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OF
MAIN ROADS
NEW SOUTH WALES

MARCH, 1963

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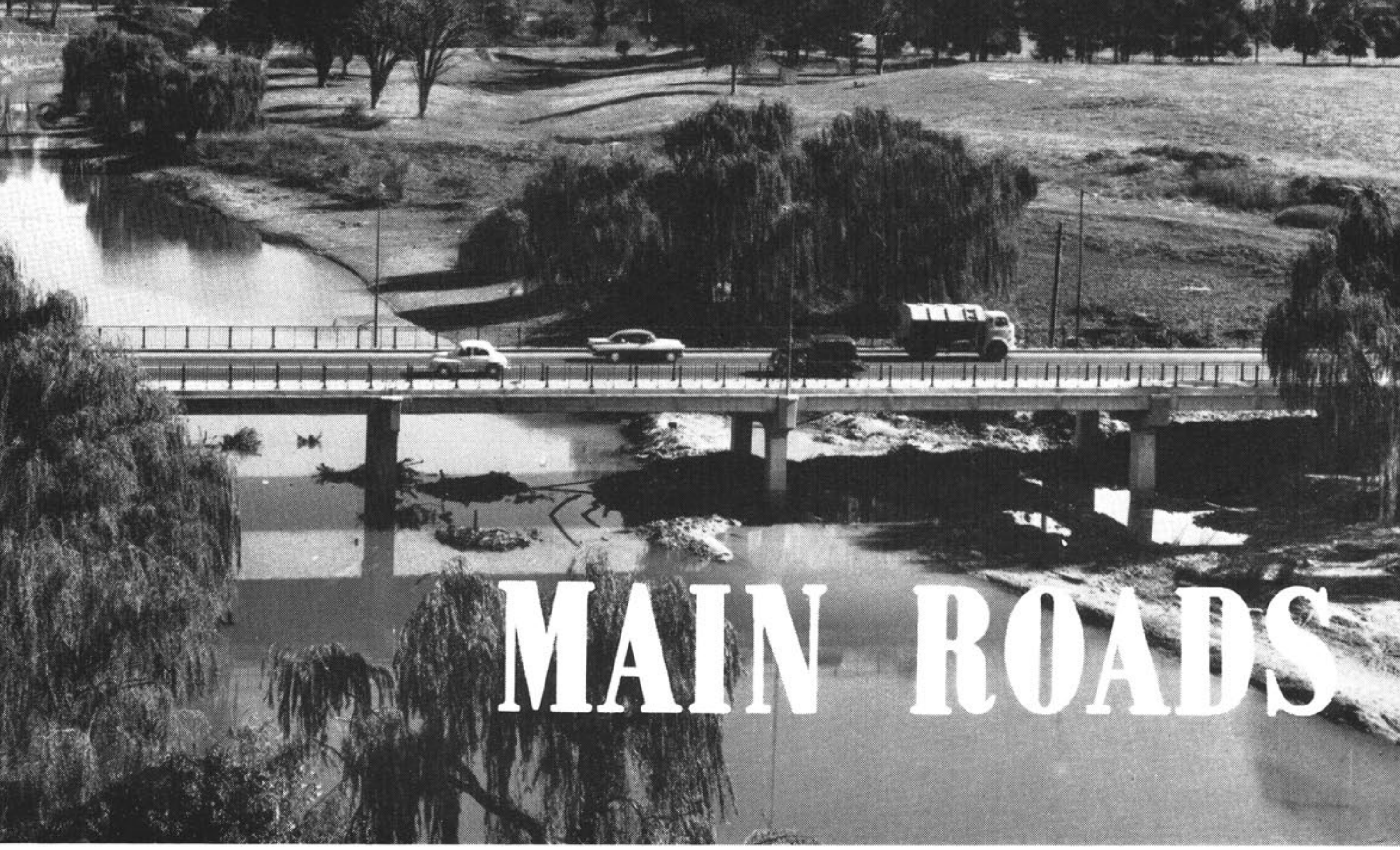

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COVER SHEET

Obelisk in Macquarie Place, Sydney. Designed by Francis Howard Greenway, the obelisk was erected at the direction of Governor Lachlan Macquarie " To Record that all Public Roads Leading to the Interior of the Colony are Measured from it ".

MAIN ROADS

JOURNAL OF THE
DEPARTMENT OF MAIN ROADS
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Six Year (1962-1968) Construction Plan for New South Wales

The Minister for Highways, the Hon. P. D. Hills, M.L.A., recently announced a six-year construction plan which provides for the expenditure of £100m. on Main Roads in the Country and £54m. on Main Roads and Expressways in the County of Cumberland. This plan has been made possible as a result of the continued growth in the number of registered motor vehicles in New South Wales and the recent increase of $33\frac{1}{3}$ per cent. in the rate of motor vehicle taxation.

The Country part of the plan includes such works as—

- Construction of the Hawkesbury River-Calga section of the Sydney-Newcastle Expressway.
- An accelerated rate of extension of bitumen surfacing on State Highways, Trunk Roads and Main Roads.
- Strengthening and widening existing two-lane bitumen pavements to a width of 24 feet on the more heavily trafficked State Highways and to a width of 22 feet on other State Highways.
- Construction of large bridges, including bridges over the Murrumbidgee River at Gundagai and over the Clarence River at Harwood in replacement of the last remaining vehicular ferry on the Pacific Highway between Sydney and Brisbane.

The County of Cumberland part of the plan provides for an expenditure of £$26\frac{1}{2}$m. on expressways and includes the construction of—

- Section of the Warringah Expressway from the Sydney Harbour Bridge to Miller Street, Cammeray.
- Tarban Creek Bridge and approaches.
- Taren Point Bridge.
- Section of the North-Western Expressway from Druitt Street across Darling Harbour Goods Yards to Wentworth Park.
- Road tunnels under William Street and Taylor Square.
- By-passes around Parramatta, Sutherland and Penrith.

The balance of the County of Cumberland part of the plan provides £$27\frac{1}{2}$m. for—

- Reconstruction of State Highways, including provision of four-lane and six-lane divided carriageways.
- Widening and strengthening of Main and Secondary Roads.
- Construction of bridges over Lane Cove River (De Burgh's Bridge), over Middle Harbour at Roseville, and over George's River at Milperra in replacement of existing bridges which are obsolete and too narrow.
- Construction of new bridges over the Parramatta River at Camellia, over the mouth of the Hawthorne Canal at Haberfield, and over George's River at Mickey's Point.
- Construction of railway overbridges at Aston Street, Rosehill, in elimination of a level crossing, and at Stacey Street, Bankstown.

Although the extent of the work to be carried out on Main Roads during the currency of the six-year programme will be greater than that undertaken during recent years, it is still insufficient to overcome existing deficiencies in the Country and County of Cumberland Main Road Systems and to provide the additional facilities which will be needed because of increases in traffic. However, it represents a marked improvement in the annual amount of construction work which has been possible on Main Roads with the funds previously available.

Winning secondary limestone gravel for pavement base and surface courses

BROKEN HILL-MENINDEE TRUNK ROAD

Reconstruction and Bitumen Surfacing

BROKEN Hill, a mining city in the far west of New South Wales, is situated on the Barrier Range and is 984 feet above sea level. The climate is arid and the average annual rainfall is about 9 inches. In the numbers of "Main Roads" for March, 1959, and September, 1962, articles dealing respectively with the Barrier Highway and Silver City Highway, cover the early exploration of the area in which Broken Hill is located and the foundation of the City.

Menindee is situated on the western bank of the Darling River, 69 miles from Broken Hill and at a height of 204 feet above sea level.

Charles Sturt, on a journey from Adelaide to the centre of Australia, camped in a bend of the Darling in October, 1844, at a spot later called "Laidley's Ponds".

Aerial view of the Darling River upstream from Menindee

Aerial view of the Main Weir (on right) and inlet and outlet structures—Lake Pamamaroo

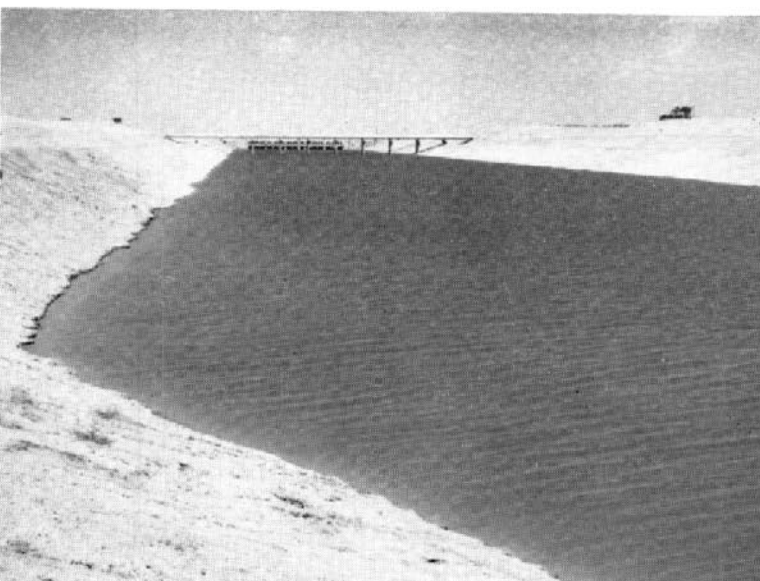
Loading secondary limestone gravel

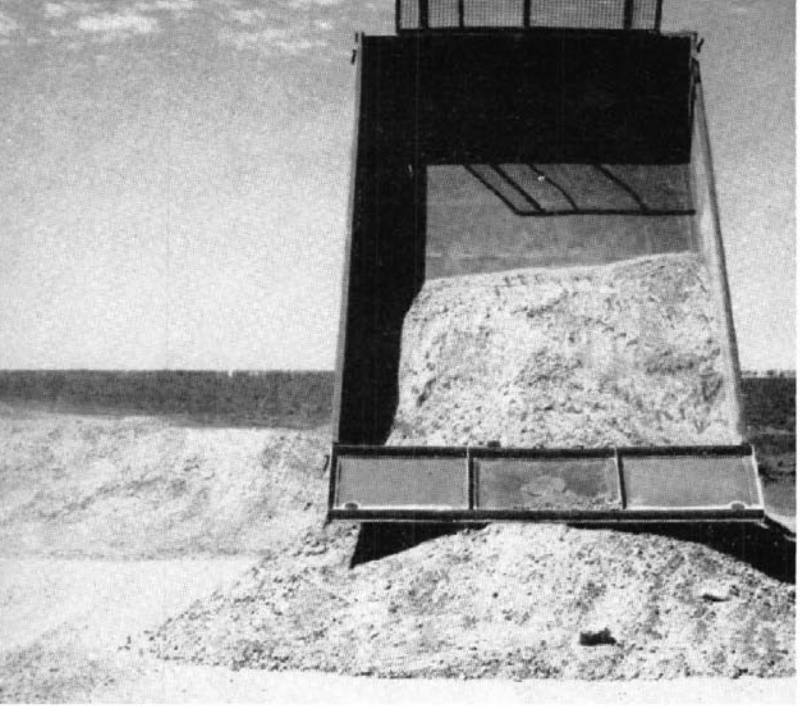
Here, eventually, Menindee developed. The first town formed west of the Darling, it owes its existence to the fact that Francis Cadell, the pioneer of river navigation in New South Wales, established a store there in 1859. By 1862, an inn had been opened near the store and a punt had begun to ply across the Darling. Notice was given in the *Government Gazette* in June, 1862, that a site had been fixed upon for a town to be called " Perry ", about 2½ miles above the junction of Menindee Creek with the Darling. However, in November, 1863, the *Gazette* announced that it had been decided to abandon the name " Perry " in favour of the native name of the place, " Menindie ". The name was later spelt Menindee and that form was officially adopted.

Menindee lies in flat country and the climate is arid. The surrounding district is used for grazing and for the production of fruit and vegetables on the banks of the Darling River. Near the town there is a number of lakes, the chief five of which are named Bijijie, Tandure, Pamamaroo, Menindee and Cawndilla. These lakes were, in 1949, made the site of a water conservation scheme designed to impound 2,000,000 acre-feet of water from the Darling, and thus to store water which would otherwise be wasted in times of flood. It was intended that the water should be used for irrigating pastures, citrus orchards and gardens, and also that the scheme should be the means of supplying the water requirements of Broken Hill. The Menindee Lakes

Aerial view of the Main Weir

Road bridge over channel connecting Lake Pamamaroo and Lake Menindee





Placing secondary limestone gravel for the road pavement

Storage was officially opened late in 1960. In addition to serving its primary functions of water conservation, irrigation and supply, it provides residents of Broken Hill and Menindee and surrounding districts with an ideal site for water sports and activities usually associated with coastal areas.

Access by road from Broken Hill to Menindee is by way of Trunk Road No. 66 which commences at Broken Hill and runs in a generally south-easterly direction for about 55 miles through the unincorporated area of the Western Division. It then passes through the Central Darling Shire to Menindee.

For about 12 miles east of Broken Hill the road winds through undulating to hilly country forming the south-eastern extremity of the Barrier Range. Easterly from this point to Menindee the country is gently undulating and comprises desert loams and drift sands, with sand dunes predominating along the last 14 miles to Menindee.

The country served by the road is used almost exclusively for grazing. The average annual rainfall is approximately 9 inches and the average carrying capacity of the country is one sheep to 15 acres.

With the increased traffic brought about by the completion of the Lakes Scheme, the need for a dustless surface to connect Broken Hill and Menindee became more urgent.

The work of reconstructing and bitumen surfacing Trunk Road No. 66 throughout was undertaken by the Department of Main Roads in three stages.

The length extending to 13 miles east of Broken Hill was completed in 1954-55, while the length of 14 miles immediately west of Menindee was completed in 1956-57. The reconstruction and bitumen surfacing of the intervening length of 42 miles were recently completed.

A design speed of 60 m.p.h., with pavement and formation widths of 20 feet and 28 feet respectively, was adopted. A raised formation averaging 18 inches above natural surface at the centreline was constructed to assist in drainage. The average pavement thickness throughout is 8 inches. Reinforced concrete box culverts were provided at six major waterways, with pipe culverts being constructed at other waterways. A steel bridge 400 feet long was constructed over Stephens Creek at Quondong approximately 31 miles from Broken Hill, to replace a narrow timber bridge.

Elevating grader widening shoulders

With the exception of the six reinforced concrete box culverts and the bridge over Stephens Creek, the work was carried out by the Department by day labour. Earth works were of conventional borrow and fill, the greater part of the raised formation being carried out by elevating grader, which also completed shouldering where earth works were light.

The pavement base course was constructed with secondary limestone gravel obtained from deposits generally adjacent to the road, except on those sections where tests indicated that the subgrade could be stabilised with sand to act as a base course and where sand was readily available for this purpose.

The surface course consisted of secondary limestone gravel, similar to that used for the basecourse, stabilised with coarse sand obtained from local creeks and the foreshores of Lake Menindee. The proportion of sand varied from one part of sand to one to three parts of gravel. The materials were mixed with a pulvi-mixer, two to three passes of the mixer being made with the materials dry and a further three to four passes while introducing the appropriate quantity of water for consolidation from a supply bar mounted above the mixing tynes. Compaction was effected by a vibrating roller followed by pneumatic tyred rollers. Water for mixing and compaction was obtained from the Menindee-Broken Hill pipeline.

The bitumen surfacing was carried out by day labour, the bitumen being railed from Sydney to sidings in reasonable proximity to the work, while the cover aggregate was obtained from a commercial quarry at Broken Hill.

The principal quantities involved were as follows:—

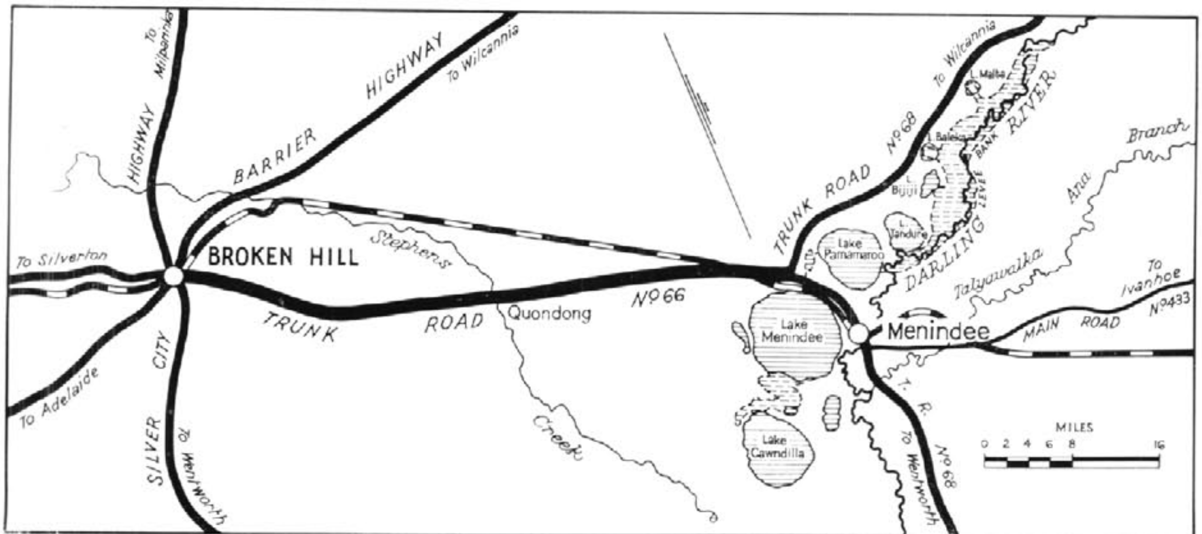
Earthworks	130,000 cu. yds.
Basecourse gravel	26,400 cu. yds.
Sand for stabilising subgrade ..	8,000 cu. yds.
Surface course gravel..	73,000 cu. yds.
Sand for stabilising surface course gravel	45,000 cu. yds.
Bitumen	148,000 gallons
Cover aggregate	7,200 cu. yds.
Concrete in box culverts	540 cu. yds.
Water for compaction	4,000,000 gallons

TOP

Watering and trimming surface course prior to stabilisation

BOTTOM

Mixing secondary limestone gravel and sand for stabilisation of pavement surface course



Locality sketch

Box culvert under construction 23.5 miles from Broken Hill

Bitumen sprayer in operation approximately 25 miles from Broken Hill

The total cost of the work, including the bridge over Stephens Creek at Quondong, was approximately £343,000.

