1942.

VICTORIA.

COUNTRY ROADS BOARD.

TWENTY-NINTH ANNUAL REPORT

FOR YEAR ENDED 30TH JUNE, 1942.

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

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COUNTRY ROADS BOARD.

TWENTY-NINTH ANNUAL REPORT.

Exhibition Building,
Carlton, N.3.
10th November, 1942.

The Honourable Sir George Goudie, K.B., M.L.C.,
Minister of Public Works,
Melbourne.

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, 1942.

FINANCIAL POSITION.

The gross revenue derived from motor registration fees and paid into the Country Roads Board Fund was £1,563,106, compared with £1,804,139 received during the previous year—a decrease of £241,033. Refunds and cost of collection totalled £119,509, so that the net revenue was £1,443,597.

The amount received under the Federal Aid Roads and Works Agreement was £391,858, as against £541,723 received during the previous financial year. The total gross amount received from both sources of revenue was, therefore, £1,954,964, a decline of £390,898 in comparison with the year 1940–41.

No loan expenditure was incurred under Acts 4188, 4414, and 4498 on metropolitan roads. The balance of £246,742 from the previous year remained at the 30th June, 1942, out of the total authorisation of £500,000.

COUNTRY ROADS BOARD FUND.

The total expenditure from the Country Roads Board Fund on the maintenance of State highways, main roads, tourists' roads and Murray River bridges and approaches was £630,670 for the year, as against £1,013,511 for the previous year, a decrease of £382,841.

The annual statement of the Country Roads Board discloses a credit balance of £299,879, which includes an amount of £135,000 to meet liabilities on contracts and direct labour works, and £125,000 reserved for reconstruction of roads and bridges, leaving an available balance of £39,879 to be carried forward to next financial year.

A large amount of work for which provision had been made last financial year could not be carried out owing to the difficulty in obtaining labour and materials, the transfer of plant and the necessity for restricting operations to only essential work in order to make labour plant and materials available as far as possible for urgent defence works.

This has been the case particularly with bridge works, owing to the difficulty in securing steel and timber as well as skilled labour. With the restricted expenditure, it is recognised that deterioration of roads and bridges will result and that heavy expenditure will be involved at a later date in restoring these works to a proper standard of utility. For that reason the Government as a matter of prudence decided that an amount of £125,000 should be reserved out of the balance standing to the credit of the Country Roads Board Fund at the end of the year towards meeting the extra cost of bringing these works up to a proper standard as soon as the opportunity offers.

From figures supplied by the Police Department and the Federal Government at the commencement of the financial year, and following the announcement of the Federal Government of a further cut in petrol allowances from August last, it was estimated that the Board would not have sufficient funds for necessary maintenance and interest and sinking fund payments. Towards the end of the year, however, it was found that the revenue both from registration fees and the State's proportion of petrol taxation under the Federal Aid Roads Agreement was well above the estimates, and if manpower and materials had been available the road system could have been adequately maintained by the Board and the municipalities.

The decision of the State Government to reduce by 25 per cent. motor registration fees in respect of vehicles driven with petrol, provided the vehicle has a petrol allowance of 25 gallons or less per month, came into operation on the 14th April last. The decision does not apply to vehicles fitted with gas producer units. While it is too early to predict the effect on the revenue it is considered by the Board that the reduction will not immediately affect the Board's financial position.

Federal Aid Roads Account.

Of the total expenditure of £168,547, £27,091 was on main roads, £70,352 on works of a developmental character, £276 on the construction of tourists' roads, and the balance on the maintenance of roads and bridges previously constructed under the Federal Aid Roads Agreement, restoring and rebuilding bridges and assisting municipalities in the maintenance of main and developmental roads constructed from loan funds and unemployment relief funds provided by the Government.

Under the Federal Aid Roads and Works Agreement a sum of £5,000 was made available for the maintenance and repair of public roads adjoining or approaching properties of the Commonwealth within the State of Victoria, together with an amount of £2,442 brought forward from the previous year. The total expenditure was £3,188 and £4,254 was carried forward to the financial year 1942–43.

At the 30th June an amount of £356,851 stood to the credit of the Federal Aid Roads Account, but taking into consideration unexpended amounts allocated last year to assist in the maintenance of roads and bridges, liabilities on contracts entered into and works in progress at the 30th June, the actual balance to the credit of the account is £294,058.

As in the case of the Country Roads Board Fund, the large amount carried forward is due to the fact that a considerable amount of work for which money had been allocated last year was held up through the difficulties already mentioned and extensive and important works which the Board is carrying out for defence authorities having to take precedence over all other activities.

Defence Expenditure.

On completion of the construction and improvement of strategic roads and road construction and allied works in Army camps and Air Force stations, the Board was called upon by the Federal Government to carry out a wide variety of works in defence establishments throughout the State, as well as in the Northern Territory.

The total value of defence works completed or in hand at the 30th June last was approximately £2,666,000, the actual expenditure for the year £791,823, and the total expenditure for the war period £1,252,216.

STATE HIGHWAYS.

As it has been found impossible, in view of the shortage of manpower and materials, to carry through a full programme of maintenance at the present time, the Board has adopted the only practical course of keeping the highways in as good a state of repair as possible.

The principal work done on State highways consisted of general maintenance carried out by permanent patrolmen over a total length of 2,810 miles. No new construction works were put in hand, with the exception of the replacement of a number of old bridges which were no longer capable of carrying the traffic.

The total amount expended on maintenance and repairs was £237,136, which included the cost of some reconstruction work which had become an urgent necessity. £236,492 was provided from the Country Roads Board Fund and £644 from Federal funds.

With the exception of short lengths urgently required to meet defence needs, the Board was again compelled to suspend the extension of surface sealing and, owing to the shortage of bitumen supplies only sections of sealed highways requiring urgent attention were resealed. The total lengths were 12 miles of new sealing and 201 miles of resealing, a total reduction of 138 miles on the previous year's work.

Restrictions imposed by the Federal Government on supplies of petrol have caused a marked decrease in civil traffic on State highways and main roads, particularly in the operation of private cars. A census taken by the Board on State highways in September, 1941, shows a considerable reduction in the average traffic density observed when a census was taken in February of that year. In particular it disclosed a further fall in the percentage of motor cars and motor cycles, whilst motor trucks, omnibus and horse traffic showed a continued increase.

For some time past it has become increasingly difficult to obtain supplies of paint for marking traffic lines on roads under the jurisdiction of the Board, and substitute paints of inferior quality have had to be utilised. This difficulty, combined with the shortage of manpower, is responsible for the line marking not being up to the required standard, but every care is being taken to make the best use of such materials as can be obtained in order to maintain the safety of the road.

Reconstruction works, including the erection of new bridges to replace worn-out structures, and the restoration of existing bridges, were carried out on State highways mainly to meet the requirements of defence traffic. Twelve miles of highways were dealt with and nine bridges were rebuilt and restored. £14,671 was expended in repairing and reconstructing sixteen structures.

Under the abnormal conditions now existing, deterioration of road surfaces has occurred, owing to the difficulty experienced in securing adequate manpower and materials, and the urgent necessity of restricting operations to only essential works. On major roads of strategic importance, which include the State highways and many of the declared main roads, every endeavor is being made to maintain the pavements and bridges in reasonable condition, but, for the reasons stated, the maintenance standard has had to be reduced.

MAIN ROADS.

Some works of improvement and reconstruction of main roads of major importance were carried out to preserve existing assets and restore safe conditions. It was impossible to keep pace with requirements and the commencement of many works of this description had to be deferred. This has resulted in a steady, though at present not a serious, deterioration of a considerable mileage of main roads and bridges and it is probable that on many of the roads of minor importance this depreciation may be marked in a very short time.

On major roads of strategic importance, special efforts have been made by the use of machinery wherever possible to maintain the surface to a reasonable standard. However, there has been a loss of material which it has not been possible to replace. Over a long period this may prove serious, and extensive reconditioning in the nature of strengthening and repair work will be required when the present emergency is passed.

In cases where reconstruction and maintenance works have been carried out primarily for military traffic, the Commonwealth Government has contributed towards the cost.

The cost of maintaining, improving, and reconditioning 8,490 miles of declared main roads amounted to £397,148, for the year, for which provision of £372,335 was made from the Country Roads Board Fund, and £24,813 from funds available under the Federal Aid Roads and Works Agreement. Municipal councils carried out the work generally, but in accordance with the established practice, the Board, with the approval of the Governor-in-Council, undertook the maintenance of certain through roads carrying traffic not of local origin previously constructed or restored from either loan or Federal Aid funds.

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 extent of the assistance given in this way amounted to £33,247 for the year.

The relief granted to country municipalities under Act No. 4415 on account of interest and sinking fund payments in respect of main and developmental roads for the year was £223,790.

