MAIN ROADS

JOURNAL OF THE DEPARTMENT OF MAIN ROADS

NEW SOUTH WALES

MAIN ROADS

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

Vol. XXIV, No. 1. *Sydney, September, 1958.* *Price: Two Shillings.*

CONTENTS

Additional copies of this journal obtainable from the—

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

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

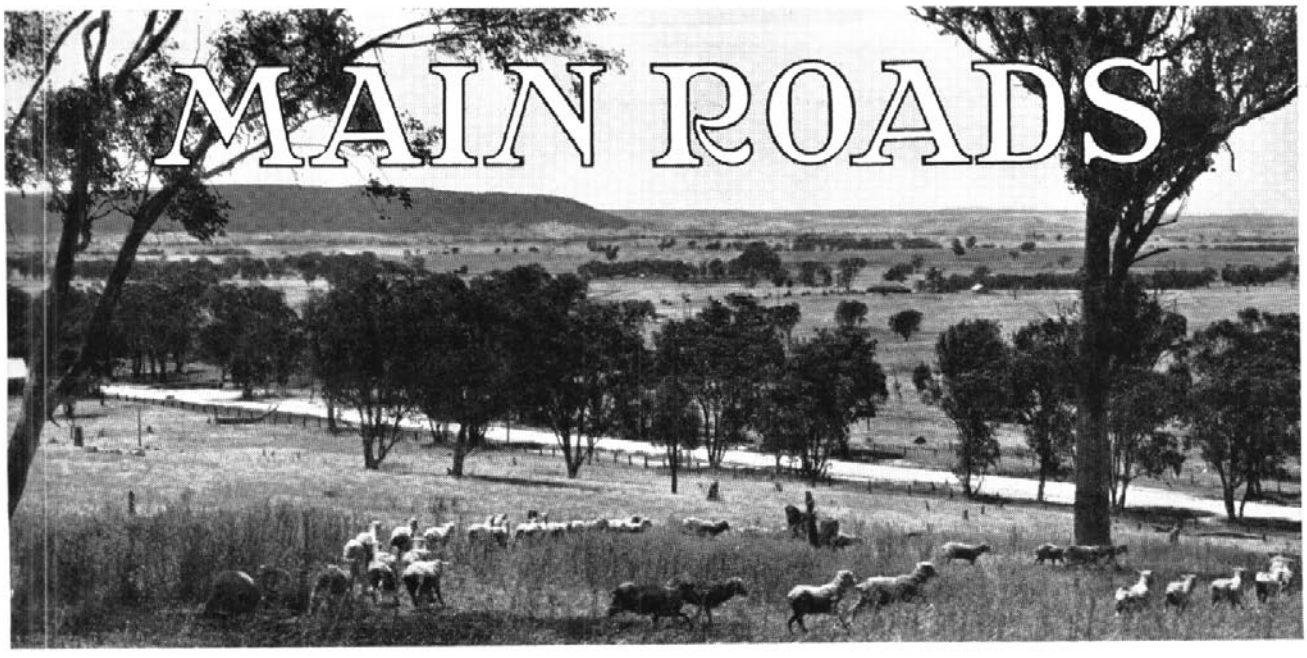
Annual Subscription, 8/-; Post Free.

Cover Page

Spraying bitumen 20 ft. wide on the Pacific Highway, 12 miles south of Taree.

Next Issue: December, 1958.

*47718



Vol. No. XXIV *September, 1958*

Control of Weight of Loads on Vehicles

General Administration of Ordinance 30C

THE provisions of Ordinance 30C under the Local Government Act, 1919, relating to the control of loads on vehicles using Main Roads were referred to in two earlier articles published in "Main Roads" in September, 1950, and December, 1953.

The purpose of this article is to describe some of the features relating to the administration by the Department of Main Roads of the Ordinance since 1950, when more intensive control of loads on vehicles using Main Roads was undertaken by the introduction of a specially equipped field unit.

The necessity for limiting the gross loads of such vehicles was foreseen many years ago and was effected in 1934 by the gazettal of Ordinances 30C and 30D under the Local Government Act, 1919. Ordinance 30C applies to Main Roads and is administered by the Department of Main Roads. Ordinance 30D generally corresponds to Ordinance 30C but applies to roads other than Main Roads, and is administered by Municipal and Shire Councils.

Between the years 1934 and 1948 Ordinance 30C proved generally adequate in protecting Main Roads from damage. Isolated cases of overloading were detected and, where necessary, prosecutions were launched and overloading thereby kept under control.

*47718—1

However, it became apparent in 1949 that the volume of transportation of goods by road was rapidly increasing and there was every indication that this trend would continue. Many vehicles were heavily overloaded and were causing extensive damage to roads, bridges and culverts.

There was no alternative other than to intensify the enforcement of Ordinance 30C limitations. With this in view, two officers were appointed by the Department of Main Roads in March, 1950 for the sole purpose of inspecting and reporting on vehicles suspected of being laden in excess of the prescribed limits.

During the next three months these Inspectors intercepted and check-weighed numerous vehicles and reported that 223 had been overloaded. As a result, 88 warnings were issued and 65 prosecutions authorised. By September, 1951, the inspecting strength had been increased to nine and was generally maintained at that figure until 1955, when it was raised to twelve. There was no further increase in strength until June, 1956, when four additional Inspectors were appointed. The current strength of field Inspectors is seventeen.

Some idea of the growth in the number of vehicles, both intrastate and interstate, engaged in the transportation of raw materials, manufactured goods, food-

Loadometer weighing station operated by Department of Main Roads, at Hexham.

stuffs, etc., by road, as well as the progressive results of the action taken in the detection of overloading, can be gauged from the following comparative tabulation—

	Period March, 1950, to 30th June, 1953	Year Ending 30th June, 1956	Year Ending 30th June, 1957	Year Ending 30th June, 1958
Vehicles checked	.....	23,571	40,116	36,909
Vehicles reported as overloaded	7,558	5,836	6,001	4,843
Warnings sent to drivers and/or owners ...	2,452	2,464	2,857	2,358
Prosecutions authorised	3,406	2,914	2,960	2,182
Cases determined by courts	2,511	2,300	2,755	2,049
Total fines and costs inflicted	£39,728	£30,703	£40,790	£31,619

During 1957, as a result of legal decisions, the use of portable loadometers for weighing vehicles was suspended pending the necessary amending legislation authorising their use. An amended Ordinance 30C was gazetted on 28th March, 1958. During the eight months which elapsed between July, 1957, and March, 1958, weighing of vehicles was restricted to fixed public weighbridges and this severely curtailed the effective policing of the Ordinance. The result of this is shown in the reduced number of infringements dealt with during the year ended 30th June, 1958.

An important amendment in Ordinance 30C is the increase in the maximum penalty from £50 to £200. Other amendments are confined to matters of a procedural nature, including the method of weighing vehicles by loadometer as well as at fixed weighbridges.

Following the recent introduction of Regulation 120A under the Motor Traffic Act, 1909, which is administered by the Department of Motor Transport, further restrictions have been placed on certain vehicles so far as their permissible loaded weights are concerned. These restrictions relate to the "safe loading" of a vehicle and if the loaded weight allowable under that Regulation is less than that allowable under Ordinance 30C, the latter prevails.

Field Enforcement

It will be appreciated that with the present strength of seventeen field inspectors, and a Main Road network as extensive as that which exists in this State, it is not possible to check intensively on all Main Roads. Field Inspectors journey as far north as Wallangarra and Tweed Heads, to Eden and Albury in the south and at times as far west as Broken Hill. However, as the greatest volume of traffic is on the Hume, Pacific, New England, Prince's and Great Western Highways, checking operations are mainly concentrated on these main arteries and main road "escape" routes leading therefrom.

In an endeavour to obtain a greater coverage, and thereby further protect Main Roads and structures from undue damage, the co-operation of Shire and Municipal Councils is enlisted by the delegation by the

Inspector reading loadometer.

Weighing of rear axles at public weighbridge.

Commissioner for Main Roads of appropriate powers under Ordinance 30C to officers of Councils. Participation by such officers in the active enforcement of the load limitations laid down under Ordinance 30C as regards Main Roads, and Ordinance 30D as regards other public roads, could be a significant factor in reducing overloading and thus preventing damage to roads and bridges.

Vehicle and load having combined weight of 200 tons in transit between Walsh Bay, Sydney, and Port Kembla.

Special Permits for Transporting Loads in Excess of Ordinance Limitations

The establishment of new plant for heavy industry, power stations and the like, continues to present many problems regarding the movement of heavy equipment. Applications for permission to transport non-divisible loads by road have increased greatly over the past few years.

Consideration in the first instance is dependent on whether or not it is practicable to transport an item by rail or sea, and secondly, on whether it cannot be broken down sufficiently to comply with Ordinance limitations. If neither is possible it is generally a prerequisite of consideration being given that the item is to be transported on a special purpose vehicle. Whether a permit can be issued is dependent on the axle loads of the vehicle to be used, the route to be traversed and the condition of the structures thereon. Weather conditions, too, must, of a necessity, be taken into account for each individual movement.

The heaviest load for which a special permit has yet been issued was in respect of a mill housing weighing 118 tons which was transported from Walsh Bay, Sydney, to Port Kembla. This housing was transported on a special vehicle with 96 load-carrying tyres. The tare weight of the vehicle together with the prime mover was 82 tons which with the added load of 118 tons gave a gross load of 200 tons.

Co-operation with Hauliers

It is the Department's policy to seek the co-operation of hauliers and, over the years, many owners and drivers have been interviewed and their loading problems discussed. On numerous occasions the result has been of mutual advantage to both the operator and the Department of Main Roads.

A considerable number of hauliers have overcome their difficulties by the addition of a second, *i.e.*, trailing axle, to existing rigid single drive axle vehicles so as to form tandem axles. Others have purchased loadometer jacks to enable them to check axle weights prior to travelling on Main Roads. Structural alterations to vehicle bodies have sometimes provided a practical solution.

An ever increasing number of road transport operators is becoming load-conscious and there appears to be no reason why this trend should not continue. Providing it does, the easier it will become to preserve existing roads and structures and thereby enable funds to be expended on desirable improvement works rather than on excessive maintenance.

RECEIPTS AND PAYMENTS—MAIN ROADS FUNDS

For the period from 1st July, 1957, to 30th June, 1958

Heading	County of Cumberland Main Roads Fund	Country Main Roads Fund
	£	£
Receipts—		
Motor Vehicle Taxation (State)	1,656,753	6,627,010
Charge on heavy commercial goods vehicles under Road Maintenance (Contribution) Act, 1958 (State)	28,196	112,783
Road Transport and Traffic Fund (State)	.....	19,847
Petrol Taxation paid to the State by the Commonwealth Government	1,032,502	4,130,008
Receipts under Commonwealth Aid Roads (Special Assistance) Act, 1957	147,283	589,133
Repayable loan moneys provided by the State Government	.....	150,000
Contributions by councils	1,104,212	15,519
Miscellaneous	46,130	118,316
Total Receipts	£4,015,076	£11,762,616
Payments—		
Maintenance and minor improvements of roads and bridges	1,058,446	5,007,195
Construction and reconstruction of roads and bridges	2,433,983	5,635,532
Land acquisitions	252,251	83,472
Administrative expenses	139,339	474,759
Loan charges (repayment of principal and payment of sinking fund, payment of interest, exchange, management and flotation expenses)	.....	224,033
Purchase of assets, other than plant and motor vehicles	98,378	182,286
Department of Public Works for expenditure on transport by water	.....	100,000
Miscellaneous	24,376	44,053
	4,006,773	11,751,330
Less Suspense items, including the purchase and operation of the Department's plant and motor vehicles	39,975	26,443
Total Payments	£3,966,798	£11,724,887

The Minister for Highways, and for Local Government, the Hon. J. B. Renshaw, M.L.A., speaking at the opening ceremony.

New Bridge Over Mirrool Creek at Mirrool on the Newell Highway.

The Minister for Highways, the Hon. J. B. Renshaw, M.L.A., officially opened to traffic a bridge over Mirrool Creek at Mirrool, on the Newell Highway, on 23rd May, 1958. The ceremony was arranged by the Bland Shire Council, presided over by the Shire President, Councillor R. J. Murrells.

Designed by the Department of Main Roads and built under contract to the Bland Shire Council by H. E. Ibbotson and Son, the new bridge consists of five timber spans supported on timber piles potted into rock foundations. The new bridge, which has a length of 154 feet and a width of 20 feet between kerbs, replaces a causeway subject to submergence following heavy rain.

The construction of the approaches was carried out by the Bland Shire Council by day labour.

The cost of the bridge and approaches amounted to approximately £13,000 and was met by the Department of Main Roads.

SYDNEY HARBOUR BRIDGE ACCOUNT

Receipts and Payments for the period 1st July, 1957, to 30th June, 1958.

Receipts	£
Road tolls	839,597
Contributions—	
Railway passengers	138,791
Tramway and omnibus passengers	17,371
Rents from properties	24,357
Miscellaneous	838
	£1,020,954

Payments	£
Cost of collecting road tolls	86,578
Provision for traffic facilities	11,749
Alteration to archways	1,119
Maintenance and minor improvement	156,149
Widening of pavement and provision of additional toll gates	45,041
Improvement at intersection of Bradfield Highway and Kent and Alfred Streets	8,854
Conversion of tramway area to roadway	68,624
Administrative expenses and miscellaneous charges	4,951
Payment of sinking fund and loan charges	403,587
	£786,652

Main Road Construction at Port Kembla Effect of Inner Harbour Scheme

PORT Kembla, within the City of Greater Wollongong, is one of the two main centres of iron and steel production in Australia and the site of various other industries, including the refining and fabrication of non-ferrous metals and the manufacture of fertilisers. In addition, the Greater Wollongong district is one of the principal coal mining areas of New South Wales. The City of Greater Wollongong has a population of approximately 110,000. It is rapidly increasing with the growth of manufacturing industry.