Special Features

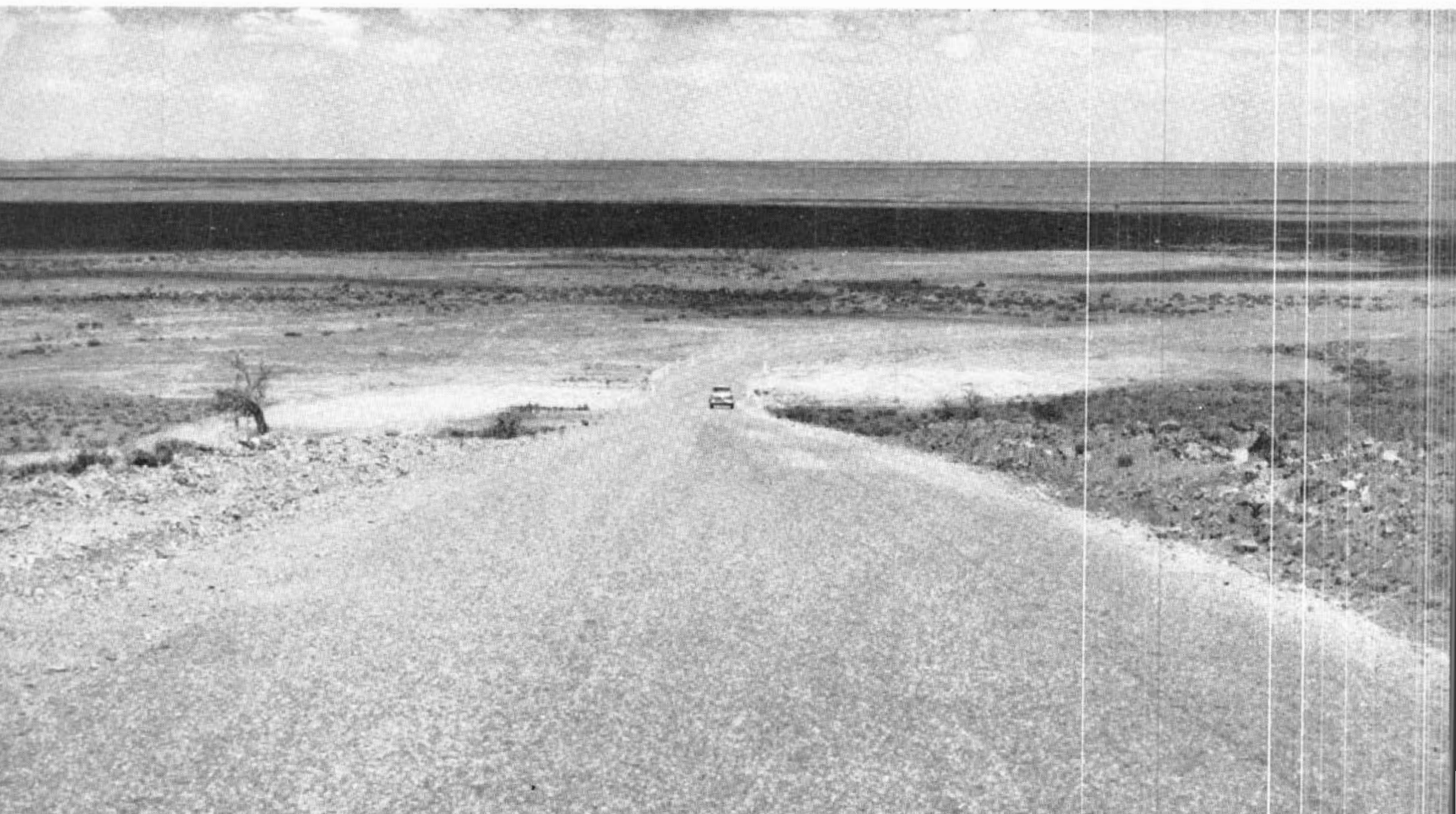
The new bridge over Stephens Creek at Quondong, referred to previously, has ten 40-ft. spans and a carriageway width of 24 feet between kerbs. It consists of steel (" H " section) pile bents supporting RSJ spans covered with pressed steel planks forming the deck on which a thin wearing surface of concrete was placed. The abutment sheeting was also constructed with pressed steel planks. Another reference to this bridge appears on page 71.

One experimental section of bitumen surfaced pavement one mile in length using secondary limestone gravel without the admixture of sand, was included in the work. To meet the Department's general standards for gravel to be bitumen surfaced, the secondary limestone gravels in the area served by the Broken Hill-Menindee Trunk Road require the admixture of sand. The object of including the test length in the work is to obtain information on the comparative life of secondary limestone with and without sand stabilisation in arid zones.

The work was carried out under the direction of the Department's Divisional Engineer at Broken Hill, Mr. B. J. Sexton.

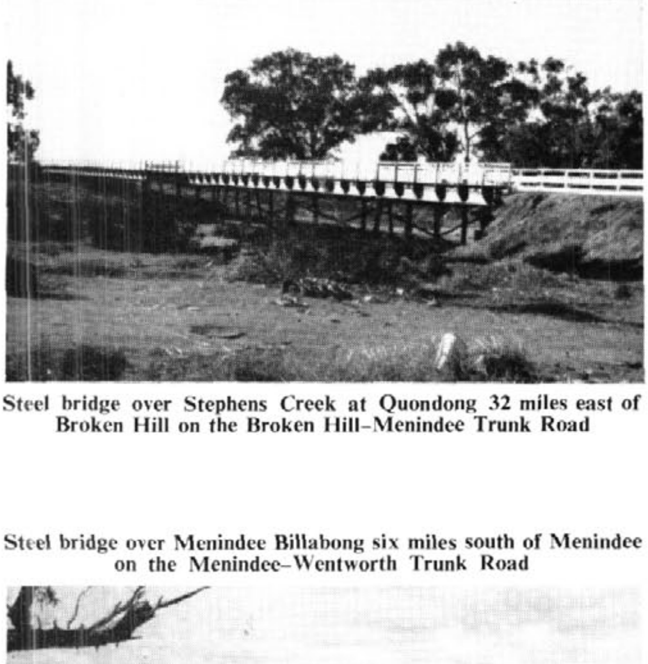
The photographs used to illustrate this article were supplied by The Zinc Corporation Ltd.

Typical view of the area served by the Broken Hill–Menindee Trunk Road



Steel bridge over Pine Creek 30 miles south of Broken Hill on the Silver City Highway

Some New Bridges on Main Roads



Steel bridge over Stephens Creek at Quondong 32 miles east of Broken Hill on the Broken Hill–Menindee Trunk Road

Steel bridge over Menindee Billabong six miles south of Menindee on the Menindee–Wentworth Trunk Road

IN the financial year which closed on the 30th June, 1962, 147 bridges and box culverts of bridge size were built on Main and Developmental Roads in New South Wales, the highest number in any one year. This meant that a new bridge was completed every two working days of the year. At the close of the year, a further 62 bridges were under construction.

Some of the large bridges completed and under construction were listed on page 35 of the article " Review of Year's Work " which appeared in the December, 1962, number of " Main Roads ".

Among the bridges recently completed on Main Roads were the following nine structures:—

Bridge over Pine Creek on the Silver City Highway (State Highway No. 22) about 30 miles south of Broken Hill.

Bridge over Stephens Creek on the Broken Hill-Menindee Trunk Road (No. 66) at Quondong 32 miles east of Broken Hill.

Bridge over Menindee Billabong on the Menindee-Wentworth Trunk Road (No. 68) 6 miles south of Menindee.

These three bridges, built for the Department of Main Roads by contract, were specially designed to overcome the difficulties brought about by the scarcity in the dry western part of the State of suitable timber for bridge work and of water, sand and coarse aggregate for making concrete. They are built almost completely of steel—piles, capwales, girders, decking, handrails, and even abutment sheeting are of steel. The wearing surface on the deck of the bridge is the only portion of the bridge made of concrete.

The Pine Creek and Stephens Creek Bridges each consists of ten 40-ft. spans and the bridge over Menindee Billabong has four 40-ft. spans. The carriageway of each bridge is 24 feet wide.

Bridge over Muttama Creek on the Hume Highway (State Highway No. 2) near Coolac.

Bridge over Evans Plains Creek at Dunkeld on the Mitchell Highway (State Highway No. 7) 6·3 miles west of Bathurst.

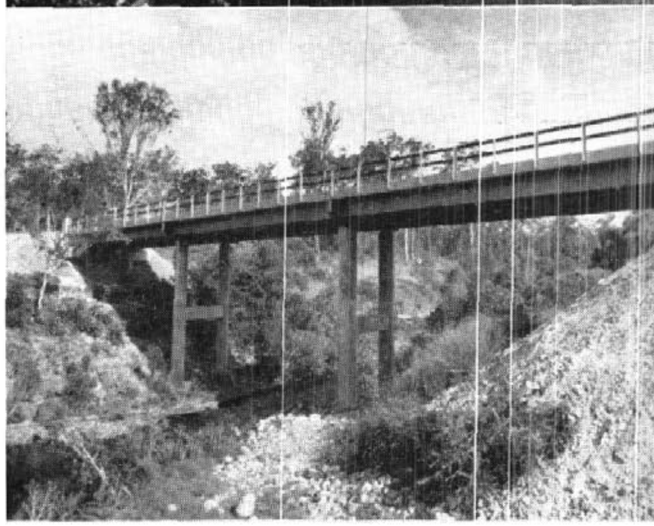
These bridges replaced old and narrow timber truss bridges which had outlived their usefulness. The new Muttama Creek Bridge is a six-span composite steel and concrete structure, 310 feet long and 28 feet wide, on reinforced concrete piers and abutments, while the new Evans Plains Creek Bridge is a five-span prestressed concrete girder bridge, 277 feet long and 28 feet wide, on bored piles.

The Muttama Creek Bridge was constructed for the Department by contract and the bridge over Evans Plains Creek was built by the Department by day labour.

In constructing the bridge over Evans Plains Creek, the Department of Main Roads employed for the first time its Benoto pile driving equipment to carry out the foundation work.

Steel and concrete bridge over Muttama Creek near Coolac on *the Hume Highway*

Prestressed concrete bridge over Evans Plains Creek at Dunkeld six miles west of Bathurst on the Mitchell Highway



Twin steel and concrete bridges over Ironbark Creek between Sandgate and Hexham on the Pacific Highway

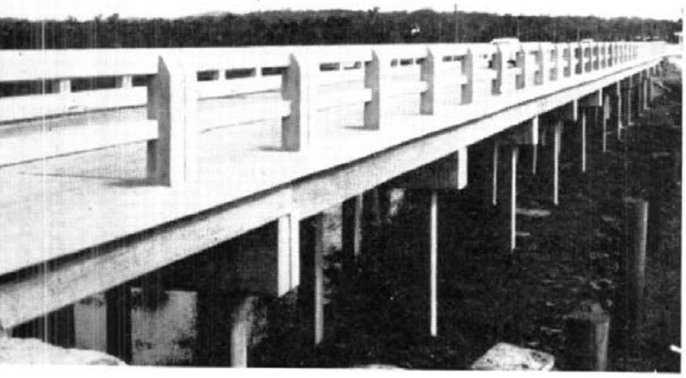
Steel and concrete bridge over Dingo Creek at Rocky Falls on the Wingham–Bulgong Main Road

Bridge over Ironbark Creek between Sandgate and Hexham on the Pacific Highway (State Highway No. 10).

The new Ironbark Creek Bridge consists of twin structures each carrying a carriageway 26 feet wide and will form part of a four-lane divided carriageway on the Pacific Highway between Newcastle and Hexham. Each structure comprises four spans of steel and concrete on driven concrete piles and is 320 feet long. The new bridge was constructed for the Department by contract and replaced a two-lane timber structure.

Bridge over Dingo Creek at Rocky Falls on the Wingham-Bulgong Main Road (No. 109) in the Shire of Manning.

Designed by the Dept. of Main Roads and constructed by Manning Shire Council by contract, this bridge is a three-span steel plate girder and reinforced concrete structure 180 feet long on reinforced concrete piers and abutments. It replaced, on an improved alignment, an old low-level timber bridge.



Concrete bridge over Tucombil Canal near Woodburn on the Pacific Highway

Steel and concrete bridge over Erina Creek near Gosford on the Gosford–The Entrance Main Road →

Bridge over Tucombil Canal near Woodburn on the Pacific Highway (State Highway No. 10).

This bridge is 340 feet long, and consists of twelve spans of precast prestressed concrete girders on driven reinforced concrete piles and trestle piers. It was constructed by the Department by day labour to replace an old timber beam bridge over Tucombil Canal, an escape waterway for floodwaters from the Richmond River. The alignment of the Highway in approach to the bridge on the northern side has been improved in conjunction with the construction of the bridge.

Bridge over Erina Creek near Gosford on the Gosford-The Entrance Main Road (No. 336).

The new bridge replaced an old steel drawbridge, built in 1887, which had become inadequate for traffic. The drawbridge had not been opened for navigation since 1935. The new structure is a three-span steel and reinforced concrete bridge, 136 feet long, on cylinders, and was built for the Department by contract.

NORTH-WESTERN EXPRESSWAY

Overpass at Huntley's Point

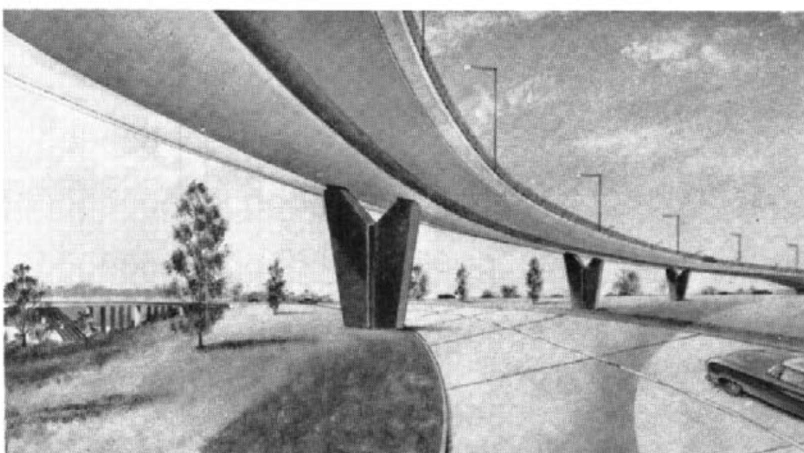
THE Department of Main Roads has accepted a tender for the construction of an overpass to bridge the main route of the North-Western Expressway at Huntley's Point.

The successful tenderer is Hutcherson Bros. Pty. Ltd. in an amount of £119,949 16s. 6d.

The tender of Hutcherson Bros. Pty. Ltd. was the lowest of seven received.

The overpass will form part of the approach to the new Gladesville Bridge for traffic travelling towards the City from Gladesville, Ryde and other areas to the west of the bridge. The overpass will also span the link road to be provided to enable traffic from these areas to join the expressway for northbound travel.

The overpass will be a prestressed concrete bridge 625 feet long and 38 feet wide. The contract time for completion of the work is 45 weeks.



Top—An artist's impression of the overpass at Huntley's Point

Bottom—An aerial photograph showing the location of the overpass

Standard Railway Gauge

SYDNEY – MELBOURNE

Effect on Road Traffic

THE carriage of goods by rail between Sydney, New South Wales, and Melbourne, Victoria, without transhipping at the border city of Albury commenced on 2nd January, 1962, with the extension of the existing standard gauge railway line in New South Wales from Albury to Melbourne.

To determine the effect of this through railway service on the volume of heavy transport vehicles using the Hume Highway, traffic surveys were undertaken by the Department of Main Roads before and after the change was made.

The surveys consisted of turning movement and classification counts which were carried out continuously for seven days at the junction of State Highway No. 2 (Hume Highway), with Trunk Road No. 57 (Wagga Wagga-Albury Road), 6 miles north of Albury. The first count was carried out from the 29th October to the 5th November, 1961, *i.e.*, before the break of railway gauge at Albury was eliminated, and the second count between the 28th October and 4th November, 1962.

The following tabulations give a comparison of the traffic volumes recorded and the changes in the 1962 count both as volumes and percentages of the 1961 count.

Table 1 shows comparisons for various classes of vehicles entering the intersection from both roads while Table 2 treats the two roads separately and differentiates between the two directions of travel. Because unusual conditions occurred on one day of the 1962 count, due to a local cattle sale, all totals shown in Table 2 are for six days.

It may be assumed that generally single unit vehicles are mostly local traffic while double unit vehicles form the bulk of long distance interstate traffic.

