrundie railway siding to Annabaroo Convalescent Depot.

Pine Creek Abattoirs—Access road constructed 5¼ miles long, from Stuart Highway at 153 miles to abattoirs.

1943—

During the year a considerable amount of work was done on maintenance of access roads previously constructed by the Department. Two new works, earthworks on Middle Arm Spur Railway Line and construction of Batchelor Water Supply, were commenced but were cancelled before they had proceeded far towards completion.

1944—

Woods Street, Darwin—Construction of approximately ½ mile to provide better access to the waterfront.

Darwin Roads, Surfacing—Bituminous surfacing of various streets in Darwin proper.

12 *Aircraft Repair Depot*—At R.A.A.F. Aerodrome, Darwin. Earthworks and provision of bitumen surfaced roads and tarmacs over an area of 20,400 square yards.

Batchelor Road—Road initially constructed by Department of Interior and improved by D.M.R. in latter part of 1943. Bituminous surfacing for full length of 7½ miles, 20 feet wide, in 1944.

Batchelor Water Supply—Completion of scheme including installation of pumps and laying of 63,000 feet of mains. Also erection of three 30,000 gallon storage tanks.

D.O.R.A.T.—The Darwin Overland Road Authorities Transport service deserves special mention. Enemy action, early in 1942 resulted in sea communication with Darwin being cut off for some months.

Elevating Grader loading gravel.

At the Department's suggestion, all State Road Authorities concerned with work in the Northern Territory joined forces in the establishment of an independent road transport service between Alice Springs and Larrimah, to handle road authorities freight. The necessary vehicles and staff were obtained and the service put into operation in March, 1942. D.O.R.A.T. continued to function throughout 1943-44 and greatly facilitated the movement of mechanical equipment, stores and personnel.

ORGANISATION.

The Department's activities in the Northern Territory during 1940, 1941 and 1942 were confined to previously specified construction and maintenance works. Some changes were made during the progress of the work, but, in general, it was possible to make an estimate of the equipment, stores and personnel required for the proposed work each year, and make preparations accordingly. Each year a new organisation was built up and sent forward, and returned on completion of its allotted work.

At the end of 1942 the Department was entrusted with the continuous maintenance of the Stuart Highway, 4 miles to 332 miles south of Darwin, in addition to other specified construction and maintenance works. This necessitated the formation of a permanent organisation and, in May, 1943 the Northern Territory Division of the Department of Main Roads was established. Section offices were set up and there was a general increase in the organisation to cope with the additional works. Prior to this the Department had dealt directly with the Service Authorities for whom the work was being done, but in 1943 works co-ordination was undertaken by the Allied Works Council. The Council then consulted the services as to their requirements and allocated works to the State Authorities and to its own forces. The Allied Works Council expanded its activities until, by the end of 1943, it had become the principal supplier of plant and the sole supplier of labour to all other Civil Authorities in the Territory. Hitherto, the Department had recruited its own labour and supplied the bulk of the plant for its own work.

Throughout the work all possible assistance was given the Department by Army and R.A.A.F. As an instance of this, the following services and supplies were provided by the Army for the Department's 1941 organisation.

Transport to and from the Northern Territory.
Communications—signals, telegrams, etc.
Medical Services.
Canteens.
Fuel, oil and lubricants.
Rations.

The special conditions under which the work was carried out made the task of internal job organisation a difficult one. Primitive communications and transport facilities in the early stages, and the great distance (approximately 2,000 miles) from the nearest substantial civilian centre, complicated the problem. As time, rather than cost, was the governing factor, it was necessary for all members of the organisation to act a good deal more on their own initiative, and to accept a greater measure of responsibility than on an ordinary peace-time job.

WORK BY OTHER AUTHORITIES.

Other State Road Authorities were actively engaged on works in the Northern Territory. Some mention of their operations has been made elsewhere in this article, but further mention of, at least, the major roadworks carried out by other Authorities is necessary to form a complete picture.

On the Stuart Highway the South Australian Department of Highways and Local Government constructed two lengths, Tennant Creek to Powell Creek Telegraph Station and Larrimah to Maranboy. The Queensland Main Roads Commission constructed the length from Powell Creek to Dunmarra. The Department of the Interior employed its forces on maintenance and improvement work principally between Alice Springs and Tennant Creek, while during 1942 regravelling between Tennant Creek and Larrimah was carried out by the 2/9 and 2/15 Field Companies R.A.E. The whole of the bituminous surfacing from Alice Springs to Larrimah (621 miles) and from Mataranka for 171 miles northwards was executed by the Country Roads Board of Victoria.

In addition the Queensland Main Roads Commission completed a particularly important work in the construction of the Barkly Highway, running roughly westward from Mount Isa (in Queensland), through Camooweal to a point on the Stuart Highway, 16 miles north of Tennant Creek, a total distance of 403 miles.

Planning Activities.

When the Main Roads Act was passed in 1924 a large mileage of proclaimed main roads existed. Soon after the passing of the Act these roads were classified into State Highways, Trunk Roads and Main Roads, to form a definite system and additions and amendments to that system have been made from time to time to enable it to serve the community more fully. Thus planning was involved and from its inception the Department of Main Roads has recognised the importance of close investigation and deliberate planning in the development, not only of the Main Roads system, but of the State generally.

Prior to the war difficulty was experienced in obtaining sufficient correlated basic data for planning. During the early war years the position was more difficult and staff was not available to advance the Department's investigations. However, when its activities in defence construction passed the peak, it became practicable to devote a small staff to investigations relating to long range main road requirements in urban areas where traffic problems had become, or threatened to become, acute.

From these investigations the Department was able, in association with the Councils of the City of Greater Newcastle and Lake Macquarie Shire, to prepare a long range road development plan for Greater Newcastle District and the plan has been adopted by those Councils. A road plan for the Wollongong-Port Kembla Area has been prepared in conjunction with the Councils concerned; some parts of this plan have been adopted and others are being considered.

In the Sydney Metropolis, the problems involved in the preparation of a Main Roads Development Plan are greater and more complex than in other areas. One of the major difficulties has been the absence of basic data in the form required. When the Department of Main Roads commenced its investigations the legislation providing for establishment of the Cumberland County Council did not exist nor did there appear much prospect of any other authority or organisation making a reasonably early commencement of investigations necessary to assemble the information required for comprehensive planning of the future main roads system. Accordingly, an extensive, but not exhaustive, investigation has been made by the Department. Every effort was made to ensure that, within the limitations of time and strength of staff, there should be assembled and presented in suitable form factual information giving an unprejudiced and reasonably comprehensive view of the present metropolis and its trends. There was also investigated the available information relating to other cities in order to make comparisons and to profit by the experience of others.

Investigations were conducted with the clear realisation that the road system must be designed as an integral part of the transport system as a whole. The various types of transport must be taken into consideration in order that they blend to provide an efficient service that has due regard to the factors of time, convenience, economy and safety, in the movement of people and goods over all parts of the metropolis and in linking with areas outside the metropolis. Planning of a metropolitan transport system demands, amongst other things, a knowledge of the various types of land use, and intensities of use, that the transport system is to serve. This does not mean that the future land use should first be planned and the transport system then designed to fit that land use, but rather that there should be a parallel planning of the various elements that go to make the future metropolis, with the future main roads forming a very important framework. This planning might be regarded as divided into two parts:—

1st Part: The assembly of data as to the past and present development, and the analysis and presentation of that data in such a manner as to convey a broad picture of the metropolis and its trends. Also the formulation of a plan of anticipated future land use; such plan to be used as a basis for estimation of future road traffic.

2nd Part: Preparation of estimates of future road traffic and design of Main Roads Development Plan to provide for traffic growth from present volumes to the estimated future volumes.

