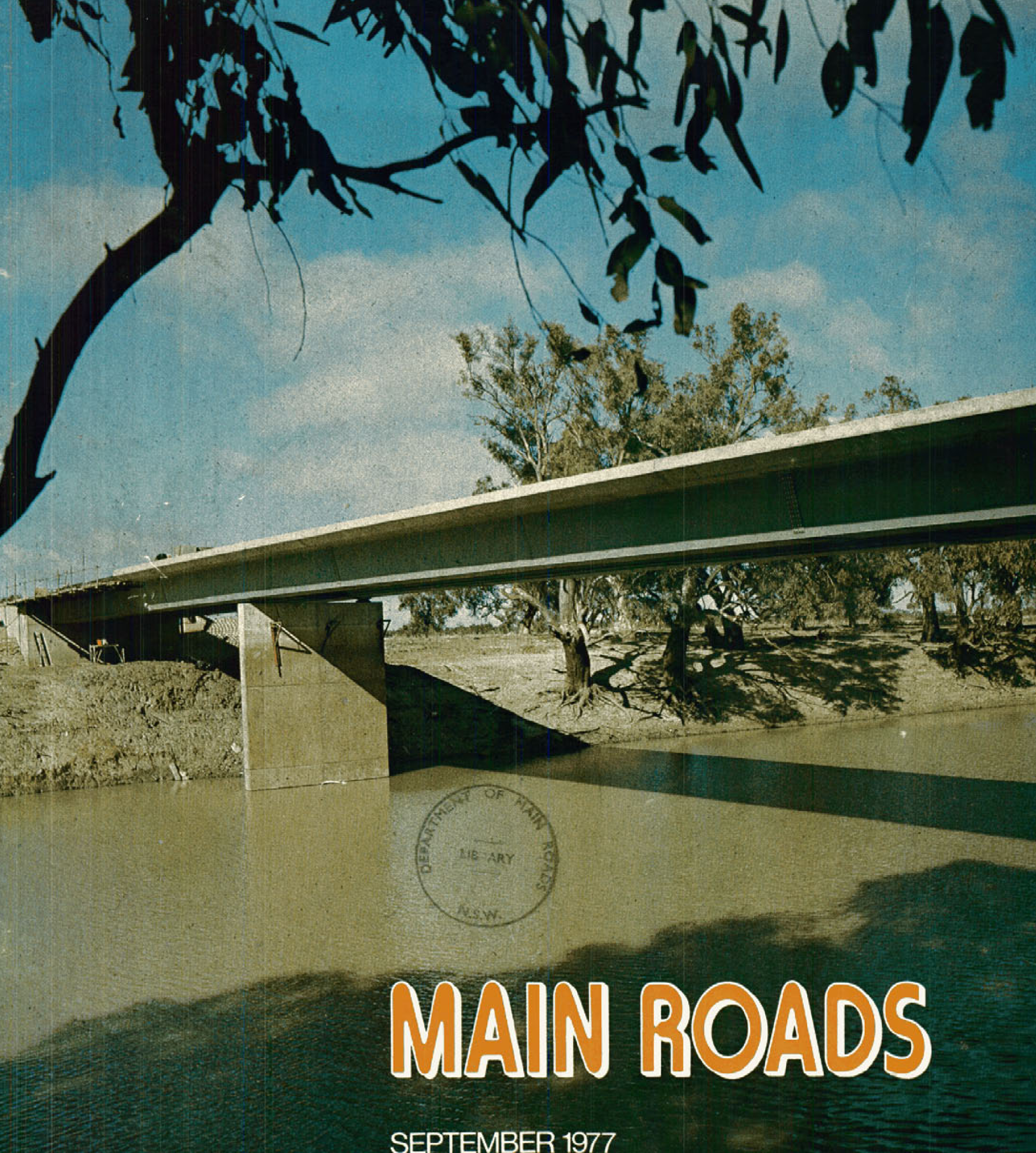
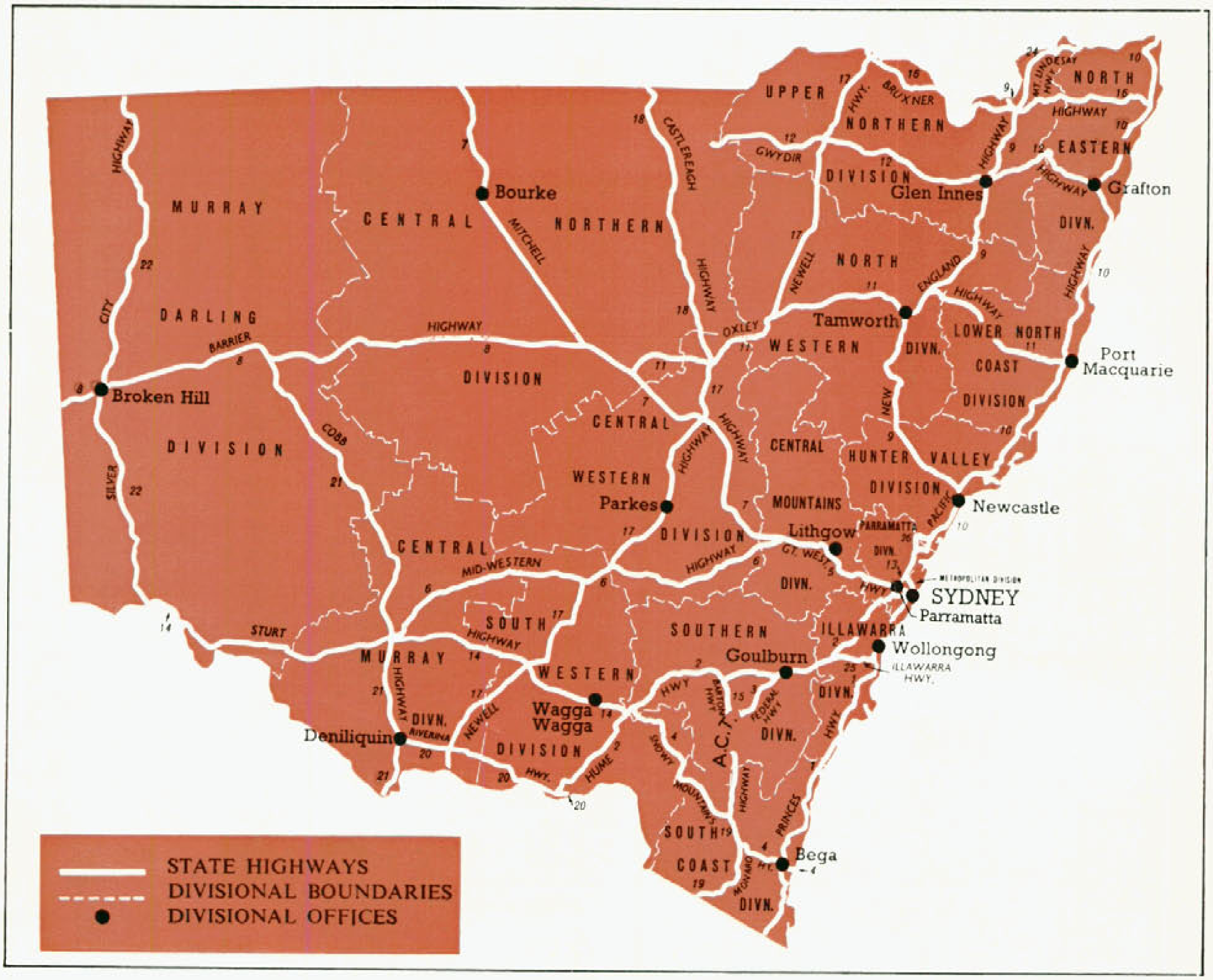