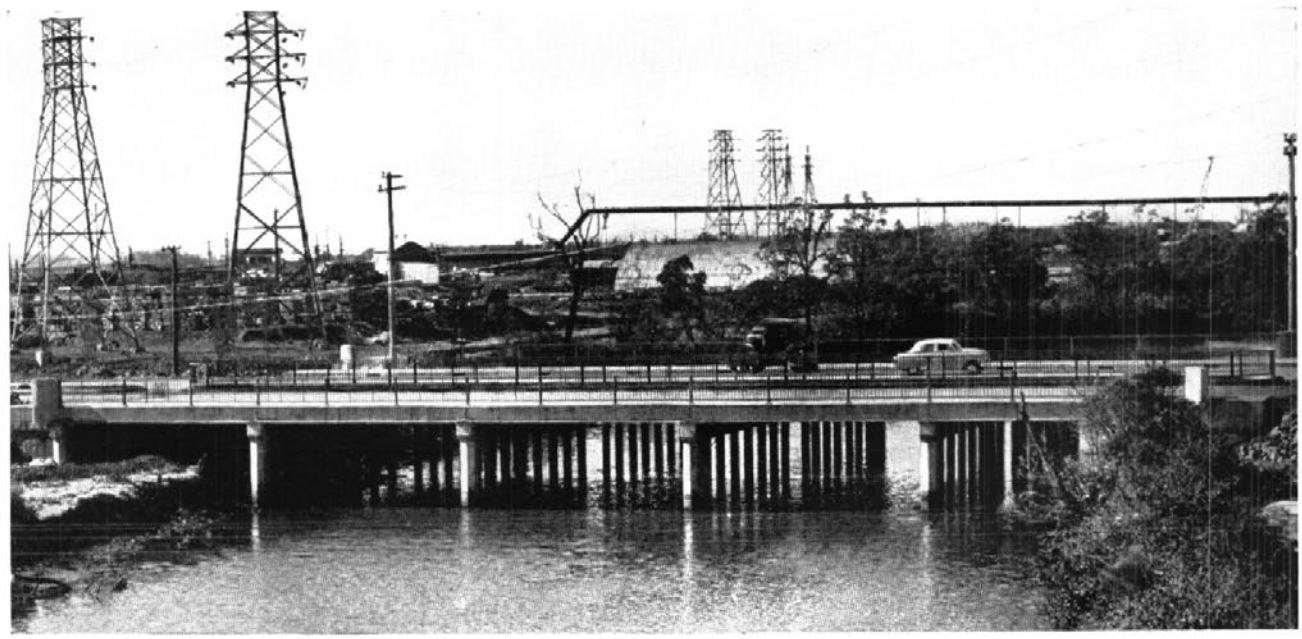
Following the early development of the coal mining industry in the area, a deepwater jetty was brought into use at Port Kembla in 1883. As other industries developed, construction of an improved harbour formed by two stone breakwaters was commenced and substantially completed in 1937. The continued expansion of industry resulted in the decision in 1955 to proceed with construction of an inner harbour by the dredging of Tom Thumb Lagoon, a swampy tidal area between Port Kembla and Wollongong. This work results in the severing of the principal direct Main Road connection between Port Kembla and Wollongong, and the purpose of this article is to describe the Main Road works now being undertaken by the Greater Wollongong City Council, to provide for traffic.

Main Roads Serving Port Kembla

Port Kembla Road (Main Road No. 295), where it parallels and is close to the coast, has been the principal route between Wollongong and Port Kembla for many years. In 1951 a north-south road, Springhill Road, lying on the west of Tom Thumb Lagoon was also proclaimed as a Main Road (No. 568). It joins Five Islands Road (part of Main Road No. 295) on the west side of Port Kembla. Each of the two Main Roads mentioned is built for two lanes of traffic. Both are under the care and control of the Greater Wollongong City Council which is assisted by the Department of Main Roads to the extent of two-thirds of the cost of maintenance and construction.

Effect of Construction of Inner Harbour on Main Road Routes

After it had been decided to proceed with the construction of an inner harbour at Port Kembla, involving the severing of the Port Kembla Road, various road alternatives were investigated. Finally, it was decided to develop Springhill Road and Five Islands Road as the principal Main Road route between Wollongong and Port Kembla and to increase their capacity to



New prestressed concrete bridge with divided six-lane carriageway over Allan's Creek on Springhill Road.

Additional two-lane carriageway under construction alongside existing carriageway in Springhill Road.

enable them to handle existing traffic using both Main Roads between the two centres and at the same time to provide for further traffic development in the future.

Springhill Road and Five Islands Road—Improvement

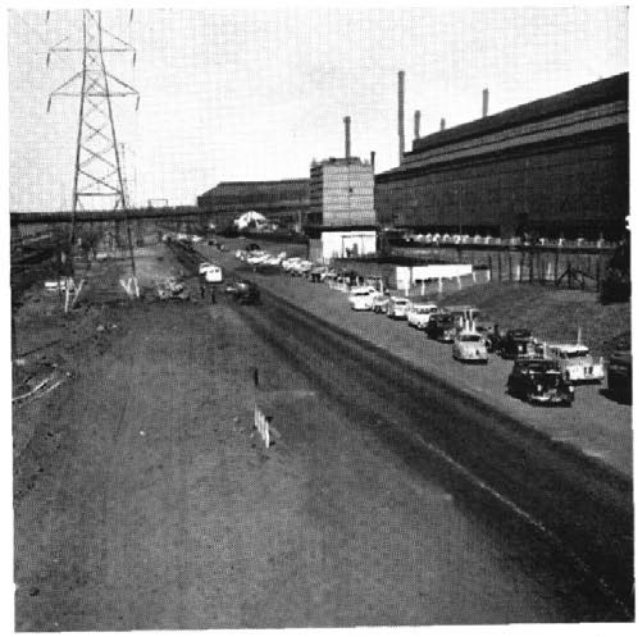
The existing routes of both Main Road No. 295 and Main Road No. 568 will continue in use from the main business area to the southern side of central Wollongong. There, as indicated in the locality sketch herewith, the two roads will be brought together at point "M" south of Swan Street by means of new construction. From this junction, a four-lane road will be constructed as a deviation of Springhill Road to point "Q". From the southern end of the deviation two additional lanes of roadway will be provided generally alongside the carriageway existing on Springhill and Five Islands Road as far as Military Road, Port Kembla, at "T". In addition, the two existing lanes will be improved as necessary.

The work involves the provision of a divided six-lane bridge over Allan's Creek and two bridges over present and future railway lines on the deviation of Main Road No. 568. Widening of the existing two-lane bridge at "S" over a private railway owned by Australian Iron and Steel Limited, is also included; the cost of this is being partly borne by the Company.

Survey and Design

The Department of Main Roads provided some assistance to the Council in the general determination of the future road boundaries and the Council undertook to prepare final widening plans and carry out engineering designs for all roadwork.

The road design provides for a road reserve width ranging from 95 ft. to 150 ft., and, ultimately, for two carriageways each 33 ft. wide separated by a median. Cycle-ways can be accommodated, if required. Provision is also included for footways where necessary, bays to enable buses to stop clear of main traffic streams, and a stormwater drainage system. Special



Area cleared for provision of additional two-lane carriageway in Five Islands Road.

consideration is being given to the detailed design of all intersections, particularly that at the junction of Springhill Road and Five Islands Road.

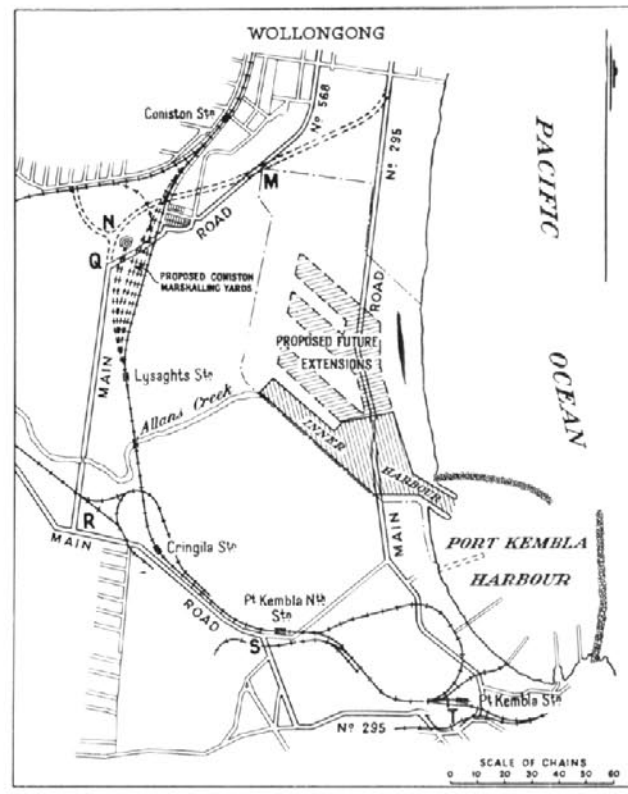
The design of the bridge over Allan's Creek was prepared by the Department of Main Roads. It comprises two separate parallel structures 154 ft. long, each having a carriageway 33 ft. wide and a footway 9 ft. wide. The substructure is of prestressed concrete piles, 12 in. x 12 in., with reinforced concrete headstocks; the superstructure consists of prestressed concrete deck units.

Construction

The Greater Wollongong City Council is the constructing authority for both road and bridge work. Construction is at present proceeding on Springhill Road between the southern end of the proposed deviation at "N" and Five Islands Road, and on Five Islands Road between its junction with Springhill Road at "R" and Cringila. The work in hand consists of the provision of a divided roadway, each carriageway being 23 ft. wide with a bituminous concrete surface.

Pending construction of the deviation "N" to "M", a temporary connection to the northern end of the divided carriageway being constructed in Springhill Road will be made along the existing road over the railway level crossing, so that the first section of the new work in Springhill Road can be brought into use as soon as it is completed. The level crossing is being widened and equipped with automatic boom gates.

The construction of the bridge over Allan's Creek was carried out by Hornibrook McKenzie Clark Pty. Ltd. under contract to the Greater Wollongong City Council and has been brought into use. The prestressed concrete piles were driven with a double-acting steam hammer mounted in steel runners supported, together with a winch and steam boiler, on an independent frame. This frame was moved across the creek on rail tracks supported on timber falsework, access to every pile position being obtained by swivelling the frame and/or moving along the rail track.



Locality Sketch.

The cost of the main road works being described is estimated to be about £800,000, and is being met half by the harbour authority (Department of Public Works); one-eighth by the Department of Railways; one-quarter by the Department of Main Roads; one-eighth by the Greater Wollongong City Council. (In the case of Allan's Creek bridge a somewhat different basis of cost sharing applies.)

Investigation into Vehicle Characteristics

The "Average" Motor Car

THE purpose of any road design is to provide an efficient facility for the movement by vehicles of persons and goods. Road designers, therefore, need to have information as to the characteristics of the vehicles to be used, as well as information as to the number of vehicles, and the weights and sizes of loads to be handled.

Vehicle characteristics affect design in many ways; for example, vehicle length and turning circle determine curve radii at intersections and the shape of channelising islands; acceleration and deceleration performance affects the design of speed-change lanes; width has a bearing on road cross-section.

Much research has been carried out abroad on vehicle characteristics and some of the data so collected has been used in this country to provide a basis for design work. As the results of local research become available, the data is modified to satisfy Australian conditions more closely.

As a part of the co-ordinated research programme of the Australian Conference of State Road Authorities, the Department of Main Roads, New South Wales, has undertaken an investigation into the "average" passenger car. A brief outline of the work carried out and the results obtained is given here. The full report has been circulated among all State Road Authorities.

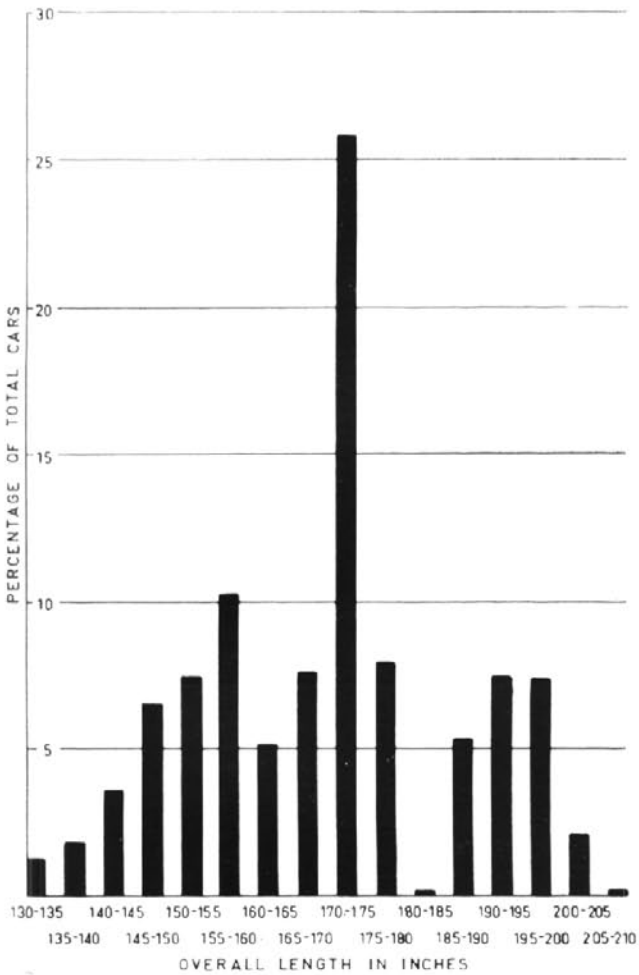


FIG. 1: Percentage of cars with overall lengths in class intervals shown

The field of study was the estimated total of 571,424 passenger cars registered in New South Wales at 31st December, 1957. The Department of Motor Transport and the Bureau of Census and Statistics were able to supply a break-down of registrations into make and year model of vehicles.

Information was collected for all passenger car models of which there were 1,000 or more registered at the end of 1957, i.e., models which each represent 0.2 per cent. or more of the total registrations. On this basis, data was collected for eighty-nine different models, which represented 524,466 passenger cars registered or 91.8 per cent. of the total registrations at the end of 1957.

The National Roads and Motorists' Association kindly made available to the Department details of all tests carried out on passenger cars by their technical section since 1934. From various motoring magazines details of tests of other models of cars dating back to 1928 were obtained. In some cases where information respecting particular models was not readily available in technical literature, the distributors of the vehicles concerned were consulted and generally were able to provide specifications for the model under investigation.

This information was assembled into a table in which the eighty-nine models of cars, which made up the field of study, were listed with details of numbers registered as at December, 1957; physical dimensions (height, weight, wheel base); engine specifications (horsepower, capacity); performance (average fuel consumption over the test course, acceleration, braking). In all, twenty-four separate specification details were listed.

Following initial analysis, bar diagrams were plotted to show the percentage of vehicles in each range of value for each of the dimensions and specification details. Sample results are shown in Fig. 1, Overall length, and Fig. 2, Turning circle.

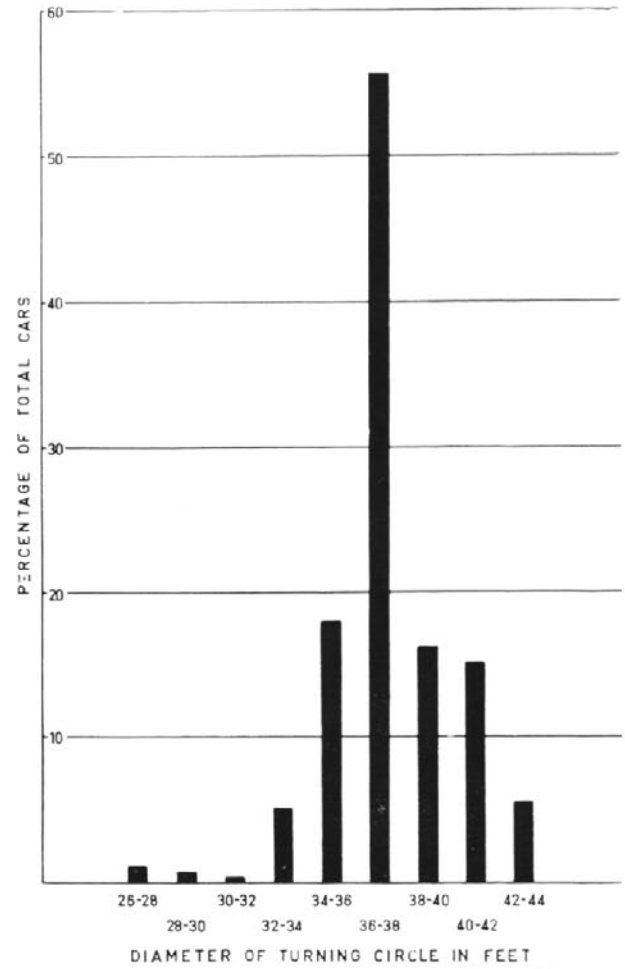


FIG. 2: Percentage of cars with turning circles in class intervals shown

From these diagrams the value of a particular dimension may be determined such that a specified percentage of vehicles on the road will have dimensions less than, or greater than the value determined. This is the method generally adopted for specifying a design standard since, in general, it is not economically practicable to design for the largest value, and the average, or some higher value such as the eighty-five percentile, is used.