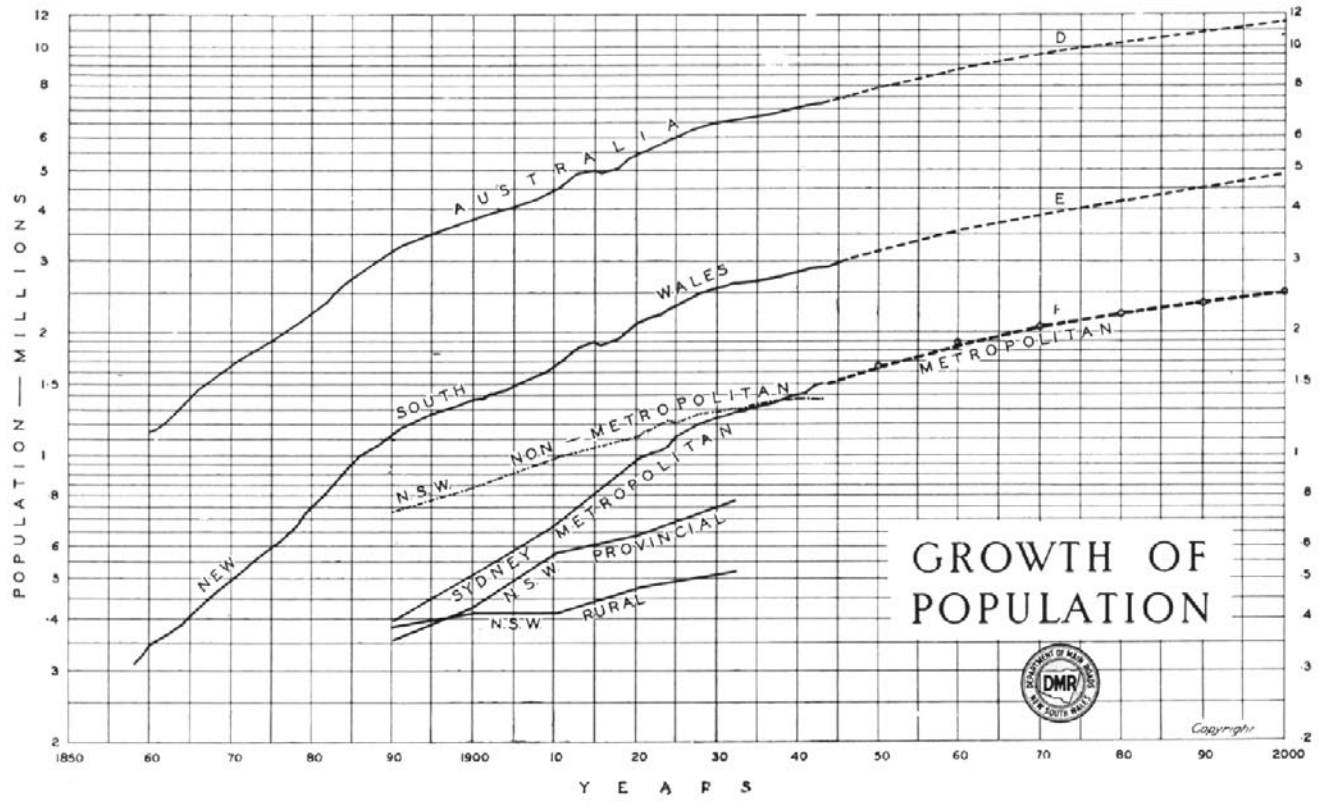
The first part as above has been carried out and the second is well advanced.

There follows a brief outline of the investigations made and data assembled under the first part.

POPULATION.

The past growth and present trends in population of Australia, New South Wales and the Sydney metropolis have been examined. Investigations lead to the conclusion that it is improbable that the population of the metropolis will exceed 2½ millions by the end of the century. It would be unwise to attempt to plan too far ahead, because social habits and conditions are steadily evolving and there is a limit to the period we can plan ahead from study of data gathered from the past and present.

For road planning purposes an ultimate metropolitan population of 2½ millions has been adopted. This does not mean that the suitability of the plan is dependent upon the population reaching 2½ millions, but that the plan will serve any population figure intermediate between the present population and 2½ millions.



TOPOGRAPHY.

Aerial photographs covering about 400 square miles of the metropolis were taken, and from these, maps or mosaics were prepared by piecing together the photographs. With the aid of the mosaics and detailed stereoscopic examination of pairs of photographs a close study of topography and development in all parts of the metropolis has been made.

MAP OF PRESENT LAND USE.

A map has been prepared showing the present land uses within the County of Cumberland. This shows the land uses classified under the following headings:

Residential.
Industrial.
Abattoirs.
Brickworks, Quarries, etc.
Commercial.
Public Buildings and Institutions.
Public Parks and Reserves of Unrestricted Access.
Recreation Grounds of Restricted Access.
Reserves for Public Purposes—no right of access by public.
Cemeteries.
Railways and Transportation.
Wartime Establishments.

AREA OF STREETS.

The relationship of area of streets to total area of land in use in Sydney and other cities has been examined.

RESIDENTIAL AREAS.

A set of maps showing proclaimed Residential Districts under the Local Government Act has been prepared and the present distribution of flats, which has an important influence on density of population, has also been mapped.

The decline in the average number of persons per dwelling has required an increase in the numbers of dwellings required per 1,000 persons and this decline has been illustrated by graphs.

Present densities of population in the different parts of the metropolis and in different parts of individual municipalities have been examined and presented on a population density map. These densities of population have been compared with densities in other cities.

The population capacities of the various parts of the metropolis have been examined to arrive at the area required to accommodate a future population of 2½ millions.

INDUSTRIAL AREAS.

The relationship between acreage of industrial land and population, employees, etc., has been examined, and compared with similar relationships in other cities. Growth in factory employment, and the relationship between factory employment and population have been examined. From a study of these various relationships estimates of the required future acreage of industrial land have been made.

COMMERCIAL AREAS.

Comparisons have been made between present acreages in Sydney and acreages in other cities. These have served as a guide in estimating future requirements.

PUBLIC BUILDINGS AND INSTITUTIONS.

Present acreages and the need for additional acreages have been examined, and comparisons made with other cities.

PARKS AND RECREATION AREAS.

Present acreages and distribution have been examined in relation to population and compared with conditions existing in other cities. Future requirements have been estimated.

TRANSPORTATION.

Information relating to the geographical distribution of employment and of the relationship between places of residence and places of employment has been assembled and presented graphically on maps. Passenger movement at week-day peak hour has been shown on a map-diagram.

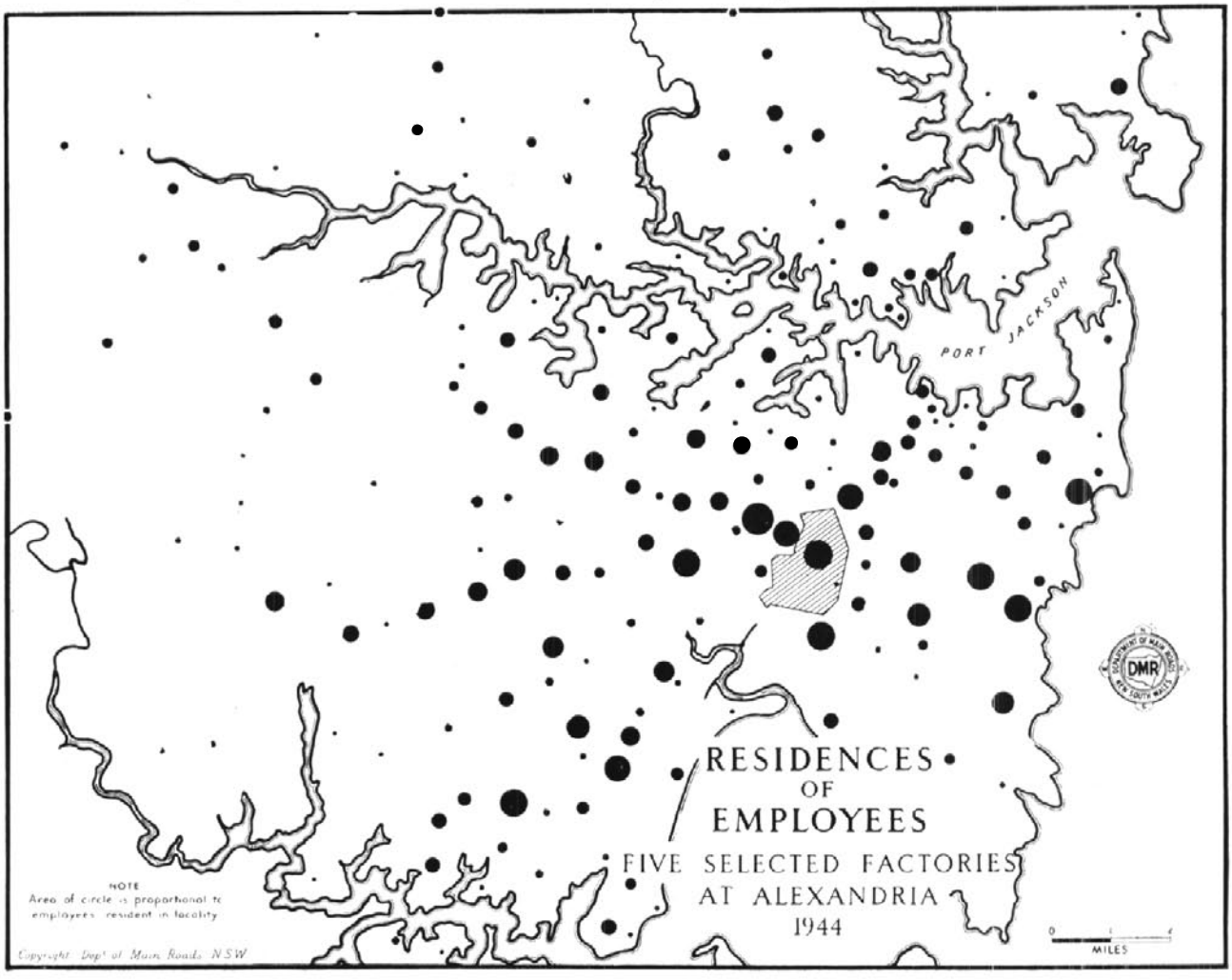
THE FUTURE METROPOLIS.