MAIN ROADS

SEPTEMBER 1977



New South Wales

Area—801 428 km²

Population as at 30 June, 1977—4 956 700

Length of Public Roads—208 804 km

*Number of Motor Vehicles registered as at 30 September, 1977—2 271 500**

* *This figure has been obtained from the Australian Bureau of Statistics. It should be noted that, due to the exclusion of certain categories of vehicles (such as tractors and trailers), etc., this figure is considerably lower than the statistics published prior to December, 1974, which were obtained from the New South Wales Department of Motor Transport.*

ROAD CLASSIFICATIONS AND LENGTHS IN NEW SOUTH WALES

The lengths of roads within various classifications and for which the Commissioner for Main Roads was responsible as at 30 June, 1977 were:

Freeways	127
State Highways	10 478
Trunk Roads	7 075
Ordinary Main Roads	18 365
Secondary Roads	287
Tourist Roads	403
Developmental Roads	3 618
Unclassified Roads	2 478
TOTAL	42 771 km

MAIN ROADS

JOURNAL OF THE DEPARTMENT OF MAIN ROADS, NEW SOUTH WALES

SEPTEMBER, 1977

VOLUME 43 NUMBER 1

ISSN 0025-0597

Issued quarterly by the
Commissioner for Main Roads
A. F. Schmidt

Additional copies of this Journal may be obtained from
Department of Main Roads
309 Castlereagh Street
Sydney, New South Wales, Australia

PRICE
Fifty Cents

ANNUAL SUBSCRIPTION
Two Dollars
Post free

CONTENTS

Front cover: Taken in August, 1976, this photograph shows construction of the new road traffic bridge over the Darling River at Menindee. See the article starting on page 2.

Back cover: The Marlborough Street overbridge near Flemington Markets spans eight sets of railway tracks in one graceful sweep. Some comparatively new techniques were used in its construction, details of which are given in the article starting on page 26.

A BRIDGE IS A BRIDGE IS A BRIDGE . . .

In its simplest definition, a bridge is any natural or man-made link that spans a traffic gap. The traffic can be by foot (human, animal or both), by wheel (rubber-to-road or steel-on-steel) or even by water (although there are no canal overpasses in Australia).