The difficulties experienced during the previous year in obtaining adequate supplies of bitumen continued during the year under review, due to the various restrictions placed on the importation of the material under war conditions. It was, therefore, necessary to use binders of local origin such as horizontal retort tar, or coke oven tar.

A programme of resealing was carried out over a length of 361 miles of main roads in order to preserve the existing pavements, whilst first seals over short distances totalling 17 miles were limited to urgent sections. The lengths treated during last year show a reduction of 117 miles compared with the 1940–41 programme.

DEVELOPMENTAL ROADS.

The only permanent works for which provision was made were (1) those which, owing to various circumstances due to the war, could not be carried out or completed during the year ended 30th June, 1941, and (2) urgent works such as the restoration and reconstruction of bridges and approaches. The amount expended was, therefore, only £47,598. In addition, the Councils contributed an amount of £9,978 towards these works.

Assistance to the extent of £29,956 was, however, given to municipal councils towards the maintenance of the more important roads previously constructed from funds derived from loan, Federal-aid and unemployment relief sources on the basis of the municipalities supplementing the amount from their own funds. The total amount contributed was £9,912. Having regard to the increased cost of labour and materials, the assistance was on a higher scale than that of previous years, and proved to be of considerable benefit to the Councils concerned.

The expenditure on construction of roads to farms isolated from the main roads system, was £23,858, supplemented by municipal contributions totalling £2,281. An expenditure of £6,069 was incurred on the reconstruction of 23 bridges, including £3,111 on 12 new bridges on isolated settlers' roads.

FEDERAL AID ROADS.

Since the cessation of loan expenditure on country roads, the Board has utilized Federal aid funds for construction and restoration of roads and bridges, and many important works have been carried out.

During the year £391,858 was made available to the State of Victoria under the terms of the Federal Aid Roads and Works Agreement and £129,295 was brought forward from the previous year. Of the expenditure of £168,547, £70,352 was incurred on the construction of roads of a developmental character, including roads to isolated farms, £27,091 on the improvement of main traffic routes and restoration of bridges, £276 on the construction of tourists' roads, and £70,828 in assisting Councils to maintain roads constructed from loan funds or from moneys provided under the Federal Aid Roads Agreement and from unemployment relief funds.

The sum of £294,058 was carried forward to next financial year.

From the proceeds of $^{1}/_{12}$ of the extra $\frac{1}{2}$d. per gallon customs duty on petrol, which may be expended on the maintenance and repair of roads adjoining or abutting properties of the Commonwealth, an expenditure of £3,188 was incurred during the year.

DEFENCE WORKS.

In conformity with the State Government's policy of rendering all possible assistance and the fullest co-operation with the Commonwealth Government in the war effort, the Board carried out extensive and important defence works in close contact with the Federal Departments concerned, the Allied Works Council, and State Departments and Instrumentalities.

The works comprised a wide variety in Air Force, Army, Navy, munition, and ordnance establishments in various parts of the State and included projects such as construction of runways, taxiways, hangar floors, roads, paths, drains, bituminous surfacing, &c.

In addition, extensive and important works are being carried out in the Northern Territory.

Soon after the outbreak of war, a number of works were put in hand for the Defence Department, comprising the construction of improvements of strategic roads, road construction, and allied activities in Army camps and at Air Force Stations.

The total expenditure incurred was £791,823 for the year, the money being provided by the Commonwealth Government, as the works progressed. Added to the expenditure incurred since the beginning of the war, a total of £1,252,216 has been expended by the Board on defence works on behalf of the Commonwealth Government.

BRIDGES.

In the last Annual Report reference was made to the fact that a specially qualified Bridge Inspector had been appointed to examine bridges in detail and report on their condition. As it became necessary to transfer the Inspector to urgent defence works during the early part of 1942, it was not possible to complete the investigations throughout the State.

From the information submitted a classification was made of all structures examined and this was used as a basis in making provision for repair or replacement, having regard also to the importance of the road.

The total sum expended on new bridges, and in repairing, restoring and widening structures was £31,735 for the year, of which £25,666 was provided from the Country Roads Board Fund and £6,069 from the Federal aid funds.

Forty-six bridges were reconstructed or in course of erection by municipalities and the Board at the 30th June, and six were repaired. Up to the end of the previous year 2,750 bridges had been completed since the establishment of the Board.

Under the provisions of Act No. 4458 a number of bridges and ferries over the Murray River together with approaches were maintained by the Board in conjunction with the Department of Main Roads, New South Wales, and the Victorian Railway Department. Each State pays a moiety of the cost of 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 during the financial year was £2,908 whilst, £3,393 was expended from Federal aid funds.

For some time past it has been difficult to obtain supplies of timber when required, but the Board with the assistance of the Federal Controller of Timber, has been able now to build up reserve stocks of structural timber to meet sudden demands for essential services and for emergency purposes in any part of the State.

In the building of larger bridge structures, the position is complicated through the difficulty in securing supplies of suitable materials such as structural steel and the availability of transport facilities. In many cases the Board has, therefore, been compelled to alter designs in order to avoid the use of priority materials or use shorter lived and less economical materials to ensure the erection of the structure in the shortest possible time.

METROPOLITAN ROADS.

During the year, no important works were carried out on main roads adjacent to Melbourne either by the Board or by municipalities. Work carried out has been confined to ordinary routine maintenance together with the small amount of bituminous surface treatment work which was considered necessary to preserve the surface and to keep it in reasonable condition.

It is hoped that, despite the shortage of men and materials, it will be possible to keep these roads—many of which are important traffic arteries—in satisfactory condition to prevent serious deterioration of the asset.

ROADS FOR ISOLATED SETTLERS.

The expenditure during the year was £23,858 on the construction of roads carrying light traffic between farms and the main road system. Applications made by councils for funds for this work were dealt with in order of urgency and a total amount of £36,840 was allotted. Municipal councils supplemented the grants by a grant equivalent to 10 per cent. Four hundred and two roads and twelve bridges were constructed or partially completed to the 30th June.

TOURISTS' ROADS.

On 392 miles of Tourists' roads declared under Act No. 4405, a total amount of £18,936 was expended during the twelve months, which was provided from the Country Roads Board Fund. The expenditure was confined to purely maintenance and repair of roads and bridges, no construction works having been undertaken.

The section of the Ocean Road between the Sheoak River and the Jamieson River which, for some time past, has been subjected to continuous heavy timber traffic under exceptional weather conditions, has shown marked deterioration, and as strengthening of the section by resheeting had been held over during the last twelve months on account of the difficulty in securing labour and plant, it became necessary to carry out reconditioning work.

In view of the fact that sawn timber had to be transported under No. 1 priority orders issued by the Commonwealth Timber Controller, an urgent request was received from the Forests' Commission to have the necessary work put in hand. Provision of £5,500 was therefore made during the current year to enable this to be done and the work is now proceeding.

DAMAGE TO ROADS.

For a number of years the Board, in conjunction with municipal councils, has constructed a considerable mileage of lightly surfaced roads throughout the State, and an economical programme has been carried out at small initial cost. As traffic increased, the surfaces have been strengthened and improved to a higher standard to meet traffic requirements.

Included in this type of roads are those serving farming districts and, under the abnormal conditions now existing, deterioration of road surfaces and bridges has occurred and great difficulty is being experienced in maintaining them.

Many roads of major and minor importance are being subjected to continuous heavy traffic such as milled timber and logs resulting in many of the lightly constructed settlers' roads being detrimentally affected.

Realizing the urgent need of the defence authorities for securing supplies, the Board has modified the conditions relating to gross weights to be carried over certain roads by increasing the allowable weights, provided the goods are transported in vehicles fitted with suitable tyres and brakes.

On roads leading to and traversing forest areas from which timber is being milled, it has in several instances been necessary to strengthen the road pavements in order to withstand the heavy traffic. The Forests' Commission is in close co-operation with the Board in order to prevent these roads being subjected to unreasonable loads beyond their carrying capacity.

In the case of roads constructed for the transport of farm produce, however, the surfaces of which consist of a light layer of crushed rock or gravel, it is equally important that these roads be protected from damage by excessive loads. Instances have come under the notice of the Board where heavy traffic is passing over roads of this type, and if allowed to continue, will speedily destroy the road and prevent the cartage of produce so urgently required for the defence forces.

To meet the position the Transport Regulation Board is co-operating with the Country Roads Board with a view to preventing cartage taking place over unsuitable roads by insisting on the use of available alternative routes.

TRAFFIC LINES.

In December when lighting restrictions were enforced in the metropolitan area and the authorities were contemplating imposing a complete blackout, the Board, realizing the value and assistance given to traffic by white lines painted along the centre of roads, offered to undertake the necessary work. This offer was passed on by the State Emergency Council to the metropolitan municipalities and a considerable number took advantage of it, resulting in over 100 miles of lines being painted.