Maximum and minimum values were readily available from the collected data and these were tabulated.

As the number of vehicles registered of each model and the specifications of each model were known a series of average dimensions were calculated.

Average values of dimensions were also calculated for the range of new cars registered in 1957. This was done with a view to establishing trends and to determine, for example, if designs should allow for wider or longer cars in the future.

The results of the study are summarised in the Table below which compares the average values for all cars on the road with the average values for all 1957 cars. The table shows maximum and minimum values for each specification.

It is proposed that experimental work be carried out to determine turning paths, and also the effect of performance of cars in average condition on accelerating, overtaking and stopping distances.

AVERAGE MOTOR CAR

	Average Car	1957 Car	Greatest Values	Smallest Values	Units
Weight	21.8	21.0	34.5	11.0	Cwt.
Wheelbase	101.2	104.6	122	82.5	in.
Front track	54.1	52.9	60	44.8	in.
Rear track	52.6	52.7	62	44.8	in.
Ground clearance	7.4	7.2	9	6	in.
Length	167.2	170.3	207.5	131.3	in.
Width	66.3	65.4	76.8	54	in.
Height	64.2	60.8	72.3	57	in.
Turning circle (dia.)	37.8	36.1	43	26.5	ft.
Tyre size	*5.6 x 15	*5.9 x 14	7.1 x 15	4.4 x 14.5	in.
No. of cylinders	*6	*6	8	4	....
Bore	74.2	75.7	99	54.5	m.m.
Stroke	89.1	81.0	127	64	m.m.
Capacity	1748	2031	4680	748	c.c.
Horsepower (R.A.C.)	18.4	19.8	42.5	7.4	h.p.
Brake-horsepower	59.2	66.4	170	19	b.h.p.
Power/Weight ratio	52.6	61.0	102.5	29.1	b.h.p./ton
Compression ratio	6.6	7.0	8.3	5.2	....
Fuel consumption	28.8	30.2	57.8	16	m.p.g.
Acceleration (through gears) 0 to 30 m.p.h.	6.6	6.0	11.5	4.1	sec.
0 to 40 m.p.h.	10.6	9.7	17	6.8	sec.
0 to 50 m.p.h.	17.1	13.6	29	9.2	sec.
Braking efficiency (Ferrodo Tapley meter)	92	95	100	68	per cent.
Seating capacity	*5	*5 to 6	6	4	persons

* Nearest actual value to the computed average.

View from Mid-Western Highway west of Bathurst.

Historical Roads of New South Wales
The Mid-Western Highway

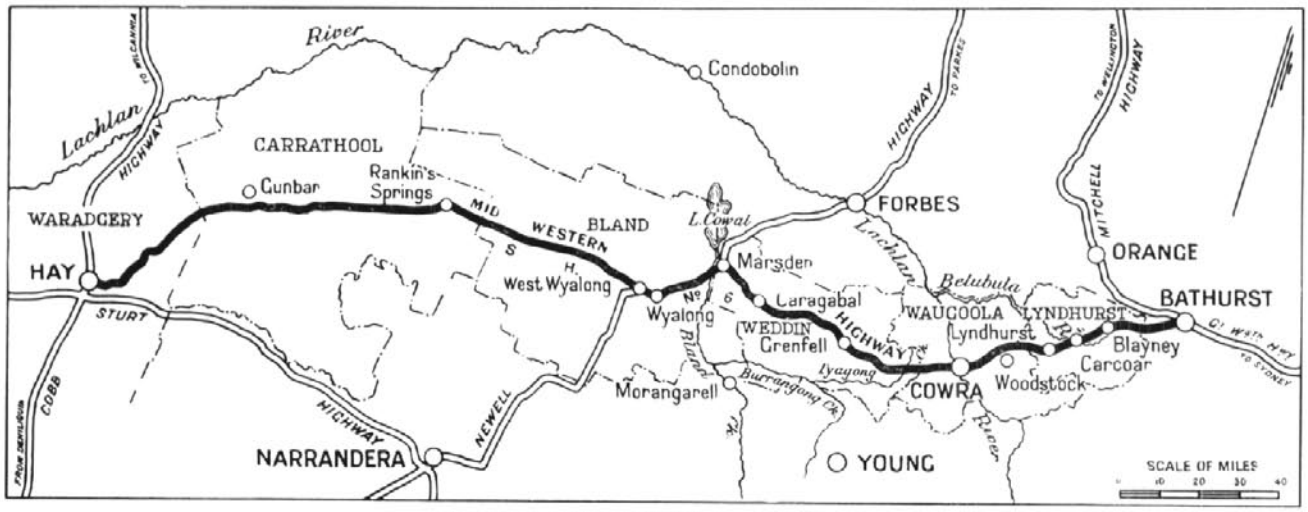
Many of the State Highways of New South Wales follow continuous routes of long distance travel used by explorers, or developed by trial and error, in the earliest days of settlement. The Mid-Western Highway is not of this nature; it is rather a creation of recent years, and the justification for its establishment lies in the fact that not only does it provide the shortest route from the west of Sydney to the large and productive areas through which it passes, but that it also provides a link to the south west of New South Wales, to the north west of Victoria, and to Adelaide, South Australia. The traffic which has developed along it, in spite of long lengths not yet providing the desirable standards of surface, has demonstrated that the route is one of considerable significance. It is but little subject to interruption by inundation in time of flood rains, and has very few steep grades, and these are mainly of short length.

Route of the Highway.

The Mid-Western Highway, as proclaimed in 1928, left the Great Western Highway at Bathurst and passed through Blayney, Carcoar, Cowra, Grenfell, Marsden, Wyalong, Rankin's Springs, Gunbar, Booligal, and Oxley to Balranald and thence to the South Australian border via Euston and Wentworth.

In 1929 the route of the Highway was altered between Gunbar and Balranald to pass through Hay instead of through Booligal and Oxley.

In 1933 the Sturt Highway (State Highway No. 14) was proclaimed. This starts at the Hume Highway near Tarcutta and goes west, following generally the course of the Murrumbidgee and Murray Rivers to the Victorian border near Mildura (whence it continues to Adelaide, South Australia). That portion of the Mid-Western Highway which extended beyond Hay was absorbed into the Sturt Highway. Thereafter, the route of the Mid-Western Highway has followed that adopted in 1929 as far as Hay, where it terminates. In its length of 326 miles the Mid-Western Highway passes through the Municipalities of Cowra and Grenfell and the Shires of Lyndhurst, Waugoola, Weddin, Bland, Carrathool and Waradgery, and traverses some of the great wheat and wool producing areas of New South Wales. At Marsden it junctions with the Newell Highway (State Highway No. 17) which extends from Victoria in the south to Queensland in the north, and at Hay it connects to the Cobb Highway (State Highway No. 21) which extends from Victoria to the Barrier Highway which links Broken Hill to eastern New South Wales.



The route of the Mid-Western Highway.

Exploration

As a result of Governor Macquarie's examination of the country surrounding Bathurst, following its inauguration on May 7th, 1815, he instructed Assistant Surveyor G. W. Evans to continue his explorations beyond the area which already had been covered. Evans acted quickly and by May 27th, 1815 had arrived at the bank of a river which he named the Lachlan. His report was such that the Governor ordered the fuller exploration of the area and in December of the following year, Lieut. William Cox, who had been responsible for the building of a road over the Blue Mountains and was then Commandant at Bathurst, was instructed to follow the line taken by Evans and to establish a depot at the Lachlan River. This was to serve as a starting point for an expedition which it was proposed to undertake the following year, to ascertain the course of the Lachlan River and generally to examine the western interior of New South Wales. On March 24th, 1817, the Surveyor-General, John Oxley, received the Governor's instruction to take charge of this expedition.

Oxley followed the course of the river downstream until progress was stopped by a succession of swamps from which he could find no outlet. Attempts to proceed southwards in an effort to trace the course of the river to the coast failed and a further attack on the Lachlan at a lower section of its course was unsuccessful because of the intervention of the marshes. Oxley therefore turned northwards towards the Macquarie River which he reached at a spot near where Wellington now stands.

A second expedition in 1818 was no more successful. In this an attempt was made to trace the course of the Macquarie River but Oxley was again halted by marshes, similar to those which baffled his efforts on the Lachlan, and the course of the Macquarie was entirely lost. Bitterly disappointed, he recorded in his journal—"It is with infinite regret and pain that I was forced to come to the conclusion that the interior of this vast country is a marsh and uninhabitable. The further we proceed westerly the more convinced I am that, for all practical purposes of civilised man, the interior of this country westward of a certain meridian is uninhabitable, deprived as it is of wood, water and grass."

Oxley's explorations revealed the peculiar character of the inland rivers and provided more detailed information concerning the country between the rivers than previously had been available. He was unable to decide whether the rivers terminated in a vast inland sea—a theory to which he strongly inclined—or whether they made their way to estuaries on the coast.

A succession of dry seasons in 1828 and 1829 provided an opportunity for testing the fate of the inland rivers and in September, 1829 the explorer Charles Sturt was commissioned by Governor Darling to lead an exploring party in an attempt to solve the problem of the rivers. Although the conclusions reached by Oxley were treated by Sturt with considerable respect, he was not prepared to accept, without investigation, the theory put forward of the existence of an inland sea. As a result of his exploration Sturt reported that he was able to "put to rest for ever a question of much previous doubt. Of whatever extent the marshes of the Macquarie might be, it was evident they were not connected with those of the Lachlan". In a later journey Sturt made discoveries which provided a solution of the problem of all the north-western streams. (The story of Sturt's journeys is told in "The History of the Sturt Highway" in "Main Roads", Vol. 20, No. 1, September, 1954.)

Oxley's pessimism regarding the character of the western country was later to be proved unfounded but his work was of great geographical importance, and, with that of Evans before him and Sturt and Mitchell who followed, was instrumental in opening up a vast and potentially rich province the extent of which was then incalculable.

First Settlement

When, in 1816, Macquarie had ordered the establishment of a depot on the Lachlan River to assist in the exploration of the western interior, he had in mind

plans for the settlement of the country already discovered and the further tracts which he hoped the exploring party would find. He had asked that further troops be sent to the Colony because of the expansion due to the newly discovered country and the fear of attacks upon the settlers by the aborigines. He had himself examined the country surrounding the site of Bathurst and had estimated that it could "maintain all the stock of the colony for the next thirty years". The recurring shortages of grain and the constant difficulty of supplying the needs of the increasing population had inspired a plan of settlement which, as well as providing for the needs of the colony, was designed to assist persons who had been transported for trivial offences to carve out a new career in a free atmosphere by a system of land grants. Pending approval to his plan he refrained from making any grants beyond the Blue Mountains and no one was permitted to cross the mountains without his written approval. However, a severe drought had been experienced in the coastal area, and because of the great loss of stock that had been experienced, permission was given for cattle to travel over the mountains to graze in the new lands. A Government stock station was established at King's Plains, later to be known as Blayney.

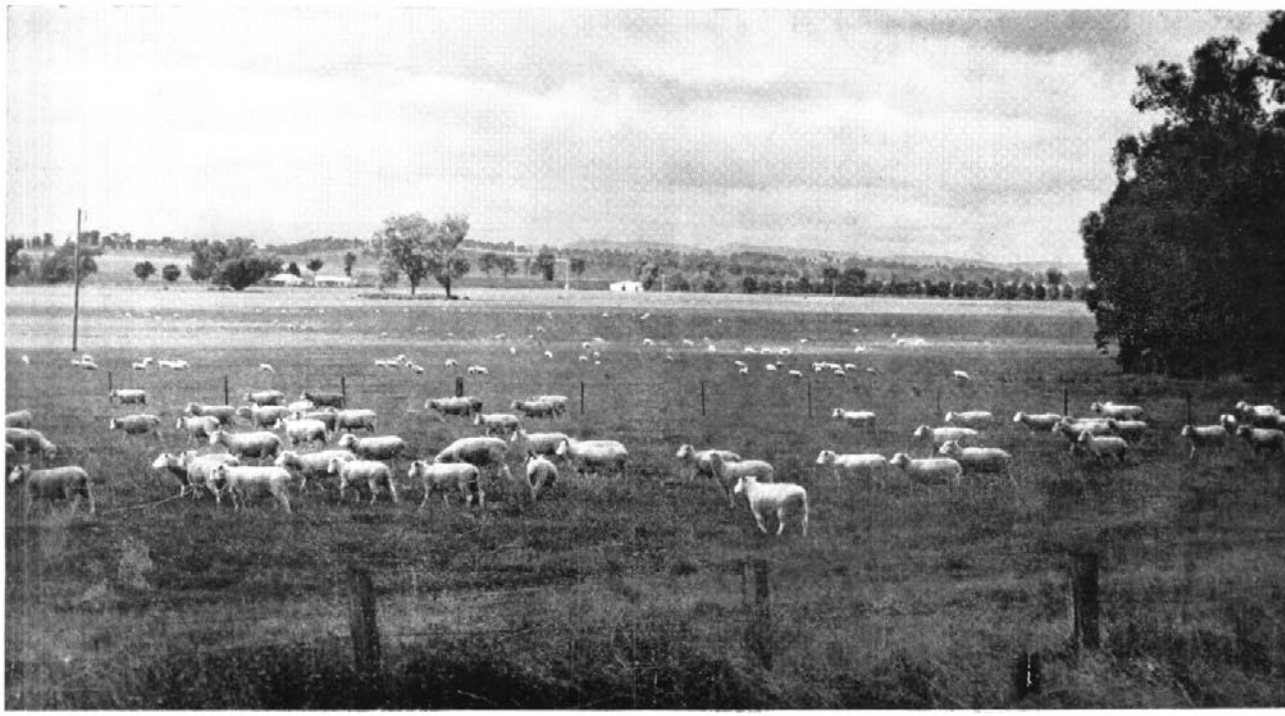
Approval to the scheme of settlement designed by Macquarie was received in 1817 and in the following year the first land grants west of the mountains were made. Macquarie's successor, Governor Brisbane, furthered the scheme of settlement and in 1830 Governor Darling commenced the settlement of the Upper Lachlan.

Meanwhile the first defined area to be proclaimed westward of the Blue Mountains—The County of Westmoreland—had been proclaimed by Governor Macquarie in August, 1817. The County was described as extending from Mount York westward beyond the town of Bathurst and in that direction "without any limitation of boundaries whatever". Between 1828 and 1835 this area was divided into four separate counties and in the course of the surveys for this division, reservations were made for villages at King's Plains (Blayney) and at Carcuan (Carcoar). So began the development of a line along which the future Mid-Western Highway was to extend.