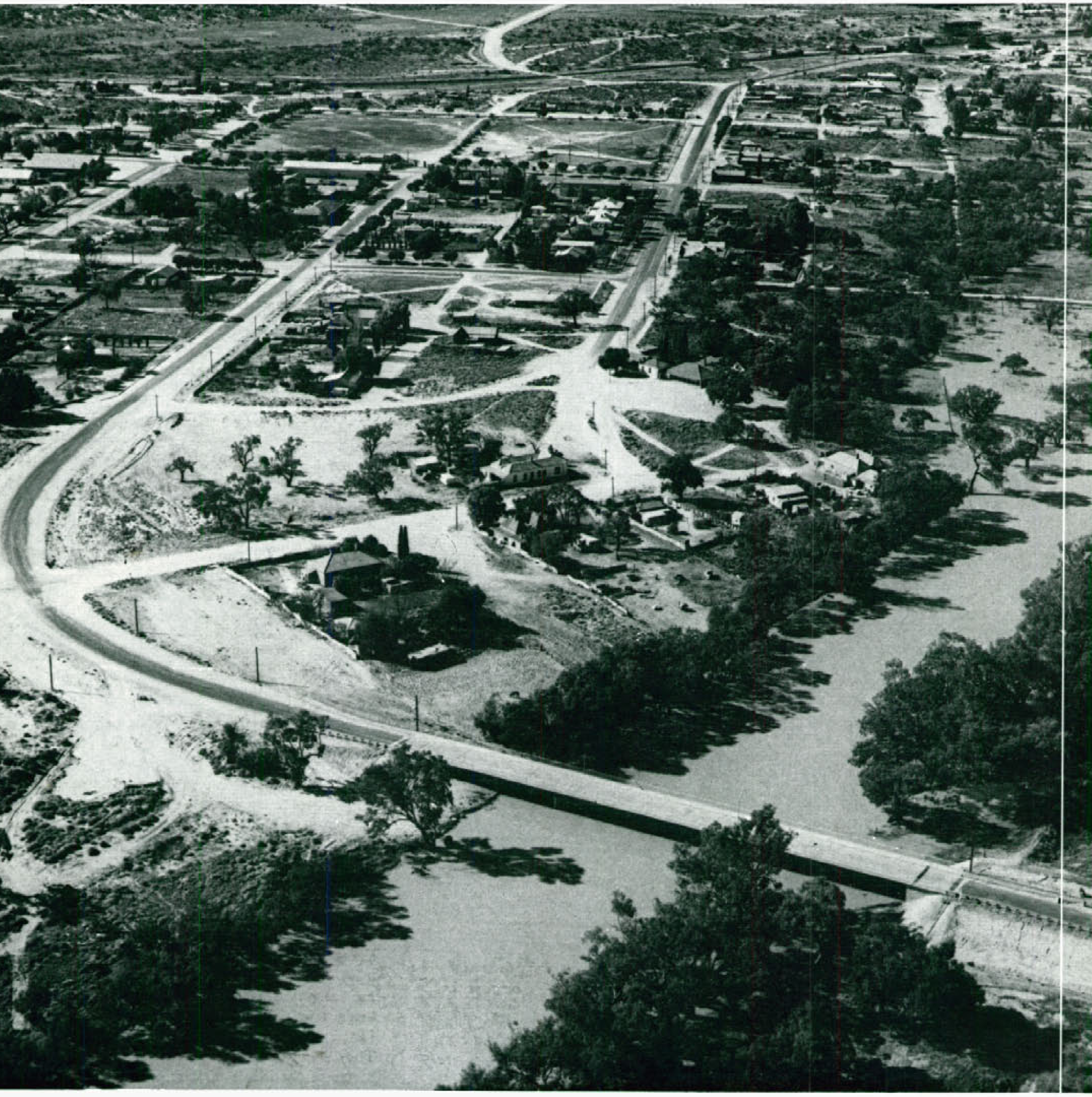
Sometimes the gap to be spanned is more or less passive—a gully between steep hills, an inland bay or a river valley whose dimensions may vary with the seasons.

Nowadays, however, the gap to be crossed is almost as likely to be a more active type. Roads cross railways. Pedestrians cross roads. Roads cross roads. And wherever streams of traffic cross paths there are always possibilities of delay and danger. In nearly every case, some form of bridge is the safest (although usually the most expensive) way of separating the traffic streams.

The archaeology of bridges is one of the best documented segments of human history, almost certainly because of their usually completely functional nature. Even before there were humans there were bridges—trees that happened to fall across chasms and over rivers, soon became natural game trails.

Because of the emphasis on their functional nature, bridges have usually been built and maintained by the most advanced technology available. Except for a few *grotesqueries* which can be excused on the grounds of their quaintness, the bridges we see and drive over today are functional blends of engineering and art. They stand on their own merits as statements of the ideals of their designers. In this issue are featured several bridges which exemplify these ideals. ●

