MAIN ROADS

A month to month account of the activities of

THE MAIN ROADS BOARD OF NEW SOUTH WALES.

Issued by and with the authority of the Board

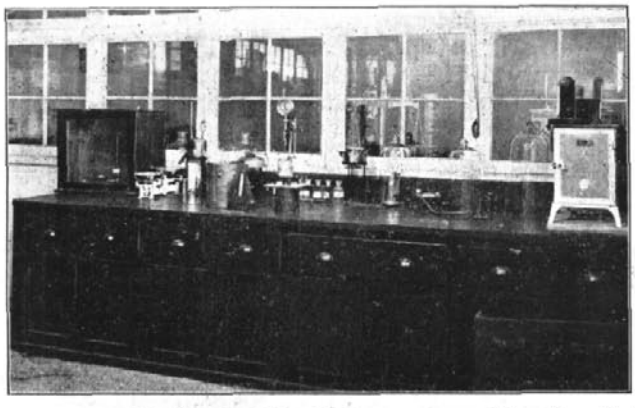
Vol. II, No. 7 — March, 1931.

News of the Month.

Metropolitan Division.

The reconstruction of Balmain-road and Darling-street (Secondary Road No. 2,007), between Perry-street and Weston-road, in the Municipalities of Leichhardt and Balmain, has been completed by Messrs. Burt, Boulton and Haywood, Ltd. The work consists of a 1 : 2½ : 5 cement concrete base, surfaced with 2 inches of asphaltic concrete placed by the Neuchatel Asphalte Company under sub-contract. The cost is being borne jointly by the Board and the two municipalities.

July, 1930, a landslide occurred in the southern bank of the river, carrying with it the southern pier, and causing the pier to lean at a dangerous angle towards the centre of the river. The effect of the landslide was mainly concentrated on the upstream cylinder of the pier; and the steps taken to arrest further movement and to support the bridge over this cylinder were fully described in the October, 1930, issue of *Main Roads*, which also outlined a scheme for restoring the displaced cylinder to its normal position. It was



The Board's Testing Laboratory.

Left, equipment for testing tar and bitumen. Right, the section of the laboratory devoted to testing stone, sand and gravel.

Outer Metropolitan Division.

The upstream cylinder of the southern pier of the Belmore Bridge, West Maitland, has been restored to its original position. Following the severe floods of

subsequently found, however, on examination by a diver, that the cylinder had become fractured below water, the lower section having taken a considerable cant outwards, thereby necessitating the employment of somewhat modified methods to bring it back to its

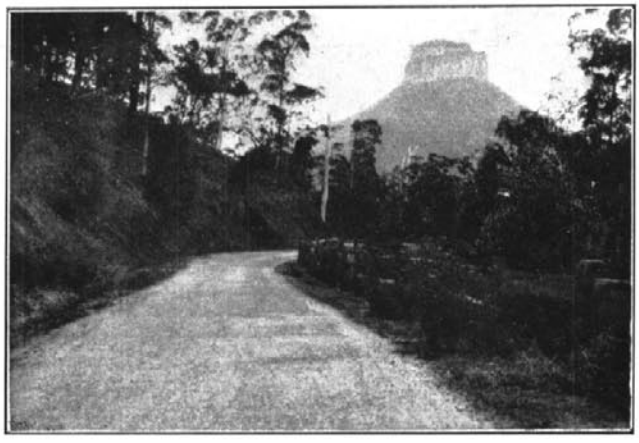
normal position. It was found that the lower section, which is 11 feet in diameter, was firmly embedded in tightly-packed stone rubble, and some difficulty was consequently experienced in moving it. The cylinder was finally restored to its true vertical position on 13th February, 1931.

The Prince's Highway at Minnamurra Rivulet, Municipality of Kiama.

Reconditioning of the Great Northern Highway, between Muswellbrook and Aberdeen, in the Shire of Muswellbrook, has been commenced by the Board's maintenance forces.

On the Stockton-Nelson's Bay road (No. 108), in the Municipality of Stockton, tar re-surfacing between Flint-street and the northern municipal boundary has been completed by the B.H.P. By-products Pty. Ltd.

Unemployed relief work is proceeding on the Macquarie Pass (No. 262), in the Municipality of Shellharbour, slightly more than half of the Pass having been surfaced in tar penetration macadam.



The Great Northern Highway near the Queensland border, with Mt. Lindesay in the distance.

A new five-span concrete bridge, 75 feet long, over Raglan Creek, near Kelso, has been constructed by Contractor A. G. Brown at a cost of £1,127. This structure, which eliminates an open crossing on the Kelso-O'Connell road (No. 256), was built under the supervision of the Turon Shire Council.

The construction of a concrete culvert and a short deviation at Ward's River, on the North Coast Highway, 14 miles north of Stroud, has recently been completed by Stroud Shire Council. The deviation eliminated the poorly-aligned approaches to the old timber bridge which was destroyed by floods.

Chinaman's Creek Bridge on the Hume Highway, within the Municipality of Mittagong, has been reconstructed by Contractor S. G. Lipscomb at a cost of £870 12s. 6d., and opened to traffic. The work was supervised by Nattai Shire Council, which constructed the approaches. The old bridge consisted of masonry abutments, rolled steel joists and buckle plates, and had been constructed at an angle to the direct line of the road. The old abutments were extended to eliminate the skew, and a reinforced concrete superstructure provided.

Upper Northern Division.

Repairs to the bridge over the Meehi River at Moree, on the Gwydir Highway, have been completed

Concrete bridge, 210 ft. long, recently completed over the Brunswick River at Mullumbimby, North Coast Highway.

by the divisional bridge maintenance gang. The bridge, which was built in 1899, consists of seven beam spans and one truss span. The repairs included the complete renewal of the western abutment, redecking the four beam spans at the western end, and the renewal of other defective members.

The construction of a deviation comprising 2,149 feet of gravel pavement and an 8 feet x 4 feet reinforced concrete box culvert at Dingo Gully, on the Kyogle-Woodenbong road (No. 140), in the Shire of Kyogle, has been completed by Contractor G. W. Westaway, who has also completed the gravelling of a length of 2,000 feet of pavement at Grevillia, on the same road.

Contractor C. V. Lawson has completed and opened to traffic a four-span timber beam bridge over Mulgum Creek, near Nimbin, on the Lismore-Murwillumbah road (No. 142), in the Shire of Terania.

On the Mullumbimby-Upper Main Arm developmental road (No. 1,043), the Byron Shire Council has constructed 16 reinforced concrete causeways, with gravel approaches. These causeways are a considerable improvement on the old stone crossings and are

much safer for traffic. Thirteen similar causeways have been constructed by the council on the Mullumbimby-Wilson's Creek developmental road (No. 1,127).

The reconstruction in bitumen penetration macadam of the North Coast Highway between Maclean and Harwood Ferry, in the Shire of Harwood, is being carried out by Contractor O'Meara. The base course has been laid over the full length of the work, 2¾ miles, whilst 1¼ miles of surface course have been penetrated and opened to traffic.

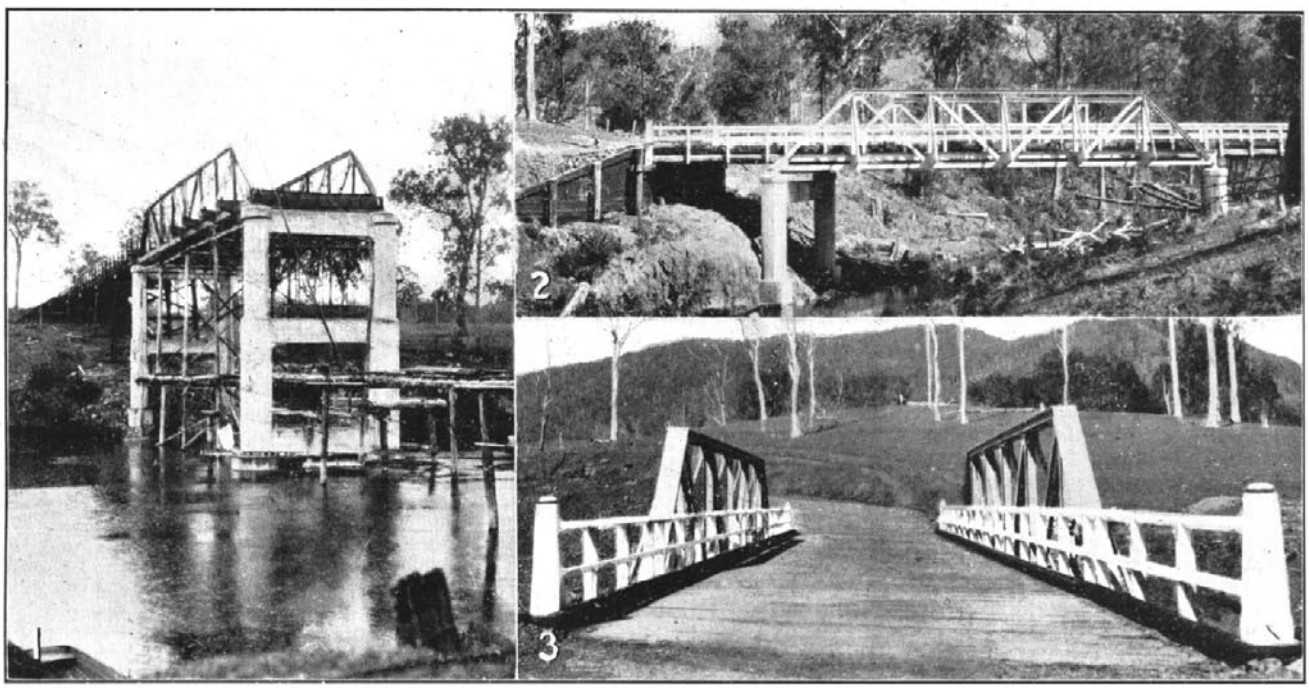
Lower Northern Division.