TABLE 1

Comparison of Volumes of Heavy Traffic by Classes in 1961 and 1962 Counts

Class of Vehicle	1961 Count	1962 Count	Change in 1962 Count	
			Volume	Per Cent
Single Units—				
Trucks and vans with dual tyres—				
2 axles	867	870	+ 3	+ 0·3
3 axles	85	90	+ 5	+ 5·9
4 axles	26	35	+ 9	+ 34·6
Total Single Units	978	995	+17	+ 1·7
Double Units—				
Truck-Trailer and Semi-Trailer Combinations—				
3 axles	947	809	− 138	− 14·6
4 axles	1,200	1,165	− 35	− 2·9
5 and 6 axles	39	76	+ 37	+ 94·8
Total Double Units ..	2,186	2,050	− 136	− 6·2
Total Heavy Vehicles ..	3,164	3,045	− 119	− 3·8

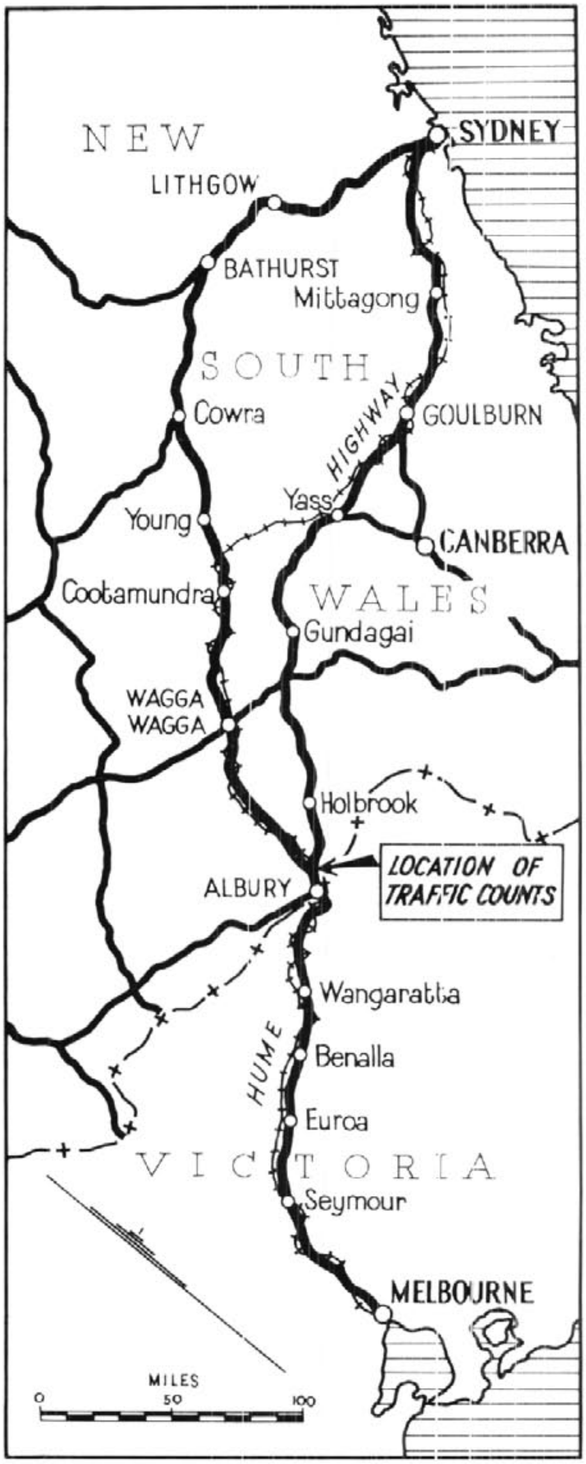


TABLE 2

Comparison of 1961 and 1962 Count of Heavy Vehicles According to Road Used and Direction of Travel

Class of Vehicle	1961 Count	1962 Count	Change in 1962 Count	
			Volume	Per Cent
Single Units—				
Hume Highway—				
Northbound	269	259	— 10	— 3·7
Southbound	255	293	+ 38	+ 14·9
Combined	524	552	+ 28	+ 5·3
Wagga Wagga-Albury Trunk Road—				
Northbound	248	222	— 26	— 10·5
Southbound	206	221	+ 15	+ 7·3
Combined	454	443	— 11	— 2·4
Total	978	995	+ 17	+ 1·7
Double Units—				
Hume Highway—				
Northbound	749	735	— 14	— 1·9
Southbound	789	796	+ 7	+ 0·9
Combined	1,538	1,531	— 7	— 0·5
Wagga Wagga-Albury Trunk Road—				
Northbound	305	251	— 54	— 17·7
Southbound	343	268	— 75	— 21·9
Combined	648	519	— 129	— 19·9
Total	2,186	2,050	— 136	— 6·2
Total Heavy Vehicles ..	3,164	3,045	— 119	— 3·8

From counts made between 1955 and 1961 on the Hume Highway near Yass, it is known that the volume of heavy traffic using the Highway has remained almost constant during that period.

It now appears from the counts taken at the intersection of the Hume Highway and the Wagga Wagga-Albury Trunk Road that the elimination of the break in railway gauge at Albury has not caused any appreciable change in the volume of heavy traffic travelling on the Hume Highway between New South Wales and Victoria and vice versa.

So far as the Wagga Wagga-Albury Trunk Road is concerned, there are not any records available to give trends in volumes of heavy traffic prior to the count of 1961. However, there is no known reason for the variation in the volume of heavy traffic on this Trunk Road between 1961 and 1962 other than the elimination of the break in the railway gauge at Albury, and it is considered reasonable to attribute the decrease of 19·9 per cent, given in Table 2, to this cause.

The Department of Main Roads proposes to carry out a further traffic count towards the end of 1963 to check trends in volumes of heavy traffic revealed in the two counts already taken.

LOADS ON MOTOR VEHICLES

Control of Weights

To protect pavements and bridges on Main Roads from damage, a limitation is placed on the weights of loaded motor vehicles.

The gross load and individual axle loads which may be imposed on the formations, pavements, structures and ferry vessels on Main Roads are governed by Ordinance No. 30C of the Local Government Act, 1919.

A detailed guide to load limitations is published by the Department of Main Roads and copies of this may be obtained on application to the Head Office at 309 Castlereagh Street, Sydney. In addition, technical advice regarding the application of the Ordinance limits to all types of vehicles is available to vehicle operators, transport interests, manufacturers and importers.

Penalties are imposed for failure to observe the limitations set out in the Ordinance, the maximum amount being £200.

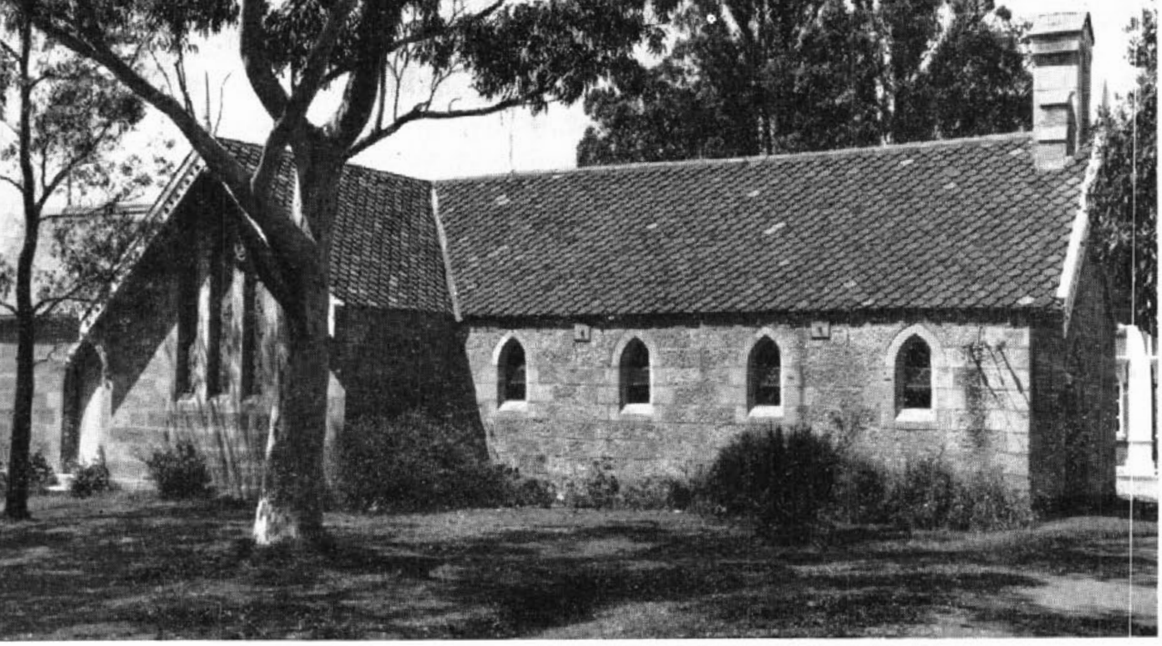
The following statistics summarise the action which was taken in the administration of the Ordinance during the year ended 30th June, 1962:—

Vehicles stopped for checking	40,275
Vehicles reported as overloaded ..	4,238
Notices of overloading issued	3,728
Prosecutions authorised	2,564
Number of cases heard by Courts ..	2,539
Total penalties inflicted	£62,536
Maximum penalty (£200)	5
Average penalty, including all costs to be met by the defendant, per case ..	£24 12s. 7d.
Permits issued for individual non-divisible loads exceeding Ordinance limitations, involving a gross tonnage of 81,768	2,318
Permits issued for series of non-divisible loads exceeding Ordinance limitations involving a gross tonnage of 117,550..	61

Of the total number of vehicles stopped, 4,238 or approximately 10·5 per cent were found to be overloaded in contravention of the prescribed load limitations.

Overloading on the single drive axle of two-axled rigid vehicles accounted for 39 per cent of the total prosecutions instituted. The fitting of an additional rear axle to provide a tandem assembly would enable many such vehicles to be operated in conformity with load limitations.

Applications for permission to transport non-divisible loads over Main Roads on special purpose vehicles, such as low loader combinations with multiple axle-tyre assemblies, totalled 2,379 during the year, an increase of 259 over the number for the previous twelve months.



"All Saints" Church prior to relocation

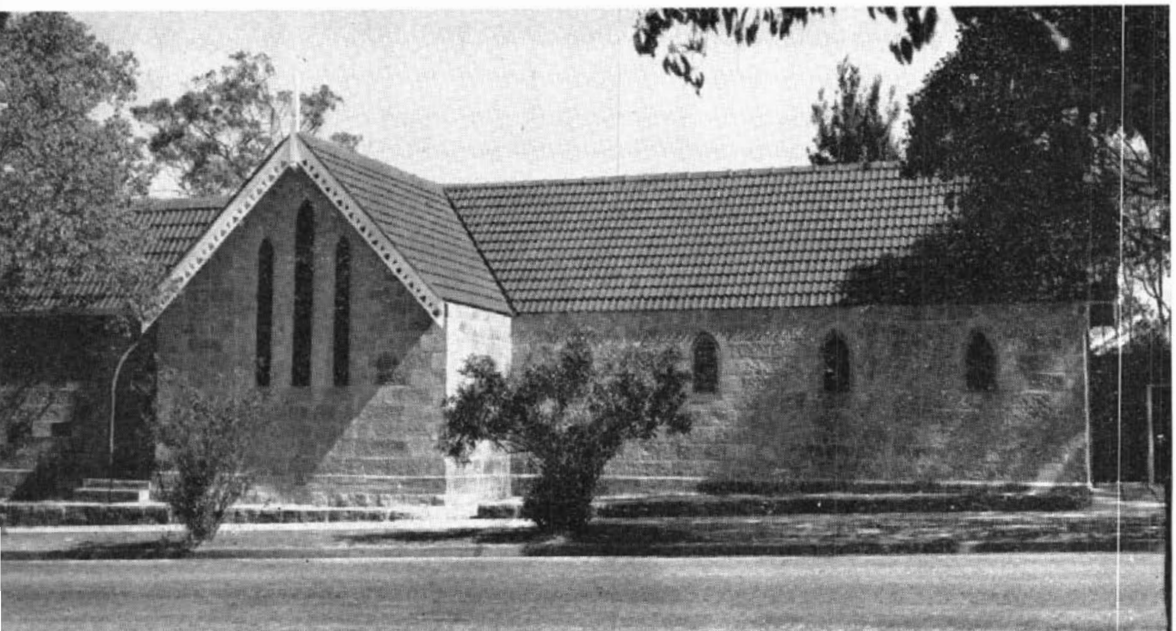
HISTORICAL CHURCH RE-LOCATED

AMONG a number of buildings recently acquired by the Department of Main Roads to enable commencement of work on part of the North-Western Expressway was "All Saints" Church of England, which was located in the path of the expressway at the corner of Joubert and Church Streets, Hunter's Hill.

In view of the historic and architectural significance of this Church, the Department considered that the building merited re-location and for this purpose an alternative site, providing a setting in harmony with the Church, was purchased at the corner of Fig Tree Road and Avenue Road, Hunter's Hill, after consultation with the Church Authorities.

Dismantling of the Church commenced in March, 1962, and its re-erection on the new site was completed about seven months later. The work was carried out for the Department by Mr. R. J. Clark of Rose Bay, under the supervision of Mr. Morton Herman, M.Arch., F.R.A.I.A., Architect, of Sydney.

In preparing detailed plans of the building, Mr. Herman assigned code numbers to each stone and to each section of the roof to ensure their re-erection in the correct positions.



The Church re-erected at the new location

" All Saints " Church of England had stood on its original site for a period of 104 years.

The decision to build the Church was made on the 18th July, 1857 at a meeting held at the residence of Mr. Jules Joubert, member of a prominent Hunter's Hill family. The meeting was presided over by the Lord Bishop of Australia, Bishop Barker, and it was resolved that a small school house would be built, which could be used also as a chapel.

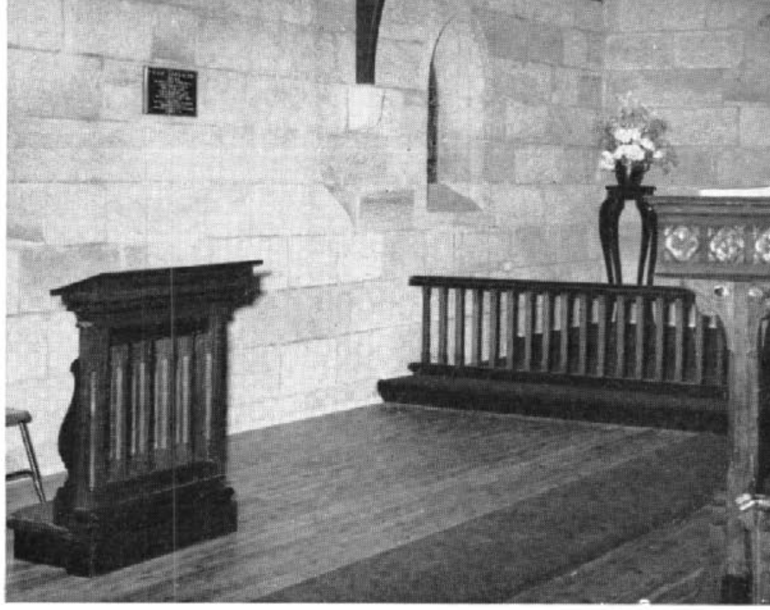
A piece of land on the corner of Joubert and Church Streets was donated by Mr. D. N. Joubert, the elder brother of Mr. Jules Joubert, and a design was prepared by Messrs. Weaver and Kemp, Architects. Tenders for the erection of the building were invited by advertisement on the 7th September, 1857.

The structure was apparently completed by early 1858, as in a diocesan publication of February of that year, it was described as " a school house distant four miles from St. Anne's Church, Ryde, licensed by the Bishop for service and the administration of the Holy Communion on the application of the Rev. G. E. Turner." The Rev. G. E. Turner was at that time the incumbent of St. Anne's. On the 1st February, 1858, the Rev. J. A. Burke, B.A., was licensed as Minister at " All Saints ".

In June, 1859, the School was licensed for the celebration of marriages and in the same month was given the name of " All Saints Chapel ".

The structure in its new position has been named " St. Mark's " Church, having been consecrated under that name at a ceremony which was performed on the 28th October, 1962, by His Grace the Archbishop of Sydney, Dr. Gough.

The present Rector of " St. Marks " is the Rev. C. A. Sherlock.

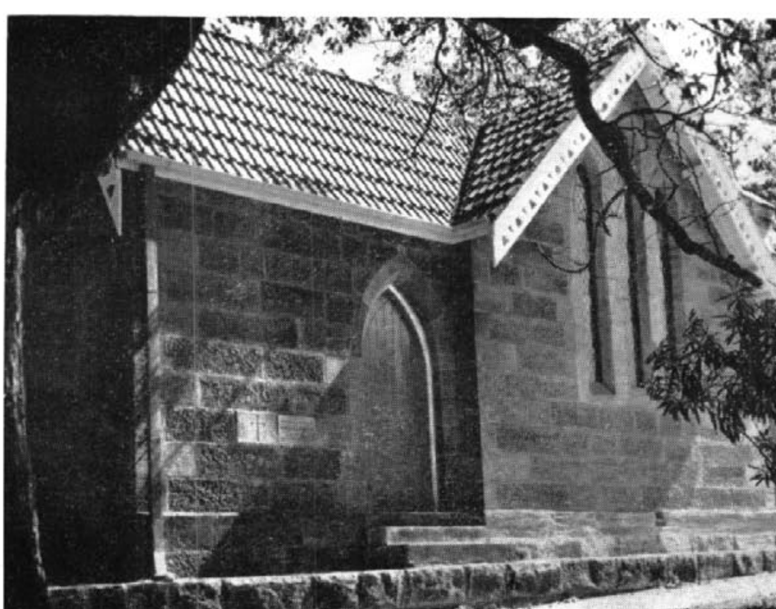


An interior view of the re-erected Church

Locality sketch

Close-up of plaque in photograph above

Another view of the re-erected Church



Hydrated Lime and Fly Ash for Stabilization of Soils

RECENTLY the Department of Main Roads conducted a number of experiments for the purpose of confirming that hydrated lime (calcium hydrate) and fly ash in combination were suitable for stabilizing certain soils. It was found that the action of lime and fly ash on plastic gravels resulted in a lowering of the plasticity and some gravels which were unsuitable for use as pavement materials before treatment were acceptable after the addition of lime and fly ash. The bearing value of soils, after treatment with lime and fly ash, was found to increase and, as a result of this change, effective thickness of pavement needed above the treated subgrade could be reduced.

Pulverized fuel ash or fly ash is a product of modern coal-fired boilers and results from the burning of fine, pulverized coal. A considerable quantity of fly ash is produced each year by thermal power stations in New South Wales. Little use for this waste product has been found to date and in fact there is often a problem in disposing of it. In the older power houses the ash has a high carbon content, but in the more modern stations the carbon content is low, usually under 5 per cent. A high carbon content interferes with the interaction between lime and fly ash.

Fly ash is an extremely fine material, over 90 per cent passing the 300 mesh sieve and 80 per cent of it having a grain size of less than one-thousandth of an inch. It consists principally of silica and alumina which react with lime to form a cementing material. Being a by-product of combustion, it is chemically a stable material.