Based on the data assembled under the above headings and other informaton, maps have been prepared showing:—

(i) anticipated future land use,
(ii) anticipated future limits of continuous urban development,
(iii) anticipated future distribution of population and employment.

These have been used as a basis for preparation of estimates of future traffic pending preparation of a master plan by the Cumberland County Council.

The Department's investigations and compiled data have been of value to other bodies as well as to itself. In particular the recently formed Cumberland County Council has been supplied information relating to various phases of planning set out above, whilst a number of other Departments interested in planning have been supplied with maps, etc., connected with their individual interests. In order to make the information available, in suitable form, to those other organisations particularly or generally concerned and to interested private persons the Department has arranged for the early publication of a comprehensive report accompanied by maps, diagrams and tables.



As mentioned previously, the second part of the Department's planning work in the metropolis is the preparation of estimates of future road traffic and the design of a Main Roads Development Plan to provide the road facilities required for traffic growth from present volumes to estimated future volumes. In this task extensive investigations of road traffic volumes, composition, and distribution have been made, and an original method has been developed for estimating future road traffic. This method has been applied to arrive at the traffic-carrying capacities required on the various parts of the future main roads system. The particular location and cross sections for the various main roads, existing or proposed, in order to provide that capacity, are now being examined.

This Department is not responsible for roadworks within the City of Sydney, but it is essential that planning of roads for which it is responsible be co-ordinated with planning within the City, and to achieve this constant contact with City Council officers is maintained. The matter of traffic in and through the city has received much attention and in consultation with the Port Roadways Development Technical Committee (of which the Department's Chief Engineer is Chairman) as well as with the City Engineer, proposals for the better delivery of traffic into the city and for the diversion of through traffic from the inner city streets have been taken fully into consideration.

The Department has already consulted some Municipal Councils as well as senior officers of the Cumberland County Council regarding particular elements of the future road system, and others will be referred to as the plan develops. When completed the Department's Main Roads Development Plan will be submitted to the County Council for its consideration as the co-ordinating authority for planning in the County of Cumberland.

In subsequent numbers of "Main Roads" there will be further articles dealing with the Department's planning work both in respect of the metropolis and the country.

Main Roads Standards.

Revision of Drawings and Specifications

During the previous period of publication of *Main Roads* it had become customary to publish in each issue a short statement covering revisions made to standard drawings and specifications since the previous issue of the journal. A brief description of any new standards adopted by the Department, and reference to existing standards cancelled, was also published. In the present issue, space will not permit this procedure to be resumed in relation to the comparatively large number of revisions, etc., made in the period during which publication of *Main Roads* was suspended.

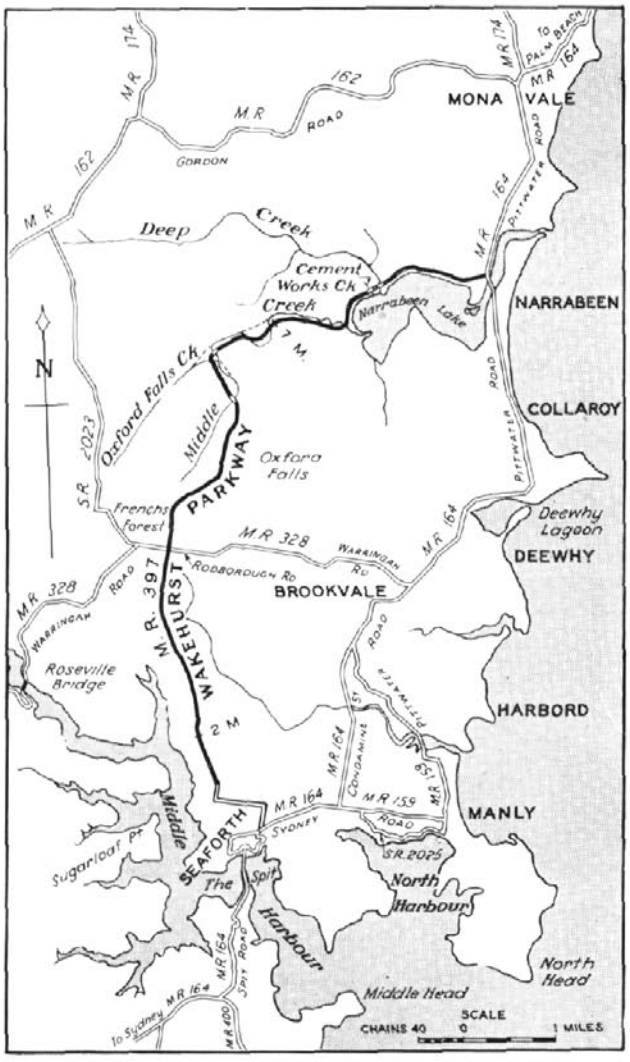
For the information of those who wish to refer to Main Roads Standards, the list published on the inner back cover of this journal has been brought up to date. It is advisable, in any case where the Department's standards are to be used, that reference should be made to this list to ensure that the latest revisions are included.

In some cases the revision may have entailed only minor amendments in connection with the wording of a specification or the dimensions on a drawing, and this will not necessarily involve the cancellation of any large stocks of the obsolete forms which may have been obtained prior to issue of the revised copy. In such cases the obsolete copies may be brought up to date by suitable insertions.

Wakehurst Parkway.

Main Road No. 397 from the vicinity of Seaforth to Pittwater-road at Narrabeen was formally opened by the Premier of New South Wales, the Hon. W. J. McKell, M.L.A., on 22nd March, 1946. As part of the opening ceremony the Premier officially named the road "Wakehurst Parkway" and unveiled a commemorative tablet at the roadside at each end of the new work.

The naming of the road is an expression of the Government's desire to pay a tribute to Lord Wakehurst, who as Governor of New South Wales from April, 1937, to January, 1946, took a great interest in the development of the State and in its natural beauty.



Wakehurst Parkway.

This is the first road in the State to merit the name "parkway," a term which is applied to a road of exceptional width, including in its width areas in their natural state or developed as strips of parkland.

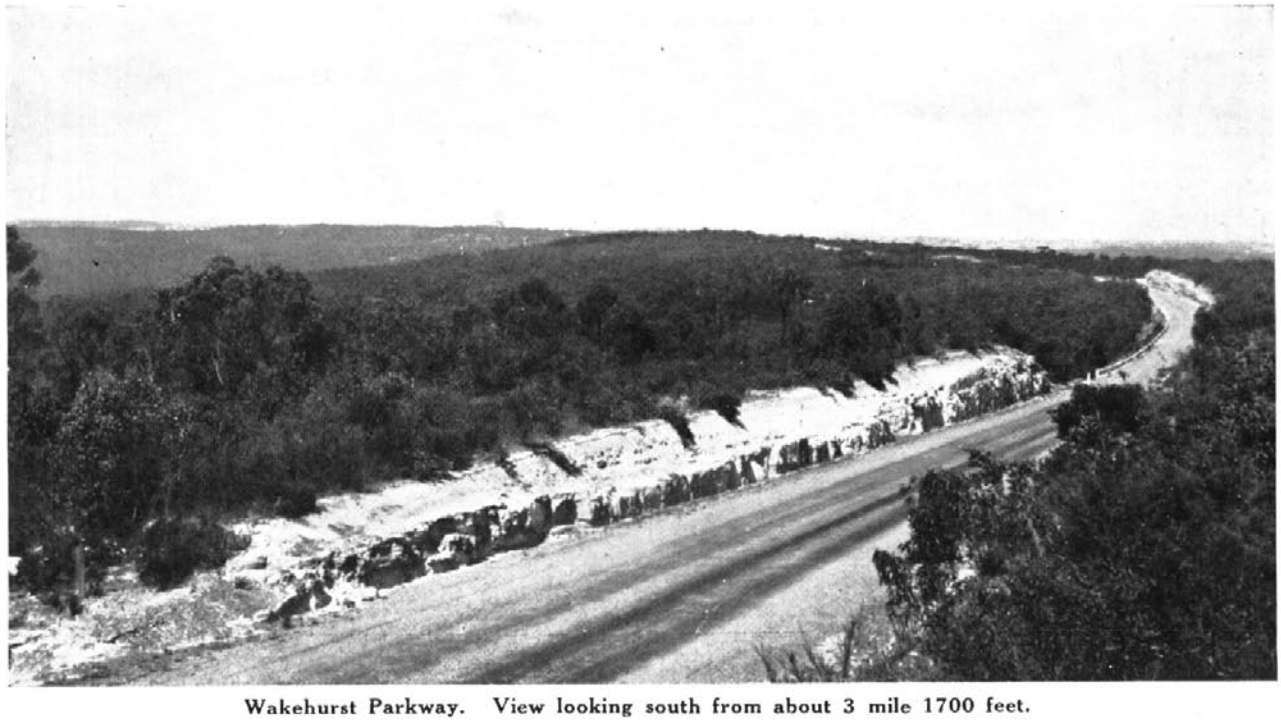
The new road passes over the heights of French's Forest and descends past Oxford Falls to skirt the western and northern shores of Narrabeen Lake. Throughout its length the road is flanked by natural bushland amid attractive scenery, and it is for the purpose of preserving these that a width of road reservation of 240 feet has been acquired through other than Crown land. In this width there will be ample area remaining for trees and shrubs even should it be necessary to provide ultimately for eight lanes of traffic.