The Great Northern Highway between Uralla and Armidale, most of which has been tar-surfaced during recent years, is in good order. Widening of narrow sections has been carried out during last year and a considerable amount of resheeting with gravel has also been done. The road is now constructed to the Board's standards of width, camber, &c., for the full length and a good surface has been obtained throughout. It is proposed to tar the remaining gravel surface sections when funds are available. Arrangements are being made by Gostwyck Shire Council for the resurfacing of 1½ miles within the next week or two, in conjunction with which it is proposed to resurface the work carried out last year in Uralla Municipality.

On the North Coast Highway in Bellingen Shire, the good surface which has existed for the last year is being preserved by systematic maintenance. For several miles from the northern shire boundary, the macadam is being sheeted with gravel to minimise the inconvenience to traffic caused by the loose, unravelled condition which frequently results from dry periods. The addition of gravel will allow a good running surface to be maintained with graders. North of the Raleigh Ferry, where the road runs along the river bank and erosion has endangered the roadway in parts, broken stone has been placed at the toe of the bank for a length of 1,000 feet, and built up to about 2 feet above high-water level. Further protection work will be carried out from time to time, but the places most urgently requiring attention have been attended to.

Central Western Division.

The constructed lengths of the developmental roads in Waugoola Shire are standing up well to the very heavy wheat traffic, much of which is now steel-tyred.



1. Bridge, consisting of three 100-feet steel truss spans and ten timber beam spans, under erection over the Nymboida River at Nymboida, on the Armidale-Grafton road (No. 121). 2. and 3. Recently completed bridge, consisting of one 78-feet steel truss span and two timber beam spans, over Ralfe's Creek, on the Oxley Highway near Yarras.

The entire length of the North-western Highway in Timbrebongie Shire has received a light application of maintenance gravel. Considerable improvement in the running surface has resulted and will be maintained by patrol grading.

Following upon the completion of the new timber beam bridge over the Bogan River at Nyngan, the Municipal Council has recently constructed lengths of earth formation linking up the North-western and Barrier Highways with the bridge.

Contractors Griffith Bros. are forming (including culverts) and gravelling 3 miles 3,960 feet of the Eugowra-Collett's Crossing developmental road (No. 1,104) in Jemalong Shire.

Southern Division.

The Murrungal Shire Council has completed 1½ miles of gravel reconstruction on the Reid's Flat-Wattamondara developmental road (No. 1,088). The

new pavement is 14 feet wide and 6 inches deep. Funds were provided by the Unemployment Relief Council.

Contractor Herbert has completed the second section of the developmental road connecting the Monaro and Prince's Highways (No. 1,054), south of Bega, in the Shire of Imlay. The work included the construction of a short deviation and the gravelling of 4,194 feet of roadway to a width of 16 feet.

Contractor De la Torre has commenced work on 2 miles of earthworks and formation on the Kiah-Lower Towamba developmental road (No. 1,045), in Imlay Shire. This is the first section of a new road, leading from the Prince's Highway at Kiah, which will provide access to rich dairying country along the Towamba River. At the present time, the only means of access is along the river bed. The country is very steep and broken, rendering it necessary to adopt a formation width of 12 feet only, with passing places at intervals.

Riverina Division.

The Chas. Hardy Contracting Coy. has completed a three-cell 8 feet by 9 feet reinforced concrete box culvert, together with 1,575 feet of approaches, at a point 13 miles south of Tarcutta, on the Hume Highway in Kyeamba Shire. The work was undertaken to eliminate a dangerous crossing of the Keajura Creek and to improve the grade and alignment of the road.

A length of 1½ miles of tar surfacing has recently been completed by the council's day labour organisation on the Yarrawonga (Victoria)-Mulwala (N.S.W.) road (No. 314), in the Shire of Coreen. This road, which carries comparatively heavy traffic, connects with the Tocumwal-Mulwala-Corowa road (No. 212).

Contractors Winnett and Son have completed the formation of a deviation 2,020 feet long at the 19 miles on the Hume Highway in Kyeamba Shire. The new road is being used by traffic pending the completion of the gravel pavement. The visibility and grades have been considerably improved by this work.

Expenditure from 1st July, 1930, to 31st January, 1931.

	Expenditure from 1st July to 31st December, 1930.	Expenditure for month of Jan., 1931.	Total Expenditure to 31st January, 1931.
	£ s. d.	£ s. d.	£ s. d.
County of Cumberland Main Roads Fund—			
Construction of Roads and Bridges	154,704 11 5	11,601 13 0	166,306 4 5
Cost of Land Resumptions	67,727 17 2	7,334 4 0	75,062 1 2
Maintenance of Roads and Bridges	99,304 6 1	8,353 9 9	107,657 15 10
Repayment of Loans	63,699 10 5	54,314 5 4	118,013 15 9
Survey, Design, Supervision and Administration	23,575 0 7	4,056 16 1	27,631 16 8
Miscellaneous	24,966 8 8	1,971 8 10	26,937 17 6
Totals	433,977 14 4	87,631 17 0	521,609 11 4
Country Main Roads Fund—			
Construction of Roads and Bridges, including Resumptions	263,605 19 4	30,849 3 3	294,455 2 7
Maintenance of Roads and Bridges	406,925 7 5	60,022 7 1	466,947 14 6
Repayment of Loans	19,761 18 1	17,062 10 8	36,824 8 9
Cost of Survey, Design, Supervision and Administration	60,445 0 11	6,091 4 1	66,536 5 0
Miscellaneous	29,753 3 11	1,434 12 6	31,187 16 5
Totals	780,491 9 8	115,459 17 7	895,951 7 3
Federal Aid Roads Fund—			
Construction of Roads and Bridges, including Resumptions	353,527 18 4	45,819 10 6	399,347 8 10
Miscellaneous	13,220 13 5	101 8 1*	13,119 5 4
Totals	366,748 11 9	45,718 2 5	412,466 14 2
Developmental Roads Fund—			
Construction of Roads and Bridges	133,627 14 6	12,102 7 9	145,730 2 3
Survey, Design, Supervision and Administration	3,973 2 1	607 9 1	4,580 11 2
Miscellaneous	10,620 2 7	42 6 8*	10,577 15 11
Totals	148,220 19 2	12,667 10 2	160,888 9 4
Summary all Funds—			
Construction of Roads and Bridges, including Resumptions	973,194 0 9	107,706 18 6	1,080,900 19 3
Maintenance of Roads and Bridges	506,229 13 6	68,375 16 10	574,605 10 4
Repayment of Loans	83,461 8 6	71,376 16 0	154,838 4 6
Survey, Design, Supervision and Administration	87,993 3 7	10,755 9 3	98,748 12 10
Miscellaneous	78,560 8 7	3,262 6 7	81,822 15 2
Grand Totals	1,729,438 14 11	261,477 7 2	1,990,916 2 1

* Credits.

Relief Work on the Attunga-Somerton Road.

By E. H. McCandless, B.E., A.M.I.E. Aust.,

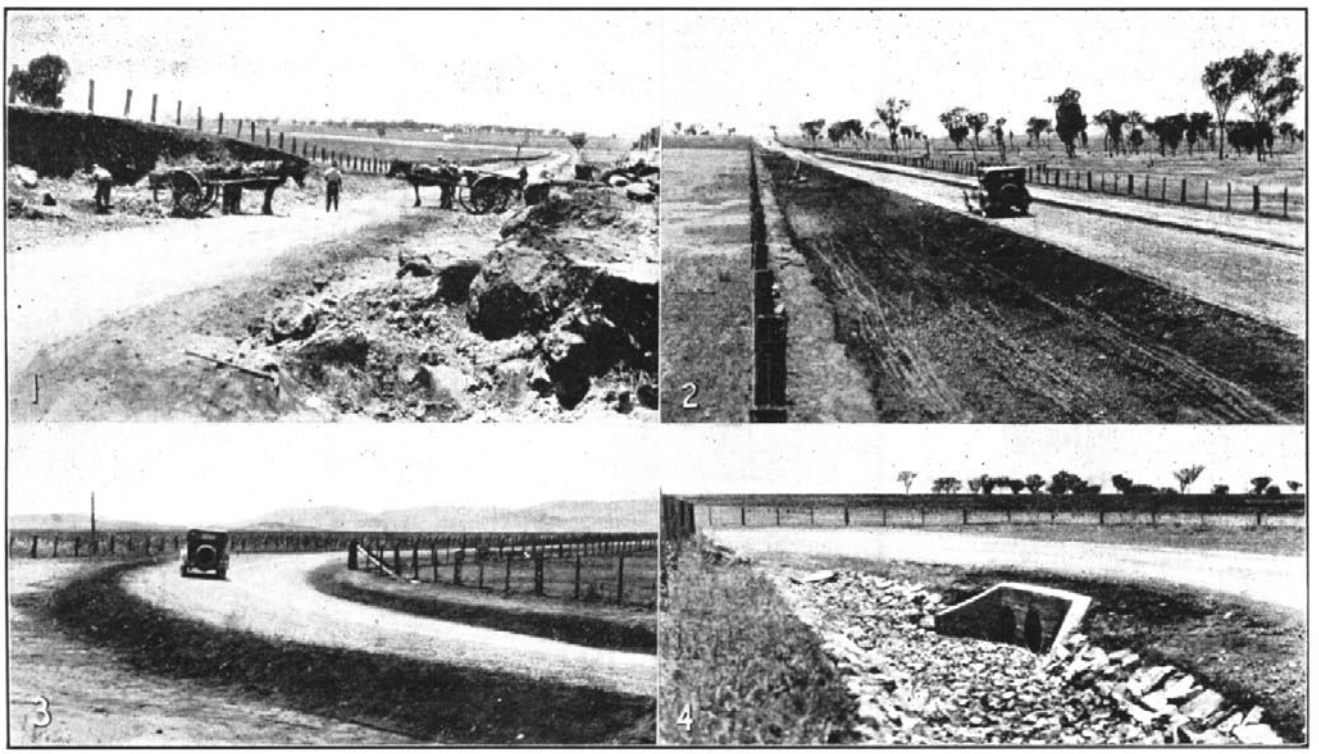
Cockburn Shire Engineer.

