1944.

VICTORIA.

COUNTRY ROADS BOARD.

THIRTY-FIRST ANNUAL REPORT

FOR YEAR ENDED 30TH JUNE, 1944.

PRESENTED TO BOTH HOUSES OF PARLIAMENT PURSUANT TO ACT No. 3662

[*Cost of Report*:—Preparation—Not given. Printing (850 copies), £50.]

By Authority:

H. E. DAW, GOVERNMENT PRINTER, MELBOURNE.

No. 22.—[1s.]—11556/44.

COUNTRY ROADS BOARD.

THIRTY-FIRST ANNUAL REPORT.

Exhibition Building,
Carlton, N.3.,
23rd October, 1944.

The Honorable J. H. Lienhop, M.L.C.,
Minister of Public Works,
Department of Public Works,
Melbourne, C.2.

SIR,

In accordance with the requirements of Section 96 of the Country Roads Act (No. 3662), the Board has the honour to submit to you, for presentation to Parliament, the report of its proceedings for the year ended 30th June, 1944.

FINANCIAL POSITION.

The receipts from motor registration fees and fines paid into the Country Roads Board Fund during the year amounted to £1,445,987, compared with £1,362,903 during the preceding year, an increase of £83,084. Cost of collection and refunds totalled £101,463, leaving a net revenue of £1,344,524.

The sum of £309,748 was received under the terms of the Federal Aid Roads Agreement as against £276,883 received from the same source during the previous year, representing an increase of £32,865.

The total gross amount received from both sources was, therefore, £1,755,735, an increase of £115,949, in comparison with the total for the financial year 1942–43.

From the loan authorization of £500,000 for the construction and reconstruction of metropolitan roads, passed by Parliament under Acts 4188, 4414, and 4498, no expenditure was incurred during last year. The balance of £246,742 therefore remains at the same figure as at the 30th June, 1943.

COUNTRY ROADS BOARD FUND.

In spite of the limited programme of maintenance works, municipal councils and the Board experienced considerable difficulty in carrying out the works to completion. As in previous war years this was due to diversion of engineers, men, and plant to defence works, and the scarcity of materials, which factors militated against the satisfactory maintenance of the road system. It was not possible, therefore, to put in hand much of the work for which provision had been made, consequently an expenditure of £360,647 only was incurred, representing approximately two-thirds of the total allocations for main roads.

Expenditure on maintaining State highways, main roads, tourists' roads, and Murray River bridges was £649,275 for the year, compared with £521,588 for 1942–43.

For the above reasons, a substantial credit balance of £788,747 is shown in the Country Roads Board Fund.

During the financial years 1941–42 and 1942–43, the Government approved of the sums of £125,000 and £250,000 respectively, being set aside towards meeting the cost of necessary reconstruction which must ultimately be faced to bring the roads up to a standard to meet post-war requirements. Out of the unexpended balance of £788,747 accrued in the Country Roads Board Fund at the 30th June last, directions have been given by the Government for a further sum of £250,000 to be reserved for the same purpose. After providing £120,000 to meet commitments on contracts and direct labour works in hand at the end of the financial year, a balance of £43,747 stood to the credit of the Country Roads Board Fund at the 30th June last.

Federal Aid Roads Account.

The amount of £309,748 received under the Federal Aid Roads and Works Agreement during the twelve months was expended as follows:—

	£
Linking up constructed sections of developmental and main roads ..	57,620
Isolated settlers' roads	19,513
Maintenance of roads previously constructed from moneys provided by the State	74,252
Restoration and re-building of bridges	7,170
Total	158,555

For the maintenance and repair of public roads adjoining or approaching properties of the Commonwealth within the State of Victoria, an amount of £3,300 was made available under the terms of the Federal Aid Roads Agreement, which, together with the amount of £2,785 brought forward from the previous year, made the total amount available £6,085. The expenditure was £1,573, and £4,512 was carried forward to the ensuing financial year.

At the 30th June, 1944, a credit balance of £650,982 is shown in the Federal Aid Roads Account, but after making provision for unexpended amounts allocated to municipalities during the year for assistance in maintaining roads and bridges, commitments on contracts entered into and works in progress by direct labour, the actual credit balance is £592,806.

Defence Expenditure.

The expenditure for the year was £1,366,906. As the works progressed, advances were made by the Commonwealth Government through the State Treasury. Pending reimbursement by the Commonwealth, £446,373 was financed from the Country Roads Board Fund under National Security Regulations. The total expenditure for the war period is £4,672,910. The aggregate value of defence works completed and in hand is £5,801,400.

DEFENCE WORKS.

On behalf of the Allied Works Council further important defence works have been undertaken, both in Victoria and the Northern Territory.

Works comprising the strengthening and bituminous surfacing of the section of the Stuart Highway in the Northern Territory, some particulars of which were given in last year's Annual Report, were completed in October, 1943. This length, which extends from Alice Springs to Larrimah covering a distance of 630 miles, was successfully carried through in close accordance with the time schedule and estimated cost. The total expenditure was £1,252,000. In addition £256,720 was expended on maintenance and sealing.

The Board's organization was then called upon by the Allied Works Council to carry out a further programme and, with the approval of the State Government, the organization was retained in the northern part of the Territory. A new divisional office has been established with technical staff, men, and equipment, and extensive works including aerodrome and road surfacing have been commenced. This involves the employment of 500 to 600 men and the operation of extensive workshops for overhauling of plant which forms an important part of the organization necessary for highly mechanized projects of this class. A considerable proportion of the Board's skilled workshop staff is employed in these workshops.

In Victoria the work included the construction of platforms and paved areas, &c., at an important ordnance depot, and provision of the necessary surfaced roads and bituminous surfacing, whilst in other areas foundation footings and floors have been constructed for workshops, stores, and factory buildings, and landing grounds, taxiways,

runways and aprons have been extended at several training aerodromes, with extensive bituminous surfacing as required. At an important testing airfield a new hard-surfaced runway has been constructed and surfaced with hot-mix bituminous thin carpet. The strengthening of weak bridges in areas where heavy army vehicles operate during training exercises has also proceeded.

On all these defence works mechanization has increased to a marked extent, requiring strict engineering control of heavy plant, overhauls at the central workshops and the development of systems of field maintenance to ensure smooth working of construction jobs.

A similar change in emphasis from older manual methods is to be expected in post-war construction in Victoria, so that the experience gained will be directly applicable to the Board's future programmes.

The Board has maintained close contact with departments of Government and other authorities concerned to secure all possible co-operation in carrying through the programmes of defence works which it has been called upon to undertake.

During the year the Board continued, on behalf of the Allied Works Council, to pay the wages of members of the Civil Constructional Corps as well as the allotments made by members engaged on works within the State of Victoria.

STATE HIGHWAYS.

Owing to the deterioration of the position, brought about by the transfer of men and plant to defence projects undertaken by the Board, the only construction works carried out were the replacement and restoration of bridges and culverts which were necessary for the safe passage of military and civilian traffic. Six old bridges which had reached the end of their useful life were replaced by new structures and six bridges were partially rebuilt.

Following the procedure of previous war years, only essential general maintenance, which was governed by the limited labour, plant, and materials available, could be carried out over the total length of State highways comprising 2,800 miles.

Highways and bridges subjected to heavy military traffic have in many instances necessitated extensive reconstruction, and constant attention is being given to strengthen sections and structures to meet military requirements.

In addition, vehicles transporting from forest areas heavy loads of logs and timber needed for defence purposes, have caused serious deterioration of highway surfaces on which there is no reserve to withstand the abnormal loads they are now called upon to bear. In many instances it has been necessary to resheet sections subjected to this class of traffic to prevent the extension of the failures which are now apparent. In the case of gravel or rock surfaces, extensive resheeting has been necessary in order to maintain a satisfactory surface, but delays are frequently met with in obtaining the necessary supplies owing to the prevailing restrictions on manpower and plant.

Owing to dry climatic conditions prevailing during the year road works were hampered, particularly in the north and north-western areas of the State, where a severe drought has been experienced for some time.

The position with respect to supplies of bitumen which is controlled under National Security Regulations by the Department of Supply and Shipping, has not improved. Bitumen cannot be used for other than essential purposes, consequently the available quantity could be used only for essential maintenance of existing sealed roads, with the exception of some short lengths totalling 5·3 miles which were treated with a first seal to meet special defence requirements. The length of resealing completed last year was 160·9 miles, compared with 106 miles during the previous year.