From the inception of the Main Roads Board in 1925 it was realised that the traffic requirements of the Shire of Warringah were likely to increase considerably. Some development was expected because of the excellent beaches and other recreational areas between Manly and Palm Beach and still more because there were large areas of undeveloped land which, though mainly unsuitable for cultivation, were suitable for residential purposes. The principal route of access to the area between Manly and Palm Beach, for traffic from Sydney or the suburban area south of Sydney Harbour, is Main Road No. 164 (Sydney, Pittwater and Barrenjoey roads) crossing Middle Harbour at the Spit Bridge and serving Manly West, Brookvale, Dee Why and coastal areas to Palm Beach. An alternative, but longer route from the city, crosses Middle Harbour at Roseville Bridge and proceeds via Main Road No. 328 to Brookvale. Most of the traffic from the northern and western suburbs uses Main Road No. 162 from the Pymble-Gordon area to Mona Vale.

Improvement and reconstruction works on all these roads were undertaken section by section but there was an increasing need for additional facilities for traffic to and through the Warringah Shire. The construction of the Wakehurst Parkway is the first stage in the development of these facilities and the road, besides being an attractive bushland drive less than half an hour's run from the City, will form an important part of any future direct road communication between Sydney and Warringah Shire.

LOCATION AND DESIGN.

From its junction with Main Road No. 164 (Sydney-road) in Seaforth, the new road follows fairly closely the alignment of French's Forest road to Main Road No. 328 (Rodborough-road) and then proceeds in a general northerly direction through the Middle Creek



Wakehurst Parkway. View looking south from about 3 mile 1700 feet.

area to the northern shore of Narrabeen Lake, which it follows to its junction with Main Road No. 164 (Pittwater-road) at Narrabeen. The length of the road is 9.8 miles, of which 7.75 miles are new construction in virgin country. For the remainder of the total length (2 miles at the southern end and 0.05 miles at the northern end) the existing pavement was resurfaced and incorporated in the new work.

One carriageway only, 22 feet wide with 9 feet shoulders has been constructed as the first stage of the ultimate design which will accommodate, if required, a total of four of these carriageways. The maximum grade is 8%, over one length of half a mile only. The minimum radius of curve is 700 feet and benching to improve visibility was required only at two curves. The design speed for the new road was 50 m.p.h. from its southern end to Main Road No. 328 and from Deep Creek to its northern end. The middle section, between Main Road No. 328 and Deep Creek, was designed for 40 m.p.h., as being the limit for economical construction.

In the design, also, due consideration was given to the possible need for ultimate connection of the southern end of the Parkway, to the approach to any high-level bridge which may be necessary in the future, over Middle Harbour.

CONSTRUCTION.

Approval was given in October, 1939, for the work to be undertaken with unemployed relief labour on a rationed basis. The construction started in November, 1939, and continued until March, 1942, when it was closed down owing to wartime demands on manpower. It was thought possible to recommence the construction in October, 1944, but changing developments in the war situation caused a further cessation in the following month. The work was taken up for the third time in March, 1945, and is still in progress. It is now close to completion, the principal operation outstanding being the placing of about 5 miles of bituminous surface course.

At the commencement of the construction in 1939, only 30 men were employed. This number was rapidly expanded to 150 men by January, 1940, and reached a maximum of 300 men in March, 1942, when the work was first closed down. The headquarters of the construction organisation was established at Rodborough-road, French's Forest. Here were located offices, store, blacksmith's shop for tool sharpening, etc., and facilities for attending to minor repairs and adjustments to the plant. A camp was established at the headquarters depot to house the Department's officers and full-time employees.

As all the men, except the gangers and plant operators, were employed on a variable rationed basis, much work was involved in forming suitable gangs. A system of transport was arranged to collect the men from various northern suburbs and take them to the Rodborough Depot, in 'buses supplied by the Department of Road Transport and Tramways. The timing of these special 'buses had to be so arranged as to allow the 'buses to return and take up regular peak hour public transport runs in the various suburbs.

The work was opened up at numerous points on the route in order to employ economically the ten gangs which had been formed, and access to the work points was obtained by sidetracks and temporary bridges, where necessary owing to the rought nature of the country. It was not possible to take the men direct to their working places in the 'buses, and transport forward from the depot was provided by lorries.

The principal items in the construction work were the excavation of cuttings, mostly in sidelong ground, and the formation of embankments in some cases across swampy ground. The ground excavated comprised approximately 82% rock and 18% soil. The total quantity of earthwork was 300,500 cubic yards. Of this total a quantity of 248,000 cubic yards was hand-loaded into lorries and the balance of 52,500 cubic yards was moved by mechanical means. The equipment used included two power shovels (for short periods) and end loader, and various tractor-drawn scoops.

The hand excavation, using unemployed relief labour, was carried out by blasting, using compressors and jack hammers, and the material was then loaded by hand into lorries and hauled to the fills.

Due to the large number of men being supplied from the labour exchanges and the fact that no additional compressors were obtainable in wartime, it was found, at one period, that loosened material being produced was insufficient to keep the hand loaders fully employed. A double shift system for drilling and blasting was therefore operated and this was carried on for a period of about two months before the closure of the job in 1942.

Over the lengths 6 m. 1,300 ft.–6 m. 1,900 ft. and 6 m. 4,160 ft.–7 m. 00 ft. parallel to Middle Creek, a marshy subgrade 10 to 12 feet deep was encountered. The necessary consolidation of the embankments on these lengths was obtained by the use of explosives. The method is illustrated in Figure 1 and the photographs on this page. At cross sections spaced approximately 12 feet apart, pipes with cone-pointed ends were driven 4 to 6 feet into the marshy subgrade, as shown in Figure 1. The rock embankment was built

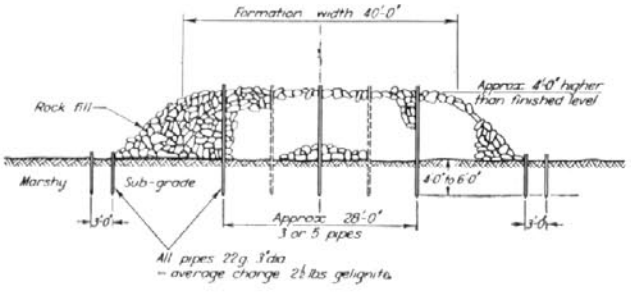


FIG. 1.

CROSS SECTION LAYOUT FOR CONSOLIDATION BY EXPLOSIVES

up around the pipes to approximately 4 feet above the required finish level. Charges were then placed in the pipes and fired electrically. The usual practice was to fire three cross sections in one operation, the pairs of charges at the toe of the embankment on each side being detonated approximately one second before the central three (or five) charges. The general effect was to displace the unstable material laterally and to allow the heavier rock fill to sink into the marshy subgrade. This procedure proved effective and produced settlement to an average depth of 5 to 6 feet, with no subsequent movement.

Side shots exploding surcharged fill. Extra height is about 2 feet 6 inches.