THE illustrations on this page show work recently completed on the road between the Oxley Highway at Somerton and the Tamworth-Manilla trunk road (No. 63) near Attunga railway station This road runs through a very rich wheat belt. The country traversed is heavy red soil, which is impassable during wet periods unless paved.

A grant of £2,500 was made available by the Unemployment Relief Council on 25th July, 1930. Work was commenced on 6th August, 1930, extending westerly from a point 4½ miles west of Attunga. For the available funds it was estimated that 12,500 feet of roadway could be constructed. The council undertook not to charge plant hire for the plant to be engaged (steam-roller, two 5-ton motor-lorries, tractor, grader and concrete mixer), and also arranged for the payment to the plant operators of the difference between their regular wages and those specified for relief work.

The specification for the work provided for a formation 24 feet wide, and a two-course pavement 14 feet wide, and was arranged so that natural deposits of road-building material existing close to the work could be utilized. For the base course, indurated shale from a breast cutting through a small hill half-way along the section was used, laid to a depth of 5 inches consolidated. This shale was so hard that blasting was practically constant. The pavement consists of either ridge gravel, or decomposed granite gravel from a small dyke in the hill mentioned above, and was laid to a depth of 3 inches consolidated. In addition, nine single, double, or triple pipe culverts, and a concrete causeway 150 feet long were constructed.

When funds became exhausted, on 29th November, 1930, 14,900 feet (2.8 miles) of roadway had been constructed, and approximately sixty men had received employment. Of the expenditure under the grant (£2,542 6s. 11d.), approximately 90 per cent. was accounted for by wages. Plant hire incurred, but not charged, by the council amounted to £569 13s. 2d.



1. Cutting from which shale for the base course was obtained. 2. Part of the finished work. 3. A super-elevated curve of 150 feet radius. 4. A triple 24-inch diameter pipe culvert on a curve of 150 feet radius.

Relief Works on Developmental Roads.

Early in the present financial year, two grants totalling £69,000 were made available to the Board by the Unemployment Relief Council for relief works on proclaimed "developmental" roads. The

(*Concluded on page* 104.)

The Cost of Bad Roads.

By A. E. Warburton,

Assistant Accountant.

IN any organisation employing a number of motor vehicles for transport, it is most desirable that some form of check should be kept on the expenditure in running costs. For the economical supervision of country and metropolitan road maintenance and construction, the Main Roads Board early realised that it would require to run a number of motor cars and utility trucks. A costing system was therefore incorporated as part of the general accounting scheme to provide—

(i) A check on the expenditure by officers responsible for the use and care of the vehicles.
(ii) A reliable comparison of the merits of various types and makes of car and truck as far as the Board's requirements are concerned.

From these returns, taken in conjunction with the cost ledger, it is possible to maintain a general supervision over the use of the vehicle, the petrol consumption, and the experience of tyres, &c., as well as record the number of miles travelled on account of each individual work. At the end of each quarter, the cost per mile for each vehicle is determined, and the running costs are debited to each work according to the mileage recorded, while the total of the debits is credited to *Car running and maintenance* account.

Over the first five financial years of its operations, the Board's cars and utility trucks have covered a total distance of about 2,000,000 miles, and the continuous record of their running costs should therefore

CAR DRIVER'S WEEKLY REPORT.

Week ending.....

M.R.B. No..... Type..... Regd. No..... Work.....

Date.	Trip No. for the Day.	Travelling. From.	Travelling. To.	Purpose of Trip.	Signature of Officer using Car.	Miles Travelled.	Speedo-Meter Reading at end of Day.	Petrol. Galls.	Oil. Qts.	Working Time. Running.	Working Time. Running Repairs.	Working Time. Idle Time.
				Totals	brought forward							
Details of Tyres (see instructions on cover).				Total for week ...								
				Total carried forward								

Report for the week.

Driver's signature .....

(iii) A means of distributing periodically the cost of running over the various works on which each vehicle was engaged.

The control of this system is contained in the General Ledger under the heading of an account called *Car and utility truck running and maintenance,* to which all payments or charges on account of petrol, oil, tyres, tubes, repairs, depreciation, insurance, &c., are made. The control account is supported by a loose leaf columnar ledger with an account for each vehicle. The cost of running is there divided under—

(i) Charges for petrol and oil.
(ii) Charges for tyres and tubes.
(iii) Charges for repairs.
(iv) Charges for depreciation.
(v) Charges for comprehensive insurance and sundries.

Apart from these individual accounts, a report is furnished each week by the driver or officer using the car or utility truck in the form shown above.

give a fairly reliable indication of the running costs of an average motor car. The average costs per mile for the 1,967,418 miles has been found to be—

Petrol, oil, tyres, and tubes ...	1·86	pence per mile.
Repairs	·91	,,
Depreciation and insurance ...	1·86	,,
Total Cost	4·63	,,

These figures, it will be noted, include all charges with the exception of motor taxation, registration and license fees, and garage costs (and, to the extent to which depreciation does not provide for it, interest).

These charges (excluding the fraction of interest) may be calculated for the average car, which travels, according to the petrol importations for the last financial year, 6,400 miles per annum. On this basis,

the total cost per mile for running the average car would be—

	d.
Petrol, oil, tyres and tubes	1·86
Repairs	·91
Depreciation and insurance	1·86
Motor taxation	·21
Registration and license fees	·06
Garaging (on a rate of 5s. per week)	·48
Total	5·38

One interesting feature of the unit costs disclosed by the Board's records is the difference in cost between operations on good and bad roads. On several occasions the Board has purchased two or more vehicles of the same make at approximately the same period and has made them available to works which have been so situated as to make possible a comparison of the costs according to the class of road used. The following statement illustrates three examples of this:

Car.	Date Purchased.	Engaged at.	From.	To.	Miles Travelled.	Cost per Mile.	
						Good Roads.	Bad Roads.
Type " A."						d.	d.
(*a*)	30 Oct., 1928	Rosehill	30 Oct., 1928	30 June, 1930	36,552	3·55	...
(*b*)	30 ,, 1928	,, ...	30 ,, 1928	30 ,, 1930	32,603	3·47	...
(*c*)	30 ,, 1928	Tobin's Creek Deviation ...	30 ,, 1928	30 ,, 1930	21,688	...	5·88
(*d*)	30 ,, 1928	Head Office, Glen Innes	30 ,, 1928 14 Mar., 1930	13 Mar., 1930 30 June, 1930	21,445	3·29	...
Type " B."							
(*a*)	9 Jan., 1929	Rosehill	9 Jan., 1929	30 June, 1930	17,599	3·03	...
(*b*)	14 Feb., 1929	Koreelah Creek	14 Mar., 1929	30 ,, 1930	4,665	...	6·73
Type " C."							
(*a*)	12 April, 1928	Mt. Darragh Deviation ...	12 April, 1928	30 June, 1930	22,609	...	4·99
(*b*)	11 June, 1928	Tobin's Creek Deviation ...	11 June, 1928	30 ,, 1930	27,433	...	5·66
(*c*)	10 Sept., 1928	Queanbeyan	10 Sept., 1928	30 ,, 1930	28,743	4·17	...

It is possible that the Board's costs may be slightly lower than the average because they include the experience of a number of comparatively new vehicles, which will later display higher unit rates on account of repairs, and possibly higher depreciation rates. The Board adopted a flat rate of depreciation of 25 per cent. per annum to 30th June, 1930, after which date the rate was increased to 33 1-3 per cent. per annum. However, it would appear safe to say that the average cost per mile of running an average car or utility truck, properly maintained, is 5½d. per mile.

With these cost figures as an indication, it is possible to form an estimate of the cost of road transport in New South Wales for the financial year 1929-30, as follows:—

	£
30,786 motor cycles travelling 6,455 miles at, say, 2½d. per mile	2,070,000
173,265 motor cars travelling 6,455 miles at, say, 5½d. per mile	25,631,000
45,419 motor lorries travelling 6,455 miles at, say, 10d. per mile	12,216,000
Total Estimated Cost	£39,917,000

This estimate does not make any provision for the wages paid to operators of motor-lorries and commercial cars which would probably amount to £15,000,000. The total cost of road transport for the year in New South Wales was therefore in the vicinity of £55,000,000. This expenditure, however, will probably be considerably reduced in the current financial year on account both of decreased registration of motor vehicles and decreased mileage covered by the average vehicle.

The Tobin's Creek deviation was a new road 22 miles long through virgin forest; and the vehicles used necessarily had to travel over forest tracks and heavy gradients. At Koreelah Creek the vehicles were used in black soil country which becomes soft and boggy in wet weather; and gives any kind of vehicle "heavy going." At Mount Darragh the work on which the vehicles were engaged was the construction of a new forest road from coast to tableland, with steep gradients, and rough bush tracks to operate upon.

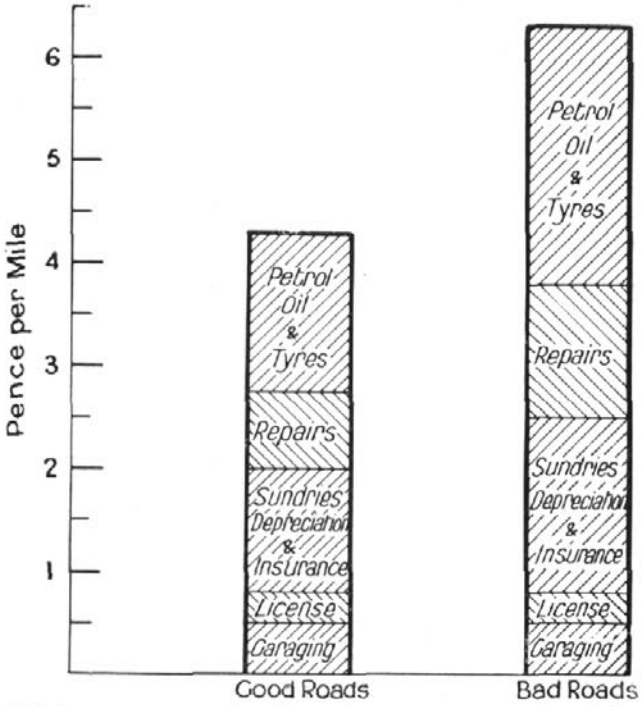
The five vehicles on good roads covered 136,942 miles at an average cost of 3.55d. per mile, and the four vehicles on bad roads covered 76,385 miles at an average cost of 5.59d. per mile. The difference in cost therefore amounts to 2d. per mile, of which some proportion doubtless represents the higher cost of petrol, oil, repairs, &c., in the districts where the bad roads referred to are located. This increase in cost, however, would not exceed ½d. per mile, and it may safely be said that operating on bad roads has, in the cases cited, cost at least an additional 1½d. for each mile travelled.