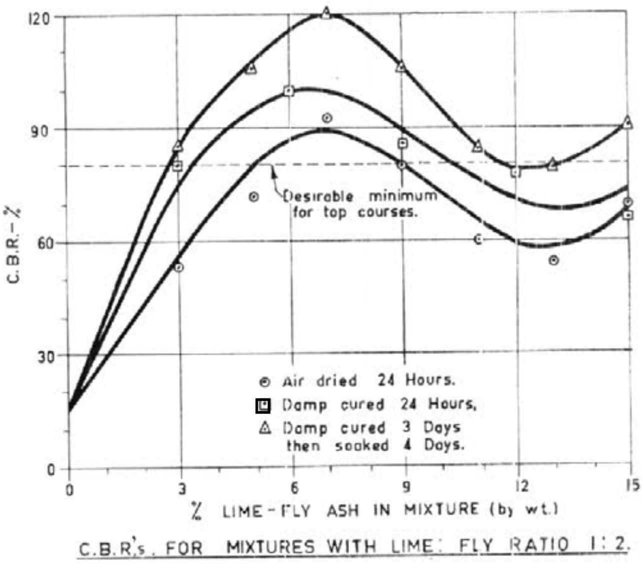
When lime is mixed with a soil in the presence of moisture a series of complicated reactions take place. The effect of a small quantity of lime on a cohesive soil in the presence of moisture is almost immediate, plasticity is lowered and workability improved, but there is little increase in strength. As the quantity of lime added is increased the strength of the soil usually improves.

Another action is possible between lime and soil, a pozzolanic action. It is valuable because the strengths developed in soils as a result can be considerable. For the action to take place the soil must be damp and contain pozzolanic minerals. Pozzolans are siliceous or alumino-siliceous materials which have the power to form cements if mixed with lime in the presence of moisture and they are often present in soils in the form of certain mineral clays. They derive their name from Pozzuoli, a town in Italy, where in Roman times a cement was made by mixing the local volcanic ash with lime.

Pozzolanic action is slow but pronounced. It is not evident as a rule for some weeks after lime is added but if the necessary conditions obtain, *i.e.*, pozzolans are present in quantity and the soil is damp, the action will continue for a long time and usually substantial gains in soil strength will be recorded. The amount of pozzolanic material present in a soil, however, is usually too small to cause significant gains in strength and to counter this lack some form of pozzolanic material needs to be added. Fly ash is suitable for this purpose as it contains considerable quantities of silica and alumina. If it should contain free carbon in any quantity, the carbon will mask the fine ash and prevent the reaction, hence it is necessary to use an ash with a low carbon content.

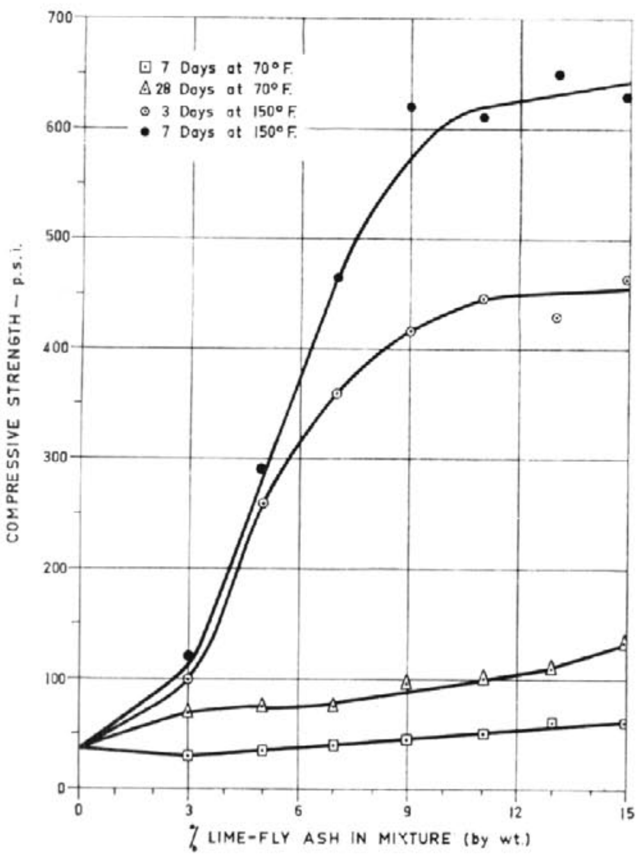
The first trial by the Department of Main Roads to assess the value of a mixture of lime and fly ash as a means of stabilizing soils and gravels was undertaken on a decomposed conglomerate gravel from a deposit near Belmont in Lake Macquarie Shire. Material from that pit is reasonably well graded but has a

CALIFORNIA BEARING RATIOS FOR LIME-FLY ASH/SOIL MIXTURES



C.B.R.'s. FOR MIXTURES WITH LIME: FLY RATIO 1:2.

UNCONFINED COMPRESSIVE STRENGTHS OF SOILS MIXED WITH LIME-FLY ASH



COMPRESSIVE STRENGTHS OF LIME-FLY ASH/SOIL MIXTURES WITH LIME: FLY ASH RATIO 1:2 SPECIMENS MOULDED IN PROCTOR MOULD AT 'PROCTOR' DENSITY AND SOAKED 4 HOURS PRIOR TO TESTING

plasticity index ranging up to 20. (The plasticity index is a measure of the plastic nature of soil and an upper limit of eight is usually fixed for soils and gravels being used in pavements.)

Fly ash varies according to the coal type and the conditions under which it is burnt; data assembled on one ash may not be pertinent to another. Fly ash from Wangi Wangi power station which is near Belmont was used in the first test. The most suitable proportions in which to combine lime and fly ash were determined by preparing mixtures of the two materials in a range of proportions, curing the mixtures and then testing them for strength. A mixture of two parts of fly ash to one of lime was found to give the strongest mortar. Various proportions of this mixture, ranging from 0 to 20 per cent, were mixed with the soil and specimens of the treated gravel were cured, one group for seven days at air temperature, one for twenty-eight days at air temperature and a third at a temperature of 150°F. for five days. Curing at a temperature of 150°F. for five days is equivalent to several months field exposure after mixing. The specimens were tested after mixing to find the change in strength. Two measures were used, the California Bearing Ratio and the Unconfined Compressive Strength.

The California Bearing Ratio values were found, after seven days of curing at room temperature, to have increased from 15 per cent for the natural soil to an average of about 100 per cent for the stabilized soil. A desirable minimum C.B.R. value for soils to be used in pavement courses is usually taken as about 80 per cent. Compressive strength figures for the stabilized soil after accelerated curing at 150°F. improved from 40 lb./sq.in. to over 600 lb./sq.in.

Subsequent field and laboratory trials confirmed that considerable improvement takes place in certain plastic soils to which lime and fly ash are added as stabilizing materials. The importance of the discovery led the Department to apply the laboratory findings to a field work in 1961 to check whether the plasticity of a clay subgrade could be so reduced and its strength so improved by the addition of lime and fly ash, that it could act as a lower course pavement material. On a natural surface consisting of heavy Sydney clay, calculations showed that 17 inches of pavement material were required and that the clay to this depth would first need to be removed. Instead, over a selected length of road, a depth of 11 inches of clay was removed and the top five inches of the remaining exposed clay stabilized by incorporating in it a mixture of lime and fly ash. The treatment was successful and later a pavement 11 inches thick consisting of crushed rock with an asphalt top was laid on the treated base.

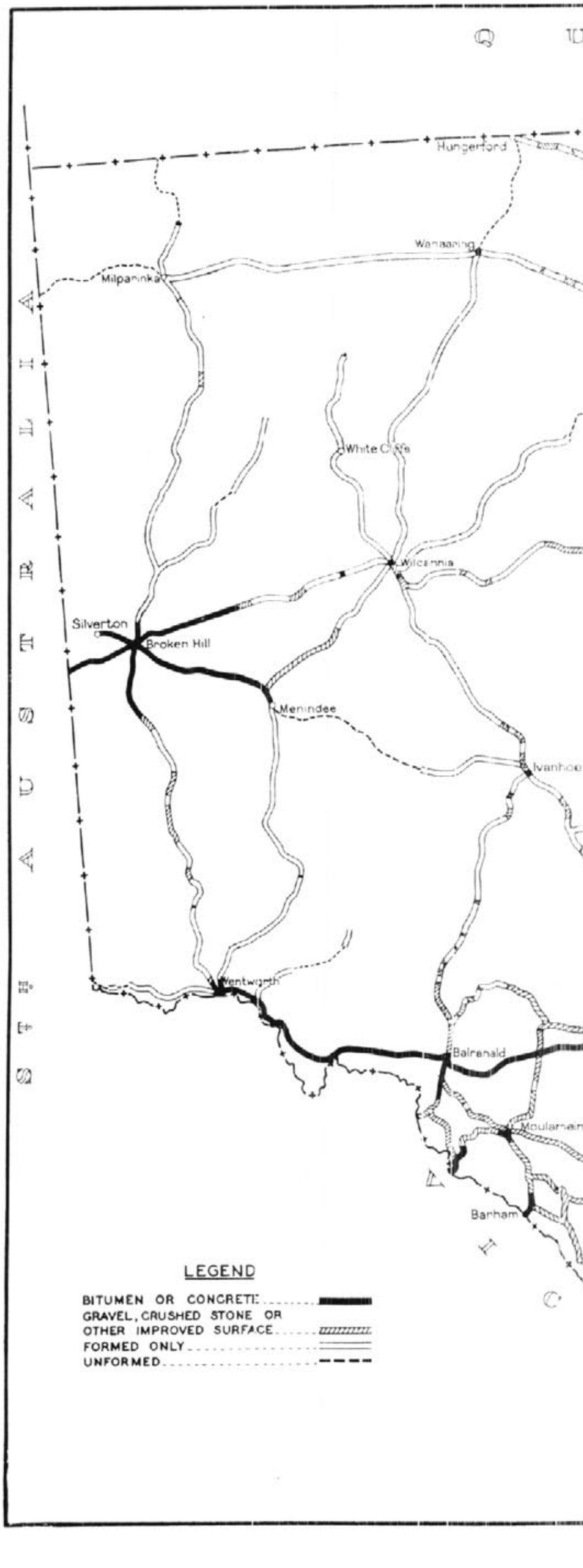
In the Laboratory a mixture of fine Botany sand, lime and fly ash mixed in the proportions of 85 per cent sand, 10 per cent, fly ash and 5 per cent lime when tested for strength after a period of accelerated curing gave readings of over 1,000 lb./sq.in. in compression. Laboratory trials showed a considerable improvement in strength of crushed shale from deposits in Stroud Shire and a reduction in the plastic nature of the material after treatment with lime and fly ash.

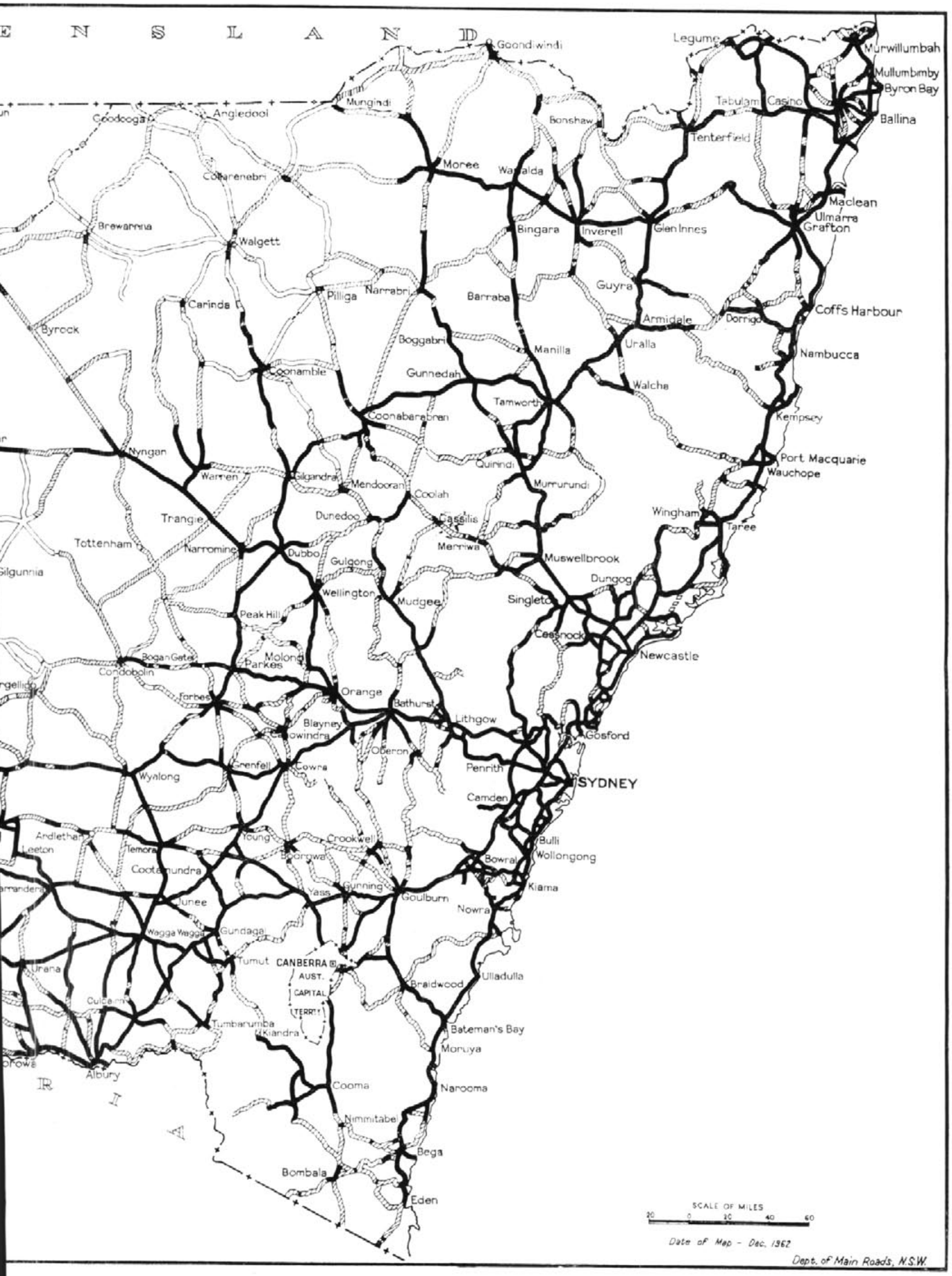
Lime with or without fly ash has certain advantages over cement in soil stabilizing work. It is slower to act and penetrates into heavy soils. In using lime there is not the need to complete the work before it sets as there is with cement. In fact, disturbance of a soil some days after it has been treated with lime generally aids the reaction between soil and lime and heavy rain on recently stabilized pavement does not readily leach lime from the pavement as may happen if cement has been used as the stabilizing medium.

TYPES OF PAVEMENT ON MAIN ROADS IN NEW SOUTH WALES

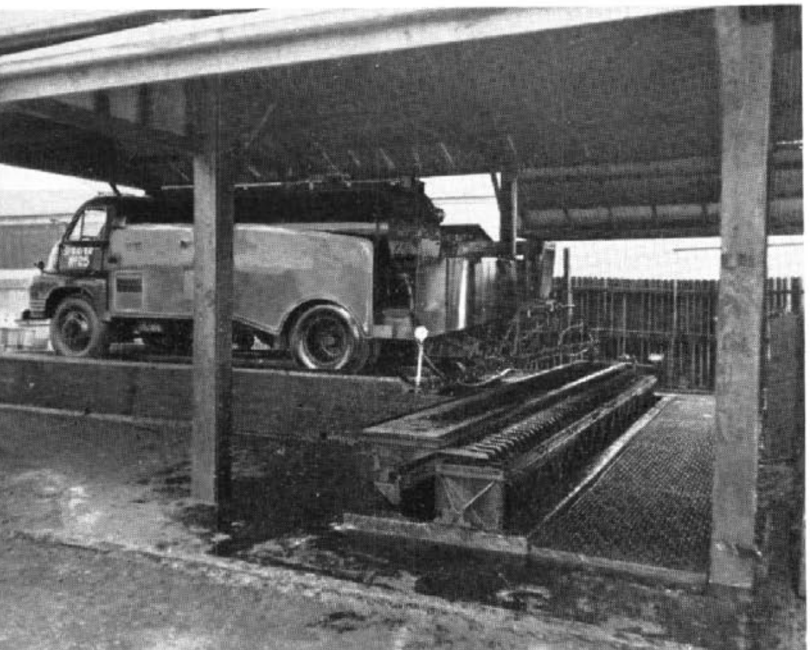
The map alongside shows the types of pavement on the Main Roads of New South Wales as at the 31st December, 1962.

Copies of the map are available free of charge at the Head Office and Divisional Offices of the Department of Main Roads.