Other unstable areas were encountered. In one case, in the vicinity of chainage 2 m. 4,300 ft., it was found impossible to consolidate the subgrade owing to a bed a white clay about 3 feet thick, with a considerable seepage of water which could not be conveniently drained away. As neither gravel, nor hand packed ballast could be used satisfactorily on this subgrade, it was decided to have recourse to cement penetration, using 2 inch crusher run metal. 800 square yards of this treatment was carried out.

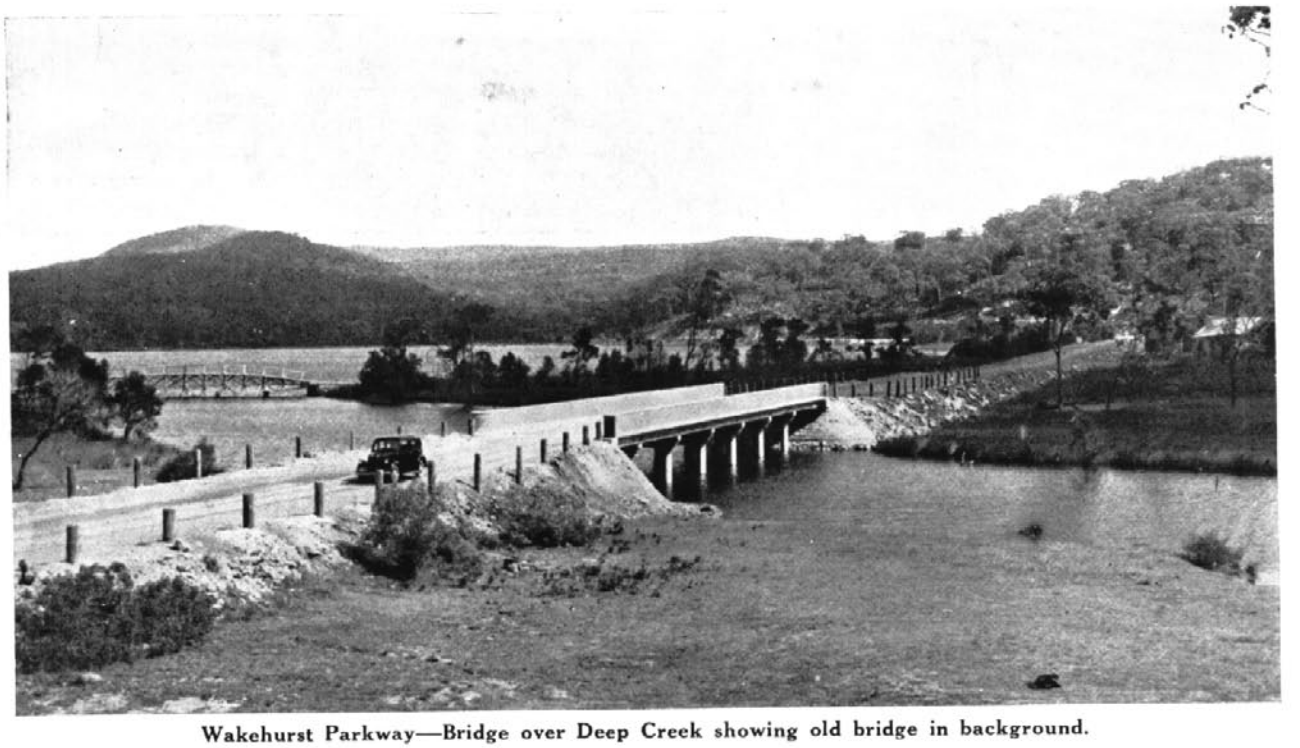
Mud welling up under displacement of filling.

In the section 5 m. 1,700 ft.–5 m. 2,200 ft., a bed of peat about 4 feet thick overlying a rock bottom had to be dealt with. Motor vehicles or mechanical equipment could not be used owing to the soft subgrade. The peat was dug out and loaded by hand into "jubilee" skips and tipped over a nearby cliff face. About 4,300 cubic yards of this material was removed.

Pipe culverts ranging in size from 15 inches to 72 inches to a total length of 2,650 feet were constructed. Catch drains to protect cuttings in sidelong country were excavated to an approximate total length of 18,800 feet. Subsoil drains in cuttings were provided, in accordance with Departmental standards.

BRIDGES.

Two diversions of Middle Creek were carried out and, by this means, the need for three bridges was obviated. However, it was necessary to construct five



Wakehurst Parkway—Bridge over Deep Creek showing old bridge in background.

bridges to cross Middle, Cement Works and Deep Creeks. Bridge construction was by contract in each case. Brief details of the structures completed are given below:—

(*a*) Over Middle Creek at 5 m. 5,060 feet.
Single span reinforced concrete, length 51 feet.
32 feet between kerbs, no footway.
42° skew.
Footings on rock.

(*b*) Over Middle Creek at 6 m. 1,633 feet.
2 spans reinforced concrete, length 100 feet.
32 feet between kerbs, no footway.
50° skew.
Founded on piles.

(*c*) Over Middle Creek at 7 m. 4,800 feet.
5 spans reinforced concrete, length 99 feet.
32 feet between kerbs, 5 feet footway.
On curve of 685.5 feet radius.
Founded on piles.

(*d*) Over Cement Works Creek at 8 m. 1,780 feet.
Single span timber, length 30 feet.
22 feet roadway, 5 feet footway.
On slight skew.
Founded on timber piles.

(*e*) Over Deep Creek at 8 m. 2,900 feet.
7 spans reinforced concrete, length 142 feet.
22 feet between kerbs, two 18-inch footways.
30° skew.
Founded on piles.

PAVEMENT.

Approximately 2.8 miles of gravel base and gravel surface course with a bitumen seal was completed in the first period of operations during 1939-42. The remainder of the pavement, some of which is at present in hand, consists of gravel base with a crushed sandstone surface course which is later to be sealed with drag-spread premix or by other suitable treatment. The crushed sandstone, which is of a particularly hard type, is being obtained from the Oxford Falls quarry of the Warringah Shire Council.

Approximately 25,000 cubic yards of gravel in the shoulders and base course has been obtained from a gravel pit of about 13 acres at Belrose in French's Forest. The gravel in this pit deteriorated in quality during the later stages of the operations, and this led to the decision to use crushed sandstone for the remainder of the paving work. The lead from the pit to Rodborough depot is about 3½ miles and about 70% of the gravel was won by the use of loading ramps and scoops of 2½ cubic yards capacity. The remainder of the gravel was loaded by skimmer shovel.

Although the distance between Seaforth and Narrabeen is 1½ miles longer by the new road than via Main Road No. 164, there is better alignment, and built up areas (with traffic congestion) are by-passed, so that higher average speed may be expected on Wakehurst Parkway than on the alternative route. It is probable that the scenic attractions offering will induce a large volume of traffic to this route, especially at week-ends and holidays. These are the possible immediate effects. The more important aspect is the part Wakehurst Parkway will play in the future development of Warringah Shire and in the expansion of road transport facilities in that area. The Department's plans provide ultimately for a new bridge over Middle Harbour with a direct connection to the Sydney Harbour Bridge, and the distance by this route between Sydney and Narrabeen, including the Wakehurst Parkway, will be over one mile shorter than by the present route via Main Road No. 164.

Tenders Accepted.

The following Tenders (exceeding £500) were accepted by the Department during the months of April, May and June, 1946:—

Council.	Road No.	Work.	Name of Accepted Tenderer.	Amount of Accepted Tender.
		METROPOLITAN DIVISION.		£ s. d.
Balmain M. and Drummoyne M.	165	Manufacture, supply and delivery of steelwork for steel bridge over Iron Cove.	Clyde Engineering Co. Ltd.	99,763 0 0
		OUTER METROPOLITAN No. 2 DIVISION.		
Cudgegong S. ...	...	Supply and delivery of steelwork for Wilbertree Bridge ...	S. E. Statham	3,698 0 0
		CENTRAL WESTERN DIVISION.		
Goobang S. ...	17	Construction of approaches to bridge over Billabong Creek near Tichborne.	J. Gam	6,316 17 9
Talbragar S. ...	17	Construction of approaches to reinforced concrete bridge over Coolbaggie Creek.	A. R. Wheeler ...	2,398 10 0
		SOUTH COAST DIVISION.		
Clyde S., Eurobodalla S., Imlay S. and Ulladulla M.	1 & 4	1945-1946 State Highway Maintenance and Improvement Programme: Resealing sections.	B.H.P. By-Products Pty. Ltd.	3,217 2 7
		LOWER NORTHERN DIVISION.		
Wallarobba S. ...	Dungog-Upper Wangat Road.	Manufacture, supply and delivery of steelwork for bridge over Williams River at Bandongrove.	Thos. C. Pollard ...	5,786 0 0
	108	Purchase of Vehicular Ferry Vessel D.M.R. No. 32 s.s. "Mildred."	Phillip Island and Westernport Shipping Co.	9,250 0 0
		NORTH-WESTERN DIVISION.		
Barraba S. ...	63	Construction of 4-span reinforced concrete bridge over Cobbadah Creek, 11½ m. north of Barraba.	McLean Construction Co.	9,148 17 0
		NORTH-EASTERN DIVISION.		
Byron S.	10	Construction of 3-span reinforced concrete bridge over Byron Creek.	Beattie & Frost ...	5,783 15 4
Lismore M. ...	65	Construction of 3-span reinforced concrete bridge over Lagoon Creek.	,, ,, ...	4,302 16 6

The following Tenders (exceeding £500) were accepted by the respective Councils during the months of April, May and June, 1946.