All declared main roads immediately surrounding Melbourne were also treated and 130 miles of lines were painted since March last.

During the year, 875 miles of lines were painted by the Board's machine on main roads, State highways and other roads.

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 for motor cars carrying goods for hire or in course of trade, on State highways and main roads. In 202 cases fines totalling £692 were imposed for travelling at excessive speeds and £911 in 382 instances for carrying weights in excess of those permitted under the Act.

For allowing stock to wander unattended on State highways 81 prosecutions were launched and fines totalling £136 were imposed.

Owing to the additional menace to the safety of traffic caused by blackout conditions, and the impossibility of the Board's Ranger adequately coping with the nuisance, additional precautions were taken by the Board to deal with unattended stock on State highways by instructing its patrolmen to impound them and, as a result, 1,018 cattle, 115 horses, and 15 sheep were impounded during the year.

A number of councils has taken similar action to deal with cattle, &c., wandering on main roads.

The total number of prosecutions for all offences under acts administered by the Board during the year was 711. The total fines imposed amounted to £1,882 and costs to £151.

RESEARCH WORK.

The necessity for exercising economy of materials, and the fact that these materials often differ in essential characteristics from those which would be available under normal conditions, has required a great deal of laboratory work in order that methods of construction may be adapted to the amount and nature of the material available.

The Board's laboratory facilities are being used to an increasing extent on work for various Commonwealth Departments.

A summary of the laboratory tests carried out during the year is as follows :—

	Number of Samples.	Number of Tests.
Soil, gravel, concrete, aggregate	570 ..	800 approximate.
Bituminous and tarry materials	99 ..	334
Traffic marking lacquer	21 ..	42
Charcoal	6 ..	20

MUNICIPAL ENGINEERS' CONFERENCE.

In November last the second Annual Conference between Municipal Engineers and the Members and Officers of the Board was officially opened by the Minister of Public Works, the Honorable Sir George Goudie, K.B., M.L.C.

From the discussions on the technical, financial, and administrative sides of road construction and maintenance, it is felt that the conference served a very useful purpose.

AMENDING LEGISLATION.

Country Roads Board Fund Act 1941 (*No.* 4832).

Provision was made under this Act for :—

(1) Fees for licences to drive motor cars under the Motor Car Act during the financial year 1941–42 not to be paid into the Country Roads Board Fund.

(2) Suspension of annual payment of £50,000 from consolidated revenue into the Country Roads Board Fund for the year 1941–42.

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

APPORTIONMENT OF COSTS.

In accordance with the provision of Section 287 of the *Country Roads Act* 1928, the cost of permanent works and maintenance was apportioned for the year ended 30th June, 1941. £916 was apportioned to municipalities in respect of permanent works and £150,419 on account of maintenance.

South Gippsland Shire was the only council which did not pay its contribution by the 30th June, but the amount due, namely £1,004 2s., was paid on the 19th September last.

MOTOR REGISTRATION.

During the year a total of 230,780 motor 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 a decrease of 31,863 in the figures of last financial year. The decrease in registrations during 1940–41 against those of 1939–40 was 9,386, so that the total decline in 1941–42 compared with 1939–40 was 41,249.

Vehicles.	Financial year 1940–41.		Financial year 1941–42.		Increase.	Decrease.
Private—						
New	4,944		1,242		..	3,702
Secondhand—re-registered	14,627		13,216		..	1,411
renewals	126,336	145,907	106,671	121,129	..	19,665
Commercial—						
New	2,142		1,190		..	952
Secondhand—re-registered	3,258		2,836		..	422
renewals	29,401	34,801	30,020	34,046	619	..
Primary Producers—						
New	882		381		..	501
Secondhand—re-registered	3,263		3,079		..	184
renewals	45,150	49,295	46,061	49,521	911	..
Hire		2,530		2,465	..	65
Licensed under Omnibus Act		629		636	7	..
Trailers		5,620		6,086	466	..
Traction Engines, &c.		289		209	..	80
Motor Cycles		23,572		16,688	..	6,884
Total		262,643		230,780	2,003	33,866

ACCOUNTS.

Statements of accounts for the year ended 30th June, 1942, of the Country Roads Board Fund and balance sheets 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, 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	206,579 10 7	30,556 13 0	237,136 3 7
2. Main Roads—			
Construction and restoration .. £27,090 12 9			
Maintenance and reconditioning .. £411,169 12 2	61,322 0 9	376,938 4 2	438,260 4 11
3. Developmental Roads—			
Construction and maintenance .. £77,204 19 8			
Roads for isolated settlers .. £23,103 6 4	7,394 17 6	92,913 8 6	100,308 6 0
4. State Unemployment Relief Works—			
Main and Developmental roads, &c.	..	1,212 8 8	1,212 8 8
5. Tourists' Roads—			
Construction £276 5 6			
Maintenance and reconditioning .. £20,329 1 0	18,439 16 8	2,165 9 10	20,605 6 6
6. Murray River Bridges and Punts—			
Maintenance	2,763 3 4	144 10 7	2,907 13 11
7. Roads adjoining Commonwealth Properties—			
Maintenance	2,968 15 8	218 17 1	3,187 12 9
8. Commonwealth Defence Works (Unemployment Relief)—			
Construction and reconstruction	9,061 13 9	10 0 0	9,071 13 9
9. Commonwealth Defence Works (Northern Territory)—			
Construction and reconstruction	131,898 2 11	..	131,898 2 11
10. Commonwealth Defence Works (Allied Works Council)	1,157 10 1	..	1,157 10 1
Totals	441,585 11 3	504,159 11 10	945,745 3 1

STAFF AND ENLISTMENTS.

With much regret the announcement of the loss of three of its officers on active service was received by the Board—Messrs. William D. Willis, Bernard G. Hutchins, and A. P. R. Bruford.

Mr. Willis joined the Board's staff in May, 1935, and enlisted with the R.A.A.F. in July, 1940. He received his commission as Pilot-Officer, and was reported missing in September, 1941, when he was presumed to have lost his life in air operations.

Mr. Hutchins who was appointed in March, 1936, to the clerical staff, joined the R.A.A.F. in May, 1941, and was killed in an air accident on the 14th October, 1941.

Mr. Bruford was engaged by the Board as a junior draughtsman in February, 1939, and enlisted with the A.I.F. in August, 1941. He died of wounds accidentally received on 24th July, 1942.

The loss of these officers who had proved themselves valuable and conscientious members of the Board's staff is deeply deplored by the members and officers of the Board.

By enlistments in the defence forces, the calling up of trainees for national service and the releasing of a number of technical officers to defence departments and the Allied Works Council, the Board's staff was further depleted during the year.

The Board again records its appreciation of the work performed by members of the Staff in carrying through an extensive programme of works, necessitating considerable overtime. The increase in the number and extent of defence projects put an additional strain on an already depleted staff, whose duties have been satisfactorily performed under trying conditions.

The total number of officers and employees of the Board who had enlisted for active service abroad and those called up for military duty, at 30th June, was 536.

We have the honor 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,
13th November, 1942.

THE CHAIRMAN,

SIR,

I have the honour to submit selected particulars of matters of engineering interest in the Board's work during the last year.

As in previous years since 1939, normal works have been confined to maintenance, and have required special care in paring down even the maintenance work to a minimum. Some bridge reconstruction had perforce to be undertaken, but only for certain very weak or dangerous structures on important routes. A large length of roads in defence areas and camps was completed, somewhat urgently, and certain aerodrome construction was also undertaken. In addition, a new temporary division was formed outside Victoria for carrying out defence works in Northern Territory.

Considerable increase took place in the amount of plant in use by the Board on these various works. Towards the end of the period, the bulk of the labour engaged directly by the Board on defence works was enrolled in the Civil Constructional Corps of the Allied Works Council, whilst remaining under the control of the Board's engineers.

Although still further depleted by enlistments and by loan of officers to various defence authorities, the engineering personnel has proved highly efficient in overcoming many types of difficulties, in expediting completion of projects often with long overtime, in assisting in the building of the new labour organization, and in co-operating with the various defence authorities requiring the Board's engineering services.

ROLLED CONCRETE.

In the metropolitan area the Board has now a total length of about 8 miles constructed in rolled concrete, most of the length having been covered with a thin course of pre-mixed drag-spread asphaltic macadam. Portion has been left with the concrete surface exposed to traffic for several years, and presents quite a reasonably finished surface, now worn down to show a mosaic with a large proportion of stone.

For work near Melbourne there are considerable supplies of crushed basalt, but sand and cement have to be carted by rail about 30 and 50 miles respectively, so that concrete containing a very low proportion of mortar is particularly economical. The mixture which the Board has adopted has generally been 1 part of cement to $2\frac{1}{2}$ parts of sand, and from 10 to 12 parts of metal by volume. Since the beginning of the war a considerable amount of rolled concrete has been used on roads in and adjacent to various defence establishments subject to heavy commercial traffic.