The total expenditure on maintenance and repairs was £240,729, including the cost of improvements required to meet urgent needs. £12,940 was expended on the erection of new bridges and the restoration of dilapidated structures. £240,660 was provided from the Country Roads Board Fund and £69 from Federal Aid funds.

MAIN ROADS.

Adequate maintenance of main roads has been one of considerable difficulty on account of the reasons already stated.

Municipal councils carried out the work, excepting on certain main roads carrying traffic not of local origin which are being maintained by the Board, but the problem of securing qualified engineers and skilled workmen has been one which has not yet been solved, although the position has somewhat improved during the past few months. Consequently, as an expedient, there has been no alternative but to continue with the engagement of municipal engineers from adjacent municipalities on a part-time basis.

As many of the roads are now being used by much heavier vehicles than formerly, particularly those transporting timber, a steady deterioration of road surfaces is apparent.

Special attention is being given by the Board to roads originally constructed for local light traffic, but which are now carrying vehicles transporting heavy loads of timber upon which a high priority has been placed by the Commonwealth Government. Large sums have already been expended in reconstructing these roads to a higher standard to enable the cartage to continue uninterruptedly. Every assistance is being given to municipal councils in maintaining roads of this type.

The volume of military traffic in rural districts of Victoria is not now as great as in previous war years, resulting in less wear and tear on the roads from army vehicles. In cases where army vehicles have caused damage, or roads have been subjected by them to exceptional wear, the Board has brought the matter under the notice of the authorities and as a result of investigation a satisfactory basis for contribution has been arrived at.

Owing to limited supplies of bitumen the resealing of main roads was strictly confined to essential works. The length of reseals for the twelve months extended over 282·5 miles, whilst new seals on sections needing urgent attention were restricted to 6·1 miles. The total lengths dealt with show an increase of 129·3 miles.

Because of manpower and material shortages, only those bridges which were becoming unsafe for traffic were replaced or repaired during the year. Eleven new bridges were built and five existing bridges strengthened at a total cost of £10,620.

An amount of £571,139 was allocated last year to municipalities for the maintenance, improvement, and reconditioning of 8,495 miles of declared main roads, but, for the reasons previously stated, the amount expended was £387,162 only, approximately two-thirds of the total allocation. Provision of £523,731 was made from the Country Roads Board Fund and £47,408 from moneys available under the Federal Aid Roads Agreement.

The following statement shows the annual expenditure since the financial year 1938–39, from which it will be noted that last year's expenditure was £382,000 below that of the pre-war year.

EXPENDITURE ON MAINTENANCE OF DECLARED MAIN ROADS.

—	Country Roads Board Fund.	Federal Grant.	Total.
	£	£	£
1938–39	718,009	51,153	769,162
1939–40	623,914	46,996	670,910
1940–41	585,596	46,500	632,096
1941–42	372,335	24,813	397,148
1942–43	295,230	22,732	317,962
1943–44	360,647	26,515	387,162

In accordance with the powers conferred on the Board under the provisions of the Country Roads Act, municipal contributions towards the cost of maintenance were reduced below one-third of the total cost in the case of declared main roads carrying traffic not of local origin or timber traffic. The assistance given in this way amounted to £22,375 for the year.

Under Act No. 4415, relief to the extent of £221,040 was granted to country municipalities on account of interest and sinking fund payments in respect of main and developmental roads for the year.

With the approval of the Governor-in-Council, short sections of roads totalling 4½ miles were declared as main roads in continuation of existing main roads.

TOURISTS' ROADS.

As with other roads under the jurisdiction of the Board only essential maintenance including the repair of bridges was carried out on tourists' roads.

The amount expended was £44,332 provided from the Country Roads Board Fund.

During the war a number of declared tourists' roads have been subjected to heavy timber and firewood traffic, resulting in considerable deterioration of the road surfaces.

Before these roads were proclaimed tourists' roads under the provisions of the Country Roads (Tourists' Roads) Act, it was not anticipated that traffic of that nature would be using them, consequently they were mostly constructed with light surfaces only, which have had to be strengthened to carry the existing heavily laden vehicles.

The only major work undertaken was the completion of that commenced the previous year on the Ocean-road between the Sheoak Creek and Wye River. In view of the considerable carting of timber over this road, extensive work was necessary to allow of uninterrupted transport under a priority order issued by the Commonwealth Government.

The expenditure incurred was £3,768 for the year under review, making the total expenditure on this project £12,335.

DEVELOPMENTAL ROADS.

Provision of £90,699 was made available from Federal Aid funds to municipal councils for linking up roads on which funds had already been expended and for completion of short lengths of constructed roads of an urgent nature. Funds were also provided for other urgent works mainly consisting of reconstruction and restoration of bridges and approaches, together with commitments brought forward from the previous year. £39,653 was expended during the year, supplemented by an amount contributed by Councils from their own funds.

An amount of £47,877 was allocated to Councils to assist in the maintenance of roads of a developmental character on which Federal Aid or other funds had previously been expended on their construction. £35,361 was expended, in addition to which municipal contributions totalled £11,821.

BRIDGES.

During the year, apart from the replacement of bridges destroyed by bush fires, 47 bridges were reconstructed and replaced to meet the demands of traffic.

The major portion of the works was carried out by the Board in addition to the routine maintenance of structures on State highways, on several main roads and tourists' roads. Twenty-three structures were completed under the Board's supervision and 24, mostly small structures, by municipalities.

Thirty-eight new projects were completed or nearing completion during the twelve months under review, making the total number of structures erected by the Board and municipal councils 2,908.

In addition to these projects, 35 bridges and more than 100 timber culverts were destroyed or seriously damaged by bush fires. A considerable number of the culverts and 19 of the larger bridges, costing £13,970, were replaced by employees made available to councils by the Board.

Whilst many of the bridges are capable of carrying the traffic using them at present, their condition is such that frequent repairs are necessary to keep them trafficable. In the list of post-war works numerous bridge structures have been included for restoration and renewal, for which a considerable expenditure must be incurred.

Under war-time conditions, it has been necessary to issue permits for exceptionally heavy loads to cross bridges throughout the State. In general, it has been found that, despite the great magnitude of many of these loads as compared with the individual units of the conventional system of live loads used in bridge design, the effect on bridges is usually within reasonable limits. This is due to the spread of these heavy loads because of their bulk and the restrictions imposed by safe tyre loads.

In addition, when considered necessary to reduce the stresses induced in structures by heavy loads, it is specified that whilst crossing the vehicle shall :—

(*a*) Pass along a designated path on the structure (usually down the centre).

(*b*) Travel at a slow speed (5 to 10 miles per hour).

(*c*) Travel at a constant speed, i.e., shall not brake or accelerate.

(*d*) Be the only vehicle on the structure.

An interesting case occurred in Melbourne where it was necessary to transport a vehicle having a gross load of 81·6 tons over the 70 ft. spans of Lynch's bridge over the Maribyrnong River on the Ballarat-road. Forty-six tons of this load was concentrated on the rear bogie in an area 8ft. 6 in. x 9 ft. 9 in. Deflection and stress measurements were made during the passage of the vehicle and showed that despite the magnitude and relative concentration of the load the stresses in the various parts of the structure were quite moderate. Details are given in the Chief Engineer's Report.

It is not possible to formulate a general statement to cover the gross load which may be taken over any particular bridge, as the stresses induced in the structure are dependent on the spacing and loading on individual wheels, together with the method of crossing adopted. Details of construction and the condition of the various parts of bridges also vary widely, so that each bridge and each arrangement of loading must be considered separately. It may be stated, however, that all loads encountered in Victoria to date could cross any bridge which has been designed in accordance with present highway standards. In some cases the load would stress the bridges considerably above the stresses normally allowed, but as the number of repetitions of such loads were few, this was considered satisfactory.

The total expenditure during the year on new bridges and in repairing and restoring existing structures amounted to £37,230. In addition, £14,836 was expended on the replacement of bridges and culverts destroyed by bush fires.

Under the provisions of Act No. 4458 a number of bridges and ferries over the River Murray, together with approaches, were maintained by the Board in conjunction with the Department of Main Roads, New South Wales, and the Victorian Railways Department. Each State pays a moiety of the cost of the maintenance of the crossings over the river, whilst the Railways Commissioners pay a proportion where the railway crosses the river. The amount expended from the Country Roads Board Fund was £3,635 for the year.

METROPOLITAN ROADS.

The work done was confined to maintenance works of an essential nature on main roads adjacent to the City of Melbourne, together with bituminous sealing considered necessary for the preservation of existing pavements. No construction works were carried out.

The amount expended was £5,082.

ISOLATED SETTLERS' ROADS.