Council.	Road No.	Work.	Name of Accepted Tenderer.	Amount of Accepted Tender.
		OUTER METROPOLITAN DIVISION No. 2.		£ s. d.
Colo S.	182	Prime with tar and seal 22,500 sq. yds. with fluxed bitumen between Ebenezer and Sackville Ferry.	B.H.P. By-Products Pty. Ltd.	1,224 11 9
Baulkham Hills S.	160 & 157.	Supply and spray 11,616 gallons of Duratenex	Australian Gaslight Company.	883 6 0
Blacktown S. ...	2012	Construction of R.C. Bridge over Eastern Creek	A. Smith	4,288 12 5
Rylstone S. ...	...	Supply and spread 6,290 cub. yds. gravel	A. and T. Lighezzolo...	2,302 15 0
Oberon S. ...	253, 255, 256.	Supply and spray fluxed bitumen	B.H.P. By-Products Pty. Ltd.	1,254 11 7
Blaxland S. ...	55	Re-seal 3m. with fluxed bitumen	,, ...	1,921 14 0
,, ...	55	Supply and delivery of 780 cub. yds. of ¾-inch aggregate...	Harris and Brown ...	554 0 0

Tenders Accepted—*continued.*

Council.	Road No.	Work.	Name of Accepted Tenderer.	Amount of Accepted Tender.
		Lower Northern Division.		£ s. d.
Lake Macquarie S.	223	Construction of R.C. culvert at Cocked Hat Creek ...	Sorenson Construction Co. Pty. Ltd.	690 16 0
Manning S. ...	1150	Construction of Timber Beam Bridge over Khatumbuhl Creek and approaches.	M. Milligan	2,783 5 0
Muswellbrook S....	209	Surfacing 13·0 m.–13·6 m., 14·9 m.–15·1 m., 19 m.–22 m....	B.H.P. By-Products Pty. Ltd.	503 0 0
Stroud S. ...	1110	Construction with gravel pavement and subsidiary works of 8,670 lin. ft. of roadway between 17 m. 3,890 ft. and 19 m. 2,060 ft.	D. Caratti	3,567 7 10
,, ...	1110	Supply and spreading of gravel in roadway—6·9 m.–9·5 m., 9·8 m.–10·2 m.	W. T. Avery and P. G. Leary.	1,771 12 6
Wallarobba S. ...	101	Surfacing Greenhill's Deviation ($\frac{3}{4}$ m.). Re-surfacing 1 m.–6 m. south of M.R. 301.	B.H.P. By-Products Pty. Ltd.	2,401 10 6
		North-Western Division.		
Coonabarabran S.	11	Gravel re-sheeting	E. Hall	1,149 18 7
Coolah S. ...	62	Formation and gravelling	J. and A. Lighezzolo ...	3,539 4 5
Liverpool Plains S.	11	Construction of R.C. Culvert	J. Gabauer	720 14 11
Cockburn S. ...	63, 105.	Supply of 45 tons 80–100 or 175–225 pen. residual bitumen, f.o.r., Sydney.	Shell Co. of Australia...	941 12 6
Dumaresq S. ...	74	Supply of 43 tons 80–100 pen. residual bitumen, f.o.r., Armidale.	W. B. Carr Constructions.	970 7 4
Liverpool Plains S.	72, 55, 357.	Scarifying and re-shaping	Messrs. Selfe and Ross	1,050 0 0
Namoi S. ...	1167	Formation and gravelling	Messrs. Griffiths and Campey.	1,969 1 6
Apsley S. ...	11	Supply and spreading 7,368 cub. yds. gravel E. and W. of Walcha.	W. H. Marshall ...	1,954 13 4
Peel S.	11	Supply of 2,000 cub. yds. $\frac{1}{2}$-inch screenings in stock piles 13·3 m. to 30·2 m. West of Tamworth.	R. C. Barber	1,800 0 0
Liverpool Plains S.	72, 55	Gravel re-sheeting	Messrs. J. and A. Swanston.	2,652 18 0
Peel S.	130	Supply of 54 tons of 80 100 or 175–225 pen. residual bitumen, f.o.r., Sydney.	Vacuum Oil Co. ...	1,129 19 0
Tamarang S. ...	126, 129.	Supply and spreading of 5,560 cub. yds. of gravel ...	W. H. and H. W. Flanagan.	1,054 13 4
		Upper Northern Division.		
Booloorroo S. ...	507	Construction of 240 chains of re-forming and boxing, supply, delivery and spreading 5,700 cub. yds. of loam between 28 m. 61 ch. and 31 m. 61 ch. and supply, delivery and spreading of 1,600 cub. yds. gravel between 46 m. and 50 m.	R. Peachey	1,636 0 0
,, ...	232	Construction of 72½ chains of new road, reconstruction of 13½ chains and construction of 9 chains of gravel causeway between 3 m. and 4½ m.	Muggleton Bros. ...	650 7 0
Boomi S. ...	367	Boxing and shouldering of pavement and spreading 8,700 cub. yds. of loam between 38 m. 79 chns. and 37 m. 34 chns.	,, ...	1,667 10 0
,, ...	232	Boxing and shouldering of pavement and spreading 5,250 cub. yds. of loam between 0 m. 58 chns. and 5 m. 8 chns.	,, ...	1,006 5 0
Macintyre S. ...	73, 134, 135, 136, 137.	Supply, deliver and spread 16,043 cub. yds. of gravel, including scarifying and reshaping of 155,232 lin. ft. of pavement.	L. W. Keft	4,424 14 7
		Central Western Division.		
Goobang S. ...	...	Supply, delivery and spreading of 19,117 cub yds. gravel...	R. E. Torrens	3,823 8 0
Cowra M.... ...	78, 310, 56.	Supply and delivery of 290 cub. yds. $\frac{1}{2}$-inch and 253 cub. yds. $\frac{3}{16}$-inch aggregate.	Downes Bros.	543 0 0
,, ...	78, 310, 56.	Bituminous sealing and re-sealing	B.H.P. By-Products Pty. Ltd.	1,725 0 0
Jemalong S. ...	377	Supply, delivery and spreading of 2,566 cub. yds. gravel...	J. H. O'Donaghue ...	662 10 0
,, ...	236	Supply, delivery and spreading of 3,416 cub. yds. gravel...	,, ...	882 9 4
,, ...	56	Supply, delivery and spreading of 4,464 cub. yds. gravel...	J. P. Dean	1,020 19 4
,, ...	377	Supply, delivery and spreading of 4,830 cub. yds. gravel...	J. H. Smith	2,265 13 4