After 50 years — Road



users get their own river crossing at Menindee

New bridge over the Darling River eliminates long detour around town

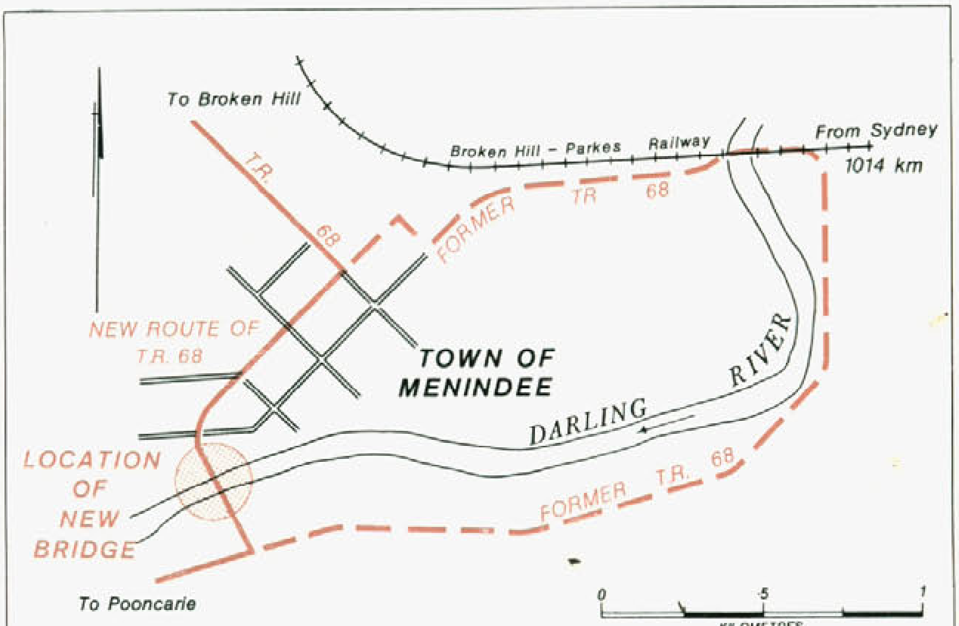
Menindee is a town whose roots run deep into Australia's colonial past. It was at this location, at a bend of the Darling River, that Charles Sturt camped in 1844 on a journey from Adelaide to the centre of Australia. In 1860, the ill-fated Burke and Wills expedition established a depot at the same place. Later, for a while, the spot was known to the white man as Laidley's Ponds.

The establishment of an actual township at the site owes much to the pioneering of the noted river navigator, Captain Francis Cadell, who established a store there in 1859. In 1862 an inn was added and so there then existed the nucleus of a settlement, with a punt plying across the Darling.

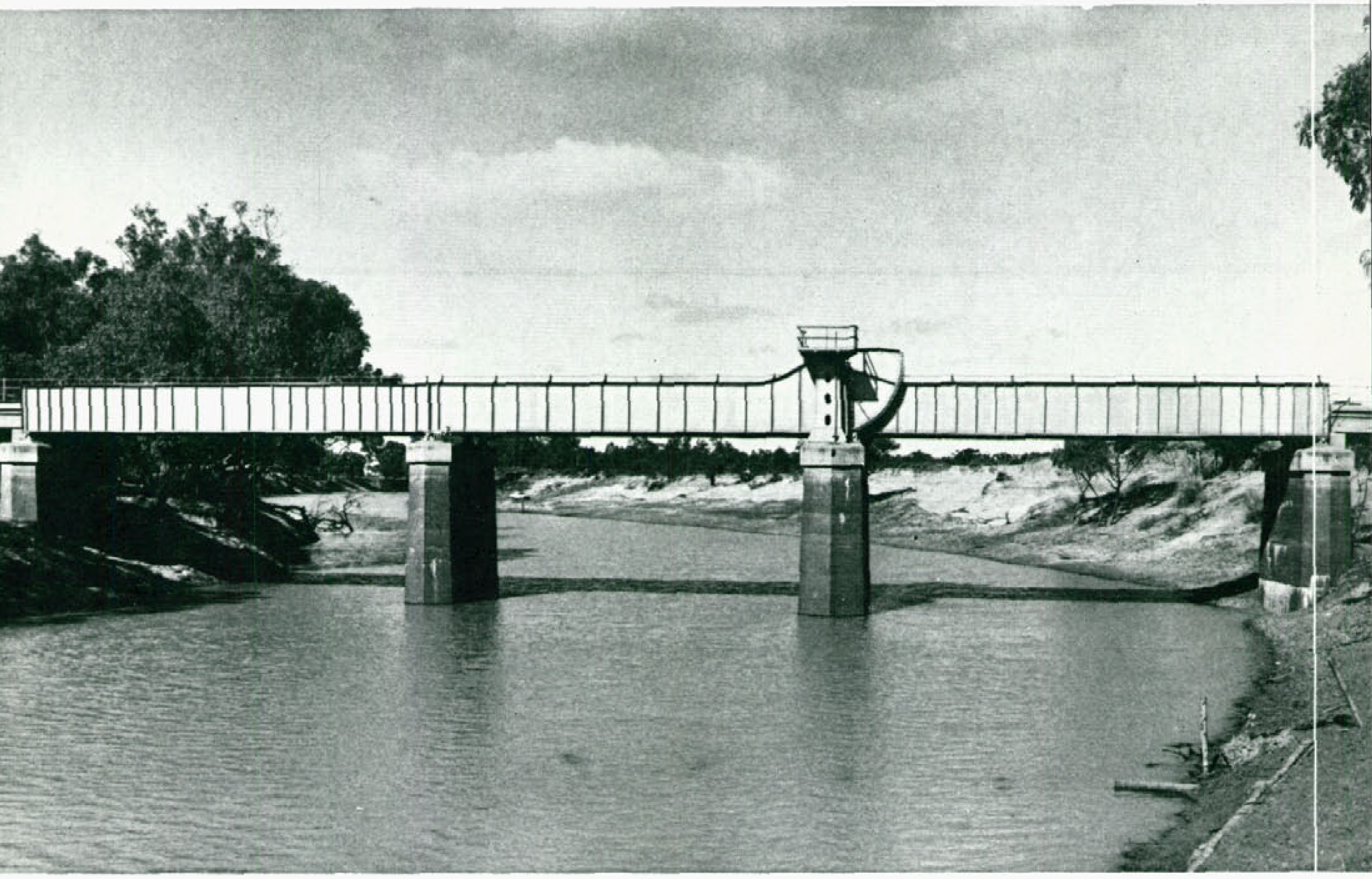
In June, 1862, the *Government Gazette* announced that the site had been fixed upon for the first town west of the Darling. Its name was first proclaimed to be Perry, after the parish in which it lay. In November of the following year, the *Gazette* announced that it had been decided to revert to the local aboriginal name for the region, Menindie. The spelling was later rationalised to Menindee, and that form was officially adopted. The word itself means "yolk of an egg", but the reason for that name has been lost.