A further use for this type of construction has been developed where very large areas of runways and taxiways have required to be built in concrete, and economy in transport of ingredients was an important factor in the choice of rolled concrete. Previous road construction has generally been done with $\frac{1}{2}$ cubic yard concrete mixers producing about 80 cubic yards per day, but where the larger areas have had to be built, in order to get a high rate of construction and bring the pavements into use in reasonable time, it was necessary to secure concrete pavers of 21 to 27 cubic feet capacity, producing about 200 cubic yards per day each. On large works such as these, where speed of construction is of great importance, the quality of finish is always very liable to suffer, and this is probably more noticeable with rolled concrete than with ordinary rich concrete.

When the small mixers were used the material was always spread from spreading sheets, but with the paving type of mixer a large proportion of the batch is deposited directly in place, with a resulting tendency for separation of coarse material from the mortar, so that the gauging of the thickness and the distribution of the material in a uniform manner is more difficult. Inequalities due to spreading are rapidly brought to light by initial rolling. To correct the inequalities it is necessary to scarify high or low places and remove the material to a sufficient depth so as to allow fresh material to be placed by hand to the correct levels. It was found that the inequalities were very much more numerous with spreading by a paver than with the previous careful hand spreading. The strain on the finishing gang is thus considerably increased. After correction and rolling, the surface is tamped with a longitudinal stiff steel tamper 22 feet long.

With harsh roller compacted mixtures it is necessary to select from the material deposited a proportion of the richer material to place along the side forms, so as to avoid honeycombed edges. With large capacity pavers a little more attention to this was required. For a time vibrators were tried to improve the finish of the edges, but were not found effective owing to the harsh nature of the material. With the precaution mentioned the roller was quite able to cope with the situation and give a respectable edge finish.

In spite of the care taken with finishing, weather conditions sometimes were responsible for irregularities, rain either spoiling the surface directly by washing away the mortar or indirectly by softening the subgrade. The effect of enriching the mixture to $1:2\frac{1}{2}:8$ was tried on one section of the work where the base was in an average moist condition, but it was found that the lubricating effect of the additional grout increased the mobility of the material, and the roller tended to bog, and, consequently, the finish was more uneven than previously.

On another trial section on an unyielding base the same rich mixture was used, and while compacting on this base was apparently quite feasible, there was still some tendency for the material to move horizontally with the rolling. On another section with the rich mixture the normal three-axle roller was replaced by a light 3-ton roller, which, however, was no more successful than the usual type.

In spite of the difficulty of finishing and the necessity of proceeding even under very unfavourable conditions, the finished work is quite serviceable, but a small amount of hand trimming of very rough areas by removal of the projections, together with a little patching with pre-mixed bituminous material of a fine graded type, will be required on the sections most seriously affected. Later work in which less emphasis on speed was necessary is almost as smooth as screeded concrete.

On a rolled concrete road which was constructed in three continuous thickened-edge slabs, each about 12 feet wide, the centre slab was poured last, and tongue and groove longitudinal joints were used to afford load transfer; it was later noted that transverse cracks were about twice to three times as numerous in the centre slab, and this was attributed to longitudinal restraint during initial shrinkage of the slab. For runway construction, therefore, the responsible engineers required complete edge separation of adjoining slabs, which were made of uniform thickness and provided with greased longitudinal dowel rods to minimize the effect of transverse cracks. At the end of each day's work transverse expansion jointing was used. With large aeroplane tyres edge and corner stresses are probably much less critical than with road vehicles.

SOIL CEMENT EXPERIMENTS.

With the reduction in the availablity of bitumen, and an increasing demand for local tar as industrial fuel, the Board has investigated "soil cement" as a substituate paving material. Six sections of road have been so constructed on the Henty Highway near Warracknabeal, and particulars are shown in Table A.

The soil was pulverized by scarifying the formation to 4-in. depth, blading and disc harrowing, a steel-tired multi-wheeled roller being used effectively to break the larger clods. The cement was spread at the desired rates, and dry mixing was performed by power grader or by numerous passages of a tractor-drawn agricultural combine drill and scarifier. Water was added by sprinkling or by fire hose and nozzle from the side of the road. Wet mixing with disc harrows was not satisfactory owing to clogging, and mixing by tandem power grader was not satisfactory owing to wheel slip. Eight traverses of the combine drill during watering gave the most effective mixing, the grader being used to maintain the shape only. Compaction was by sheepsfoot roller and crawler tractor, followed by dual-tired motor trucks and a pneumatic-tired multi-wheeled roller. Construction was completed in May, and the road carried light traffic (less than 50 vehicles per twelve hours' count) during the following spring and summer. Pneumatic-tired vehicles did not appear to cause undue abrasion, although owing to rather extensive cracking (most serious on the heavier clay soil) some spalling at the cracks commenced at mid-summer. There is a proportion of steel-tired wheat traffic in this district, and to avoid excessive damage the pavement was covered in March, 1942, by priming with tar at 0·20 gallon per square yard, and sealing with road oil at 0·25 gallon per square yard, to which $\frac{5}{8}$ inch to No. 8 gravel aggregate was applied at 1 cubic yard per 65 square yards. For further observation, two sections of 50 feet were left unsealed, one on the sandy soil being still in fair condition, and the other on the heavy clay exhibiting progressive cracking and disintegration.

The seal coat appears to be adhering satisfactorily to the soil cement, the surface of which had been worn by traffic so as to free it from the thin layer of loosely-bonded material produced during final shaping and rolling.

Attempts to slightly increase the proportion of cement at the surface by adding cement slurry were not successful, as the layer so formed quickly scaled off.

For concentrated road traffic it appears unlikely that soil cement will have any great field of usefulness in Victorian conditions, since a proper use of local materials will nearly always produce an adequate pavement at lesser cost. For dense traffic some form of bituminous seal coat appears necessary, and may as well be applied to the cheaper type of pavement, or to the natural formation where it is suitable. However, for runway purposes it is likely that, at any rate for the duration of the war, a saving of bituminous materials may be effected by use of soil cement, the abrasion of which may be much less serious with aeroplane traffic than it has proved to be with road traffic. In locations where cement is readily obtained, and where there is adequate water supply, soil cement may be especially suitable for paving runways. It will often be sufficient to treat only the ends, where dust is especially a nuisance, and where maximum loading conditions occur.

The Board is being called on to undertake construction of many runways, and it has, therefore, been necessary to provide laboratory equipment for soil cement tests. This includes apparatus for the wet-dry durability test, i.e., a humidifier box for curing the samples, cradles to hold them, and the wire brush to abrade them at the end of each wet-dry cycle. Some preliminary tests on various materials have been done to gain experience with this apparatus and with the test procedure. Results of these tests are given in Table B, together with other results used in soil cement design and control, these being tests already in use in the laboratory for some years in other forms of soil stabilization, and for soil identification and rating, or for control of compaction of earth works.

TABLE A.—EXPERIMENTAL SOIL CEMENT SECTIONS.

Section Number.	Extent of Section (feet).	L.L.	P.L.	P.I.	Cement (per cent. by volume).		Dry Weight (lb. per cub. ft. of mix.).	Field Moisture of Samples (per cent.).	Total Moisture of Wet Mix (per cent.).
					Designed.	Actual.			
1	166,750—166,687 ..	18·2	..	..	6·66	6·50	115·2	7·04	21·2
2	166,687—166,624 ..	Similar to Section 1			6·66	..	..	..	30·8
3	166,624—166,651 ..	Similar to Section 4			10·0	..	..	..	24·2
4	166,651—166,498 ..	39·9	18·5	21·4	10·0	9·68	96·2	15·45	27·0
5	165,811—165,748 ..	Similar to Section 6			13·30	..	..	..	34·6
6	165,748—165,685 ..	48·7	22·0	26·7	13·30	14·75	95·8	12·84	30·8

TABLE B.—MISCELLANEOUS SOIL CEMENT TESTS.