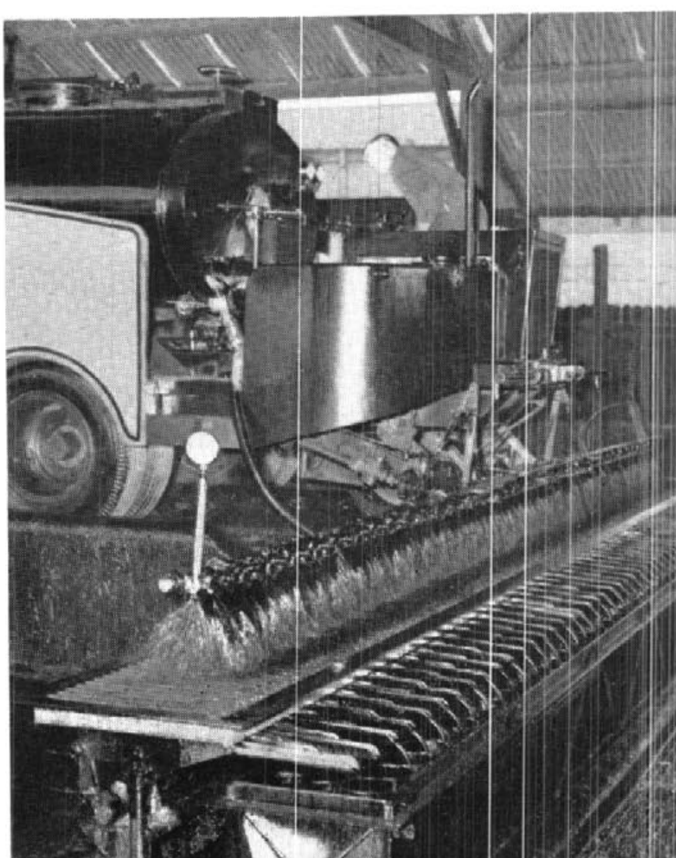




E N S L A N D
Goondiwindi
Legume
Murwillumbah
Mullumbimby
Byron Bay
Tabulam
Casino
Ballina
Mungindi
Goodooga
Angledool
Bonshaw
Tenterfield
Moree
Warialda
Collarenebri
Maclean
Ulmarra
Grafton
Brewarrina
Bingara
Inverell
Glen Innes
Walgett
Guyra
Pilliga
Narrabri
Barraba
Carinda
Armidale
Dorrigo
Coffs Harbour
Byrock
Boggabri
Manilla
Uralla
Nambucca
Coonamble
Gunnedah
Walcha
Tamworth
Coonabarabran
Kempsey
Nyngan
Quirindi
Port Macquarie
Wauchope
Warren
Gilgandra
Mendooran
Coolah
Murrurundi
Trangie
Dunedoo
Cassilis
Wingham
Taree
Tottenham
Narromine
Dubbo
Merriwa
Muswellbrook
Gulgong
Dungog
Wellington
Mudgee
Singleton
Peak Hill
Cessnock
Bogan Gate
Molong
Parkes
Newcastle
Condobolin
Orange
Forbes
Bathurst
Lithgow
Blayney
Canowindra
Gosford
Oberon
Penrith
Grenfell
Cowra
SYDNEY
Wyalong
Camden
Ardlethan
Leeton
Young
Crookwell
Temora
Boorowa
Bulli
Wollongong
Bowral
Cootamundra
Kiama
Junee
Yass
Gunning
Goulburn
Nowra
Wagga Wagga
Gundagai
Urana
Tumut
CANBERRA
AUST. CAPITAL TERR'Y
Braidwood
Ulladulla
Culcairn
Tumbarumba
Kiandra
Bateman's Bay
Moruya
Albury
Cooma
Narooma
Nimmitabel
Bega
Bombala
Eden
SCALE OF MILES
20 0 20 40 60
Date of Map - Dec. 1962
Dept. of Main Roads, N.S.W.



TESTING OF BITUM



Bitumen sprayer positioned for testing with spraybar over partitioned tray (photograph No. 1)

Transverse distribution test in progress (Photograph No. 2)→

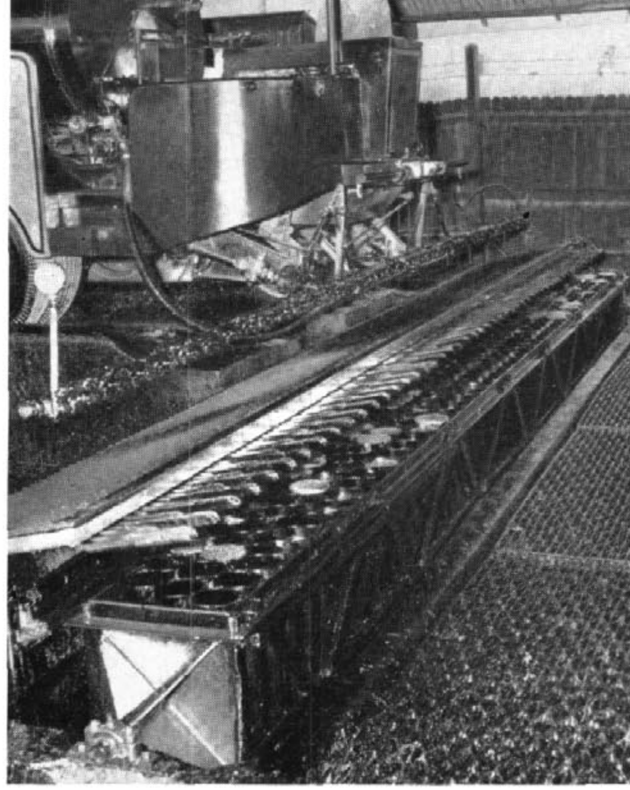
BITUMEN sprayers employed on bituminous surfacing of Main Roads in New South Wales are tested periodically by the Department of Main Roads.

The tests are conducted as a check on the condition of the machines and their ability to apply binder to the road surface at a predetermined and uniform rate, both along and across the road. The test procedure ensures that, provided the sprayer is maintained properly, there will be no longitudinal " streaks ", in which excess binder becomes sticky in hot weather, and that there will not be any deficiency of binder to cause loss of aggregate in narrow strips.

Figures relating to pump capacities, road speeds and application rates are obtained during the tests and are tabulated to provide the operator with information necessary for field work.

The following changes in requirements and test procedure have taken place since publication of the article " Testing of Bitumen Sprayers " in the December, 1953, number of " Main Roads ":—

(*a*) A provisional specification—" Standard Performance Requirements for Mechanical Sprayers for Bituminous Materials—D.M.R. Form No. 272 "—has been adopted.



Partitioned tray being tilted to enable cylinders to be emptied (Photograph No. 3)

RAYERS

EQUIPMENT AND PROCEDURES

(*b*) A new partitioned trough has been installed at the Department's Central Workshop at Granville. This trough is a different type to that previously used and achieves a higher degree of accuracy.

(*c*) A test procedure has been developed for use in the field where a partitioned trough is not available. The test involves the use of a special mat and can be performed in conjunction with normal spraying work, or on a level test site. The test procedures used at Granville and in the field differ in a number of respects and will be described separately.

TEST PROCEDURE USED AT THE DEPARTMENT'S CENTRAL WORKSHOP, GRANVILLE

(a) Testing Equipment

Tests associated with the spraying mechanism are carried out with the machine stationary on a platform and with the spraybar situated centrally over a partitioned tray as shown in photographs Nos. 1 and 2. The height of the spraybar above the tray corresponds with the operating height of the spraybar above the road surface.

The testing equipment comprises the following:—

(i) A tray approximately 2 feet wide and divided into 156 shallow compartments, each 2 inches wide, in a total length of 26 feet. Sheet metal chutes conduct the material from each individual compartment into measuring cylinders.

(ii) 156 steel measuring cylinders, $5\frac{3}{4}$ inches inside diameter and 21 inches deep, are arranged in three staggered rows and mounted in a frame. Each cylinder receives the material which has been sprayed into the corresponding tray compartment. The frame is supported by a shaft welded on each end to enable the cylinders to be tipped for emptying.

(iii) A large open trough or sump is located below the tray and measuring cylinders to receive the material at the completion of each test. The material is pumped back into the machine, from this sump, for repeated tests.

(iv) A mechanism is provided to tilt the tray clear of the measuring cylinders so that the cylinders can be emptied at the completion of the test. The tilting is shown in photograph No. 3.

As hot bitumen would tend to cool and set in the troughs, field conditions are simulated by the use of a cold test oil, prepared by mixing flux oil and bitumen, and having a viscosity of 10° Engler at 68° F. This viscosity is similar to that of normal binders at standard application temperatures.

A measured section of 440 yards of local roadway is marked to facilitate checking of the road speed indicator.

(b) Test Procedure

(i) *General Inspection*—The unit is inspected to ensure that it has been constructed in accordance with the Department's requirements, and that the tank dipstick has been calibrated in accordance with a certificate issued by the Department of Weights and Measures.

(ii) *Road Speed Indicator Test*—The road speed indicator is checked with a stop watch over a measured distance of 440 yards. Speeds from 200 to 800 ft./min., in 100 ft./min. increments, are checked, two tests being carried out at each speed for greater accuracy. The results are calculated, and a graph of road speeds and indicator readings is established for use in the preparation of a table of application rates. It may be noted that it is not essential for the instrument to indicate true road speeds, provided the pointer does not fluctuate during use and the results are consistent.

(iii) *Transverse Distribution Test*—This test is conducted with the machine on the platform and the spraybar over the centre line of the tray. The lower faces of the nozzles are set at a height of 10 inches to 12 inches above the top of the tray and the spraybar is examined for damaged or misaligned nozzles.

Pressure gauges are mounted at each end of the spraybar and a series of trial sprays are conducted to determine the pump speed necessary for satisfactory spraybar pressure. All defects which can be detected at this stage are corrected.

An actual distribution test is then conducted for a spraying period of approximately 30 to 45 seconds, or until some of the measuring cylinders are almost full.

The depth of material in each cylinder is then measured and plotted in graph form.

The average depth is calculated and drawn on the graph. A strip of up to 6 inches in width (three compartments) along each side of the width sprayed may be disregarded when calculating the average depth. Lines are also drawn on the graph to represent 20 per cent, 15 per cent and 10 per cent above and below the average as shown in the example on page 86. The graph is then examined for conformity to the following standard requirements:—

(1) The material applied on any width of 2 inches shall not differ by more than 20 per cent from the average application on all 2-inch widths.

(2) Not more than two of any consecutive ten widths of 2 inches shall differ by more than 15 per cent from the average application on all 2-inch widths.

(3) Not more than four of any consecutive seven widths of 2 inches shall differ by more than 10 per cent from the average application on all 2-inch widths.

(4) The effective width of spray is the width within which the application complies with the above three requirements. Outside of the effective width the spray application shall be sharply tapered off and reduced by at least 90 per cent within 4 inches and $97\frac{1}{2}$ per cent within 6 inches. There shall be no appreciable spray application beyond a 6-inch strip on each side of the effective width of spray.

Requirements (1), (2) and (3) control any tendencies for longitudinal streaks and requirement (4) controls any tendency for insufficient application at the edge of the road surface.

(iv) *Checking Commencement and Cut-off of Spray*—The commencement and cut-off of spray are examined visually during distribution tests, and if the testing officer doubts whether they are sufficiently sharp, a field test is carried out.

The test is carried out by spraying test oil or bitumen on a level road surface. If the full depth of spray application is reached and terminated within 1 ft. 6 in. of sprayer travel in each case, the machine, when engaged in future work, will be required to cut-on and cut-off on 3-foot wide strips of paper. If the figure of 1 ft. 6 in. is exceeded in either case, a wider strip of paper will be required.

(v) *Checking Rate of Spray*—During and after the transverse distribution tests, a series of tests are conducted to establish the spray output, using spray bar lengths varying between 2 feet and 24 feet in increments of 2 feet. The periods of spray are timed with a stop watch, the tank is dipped prior to and after each spray, and the spray output in gals./min. is calculated. If the machine operates on the principle of constant pressure *without* by-pass, the appropriate pump speed for each bar length and spray output is noted.

If the machine operates on the principle of constant pressure *with* by-pass, the pump pressure and by-pass setting are also noted.

(vi) *Establishment of Application Rates*—An application rate chart is prepared using the spray output data and the road speed indicator readings.

The actual road speeds required for the various application rates are calculated from the following formulae, but the appropriate road speed indicator readings are shown in the chart:—

$$Sm = \frac{0{\cdot}102 \times P}{L \times A} \quad \text{or,}$$

$$Sf = \frac{9 \times P}{L \times A}$$

where

Sm = Road speed in M.P.H.
Sf = Road speed in ft./min.
L = Bar length in feet
P = Output in gallons/min.
A = Application in gals./sq. yd.

(vii) *Test with Hot Materials*—Machines being tested for the first time are checked with hot R.90 grade bitumen to ensure that:—

(1) The pump will handle hot material without seizure.

(2) The burners can raise the temperature of a full tank of material from 200° F. to 350° F. in not more than two hours.

(3) The insulation of the tank is such that the temperature drop of a full load of material at 350° F., with air temperature not less than 60° F., does not exceed 20° F. per hour with the burners not in use.

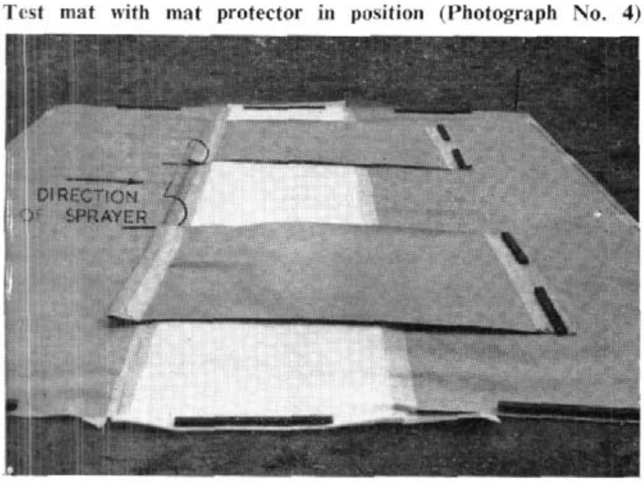
TEST PROCEDURE USED IN THE FIELD

(a) Equipment and Materials

(i) *Open Trough*—A simple open trough is required for checking the rate of spray and to assist in " trouble shooting ". The trough is constructed from nine used 44-gallon drums which are welded end to end to make a total length of approximately 26 feet. A section of the side of each drum and adjoining ends are removed to form the open trough.

(ii) *Transverse Distribution Test Mat*—The test mat is made approximately 4 feet longer than the length of spraybar to be tested. The mat comprises a strip, 2 feet wide, of a special acetate rayon material, which resembles cotton wool, attached to a backing sheet, 3 feet wide, of bituminous building paper. A strip of paper 3 feet wide is attached to each side of the rayon material and masking tape is accurately positioned so as to leave exposed a 22-inch width of the rayon material.

Test mat with mat protector in position (Photograph No. 4)



(iii) *Mat Protector*—A steel framed mat protector is required to ensure that the wheels of the sprayer do not deposit any stones or foreign material on the mat when passing over it. The mat protector consists of two 3-ft. x 5-ft. sheets of bituminous building paper attached to a wire frame, as shown in photograph No. 4.

(iv) *Pick-up Hooks*—Two pick-up hooks of 1 in. x $\frac{1}{8}$ in. mild steel bar are required for attachment to the rear axle of the vehicle so that, when passing over the mat, the protector is picked up and dragged away with the truck.

(v) 300 gallons of light priming tar for use in checking the rate of spray and when " trouble shooting " over the open trough.

(vi) 500 gallons of hot R.90 grade bitumen for the distribution tests. Normally about 20 to 30 gallons of bitumen are used in a field distribution test and the remainder can be returned to the storage tank.

(b) Test Procedure

(i) *General Inspection*—The unit is inspected in the same way as for the Workshop Test.

(ii) *Road Speed Indicator Test*—This test is also carried out in a similar manner to that described for the Workshop Test.

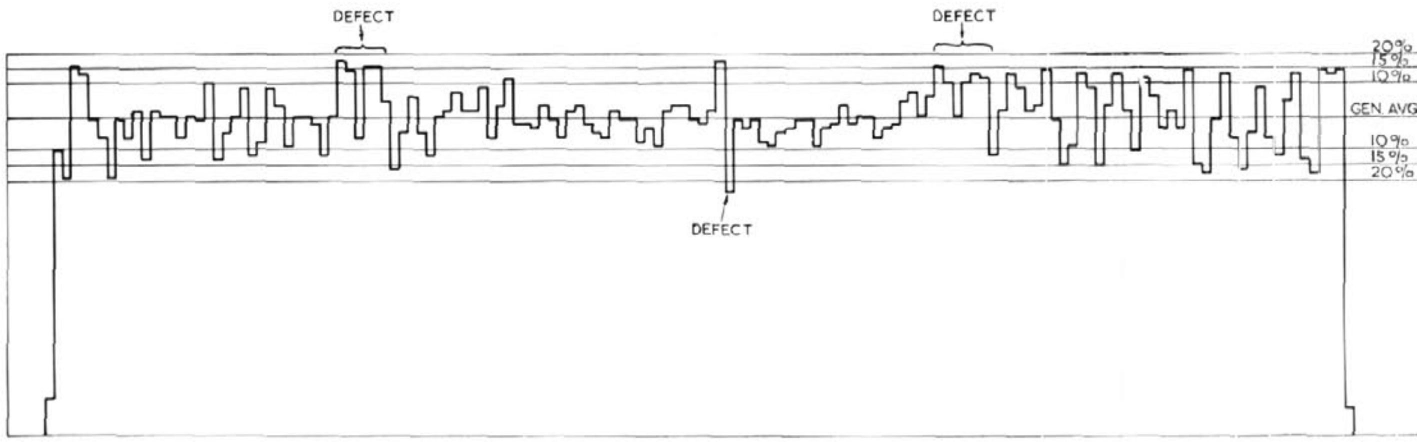
(iii) *Checking Rate of Spray*—The rate of spray is checked over the open trough using light priming tar at ambient temperature, or an equivalent cold material having a viscosity similar to that of normal binders at standard application temperatures. Trial sprays are conducted to determine the correct pump speeds and to ensure that all defects which can be detected at this stage are corrected.

The spray output data is then obtained from a series of tests in a similar manner to that used in the Workshop Test.

(iv) *Establishment of Application Rates*—An application rate chart is prepared in the same manner as set out for the Workshop Test.

(v) *Transverse Distribution Test*—The distribution test can be conducted in conjunction with normal spraying work, at the end of the section to be sprayed, or on a special test site.

The mat is laid across the pavement and its edges are secured by means of taut string lines held on each side of the pavement with steel pegs. The string is fastened to the mat at intervals with masking tape and nailed to the roadway with 2-inch roofing nails through the strips of masking tape. The mat protector is positioned to suit the wheels of the machine (illustrated in photograph No. 4), and the pick-up hooks are suitably positioned on the rear axle of the vehicle.