Applications received from Councils for the construction of roads to isolated farms were confined to a limited number of works for which seasonal labour was available and works which would facilitate the transport of primary produce.

£36,605 was allocated to municipal councils from Federal Aid road sources which amount included commitments brought forward from the preceding year. The expenditure incurred was £19,513 supplemented by a contribution of 10 per cent. from the Councils concerned.

Three hundred and seventy-five projects were constructed or partially constructed to the end of June.

POST-WAR RECONSTRUCTION.

At the request of the Deputy Works Co-ordinator, the Board prepared a programme of post-war works which was submitted to the Honorable J. H. Lienhop, M.L.C., Minister of Public Works, for his approval before being forwarded to the National Works Council for consideration. The programme includes road works under priorities A, B, and C, up to a total amount equivalent to two years' normal work, and comprises the restoration of roads on which maintenance has had to be deferred and the re-erection and restoration of a large number of important bridge structures. Later a further programme was submitted at the request of the Deputy Co-ordinator, covering plant and workshop requirements for the post-war period.

TRANSPORTATION SURVEY.

Due to conditions imposed by the war, roads in general have been subjected to heavy traffic far beyond the capacity for which they were originally designed.

A marked increase in the number of heavy vehicles, as well as a general increase in the average gross truck load has been evident for some time past, the effect of heavier wheel loads and of cumulative repetitions having caused failures frequently near the edge of the roadway.

A series of investigations was therefore made by the Board into the strength and and carrying capacity of the road system. Part of the investigation involved the weighing of trucks in operation, so that in conjunction with the ordinary count of vehicles which has been regularly taken by the Board throughout the State, some estimate of the total tonnage carried and of the number of repetitions of the heavy wheel loads could be made.

For this purpose a special census station was established near Dandenong and during a period of about one week a special examination was made of heavy commercial vehicles operating along the Princes Highway.

The survey disclosed that the car traffic at the station was a little more than one-third of that before the war, but that truck traffic nad dropped only 20 per cent. There was, however, a considerable increase in the proportion of heavy trucks, so that the actual number of these trucks was greater than before, whilst practically all heavy trucks were loaded to their full capacity.

Wheel loads of three tons per wheel were common, whereas before the war few trucks had wheel loads of that weight. As the life of the road and its maintenance costs are affected most of all by the number of heavy wheel loads, this increase is giving the Board some concern, as it has already resulted in the failure of some roads, particularly those subjected to heavy timber traffic, although the loads are generally within the legal limit.

The heavier loading of the trucks is obviously due to the necessity for using as few vehicles as possible, and thus loading the large truck to its maximum capacity. Further, the strain on the railway system and the urgent necessity of getting, for instance, timber to the metropolis and milk to the dairies and condenseries, has caused many commodities to be carted over much greater distances than before the war.

An analysis is now being made of the information gained such as height, width, over-all length of vehicles, full route traversed in order to assist in the Board's maintenance and reconstruction programme.

The information gained from the survey, which is the first of its kind in Australia, will be of great assistance in planning a series of such surveys which it is proposed to undertake in the early post-war period, in order to obtain a complete picture of the State's road requirements.

BUSH FIRE DAMAGE.

In January and February last, extensive bush fires occurred in the Western District, Gippsland, and in the northern areas of the State, resulting in serious loss of life and considerable damage to property.

As far as roads and bridges were concerned, the damage was confined mainly to bridges under the jurisdiction of municipal councils. To assist the councils in the restoration of the burnt out structures, with the approval of the Government, moneys were allocated by the Board, and works were at once put in hand. Owing to the fact that a number of municipalities had only limited plant and labour available, the Board itself undertook the restoration and re-erection of many bridges and culverts.

The total amount made available by the Board in respect of main road bridges and culverts was £2,012, of which £1,226 was provided from the Country Roads Board Fund and £786 from Federal-Aid funds, whilst £21,510 was provided from Federal-Aid funds, supplemented by municipal contributions totalling £2,330, in respect of bridges under municipal control.

SOIL EROSION.

From time to time the Board has expended sums of money on State highways and main roads on work considered necessary for the prevention and control of erosion, and attending to drains and scours, after seeking the advice and guidance of Mr. H. G. Strom now Chairman of the Soil Conservation Board.

This Board is of opinion, however, that whilst the action already taken has had beneficial effects as far as the roads are concerned, it can only be considered a palliative and a small contribution in tackling what is already a serious problem which, unless dealt with on proper lines under expert guidance and in active co-operation with other Government departments and property owners concerned, must ultimately create disastrous conditions.

The Board, therefore, is strongly of opinion that all possible facilities should be made available to cope with the menace and to this end that the Country Roads Board be given power to carry out, with the consent of the owner and after consultation with the Soil Conservation Board, works on any land for the control of erosion of such land where it is considered necessary for the protection of State highways, main roads, forrest roads, and tourists' roads.

This would frequently enable the Board to protect the roads more effectively and at less cost than under present conditions which confine the Board's activities to works within the road boundaries.

TRAFFIC LINES.

The work done by the Board's traffic line marking machine during last year comprises the painting and repainting of 734·82 miles of State highways and main roads, 25·36 miles of roads on behalf of metropolitan municipalities and 5·70 miles of roads under the control of the State Electricity Commission at Yallourn. In addition, respotting of 103 miles of pavements was completed by the Board's gang. The total expenditure was £4,535 of which £161 was charged to municipalities and £32 to the State Electricity Commission.

OFFENCES UNDER ACTS AFFECTING THE BOARD.

Under the provisions of the Motor Car Act a number of offenders was proceeded against for exceeding the limits allowed in respect of weight and speed of motor cars carrying goods for hire, or in the course of trade, on State highways and main roads. In 118 cases fines totalling £486 were imposed for travelling at excessive speeds and £102 in 28 instances for carrying weights in excess of those permitted under the Act.

For allowing stock to wander unattended on State highways 45 prosecutions were launched and fines totalling £77 were imposed. In addition 960 cattle and 78 horses were impounded by the Board's ranger and patrolmen.

The total number of prosecutions for all offences under Acts administered by the Board during the year was 219. The total fines imposed amounted to £771 and costs to £49.

RESEARCH WORK.

Owing to shortage of suitable senior scientific personnel it has been necessary to carry on the Board's laboratory work with an unbalanced staff, most of whom do not possess the qualifications which in normal times would be regarded as essential. However, some investigation has been made into the use of the Californian Bearing Test in pavement design under Victorian climatic conditions and also into the moisture conditions existing in soils under sealed pavements.

Tests have also been carried out for the Commonwealth in connection with defence works both in Victoria and in other parts of the Commonwealth and in addition technical instruction has been given to service personnel.

The following summary gives the number of laboratory tests carried out during the year :—

—	Total Tests.		Tests Done for Commonwealth Authorities.	
	Samples.	Tests.	Samples.	Tests.
Soils and gravels	661	2,600	225	900 approx.
Concrete cylinder	49	..	31	..
Bituminous materials	68	515	32	424
Tar	12	28	2	8
Fuel and flux oils	4	8	..	..
Paint and lacquer	41	97	..	..
Lubricants	1	10	..	..
Aggregate bitumen mixture	..	..	1	3
Wood preservatives	1	6	..	..
Totals	837	3,264	291	1,335

APPORTIONMENT OF COSTS.

In accordance with the provisions of Section 287 of the *Country Roads Act* 1928, the cost of maintenance was apportioned for the year ended 30th June, 1943, the amount apportioned to municipalities in respect of such expenditure being £76,035.

AMENDING LEGISLATION.

During the year the following Acts affecting the Board were passed by Parliament :—

Country Roads (Forest Roads and Stock Routes) Act 1943 *No.* 4953.

From time to time requests have been made by municipalities for Government assistance towards the maintenance of roads carrying timber and firewood from areas controlled by the Forests Commission and from privately owned timbered land. To enable assistance to be given to municipalities in these cases, and to ensure the upkeep of the roads, the above Act authorizes the proclamation as forest roads of certain roads subjected to this class of traffic.

The Governor-in-Council on the recommendation of the Country Roads Board, may, after consultation with the Minister of Forests and the Commissioner of Crown Lands and Survey, and on the recommendation of the Commissioner of Public Works, proclaim any existing road or part of any existing road to be a forest road, or approve of a new forest road or deviation. Such roads may only be proclaimed or constructed in those areas of the State within or adjacent to any State forest area or as the Board considers to be timbered, mountainous, or undeveloped areas. The cost of maintenance and the carrying out of works of a permanent nature is to be borne from the Country Roads Board Fund without any contribution from municipal councils, and any cost incurred in construction or maintenance or the carrying out of permanent improvements may be defrayed out of—

(*a*) Any moneys provided by Parliament for the purpose, or

(*b*) Any other moneys at the disposal of the Board not being (except where otherwise expressly provided) moneys standing to the credit of the Country Roads Board Fund.