Early Roads

Penetration of the area was from different directions and the only means of communication between the settlements were the tracks made by the settlers between the various holdings. For a number of years after settlement commenced, aborigines were fairly numerous and because of their highly developed gift of location they were employed in marking trees and setting out lines for the settlers to follow. One aboriginal named Jackie Cubbon is recorded as having marked many such lines which later became roads. One of these is stated to have been fifty miles in length and traversed the whole of a pastoral holding known as "Euroka" situated in the district within which Grenfell is now located.

On one of the first maps published, Dixon's of 1837, roads radiating from Bathurst towards the west and north-west are shown. One of these passed through



Typical country along the Mid-Western Highway near Cowra.

"Princess Charlotte's Valley" to King's Plains (Blayney) and on to the Belubula River, a little west of where Carcoar now stands. Just before reaching King's Plains this road branched and continued in a south-westerly direction to the Lachlan River and terminated at a point near to the future site of Cowra.

On a map compiled and drawn under the direction of the Surveyor-General in 1861, roads are shown extending outwards from Bathurst in the general direction now taken by the Mid-Western Highway. On this map, Blayney, Carcoar and Lyndhurst are shown to be directly connected and Cowra is also marked, but not on the line of road, which terminated at the Burrangong Creek. Further west a road running roughly parallel with the Lachlan River is shown to have passed through Booligal, Oxley and Balranald and then on through Euston and Wentworth to the South Australian border past Lake Victoria. A branch road to Hay joined this road at a point roughly midway between Booligal and Oxley.

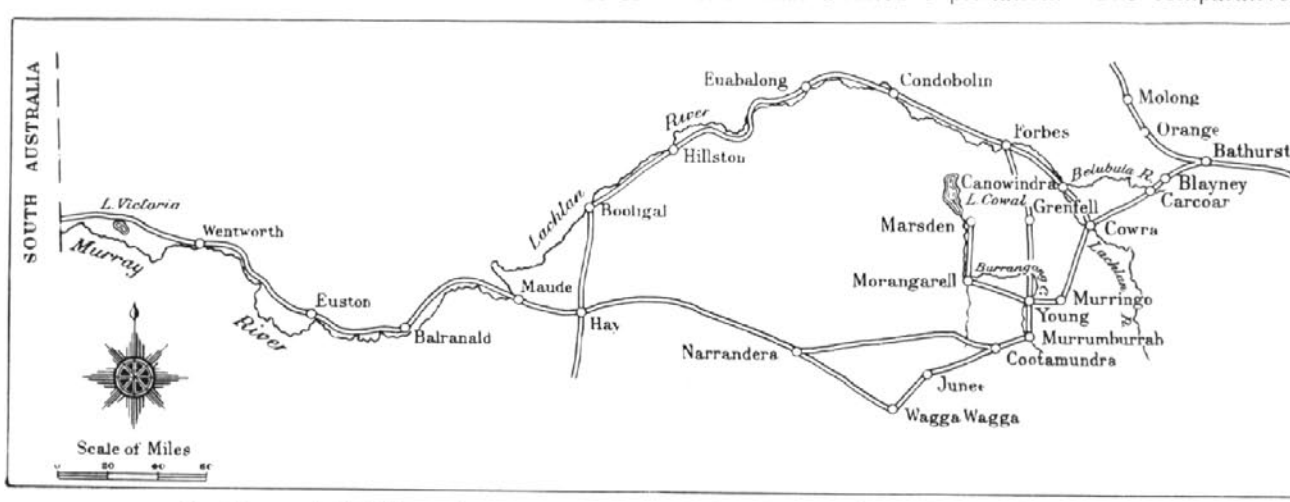
The "New Atlas of Australia" published in 1886 includes a map of New South Wales on which Blayney is shown to be situated on the "main road" from Bathurst to Orange and Wellington. A minor road is shown as passing through Lyndhurst to Cowra and on to Young where it connected with the railway. Grenfell is shown on this map but without road connection eastwards. Hay also is marked on this map as the terminus of the railway via "Jewnee" and Narrandera, but has no road connection shown. A road from the Bogan River is shown to reach the Lachlan a little westward of Condobolin and this road roughly parallels the Lachlan to Booligal, then to Oxley, Balranald, Euston and Wentworth to Lake Victoria and beyond. Up to the date of this map, therefore, no road approximating the present route of the Highway westward of Cowra, had been defined.

An "Atlas of the Settled Counties of New South Wales and a Road and Distance Map of the Entire Colony" said to be the first published in the colony, was issued about the same time as the "New Atlas of Australia". The exact date of publication is not known but the maps included in the Atlas are believed to have been drawn by George Bishop, a Surveyor of Sydney, between the years 1866 and 1870. On the "Road and Distance" map a road is shown to extend from Bathurst to Cowra via Blayney and Carcoar; at Cowra it turned south to Young then continued through Morangorell to Marsden's (now known as Marsden) where it terminated. From Young a road went south to Murrumburrah then turned west through Junee and Wagga Wagga to Hay and continued through Maude and Balranald to the South Australian border along the route shown on the earlier maps. At Hay this road was intersected by one which went north to Booligal and then in a general easterly direction through Condobolin and Forbes back to Cowra.

A map was issued in 1895 of the New South Wales railways showing also coach and other routes branching out from various railway stations, and on this map a coach route was shown to extend westerly from Cowra, through Grenfell to Marsden. Another route connected Wyalong with Temora at which place the route divided, one branch going on to Cootamundra and the other to Junee. Rankin's Springs is shown on this map to have been connected by coach with Narrandera in the south, and further west another route connected Gunbar with Hay. There were, at this date, no east-west connections beyond Marsden. A later edition of this map issued in 1914 showed a coach route between Marsden and Wyalong and by this date therefore, the line of the Mid-Western Highway as far west as Wyalong had taken shape.

Development of the Settled Areas

When Governor Macquarie instructed Assistant Surveyor G. W. Evans to continue his exploration beyond the area the Governor had himself examined, it was with a view to expanding the agricultural and pastoral possibilities of the Colony. Nothing was known, and probably little suspected, of the mineral wealth that awaited exploitation. The comparatively



Road layout in Mid-West about 90 years ago. (Taken from "Atlas of the Settled Counties of New South Wales and a Road and Distance Map of the Entire Colony".)

The Mid-Western Highway west of West Wyalong.

rapid development of the settled area and the foundation of the towns that now mark the route of the Highway, was due more to the discovery of gold and other metals, than to the extension of the farming and grazing industries that now characterize the area.

Blayney.

The district within which the town of Blayney is located was known originally as "King's Plains". From 1821 to 1828 occupation of the country between the Macquarie and Belubula Rivers was thought to be only temporary and was reserved principally for the grazing of Government cattle. Stations for use as centres for the stockmen who cared for the cattle were dotted throughout the area and one of these was located on the site of the present town.

In 1828 division of the County of Westmoreland was commenced and a site for the township was reserved. The railway was extended from Bathurst to Blayney in 1876 and the township became a centre from which the produce of the area was railed to market and from which supplies could be obtained. Later when the railway was brought from Cowra to link with the Great Western line, Blayney became an important junction and railway town.

Carcoar.

Carcoar was the third town to be founded by the Government west of the Blue Mountains. Built on the northern bank of the Belubula River, a tributary of the Lachlan, Carcoar has often been described as the "mother town" of the Lachlan Valley and was for a long period the commercial centre for the inward and outward traffic of the region. Carcoar dates its first permanent and effective settlement from the establishment in 1831 of stock stations and homesteads by Thomas Iceley, who pioneered the pastoral industry in a section of the Belubula Valley, then the extreme limit of authorised occupation.

On July 9th, 1840 a sale of town allotments was held and from then on settlement and population rapidly increased. In 1848, according to Well's "Geographic Dictionary and Gazeteer of the Australian Colonies" published in that year, the township comprised 244 houses and 2,057 inhabitants.

The name attached to the village reserve, surveyed in 1829 on which the present town is built, was Carcuan.

The origin of this name is uncertain. In "Tegg's Almanack" of 1838 the village is called "Carcoon" but on the plan submitted for the Governor's approval in June, 1839, the name "Corcoran" is used. According to one account this was the name of a shepherd who was the first person to occupy the site and the words "Carcuan" or "Carcoon" are believed to be misspellings of this name. In Mitchell's "Map of the Nineteen Counties" which was compiled during the period 1831-1834, the name given to the site is "Carcoar".

Copper was discovered in 1845 on one of Iceley's homesteads and gold was found in the district in 1851.

Carcoar was incorporated a Municipality in 1879 but in November, 1935, the town was included in the Shire of Lyndhurst.

Cowra.

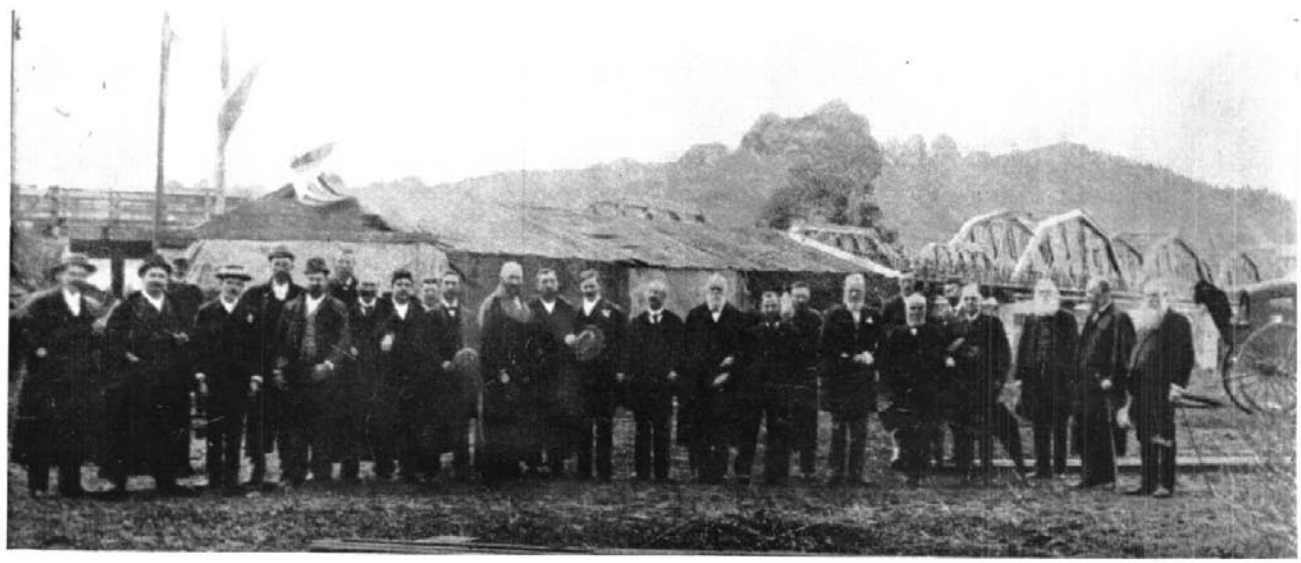
The track from Bathurst towards the south crossed the Lachlan River by some rocks which the aborigines called "Coura". The Rev. Henry Fulton, one of the first settlers in the Upper Lachlan district, called his leasehold "Cowra Rocks", the spelling of which is believed to be a corruption of the aboriginal name, and from this property the present town takes its name.

View overlooking Cowra.

In 1845 Cowra consisted of one solitary hut, that of a pound-keeper named Best. This was situated on the bank of the river near to the spot reached by Evans when he discovered the Lachlan in 1815.

The first survey of Cowra was made during 1852 and a land sale followed soon after. At this time the only means of transport between the township and other centres were bullock waggons which carried wool to Sydney and returned with supplies for the settlers. These frequently occupied three months on the journey.

The gold discoveries of the late 1850's added to the importance of the river crossing at Cowra as this was



Official Opening of bridge over Lachlan River at Cowra, 1893. (Original photograph at Cowra School of Arts.)

the readiest means of communication between the western goldfields and the new discoveries at Lambing Flat (Young), and Kiandra.

Erection of a bridge was commenced in 1868 but shortly after its completion in 1870 it was submerged in a flood, its approaches destroyed and the whole structure moved out of line. The flood also caused other damage and serious loss on the river flats.

The present road bridge over the Lachlan River at Cowra was opened on the 16th September, 1893. The bridge is 1,320 ft. in length and it cost approximately £26,500.

At the time of the flood in 1870 the "village of Cowra" was rapidly developing but the loss experienced as a result of the flood led to the re-establishment of the town on its present site on high ground.

The main western railway was opened to Blayney in 1876 and was being pushed towards Orange and Forbes. An agitation developed for the extension of railway facilities to Cowra and in May, 1886, the first passenger train reached a temporary station on the southern side of the river from the direction of Young. In the following year a railway bridge over the river was completed and communication with the south was established.

The Municipality of Cowra was incorporated in 1888.

John Granville Grenfell, after whom the town of Grenfell is named.

Old inn building at Piney Range west of Grenfell.

Grenfell.

A former Premier of New South Wales—the Hon. W. A. Holman, once wrote:—"No region's records show more of both the poetry and prose of Australian history than those of Grenfell. Seen as it is at the earliest in the dim light of Australian exploration, it has been the scene of every kind of event and the theatre of every kind of exploit with any claim to romance".

Grenfell was the birthplace of the famed Australian poet, Henry Lawson.

The earliest known penetration by white men of the area within which Grenfell is situated was during the first expedition led by Oxley to the Lachlan River when he came within 25 or 30 miles of the present site of the town.

One of the earliest settlers in the district was one J. B. Wood who, in 1833, set out with his father from Parramatta seeking land on which to settle. On their journey they fell in with a party of aborigines from whom they learned of well watered country, suitable for stock raising, to the south-west of their route. Following the directions given them they eventually reached a place known to the aborigines as Booroodeen —"The Windy Place", at which they settled. They called their selection "Brundah" by which name the locality became known and on portion of which the town of Grenfell now stands.

Survey of the area which became known as the Lachlan Pastoral District commenced in 1847. By 1860 the district had become a thriving pastoral area but a township had not yet developed.

The discovery of gold in 1866 completely changed the character of the district and laid the foundations of the town.

The town derived its name from that of a former Gold Commissioner of the district who was killed by bushrangers in 1866. At the time Grenfell was Commissioner of Crown Lands and whilst on a journey the coach on which he was travelling was held up near Dubbo by bushrangers who demanded the mails. The coach driver and the only other passenger were willing to surrender the mails but Grenfell, who was armed

with a revolver, refused and opened fire. The bushrangers returned the fire and Grenfell was fatally wounded and died before assistance could be obtained.

Until 1867 the district was known as the Emu Creek gold-field but in that year it was decided to establish a post office and to name it Grenfell in commemoration of the courage displayed by the bearer of that name in his attempt to save the mails.

The town was surveyed in 1867 and buildings of a more permanent nature began to replace the canvas and bark structures of earlier days. Gold mining had practically ceased and farming and agricultural pursuits had taken its place. By the early 'eighties Grenfell had grown to become the centre of a great pastoral and agricultural district which it has since remained.

A Municipal Council was formed in 1883 and railway communication with the town was established in 1901 by the building of a line from Koorawatha, a station on the railway connecting Blayney with the main southern line.

Wyalong–West Wyalong.

The twin towns of Wyalong and West Wyalong developed on the border of what was known in the early days of the colony as the Bland country. Occupation was at first prohibited as being "beyond the limits of location" but an Act of 1833 enabled land to be held under pastoral license and later Acts of 1836 and 1839 extended the principle of permissive occupancy. Little settlement took place until about 1889 when land was taken up under Conditional Lease or Purchase within a few miles north and north-west of the present towns. As in the case of Grenfell the emergence of the towns was due to the discovery of gold and the rush to the district which followed.