Menindee lies in a flat arid landscape, 119 km east of Broken Hill, and partly within a bend of the Darling River. The region around the town has traditionally been devoted to grazing and fruit and vegetable growing. In 1919, the town was linked by rail to Broken Hill. Eight years later, the rail section between Menindee and Ivanhoe was completed, putting Broken Hill into direct rail communication with Sydney.

Left: An aerial view of the new two-lane road bridge over the Darling River at Menindee, looking roughly northwards with the town in the background. Trunk Road No. 68 now leads directly into Menindee instead of detouring around as it did with the original river crossing.



BRIDGE OVER DARLING RIVER AT MENINDEE



Above: The first Menindee bridge which is now used solely by the railways. The only indications left that it once had a bascule lift span are the gear-cogged quadrants and the platform (seen here above the second pier from the right).

THE FIRST BRIDGE

To carry the rail line over the Darling, a bridge was built over the river east of the town. This was designed as a combined road/rail bridge and Trunk Road No. 68 followed around the river's course to share the same deck space with the single rail line. This meant, of course, that whenever a train came through, road traffic had to be halted.

A complex system of gates and interlocking switches, controlled by either a resident gatekeeper or the train crews, gave a reliably "fail-safe", but rather slow, changeover from road to rail traffic and vice versa. On some occasions, a train crossing the bridge would hold up traffic as long as 30 minutes.

To allow fairly large vessels to pass up and down the Darling past Menindee, the bridge had a central bascule-type lifting span. This proved prone to mechanical troubles. It frequently took six men 45 minutes to raise or lower the span. In mid-1947 the Maritime Services Board decided that traffic had declined to such a low ebb that this facility was no longer needed. Maintenance of the bearings and mechanism was terminated and the span has remained in the down position ever since.

When, in 1970, rail gauge standardisation made it obviously practical and profitable to transport semi-trailers between Parkes and Western Australia by rail, it was discovered that the concrete counterweight allowed only a little over 5 m clearance above track level instead of the required 6 m. To meet rail requirements the counterweight and its associated towers were removed and the bridge lost those features that most readily identified it as once being of the opening type.

THE MENINDEE LAKES SCHEME

Along the west bank of the Darling in this region are a number of natural lakes, the main ones for the purpose of this article being named Malta, Balaka, Bijijie, Tandure, Pamamaroo, Menindee and Cawndilla.

In former years these lakes were only intermittently filled. During flood times, some of the river's excess water poured into them through overflow channels. As the floodwaters receded, most of the water drained back to the river and the remainder generally evaporated to leave a series of shallow empty basins.

In 1949 plans were drawn up to save much of this otherwise wasted water for local irrigation and as an adjunct to Broken Hill's water supply. Work was begun in 1952 and is now complete, although storage capacity is not necessarily always full.

Simply stated, the scheme consists of a block dam and weir in the river designed to raise the water level about 9 metres above bed level, creating a river storage known as Lake Wetherell. At this level, water will flow into Lakes Malta, Balaka, Bijijie and Tandure. It will also flow through a regulator into Lake Pamamaroo where it can be stored to a maximum depth of 6 metres.

From Lake Pamamaroo a large artificial canal to Lake Menindee permits water to flow into that lake and on to Lake Cawndilla. Water can be stored to a maximum depth of 7 metres in Lake Menindee and 9 metres in Lake Cawndilla. An outlet regulator between Lake Menindee and the Darling River permits the release of water as required. Water can also be released to the Great Ana Branch of the Darling River, by means of a regulator and a cutting from Lake Cawndilla to the creek system leading to the Ana Branch.

The total operating capacity of the storage is approximately 1 794 000 megalitres (394,850 million gallons) covering an area of about 46 000 hectares.