Material.	L.L.	P.I.	F.M.E.	Percentage by Weight Passing.					Proctor Maximum Density. (lb. cub. ft.)	Optimum Moisture. (per cent.)	Cement. (Percentage by volume.)	7-day Strength. (lb. per sq. in.)	Wet-dry Loss. (Percentage by weight.)	Remarks.
				3/16".	No. 8.	No. 18.	No. 36.	No. 200.						
Basaltic Clay A6–7	42·5	22·0	25·7	96·0	..	..	94·0	85·6	(Combined) 93.6	(Combined) 20.5	13·0 15·0 17·0	.. .. ..	3·0 2·0 1·8	Tests made to ascertain cement required in this clay soil; 15 per cent. appears reasonably satisfactory
„	47·7	25·0	27·5	100·0	..	..	99·0	90·0			13·0 15·0 17·0	.. .. ..	14·3 12·3 2·7	
„	68·0	39·0	25·0	100·0	..	..	99·5	95·6			13·0 15·0 17·0	.. .. ..	15·8 3·1 1·7	
Sand A2	..	..	..	..	100·0	92·0	73·0	0·0	107·5	10·5	12·5 16·0 23·0 27·5	132 252 680 1,480	.. ..	Tests made on sand used in test areas of floors for stores. Strengths given are average of two cylinders
Limestone Gravel A2	22.5	4.5	..	..	..	..	..	..	..	Approx. 14.0	8·0 16·6 26·3	.. 620 920	1·35	Tested for use in external aprons
River Gravel A3	..	..	..	76.0	57.0	27.0	6.0	0.2	..	..	11·0 15·0 18·5	325 780 1,220	.. .. ..	Tested for use in external aprons
Pit Gravel A2	36.2	17.5	27.0	82.0	69.0	52.0	34.5	23.0	..	..	11·0 15·0 18·5	440 505 760	.. .. ..	Tested for use in external aprons. Tensile strength of fraction passing No. 36 (no cement) was 146 lb. per sq. inch

BEARING CAPACITY.

In peacetime, when new roads were being built for civil purposes, in most instances a policy of stage construction has been followed by the Board. For military and air purposes it is more usually necessary to construct a complete pavement in one rapid operation to a standard sufficient for the traffic, but, of course, not so strong as to be extravagant in cost, and (what is probably of more vital importance) in use of man power, of plant, and of materials. As, however, all pavements rest on soil which is usually far from uniform in properties, and whose moisture content continually varies, the problem of how strong to make the pavement is extremely complex. The Board has felt that it is none the less one which urgently demands more local research. An extension of the laboratory has, therefore, been undertaken to house both the soil-cement apparatus referred to earlier, and also equipment with which it is hoped to attack various phases of the bearing capacity problem.

The investigation of bearing capacity is one which will be of great value in post-war work, when arrears of reconstruction of obsolete sections of main roads will have become urgent, and rapid completion to the desired standard will probably be called for.

Meanwhile, in the construction of defence roads and other works, the Board's engineers have been able to bring to bear their experience so as to advise the several defence authorities what forms and materials of construction and what pavement thicknesses are necessary and sufficient in particular cases.

A rational basis for use in aiding the judgment of the engineers was applied during 1940 by one of the Board's testing engineers to the design of pavement for an important deviation of a State highway. The bearing capacity of the cohesive formation soil was estimated from a simple laboratory shear test. The specimen measured 2 inches wide, 2 inches high, and 16 inches long, and was filled and compacted in a galvanized iron mould at the desired moisture content (generally within the plastic range).

The mould was made in three pieces, and the end portions were clamped down. The centre portion was supported by a cradle so that by application of an upward vertical load a length of about 5 inches was quickly sheared away in double shear. No axial load was applied to the sample. The rapid test conditions do not allow adjustment of capillary pressures, and, therefore, frictional forces do not come into play, and the shearing strength is contributed wholly by cohesive resistance. Authorities differ somewhat in estimation of bearing capacity (q) from known cohesive strength (c), e.g., Prandtl derived the relation $q = (\pi + 2)\ c$, the load being applied over a long rigid area, while Terzaghi, for a load applied over a long but not entirely rigid area (a condition somewhat resembling that of a road pavement) deduced $q = 4c$.

On the particular job, it was necessary to estimate the maximum moisture content likely to exist in the finished work, and to use this moisture content in the test, or else perform the test at (say) three moisture contents and interpolate (or if necessary extrapolate) for the adopted moisture. The estimation of maximum moisture may be made by measuring the moisture under an existing pavement, if there be one in the locality of similar type and thickness to those proposed. Table C shows some typical measurements of subgrade moisture made by the Board from time to time. The results tabulated refer generally to sound pavements. As was reported in 1934 from study of numerous tests, a well-compacted pavement has a great stabilizing effect on the moisture content of the subgrade under it. However, as Table C indicates, this moisture may be in excess of the plastic limit of a cohesive subgrade, and critical bearing conditions may therefore arise. Above the plastic limit the cohesion and bearing capacity decrease very quickly. The thickness of pavement required to withstand frequent load repetitions accordingly rises rapidly as the moisture content increases above the plastic limit. If pavement materials are costly or (in wartime) require excessive transport, careful consideration must be given to such alternative measures as

TABLE C.—MOISTURE CONTENT OF SUB-GRADES.

Locality.	Pavement (at centre line unless stated).	Seal Coat.	Depth.	Date Sampled.	Moisture. (per cent.)	L.L.	P.L.	F.M.E.
Port Campbell	Scoria 0″ to 4″	Nil	..	..	..	..	..	..
	Sandy loam 4″ to 8″	Nil	..	..	..	..	..	..
	Yellow clay sub-grade	Nil	8″ to 11″	Oct., 1935	30·4	100·0	30·0	45·0
Timboon ..	Buckshot gravel 0″ to 3″ ..	Nil	..	..	..	..	..	..
	Loam 3″ to 12″	Nil	..	..	..	..	..	..
	Yellow clay sub-grade	Nil	12″ to 15″	Oct., 1935	35·7	100·0	36·0	55·0
Timboon ..	Crushed soft limestone 0″ to 3½″ ..	Nil	..	..	..	..	..	..
	Loam 3½″ to 7½″	Nil	..	..	..	..	..	..
	Yellow clay sub-grade	Nil	7½″ to 10″	Oct., 1935	25·3	100·0	36·0	55·0
Kerang ..	Crushed granite 0″ to 2″ ..	Nil	..	..	..	..	..	..
	Dark brown clay formation ..	Nil	2″ to 4″	Aug., 1933	25·0	60·5	21·0	28·2
Kerang ..	Crushed granite 0″ to 2″ ..	Primed and sealed Dec., 1933	..	..	..	..	..	..
	Dark brown clay formation ..		2″ to 4″ ..	Aug., 1934	23·0	60·5	21·0	28·2
Kerang ..	Crushed granite 0″ to 2″ ..	Nil	..	..	..	..	..	..
	Brown clay formation	Nil	2″ to 4″ ..	Aug., 1933	25·0	67·7	27·2	42·0
			2″ to 4″ ..	Aug., 1934	24·6	67·7	27·2	42·0
Werribee ..	Crushed basalt 0″ to 8½″ ..	Primed and sealed Nov., 1940	..	..	..	..	..	..
	Sandy loam 8½″ to 10¼″ ..		..	..	..	..	..	..
	Clay formation		10¼″ to 13¼″	Oct., 1941	31·4	61·4	27·4	..
Werribee ..	Crushed basalt 0″ to 7¼″ ..	Primed and sealed Nov., 1940	..	..	..	..	..	..
	Brown clay formation		7¼″ to 10½″	Oct., 1941	34·9	56·0	27·6	..
	Brown clay sub-grade		10½″ to 15½″	..	30·4	56·5	30·3	..
Werribee ..	Old edge strip 0″ to 12″ of penetration macadam on macadam base (1929)	Sealed 1929 Resealed 1930 R.M. seal 1935	..	..	..	..	..	..
	Clay sub-grade	.. ..	At 12″ ..	Feb., 1940	32·2	..	..	..
Werribee ..	Crushed basalt 0″ to 12″ (1934) ..	Sealed 1935 .. R.M. seal 1935	..	..	..	..	..	..
	Red clay sub-grade	.. ..	At 12″ ..	Mar., 1940	25·3	..	..	..
	Red clay sub-grade	.. ..	At 18″ ..	Mar., 1940	21·8	..	..	..
	Red clay sub-grade	.. ..	At 24″ ..	Mar., 1940	33·6	..	..	..

(*a*) sub-drainage, (*b*) use of raised formations, (*c*) use of the best local loamy materials carefully compacted as a base course, (*d*) cement modified soil, &c.

The estimation of pavement thickness in the instance previously mentioned was based on cohesion tests as follows. Table D shows change in measured cohesion (and thus in estimated bearing capacity) with changing moisture content for a typical material from the road (L.L. about 50, P.L. about 23).

TABLE D.—COHESION TESTS.

Moisture. (Percentage by weight.)	Cohesion. (lb. per sq. inch.)	Bearing Power. (lb. per sq. inch.)	Remarks.
25	3·5	14·0	Proctor optimum
30	2·0	8·0	
35	1·1	4·4	
37	0·85	3·4	F.M.E.

Assuming a wheel load of 2 tons, giving an average pressure of 90 lb. per square inch on a tire contact area of 50 square inches, and assuming 45° load distribution through the fine crushed rock pavement, Table E shows the calculated bearing capacities corresponding to various thicknesses.