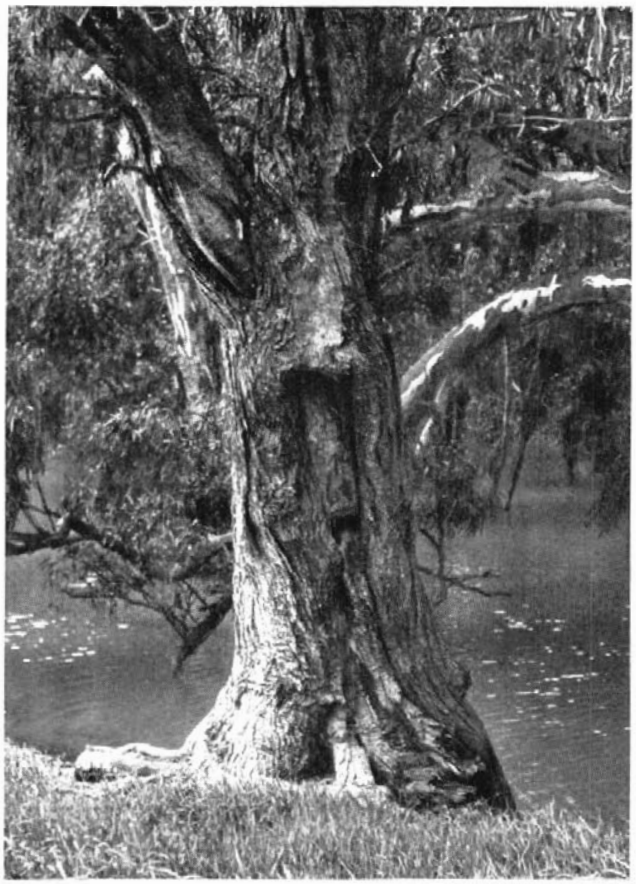
The discovery of gold was due primarily to George Woolten Neeld who left Victoria in 1893 with the intention of taking up land in New South Wales. One of his sons had already settled near to the site of Wyalong and Neeld Senior selected an area between where the twin towns now stand. Having had mining experience in Victoria another of Neeld's sons was attracted by some loose fragments of quartz lying on the ground and on further search, gold was found on part of Neeld's selection. Intensive prospecting followed and in October, 1893, an important discovery was made by one of the family when going to a neighbouring dam, known as the "White Tank", for water. Within six months of the discovery 10,000 people were camped in the vicinity of the dam, the locality being called "Main Camp". The dam constituted the only water supply available to the gold seekers and their families and is one of the more important links with the early history of the district.

Within two months of the gold discovery instructions were given for the laying out of a township for the new field. A position nearly two miles east of "Main Camp" was selected. The designation of the old run and parish of which it formed a part was chosen as the name of the new township and on June 23rd, 1894, it was proclaimed a village under the name of "Wyalong".

An immediate demand for allotments developed and by the date of its proclamation 120 houses had been erected within the confines of the village. Although this development continued it did not result in the transfer of the residents or business activities from "Main Camp" and following considerable agitation instructions were given for the survey of the occupied area at the diggings. Surveys of this area were completed in December, 1895, and when the plan was approved the locality was designated "West Wyalong" by which it has since been known.

Wyalong was proclaimed a Municipality on December 22nd, 1899 and on October 1st, 1935 it was absorbed into the Shire of Bland.

Neeld family—father and sons, and their hut in main street of Wyalong—now Mid-Western Highway.



The tree believed to have been blazed by Sturt situated on the southern side of the Highway, three miles east of Hay.

Hay.

If Oxley, in 1817, had continued in a southerly direction for about another 40 miles instead of turning north to reach the Lachlan again, he would have come upon the Murrumbidgee River between where the towns Narrandera and Hay are now located. Sturt passed the present locality of Hay in December, 1829, during his expedition down the Murrumbidgee and he was the first white man known to travel the banks of the river and to explore the adjacent country. Following Sturt's exploration the country along the river banks was gradually penetrated by stock-men, and by 1848 the country surrounding the Murrumbidgee and adjacent rivers was dotted with stock stations.

The locality within which Hay is situated was originally called Lang's Crossing after two brothers who, in 1848, occupied a stock run called Mungadingadal (now Mungadal). The present town, however, formed part of the Illilawa Run which was first occupied in 1850. A tree believed to have been blazed by Sturt is still preserved on this property.

The site of the present town was surveyed in 1859 when it was proposed to call the town "Waradgery". When, however, approval was given to the design, the town was named "Hay" after John Hay (later Sir John Hay) member of Parliament for the district at that time.

An auction sale of town lands was held on October 11th, 1851, and by 1864 the town had become a place of considerable importance. The country on the north bank of the Lachlan was then being considerably improved and the former "Lang's Crossing" was regularly used by stock travelling from the Lachlan to

The main street of Hay.

The Murrumbidgee River from the Highway bridge at Hay.

Melbourne and other southern centres. A punt was established at the crossing in 1857 and in 1870 a contract was let for the construction of a swing bridge across the river. This was opened by Sir Henry Parkes on August 29th, 1874 and is still in use.

A service of river steamers was inaugurated by Captain Francis Cadell, one of the earlier settlers in the district, in 1858 and Hay became an important depot. The river steamers were for several years the principal means of transport for the produce of the district but the river trade fell away rapidly when the railway reached Hay in 1882.

Hay was proclaimed a Municipality in 1872.

Development of the Present Route of the Highway.

At the date of its proclamation in 1928 the Mid-Western Highway had not been developed as a continuous route, and its establishment involved the in-

The Highway bridge over the Murrumbidgee River at Hay.

corporation of lengths of road which previously had been mainly of local significance; such improvements as existed had been carried out to serve only local needs, and for nearly 200 miles from just westward of Grenfell to Hay the road for the greater part lacked any kind of surface and was largely unformed. Travel between Grenfell and Hay was only possible under favourable weather conditions and involved slow and difficult movement. As a first major work, therefore, it was decided to undertake the construction of the more westerly section of the Highway in order to establish better travelling conditions over the full length of the route.

From Grenfell to Caragabal, a rail centre for the trucking of wheat and wool, a gravel or broken stone pavement had been provided but for the next fifteen miles to Marsden it was unformed.

Between Marsden and a few miles beyond West Wyalong, some gravelling had been carried out but from then on, for fifty miles to Rankin's Springs, through alternating ridge country, gently undulating wheat lands, and mallee scrub, it was unformed, and for only the first twenty miles had it been cleared of tree growth. Leaving Rankin's Springs, the Highway passes through the isolated Cocoparra Range, and, after going through a belt of mallee scrub and wheat country, enters typical western plains devoted almost entirely to the growing of wool. Over the 105 miles between Rankin's Springs and Hay, little more than clearing had been attempted prior to 1928 and, although a track for traffic was maintained, this became impassable during or after rain.

In effect, it was necessary in establishing the route, to construct or reconstruct practically the whole of the 197 miles from Caragabal to Hay, including a number of deviations, as well as providing for improvements, minor deviations and creek crossings between Marsden and Wyalong.

The first major work was undertaken in 1930-31 and comprised the building of a raised formation with gravel pavement across five miles of low-lying country just east of Marsden. Subsequently the formation and gravelling were extended eastward to Caragabal, joining up with the previously existing gravel surface leading into Grenfell.

In 1931-32, a 29-mile length extending east and west of Goolgowi was cleared, formed and loamed.

In later years, works of clearing, forming, and loaming or gravelling were extended, and culverts and bridges provided where necessary, and by 1940 a gravel pavement had been provided over 128 miles westward of Caragabal and a loam pavement for the further 69 miles to Hay.

As the major works on the more western section approached completion, improvements on the eastern section were undertaken and these have now resulted in a continuous bitumen surface as far as Grenfell, 234 miles from Sydney. Bitumen surfacing is now proceeding over several lengths to the west of Grenfell and the ultimate aim is to provide a road conforming to modern standards of width and alignment, and with surface appropriate to the needs of traffic over the full length between Bathurst and Hay.

S.G.P.

Acknowledgments.

Material for this article has been obtained from—

The Mitchell Library, Sydney;

The Public Library of New South Wales;

Journals and Proceedings of the Royal Australian Historical Society;

"Golden Granary—The History of Grenfell and the Weddin Shire"—W. A. Bayley;

"Australian Discovery"—E. Scott.

Widened cement concrete pavement in Canterbury Road looking from Quigg Street towards Victory Street. Municipality of Canterbury.

Recent Main Road Construction by Councils in the Metropolitan Area

Municipality of Canterbury—Main Road No. 167—Canterbury Road

As the result of the increased weight and volume of traffic using Canterbury Road in post-war years, an old lightly-constructed bituminous pavement had deteriorated rapidly and the cost of routine maintenance had become excessive. In addition, the effective width on many sections of the road had been reduced by severe crossfalls.

It was arranged that the Canterbury Municipal Council should reconstruct the carriageway, 42 ft. wide, in cement concrete, and in March, 1955, an experienced day labour force commenced work on the first section extending from Victory Street to Hillview Street. The second stage of the work from Hillview Street to Belemba Avenue was subsequently completed in March, 1957, and a further grant by the Department of Main Roads has enabled Council to proceed with the third section extending to King George's Road and thus to continue the improvement of Canterbury Road without interruption.

Careful organisation of the reconstruction work was necessary to avoid interruption of traffic flow and, in the early stages particularly, co-ordination of road work with removal of public utilities from the old pavement required special attention.

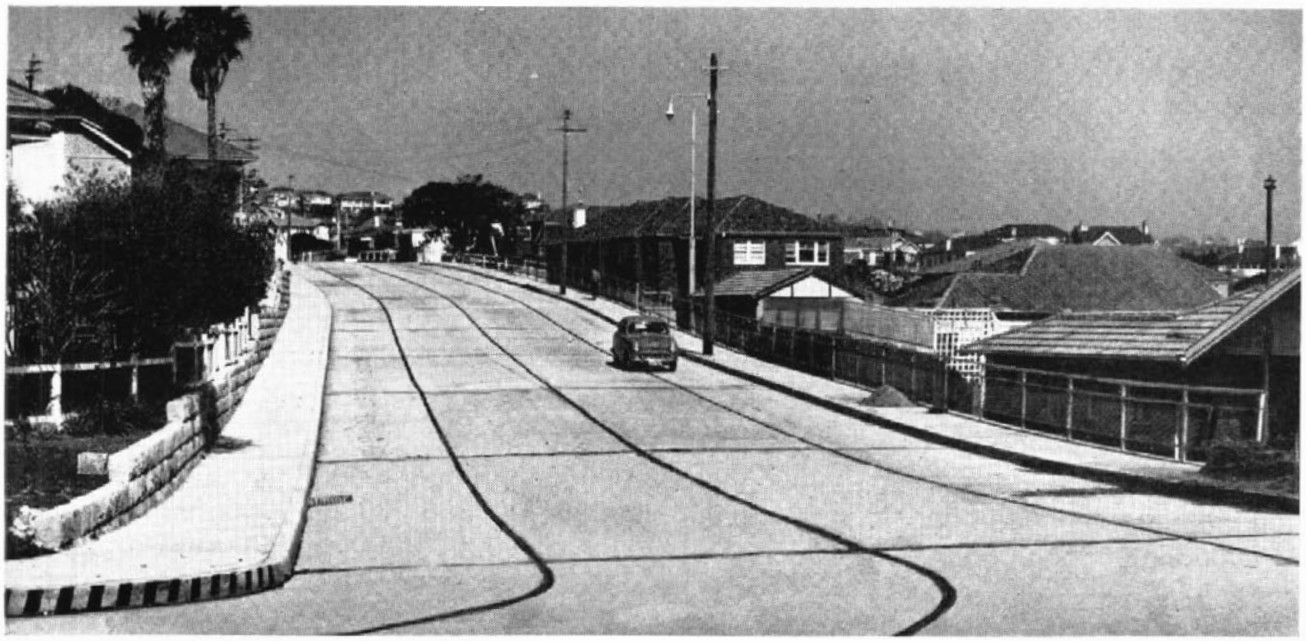
The average unit cost of the reconstruction of Canterbury Road between Victory Street and King George's Road, based on actual costs to date and excluding alterations to public utilities, is approximately £110,000 per mile, 42 ft. wide. Funds for the work were provided by the Department of Main Roads.

Municipality of Woollahra—Main Road No. 173—Hopetoun Avenue

In order to eliminate a length of poor alignment and two steep gradients in Hopetoun Avenue, Watson's Bay, a deviation was recently constructed by the Woollahra Municipal Council. The work involved only minor alterations to property.

The construction of the deviation, which was carried out by day labour, included approximately 600 ft. of four-lane concrete pavement, 480 ft. of mass concrete retaining wall, underground drainage, and kerb and guttering. Concurrently with the main work, a reinforced concrete wall, 175 ft. long and 12 ft. to 16 ft. high was constructed by contract under Council's supervision.

Dressed sandstone retaining walls were erected by contract to Council along properties above road level. These present a pleasing appearance and, due partly



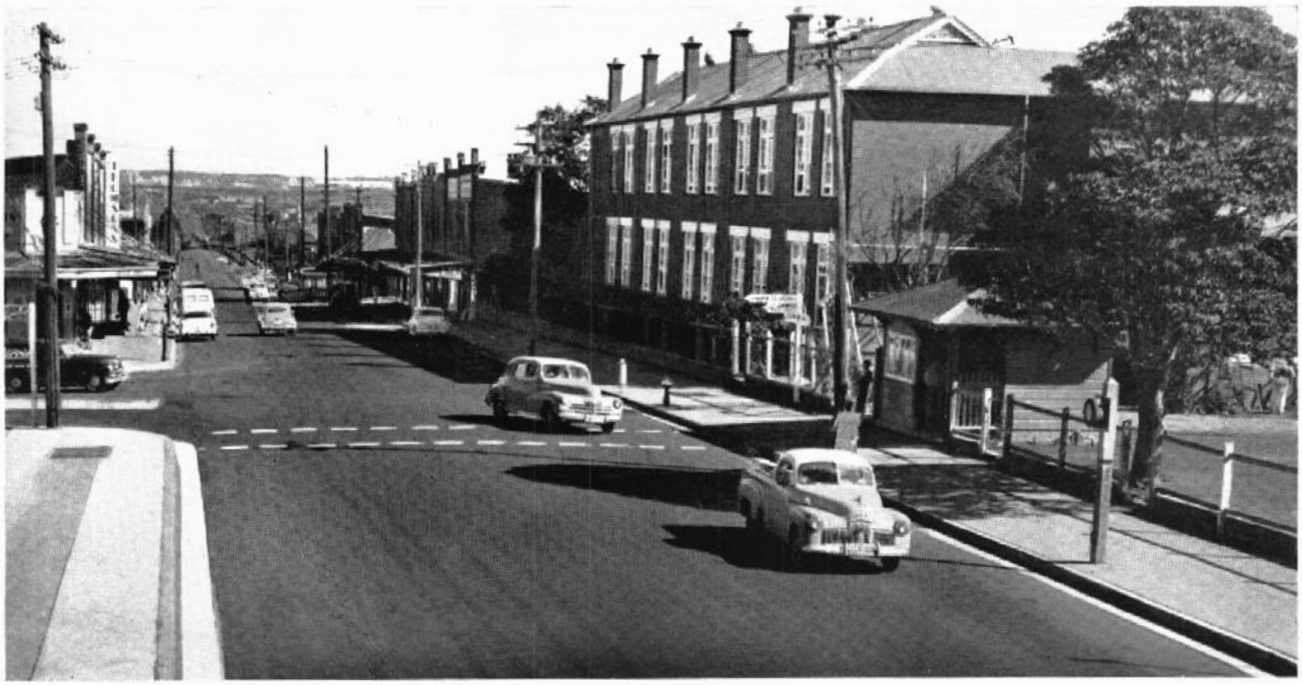
Deviated section of Hopetoun Avenue at Watson's Bay. Municipality of Woollahra.

to the availability locally of good quality stone, the cost was reasonable compared with that of concrete walls.