TYPICAL TRANSVERSE DISTRIBUTION TEST

The spraybar is adjusted to the correct height and the nozzles and other equipment are checked for any faults likely to interfere with the distribution. R.90 bitumen is then sprayed at a suitable vehicle speed, and a record is made of the pump speed (in revolutions per minute), the pump pressure, and the road speed. After spraying is complete, the two brown paper strips and masking tape are removed from the rayon material, and the sprayed portion is covered with a length of clean paper to enable it to be rolled on a wire reel. The mat is later rolled out onto a table; all paper in excess of the sprayed portion is removed, and the rayon material is cut (in the direction of spraying) into strips 2 inches wide. Each strip is weighed to the nearest 0·10 gram, and the weights of the rayon material and paper are subtracted. The resultant weight of bitumen deposited on each strip is then plotted in graph form, and the distribution is examined for conformity with the standard performance requirements as is done in the Workshop Test Procedure.

(vi) *Checking Commencement and Cut-off of Spray*—The start and finish of spray are examined at the conclusion of the Distribution Test, and the width of paper necessary to use at commencement and cut-off is determined as in the Workshop Tests.

(vii) *Longitudinal Distribution Test*—This test is carried out when it is desired to determine the consistency of the sprayer output, and the accuracy with which the sprayer is driven.

Nine-inch square pieces of the special acetate rayon material used in the Transverse Distribution Test are placed on thin steel plates of slightly greater area. Cellulose strip is placed along the edge of the rayon material and the mat is then attached to the steel plate with masking tape. Looped pieces of wire attached to opposite sides of each plate enable them to be picked up with a pole immediately after spraying. Five or more mats are placed along the section of road to be sprayed, so that they are at equal distances from the edge of the spray. After spraying, and before the cover aggregate is applied, the mats are removed, separated from the plates, and weighed. The tare weights of the mats are deducted, and the actual rate of application of binder is determined for each mat. The longitudinal spray application, from point to point, is required to be within $7\frac{1}{2}$ per cent of the application rate ordered.

Classification Traffic Counts

AT RURAL LOCATIONS IN NEW SOUTH WALES

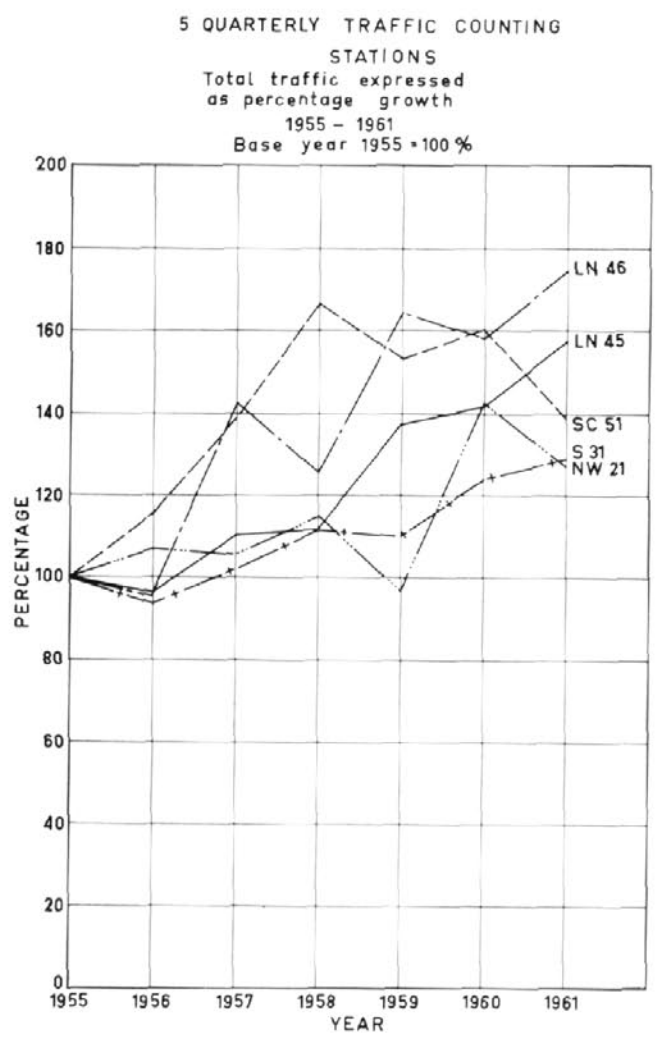
CLASSIFICATION counts of traffic have been carried out quarterly by the Department of Main Roads for many years at locations in the Eastern Division of New South Wales. The main purpose of the counts has been to ascertain the extent of commercial traffic and its relationship to total traffic.

In the years 1955 to 1961 classification counts were conducted at the following five locations:—

- New England Highway (State Highway No. 9) at junction with Willow Tree–Narrabri Trunk Road (Trunk Road No. 72)—one mile north of Willow Tree; Shire of Murrurundi. Station N.W. 21.
- Hume Highway (State Highway No. 2) at junction with Yass–Forbes Trunk Road (Trunk Road No. 56)—five miles west of Yass; Shire of Goodradigbee. Station S. 31.
- Pacific Highway (State Highway No. 10) at junction with the Taree–Gloucester–Twelve Mile Creek Trunk Road (Trunk Road No. 90)—two miles south of Taree; Shire of Manning. Station L.N. 45.
- Taree–Gloucester–Twelve Mile Creek Trunk Road (Trunk Road No. 90) at junction with the Booral–Bulahdelah Main Road (Main Road No. 110 and temporary route of the Pacific Highway)—five miles south of Stroud; Shire of Stroud. Station L.N. 46.
- Snowy Mountains Highway (State Highway No. 4) at junction with the Cooma–Berridale–Mount Kosciusko Main Road (Main Road No. 286)—five miles west of Cooma; Shire of Snowy River. Station S.C. 51.

The data obtained during these classification counts have been analysed and the results have been set out in

FIGURE 1



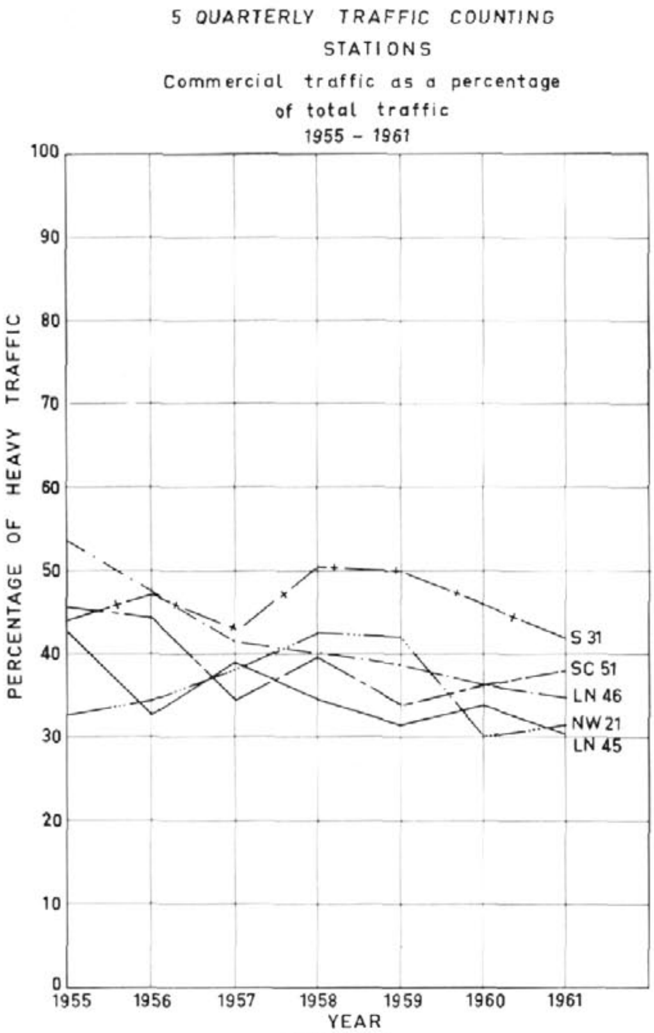


FIGURE 2

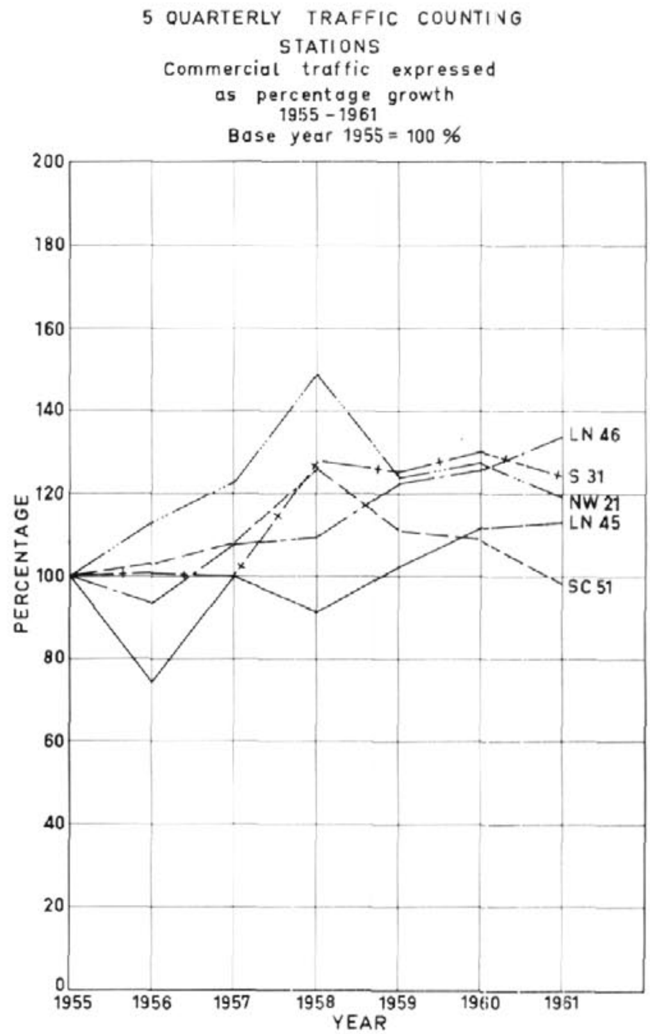


FIGURE 3

the Table and Graphs accompanying this article. As a result of the analysis the following observations may be made:—

- *Total traffic volumes* at each of the five counting stations showed an overall increase, but the pattern of change varied considerably at each station.

  The largest rate of growth was on Trunk Road No. 90 (temporary route of Pacific Highway) south of Stroud, the increase over the seven years being 75 per cent. At two locations, on the New England Highway near Willow Tree and on the Snowy Mountains Highway near Cooma, there were reductions in the volumes of traffic during 1961.

- *The proportion of commercial traffic to total traffic* was decreasing at each of the five counting stations—in other words, the volume of car traffic was growing more rapidly than the volume of commercial traffic.

  The greatest decrease occurred on the Snowy Mountains Highway near Cooma where the percentage of commercial traffic fell from 53·4 per cent to 37·8 per cent of the total traffic in the seven years. One of the causes of this decrease could have been variations in the programmes of work undertaken by the Snowy Mountains Hydro-Electric Authority.

  On the Hume Highway and on the New England Highway the percentages of commercial traffic showed slight decreases (2·1 and 1·9 per cent respectively). These two highways form the main transport route between Melbourne (Victoria) and Brisbane (Queensland) through New South Wales.

- *Volumes of commercial traffic* at each of the five stations except Station SC. 51 on the Snowy Mountains Highway near Cooma were higher in 1961 than in 1955. The greatest increase occurred on Trunk Road 90 (temporary route of the Pacific Highway) near Stroud, where the volume of commercial traffic in 1961 was 134 per cent of the 1955 volume. On the Snowy Mountains Highway near Cooma, the volume of commercial traffic in 1961 was 98 per cent of the 1955 volume.

TABLE

Annual Average of Daily Traffic on the most heavily trafficked leg of each intersection for each of the five years 1955 to 1961 inclusive

Year	Station N.W. 21 on S.H. 9 Southern Leg			Station S. 31 on S.H. 2 Northern Leg			Station L.N. 45 on S.H. 10 Northern Leg			Station L.N. 46 on T.R. 90 Southern Leg			Station S.C. 51 on S.H. 4 Eastern Leg		
	Av. Total Traffic	Av. Commercial Vehicles		Av. Total Traffic	Av. Commercial Vehicles		Av. Total Traffic	Av. Commercial Vehicles		Av. Total Traffic	Av. Commercial Vehicles		Av. Total Traffic	Av. Commercial Vehicles	
		Vol.	% of Total		Vol.	% of Total		Vol.	% of Total		Vol.	% of Total		Vol.	% of Total
1955 ..	930	306	32·9	1,366	602	44·1	1,582	679	42·9	736	336	45·7	1,018	544	53·4
1956 ..	999	345	34·5	1,287	607	47·2	1,527	503	32·9	705	314	44·5	1,175	561	47·7
1957 ..	985	375	38·1	1,389	604	43·2	1,745	680	39·0	1,052	362	34·4	1,420	589	41·5
1958 ..	1,072	456	42·5	1,523	769	50·5	1,777	617	34·7	925	368	39·8	1,701	684	40·2
1959 ..	897	378	42·1	1,502	751	50·0	2,174	686	31·6	1,212	411	33·9	1,560	605	38·8
1960 ..	1,314	389	29·7	1,698	784	46·2	2,243	762	34·0	1,166	423	36·3	1,632	593	36·3
1961 ..	1,179	365	31·0	1,767	747	42·0	2,496	765	30·6	1,289	448	34·8	1,413	534	37·8