TABLE E.—THICKNESS REQUIRED.

Sub-grade Pressure (lb. per sq. inch).	Thickness (inches).
25·5	3
20·0	4
16.0	5
13·0	6
11·0	7
9·0	8

It was deemed unlikely that the moisture content could be kept on the average below the optimum value of 25 per cent. throughout the year, but it was also considered unlikely to approach the F.M.E. A check of actual moisture content under adjoining lengths of old road gave 32 per cent. at a depth of 12 inches under an old widening strip constructed with penetration macadam on macadam base in 1929, and 25 per cent. at a depth of 12 inches under a sealed fine crushed rock pavement constructed in 1934. Accordingly, for the new work being constructed in fine crushed rock a moisture content of about 30 per cent. seemed the probable upper limit, and a thickness of 8 inches was recommended in February, 1940.

It was necessary to carry traffic at an early stage, and a stage construction procedure was adopted. The fine crushed rock was laid on a cinder bed except on the less active clay, giving a total thickness of about 7½ inches. This was sealed late in 1940, and it was hoped to add a pre-mixed drag spread coat before the winter of 1941. This, however, had to be postponed with other reconstruction projects, and a large portion of the sealed rock has withstood the traffic without the additional thickness. Some sections did, however, fail, and in order to ascertain a basis for strengthening the pavement, the sub-grade moisture contents and soil properties were measured at numerous points along the road after the spring of 1941. Some of the results on sound sections are included in Table C. At other points near where failures had occurred, moisture contents exceeded the plastic limit by 1/10 to 1/4 of the P.I. Except where the P.I. was less than 20, a pavement thickness of 7 inches (corresponding to a calculated sub-grade pressure of 11 lb. per square inch) appeared very liable to failure. Although the basis of design is admittedly approximate, and the soil properties are

by no means uniform along the length, these observations afford quite a good verification of the method. When more convenient apparatus for measuring cohesion is secured, it is proposed to make extensive use of it where cohesive soils are encountered.

On the particular work, additional drains have been dug and failed sections removed, together with soft sub-grade, and replaced with fresh pavement material to about 9 or 10 inches depth, mitre drains being provided to drain the patches during consolidation under traffic. It is proposed later to lightly resheet the whole length and finish with a new bituminous surface treatment.

During the year, preparations have also been made to extend the Board's researches into this important problem by provision of additional testing equipment, namely:—

(*a*) Two hydraulic presses for forming and testing samples by the Californian bearing power test.

(*b*) Apparatus for measuring the amount of swelling when compacted soils are exposed to water. (Californian swell test.)

(*c*) Jacks and dial micrometers for field bearing tests.

MOBILE LABORATORY.

For use in Northern Territory where testing facilities were not available, a mobile laboratory was built on a "Ford" chassis. A two-wheeled laboratory trailer adapted from a holiday caravan was also fitted out to be towed by the "Ford" vehicle. The trailer will normally be left at the principal headquarters in the area, whilst the towing vehicle is available either at the same location or at any desired point on the works.

The equipment provided includes that required for mechanical analysis of gravel, soil tests, and consistency tests for bituminous materials.

A horizontal rolling type sieve shaker was provided, and proved effective and readily operated by hand. For dispersing soil and gravel samples with water a small commercial eccentric type hand-operated churn was found to be quite suitable. For drying samples a kerosene stove was built, incorporating a commercial heating unit, the products of combustion being suitably directed around the drying chamber and portion by-passed for temperature control. Temperature control fittings consist of an incubator thermostat in which ether is replaced by toluene. The heating chamber was made large enough to deal with soil-cement samples if required, although the heating unit is working at the limit of its capacity to keep the large chamber at correct temperature. For use in 77°F. penetration test of bitumen, an evaporation cooler was devised incorporating a fan driven by a small d.c. electric motor from the 32-volt lighting circuit available at the base camp.

The units have so far operated chiefly at a fixed location, and have assisted the Board's engineers very greatly in many engineering problems that have arisen in an area where detailed tests of the local materials were not previously available.

BITUMINOUS SURFACE TREATMENT.

During the year about 3,700 tons of bitumen and 2,500 tons of tar products were used on the various works carried out under the Board's control. As shown in Table F a reduced mileage of roads was treated, and re-sealing formed the bulk of the programme.

TABLE F.—TOTAL MILES OF WORK ON C.R.B. ROADS CARRIED OUT BY BOTH C.R.B. AND MUNICIPALLY-OWNED PLANT.

Year.	Miles of Work.					
	New Work. First Seals.	Re-treatments.				Grand Total.
		Reseals.	R.M.S.	P.M.S.	Total.	
1936–37 ..	522·99	3·5	316·7	17·8	338·0	860·9
1937–38 ..	591·2	35·8	286·1	..	321·9	913·3
1938–39 ..	595·2	..	246·3	45·9	292·2	887·4
1939–40 ..	332·1	252·3	105·2	37·6	395·1	727·2
1940–41 ..	147·8	429·5	253·1	43·8	726·4	874·2
1941–42 ..	30·35	561·38	1·27	1·24	563·9	594·2

Besides some municipal plants, one 600-gallon and eight 400-gallon sprayers owned by the Board were used.

The total work done on C.R.B. roads was 594 miles. In addition, work was carried out on 633,294 square yards of roads and large paved areas of Commonwealth projects. The average mileage on C.R.B. roads for the five-year period 1937-38 to 1941-42 was 800·6 miles per season. The total on all except Commonwealth roads was divided as follows:—

	Miles.	*Miles.*
C.R.B. plant on C.R.B. roads	583	
Municipal plant on C.R.B. roads	11	
Total work on C.R.B. roads ..	..	594
C.R.B. plant on municipal roads	..	5
Grand total		599

Table G shows the relative quantities of petroleum products (bitumen, fuel oil and kerosene) and tar products purchased. However, of the 7,900 tons of bitumen purchased, some 3,550 tons was transferred to works in other States. From the balance (4,350 tons) the Board supplied all the bituminous binder required for its Defence works in Victoria.

The 2,332 tons of tar binder comprised 1,836 tons of coke oven tar and 496 tons of distilled horizontal retort tar. The whole of the distilled horizontal retort tar and most of the coke oven tar was used for work on main roads and State highways. Re-sealing with tar was adopted on sound pavements and was confined generally to the southern portions of the State, as the life even of horizontal retort and coke oven tars is very short in the hotter and drier climate of northern Victoria. In normal times these materials would not be used for re-sealing on account of their rapid ageing, but in order to save bitumen they were used as mentioned, and should tide the pavements over a year or two.

TABLE G.—TOTAL MATERIALS PURCHASED.

Material.	Tons.	
	Petroleum Products.	Tar Products.
Binder	7,900	2,332
Primer	..	584
Miscellaneous	1,065	88
Total	8,965	3,004
Percentage	75	25
Total	11,969	

As shown in Table H, more than half the re-sealing of roads was done at 0·20 gallons per square yard at an average cost of 7·55 pence per square yard, and the remainder chiefly at 0·15 gallons per square yard at an average cost of 6·06 pence per square yard. The corresponding costs for the previous financial year were respectively 7·64 and 4·76 pence per square yard, the increase being chiefly in material costs.

TABLE H.—COST OF RE-SEALING (PENCE PER SQUARE YARD).

Nominal rate of Application of Binder (galls. per sq. yd.)	0·10	0·15	0·20	0·25
Area Costed (sq. yds.)	311,145	1,258,253	2,264,414	285,653
Materials	2·35	4·42	5·68	6·04
Labour	0·42	0·90	0·96	1·12
Stores	0·13	0·13	0·17	0·18
Plant	0·40	0·61	0·74	0·93
Total ..	3·30	6·06	7·55	8·27

The rates of application of binder and aggregate used for retreatments by the process of simple re-sealing were under normal circumstances those set out in Table I.

TABLE I.—RATES OF APPLICATION OF BINDER AND AGGREGATE USED WHEN RE-SEALING.

Materials.		Rate of Application.			
		Binder.—Gallons per square yard. Aggregate.—Sq. yards covered by 1 cubic yard.			
Binder (Application)		0·1	0·15	0·20	0·25
Nature of the Binder.	Type of Aggregate.				
Petroleum ..	Gravel or Screenings	130	110	75	65
	Scoria	110	80	60	50
Tar ..	Gravel or Screenings	..	110	85	70
	Scoria	..	90	65	55

GRADER BLADES.

The great utility of power graders, both in construction and maintenance, has been referred to in several of the Board's Annual Reports since the first light machines were introduced into Victoria in 1927.