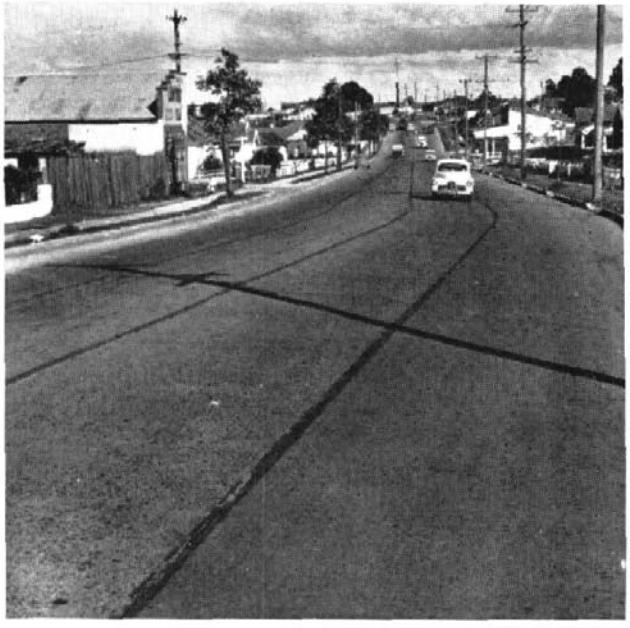
The road work was completed by the Council in March, 1958, the total cost, including alterations to public utilities, being approximately £44,000. Funds for the work were provided by the Department of Main Roads.

Municipalities of Burwood and Canterbury—Main Road No. 549—George's River Road

By mutual agreement between the Burwood and Canterbury Municipal Councils and the Department of Main Roads, the reconstruction of this Main Road between Greenhills Street and Coronation Parade (Main Road No. 315), was commenced by the Canterbury Municipal Council by day labour during April, 1957.



Reconstructed section of George's River Road at junction with Brighton Avenue, Croydon Park. Municipalities of Burwood and Canterbury.



Widened pavement of Chapel Road, South Bankstown. Municipality of Bankstown.

The work comprises the provision of a cement base course with an asphaltic concrete surface course, 42 ft. wide.

The first section, extending from Greenhills Street to Beaufort Street, was completed by the Council in May, 1958, the asphaltic surface course being supplied and laid by the Department of Main Roads at Council's request.

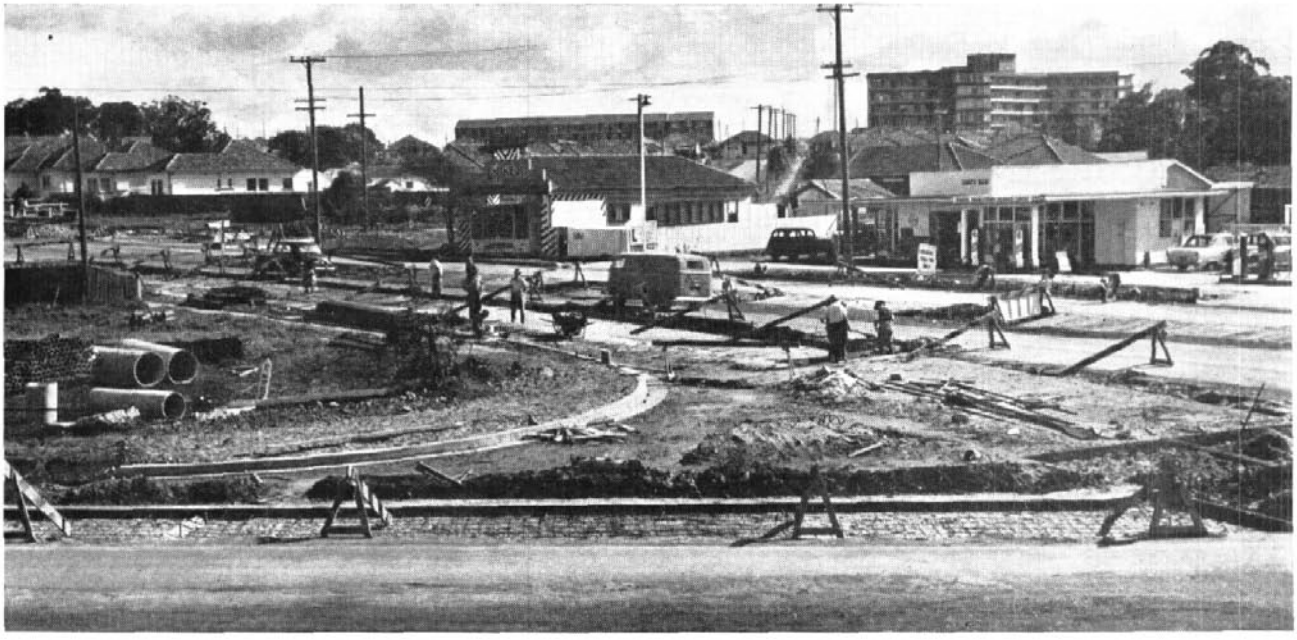
Traffic using George's River Road includes both single and double-decked buses and careful planning of the reconstruction work was necessary to avoid delays to transport, particularly through the Croydon Park shopping centre where deliveries to shops were heavy during the Christmas period. It was necessary also to co-ordinate the reconstruction of the carriageway with the removal of tram tracks and alteration of public utilities.

To ensure continuity of the improvement of George's River Road, a further grant has been made by the Department of Main Roads to the Canterbury Municipal Council for the reconstruction of a second section between Beaufort Street and Burwood Road. Excluding the cost of adjustment of public utilities, the overall rate for the work completed is £110,000 per mile and this includes the cost of underground drainage shared between the Councils and the Department of Main Roads on the normal basis. Apart from this, the cost of the road work was met by the Department of Main Roads.

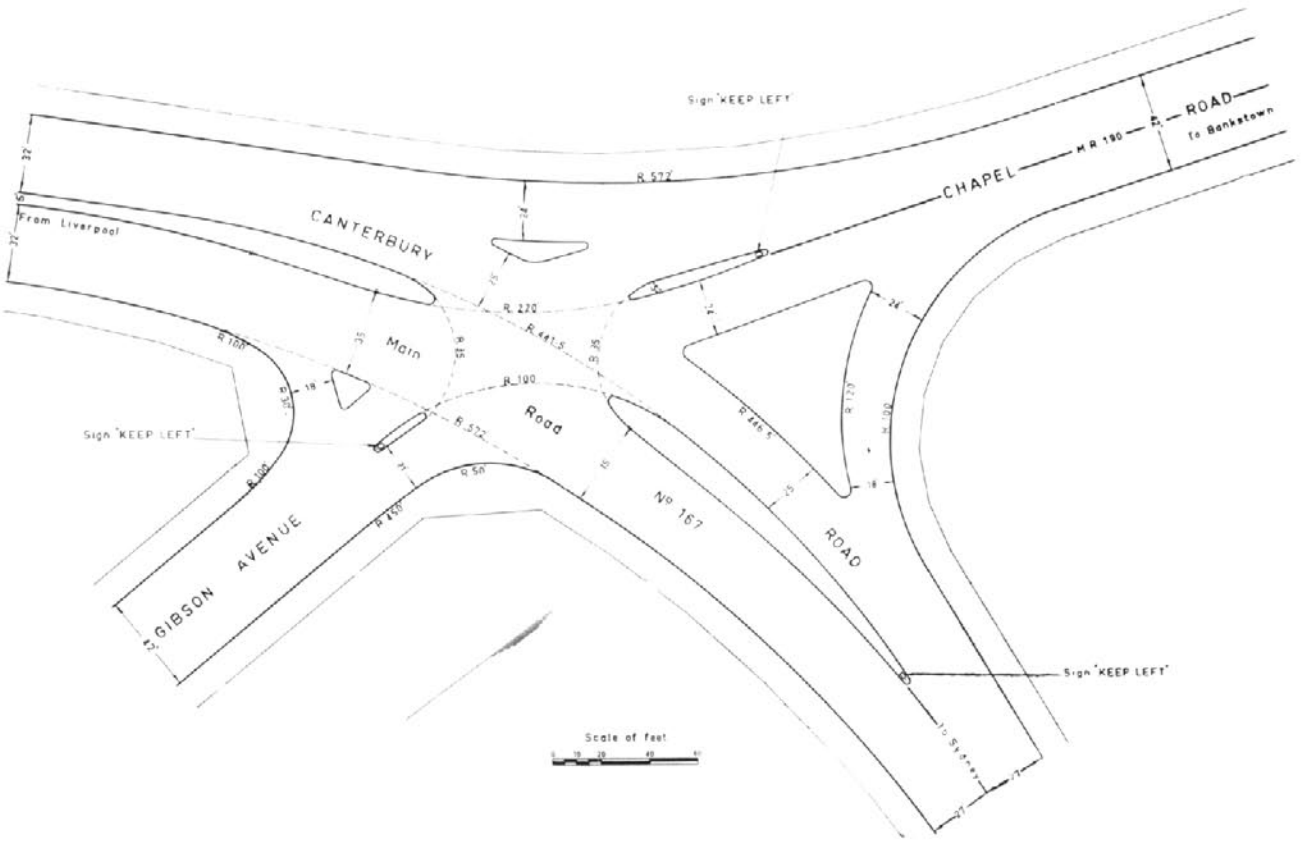
Municipality of Bankstown—Main Road No. 190—Chapel Road

Chapel Road is part of a north-south Main Road linking the Great Western Highway (State Highway No. 5) with the Hume Highway (State Highway No. 2) and with Canterbury Road (Main Road No. 164).

The normal flow of through traffic supplemented by a considerable volume of local traffic exceeded the capacity of a two-lane pavement on Chapel Road south of Bankstown, and the Council agreed to undertake with its day labour organisation pavement widening to the kerbs between Brandon Avenue and Eldridge Road.



Reconstruction in progress at intersection of Chapel Road and Canterbury Road. Municipality of Bankstown.



The new layout of the intersection of Chapel Road and Canterbury Road. Municipality of Bankstown.

In order to conform with the existing two-lane pavement which was in sound condition, the widening work was carried out in two sections. On the section between Brandon Avenue and Chertsey Avenue a flexible-type broken stone pavement with an asphaltic concrete surface course was provided and on the section between Chertsey Avenue and Eldridge Road the road pavement was widened in cement concrete.

The construction of the kerbside lanes to give a total pavement width of 42 ft., including drainage, kerbing and guttering and property adustments, was completed by the Council at a total cost of £54,000. The cost of alterations to public utilities is included in this figure. Funds for the work were provided by the Department of Main Roads.

Municipality of Bankstown. Intersection of Chapel Road (Main Road No. 190) and Canterbury Road (Main Road No. 167)

Traffic growth at this important intersection brought about a need for its widening and channelisation. Following on the completion of necessary land acquisitions by the Department of Main Roads, the Canterbury Council agreed to undertake the construction of the channelised intersection at an estimated cost of £35,000, the work including 8,460 sq. yds. of pavement in cement concrete with a bituminous concrete surface course. Traffic control signals are to be provided at this intersection by the Department of Motor Transport.

Alterations to public utilities at this intersection were extended along Canterbury Road to include the nearby important Main Road intersection of Canterbury Road, Milperra Road, River Road and Turvey Street where reconstruction is to proceed also in the near future.

Municipality of Ryde—Main Road No. 191—Lane Cove Road

The Ryde Municipal Council is carrying out by day labour the construction of two lanes of the western carriageway of a section of Lane Cove Road (Main Road No. 191) between Bridge Road and Epping Road. Exclusive of the bituminous concrete surface course which is to be supplied and laid by the Department of Main Roads at an estimated cost of £8,600, the estimated cost of the work being carried out by the Council is £51,000. In addition, the cost of public utility alterations chargeable to the road work will be approximately £5,000. Cost of Main Road work is being met by the Department of Main Roads.

The work includes provision of stormwater drainage, which accounts for a considerable proportion of the total cost, and kerb and guttering along the western side.

A "Mixing Test" to Determine the Rate of Break of Bitumen Emulsion

Bitumen emulsions manufactured in New South Wales for road work fall into three classes according to the type of work for which they are suitable, viz:—

Rapid setting (R.S.).—Suitable for penetration (grouting and semi-grouting) and sprayed surface dressings.

Medium setting (M.S.).—Suitable for pre-mixing with coarse aggregate substantially all of which is retained on $\frac{1}{8}$ in. B.S. sieve.

Slow setting (S.S.).—Suitable for pre-mixing with fine aggregate substantially all of which passes a $\frac{1}{8}$ in. B.S. sieve.

The Department of Main Roads uses only small quantities of S.S. emulsions and the testing of these usually includes a practical mixing test with a sample of the aggregate or soil to be used in the field. This procedure would not be practicable for the numerous consignments of R.S. and M.S. emulsions tested in Sydney and distributed throughout the State for use with a large variety of aggregates. In these circumstances it is necessary to use a laboratory test which will determine whether the setting time of the emulsion is suitable for the particular type of work on which it is to be used, *i.e.*, whether it is an R.S. or an M.S. emulsion.

Until 1952 the Department used the Meyer's Demulsibility Test (A.A.S.H.O. Designation T59-49, Demulsibility) for determining the rate of break of bitumen emulsion. It has since been replaced in the Department's specifications by a test described hereunder and referred to as the "Mixing Test". This test was adapted from the A.A.S.H.O. Coating Test which is ordinarily used for determining whether medium setting emulsions are capable of uniformly and thoroughly coating a standard aggregate without appreciable separation of the bitumen base from the water of emulsion. (For details of the Coating Test, see Standard Methods of Testing Emulsified Asphalts—A.A.S.H.O. Designation T59-49).

Experimental Work

Experimental work, leading to the adoption of the "Mixing Test", was conducted in three stages as follows:—

(i) Investigation of the A.A.S.H.O. Coating Test for reproducibility and general suitability as a classification test.

(ii) Development of a standard technique and selection of a standard aggregate for the Mixing Test.

(iii) Check testing of emulsion from five sources with a large variety of aggregates, to ensure that under average field conditions emulsions would show rapid or medium setting properties in agreement with the laboratory test results.

Standard Test Procedure.—The A.A.S.H.O. Coating Test allows considerable freedom in the choice of apparatus and in the method of mixing, and it was found after a series of aggregates had been tested by different operators that reproducible results could be obtained only when (*a*) the rate and method of mixing were controlled, and (*b*) a porcelain dish was used instead of an iron one. (The presence of rust affected the rate of break of some emulsions.) Other variables (*e.g.*, temperature and humidity within laboratory range) were not fully investigated but they did not appear to be of great importance in this test except perhaps in border-line cases.