In 1970 the Menindee Lakes Storage Agreement of 1963 was incorporated in the River Murray Waters Agreement with the effect that the storages are operated, principally, as a work of the River Murray Commission in conjunction with other River Murray Commission storages. New South Wales has prior entitlement to use 125 000 megalitres a year of water in the Darling River system below Menindee.

With this comparatively permanent expanse of water available, the Menindee Lakes complex has become a popular aquatic sports centre for the people of Broken Hill and other residents within a fairly wide area. Swimming, water skiing and boating are possible throughout the year.

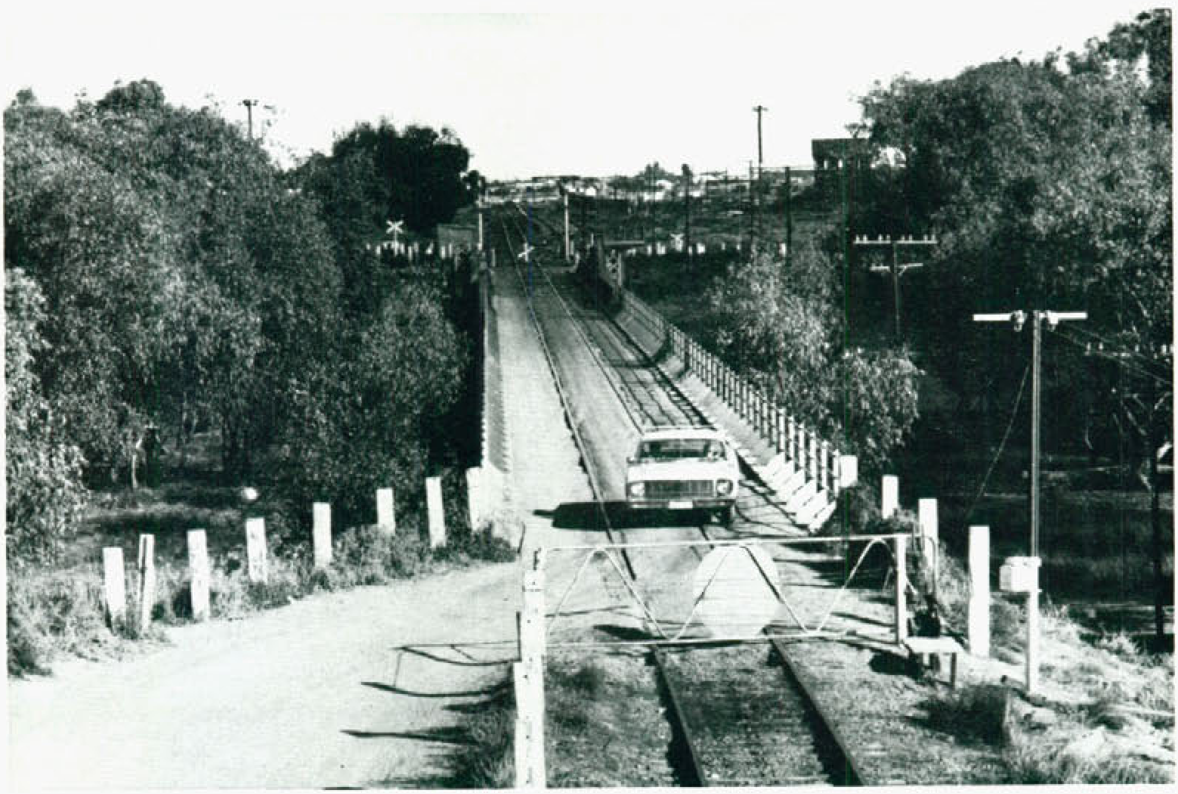
This fact, plus the natural growth of both road and rail traffic over the years, made the deficiencies of the original bridge all too obvious.