In this particular respect comparison is possible with a similar and more extensive examination made by Professors T. R. Agg and H. S. Carter, of the Iowa State College Engineering Experiment Station.* In this examination, which included the tabulation of the detailed costs of operating roughly 800 vehicles throughout the United States, and the co-ordination of much research data on the effect of road types on petrol consumption, tyre wear, &c., it was estimated

* Bulletin No. 91, Engineering Experiment Station, Iowa State College, Ames, Iowa, 1928.

that, in Iowa, the cost per mile of operating an average car on high type roads was 5.44 cents, on intermediate type roads 6.43 cents, and on low type roads 7.50 cents. In other words intermediate roads cost the motorist 18 per cent. more than good roads, and bad roads cost 38 per cent. more than good roads. If we apply these percentages to the average New South Wales cost of 5½d. per mile, we find that running on good roads costs 4.9d. per mile and on bad roads 6.4d. per mile, or a difference again of 1½d. per mile.

We may reasonably assume that the difference in costs per mile on good and bad roads for cycles and lorries is in, roughly, the same proportion to the normal cost as in the case of cars. We may also assume that approximately one-half of the running



Relative costs per mile of running a car on good and bad roads, respectively, as shown by the Board's records.

of motor vehicles in this State is done over roads not yet constructed, and roads traversing heavy black soil or heavy red soil. On these assumptions an estimate of the cost of running on roads of this type not yet made good may be made as follows:—

	£
For 30,786 motor cycles each travelling 3,227 miles at ·68d. per mile... ...	281,000
For 173,265 motor cars each travelling 3,227 miles at 1½d. per mile	3,495,000
For 45,419 motor lorries each travelling 3,227 miles at 3·2d. per mile... ...	1,954,000
Total Cost of Bad Roads ...	£5,730,000

This cost represents what owners had to pay out in 1929-30, but would have saved if all the roads had been made good.

It is interesting to compare the average additional cost of 1½d. per mile with the amount paid in motor and petrol taxation for the maintenance of good roads, and for the improvement of bad roads. The amount of petrol taxation devoted to road improvement is approximately 2½d. per gallon, or at the rate of 0.125d. per mile travelled. This rate added to the cost of 0.21d. per mile for motor taxation mentioned previously gives a total contribution made by the motorist towards road improvement for each mile travelled of 0.335d. per mile.

The truth of the somewhat paradoxical remark of Mr. Thos. H. Macdonald, the Chief of the Bureau of Public Roads, U.S.A., that, "We pay for good roads whether we have them or not, and we pay less for them if we have them than if we have them not," is therefore amply borne out from experience in this State.

Relief Works on Developmental Roads.

(*Continued from page* 101.)

amount was allocated amongst twenty-nine Shire Councils for specified works on thirty-five roads, under agreements which provided for the clearing of about 52 miles of road and the construction (clearing, forming, gravelling, and culverts, or widening) of a further 67 miles 30 chains. Particulars of these, together with the conditions applying, were published in the September, 1930, number of *Main Roads*.

Up to 12th February, 1931, advice of completion of the work had been received from seventeen councils and most other works were then nearing completion. In the case of the works already finished, the results obtained were generally very satisfactory, the length of work carried out being in excess of that specified, as is indicated by the following table:—

	Clearing only.	Construction.			Total Clearing and Construction.
		Formation only.	Forming and Gravelling.	Widening.	
	m. ft.	m. ft.	m. ft.	m. ft.	m. ft.
Work specified	40 4,356	8 2,652	20 606	0 3,960	70 1,014
Work carried out ...	39 2,376	10 2,372	24 2,027	1 2,180	75 3,625

The cost of these works, exclusive of plant hire, &c., not charged to the grants, was £32,292 3s. 9d., of which £31,300 consisted of the moneys granted and the remainder, £1,192 3s. 9d., was contributed by Councils from their own funds. The total amount expended in direct payment of wages on these completed works was £27,825, equal to 86.2 per cent. of the total expenditure and 88.8 per cent. of the amount made available from Unemployment Relief Funds. The balance of £4,466 represents the cost of materials purchased and haulage charges.

Returns furnished by Councils up to 31st January, 1931, show that on the whole of the works 800 men have been employed on the average over a period of twenty-two weeks, the maximum number engaged at any one time being about 1,200. About 360 men were still in employment on these works at the end of January.

Joints and Reinforcement in Cement Concrete Pavements.

In the construction of cement concrete pavements it is the Board's practice to provide transverse expansion joints at regular intervals of not more than 50 feet, while the pavement is also divided longitudinally by joints into strips normally 10 feet in width, but varying where necessary from 8 feet to 14 feet.

The transverse joints are formed in a perpendicular plane at right-angles to the centre line of the road, completely separating the adjoining concrete slabs with a strip of prepared bituminous joint filler three-eighths of an inch in thickness. These joints are placed at manholes and gully pits or at other similar openings in the slab, at changes in alignment, at tangent points of curves and at junctions of reinforced and unreinforced sections. Where no such special features exist, a maximum spacing of 50 feet is adopted. To provide continuity of support against rolling wheel loads, dowel bars are provided at the transverse joints. (See Fig. 1.) These dowels are firmly bonded in the concrete at one end, while the other end is first dipped in bitumen and provided with a standard cardboard cap (see Fig. 2), having an end space to enable sliding to take place as the individual slabs expand and contract with temperature and moisture changes.

Surrounding all slabs are placed steel edge bars. The corner of a slab is its weakest part, and the upper edge bars are accordingly bent in at the corners (see Fig. 1) to give additional strength to these portions of the slab.

Where the subgrade is weak, uneven in bearing value or in moisture content, or where the pavement is to be constructed on a new embankment, general

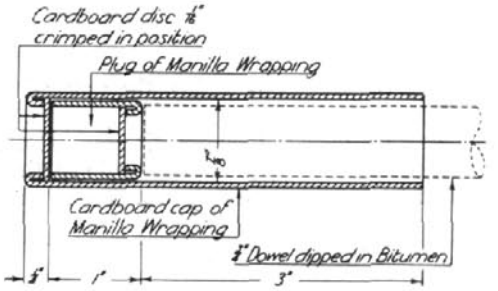


Fig. 2—Standard cardboard dowel cap.

reinforcement is also provided to distribute the pressure on the foundation and to give additional flexural strength to the pavement. This reinforcement is made in advance in sheets from either mild steel bars or cold drawn steel wire. On account of the higher tensile strength of the cold drawn steel wire, a reduction in weight is permitted where this material is used.

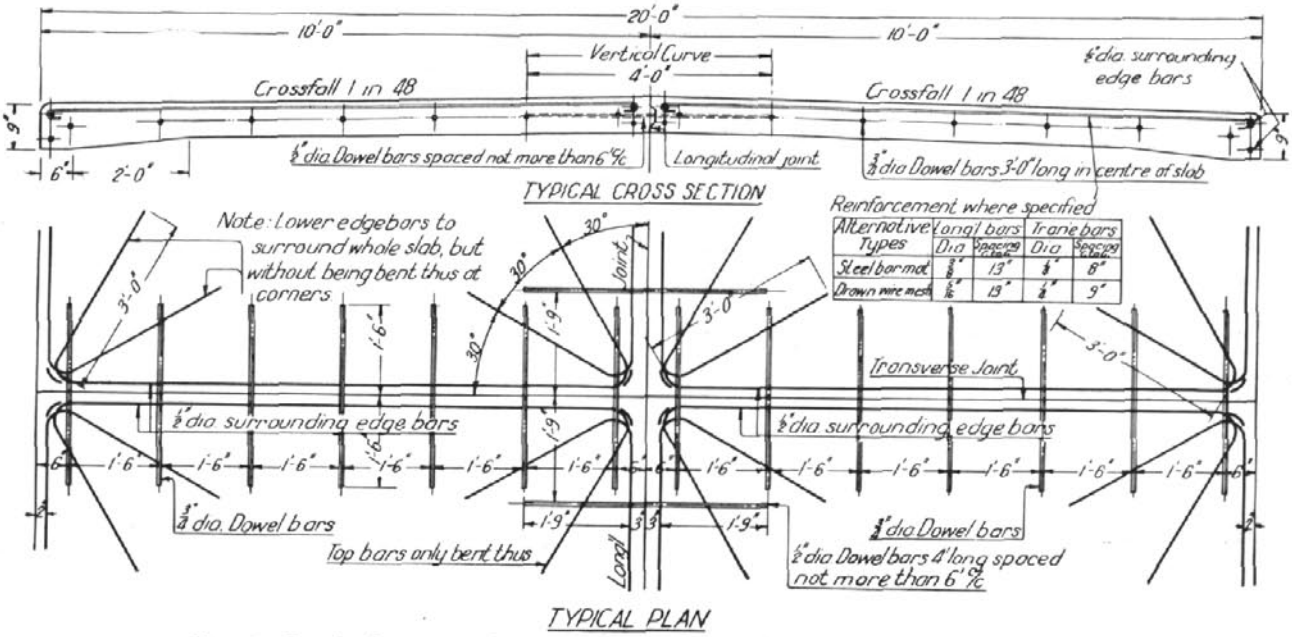


Fig. 1—Standard joint and reinforcement details for cement concrete pavement.