Details of the apparatus and procedure for the Mixing Test are included in Appendix I.

Standard Test Aggregate.—Experience up till 1952 had shown that, so far as rate of break was concerned, bitumen emulsions supplied by New South Wales manufacturers conformed fairly well to the general use classification for R.S. and M.S. emulsions. It was, therefore, decided to accept the nominal classification of the emulsions as the basis for selecting a standard test aggregate which would mix with the M.S. emulsions without breaking but would cause partial or total break with the R.S. emulsions.

Various rock types were tried including basalt, volcanic breccia, dolerite, limestone, quartz, quartzite, quartz porphyry, all in a clean state free from dust. Some of these aggregates were too porous and drastic on the emulsions, others were too smooth and unreactive. The best results were obtained with a combination (now termed "the standard aggregate") as follows:—

Dolerite ex Prospect.—80 per cent. by weight. This is a rock of medium intensity as regards breaking effect on emulsion.

Limestone ex Caloola.—10 per cent. by weight. This is a granular, absorbent rock, fairly severe in breaking effect.

Quartz ex Newbridge.—10 per cent. by weight. This is a smooth-surfaced, white rock which acts as an indicator by becoming plainly visible when the emulsion breaks.

The dolerite is obtained from a well known quarry area at Prospect near Sydney, the limestone and the quartz from deposits near the Newbridge—Rockley Road about 24 miles south of Bathurst.

Check Testing with Various Aggregates.—A series of tests was made with five locally manufactured R.S.

and five M.S. emulsions on a range of aggregates commonly used in New South Wales. Each aggregate was substituted in turn for the standard aggregate in the mixing test. Unlike the standard aggregate, however, they were not washed or specially graded, but were tested in the condition in which they would normally be used for mixing or for surface dressing work in the field. Some details of the test results obtained are given below.

Discussion of Results.—There is reasonable agreement between the test results using the various aggregates and those using the standard aggregate, including emulsion E which showed up in each series of tests as being more stable than the other four. It was, therefore, considered that the standard procedure used was a satisfactory laboratory test for distinguishing between R.S. and M.S. emulsions.

General

Cases of "break" and "no break" in the Mixing Test are usually well defined. With R.S. emulsion the bitumen freed from the emulsion appears in different forms, depending on whether it adheres to the stone or remains as small free pieces. When the bitumen adheres, severe "balling" or agglomeration occurs—a condition which is readily detected. When the bitumen does not adhere, the indicator stone (quartz) serves to distinguish unbroken emulsion from the broken emulsion which appears as a brown watery liquid. Streakiness on the side of the porcelain dish and bitumen adhering to the spatula also assist in detecting when the emulsion has broken.

TEST RESULTS

(*a*) *Mixing test using standard aggregate*

Emulsion Manufacturer	Emulsion Type	
	M.S.	R.S.
A.	A smooth " creamy " well-coated mix of aggregate and emulsion was formed. There was no evidence of free bitumen and the indicator stone could not be distinguished.	Emulsion showed considerable " break " as evidenced by :— (i) thin watery, brown fluid in bottom of dish and streaky brown appearance on side of dish; (ii) " indicator " stone seen; (iii) stones loose and " watery " in appearance; (iv) much bitumen adhered to top of spatula.
B.	Do ...	As for "A" except for (iii); the stones formed an agglomeration with the bitumen.
C.	Do ...	As for "A" above.
D.	Do ...	do do
E.	Do ...	Not much evidence of " break " except slight amount of bitumen on tip of spatula.

(*b*) *Mixing test using various aggregates*

Twenty-five aggregates were used with each emulsion. The figures in the following table are the number of tests (out of twenty-five) in which the emulsion conformed to type as described by the manufacturers.

Manufacturer	M.S. Type	R.S. Type	Remarks
A.	24	20	A very dusty basalt caused failure of M.S. type in one case. In five cases involving clean and non-absorbent aggregates, the R.S. emulsion did not break.
B.	22	24	Very dusty aggregates caused 3 M.S. failures, 3 R.S. cases were borderline and one a failure.
C.	18	24	One R.S. failure, 3 R.S. cases borderline. The M.S. emulsion from this source less stable than the others; but most failures involved dusty aggregate.
D.	25	23	Two R.S. failures and 3 borderline cases.
E.	23	18	Of the 18 R.S. cases, 10 were borderline.

The test is not intended to distinguish between M.S. and S.S. type emulsions nor is it designed to set a lower limit for the rate of break of R.S. emulsions. Instability in R.S. emulsions would usually become apparent by the partial breaking of the emulsion on equipment used for other routine tests, *e.g.*, the sieve test, storage test or viscosity test.

The Department has now been using the Mixing Test in routine acceptance testing for about six years; it has proved to be a suitable laboratory method for distinguishing between M.S. and R.S. type bitumen emulsions as manufactured for roadmaking purposes in New South Wales.

Appendix I

MIXING TEST FOR BITUMEN EMULSION

Apparatus.

Porcelain evaporating dish 9 inches $\pm \frac{1}{2}$ inch diameter.

Ebonite or similar spatula with blade $\frac{3}{4}$ inch $\pm$ 1/16 inch wide and with rounded end.

Test aggregate, comprising crushed stone passing $\frac{3}{8}$ inch square opening sieve and retained on 3/16 inch square opening sieve, washed, dried and weighed out into 500 gm. charges, each composed of—

400 gms. Dolerite ex Prospect;

50 gms. White Limestone ex Caloola;

50 gms. White Quartz ex Newbridge.

Temperature and Humidity.

The standard conditions of test are an atmosphere of 75 $\pm$ 5°F. temperature and 75 $\pm$ 5 per cent. relative humidity with apparatus and material at room temperature. Where these conditions cannot easily be attained a good estimate of the suitability of the emulsion may be made by performing the tests under other conditions and allowing for the effect of the differences on the result (most important is that setting is accelerated by an increase in rate of evaporation). In close or disputed decisions it may be necessary to arrange for a test under standard conditions of temperature and humidity.

Method.

Place 500 gms. charge of test aggregate in dish and spread flat.

Pour on 35 gms. of emulsion.

Mix with spatula for three (3) minutes by the following action:—

Turn stone in from edges to centre with spatula, about two strokes of spatula per second.

For each stroke, push spatula lengthwise into left half of stone in mixing dish to full depth of material and at an angle of about 30 degrees to the horizontal.

Cast stone over material in centre of dish by lifting spatula forward and upward with a turn of the wrist.

Rotate dish about 45° in clockwise direction between each stroke.

Classification.

The emulsion shall be classified as:—

(i) Rapid Setting Type.—If a considerable separation of free bitumen is apparent before the conclusion of mixing.

(ii) Medium Setting Type.—If, after mixing and standing, all pieces of stone are smoothly and uniformly coated with emulsion which completely masks the colour of the stone and there is no free bitumen apparent.

Publication of Maintenance Manual

A "Field Manual of Road Maintenance" has been published recently by the Department of Main Roads. The Manual has been prepared for the information and guidance of employees engaged on the maintenance and improvement of Main Roads, in order to aid in securing efficient and economical working.

The Manual has been written in such a way that it may also be used, for the greater part, by Municipal and Shire Councils for the guidance of their employees on Main Roads. A copy of the Manual has been supplied to each Municipal and Shire Council.

In addition to outlining the works to be undertaken and matters to be reported upon by the employees concerned, the Manual deals in detail with—

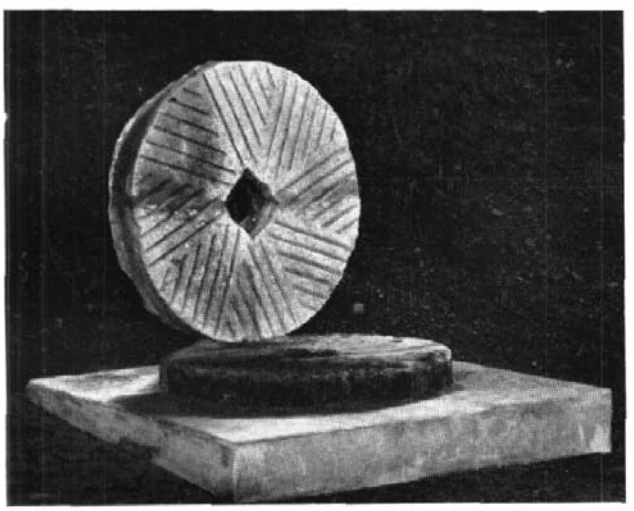
(*a*) Stores, materials and tools.
(*b*) Care and operation of plant.
(*c*) Control and guidance of traffic at works in progress.
(*d*) Use of graders in maintenance work.
(*e*) Formation.
(*f*) Drainage.
(*g*) Unformed roads.
(*h*) Formed earth roads.
(*i*) Gravel, sand-clay, fine crushed rock and broken stone pavements.
(*j*) Bitumen surfaced pavements.
(*k*) Concrete pavements.
(*l*) Road openings and restorations.
(*m*) Concrete, stone and timber work, painting, etc.
(*n*) Care of roadside trees, etc.
(*o*) Signposts and mileposts.
(*p*) Traffic facilities, safety fencing, fender and guide posts, linemarking, etc.
(*q*) Equipment and methods for setting out works.

The Manual, which contains 211 pages, has been bound in a durable limp cloth cover and is of pocket size.

The Manual (No. 7) may be obtained at a cost of eight shillings per copy, post free, on application to the Department's Head Office, 309 Castlereagh Street, Sydney.

Old Mill Stones Re-established on Bell's Line of Road at Kurrajong

Two mill stones, which were part of one of the old watermills on Wheeney Creek used by early settlers, have been re-established as a roadside monument on Bell's Line of Road (Main Road No. 184) at Kurrajong. Retrieved from the creek, they had been erected



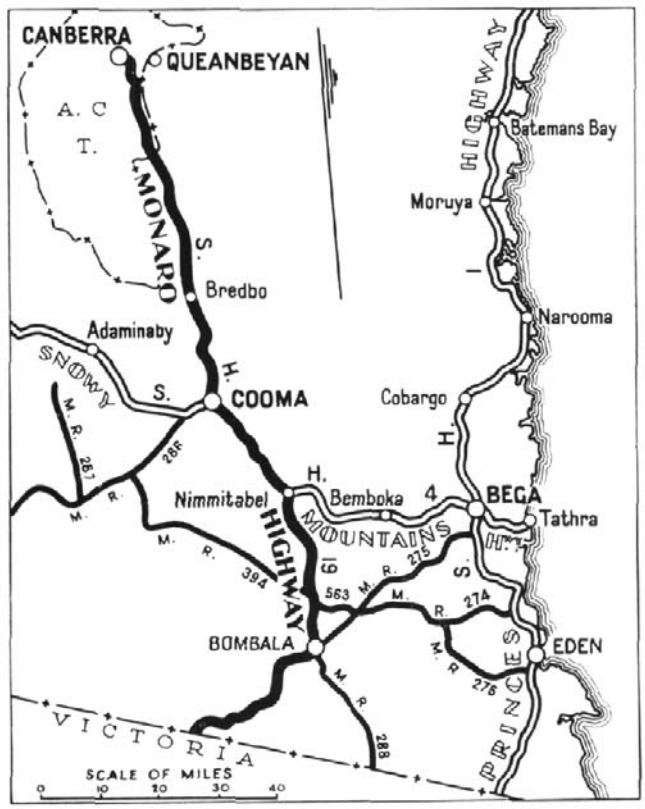
The mill-stones.

near Kurrajong village until re-alignment of Bell's Line of Road in this locality necessitated their temporary removal.

The mill stones have been repaired and re-erected by the Department of Main Roads on a concrete base on the north-western corner of Bell's Line of Road and Comleroy Road, Kurrajong, the site selected by representatives of Colo Shire Council and local organisations.

State Highway No. 19 Now Named Monaro Highway

State Highway No. 19 which extends from Canberra via Michelago, Bredbo, Cooma, Nimmitabel, Bombala and Delegate to the Victorian border has been named "Monaro Highway" by proclamation in the *Government Gazette* of the 27th June, 1958. The Commonwealth authorities have also agreed to apply the name "Monaro Highway" over that portion of the same road which extends through the Australian Capital Territory to Canberra.



The route of the Monaro Highway.

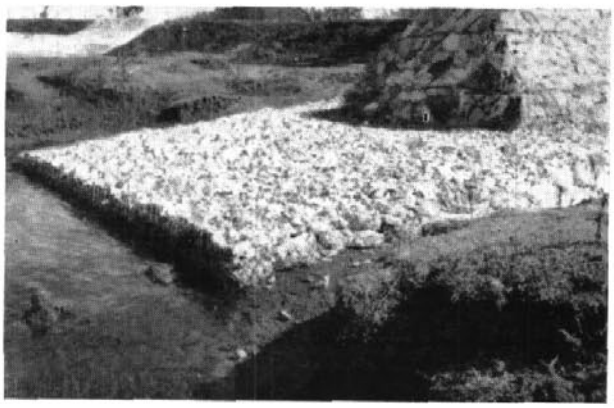
Until the 9th September, 1955, "Monaro Highway" was the name applied to State Highway No. 4 which extends from the Hume Highway at a point between Gundagai and Tarcutta and proceeds via Adelong, Tumut, Talbingo, Rules Point, Kiandra to Cooma and from Nimmitabel via Brown Mountain and Bemboka to Bega and the coast.

The name "Snowy Mountains Highway" was adopted for State Highway No. 4 in lieu of the name "Monaro Highway" for the reason that it is the principal road serving the Snowy Mountains area, whereas only part of its total length crosses the region known as "Monaro". On the other hand, State Highway No. 19 traverses the "Monaro" for practically its full length and forms the backbone of the road system of that region. The reason for not naming State Highway No. 19 as the "Monaro Highway" immediately after the change in name of State Highway No. 4 was to avoid confusion.

It might be mentioned that when State Highway No. 4 was originally given the name "Monaro Highway", the proclamation of the Canberra-Cooma-Bombala road as a State Highway had not been considered.

Erosion Control to Protect Boggabri Bridge over Namoi River

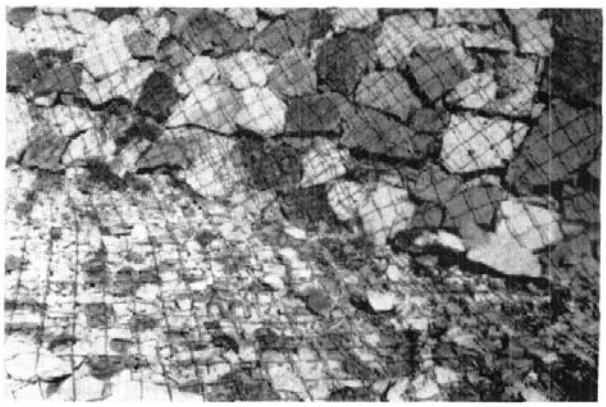
As a result of successive floods since 1949, severe scouring of a bend on the western bank of the Namoi River was endangering the Boggabri Bridge, a steel and concrete structure about three miles from Boggabri on the Boggabri-Manilla Main Road. A deep circular scour extending for approximately 700 feet upstream from the bridge had developed above natural water level, and because of the friable nature of the black soil river banks, was progressing rapidly downstream towards the Boggabri abutment of the bridge, having reached a point only 75 feet from the structure. In addition, a deep scour was also developing near the main pier of the bridge on the Boggabri side.