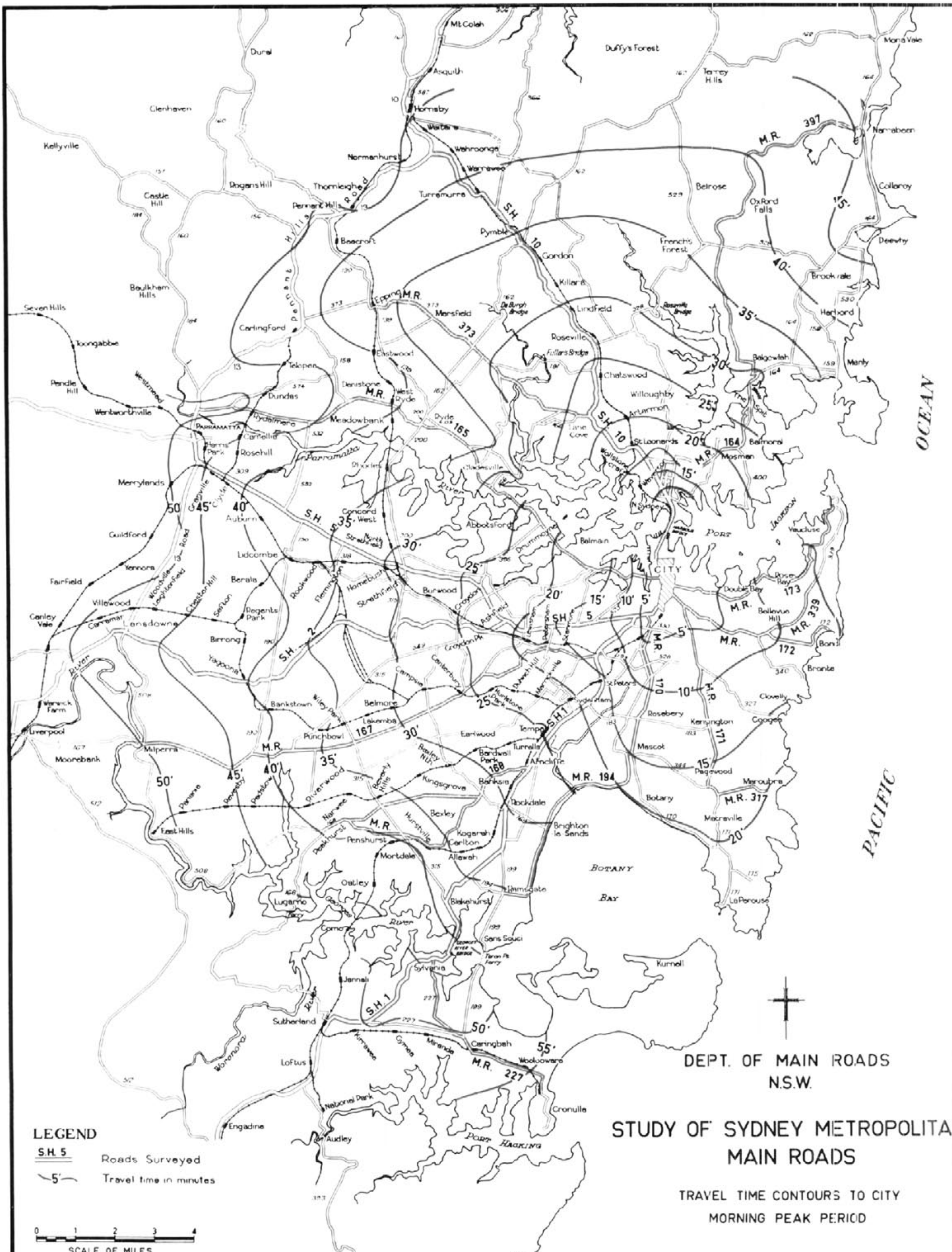
TRAVEL TIMES SURVEY

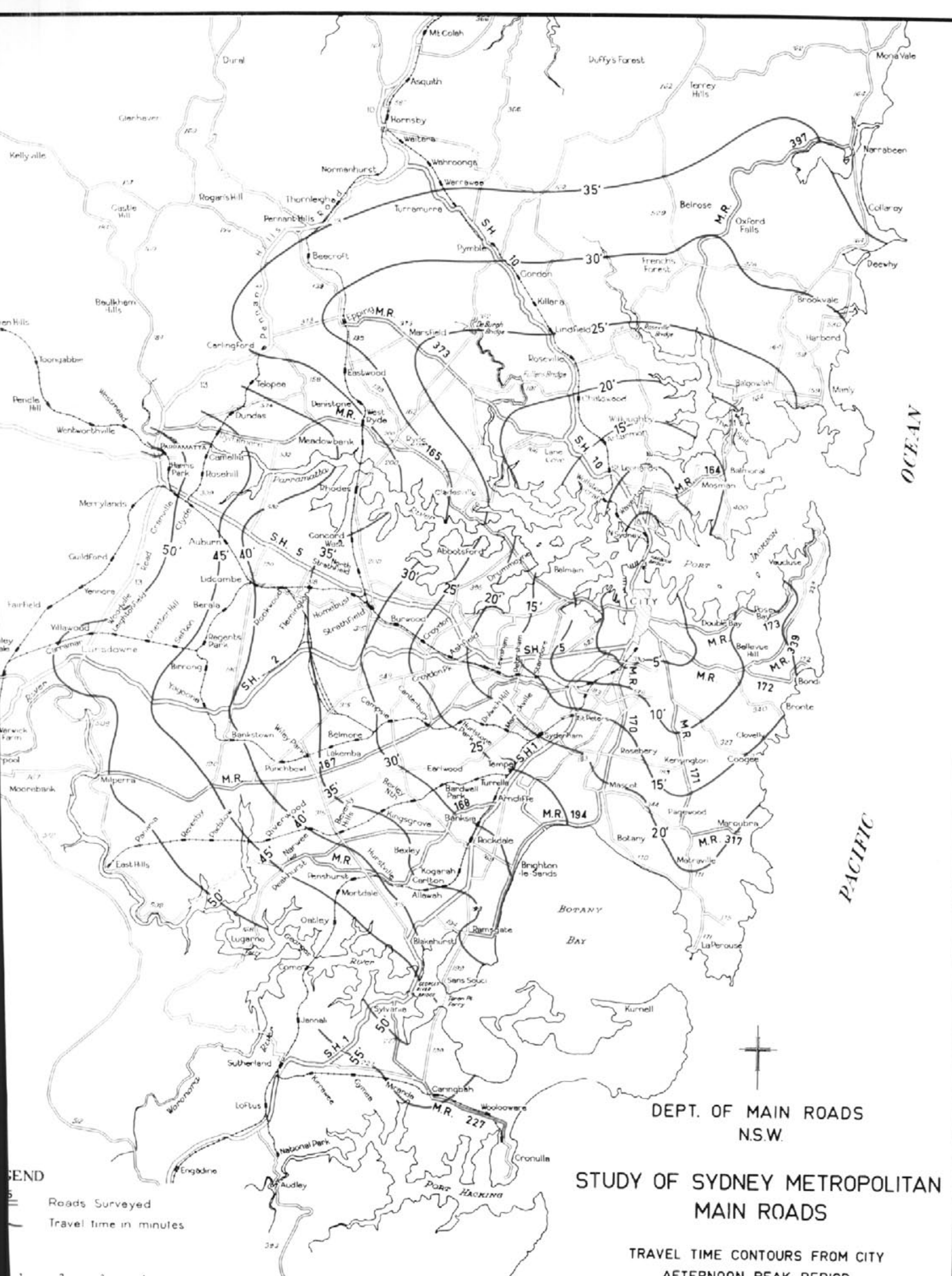
THE Department of Main Roads recently conducted studies of the times of travel during peak periods on the principal arterial routes leading to and from the City of Sydney.

The information collected during the studies has been plotted on maps to show by contours, at five minute intervals, times of travel along the arterial routes during the week-day morning and afternoon peak periods. The period of the morning peak is regarded as extending from 7.00 a.m. to 9.00 a.m. and the afternoon peak from 4.00 p.m. to 6.00 p.m.

A number of runs was made along each of the arterial routes and each of the times used in the preparation of the maps is the average of the three longest journeys on each route.

The maps appear on pages 90 *and* 91

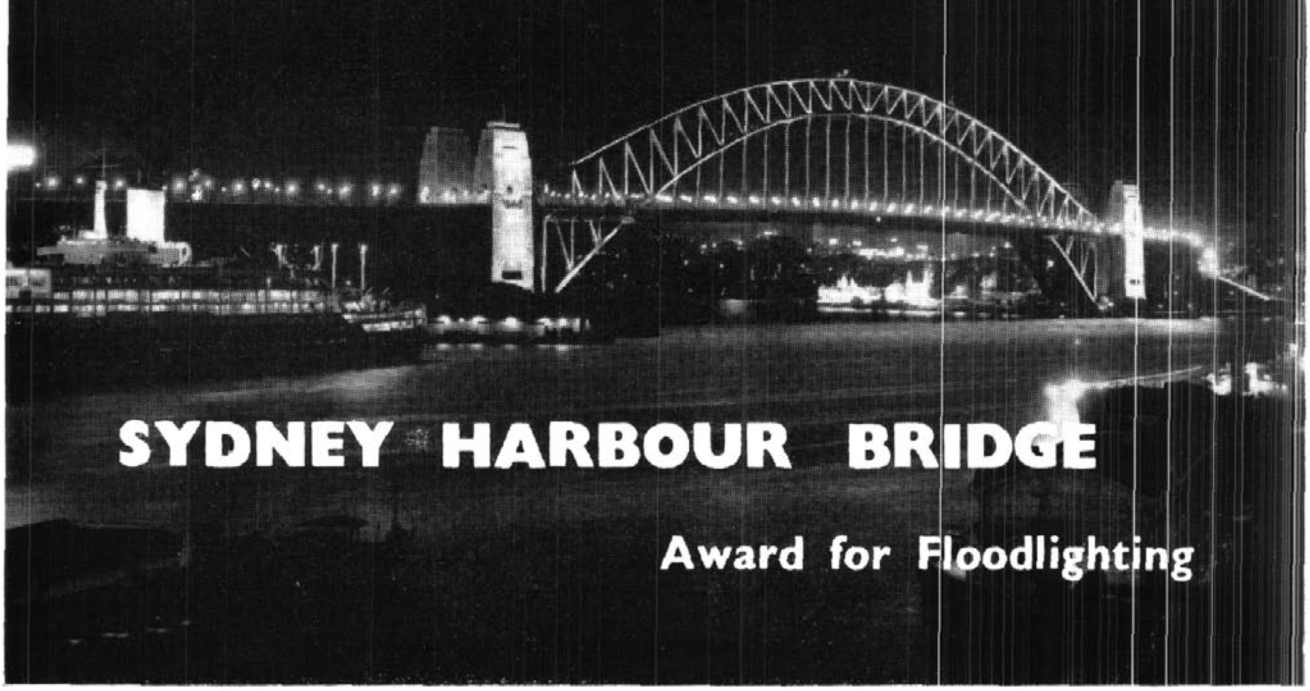

DEPT. OF MAIN ROADS
N.S.W.
STUDY OF SYDNEY METROPOLITA
MAIN ROADS
TRAVEL TIME CONTOURS TO CITY
MORNING PEAK PERIOD
LEGEND
S.H. 5 Roads Surveyed
5' Travel time in minutes
0 1 2 3 4
SCALE OF MILES
PACIFIC
OCEAN
BOTANY
BAY
PORT HACKING
PORT JACKSON
CITY



DEPT. OF MAIN ROADS
N.S.W.

STUDY OF SYDNEY METROPOLITAN MAIN ROADS

TRAVEL TIME CONTOURS FROM CITY
AFTERNOON PEAK PERIOD



SYDNEY HARBOUR BRIDGE

Award for Floodlighting

THE floodlighting of the main arch of Sydney Harbour Bridge received the Illuminating Engineering Society's Award for Meritorious Lighting, 1962.

The various lighting installations were judged by a panel of ten. The comments of the Judges in regard to the floodlighting of the bridge were:—

" The aim had been to illuminate the main arch of the Sydney Harbour Bridge evenly and effectively so that the Bridge became visible at night from all points of the Harbour between Kirribilli and North Head, between Mrs. Macquarie's Chair and the Signal Station at Watson's Bay.

" The designers had been confronted with a most adverse set of circumstances . . . a narrow structural member of varying profile with points of specular components and low reflection factors; limited off-sets for the installation of the lighting equipment; and, above all, dimensions on a grand scale; the arch of the Bridge was to be lighted to a higher level than the hangers to emphasise the structural strength of the Bridge; all floodlights had to be carefully placed to prevent glare in unwanted directions.

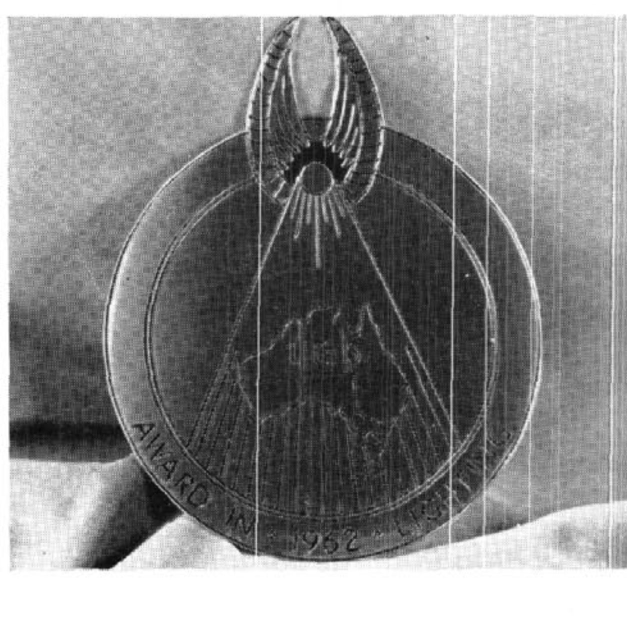
" To solve their problems, the designers had to establish theoretically a photometric solution, had to design the floodlights to provide the calculated candle power and distribution, had to install each individual floodlight and focus this according to the pre-determined beam pattern, and had to lock each into position so that future maintenance requirements would not disturb the location of the beam.

" It is indeed highly meritorious that the designers accomplished all this successfully and provided Sydney with a visual attraction at night of great eminence and singular beauty. Viewed from Mrs. Macquarie's Chair between the lighted facades of the tall city buildings and their multi-coloured neon signs in the south, and the satellite city of North Sydney and the myriads of twinkling lights of the flats at Kirribilli in the north, the Bridge stands out as a filigree of light, a most delicate tracery spanning the blackness of the Harbour, yet, by its own reflections, relieving the water's bleakness and enlivening the surface. Glimpses of the projected pylon lighting being tested during the judging period persuaded the Judging Panel to suggest that the pylons are, in fact, an integral part of the Bridge at night, even if their structural value is nil and their daylight significance debatable.

" In all a highly successfully designed and engineered lighting installation, providing joy for many and the city of Sydney with one of the finest examples of floodlighting."

The Lighting Designers were W. E. Bassett and Partners and the British General Electric Company Pty. Ltd. in association.

The Society's Plaque (illustrated) and Certificate for the installation, were presented to the Commissioner for Main Roads, Mr. J. A. L. Shaw, D.S.O., B.E., by the Society on the 15th December, 1962.



NEW BRIDGE OVER THE PARRAMATTA RIVER AT GLADESVILLE

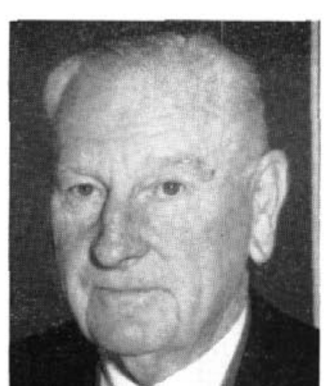
THE last concrete box unit to complete the third of the four ribs of the concrete arch is being hoisted to the top of the falsework. This rib and the first and second ribs have been jacked off the falsework to become self-supporting. The falsework will be moved sideways to hold up the fourth rib.

Retirement of Main Roads Secretary

Appointment of Successor

HAVING reached the age of 65 years, Mr. John H. Fleming relinquished the office of Secretary of the Department of Main Roads, New South Wales, on the 21st November, 1962. Mr. Fleming had been in the Public Service since 1914 and was associated for some years with the Treasury. He joined the staff of the then Main Roads Board at its inception in 1925.

Mr. Wallace W. Weir, who had previously held the position of Chief Accountant, succeeded Mr. Fleming as Secretary. In addition to being a qualified accountant, Mr. Weir is a certificated Local Government Clerk. He joined the staff of the Main Roads Board in 1927.



SYDNEY HARBOUR BRIDGE ACCOUNT

Receipts and Payments for the period from 1st July, 1962, to 31st December, 1962

Receipts	£
Road Tolls	841,796
Contributions—	
Railway Passengers	72,248
Omnibus Passengers	8,633
Rent from properties	69,517
Other	333
	£992,527

Payments	£
Cost of collecting road tolls	82,694
Maintenance and minor improvement	136,445
Alterations to archways for occupation by tenants	670
Administrative expenses and miscellaneous charges	15,479
Transfers to expressways fund	1,102,500
Provision of traffic facilities	14,927
Other	6
	£1,352,721

TENDERS ACCEPTED BY DEPARTMENT OF MAIN ROADS

The following tenders (in excess of £3,000) for Road and Bridge Works were accepted by the Department during the three months ended 31st December, 1962.

Work or Service	Name of Accepted Tenderer	Amount £ s. d.
State Highway No. 1—Prince's Highway—Shire of Imlay. Supply and delivery of 1,880 cubic yards of aggregate to various stockpiles south of Eden.	Peter Hayes Pty. Ltd.	10,340 0 0
State Highway No. 1—Prince's Highway—Shires of Eurobodalla, Mumbulla and Imlay. Supply and delivery of aggregate to stockpiles 2.90 m. north of Bateman's Bay and 28.50 m. south of Bega.	Peter Hayes Pty. Ltd.	8,231 16 0
State Highway No. 8—Barrier Highway—Broken Hill District. Construction of two multi-cell reinforced concrete box culverts located 48.55 m. and 48.80 m. east of Broken Hill.	DeFranceschi Bros.	5,262 8 0
State Highway No. 9—New England Highway—Severn Shire. Supply and delivery of 1,535 cubic yards of ½-inch aggregate to various stockpiles.	Glen Innes Blue Metal Coy.	4,764 12 6
State Highway No. 10—Pacific Highway. Supply, heating and spraying 30,760 gallons bitumen and 1,540 gallons flux oil at various locations.	B.H.P. By-Products Pty. Ltd.	5,899 14 5
State Highways Nos. 10—Pacific Highway—and 16—Bruxner Highway and Trunk Road No. 83. Supply, heating and spraying 45,490 gallons bitumen and 2,270 gallons flux oil at various locations.	B.H.P. By-Products Pty. Ltd.	9,558 9 10
State Highway No. 17—Newell Highway. Construction of two prestressed concrete bridges, one 3-span 75 ft. 6 in. long and one 6-span 150 ft. 6 in. long, over Colombo Creek on deviation of highway at Morundah.	Danckert Constructions Pty. Ltd.	26,580 18 0
State Highway No. 19—Monaro Highway—Municipality of Cooma. Construction of new bridge over Cooma Creek in Sharp Street, Cooma.	M. R. Hornibrook (N.S.W.) Pty., Ltd.	68,636 0 0
State Highway No. 21—Cobb Highway—Waradgery Shire. Supply and delivery of 1,848 cubic yards ¾-inch aggregate and 276 cubic yards ⅜-inch aggregate to stockpiles between 4.00 m. and 22.00 m. north of Hay.	Stevenson's Blue Metal Quarries	8,958 0 0
Main Road No. 286—Shire of Snowy River—Supply and delivery of 955 cubic yards aggregate to stockpiles between Jindabyne and Garden Gully.	M. J. Shelley	4,464 12 6
Main Road No. 508—Municipality of Bankstown. Construction of bridge over Little Salt Pan Creek.	Hutcherson Bros. Pty. Ltd.	20,988 1 0
Developmental Road No. 1276—Shires of Oberon and Blaxland. Construction of foundations for bridge over Duckmaloi Creek.	Frankipile Australia Pty. Ltd.	5,988 14 0

MAIN ROADS FUNDS

Receipts and Payments for the period from 1st July, 1962, to 31st December, 1962

General Purposes

Heading	County of Cumberland Main Roads Fund	Country Main Roads Fund
	£	£
RECEIPTS—		
Motor Vehicle Taxation (State) ..	996,801	3,987,195
Charge on heavy commercial goods vehicles under Road Maintenance (Contribution) Act, 1958 (State)	399,496	1,597,984
Commonwealth Aid Roads Act, 1959 ..	883,298	3,439,792
From Councils under Section 11 of Main Roads Act and for cost of works	813,705	6,471
Other..	187,287	81,717
Total Receipts .. £	3,280,587	9,113,159
PAYMENTS—		
Maintenance and minor improvement of roads and bridges ..	474,946	2,737,487
Construction and reconstruction of roads and bridges..	1,383,619	4,110,938
Land acquisition ..	516,821	93,357
Administrative expenses ..	170,141	434,964
Loan charges—		
Payment of interest, exchange, management and flotation expenses ..	23,940	146,485
*Miscellaneous ..	655,983	580,209
Total Payments .. £	3,225,450	8,103,440

* Includes transfers to Special Purposes Accounts in respect of finance for Operating Accounts, Suspense Accounts and Reserve Accounts.

TENDERS ACCEPTED BY COUNCILS

The following tenders (in excess of £3,000) were accepted by the respective Councils for Road and Bridge Works during the three months ended 31st December, 1962.