The longitudinal joints are deformed and are usually made with a 20-gauge metal parting strip. Where, however, the adjoining strips of pavement are not constructed monolithically, the metal parting strip is not required, and the edge of the strip of pavement first laid is painted with a bituminous material. Across these joints dowels are also provided, but are bonded in the concrete on each side of the joint and prevent the slabs from spreading apart, loads being transmitted by the keying action of the deformed joint.

This reinforcement is placed 2 inches from the top of the slab where it is of value in resisting temperature stresses and controlling surface cracking as well as giving flexural strength to the pavement. Where particularly marked local variation in the supporting power of the subgrade is to be expected, as, for example, over newly-refilled pipe trenches or adjacent to recently-constructed bridge abutments, special reinforcement suited to the requirements of the site is provided.

Standard Drawings for Flat-Country Roads.

By J. James, B.C.E., A.M.I.E.Aust.

Engineer.

In the January number of *Main Roads,* the standard types of road plan which have been evolved for streets and undulating country, respectively, were illustrated and described. A similar standard (reproduced in Fig. 1) has since been drawn up for describing work in flat country.

Throughout the Western plains, the natural surface of the various roadways is almost level, broken only by watercourses and a few isolated ridges. Roads are, in the main, constructed of machine-made earth formation, with or without a cheap form of pavement. From the nature of the country, it is obvious that plans less elaborate in detail than those adopted for undulating country will adequately describe flat-country work. Further, since this work is relatively inexpensive, the cost of surveys and preparation of plans must be reduced considerably below that obtaining in more difficult country if it is not to be unduly high in proportion to the cost of construction.

In surveying a flat-country road, it is necessary to fix the centre line, complete with reference pegs, just as in the more general case of undulating country, except that pegs at 100 feet intervals, or less, are necessary only at curves or the sites of culverts, causeways, or any irregularities of surface necessitating cuttings or embankments, and departure from a typical flat-country cross-section. For the remainder (the greater part of the work, generally), pegs at intervals of 200 feet are sufficient. Since flat-country formations are thrown up by machines to a cross-section in which the levels are all referred to natural surface, it is not essential for the centre line to be levelled, except where the typical flat-country cross-section is not applicable. However, as the latter points must be referred to a common datum, it is generally convenient to effect the connection by levelling the centre line pegs throughout, which, incidentally, is of value for comparison with flood levels and in demonstrating that the flat-country cross-section will give a satisfactory grade line.

The drawing is made upon the same sized sheet as the other typical drawings, *i.e.,* 1 mile of road is shown

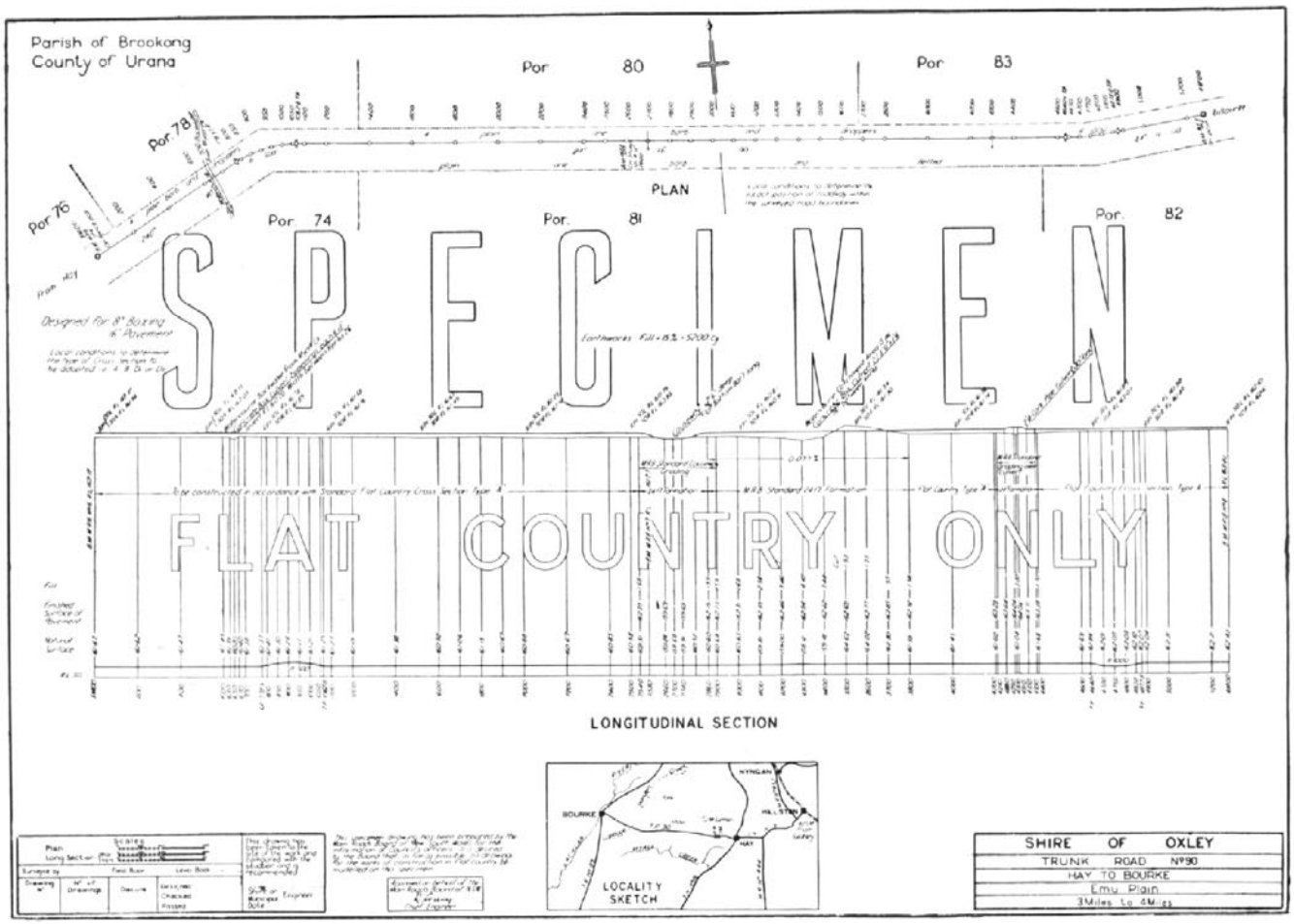


Fig. 1—Standard type of plan for road work in flat country.

upon each sheet. The plan shows the relation of the pegged centre line to the road boundaries. The longitudinal section shows the natural surface levels at each peg, but finished surface levels are shown only over those sections to which the typical flat-country cross-section cannot be applied. The standard flat-country

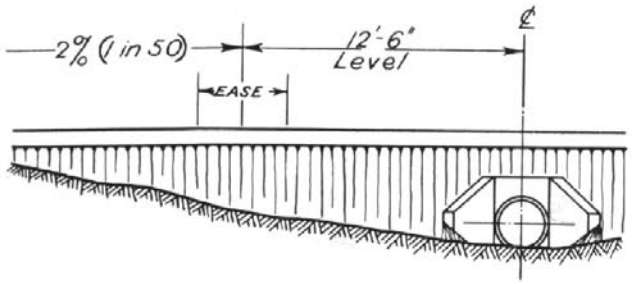


Fig. 2—Standard grading over culverts in flat country.

cross-sections each define the level of the finished surface with reference to the natural surface, minor inequalities in the longitudinal grading being smoothed out by the road machines; thus, finished surface levels are unnecessary except where the flat-country cross-section cannot be utilised.

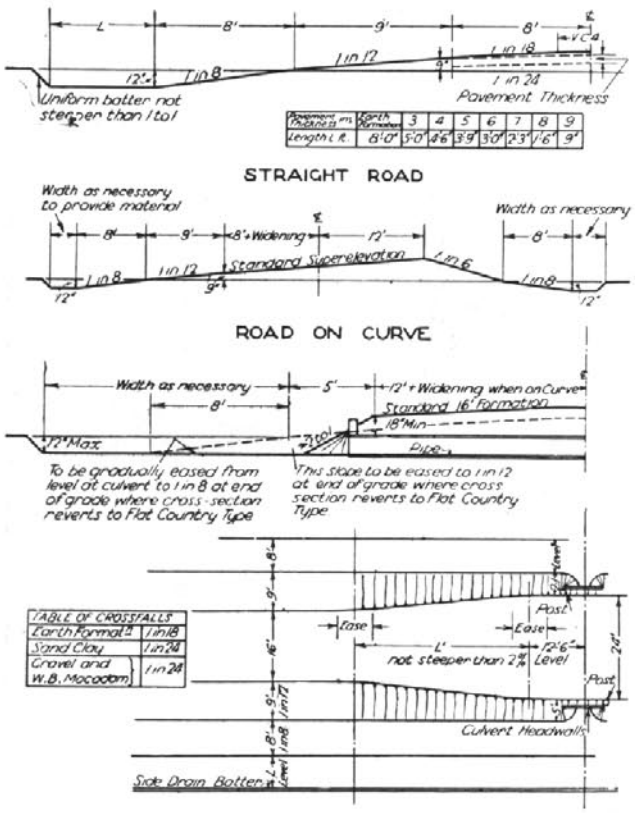


Fig. 3—Standard typical cross section, Type A, for use in flat country subject to slight inundation.

At culverts, where embankments must be constructed to give the necessary cover, the width of formation is specified, following the ordinary standard cross-section for 16 feet pavement (24 feet formation), 18 feet pavement (26 feet formation), or 20 feet pavement (28 feet formation) in accordance with the standard

of width laid down for the particular road. Finished surface levels are also shown, calculated in conformity with standard drawing No. A 243 (see Fig. 2).