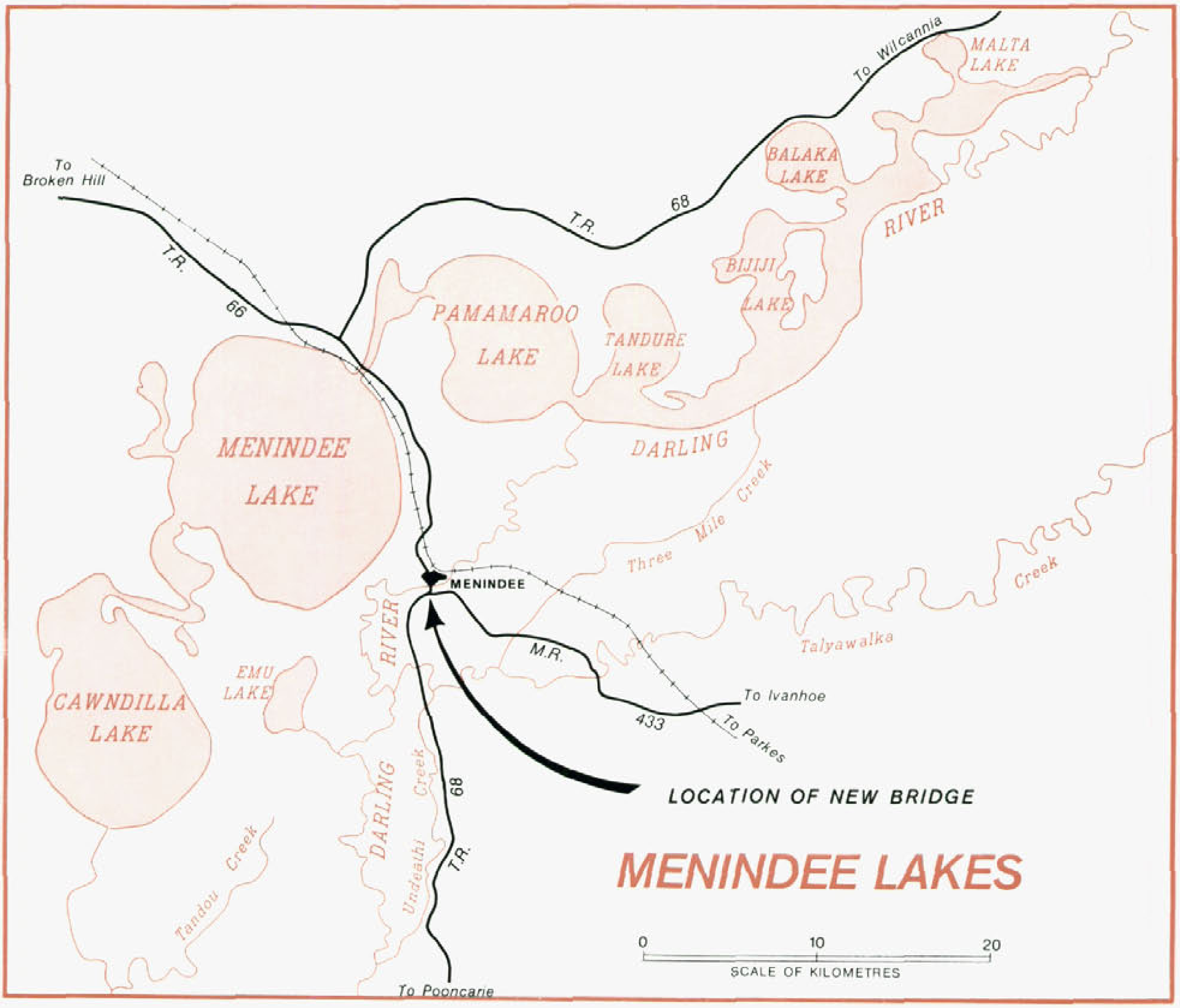
THE NEW BRIDGE

In December, 1973, the Commissioner for Main Roads announced that a tender had been accepted for the construction of a new bridge across the Darling River at a more convenient site for the people of Menindee and other road users. The site chosen was about 2.5 km downstream of the old bridge.

The alignment was planned to lead traffic via Nora Street into the commercial centre of the town. The new route for Trunk Road No. 68, of which the bridge is a part, also reduces traffic flow past the nearby school.

Below: Looking west across the old bridge, showing how road traffic shared the deck space with the railway. In the foreground is one of the gates that served to keep the two kinds of bridge traffic separated.