Tenders Accepted—*continued.*

Council.	Road No.	Work.	Name of Accepted Tenderer.	Amount of Accepted Tender.
		CENTRAL WESTERN DIVISION—*continued.*		£ s. d.
Gilgandra S. ...	18	Supply and delivery of 3,168 cub. yds. of gravel	W. T. Sunderland and J. F. Murphy.	936 0 0
Wingadee S. ...	18	Supply, delivery and tipping of 7,736 cub. yds. of sandy loam and 652 cub. yds. river shingle.	Frost and Spriggs ...	1,260 11 0
,, ...	120, 202, 205, 383.	Supply, delivery and tipping of 32,027 cub. yds. of sandy loam.	W. Donnelly and W. H. Scifleet.	4,548 2 0
Waugoola S. ...	56	Supply, delivery and spreading of 4,600 cub. yds. gravel ...	Mackie Bros.	824 3 4
,, ...	310	Supply, delivery and spreading of 3,200 cub. yds. gravel ...	,, ...	603 6 8
Lachlan S. ...	57	Supply, delivery and spreading of 4,080 cub. yds. gravel ...	S. Barter	918 0 0
Weddin S. ...	236, 237, 239, 398.	Supply, delivery and spreading of 10,968 cub. yds. gravel ...	C. J. Gavin	2,362 16 10
Macquarie S. ...	233	Supply of timber for repairs to bridge over Bell River at Wellington.	Allen Taylor & Co ...	520 17 5
Lyndhurst S. ...	390	Supply delivery and tipping of 3,224 cub. yds. gravel ...	G. P. Nixon	1,006 17 6
Marthaguy S. ...	202	Supply and delivery of 7,865 cub. yds. loam	J. C. Beaumont ...	862 6 3
,, ...	333	Supply and delivery of 5,670 cub. yds. of loam	,, ...	819 5 0
		SOUTHERN DIVISION.		
Gunning S. ...	241, 248, 249, 251, 283.	Supply and delivery of 4,523 cub. yds. of gravel	L. Delbouse	1,149 11 11
Yarrowlumla S. ...	51, 52, 268.	Supply and delivery of 6,200 cub. yds. of gravel	C. A. Genge	1,769 7 6
Mulwaree S. ...	79, 256	Supply of 1,150 cub. yds. of aggregate	Blue Metal and Gravel Pty. Ltd.	991 10 10
Crookwell S. ...	54, 249	Supply and delivery of 2,853 cub. yds. of gravel	J. B. Charnock ...	775 4 4
		NORTH-EASTERN DIVISION.		
Harwood S. ...	152	Supply and delivery of 1,505 cub. yds. and supply only ex bins of 100 cub. yds. fine crushed stone.	J. McMahon	1,295 0 0
,, ...	152	Reconstruction from McFarlane's Bridge to 3,500 feet (Camp Creek Deviation).	Bellamy Bros.	3,043 15 5
Byron S.	65	Construction of R.C. box culvert over Paddy's Creek ...	Sorenson Construction Co.	1,960 0 0
		SOUTH-WESTERN DIVISION.		
Bland S.	57	Re-sheeting with gravel (5,920 cub. yds.)	Miller and Lewington	1,029 0 0
Willimbong S. ...	80	Re-surfacing with bitumen	B.H.P. By-Products Pty. Ltd.	5,179 1 4
Murrumbidgee S.	14	Supply and delivery of 11,958 cub. yds. of loam	Hardie & Co.	2,239 8 4
Wade S.	254	Re-sealing 102,500 sq. yds. including supply of bitumen...	B.H.P. By-Products Pty. Ltd.	3,440 0 0
Bland S.	6	Re-sheeting with gravel 9,400 cub. yds.	Miller and Lewington ...	1,649 6 8
Carrathool S. ...	6	Supply and delivery of 15,048 cub. yds. of loam	D. McCallum	2,195 12 0
Hume S.	57	Supply of 700 cub. yds. of aggregate	Hurricane Hill Quarries	700 0 0
Coolamon S. ...	240	Supply and delivery of 9,168 cub. yds. of gravel	Staines and Grundy ...	1,585 6 0
Holbrook S. ...	331	Construction of R.C. Bridge over Wantagong Creek ...	A. McKallam	2,022 6 10
Coolamon S. ...	1091	Construction of 2 m. 2,000 ft.	Galvin and Alexander...	2,054 14 9
Hume S.	1152	Construction of 3 m. 4,400 ft.	L. W. Alexander ...	3,707 16 2
		CENTRAL MURRAY DIVISION.		
Murray S. ...	341	Re-sheeting with loam	V. Murphy	996 0 0
Wakool S. ...	1146	Construction of bridges and pipe culverts	R. J. & S. G. Weekley...	3,273 9 5

Sydney: Thomas Henry Tennant, Government Printer 1946.

MAIN ROADS STANDARDS.

NOTE:—Numbers prefixed by "A" are drawings, the remainder are specifications unless otherwise noted.

EARTHWORKS AND FORMATION.

Form No.

70* Formation. (Revised, August, 1942.)
A 1532* Standard Typical Cross-sections.
A 1149* Flat Country Cross-section, Type A. (Revised, 1930.)
A 1150* Flat Country Cross-section, Type B. (Revised, 1936.)
A 1151* Flat Country Cross-section, Type D1. (Revised, 1936.)
A 1152* Flat Country Cross-section, Type D2. (Revised, 1930.)
A 1476 Flat Country Cross-section, Type E1. (Revised, 1937.)
A 1101 Typical Cross-section One-way Feeder Road. (1936.)
A 1102 Typical Cross-section Two-way Feeder Road.
A 83 Earthworks Quantity Diagram.
A 114 Rubble Retaining Wall.
271 Setting out side widths (instruction for use of ordinary survey instruments).
272 Setting out side widths (instruction for use of tape-staff).

PAVEMENTS.

71* Gravel Pavement. (Revised, January, 1939.)
228* Reconstruction with Gravel of Existing Pavements. (Revised, January, 1939.)
254 Supply and Delivery of Gravel. (Revised, August, 1939.)
72* Broken Stone Base Course. (Revised, October, 1933.)
216* Telford Base Course. (Revised, August, 1931.)
68* Reconstruction with Broken Stone of Existing Pavement to form a Base Course. (Revised, October, 1933.)
296 Tar. (Revised, March, 1939.)
337 Bitumen. (Revised, February, 1939.)
305 Bitumen Emulsion. (Revised, September, 1942.)
351 Supply and Delivery of Aggregate. (Revised, July, 1941.)
65* Waterbound Macadam Surface Course. (July, 1939.)
301* Supply and Application of Tar and or Bitumen. (Revised, June, 1940.)
122* Surfacing with Tar. (Revised, May, 1940.)
145* Surfacing with Bitumen. (Revised, August, 1940.)
93* Re-surfacing with Tar. (Revised, May, 1940.)
94* Re-surfacing with Bitumen. (Revised, July, 1940.)
230* Tar or Bitumen Penetration Macadam, Surface Course, 2 inches thick. (Revised, December, 1936.)
66* Tar or Bitumen Penetration Macadam, Surface Course, 3 inches thick. (Revised, September, 1936.)
125* Cement Concrete Pavement (April, 1939) and Plan and Cross-section, A 1147 (March, 1932).

GENERAL.

342* Cover Sheet for Specifications, Council Contract. (Revised, April, 1939.)
248* General Conditions of Contract, Council Contract. (Revised, May, 1945.)
64* Schedule of Quantities.
39* Bulk Sum Tender Form, Council Contract. (Revised, July, 1944.)
38* Bulk Sum Contract Form, Council Contract.
121* Provision for Traffic (Revised, March, 1944) with general arrangement, A 1323*, and details of warning signs, A 1325.* (Revised, July, 1939.)
A 1342* Warning Signs, Details of Construction.
A 1346 Iron Trestles for Road Barriers.
A 1341 Timber Trestle and Barrier.
353 Welded Steel Broom Drag and drawing, A 1400.
A 1824 Light Broom Drag.
A 1924 Pipe Frame Drag.
A 178 Mould for Concrete Test Cylinder.
A 1381–3, A 1452–5 Tree Guards, Types A, B, C, D, E, F, and G.
197* Hire of Council's Plant. (Revised, April, 1937.)
A 478* Specimen Drawings, Rural Road Design, with drawings A 478A* and A 478B*.
A 478C* Specimen Drawing, Flat Country Road Design.
A 1113* Rural Road Plan and Longitudinal Section Form (tracing cloth).
A 1114* Rural Road Cross-section Form (tracing cloth).
A 1115* Urban Road Plan Forms (tracing cloth).
193 Duties of Superintending Officer (instructions). (Revised, July, 1938.)
A 1645 Stadia Reduction Diagram.
355* Instructions for Design of Two-lane Rural Highways (1937).
A 1487* Horizontal Curve Transitions (diagrams).
A 1488*, A 1488A*, A 1488B*, and A 1488C*.—Horizontal Curve Transitions (tables for speeds of 30, 40, 50, and 60 miles per hour).
A 1614 Widening of Shoulders on Crests.

Form No.

369* Instructions for Design of Urban Roads (1939).
288 Instructions for Design of Intersections (1939).
402 Instructions for Design of Rural Intersections (acceleration and deceleration lanes).

KERBS, GUTTERS, AND GULLY PITS.

243 Integral Concrete Kerb and Gutter and Vehicle and Dish Crossings (Revised, July, 1939) and Drawing. (A134A.)
245 Gully Pit (Revised, May, 1930) and Drawings (*a*) with grating (A 1042); (*b*) Kerb inlet only (A 1043); (*c*) with grating and extended kerb inlet (A 1352); (*d*) extended kerb inlet (A 1353).
A 190 Gully Grating. (1933.)
A 1418 Concrete Converter.