At causeways, one or other of the types of grading shown on the standard instruction, *Grading of Causeways* (M.R.B. No. 269), is selected in accordance with

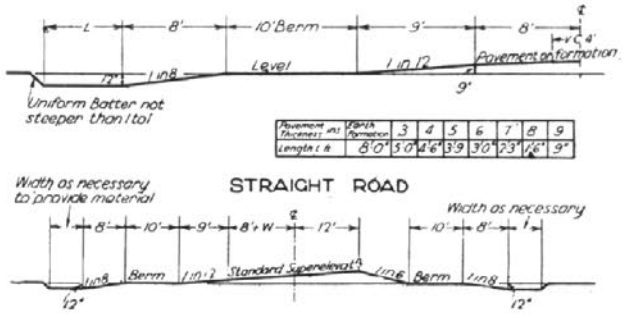


Fig. 4—Type B, which is similar to Type A, but has a berm on either side of the formation.

the principles outlined on page 28 of the October number of *Main Roads*. The overall length, bottom width, and depth are shown on the drawing, and finished surface levels are shown at either end and at the bottom of the causeway.

For undulating sections, the width of formation to apply is noted on the drawing. This will be formed in accordance with the ordinary standard cross-section for 24, 26 or 28 feet formation, as may be suitable, and finished surface levels and grades are shown as in the specimen drawing for undulating country.

A small locality sketch completes the drawing.

The standard typical cross-sections for flat country have recently been revised and now comprise four types, A, B, D1, and D2. Types A (see Fig. 3) and B (see Fig. 4) are suitable for work in very flat country subject to slight inundation and/or wind erosion and are similar, except that type B (see Fig. 3) includes a berm on either side between the formation and the side-drain, while type A does not. Each provides an earth formation 14 inches above the natural surface at the crown. Type D 1 (see Fig. 5) is

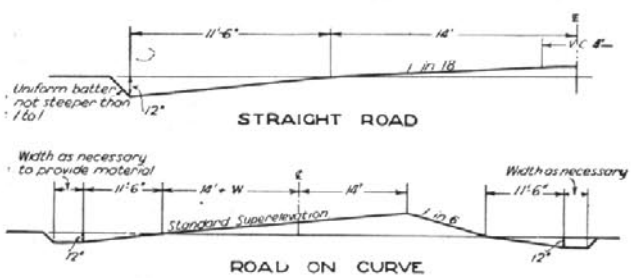
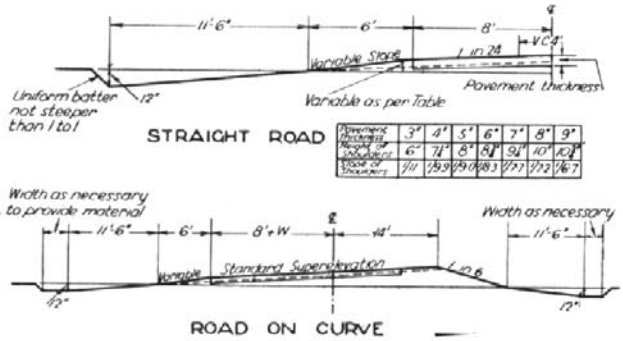


Fig. 5—Type D1, for earth formation in average flat country having fair drainage.

suitable for average flat country having a slight slope and fair drainage. It involves a smaller amount of cut and fill than types A or B, the height of the crown of the formation being 9 inches above the natural surface. Type D2 (see Fig. 6) is similar to type D1, except that modifications to cover different pavement

thicknesses are included. In each case, a sketch showing the treatment over culverts is included, that shown in Fig. 3 being typical.

Where traffic makes use of the flanks of an earth formation during dry weather, the splayed wings of the ordinary type of pipe culvert headwall may be considered an obstruction. For optional use in such cases,

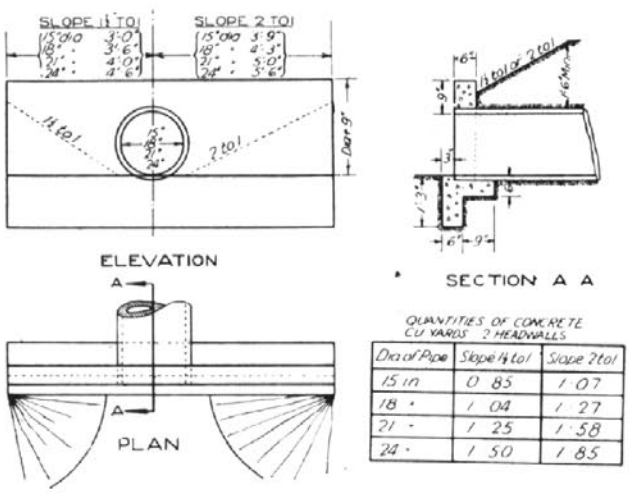


Pavement thickness	3"	4"	5"	6"	7"	8"	9"
Height of culvert	6"	7"	8"	8"	9"	10"	10"
Slope of Shoulders	1/11	1/9	1/9	1/8	1/7	1/7	1/6

Fig. 6—Type D2, which is similar to Type D1, but includes variations to cover different thicknesses of pavement.

a standard straight headwall has been designed (see Fig. 7), but it should be noted that the quantity of concrete for each size is in excess of that for the corresponding splayed-wing headwall.

Councils are strongly urged to avail themselves of the benefits appertaining to standardised methods by

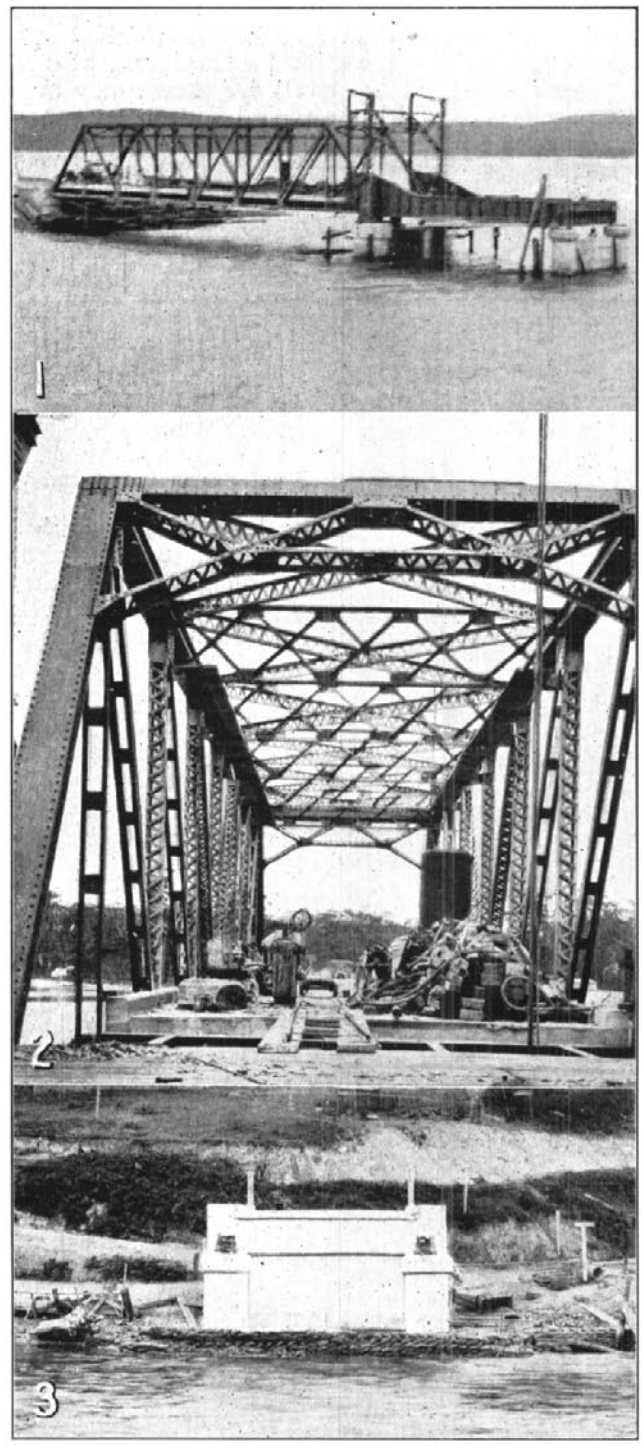


QUANTITIES OF CONCRETE CU YARDS 2 HEADWALLS

Dia of Pipe	Slope 1½ to 1	Slope 2 to 1
15 in	0 85	1 07
18 "	1 04	1 27
21 "	1 25	1 58
24 "	1 50	1 85

Fig. 7—Standard straight headwall for optional use in flat country.

setting out their proposals for flat-country work, whenever possible, in conformity with the standards described above. Copies of alll the drawings mentioned are obtainable in the usual way.



1. Southern truss span and bascule span.
2. Looking south from the bascule span.
3. Northern abutment and approach road.

Wagonga Inlet Bridge.

Satisfactory progress continues to be made with the new Wagonga Inlet bridge at Narooma, on the Prince's Highway. Both piers and the abutments have been completed, the southern truss span has been erected with deck complete, and the steel work for the bascule span has been placed in position. The erection of the northern truss span cannot be undertaken until the bascule span is available for use by shipping. The accompanying illustrations show the present state of the work.

Night Traffic at Peat's Ferry.

In the February number of *Main Roads*, complete statistics of the traffic at Peat's Ferry were given, showing both the weekly and hourly variations of traffic from the time the service was inaugurated until 11th January, 1931. Until 20th December, 1930, the service was maintained between the hours of 6 a.m. and 10 p.m. daily, but from 20th December throughout the holiday period, the service was continuous.

11th January to 27th January, 1931, the comparable figure was 4.6 per cent., which indicates that traffic was tending to spread slightly. For the period 27th January to 8th February, during which the service ceased at 12.30 a.m., the traffic carried between 10 p.m. and 12.30 a.m. amounted to 2.2 per cent. of the total for the same period.

During the full period of continuous running, when the traffic carried between 10 p.m. and 6 a.m. was 3.9

HOURLY RECORD OF MOTOR CAR TRAFFIC BETWEEN 10 P.M. AND 6 A.M.