Country Roads Board Fund Act 1943, *No.* 4973.

Provision is made in this Act for—

(1) Fees for licences to drive motor cars not to be paid into the Country Roads Board Fund for the year ended 30th June, 1944.

(2) Suspension of annual payment of £50,000 from Consolidated Revenue into the Country Roads Board Fund for the year 1943–44.

Under the original Act £10,000 was to be used for the maintenance of main roads and State highways, and £40,000 for distribution amongst certain municipalities towards the construction, renewal, and maintenance, &c., of streets and roads.

MOTOR REGISTRATION.

During the year a total of 249,955 vehicles, including traction engines and motor cycles, were registered.

The number of motor vehicles of various classes registered for the past two financial years, as set out in the following statement, shows an increase of 10,801 in the figures of last financial year.

The decrease in registrations during 1941–42 as against those of 1940–41 was 31,863, whilst there was an increase of 8,374 in 1942–43 against 1941–42, so that the total decline in 1943–44 compared with 1940–41 was 12,688.

Vehicles.	Financial Year 1942–43.		Financial Year 1943–44.		Increase.	Decrease.
Private—						
New	833		525		..	308
Secondhand—re-registered	17,923		13,920		..	4,003
renewals	109,911		119,528		9,617	..
		128,667		133,973	..	..
Commercial—						
New	805		2,721		1,916	..
Secondhand—re-registered	2,665		2,205		..	460
renewals	29,337		29,864		527	..
		32,807		34,790	..	..
Primary Producers—						
New	252		509		257	..
Secondhand—re-registered	3,635		2,859		..	776
renewals	47,471		49,277		1,806	..
		51,358		52,645	..	..
Hire		2,553		2,611	58	..
Licensed under Omnibus Act		666		688	22	..
Trailers		6,757		7,240	483	..
Traction engines, &c.		79		71	..	8
Motor cycles		16,267		17,937	1,670	..
Total		239,154		249,955	16,356	5,555

ACCOUNTS.

Statement of accounts for the year ended 30th June, 1944, and the Country Roads Board Fund and balances as at that date appear in the Appendix.

The following statement shows the expenditure on road construction, maintenance, &c., from funds provided from moneys at the disposal of the Board in the Treasury, including expenditure under special appropriations :—

——	Under Board's Supervision.	Under Council's Supervision.	Total.
	£ s. d.	£ s. d.	£ s. d.
1. State Highways—			
Maintenance and reconditioning	218,119 13 8	22,609 4 8	240,728 18 4
2. Main Roads—			
Construction and restoration 23,022 4 4			
Maintenance and reconditioning 399,866 1 11	66,621 10 11	356,266 15 4	422,888 6 3
3. Developmental Roads—			
Construction and maintenance 75,013 7 2			
Roads for isolated settlers 19,512 10 3	14,982 7 7	79,543 9 10	94,525 17 5
4. Tourists' Roads—			
Maintenance and reconditioning	41,294 5 9	3,184 14 5	44,479 0 2
5. Murray River Bridges and Punts—			
Maintenance	3,399 19 0	235 6 3	3,635 5 3
6. Roads adjoining Commonwealth Properties—			
Maintenance	1,239 3 9	333 3 9	1,572 7 6
7. Commonwealth Defence Works (Unemployment Relief Funds)—			
Construction and reconstruction	5,106 3 4	..	5,106 3 4
8. Commonwealth Defence Works (Northern Territory)	894,435 17 0	..	894,435 17 0
9. Commonwealth Defence Works (Allied Works Council)	20,991 1 0	..	20,991 1 0
Totals	1,266,190 2 0	462,172 14 3	1,728,362 16 3

In addition to the amounts shown in the above statement, an expenditure of £446,373 was incurred from the Country Roads Board Fund on defence works carried out by the Board on behalf of the Commonwealth Government under the State National Security Regulations. The cost is recouped by the Commonwealth as the works progress. The amount outstanding on account of these works at the 30th June, was £85,984.

STAFF IN DEFENCE FORCES.

Forty-four officers of the Board were in the Naval, Military, and Air Forces of the Commonwealth as at the 30th June, 1944, 13 of whom are on the permanent staff and 31 on the temporary staff. Five hundred and fifty employees were also serving in the fighting forces as at that date.

In addition, four members of the permanent staff were loaned to Commonwealth Departments on special defence works and the services of one member of the Board's engineering staff was made available to the United States Army. Five temporary officers were also temporarily transferred to Commonwealth Departments in connexion with defence works.

Again the Board has to express its appreciation of the efficient manner in which all officers and employees loyally carried out demands made upon them, often under conditions of stress and strain.

The Board takes this opportunity of expressing to all those members of its staff who are with the fighting forces the hope that an early victory will hasten their return in good health to their peace-time activities.

ACKNOWLEDGMENT.

The manner in which Government Departments and State Instrumentalities carrying out defence works in association with the Board have co-operated is again acknowledged by the Board with appreciation. The thanks of the Board are also due to the Honorable J. H. Lienhop, M.L.C., Minister of Public Works, Victorian municipal councils and their officers, and to other State Road Authorities for their courtesy and assistance.

We have the honour to be, Sir,

Your Obedient Servants,

L. F. LODER, Chairman.

W. L. DALE, Member.

F. M. CORRIGAN, Member.

R. JANSEN,

Secretary.

CHIEF ENGINEER'S REPORT.

Country Roads Board Office,
Melbourne,
26th October, 1944.

THE CHAIRMAN,

SIR,

I have the honour to submit particulars of some matters of engineering interest in the Board's work during the last year. As in other years during the war, it is necessary for brevity to refer only to selected subjects, but the volume of defence works undertaken and their diverse nature again called for large organizing efforts by the various sections of the engineering staff, and for many researches and field studies to which limitations of space prevent any reference.

DESIGN OF FLEXIBLE PAVEMENTS.

The ability of a flexible road pavement to transmit traffic loads to the sub-grade depends on a number of factors between which there are rather complex inter-relationships. The most important factors are—

(*a*) The type of soil in the sub-grade.
(*b*) The degree of compaction of the sub-grade.
(*c*) The moisture content to which the sub-grade attains under service conditions.
(*d*) The type of flexible pavement and its density.
(*e*) Where the pavement consists of waterbound materials, the moisture content and consistency under service conditions.
(*f*) Whether the pavement is sealed or unsealed.
(*g*) The number of passages of wheels of various loads during the anticipated useful life of the pavement.
(*h*) The distribution of the applications of the wheel loads over the width of the pavement.

Some progress has been made during the year with research into these factors.

No changes have been made in the use of Atterberg and grading tests in classifying soils. The Public Roads Administration and also the Highway Research Board (both of U.S.A.) have published tables in which these tests, and classifications derived from them, are used to rate sub-grades broadly in terms of the range of thickness of pavement required for road traffic. The thicknesses shown in these tables are somewhat greater than used in recent years by the Board in Victoria during continued applications of stage construction principles.

Engineers of the Californian Division of Highways have used over a period of years a further empirical test for rating soils, and have derived from test results and field observations curves showing the thickness of pavement required for sub-grades of various ratings from 3 per cent. to 80 per cent. Californian Bearing Ratio (C.B.R.). Separate curves are shown for "light highway traffic" and for "medium highway traffic." As mentioned in last report, the Board has made some use of this method of rating soils, particularly for sections of road where some failures were commencing and the thickness of necessary re-sheeting had to be decided. In general the test appears to afford a useful additional guide to engineering judgment in such cases, but the possibility of using stage construction principles has still to be borne in mind.

The importance of sub-grade compaction and of compaction of pavements built up with granular and (in general) water-bound materials is borne out by tests indicating marked increase in supporting capacity with increase in density. Accordingly field control of compaction has been generally introduced both for defence undertakings and for normal road reconstruction.

Both in Victoria and Northern Territory prolonged dry spells are common, and water is then liable to become very scarce and evaporation on the job very rapid. With high rates of output such as have been essential on many projects, it has sometime been very difficult to obtain and apply enough water and to secure uniform incorporation. In basaltic clay areas in Victoria, winter construction has on the other hand presented difficulties in compaction, and one project had to be closed down for some weeks until drying weather returned. Wide variations in nature of soil within short distances have also proved troublesome. Nevertheless the implications of compaction control are becoming understood by construction engineers, and higher standards are becoming accepted. Control by means of the Modified (Proctor) test of the American Association of State Highway Officials (as adopted by the U.S. Engineer Corps), in which a higher standard of compaction is set, is therefore being applied in the Board's work.