FENCING.

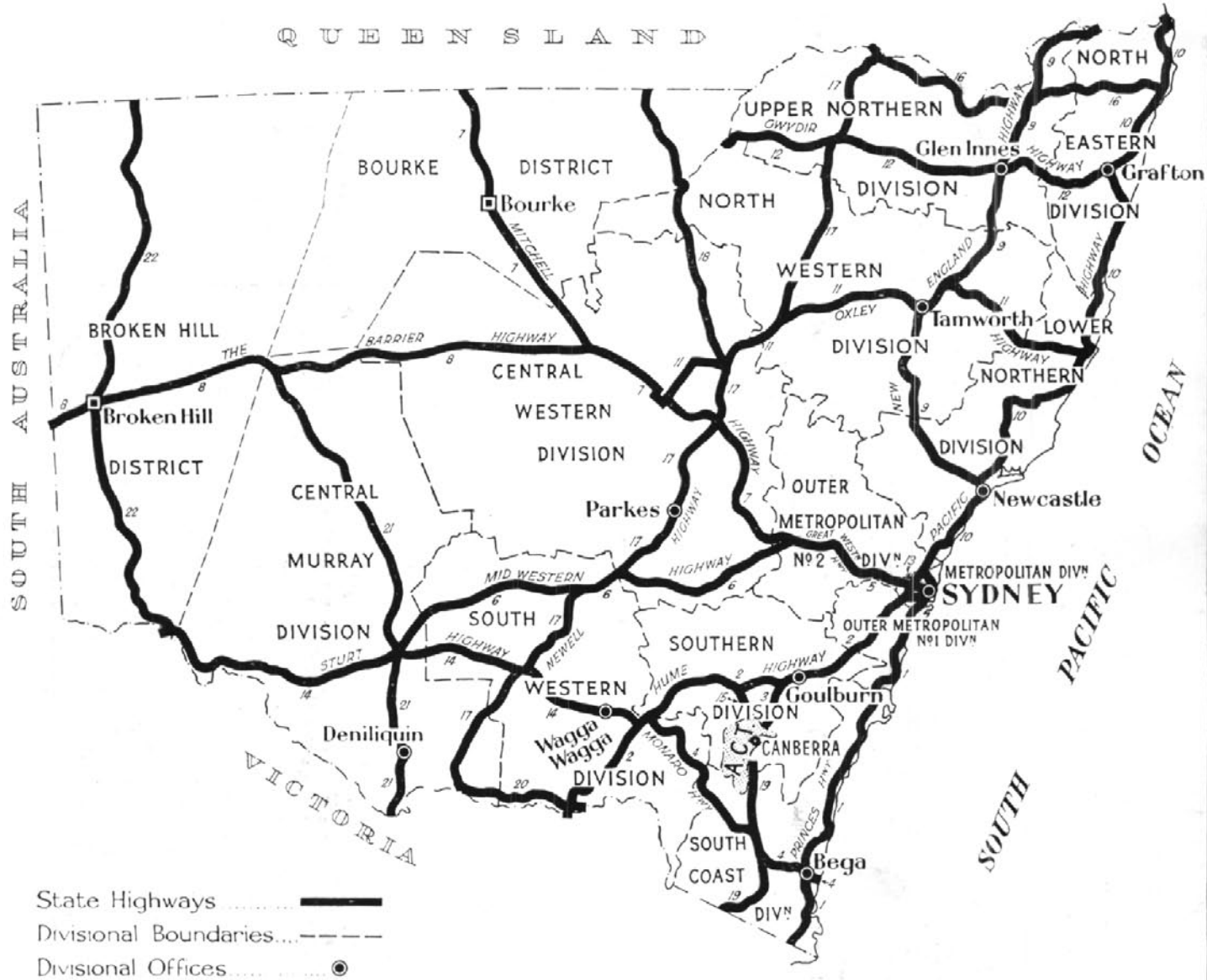
142 Split Post and Rail Fencing and Drawing (A 43).
141* Post and Wire Fencing (Revised, September, 1934) and Drawings (*a*) Plain (A 494); (*b*) Rabbit-proof (A 498); (*c*) Flood gate (A 316).
143 Ordnance Fencing (Revised, February, 1934) and Drawing A 7. (Revised, November, 1939.)
144 Chain Wire Protection Fencing and Drawing (A 149).
246 Location of Protection Fencing (instruction). (Revised, May, 1940).
A 1301 Motor Traffic By-pass 9 feet wide.
A 1875 Motor Traffic By-pass with steel grid 20 feet wide.

BRIDGES AND CULVERTS.

A 4 Standard Bridge Loading (general instruction). (1938.)
A 4A Standard Bridge Loading (instruction for dead-end Developmental Roads.) (Revised, 1938.)
18* Data for Bridge Design. (Revised, August, 1944.)
84* Data accompanying Bridge or Culvert Designs.
A 26 Waterway Diagram. (Revised, 1943.)
371 Waterway Calculations. (1939.)
A 421 Boring Gear, 2 inches.
A 44 Boring Gear, 3½ inches.
A 2847 Rod Sounding Apparatus.
25* Pipe Culverts and Headwalls (Revised, December, 1939) and drawings, Single Rows of Pipes, 15 in. to 21 in. dia. (A 143* 1936), 2–3 ft. dia. (A 139,* 1936), 3 ft. 6 in. dia. (A 172*), 4 ft. dia. (A 173*), 4 ft. 6 in. dia. (A 174), 5 ft. dia. (A 175), 6 ft. dia. (A 177); Double Rows of Pipes, 15 in. to 21 in. dia. (A 211*), 2–3 ft. dia. (A 203*, 1935), 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), 2–3 ft. dia. (A 216, 1936), and Straight Headwalls for Pipe Culverts, 15–24 in. dia. (A 1153*).
A 1* Joint for Concrete Pipes. (Revised, August, 1933.)
A 142* Sidehill Inlet Sump. (Revised, July, 1930.)
138* Pre-Cast Concrete Box Culvert (April, 1940) and drawings, 9 in. high (A 485*), 12 in. (A 446*), 1 ft. 6 in (A 447*), 2 ft. (A 448*), 2 ft. 6 in. (A 449).
A 311 Concrete Arch Culvert, 5 ft. high.
A 314 Concrete Arch Culvert, 10 ft. high.
206* Reinforced Concrete Culvert (Revised, November, 1944) and instruction sheets (A 305, A 359, A 306, A 304).
A 1832 Cast-in-Place Circular and Oval Concrete Pipe Culverts.
A 309* Concrete Culvert Posts. (Revised, June, 1937.)
303 Pile Drivers, specification for 25 ft., and drawings for 50 ft. (A 209), 40 ft. (A 253), and 25 ft. portable (A 1148).
A 1886 Arrangement of Bolting Planks for various widths of deck.
A 45 Timber Bridge, Standard Details. (Revised, March 1941.)
A 1791 Timber Beam Skew Bridge (Details).
164 Timber Beam Bridge (Revised, July, 1942) and instruction sheets, 16 ft. (A 71), 18 ft. (A 68), 20 ft. (A 70) and 22 ft. (A 1761).
A 1226 and A 1165 Timber Low Level Bridges, instruction sheets for 16 feet, and 18 feet between kerbs.
A 1222, A 1166, and A 1223 Single Span Timber Culverts, spans 12 ft., 18 ft., instruction sheets for 16 ft., 18 ft. and 20 ft. between kerbs.
139* Timber Culvert 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).
326 Extermination of Termites in Timber Bridges. (Revised October, 1940).
A 222* Pipe Handrailing Details. (Revised, February, 1938.)
350 Reinforced Concrete Bridge. (Revised, January, 1946.)

Standards marked * may be purchased from the Government Printer, Sydney.
Others may be purchased from the Head Office of the Department of Main Roads, 309 Castlereagh street, Sydney, single copies being free to Councils.

State Highway System of the State of New South Wales



State Highways .....
Divisional Boundaries.....
Divisional Offices .....

SCALE
50 0 50 100 150 200

Area of New South Wales, 309,433 square miles.
Length of public roads within New South Wales, 126,058 miles.

MILEAGE OF ROADS CLASSIFIED UNDER THE MAIN ROADS ACT, AS AT 1st JULY, 1945.

State Highways	6,504
Trunk Roads	3,758
Main Roads	12,720
Secondary Roads (County of Cumberland only)	78
Developmental Roads	2,757
	25,817
UNCLASSIFIED ROADS, in Western part of State, coming within the provisions of the Main Roads Act	2,198
TOTAL	28,015