Council	Road No.	Work	Name of Accepted Tenderer	Amount
				£ s. d.
Bingara and Guyra S.	3156	Supply and delivery of 56 prestressed concrete bridge beams to Copeton Creek.	Dowsett Products (Aust.) Pty. Ltd.	3,080 0 0
Boolooroo S. ..	12 and 16	Reseal and surfacing with bitumen— S.H. 12: From 5.35 m. to 8 m., 11 m. to 11·5 m. and 21·32 m. to 22·48 m. S.H. 16: From 9·8 m. to 10·38 m. east of Goondiwindi.	Shorncliffe Pty. Ltd. ..	4,647 2 2
	232 & 507	M.R. 232: 1·8 m. to 3·16 m. M.R. 507: 0 m. to 3 m. west of Goondiwindi.		
Canterbury M. ..	167	Reconstruction in cement concrete between Jeffrey Street and Fore Street.	Pioneer Ready Mixed Concrete (N.S.W.).	7,690 7 6
Carrathool S. ..	6	Construction of an eight-cell 8-ft. x 5-ft. R.C. box culvert at 11·9 m. west of Rankin's Springs and extension to a three-cell 7-ft. x 4-ft. R.C. box culvert at 12.3 m. west of Rankin's Springs.	K. Humphries Pty. Ltd. ..	7,387 14 0
Carrathool S. ..	6	Supply and delivery of 1,089 cu. yds. of ¾-in. aggregate and 235 cu. yds. of ⅜-in. aggregate between 17·57 m. and 23·57 m. west of Rankin's Springs.	Griffith Metal, Sand and Gravel Pty. Ltd.	3,376 4 0
Carrathool S. ..	80	Winning, loading and delivery of 6,970 cu. yds. of gravel to various stockpiles 0 m. to 0·5 m. west of Hillston and 0.5 m. to 4.5 m. south of Hillston.	Staines and Grundy ..	3,397 17 6
Carrathool S. ..	80	Bitumen surfacing 0 m. to 0.5 m. west of Hillston and 0.5 m. to 4.5 m. south of Hillston.	Allen Bros. (Asphalting Contractors) Pty. Ltd.	4,321 2 7
Cobar S.	407	Bitumen surfacing 38,506 sq. yds. of pavement 1.3 m. to 4.35 m. from Cobar.	Shorncliffe Pty. Ltd. ..	3,465 15 1

TENDERS ACCEPTED BY COUNCILS—contd

Council	Road No.	Work	Name of Accepted Tenderer	Amount		
				£	s.	d.
Cockburn S. ..	553	Reconstruction from 1.20 m. to 4.33 m. north of Somerton.	W. H. Marshall & Son ..	14,383	0	4
Cockburn S. ..	1032	Construction between 22.98 m. and 23.90 m. from Limbri.	W. H. Marshall & Son ..	4,705	0	3
Coolah S. ..	55	Bitumen surfacing 17.61 m. to 27.74 m. south of Coolah	Shorncliffe Pty. Ltd. ..	15,430	19	7
Coonabarabran S.	396, 129 & 334	Supply and delivery of aggregate to various stockpiles..	Coonabarabran Industries Pty. Ltd.	4,092	7	6
Copmanhurst S. ..	83, 150 & 151	Tar priming of 66,225 sq. yds. and bitumen surfacing of 65,441 sq. yds.	B.H.P. By-Products Pty. Ltd.	4,638	19	9
Copmanhurst S. ..	83, 150 & 151	Supply and delivery of 498 cu. yds. $\frac{3}{16}$-in. aggregate and and 1,003 cu. yds. $\frac{5}{8}$-in. aggregate to various stockpiles.	Oxenfords Pty. Ltd. ..	3,076	16	0
Goobang S. ..	61	Supply and delivery of precast culvert crown sections and 18-in. diameter pipes to specified locations west of Parkes.	Rocla Pipes Pty. Ltd. ..	4,658	5	4
Goobang S. ..	61	Reconstruction, clearing and base course gravelling 14.87 m. to 20 m. and 23.66 m. to 28.53 m. west of Parkes.	Olding Excavations Pty. Ltd.	17,520	5	0
Goobang S. ..	61	Supply and delivery of 1,832 cu. yds. $\frac{3}{4}$-in. aggregate 14 m. to 19 m. west of Parkes and 0 m. to 5 m. west of Bogan Gate.	N. C. & A. D. Bennett ..	6,320	8	0
Goobang S. ..	61	Bitumen surfacing 14.96 m. to 19.84 m. west of Parkes and 0.35 m. to 5.08 m. west of Bogan Gate.	Allen Bros. (Asphalting Contractors) Pty. Ltd.	8,317	16	2
Goodradigbee S. ..	1234	Reconstruction between 0.79 m. and 2.45 m. from Nottingham Creek.	P. & L. Constructions Pty. Ltd.	9,389	9	0
Gundurimba S. ..	65, 146, 147, 148, 555	Tar priming and bitumen surfacing of 64,702 sq. yds...	B.H.P. By-Products Pty. Ltd.	3,167	18	11
Gunning S. ..	249	Construction of approaches to Fairfield Bridge over Gundaroo Creek.	Jedco Construction ..	16,521	4	0
Guyra S.	135	Bitumen surfacing between 22.25 m. and 26.25 m., east of Guyra.	Emoleum (Aust.) Pty. Ltd.	4,859	4	0
Hume S.	57	Construction of 3-span 100 ft. long prestressed concrete bridge over Bowna Creek at 14 m. north of Albury.	Siebels Bros.	12,523	4	6
Hume S.	282	Supply and delivery of 1,460 cu. yds. of crushed aggregate to stockpiles between 20.00 m. and 28.00 m. from State Highway No. 2.	Murray Valley Sand and Gravel Co. Pty. Ltd.	4,016	11	3
Imlay S.	275	Construction 3-span reinforced concrete bridge over Wolumla Creek at Kanoona.	Itacon Pty. Ltd.	41,190	18	0
Jemalong S. ..	17, 61, 350, 377	Bitumen surfacing various roads and locations.. ..	Allen Bros. (Asphalting Contractors). Pty. Ltd.	13,920	0	10
Jerilderie S. ..	321	Supply and delivery of 61,200 cu. yds. of sand clay material to various locations between 5.00 m. and 30.25 m. north of Newell Highway.	A Hack	8,729	11	8
Macintyre S. ..	73 & 187	Sealing 16,560 sq. yds. on Trunk Road No. 73, and 27,350 sq. yds. on Main Road No. 187.	Emoleum (Aust.) Ltd. ..	4,397	4	3
Monaro S. ..	19	Bitumen resurfacing various sections of Monaro Highway.	Allen Bros.	8,383	7	5
Murrumbidgee S.	321	Bitumen surfacing 22.8 m. to 26.9 m. south of Darlington Point.	Emoleum (Aust.) Ltd. ..	4,282	18	1
Narraburra S. ..	387	Bitumen surfacing section 9.0 m. to 21.91 m. west of Temora.	B.H.P. By-Products Pty. Ltd.	4,870	12	5
Scone S.	3103	Construction of a 6-span 180-ft. long prestressed and reinforced concrete bridge over Dart Brook near Kayuga.	A. Goor Pty. Ltd.	16,033	12	0
Tallaganda S. ..	..	Bitumen surfacing various lengths of Main Roads ..	B.H.P. By-Products Pty. Ltd	8,546	10	4
Tallaganda S. ..	..	Supply and delivery of aggregate to stockpiles at various locations.	Australian Blue Metal Ltd	3,177	6	0
Yallaroi S. ..	..	Bitumen surfacing various lengths of Main Roads ..	Shorncliffe Pty. Ltd. ..	3,490	14	9
Walcha S. ..	11	Extensions to existing R.C. box culverts between 10.36 m. and 15.77 m. east of Bendemeer.	S. Heyne	7,000	0	0
Wentworth S. ..	68	Supply and delivery of aggregate to stockpiles between 5.00 m. and 9.00 m. north of Wentworth.	Fraser and Adams	4,966	6	6
Windouran S. ..	21, 296	Supply and delivery of aggregate to stockpiles at various locations.	T. Hardman	8,977	10	0
Windouran S. ..	21	Bitumen surfacing between 35.55 m. to 41.00 m. north of Deniliquin.	Carr Fowler Constructions Pty. Ltd. ..	3,657	8	6
Wingecarribee S. ..	25, 261	Cement stabilisation: State Highway No. 25 between 1.00 m. and 2.00 m. from Moss Vale. Main Road No. 261 between 0.92 m. and 3.00 m. from State Highway No. 25.	Unipave Constructions ..	6,718	13	0

MAIN ROADS STANDARD SPECIFICATIONS

Note: Drawings are prefixed by letter "A", instructions are so described; all other items are specifications or forms (Revised schedule March, 1963)

ROAD SURVEY AND DESIGN

	Form No.
Design of two-lane rural highways (Instruction) (1960)	355, 355A, 355B
Design of urban roads (Instruction)	369
Design of intersections (Instruction)	288
Design of acceleration and deceleration lanes (Instruction)	402
Design of kerb-lines and splays at corners (Instruction)	499
Design of subsoil and subgrade drainage (Instruction)	513
Horizontal curve transitions for 30, 40, 50 and 60 M.P.H. design speeds. (1963.)	A 1488, A, B and C.
Method of setting out horizontal curve transitions	A 1487

STREET DRAINAGE

Concrete converter	A 1418
Concrete kerb and gutter, light type	A 221
Gully grating	A 190
Gully pit, Specification (245) and Drawings; gully pit with grating (A 1042); kerb inlet only (A 1043); grating and extended kerb inlet (A 1352); extended kerb inlet only (A 1353).	
Integral concrete kerb and gutter	243
Mountable type kerb with reflectors	A 3536
Perambulator ramp	A 3491
Vehicle dish crossing	A 134A

CULVERTS

(a) **Cast in place reinforced concrete box culverts—**	
Reinforced concrete culvert	206
Single cell, height of opening 4 ft. to 12 ft.	A. 1014-20B
Two cell, height of opening 4 ft. to 12 ft.	A 1023-30A
Three cell, height of opening 4 ft. to 7 ft. (A 1033-36); 8 ft. (A 1038); 9 ft. (A 1040); 10 ft. to 12 ft. (A 4843-45).	
Four cell; height of opening 4 ft. to 12 ft.	A 4846-54
Reinforced concrete box culverts with concrete wearing surface and concrete handrailing, heights of opening 3 ft. to 12 ft. 1, 2, 3, and 4 cells.	A 4994-97
Posts and handrails for culverts	A 3732
(b) **Precast reinforced concrete box culverts—**	
Culverts with height of opening 12 in. 18 in., 24 in., and 30 in.	A 3847
Precast concrete box culvert	138
(c) **Pipe culverts—**	
Pipe culverts and headwalls	25
Drawings are available for the following pipe culverts— (*a*) Single row of pipes—15 in. to 6 ft. dia. (*b*) Double row of pipes—15 in. to 6 ft. dia. (*c*) Treble row of pipes—15 in. to 3 ft. dia.	
Inlet sump for pipe culverts 3 ft. dia. or less	A 142
Straight headwalls for pipe culverts 15 in. to 24 in. dia.	A 1153
Supply and delivery of precast concrete pipes	303

BRIDGES

Concrete work for bridges	350
Concrete end posts for concrete bridges	A 279
Concrete handrail for concrete girder bridges	A 279A
Concrete end post and handrailing for prestressed concrete bridge units.	A 4932-33
Data for bridge design	18
Design of forms and falsework for concrete bridge construction (Instruction).	495
Erection of precast, prestressed concrete bridge units	557
Erection of precast, prestressed concrete piles	558
Erection of precast, prestressed concrete bridge girders	561
Extermination of termites in bridges (Instruction)	326
Field erection of steel work using high tensile (friction-grip) bolts	262
Foundations for bridges and culverts	563
High tensile (friction-grip) bolts, nuts and washers	261
Manufacture of precast or cast-in-place, prestressed concrete bridge members	556
Manufacture of rubber bearings for bridge units and girders	562
Miscellaneous works for bridge construction contracts	571
Protection of steelwork by metal coating in shop	579
Protective treatment (Field) of steelwork—metal spraying and painting	584
Protection angles for bridges or culverts with concrete wearing surfaces.	A 1272
Prestressed concrete bridge drawings—	
(*a*) Bridge units for square and skew crossings 25 ft. span, square (A 4905); skew (A 4910) 30 ft. span, square (A 4696); skew (A 4911) 35 ft. span, square (A 4892); skew (A 4912).	
(*b*) Bridge girders pretensioned or post-tensioned, 40 ft. to 70 ft. spans.	A 5540-49
(*c*) Reinforced concrete deck for precast, prestressed concrete bridge girders 24 ft. and 28 ft. between kerbs 40 ft. to 70 ft. spans.	A 5550-59
(*d*) Formwork slabs for prestressed concrete bridge girders	A 5560
(*e*) Embedded rods for deck formwork for prestressed concrete bridge girders.	A 5685
(*f*) Details of cast-in-place deck for prestressed concrete bridge units 25 ft.-35 ft. spans.	A 4931
(*g*) Prestressed concrete piles—12 in. x 12 in.—35 tons (A 4764); 14 in. octagonal—45 tons (A 4943); 16 in. octagonal—50 tons (A 4944); 16 in. octagonal—75 ft.-85 ft. (A 5611).	
(*h*) Test load diagrams for prestressed concrete piles—12 in. x 12 in. (A 5601); 14 in. octagonal (A 5605); 16 in. octagonal (A 5606); 16 in. octagonal 75 ft.-85 ft. (A 5612).	
(*i*) Test loads for prestressed concrete bridge units	A 5514
(*j*) Flexural tension test loads for precast prestressed concrete bridge girders.	A 5538
(*k*) Principal tension test loads for precast prestressed concrete bridge girders.	A 5539
Reinforced concrete bridge drawings—	
(*a*) Flat slab bridges, 24 ft. and 28 ft. between kerbs; 20 ft.-30 ft. spans.	A 4862-71
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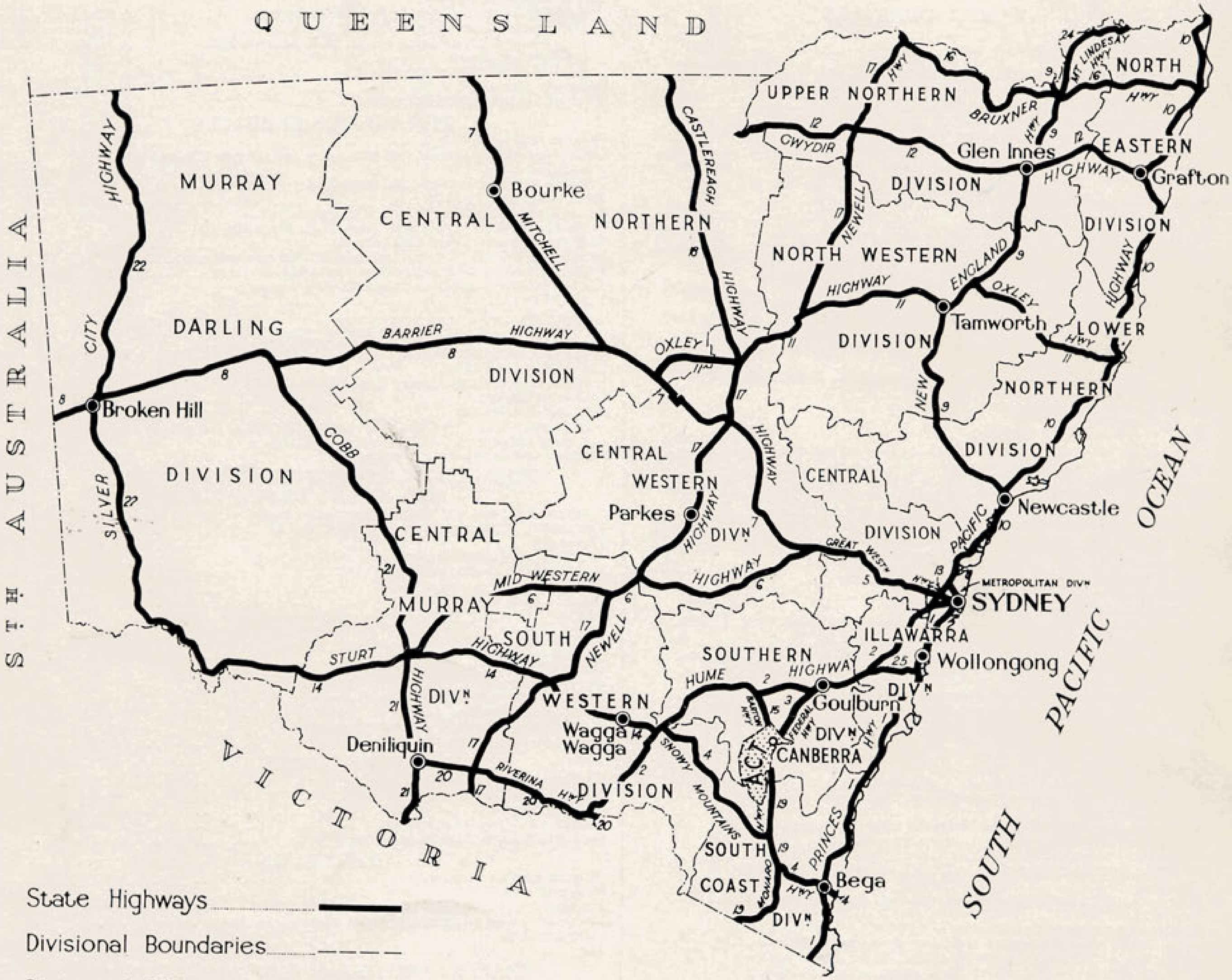
MANUALS AND BULLETINS

Bulletin relating to Miscellaneous activities on Main Roads.
Control and guidance of traffic at Works in Progress.
General Conditions of Assistance to Councils.
Guide to Main Roads Administration for use of Aldermen and Councillors.
Highway Bridge design, Specification of State Road Authorities.*
Manuals, No. 1—Plant*; No. 2—Survey and Design for Main Roads Works*; No. 3—Materials*; No. 4—Roadside Trees*; No. 5—Explosives*; No. 6—Bridge Maintenance*; No. 7—Road Maintenance*.
Proclaimed Main Roads (Schedule of gazetted descriptions).
Policy for geometric design of rural roads—State Road Authorities*.

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

Sydney: V. C. N. Blight, Government Printer—1963

State Highway System of the State of New South Wales



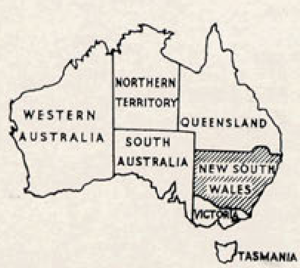
State Highways

Divisional Boundaries

Divisional Offices

SCALE OF MILES

40 20 0 40 80 120 160 200



Area of New South Walrs, 309,433 square miles.

Length of public roads within New South Wales, 129,763 miles.

MILEAGE OF MAIN AND DEVELOPMENTAL ROADS, AS AT 30th JUNE, 1962,

State Highways	6,493
Trunk Roads	4,163
Main Roads	11,647
Secondary Roads (Country of Cumberland only)	100
Tourist Roads	54
Depatmental Roads	3,082
	25,539
UNCLASSIFIED ROADS, in Western part of State, coming within the provisions of the Main Roads Act	1,031
TOTAL	26,570