Reference was made in last report to the use of the Proctor penetrometer in field diagnosis, e.g., for rapidly assessing the bearing capacity of plastic sub-grades under existing pavements which have partially failed and need reconstruction and re-sheeting. As noted in the report for 1942 such sub-grades tend to attain a stable moisture content over a period of months or years with but little change due to seasonal weather influences. Laboratory tests on eighteen various soils have established a useful approximate linear relation, namely:—

> Californian Bearing Ratio divided by Proctor penetration resistance = 0·019 either for standard Proctor needle with cylindrical point or for a needle having an ellipsoidal point.

Thus, where a sub-grade has attained a stable moisture, the C.B.R. may be inferred at least approximately from the field penetrometer reading. The Californian empirical curves can then be used to indicate desirable pavement thickness. A somewhat severe check can be obtained by measuring at one or two typical points the density of the sub-grade and reproducing this in a laboratory sample whose C.B.R. (soaked) can be obtained by test.

In obtaining penetrometer resistance of cohesive materials the ellipsoidal pointed needle such as used by engineers of T.V.A. has been found to give readings more reliable and less influenced by granular particles than the standard needle. However, to deal with more gritty materials the North Dakota cone has been investigated, and an approximate correlation determined fom tests on ten soils, namely, N.D.C. bearing value in lb. per sq. in. divided by Proctor needle resistance in lb. per sq. in. = 0·68 for standard Proctor needle or 0·83 for ellipsoidal needle.

The relation between N.D.C. and C.B.R. as found in the laboratory did not agree with results inferred from the two linear correlation curves of C.B.R. divided by Proctor resistance and N.D.C. divided by Proctor resistance. The curve actually derived has, however, been useful in inferring the C.B.R. of silty sub-grades and granular pavement materials in the Northern Territory, where C.B.R. apparatus was not available, but the North Dakota cone with its relatively small loadings was readily used.

During the last fifteen years, by stage construction methods, the Board has been able to extend the benefits of modern communications to a maximum number of settlers, and to improve a maximum mileage of its road system with the funds available. A large proportion of the more heavily trafficked roads in the State has been advanced to the "black top" stage, generally by light bituminous surface treatment. As a rule, a pavement which had proved adequate to carry the given traffic for one or two years was deemed strong enough to receive such a treatment, which in Australia is quite an expensive process.

Table A shows some details of the cost of stage construction on the Western Highway between Horsham and Dimboola in typical Wimmera country, where red fine sandy clay (A2-4) alternates with finer grey silty clay (A5-7, so-called "black" soil) and where "crab-hole" structure is common, especially on the black soil flats. The formations have generally been built 30 feet wide, with balanced cross section, or slightly raised on flats by borrowing. The sealed pavements are 18 feet wide. On section 1 the sealing was applied directly on a primed formation of natural soils. On section 2 rail-borne quartz and local desert ironstone gravels were used. On section 3 the natural soils were somewhat improved by mixing about 50 per cent. of the most sandy loam available, so that with extra working and compaction of the formation under prolonged traffic and maintenance some improvement in soil properties resulted. On sections 4 and 5 rail-borne gravel and basaltic metal were used. About 6-in. thickness was used on these sections approaching Dimboola township.

At the present time all sections are still carrying about 100 vehicles a day. Prolonged dry spells have, however, caused very extensive cracking of the whole countryside and cracks have gradually extended onto the pavement until some disintegration is taking place. In general the thicker the gravel the less serious are the cracks. Section 1 and portions of sections 2 and 3 require early re-sheeting, priming and sealing. The balance of section 2 needs re-sealing now, whilst the balance of section 3 need not be re-sealed at present. Section 4 requires early re-sealing to hold it for a further three or four years, when in common with similar portions of sections 2 and 3 re-sheeting will probably be needed. With a re-seal section 5 should require no further work for many years. Nevertheless its average cost will remain high, and it is considered that as a whole the results show that the adoption on sections 1, 2, and 3 of a policy of low construction cost has been amply justified.

TABLE A.—DETAILS OF STAGE CONSTRUCTION COSTS.

Section Number.	Mileage.	Year.	Work.	Cost.	Totals.	Cost per Mile per Annum.*
				£	£	£
1 ..	205·8 to 207·5 (1·7)	29–30	Formation	580	..	..
		31–32	Prime 0·37 g/s. yd.	770	..	..
			Seal 0·30 g/s. yd.			
		32–33	Reseal 0·28 g/s. yd.	850	..	136
		35–36	Roadmix seal ½ inch	570	2,770	..
2 ..	198·1 to 205·8 (7·7)	29–30	Formation	1,860	..	..
		31–32				
		32–33	Gravelling 4 inches	9,240	..	..
		32–33	Prime 0·37 g/s. yd.	4,580	..	216
			Seal 0·34 g/s. yd.			
		35–36	Roadmix seal ½ inch	2,570	18,250	..
3 ..	191·4 to 198·1 (6·7)	28–29	Formation (sand-clay)	5,070	..	..
		31–32	Prime 0·38 g/s. yd.	4,480	..	..
			Seal 0·32 g/s. yd.			
		32–33				
		33–34	Reseal 0·27 g/s. yd.	2,750	..	..
		36–37	Sealing two curves	200	..	224
		36–37				
		37–38	Roadmix seals ½ inch, ¾ inch, and 1 inch	3,860	..	..
		38–39				
		38–39	Light reseal 4 miles	730	..	..
		39–40	Regulation and reseal 1·3 miles	640	..	..
		41–42	Resheet and seal small section	200	17,930	..
4 ..	207·5 to 208·1 (0·6)	29–30	Gravelling	1,000	..	..
		31–32	Prime 0·37 g/s. yd.	330	..	250
			Seal 0·30 g/s. yd.			
		32–33	Reseal 0·28 g/s. yd.	280	..	..
		35–36	Roadmix seal ½ inch	190	1,800	..
5 ..	208·1 to 209·2 (1·1)	27–28	Basalt metalling	3,780	..	..
		28–29	„ „			
		32–33	Gravel resheeting small section	220	..	430
		32–33	Prime and seal with "Bitural"	740	..	..
		33–34	Bitumen reseal 0·3 g/s. yd.	480	5,220	..

* Total Cost divided by length of section divided by number of years since sealing.

In the Board's report reference is made to the commencement made with transportation surveys on typical roads. These are designed (*inter alia*) to supplement the regular traffic counts and give more exact design information about the factor (*g*) mentioned above. A set of empirical multipliers used by engineers of the California Division of Highways in designing rigid pavements has been used to reduce observed wheel loads to their equivalent in numbers of repetitions of a standard wheel load (assumed as 5,000 lb.).

The life of the pavement is a factor which it will be difficult to standardize. Although periodical reconstruction work inconveniences traffic and may even involve some wastage of portions of a section of road (e.g., where a seal coat outlives the pavement provided beneath it) it may yet be sound engineering, as shown by Table "A," to save initial construction cost and effort, e.g., where pavement materials themselves are very costly.

Using recent data published in U.S.A. Highway Research Board Proceedings, an endeavour has been made to prepare a chart consisting of a series of curves each of which relates to a particular total number of standard 5,000-lb. wheel load repetitions and shows for various values of the C.B.R. from 3 per cent. to 80 per cent. the corresponding pavement thicknesses required (varying from 1 to 25 inches). The curves range from that for 100 to that for 1,000,000 repetitions.

In applying a chart of this type it is contemplated that some allowance should be made for the factors (*c*), (*e*), and (*f*). Where the pavement is left unsealed and can be maintained by graders and fresh material added if and when found necessary, it is legitimate to reduce the initial thickness somewhat. Where a seal coat is to be used in areas where droughts cause stiffening of the sub-grade by comparison with the saturated state used in the C.B.R. test, it may be possible to estimate the effect by reducing the number of load repetitions by some suitable factor based on local climatic studies and on moisture tests under old pavements in the given area. Allowance for factor (*h*) requires studies of the habits of commercial drivers on roads of various widths and these studies are in hand.

Whilst the chart and rules for its use are at present only in tentative form during a period of trial by the Boards' engineers, the principles have been outlined so that municipal engineers engaged in reconstruction works may also apply them as far as possible.

BITUMINOUS SURFACE TREATMENT.