With fine-grained pavement materials such as occur in the Murray Basin, e.g., the silty clay formation and the sand clay pavements, power graders are ideal for maintenance of roads carrying pneumatic-tired traffic. With a traffic of about 100 vehicles per day (12-hour count), one moderately large diesel-powered machine has been found capable of keeping in excellent order a length of 70 miles with only minor supplementary attention to drains and structures.

On coarser pavements the work is heavier, and the length per machine is somewhat reduced. Prior to the war the Board had carried out a series of tests on the life of grader blades of mild steel and various special steels, and found that in Victoria there was little if any advantage in using special steels. The Brinell test was found to give the best indication of the relative resistance of steels to field wear, the relation being approximately $Bw = 6 \cdot 0$, where B is the Brinell number and w the wear in lb. per mile per foot of blade.

Based on the latter conclusion Table J sets out estimated job costs for a 6-foot Canadian standard 6-in. x ½-in. blade with three alternative materials recently under consideration whose Brinell test values were measured. These materials were—

A. Mild steel.

B. A special steel suitable for flame hardening.

C. A silicon-manganese steel not suitable for heat treatment, but to be used as rolled.

TABLE J.—COMPARATIVE ESTIMATED COSTS OF GRADER BLADES OF STEELS A, B, AND C.

	A.	B.	C.
Brinnell Number	130	450	240
Wear (lb. per mile per ft. of blade)	0·046	0·014	0·025
Relative Number of Blades ..	3·28	1·0	1·79
Costs.	*s. d.*	*s. d.*	*s. d.*
Material	23 0	7 0	19 8
Machining	4 4	2 6	9 10
Transport (100 miles)	5 9	1 9	3 2
Changing Blade (labour plus plant hire while idle, diesel power grader)	13 5	4 1	7 4
Heat Treatment	..	8 0	..
	46 6	23 10	40 0

This shows an estimated advantage in favour of steel B, but at present it is very difficult to undertake the flame hardening. Also the rate of wear of the case-hardened blade is somewhat difficult to compare with that for blades of uniform hardness, and the figures given may unduly favour steel B.

On the works outside Victoria the Board has recently been faced with the necessity for saving as much as possible the use of steel, and also its transport to remote localities. On a 34-mile length of rough corrugated ironstone and sandstone gravel surface the results shown in Table K were secured. Test No. 6 was carried out under very hard conditions, which were not altogether comparable with tests 1 to 5. The Brinell tests for concave blade were approximately 190 on the bevelled edge and 285 on cross section. As far as possible alloy steel or tipped mild steel have been used in the circumstances mentioned.

TABLE K.—TESTS ON GRADER BLADES.

Material.	Brinell Test.	Life of Blade in Hours.
1. Flat M.S.	130	6·4
2. M.S. tipped with welded alloy steel about 1/32 inch depth ..	500	13·3
3. Concave alloy steel	190 to 285	28·25
4. Flat M.S. (same as 1)	..	10·0
5. Same as 2	..	16·0
6. Same as 3	..	11·5

Yours obediently,

D. V. DARWIN,
Chief Engineer.

APPENDIX.

COUNTRY ROADS BOARD FUND.

RECEIPTS.

1941.		£ s. d.	£ s. d.	£. s. d.	£ s. d.
July 1.	To Balance				153,658 10 5
1942.					
June 30.	.. Motor Car Act No. 3741—Registration Fees ..	1,550,193 17 11			
	Less Refunds	25,135 6 6			
			1,525,058 11 5		
	Fines ..	12,912 11 9			
	Less Refunds	20 10 0			
			12,892 1 9		
			1,537,950 13 2		
	Less Cost of Collection ..		94,353 3 2		
				1,443,597 10 0	
	.. Motor Omnibus Act No. 3742—Fines		.. ..	6 10 0	
	,, Country Roads Board Acts Nos. 3662; 3741, Sec. 13; and 4332—				
	Fees and Fines		458 5 6		
	Registration of Traction Engines		394 18 6		
				853 4 0	
	,, Acts Nos. 3662, 3741, 4332—Costs		.. ..	154 15 10	
	,, Municipalities' Repayments—				
	Permanent Works—				
	Outer Metropolitan Roads ..	4,795 0 5			
	Relief Acts Nos. 4140 and 4415	143,668 4 10			
			148,463 5 3		
	.. Main Roads—Maintenance ..		149,414 15 11		
				297,878 1 2	
	,, Hire of Plant		57,032 17 8		
	,, Stores and Materials		231,312 3 5		
	,, Sundries		92,976 11 9		
				381,321 12 10	
	.. Special Works—Outstanding 30.6.41—Recoup ..			24,875 1 8	
					2,148,686 15 6
					£2,302,345 5 11

PAYMENTS.

1942.		£ s. d.	£ s. d.	£ s. d.
June 30.	By Maintenance			627,762 9 9
	,, Murray River Bridges and Punts			2,907 13 11
	,, Interest and Sinking Fund—Municipalities Repayments			111,901 2 3
	.. Interest and Sinking Fund—Great Ocean Road			1,000 0 0
	.. Recoup to Revenue—Act No. 3944—			
	Interest—Main Roads		107,515 17 3	
	Developmental Roads		177,874 6 0	
	Sinking Fund Contributions		25,608 7 11	
	Exchange		41,635 6 5	
	Loan Conversion Expenses		5,088 18 4	
				357,722 15 11
	.. Relief to Municipalities—Acts Nos. 4140 and 4415		.. ..	223,790 8 8
	,, Stores and Materials		250,838 1 6	
	.. Motor Expenses		5,453 16 10	
	,, Plant Purchase and Repairs		76,131 0 8	
	.. Storeyard		41,683 10 10	
	.. Sundry Debtors		71,343 6 2	
	.. Traffic Administration—			
	Motor Car Acts		3,258 12 8	
	Country Roads Acts		1,396 11 2	
	.. Bridge Inspections		974 13 6	
	.. Act No. 4332—Impounding of Cattle		786 19 10	
	,, Act No. 4609—Tourists' Resorts Fund		10,126 16 6	
	,, Act No. 4585—Traffic Line Marking		4,976 11 4	
	.. Recoup to Revenue—Act No. 3782—Superannuation Charges		1,630 2 10	
	.. General Expenditure—			
	Salaries, &c.	85,024 0 9		
	Less Recoup	17,913 3 1		
			67,110 17 8	
				535,711 1 6
	.. Special Works—Outstanding			141,670 1 11
	,, Balance			*299,879 12 0
				£2,302,345 5 11

RECONCILIATION.

	£ s. d.
Balance as per Treasury Books	299,782 1 5
Add Transfers Outstanding	2,455 16 0
	302,237 17 5
Deduct Accounts in Transit	2,358 5 5
Balance as per Country Roads Board Accounts	299,879 12 0

* Includes amounts of :—

(*a*) To meet liabilities on contracts and direct labour works .. £135,000

(*b*) Reserve for reconstruction of roads and bridges .. £125,000

APPENDIX—*continued.*—REVENUE ACCOUNT, 30TH JUNE, 1942.

1942.		£ s. d.	£ s. d.	£ s. d.
June 30.	To Maintenance Works—General		367,825 1 10	
	,, Mansfield–Woods Point Road ..	1,717 7 9		
	,, Walhalla Road	1,157 4 8		
	,, Woods Point Road	1,635 0 2		
	,, State Highways	236,491 19 6		
	,, Tourists' Roads	18,935 15 10		
			259,937 7 11	
				627,762 9 9
	.. Murray River Bridges and Punts		.. ..	2,907 13 11
	.. Contribution to Sinking Fund		27,975 5 7	
	.. Interest on Loans		83,925 16 8	
				111,901 2 3
	,, Recoup to Revenue—Act No. 3944—			
	Interest—Main Roads ..	107,515 17 3		
	Developmental Roads	177,874 6 0		
			285,390 3 3	
	,, Sinking Fund Contributions		25,608 7 11	
	,, Exchange		41,635 6 5	
	.. Loan Conversion Expenses		5,088 18 4	
				357,722 15 11
	.. Act No. 4395—Great Ocean Road—			
	Interest		554 3 6	
	Sinking Fund		445 16 6	
				1,000 0 0
	,, Tourists' Resorts Fund—Act No. 4609		.. ..	10,126 16 6
	.. Recoup to Revenue—Act No. 3782—Superannuation Charges		.. ..	1,630 2 10
	.. Relief to Municipalities		.. ..	223,790 8 8
	,, Audit Fee		458 15 1	
	,, Insurance of Staff		82 5 11	
	.. Instruments		144 9 5	
	,, Investigation Surveys		208 17 0	
	,, Pistols		10 0 0	
	,, Motor Expenses		5,453 16 10	
	,, Offices, Exhibition Building		1,836 11 8	
	,, Divisional Offices		272 0 2	
	,, Divisional Storeyards		1,524 4 1	
	,, Promontory Huts and Garages		3 3 6	
	.. Storeyard Equipments Repairs Account ..		399 10 3	
	,, New Storeyard		2,604 9 10	
	,, Office Expenses		3,456 4 5	
	,, Office Furniture		344 4 10	
	.. Patrolmen's Cottages and Engineers' Residences ..		533 9 9	
	,, Patrol Garages		83 15 4	
	,, Plans Purchase		436 6 8	
	,, Plant Purchase		35,662 5 7	
	,, Postage and Telegrams		1,199 16 8	
	,, Printing and Stationery		1,661 14 0	
	,, Salaries		54,705 9 10	
	,, Pay Roll Tax (Staff)		1,428 19 10	
	,, Telephones		1,346 8 10	
	,, Testing Materials		576 5 1	
	,, Gravel Sites and Metal Investigation		85 2 5	
	,, Travelling Expenses		928 11 9	
	.. Timber, &c., Revenue Account		4 5 8	
	.. Motor Car Acts Nos. 3741, sections 11-13, and 3901, sections 24–36		3,258 12 8	