Toe of groyne.

Following survey of the area by the Department of Main Roads with a view to stabilising and slightly realigning the banks of the river to provide a better flow towards the bridge, the Water Conservation and Irrigation Commission co-operated with the Department in the preparation of a scheme designed to control the erosion. The work decided upon consisted mainly of the construction of three groynes in suitable positions upstream from the bridge on the Boggabri or western side of the river, the sloping back and protection with vegetation of the steep river banks, the planting of willows around the high and low level banks on the Boggabri side, the planting of poplar trees, and the removal of any obstructions in the river likely to cause deflection of the water to either bank.

The three groynes, of the trapezoidal type and consisting of rock enclosed in wire mesh, were constructed at distances of approximately 260 ft., 450 ft. and 620 ft. upstream from the bridge. A total of 850



Details of groyne.

cu. yds. of rock was used in the work, most of the rock being obtained from a rhyolite outcrop close to the site of the groynes.

Willow trees were planted in three lines around the high and low level banks on the Boggabri side, and also on each side of the groynes. The banks were trimmed to a 1 to 1 slope where required. On the sloping banks, willow stakes were laid to the slope of

View of completed work looking upstream from Boggabri Bridge.

the bank in shallow trenches with their lower ends in damp or moist ground at the foot of the bank. In most other cases, willow stakes were planted vertically. Approximately 1,000 willow cuttings were used in the work. Willow cuttings planted on the sloping banks near the bridge were protected by light brushwork, consisting of bushes and tree tops laid with their bushy ends facing downwards and held down with transverse poles wired to stakes.

Seventy-four advanced Lombardy poplar trees were planted at 10 ft. intervals near the top of the high bank on the Boggabri side in order to assist with the stabilisation of the area.

Most of the area covered by the work has been fenced to protect the trees from destruction by stock.

Due to the drought conditions experienced towards the end of 1957, some poplars and willows have died, and their replacement will be arranged during the next planting period. When the willows are well established, they will be cut back from time to time in order to provide a dense bushy growth.

Looking towards Boggabri Bridge after completion of work.

The work was carried out by the Department of Main Roads by day labour under the supervision of the Department's Divisional Engineer, Tamworth, who at the time was Mr. G. W. Mallett.

Tenders Accepted by the Department of Main Roads

The following tenders (in excess of £3,000) were accepted by the Department of Main Roads during the three months ended 30th June, 1958:—

Work or Source	Name of accepted Tenderer	Amount
		£ s. d.
State Highway No. 1—Prince's Highway. City of Greater Wollongong. Manufacture, supply and delivery of prestressed concrete piles and bridge units for bridge over Cabbage Tree Creek.	Concrete Industries (Australia) Ltd.	10,578 4 0
State Highway No. 9—New England Highway. Shire of Cockburn. Construction of bridge over Sandy Creek north of Tamworth.	Central Construction Co.	8,094 10 6
State Highway No. 12—Gwydir Highway. Municipality of Moree. Manufacture, supply and delivery of structural steelwork for bridge over Mehi River at Moree.	Superior Weld Pty. Ltd.	33,290 0 0
State Highway No. 12—Gwydir Highway. Shire of Walgett. Construction of reinforced concrete deck on bridge over Grawin Creek near Pokataroo.	Central Construction Co.	12,175 0 0
Shire of Kyogle. Main Road No. 361. Manufacture, supply and delivery of steelwork for bridge over Peacock Creek at Bonalbo.	Isles Forge and Engineering ...	12,910 0 0
Shire of Namoi. Developmental Road No. 1,167. Manufacture, supply and delivery of steelwork for bridge over Namoi River at Harparary.	Isles Forge and Engineering ...	6,745 0 0
Sydney Harbour Bridge. Supply, delivery and erection or prestressed concrete beams and supply, delivery and stacking of concrete slabs for reinforced concrete bridge over the Quay Roadway Tunnel in connection with conversion of tramway area to roadway.	Concrete Industries (Australia) Ltd.	22,496 0 0
Sydney Harbour Bridge. Supply and erection of steelwork for temporary ramp from Ennis Road in connection with conversion of tramway area to roadway.	Bernard Smith (Pty.) Ltd. ...	19,224 0 0
Supply and delivery of up to 7,000 tons of 80/100 penetration residual bitumen and 25,000 gallons of flux oil during the period 1st July, 1958, to 30th June, 1959.	Shell Company of Australia Limited	164,871 0 10 (estimated)
Supply and delivery of up to 7,000 tons of 80/100 penetration residual bitumen and 25,000 gallons of flux oil during the period 1st July, 1958, to 30th June, 1959.	Bitumen and Oil Refineries (Aust.) Ltd.	164,871 0 10 (estimated)
Supply and delivery of up to 500,000 gallons of bitumen emulsion during the period 1st July, 1958, to 30th June, 1959.	B.H.P. By-Products Pty. Ltd. ...	47,083 6 8 (estimated)

Tenders Accepted by Councils

The following tenders (in excess of £3,000) were accepted by the respective Councils during the three months ended 30th June, 1958 :—

Council	Road No.	Work	Name of accepted Tenderer	Amount
				£ s. d.
Berrigan and Jerilderie S.	17, 20	Supply and delivery of ⅜ in. and ¾ in. aggregate to stockpiles.	Berrigan Quarries Pty. Limited.	6,459 6 0
Bland S. ...	1,029	Boxing of 760 chains of roadway and supply, delivery, spreading and rolling 10,640 cu. yds. of gravel on various lengths between 1·95 m. and 43·5 m. from Yanko Shire boundary towards Weethalle. Average haul 4 miles.	I. N. and J. Miller	4,278 13 4
Camden M. ...	154	Provision of ¾ in. hot-mix levelling and strengthening course between 2·5 m. and 5·5 m. from Narellan.	Neuchatel Asphalte Co. Pty. Ltd.	13,763 5 6
Canterbury M. ...	167	Supply and delivery of up to 3,100 tons of ready mixed concrete on Canterbury Road between Belemba Avenue and King George's Road.	Ready Mixed Concrete, N.S.W. Pty. Ltd.	11,115 13 0
Do ...	167, 190	Supply and delivery of up to 3,300 tons of ready mixed concrete at intersection of Canterbury Road, Chapel Road and Gibson Avenue.	do do do	10,766 5 0
Cockburn S. ...	1,032	Construction of deviation at Ti-Tree Gully at 14·5 m. from Limbri and 2 x 24 ft. span timber beam bridge.	Gwydir Gravels	6,361 2 0 (earthworks) 4,064 8 0 (bridge)
Coolah S. ...	55	Reconstruction and bitumen surfacing 6·4 m. to 9·7 m. south of Coolah.	Town and Country Roadworks.	13,444 7 6
Do ...	334	Construction of timber beam bridge over Sand Creek at Mendooran.	Central Construction Company.	9,858 11 1
Imlay S. ...	274	Construction of bridge over Whipstick Creek 13·2 m. from the Prince's Highway.	F. L. Hall	5,817 4 0
Liverpool M. ...	535	Construction of bridge over Kemp's Creek	McDonald Constructions Pty. Ltd.	9,052 0 0
Mitchell S. ...	59	Bitumen resurfacing between 21·2 m. and 27·2 m. from Wagga Wagga.	B.H.P. By-Products Pty. Ltd.	3,053 18 6
Monaro S. ...	19	Construction of R.C. box culverts at 40·3 m. and 48·5 m. from Canberra.	Tumbarumba Construction	4,470 0 0
Newcastle C. ...	316	Construction of new deck on Throsby Creek Bridge ...	Central Construction Company.	6,440 0 0
Port Stephens S.	10	Bitumen surfacing from Twelve Mile Creek to Karuah ...	B.H.P. By-Products Pty. Ltd.	3,047 13 1
Tamarang S. ...	1,213	Construction between 6·0 m. and 7·2 m. and provision of causeways at 2·38 m., 4·25 m. and 5·74 m. from New England Highway.	W. H. Marshall	6,238 10 0
Tintenbar S. ...	555	Construction of ferry vessel for use on Richmond River at Wardell.	Barlow's Engineering Works	10,472 9 4
Urana S. ...	17	Supply, delivery and spreading of 6,485 cu. yds. of loam between 30·03 m. and 34·28 m. north of Jerilderie.	D. D. McCallum Constructions.	3,215 9 6
Wagga Wagga M.	57	Manufacture, supply and delivery of prestressed bridge units for Parken Pregan Lagoon Bridge.	Concrete Industries Australia Ltd.	10,106 12 0
Walcha S. ...	11	Improvement of alignment between 18·75 m. and 19·36 m. east of Walcha.	Gwydir Gravels	4,544 13 9
Walgett S. ...	18	Completion of construction of bridge over Nugol Swamp	L. Delatore	8,184 7 1
Wollondilly S. ...	259	Supply and laying of ¾ in. hot mix and ⅜ in. asphaltic mix course between Oakdale and top of Burragorang Mountain (13·9 m. and 17·8 m.)	Bituminous Pavements Pty. Ltd.	30,453 1 4
Do ...	259	Supply and laying of ¾ in. hot mix and ⅜ in. asphaltic course between 10·4 m. and 12·1 m. and between 12·9 m. and 13·9 m. from Camden.	do do ...	21,646 13 4
Wollongong G.C.	568	Supply and delivery of 8,000 cu. yds. of road base to Springhill Road.	Blue Metal and Gravel Ltd.	9,132 0 0

MAIN ROADS STANDARD SPECIFICATIONS DRAWINGS AND INSTRUCTIONS

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

Form No.

ROAD SURVEY AND DESIGN.

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

STREET DRAINAGE.

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

CULVERTS.

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

BRIDGES AND FERRIES.

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

FORMATION.

70 Formation. (1955.)
513 The design of sub-soil and sub-grade drainage. (1957.)
A 1532 Standard typical cross-section.
A 4618 Flat country cross-section, Type A. 1955.
A 4619 Flat country cross-section, Type B. 1955.
A 4620 Flat country cross-section, Type C. 1955.
A 4621 Flat country cross-section, Type D. 1955.

Form No.

A 1101 Cross-section one-way feeder road.
A 1102 Cross-section two-way feeder road.
A 114 Rubble retaining wall.

PAVEMENTS.

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

SURFACE TREATMENT.

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

FENCING AND GRIDS.

141 Post and wire fencing (1947) and drawings: plain (A 491); rabbit-proof (A 498); flood gate (A 316).
143 Ordnance fencing and drawing. (A 7.)
144 Chain wire protection fencing and drawing. (A 149.)
246 Location of protection fencing. (Instruction.)
224 Removal and re-erection of fencing.
A 1705 Plain wire fence for use in cattle country.
A 3598 Wire cable guard fence.

ROADSIDE.

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

MATERIALS.

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

TRAFFIC PROVISION AND PROTECTION.

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

PLANT.

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

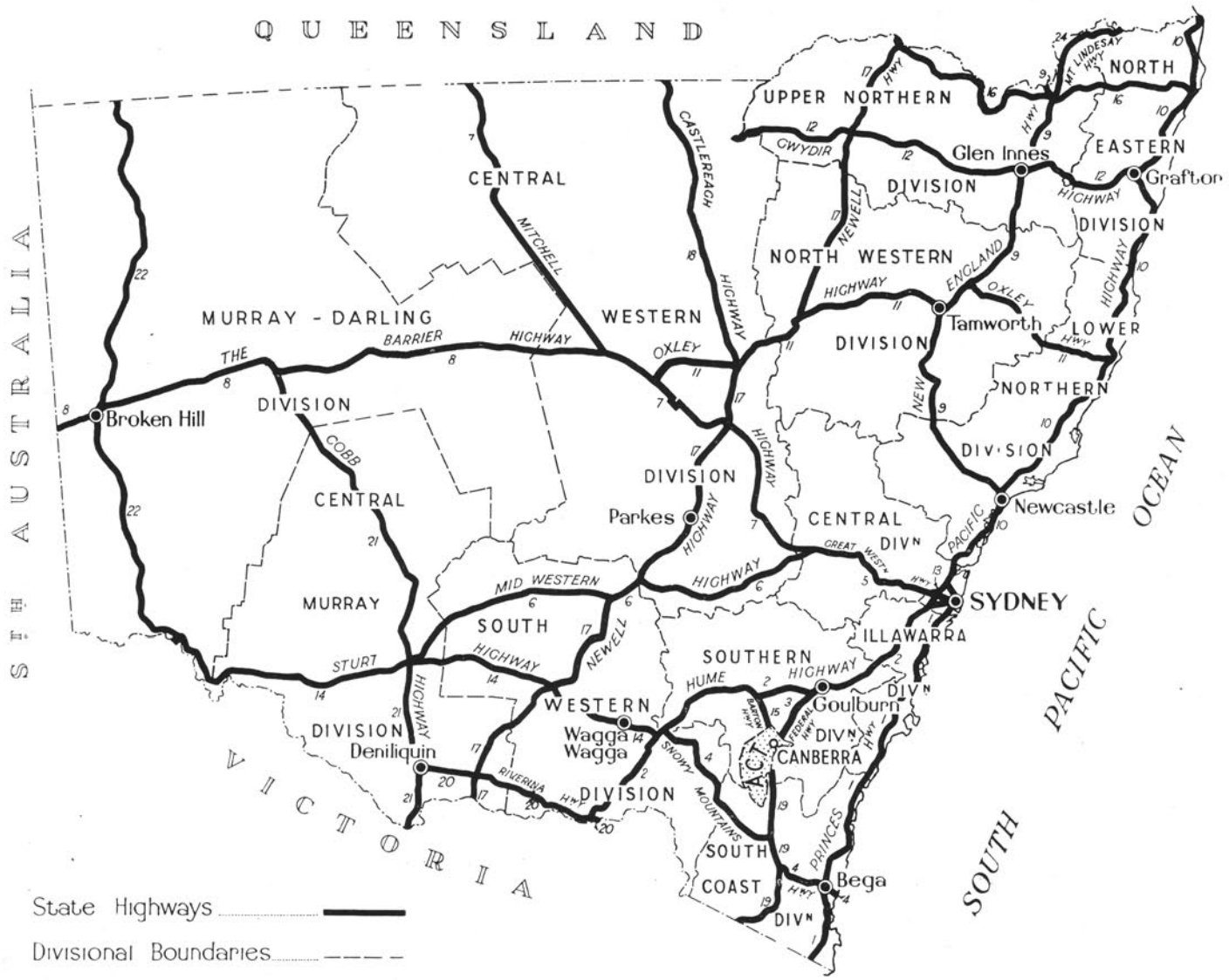
CONTRACTS.

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

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

Sydney: V. C. N. Blight, Acting Government Printer—1958

State Highway System of the State of New South Wales



Area of New South Wales, 309,433 square miles.
Length of public roads within New South Wales, 124,915 miles.

MILEAGE OF MAIN AND DEVELOPMENTAL ROADS, AS AT 30th JUNE, 1957.

State Highways	6,526
Trunk Roads	4,191
Main Roads	11,778
Secondary Roads (County of Cumberland only)	77
Developmental Roads	2,640
	25,212
UNCLASSIFIED ROADS, in Western part of State, coming within the provisions of the Main Roads Act	2,292
TOTAL	27,504