By 1941 some 60,000,000 square yards of the Board's State Highway and main road systems in Victoria had been surfaced with bitumen. This is a considerable proportion of the total area of "black" surfaced roads and streets in the whole State, the total area of such surfacing being estimated at 102,000,000 square yards and the difference consisting chiefly of urban streets. On the area aforesaid for which the Board is responsible, only the minimum essential maintenance was carried out during the year. Table "B," which refers to the "black" roads under the Board's control, shows that a light type of re-treatment averaging 7·2 tons per mile has been used in recent seasons. In the last two seasons the rate of treatment was below the average annual rate necessary to prevent depreciation of the asset, for which purpose the rate of 0·73 tons per annum per 10,000 square yards attained in 1941-42 is considered somewhere about the minimum.

It is believed that on the average a similar state of affairs prevails in the balance of the "black" streets and roads in Victoria.

TABLE B.—RATE OF USE OF BITUMEN ON ROADS UNDER BOARD'S CONTROL.

Bitumen.	Season.			Average for Three Years.
Quantity Used Exclusive of Patrol Maintenance Patching.	1941–42.	1942–43.	1943–44.	
Average tons used per 10,000 square yards retreated (approx. average mile) ..	7·8	6·9	6·8	7·2
Tons used per annum per 10,000 square yards of total area being maintained	0·73	0·29	0·50	0·51

The total mileage of work carried out on all roads under the Board's control by both C.R.B. and municipally-owned plant is given in Table "C." Of the total 443·4 miles of re-treatment, 30·3 miles were resealed at the rate of 0·10 gallon per square yard, 244·6 miles were at 0·15, 158·6 miles at 0·20, and 9·9 miles were at 0·25 gallon per square yard. The first seals, totalling only 11·4 miles, were on short reconstructed lengths on major roads.

In addition the Board re-treated 27·8 miles of municipal roads, and applied various types of bituminous surface treatment on 724,790 square yards for the Commonwealth of Australia on defence undertakings in Victoria.

TABLE C.—BITUMINOUS WORK ON ROADS UNDER BOARD'S CONTROL.

Year.	Miles of Work.					
	New Work.	Retreatments.				Grand. Total.
	First Seals.	Reseals.	R.M.S.*	P.M.S.†	Total.	
1939–1940 ..	332·1	252·3	105·2	37·6	395·1	727·2
1940–1941 ..	147·8	429·5	253·1	43·8	726·4	874·2
1941–1942 ..	30·3	561·4	1·3	1·2	563·9	594·2
1942–1943 ..	12·3	256·6	Nil	Nil	256·6	268·9
1943–1944 ..	11·4	443·4	Nil	Nil	443·4	454·8§

* R.M.S. Roadmix Seals. † P.M.S. Plantmix Seals. § Approx. 10,000 square yards per mile.

To carry out all types of work in Victoria eight sprayers were operated, three of which were hired, owing to seven of the Board's sprayers being employed on defence works in Northern Territory.

The steadily increasing cost of the work is shown in Table "D."

TABLE D.—COST OF RE-TREATMENTS BY RE-SEALING USING A ROADOIL BINDER AT 0·15 GALLON PER SQUARE YARD.

Subdivision.	Average Cost in Pence Per Square Yard.			
	Season.			
	1940–41.	1941–42.	1942–43.	1943–44.
Material	3·61	4·42	5·24	5·80
Labour	0·62	0·90	1·19	1·22
Stores	0·09	0·13	0·17	0·21
Plant hire	0·44	0·61	0·90	0·93
Total	4·76	6·06	7·50	8·16

Aggregate proved difficult to obtain. The quality was the poorest and the average price the highest to date. Much more scoria and sand were used as mineral aggregate owing to the labour demand for their production being much lower per cubic yard than for gravel or screenings.

The average cost of some 41,000 cubic yards of mixed aggregate obtained in Victoria during the season was 18s. 7d. per cubic yard stacked on the job, compared with 13s. 10d. in 1939-40.

The bitumen used in Victoria was that supplied during 1942-43. The purchase price varied from £12 17s. to £23 12s. 6d. The material was charged to jobs at its averaged price for the season, £21 15s. per ton net *ex* store Melbourne.

The following work was carried out on defence undertakings in Northern Territory:—

	Square Yards.
On roads, First seals (Plantmix) ..	2,401,070
Light surface enrichment seals ..	4,036,270
Other works, First seals (Plantmix) ..	667,900

The total bituminous surface treatment work for the year was thus in the order of 12,630,000 square yards.

On Commonwealth works in Victoria during the period 1939-1944 the Board used 10,615 tons of bituminous materials. On similar work outside Victoria during the period 1942-44 it consumed 21,860 tons of such material, making a total of 32,475 tons used by the Board on defence undertakings since the war began.

HEAVY LOADS ON BRIDGES.

In the Board's report reference is made to the necessity for allowing unusually heavy loads to cross bridges of various types, and to the general precautions specified in the permits. The conventional Class "A" loading used in design on rural main roads consists of a vehicle with a gross weight of 37,500 pounds distributed over two axles 12 feet apart and with wheels at 6 feet centres, the rear axle carrying 25,000 pounds. This load is applied on every 10-ft. traffic lane, and is proceeded and followed by a uniformly distributed load of 100 pounds per square foot. An impact factor of 1·3 is used in design.

Heavy loads investigated have been carried on specially designed vehicles fitted with pneumatic tyres with good articulation of wheels and axles, giving very good distribution of the concentrated loads. Calculations have been made by the Board's bridge engineers and checked in some instances by deflection and stress measurements. The general conclusions are set out in the Board's report. The following details relate to particular types of bridges.

On concrete slab bridges measured deflections were always much less than calculated, due partly to a probable under-estimation of the modulus of elasticity of the concrete, and also to the effect of lateral distribution. The same is generally true of concrete tee-beam bridges, except that the lateral load transfer effected depends on the relative stiffness of the beams and deck, and this needs consideration in each case. Also near piers and abutments, where little lateral load transfer can occur, shear may be a governing factor. This is especially true of the older concrete structures constructed prior to about 1920, the early designs being deficient in shear reinforcement.

On timber stringer bridges deflections observed agreed fairly well with calculated values, due allowance being made for transfer across the stringers. The amount of such transfer varies considerably, as in some cases the decking, and in more recent design the cross beams, may be continuous across the width of the structure, and in other cases the individual pieces may only extend for half the width. On steel girder and truss bridges the deflections observed agreed closely with calculated values after correction for distribution across the structure.

One of the investigations made concerned the passage of a load of 81·6 tons across Lynch's Bridge. This structure (see Board's 23rd Annual Report, 1937) contains five main spans of 70 feet, each span consisting of six rows of steel plate girders made integral with the concrete deck by steel stirrups welded to the top flange of the girder, the plate girders being propped up at the third points during the casting of the deck, so as to keep the dead load of the latter off the girder, and to allow for the composite concrete and steel sections to take dead load forces as well as those from live load. The lines of girders are 8 feet apart, the depth of the web plate is 54 inches, and the deck is 8½ inches thick, with a 6-inch haunch over the top flange of the girders.

The special load and the tractor hauling it comprised altogether a train of seven axles, the distances between them being 18 feet, 25 feet, 4 ft. 3 in., 32 feet, 4 ft. 3 in., and 4 ft. 3 in. The front axle with only two tyres carried 1·6 ton; the second axle with four tyres, 9·5 tons; the third and fourth axles with four tyres, 12·25 tons per axle; and the three rear axles or rows of wheels, carrying a combined load of approximately 46 tons, comprised four wheels with dual tyres on each, the centre pair of wheels being 3 feet apart centre to centre, and the similar distance from the outer wheels being 3 ft. 9 in. The whole group of twelve wheels at the back of the float was fully articulated.

Several passages of this vehicle with its load were made over the structure on different occasions, deflection tests being carried out on the first occasion and extensometers being used on later occasions. The maximum deflection under the two central main girders was 0·180 of an inch compared with a calculated deflection of 0·190 of an inch, assuming that modulus elasticity of steel is ten times that of concrete. The measured stress in the lower flange of the girder was 4,000 lb. per sq. inch compared with a calculated stress of 4,100 lb. per sq. inch. The stresses in the composite section due to this exceptionally heavy and relatively concentrated load were actually much less than those produced by the Class A design loading. This was no doubt due to the good distribution of the isolated load across the structure, and to the practically complete absence of impact.