1941.		£ s. d.	£ s. d.	£ s. d.	£ s. d.
July 1.	By Balance				556,172 2 6
1942.					
June 30.	,, Motor Car Act No. 3741 Registration Fees		1,550,193 17 11		
	Less Refunds		25,135 6 6		
			1,525,058 11 5		
	Fines ..	12,912 11 9			
	Less Refunds	20 10 0			
			12,892 1 9		
			1,537,950 13 2		
	Less Cost of Collection ..		94,353 3 2		
				1,443,597 10 0	
	.. Motor Omnibus Act No. 3742—Fines			6 10 0	
	.. Country Roads Act No. 3662—				
	Registration of Traction Engines			394 18 6	
	Fees and Fines			458 5 6	
	Costs—Acts Nos. 3662, 3741, and 4332 ..			154 15 10	
	.. Plans, Sale of			7 4 0	
	.. Plant Earnings		56,535 11 3		
	,, *Deduct* Working Costs ..		40,468 15 1		
				16,066 16 2	
	.. Sundry Earnings			65 8 10	
	.. Old Roads, Sale of			130 2 4	
	,, Rents			1,305 11 8	
	.. Royalty on Gravel and Metal			152 10 10	
	,, Storeyard			5,157 13 8	
	,, Timber, &c., Revenue Account			96 0 11	
	.. Materials, Sale of			6 5 2	
	.. Forfeited Deposits			12 15 6	
	,, Great Ocean Road—				
	Interest and Redemption of Mortgage		289 0 0		
	Sale of Equipment—Golf Links		24 11 2		
				313 11 2	
	.. Maintenance Works—				
	Contributions Payable by Municipalities		96,354 13 5		
	Adjustment		642 6 11		
				95,712 6 6	
	.. Permanent Works—				
	Contributions Payable by Municipalities—				
	Outer Metropolitan Roads		4,839 5 2		
	Other Main Roads ..		143,668 4 10		
				148,507 10 0	
					1,712,145 16 7

1942.								
June 30.	To Country Roads Acts			1,396	11	2		
	,, Bridge Inspections			974	13	6		
	,, Act No. 4332—Impounding of Cattle			786	19	10		
	,, Act No. 4585—Traffic Line Marking			4,976	11	4		
	,, Direction Boards and Warning Signs			1,015	18	5		
	,, Advertising—Government Printer			250	11	1		
	,, Legal Work—Crown Solicitor			300	0	0		
	,, Insurance—Public Risk			105	0	0		
	,, War Damage Insurance			5,444	19	0		
	,, Defence Leave—Employees			372	4	4		
	,, Camp Sites			27	6	9		
	,, Recoup—Berry, Roche, and Tamac Pty. Ltd. ..			0	15	0		
	,, Engineers' Conference			17	16	10		
	,, Interstate Conference			1	15	1		
				134,380	19	5		
	Less Recoup			17,913	3	1		
							116,467	16 4
	Balance			..		..	815,008	12 11
							£2,268,317	19 1

£2,268,317 19 1

BALANCE-SHEET AT 30TH JUNE, 1942.

LIABILITIES.	£	s.	d.
Contractors' Deposits	9,117	18	7
Sundry Liabilities	11,832	2	0
Revenue Account	815,008	12	11
	£835,958	13	6

ASSETS.	£	s.	d.	£	s.	d.
Country Roads Board Fund				299,879	12	0
Maintenance Expenditure—						
Contributions Payable by Municipalities	96,354	13	5			
Contributions in Arrears	1,004	2	0			
				97,358	15	5
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	35,742	7	7			
Outstanding Special Works	141,670	1	11			
				177,412	9	6
Materials—Stock—						
Storeyard	91,613	12	6			
Branches	12,068	15	6			
				103,682	8	0
Trust Fund				9,117	18	7
				£835,958	13	6

SUMMARY SHOWING VALUE AS AT 30TH JUNE, 1942, OF BOARD'S ASSETS CHARGED TO FUND (not included in Balance-sheet).

	£	s.	d.
Patrol Cottages	11,830	17	3
Divisional Engineers' Residences	6,317	12	0
Quarries, Gravel Pits, &c.	1,612	11	0
Garages, &c.	1,393	12	0
Shelter Huts, &c.	254	15	0
Storeyard and Offices—Divisional	3,701	5	8
Great Ocean Road Mortgage (Mrs. A. M. Bird)	1,895	0	0
Workshop Plant, Tools, &c.	3,182	13	0
Furniture and Fittings	7,233	4	10
Testing Laboratory Equipment	1,243	5	9
Survey Instruments	708	4	1
Pistols	21	13	4
Motor Cars	6,297	10	0
Storeyard No. 1	3,360	11	6
Works Film	4	8	0
Carried forward	£49,057	3	5

	£	s.	d.
Brought forward	49,057	3	5
Storeyard—New	8,580	16	4
Motor Registration Branch	6,438	17	3
Motor Testing Branch	20	11	0
Weighbridge	476	17	0
Police Sergeant's Office	11	4	6
Police Enquiry Section	8	14	6
Police Cycles	980	0	0
Police Motor Cars	6,330	0	0
Police Motor Accessories	30	0	0
Board Motor Accessories	30	0	0
Loadometers	260	0	0
Concrete Pipe Tester	6	0	0
	72,230	4	0
Working Plant at Valuation	126,286	3	9
	£198,516	7	9

COUNTRY ROADS BOARD LOAN ACCOUNT—ACT No. 3662.

BALANCE-SHEET AT 30TH JUNE, 1942.

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		336,021 0 6	
		4,372,846 15 4	
Less—			
Redemption Funds	85,219 1 1		
Main Roads Sinking Funds	285,688 7 7		
Repaid to State Loans Repayment Fund	488,489 9 5		
		859,396 18 1	
			3,513,449 17 3
State Loans Repayment Fund			338,258 6 1
Contribution to National Debt Sinking Fund		368,753 18 9	
Less Net Loss on Repurchase of Securities (including Exchange)		15,045 19 10	
			353,707 18 11
Loan Redemption as Itemized above			859,396 18 1
			£5,083,568 18 2

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)	17,686 18 5
	£5,083,568 18 2

DEVELOPMENTAL ROADS LOAN ACCOUNT—ACT No. 3662.

BALANCE-SHEET AT 30TH JUNE, 1942.

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		510,849 11 5	
		5,675,011 13 5	
Redemption Funds	646,386 7 4		
Developmental Roads Sinking Fund	55,083 0 2		
		701,469 7 6	
			4,973,542 5 11
State Loans Repayment Fund		.. ..	239,896 6 1
Contribution to National Debt Sinking Fund		560,613 2 1	
Less Net Loss on Repurchase of Securities (including Exchange)		22,874 5 7	
			537,738 16 6
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
			£6,546,675 13 5

ASSETS.	£ s. d.
Permanent Works Expenditure	6,425,757 10 11
National Debt Sinking Fund (Cash in Hand)	26,889 5 1
Contributions Payable by Municipalities, Act No. 3662, Sec. 86/1. (Subject to Relief)	94,028 17 5
	£6,546,675 13 5

DEVELOPMENTAL ROADS INTEREST—ACT NO. 3662—(SECTIONS 84/17, AND 86/1).

RECEIPTS.	£ s. d.	£ s. d.
1942. June 30. To Interest on Account of Municipalities—Provided by Relief—		
Act No. 3662—84/17	2,750 0 0	
86/1	77,372 3 10	
		80,122 3 10
		£80,122 3 10

EXPENDITURE.	£ s. d.
1942. June 30. By Payments to Treasury (Relief)	80,122 3 10
	£80,122 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, 1942.

E. A. PEVERILL,
Auditor-General,
8th December, 1942.

E. J. HICKS,
Accountant,
24th November, 1942.

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