HOUR.	DECEMBER, 1930.											JANUARY, 1931.												
	20–21	21–22	22–23	23–24	24–25	25–26	26–27	27–28	28–29	29–30	30–31	31–1	1–2	2–3	3–4	4–5	5–6	6–7	7–8	8–9	9–10	10–11	11–12	12–13
10-11 p.m.	1	3	3	8	15	5	15	12	13	2	3	6	8	13	17	11	7	5	6	7	6	9	13	2	6
11-12 ,,	1	3	2	7	33	5	1	5	5	2	1	17	11	5	7	8	1	2	1	1	3	7	13	6	2
12-1 a.m.	5	4	2	5	22	3	2	4	10	3	4	6	3	3	4	5	1	1	...	1	5	9	7	4	2
1-2 ,,	3	1	3	2	18	...	1	3	5	1	1	4	...	...	3	3	2	2	...	1	2	4	4	...	4
2-3 ,,	1	...	1	3	25	1	...	...	4	...	1	2	2	...	3	2	...	...	...	...	...	1	1	...	...
3-4 ,,	3	2	2	2	12	...	...	...	...	...	...	...	...	2	2	...	...	...	2	...	1	...	1	...	...
4-5 ,,	5	...	3	7	13	5	1	...	...	...	...	1	...	...	...	2	...	...	...	1	...	2	...	6	...
5-6 ,,	6	1	4	14	44	13	1	5	...	...	...	12	...	5	8	6	1	1	1	1	2	4	2	2	2
Total cars, 10 p.m.-6 a.m.	25	14	20	48	182	32	21	29	37	8	12	48	24	28	44	37	12	11	10	12	19	36	41	20	16
Total cars, preceding day, 6 a.m.-10 p.m.	752	788	520	584	1,045	1,498	1,574	1,053	1,476	568	533	649	908	670	1,053	1,500	675	570	506	409	490	856	1,017	459	337

HOUR.	JANUARY, 1931.																		FEBRUARY, 1931.						
	14–15	15–16	16–17	17–18	18–19	19–20	20–21	21–22	22–23	23–24	24–25	25–26	26–27	27–28	28–29	29–30	30–31	31–1	1–2	2–3	3–4	4–5	5–6	6–7	7–8
10-11 p.m.	6	1	5	8	14	6	2	2	2	10	11	12	23	2	...	4	6	8	8	2	6	4	...	...	2
11-12 ,,	2	2	...	2	10	2	2	2	...	12	8	6	22	8	4	2	16	2	8	10	2	2	...	6	6
12-1 a.m.	2	2	6	4	2	...	...	2	4	6	8	4	9	...*	2*	...*	2*	...*	...*	...*	4*	2*	...*	2*	4*
1-2 ,,	2	...	...	2	...	...	...	2	...	4	6	4	3	...	...	...	...	...	...	...	...	...	...	...	...
2-3 ,,	...	2	...	4	...	4	4	2	2	...	6	6	10	...	...	...	...	...	...	...	...	...	...	...	...
3-4 ,,	2	...	2	8	...	2	...	4	4	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
4-5 ,,	4	2	4	2	2	2	...	2	...	...	6	4	8	...	...	...	...	...	...	...	...	...	...	...	...
5-6 ,,	2	4	4	4	2	2	...	2	2	14	10	2	6	...	...	...	...	...	...	...	...	...	...	...	...
Total cars, 10 p.m.-6 a.m.	20	13	21	34	30	18	8	18	14	48	55	38	81	10	6	6	24	10	16	12	12	8	...	8	12
Total cars, preceding day, 6 a.m.-10 p.m.	337	377	459	751	952	466	370	375	393	597	394	861	1,809	585	376	380	448	690	872	424	275	287	243	318	527

* Service ceased at 12·30 a.m.

Over the Christmas and New Year holiday period, the traffic using the ferry between 10 p.m. and 6 a.m. was only 3.4 per cent. of the total traffic carried in twenty-four hours. As a result of this, the Board terminated the continuous service immediately after Anniversary Day (26th January, 1931), but extended the hours of running from 10 p.m. (as obtained before the holidays) to midnight, the extension to be reviewed at the end of March.

The accompanying table gives an analysis, hour by hour, of the night traffic (cars only) for the full period of continuous running, and for the extended hours up to 8th February. Between 20th December, 1930, and 11th January, 1931, the 10 p.m. to 6 a.m. traffic was 3.4 per cent. of the total. For the period

per cent. of the total for twenty-four hours, 1.7 per cent. was carried between 10 p.m. and 12 a.m. and only 2.2 per cent. during the remaining six night hours. Reference to the table will show that, on most nights, cars were carried at a rate of two or less per hour after 10 p.m. On some nights, no cars were carried for periods ranging up to four hours.

Briefly, the figures indicate that continuance of the service between midnight and 6 a.m., except at times of heavy holiday traffic, *e.g.*, Christmas Eve, is not warranted by the night traffic offering, but that extension of the service until midnight caters for approximately half the total night traffic. The matter of the continuance or modification of the present extended service will be further considered at the end of March.

Surfacing The Great Northern Highway between Peat's Ferry and Mooney Mooney Creek.

By C. K. Oliver, A.M.I.E. Aust.,

Supervising Engineer, Outer Metropolitan Division.

Whilst the earthworks between Peat's Ferry and Mooney Mooney Creek were in progress, the locality was prospected for materials suitable for the pavement. The country traversed by the road is of sandstone formation, the only other stone in the district being basalt at Mount Bushell, a distance of 10 miles from the nearest point on the highway. The cost of putting in a tramway and obtaining metal from this source was investigated and found to be prohibitive. Tests made of the sandstone gave a French co-efficient of hardness of about 2, and also indicated that there was no appreciable increase in hardness brought about by heat treatment. The only other material available was gravel, of which an extensive deposit occurred adjacent to the Highway at a point 7 miles from the ferry. This gravel consisted of ironstone, with a bauxite binding material. It consolidated excellently under the roller.

As the earthworks involved many high embankments which had only recently been constructed, the Board decided to surface the whole length of 14 miles between Peat's Ferry and Mooney Mooney Creek with gravel, which would form a good running surface for traffic whilst the earthworks attain final consolidation and serve as a base course for a higher class of pavement when found to be necessary in the future. The gravel was laid and consolidated to an average depth of 5 inches, the quantity used being approximately 43,400 cubic yards.

After the gravelling had been completed, it was found that during wet weather certain sections tended to become greasy owing to the clay content of the gravel being somewhat high. To overcome this, parts were top-dressed with gravel of a sandy nature and others with Locksley disintegrated granite gravel.

The road was opened to traffic in July, 1930. Whilst the winter lasted and the gravel remained moist it gave excellent results. When, later, dry weather conditions prevailed over an extended period the dust became troublesome, particularly on occasions when traffic was dense. Accordingly tests of various surface treatments aiming at the elimination of the dust were made in the Board's laboratory. It was found that priming tar would not adhere to the gravel at all, and that asphaltic oils tended to have a disintegrating effect. Experiments with tar and bitumen emulsions indicated that there were all the elements of a successful treatment with these materials. Small experimental patches, each a few square yards in extent, were then laid on the highway itself. The results obtained formed the basis for an experimental length of 1 mile, commencing at the ferry and using various treatments. This work was put in hand on 11th November, 1930, and completed towards the end of the same month.

The experience gained during the surfacing of this length, and the encouraging results obtained, led to a decision to surface a further length of 7 miles (between 1 mile and 8 miles from the ferry) before Christmas, in order that the dust might be overcome on that section before the holiday traffic.

The surfacing work was carried out as follows:—The road was first bladed with a tractor-drawn grader, but not scarified, the object being to remove any loose material and plane off high points. Sweeping by horse broom, and, where concentration of dust occurred, by hand, then followed. Tar emulsion was then applied by power sprayers as a priming coat, at the rate of ¼ gallon per square yard. Just before the work commenced rain fell, and the No. 2 tar emulsion took to the gravel excellently. When the pavement became absolutely dry it was found necessary to add water to the emulsion at the rate of one part of water to three parts of emulsion to secure satisfactory results. Watering the road surface immediately prior to applying the tar emulsion was not satisfactory, owing to the tendency to get too much variation in the degree of dampness—the addition of the water to the emulsion was found the more satisfactory method. When water was added the rate of application was somewhat increased, but it was not found practicable to put much more than ¼ gallon per square yard owing to the tendency of the emulsion to "run." No. 0 and No. 1 tar emulsions were also tried, the former giving the more satisfactory results when the pavement was very dry. After the rain on 15th, 16th, and 17th December, however, the No. 2 tar emulsion was reverted to, as it gave greater body to carry the traffic pending sealing and stood up to sweeping better than No. 0.