The deflections of the various girders indicated that 30 per cent. of the total live loads was carried by each of the two central girders, 15 per cent. by those next to them, and 5 per cent. by the two outer girders. It was estimated that approximately 50 per cent. of the transfer of load across the structure was made by steel cross frames which exist at the centre of each span, the balance being transferred through the very stiff concrete deck. Calculations indicate that this transfer of load between girders by means of the deck involved transverse stresses in the deck approximately 10 per cent. above those caused by full Class A loading.

The tests made on this bridge provide a useful verification of the assumptions made in the design of the comparatively long span composite steel girder and concrete deck type of construction. A small permanent set was observed after the first passage of the heavy load, but this was considered to be due to slight slips occurring between the steel and concrete sections of the composite structure, whilst adjusting itself to the load, the structure being unable to return to its original position because of friction between the various parts. This conclusion was supported by the fact that considerable noise occurred during the first crossing, due to structural adjustment, whereas in subsequent crossings there was very little noise.

From this and other deflection observations it is concluded also that with multi-wheeled bogies, well articulated and equipped with pneumatic tyres, impact can be neglected.

Yours obediently,

D. V. DARWIN,
Chief Engineer.

APPENDIX.

COUNTRY ROADS BOARD FUND.

RECEIPTS.

1943.		£ s. d.	£ s. d.	£ s. d.	£ s. d.
July 1.	To Balance	.. ..	.. ..	.. ..	409,044 6 9
1944.					
June 30.	,, Motor Car Act No. 3741—Registration Fees ..	1,436,827 4 0			
	Less Refunds	9,940 1 6			
			1,426,887 2 6		
	Fines ..	9,160 4 5			
	Less Refunds	21 0 0			
			9,139 4 5		
			1,436,026 6 11		
	Less Cost of Collection ..		91,501 16 4		
				1,344,524 10 7	
	,, Motor Omnibus Act No. 3742—Fines		.. ..	50 0 0	
	,, Country Roads Board Acts Nos. 3662; 3741, Sec. 13; and 4332—				
	Fees and Fines		244 12 0		
	Registration of Traction Engines		83 5 0		
				327 17 0	
	,, Acts Nos. 3662, 3741, 4332, and 4585—Costs		.. ..	62 12 5	
	Municipalities' Repayments—				
	Permanent Works—				
	Outer Metropolitan Roads ..	4,839 5 2			
	Relief Acts Nos. 4140 and 4415	143,668 4 10			
			148,507 10 0		
	,, Main Roads—Maintenance ..		77,145 0 8		
				225,652 10 8	
	,, Hire of Plant		104,333 3 4		
	,, Stores and Materials		270,121 7 5		
	,, Sundries		223,845 16 11		
				598,300 7 8	
	,, Special Works—Outstanding 30.6.43—Recoup ..			210,745 5 7	
					2,379,663 3 11
					£2,788,707 10 8

PAYMENTS.

1944.		£ s. d.	£ s. d.	£ s. d.
June 30.	By Maintenance	.. ..	.. ..	645,639 19 2
	,, Murray River Bridges and Punts	.. ..	.. ..	3,635 5 3
	,, Interest and Sinking Fund—Municipalities' Repayments	.. ..	.. ..	108,603 15 11
	,, Interest and Sinking Fund—Great Ocean Road ..	.. ..	.. ..	1,000 0 0
	,, Recoup to Revenue—Act No. 3944—			
	Interest—Main Roads		102,549 10 10	
	Developmental Roads		172,990 8 4	
	Sinking Fund Contributions		25,716 18 9	
	Exchange		39,946 5 2	
	Loan Conversion Expenses		1,865 16 7	
				343,068 19 8
	,, Relief to Municipalities—Acts Nos. 4140 and 4415		.. ..	221,040 8 8
	,, Stores and Materials		230,489 1 6	
	,, Plant Purchase and Repairs		106,355 6 7	
	,, Storeyard		56,836 7 2	
	,, Sundry Debtors		145,925 14 5	
	,, Traffic Administration—			
	Motor Car Acts		3,643 17 6	
	Country Roads Acts		1,561 13 2	
	,, Bridge Inspections		482 19 7	
	,, Act No. 4332—Impounding of Cattle		738 16 4	
	,, Act No. 4609—Tourists' Resorts Fund		6,711 5 5	
	,, Act No. 4585—Traffic Line Marking		4,433 5 7	
	,, Recoup to Revenue—Act No. 3782—Superannuation Charges		1,508 17 6	
	,, General Expenditure—			
	Salaries, &c.	103,526 17 9		
	Less Recoup	37,452 8 9		
			66,074 9 0	
				624,761 13 9
	,, Special Works—Outstanding		.. ..	52,209 17 0
	,, Balance		.. ..	*788,747 11 3
				£2,788,707 10 8

RECONCILIATION.

	£ s. d.
Balance as per Treasury Books	780,851 11 3
Add Transfers Outstanding	30,071 10 7
	810,923 1 10
Deduct Accounts in Transit	22,175 10 7
Balance as per Country Roads Board Accounts	788,747 11 3

* Includes amounts of:—

(*a*) To meet liabilities on contracts and direct labour works .. £120,000

(*b*) Reserve for reconstruction of roads and bridges .. £625,000

APPENDIX—*continued.*—REVENUE ACCOUNT, 30TH JUNE, 1944.

1944.		£ s. d.	£ s. d.	£ s. d.
June 30.	To Maintenance Works—General ..	.. ..	355,967 19 1	
	,, Mansfield–Woods Point Road ..	2,137 18 10		
	,, Woods Point Road	1,433 17 10		
	,, Walhalla Road	1,107 15 6		
	,, State Highways	240,659 17 9		
	,, Tourists' Roads	44,333 0 2		
			289,672 0 1	
				645,639 19 2
	,, Murray River Bridges and Punts		.. ..	3,635 5 3
	,, Contribution to Sinking Fund		27,150 19 0	
	,, Interest on Loans		81,452 16 11	
				108,603 15 11
	,, Recoup to Revenue—Act No. 3944—			
	Interest—Main Roads ..	102,549 10 10		
	Developmental Roads	172,990 8 4		
			275,539 19 2	
	,, Sinking Fund Contributions		25,716 18 9	
	,, Exchange		39,946 5 2	
	,, Loan Conversion Expenses		1,865 16 7	
				343,068 19 8
	,, Act No. 4395—Great Ocean Road—			
	Interest		531 12 6	
	Sinking Fund		468 7 6	
				1,000 0 0
	,, Tourists' Resorts Fund—Act No. 4669		.. ..	6,711 5 5
	,, Recoup to Revenue—Act No. 3782—Superannuation Charges		.. ..	1,508 17 6
	,, Relief to Municipalities		.. ..	221,040 8 8
	,, Audit Fee		565 10 11	
	,, Insurance of Staff		57 11 8	
	,, Instruments		12 14 2	
	,, Motor Expenses		7,303 18 10	
	,, Offices, Exhibition Building		1,268 6 1	
	,, Divisional Storeyards		1,598 4 2	
	,, Promontory Huts and Garages		2 2 7	
	,, Storeyard Equipments Repairs Account ..		607 16 10	
	,, Storeyard No. 2		13,727 17 6	
	,, Divisional Offices		870 13 5	
	,, Office Expenses		3,534 3 10	
	,, Office Furniture		412 5 5	
	,, Patrolmen's Cottages and Engineers' Residences ..		467 10 6	
	,, Patrol Garages		19 0 1	
	,, Plans Purchase		221 1 9	
	,, Plant Purchase		62,293 7 6	
	,, Postage and Telegrams		2,227 15 5	
	,, Printing and Stationery		1,544 13 7	
	,, Salaries		57,842 13 11	
	,, Pay Roll Tax (Staff)		1,468 17 4	
	,, Telephones		2,055 4 8	
	,, Testing Materials		2,625 9 0	
	,, Gravel Sites and Metal Investigation		52 5 6	
	,, Travelling Expenses		1,347 14 9	
	,, Motor Car Acts Nos. 3741, sections 11–13, and 3901, sections 24–36		3,643 17 6	
	,, Country Roads Acts		1,561 13 2	
	,, Bridge Inspections		482 19 7	
	,, Act No. 4332—Impounding of Cattle		738 16 4	

1943.		£ s. d.	£ s. d.	£ s. d.	£ s. d.
July 1.	By Balance				1,024,649 3 0
1944.					
June 30.	,, Motor Car Act No. 3741—				
	Registration Fees		1,436,827 4 0		
	Less Refunds		9,940 1 6		
			1,426,887 2 6		
	Fines ..	9,160 4 5			
	Less Refunds	21 0 0			
			9,139 4 5		
			1,436,026 6 11		
	Less Cost of Collection ..		91,501 16 4		
				1,344,524 10 7	
	,, Motor Omnibus Act No. 3742—Fines			50 0 0	
	,, Country Roads Act No. 3662—				
	Registration of Traction Engines			83 5 0	
	Fees and Fines			244 12 0	
	Costs—Acts Nos. 3662, 3741, and 4332 ..			62 12 5	
	,, Plant Earnings		104,698 6 5		
	,, *Deduct* Working Costs ..		44,061 19 1		
				60,636 7 4	
	,, Sundry Earnings			6 12 4	
	,, Old Roads, Sale of			191 11 3	
	,, Rents			1,447 2 1	
	,, Royalty on Gravel and Metal			377 0 5	
	,, Storeyard			10,940 9 1	
	,, ,, No. 3			1,162 17 10	
	,, ,, No. 4			919 17 9	
	,, Timber, &c., Revenue Account			205 19 11	
	,, Materials, Sale of (steel yard)			230 0 0	
	,, Great Ocean Road—				
	Interest			94 15 0	
	,, Maintenance Works—				
	Contributions Payable by Municipalities		93,256 3 0		
	,, Adjustment		124 1 0		
				93,132 2 0	
	,, Permanent Works—				
	Contributions Payable by Municipalities—				
	Outer Metropolitan Roads		4,839 5 2		
	Other Main Roads ..		143,668 4 10		
				148,507 10 0	
					1,662,817 5 0

1944.									
June 30.	To	Act No. 4585—Traffic Line Marking			4,433	5	7		
	,,	Direction Boards and Warning Signs			439	18	4		
	,,	War Damage Insurance			582	10	6		
	,,	Defence Leave—Employees			170	16	3		
	,,	Camp Sites			1	5	7		
	,,	Advertising—Government Printer			109	1	7		
	,,	Legal Work—Crown Solicitor			300	0	0		
	,,	Insurance—Public Risk			73	10	0		
	,,	Photography			159	5	1		
	,,	Works Film			13	0	10		
	,,	Traffic Census			81	4	11		
	,,	Recoups—Kelly	57	19	0				
		T. Rowe and Sons ..	1	17	3				
						77	17	0	
						174,996	1	8	
		Less Recoup				37,452	8	9	
									137,543 12 11
		Balance				..		..	1,218,714 3 6
									£2,687,466 8 0

£2,687,466 8 0

BALANCE-SHEET AT 30TH JUNE, 1944.

LIABILITIES.	£	s.	d.
Contractors' Deposits	5,207	18	4
Sundry Liabilities	5,847	14	2
Revenue Account	1,218,714	3	6
	£1,229,769	16	0

ASSETS.	£	s.	d.	£	s.	d.
Country Roads Board Fund				788,747	11	3
Maintenance Expenditure—						
Contributions Payable by Municipalities				93,256	3	0
Permanent Works—						
Contributions Payable by Municipalities—						
Outer Metropolitan Roads	4,839	5	2			
Other Main Roads (Subject to Relief)	143,668	4	10			
				148,507	10	0
Outstanding Accounts	18,572	13	10			
„ Special Works	52,209	17	0			
				70,782	10	10
Materials—Stock—						
Storeyard	108,570	2	2			
Branches	14,698	0	5			
				123,268	2	7
Trust Fund				5,207	18	4
				£1,229,769	16	0

SUMMARY SHOWING VALUE AS AT 30TH JUNE, 1944, OF BOARD'S ASSETS CHARGED TO FUND (not included in Balance-sheet).

	£	s.	d.
Patrol Cottages, Huts and Garages	12,752	15	7
Divisional Engineers' Residences	5,990	0	0
Storeyard No. 1	6,400	0	0
„ „ 2	13,000	0	0
Workshop Plant, Tools and Equipment	5,915	15	2
Divisional Storeyard and Offices	3,488	15	0
Furniture and Fittings	8,916	10	10
Testing Laboratory Equipment	2,258	4	9
Survey Instruments	818	17	9
Loadometers	260	0	0
Concrete Pipe Tester	6	0	0
Carried forward	£59,806	19	1

	£	s.	d.
Brought forward	59,806	19	1
Quarries, Gravel Pits, &c.	2,129	19	0
Great Ocean Road Mortgage (Mrs. A. M. Bird)	1,895	0	0
Motor Cars	9,404	10	4
Police Motor Cars	8,267	5	0
Police Motor Cycles	980	0	0
Motor Registration Branch	6,451	7	3
Motor Testing Branch	517	7	0
Pistols	18	13	4
	89,471	1	0
Working Plant at Valuation	176,842	5	6
	£266,313	6	6

COUNTRY ROADS BOARD LOAN ACCOUNT—ACT No. 3662.

BALANCE-SHEET AT 30TH JUNE, 1944.

LIABILITIES.	£ s. d.	£ s. d.	£ s. d.
Interest on Permanent Works		.. ..	18,755 17 10
Loan Securities Issued		4,860,784 7 1	
Less Amount Repaid		80,000 0 0	
		4,780,784 7 1	
Deduct Discount and Expenses		71,916 11 3	
		4,708,867 15 10	
Less Securities Repurchased and Cancelled from National Debt Sinking Fund		412,303 2 2	
		4,296,564 13 8	
Less—			
Redemption Funds	85,219 1 1		
Main Roads Sinking Funds	285,688 7 7		
Repaid to State Loans Repayment Fund ..	543,204 16 8		
		914,112 5 4	
			3,382,452 8 4
State Loans Repayment Fund		.. ..	338,258 6 1
Contribution to National Debt Sinking Fund		439,397 18 8	
Less Net Loss on Repurchase of Securities (including Exchange)		15,350 1 5	
			424,047 17 3
Loan Redemption as Itemized above		.. ..	914,112 5 4
			£5,077,626 14 10

ASSETS.	£ s. d.
Permanent Works	5,047,126 1 11
Interest Capitalized on Permanent Works (Act No. 3662)	18,755 17 10
National Debt Sinking Fund (Cash in Hand)	11,744 15 1
	£5,077,626 14 10

DEVELOPMENTAL ROADS LOAN ACCOUNT—ACT No. 3662.

BALANCE-SHEET AT 30TH JUNE, 1944.

LIABILITIES.	£ s. d.	£ s. d.	£ s. d.
Loan Securities Issued		6,299,024 7 0	
Deduct Discount and Expenses		113,163 2 2	
		6,185,861 4 10	
Less Securities Repurchased and Cancelled from National Debt Sinking Fund		630,251 3 11	
		5,555,610 0 11	
Less Redemption Funds	646,386 7 4		
Developmental Roads Sinking Fund	55,083 0 2		
		701,469 7 6	
			4,854,140 13 5
State Loans Repayment Fund			239,896 6 1
Contribution to National Debt Sinking Fund		671,668 13 0	
Less Net Loss on Repurchase of Securities (including Exchange)		23,464 5 9	
			648,204 7 3
Loan Redemption Itemized above			701,469 7 6
Interest, Act No. 3662 (Sec. 86/1)		77,372 3 10	
Contributions Postponed		16,656 13 7	
			94,028 17 5
			£6,537,739 11 8

ASSETS.	£ s. d.	£ s. d.
Permanent Works Expenditure		6,425,757 10 11
National Debt Sinking Fund (Cash in Hand)		17,953 3 4
Contributions Payable by Municipalities, Act No. 3662, Sec. 86/1, (Subject to Relief)		94,028 17 5
		£6,537,739 11 8

DEVELOPMENTAL ROADS INTEREST—ACT NO. 3662—(SECTION 86/1).

RECEIPTS.	£ s. d.	£ s. d.
1944.		
June 30. To Interest on Account of Municipalities—Provided by Relief—		
Act No. 3662—Sec. 86/1	77,372 3 10	
		£77,372 3 10

EXPENDITURE.	£ s. d.
1944.	
June 30. By Payments to Treasury (Relief)	77,372 3 10
	£77,372 3 10

AUDITOR-GENERAL'S CERTIFICATE.

The Accounts have been audited and compared with the books, with which they agree. Reconciliations have also been made with the books of the Treasury. Subject to the qualification that the balance-sheets do not include as assets permanent works and improvements resulting from expenditure from revenue moneys and extraneous funds, the several statements, in my opinion, exhibit a correct view of the affairs of the Board at the 30th June, 1944.

E. A. PEVERILL,
Auditor-General.
29th November, 1944.

E. J. HICKS,
Accountant,
21st November, 1944.

By Authority: H. E. Daw, Government Printer, Melbourne.