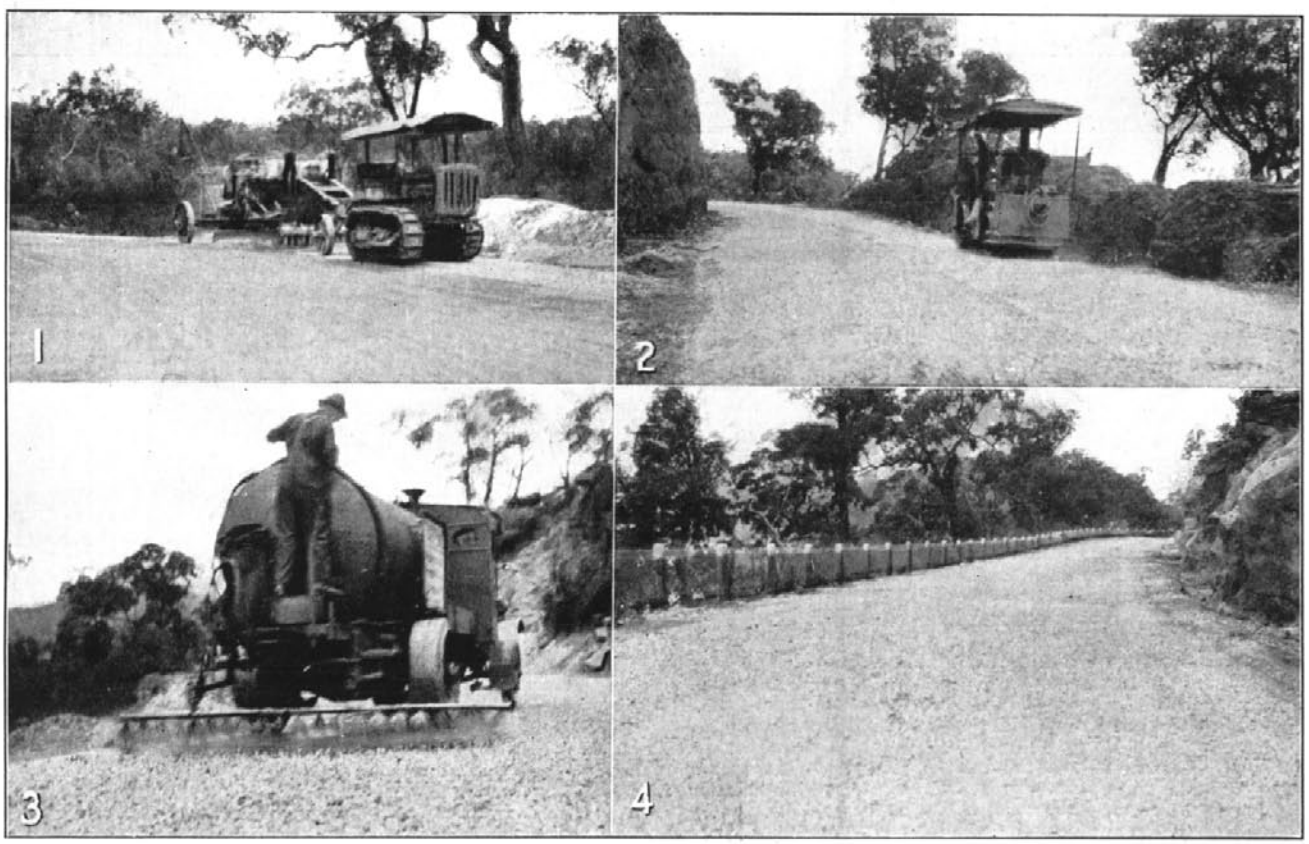
Immediately after the emulsion had been sprayed, it was covered with the gravel which had been removed by the grader, this being necessary to enable traffic to pass. Much trouble was experienced through traffic rushing on to the sprayed sections of the roadway immediately behind the spray waggon before the cover material could be applied. Where this occurred a certain amount of picking up was inevitable and, owing to the rate at which the work was carried out, no time was available for patching prior to the seal coat being applied, with the result that a few misses in the seal occurred, giving

the appearance of failures. After the priming coat had been applied and covered it was given from twenty-four to forty-eight hours to set, according as circumstances permitted, the horse broom was then put over it, and the seal coat of No. 2 tar applied at the rate of ¼ gallon per square yard, and covered with ¾ inch blue metal screenings at the rate of approximately 1 cubic yard per 75 square yards. The finished surface was then rolled with a 6-8 ton tandem steam roller, driven at about 6 miles per hour in order to keep pace with the work.

Quotations for the necessary materials were called on 27th November, 1930, and orders were placed on 5th December, 1930. The preparation of the pavement was commenced on Monday, 8th December, and the spraying of the tar emulsion primer was put in hand the following day. Delivery of blue-metal screenings on the site commenced on 10th December. It was arranged that the application of the tar seal coat should be commenced on Monday, 15th December, 1930, but rain fell on 15th, 16th, and 17th, and it was not until Friday, 19th, that the sealing could be started. There were thus only four working days remaining prior to the holidays in which to seal 7 miles of road. Arrangements were therefore made to work a second shift, commencing on Saturday, 20th, to see the work through, a foreman, ganger, and the necessary men being transferred from Wyee. The 7 miles were actually completed about 3.30 p.m. on Tuesday, 23rd December, or in slightly less than four working days. On the last three days the work was done at the rate of slightly more than 2 miles per day.

Tar emulsion was supplied at the rate of 4,000 gallons per day, tar at over 6,000 gallons per day, and metal screenings at upwards of 200 tons per day. The companies supplying the materials, the Australian Gas Light Company, the B.H.P. By-Products Pty. Ltd., and the New South Wales Associated Blue Metal Quarries Ltd., co-operated whole-heartedly in keeping up supplies at the required rates to permit of this progress being made. The whole of the work was carried out whilst the road was under traffic, being done in half widths at a time.

For future work of the same nature it is considered that better results would be obtained by the use of a heavier roller and by leaving a slightly longer period between the application of the tar emulsion primer and the seal coat. Also the use of metal screenings on the priming coat in lieu of the local gravel would give an improved mat, but would, naturally, add to the cost.



1. Grader preparing pavement for primer.
2. Rolling the completed surfacing.
3. Sprayer applying seal of No. 2 tar.
4. Completed work 5 miles north of Peat's Ferry.

Tenders and Quotations Accepted.

The following Tenders and Quotations were accepted by the Board during the month of January, 1931:—

Tenders.

Work.			Name of Successful Tenderer.	Amount of Accepted Tender.
Municipality or Shire.	Road No.	Description.		£ s. d.
Stockton	108	Tar re-surfacing between Flint-street and municipal boundary, 1 m. 5,025 ft.	B.H.P. By-Products, Ltd.	481 6 6
Yallaroi	12	Fencing, Gwydir River bridge, Gravesend, 1 m. 3,770 ft.	Manuel Bros.	257 0 0
Bulli and Sutherland	1	Hire of up to five two-ton motor trucks with approved power-operated or other quick-acting tipping gear, for use on the Prince's Highway, near Waterfall (per hour).	J. A. Budd and Sons ...	1 at 6s.
			W. J. Donovan ...	1 at 6s.
			Eric Leard	1 at 6s.
			J. Staines	2 at 5s.
		Purchase and demolition of buildings, North Sydney ...	C. G. Newland ...	166 0 0

Quotations.

No. of Quotation.	Description of Article.	Name of Successful Tenderer.	Amount of Accepted Quotation.
			£ s. d.
981	Bridge timber—17 in. dia. small end—620 ft. 6 in., 19 in. dia. small end—70 ft., 13 in. x 12 in.—235 ft. 6 in., 12 in. x 12 in.—347 ft., 12 in. x 6 in.—199 ft., 9 in. x 9 in.—200 ft., 9 in. x 7 in.—30 ft., 6 in. x 6 in.—253 ft., 4 in. x 8 in.–10 in., in 20 ft. 6 in. lengths—20,500 ft. super.	Oakley & Co.	636 19 6
983	Bridge timber—12 in. dia. small end—200 ft., 16 in. dia. 21 ft., 18 in. dia. 48 ft., 18 in. x 18 in.—153 c. ft., 14 in. x 18 in.—17½ c. ft., 14 in. x 16 in.—15½ c. ft., 8 in. x 8 in.—1,851 sup. ft., 9 in. x 5 in.—27,090 sup. ft., 9 in. x 4 in.—132 sup. ft., 6 in. x 4 in.—310 sup. ft.	J. F. Machon	546 1 9
984	Road graders—(two-horse), 3 only	British Standard Machinery Co.	147 0 0
985	Hardwood—20,000 lin. ft., 5 in. x 2 in., 2,500 pegs, 5 in. x 2 in., 18 in. long, pointed 6 in. on three sides.	Mulhearn Bros.	258 12 10
986	Bridge timber—18 in. x 12 in.—292 ft. 6 in., 16 in. x 14 in.—14 ft., 15 in. x 14 in.—14 ft., 15 in. x 10 in.—37 ft., 15 in. x 8 in.—725 ft., 14 in. x 14 in.—37 ft. 6 in., 14 in. x 9 in.—23 ft., 12 in. x 12 in.—24 ft.	Allen Taylor & Co. Ltd.	252 5 6
987	Sandstone ballast—80 cubic yards	T. Adams	27 13 4
988	Bridge timber—12 in. dia. small end—44 ft. 6 in., 13 in. x 12 in.—30 ft. 6 in.	C. T. Abbott	16 10 0
989	Sand—350 tons	Emu and Prospect Road Metal Co. ...	126 17 6
990	Blue metal—500 tons, ¾ in.	N.S.W. Associated Blue Metal Quarries...	181 5 0
992	Bridge timber—16 in. dia. small end—52 ft.	Armstrong & Royce Ltd.	9 10 0
993	Crushed Nepean gravel—500 tons, ¾ in.; 500 tons, ⅝ in. ...	Emu and Prospect Gravel and Road Metal Co.	362 10 0
994	Bitumen—50 tons, 85-100 penetration	No quotation accepted.	.....
995	Concrete pipes—15 in. dia, 102 ft.; 18 in. dia., 102 ft.	State Monier Pipe Works	38 10 0
996	Firewood—100 tons, 2 ft. 6 in. lengths	T. Hourigan	59 11 8
998	Concrete pipes—36 in. dia., 25 ft. 1 in.	State Monier Pipe Works	20 0 0
999	Blue metal—500 tons, ¾ in. gauge	N.S.W. Associated Blue Metal Quarries...	175 0 0
1000	Alignment pins—250 cast iron	Gibson, Battle & Co. Ltd.	50 0 0
2	Sand—1,000 tons	Emu and Propsect Gravel and Road Metal Co.	350 0 0

The acceptance by the respective Councils of the following Tenders has been approved by the Board during the month of January, 1931:—

Work.			Name of Recommended Tenderer.	Amount of Recommended Tender.
Municipality or Shire.	Road No.	Description.		£ s. d.
Lachlan	1139	Forming and causeways between 16 m. and 19 m. 1,120 ft.	H. Broad	325 12 0
Kyogle	1050	Two new timber bridges over Black's Camp Creek	Bugden & Bugden ...	884 2 9
Terania	1085	Gravel construction between 2,300 ft. and 1 m. 1,670 ft....	Caddell Bros.	1,540 2 0
Terania	1085	Construction of concrete culvert at 1 m. 1,270 ft.... ...	Withers & Freeman ...	318 3 9

Sydney: Alfred James Kent, I.S.O., Government Printer—1931.