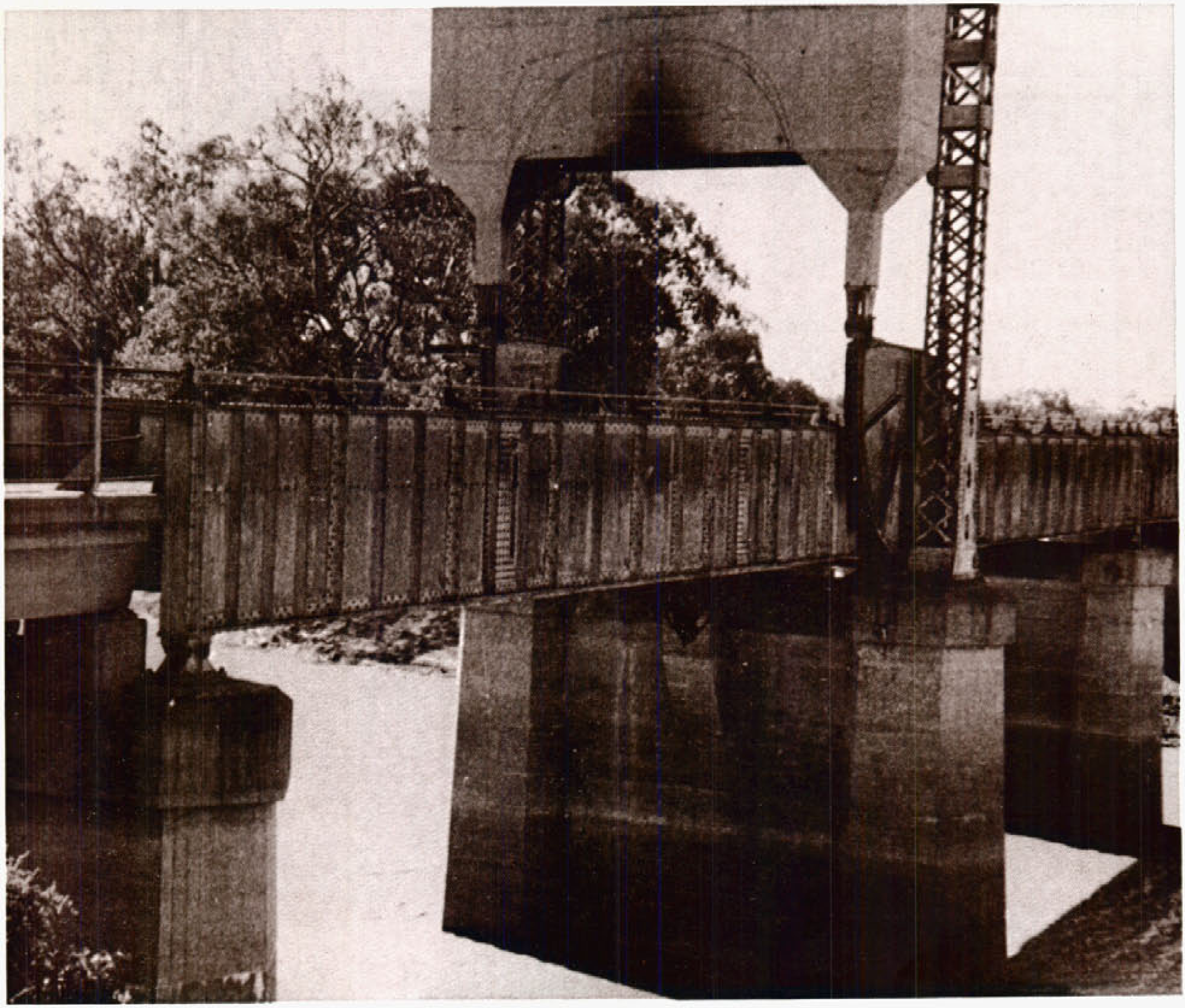


Built by L. M. Robertson Construction Co., the bridge was designed by Maunsell and Partners Pty Ltd, Consulting Engineers, to meet the specification laid down by the Department of Main Roads. Overall length of the bridge decking is 107.5 m. Kerb to kerb width is 7.3 m allowing two-way traffic, and there is a 1.5 m wide footway on the eastern or upstream side.

The water level of the Darling remains fairly constant throughout the year, because of a rockfill weir about 13 km downstream. Only flooding severe enough to submerge the weir could cause any significant rise in the water level at the bridge site. Even if the highest flood ever recorded (in 1890) should recur, the bridge would still be 0.88 m clear of the water level. Clearance over normal water level is 7.62 m.

The reinforced concrete deck of the bridge acts compositely with the 1.37 m deep twin trough shaped steel girders. The girders (which were fabricated in Adelaide and carted by road transport to the site) rest on reinforced concrete piers and abutments. These are founded on 0.5 m diameter reinforced concrete piles set inside cylindrical driven steel casings. The abutments have been set well back from the river banks to minimise interference with water flow in case of flooding.

The two outer spans measure 32.15 m in length and the middle one 42.07 m. The steel girders of the central 22.6 m were bolted to the adjoining sections. This was done to facilitate its removal and replacement by a lift span if this should be required at some future time.



Taken in 1958, this photograph shows the concrete counterweight and the associated towers. At this time the lift span had been immobile for 11 years. The counterweight and towers were removed in 1970 to give sufficient clearance for trains carrying semi-trailers between Parkes and Western Australia.

Doors have been provided to allow access to the interior of the hollow reinforced concrete abutments. Other openings in the faces of the abutments allow the girders to be entered for maintenance purposes. The diaphragms across the girders at the pier positions also have manholes so that there is a continuous passage from one end of the bridge to the other through each of the box girders.

At each side of the abutments, the filling is steeply sloped to reduce the earth pressure loading on the abutment. Concrete pitching was placed on the exposed face of the filling to protect it from erosion or scouring in case of flooding.

The new Menindee Bridge over the Darling River was opened to traffic on 11 February, 1977. On that date the old road which followed the river in a loop around the town and shared a bridge with railway tracks ceased to be part of Trunk Road No. 68. The 3.5 km detour has been replaced by a more direct 0.9 km route through the town itself. The end result: more convenience, less wasted time, growing trade opportunities for the people of Menindee and safer travel. ●

STATEMENT OF RECEIPTS AND PAYMENTS

for the Year Ended 30 June, 1977

RECEIPTS

Motor vehicle taxation
Charges on commercial vehicles under the Road Maintenance (Contribution) Act, 1958
Levy upon Councils in accordance with Section II of the Main Roads Act, 1924
State Government Loans—Repayable
Loan Borrowings under Section 42A of the Main Roads Act, 1924
State Treasury Advance—Repayable
Contributions by Councils towards maintenance and construction of Main and Secondary Roads
Contributions by other departments and bodies towards maintenance and construction of Main and Secondary Roads
State Government Grant for relief of unemployment
Commonwealth/State Government Grant for restoration of flood damage
State Government Grant for upgrading cane roads
Sydney Harbour Bridge Account for freeway approaches
Transport (Planning and Research) Act, 1974
National Roads Act, 1974
Roads Grants Act, 1974
Road Transport and Traffic Fund and Public Vehicles Fund
Ministry of Transport Vote
Other

Total Receipts

PAYMENTS

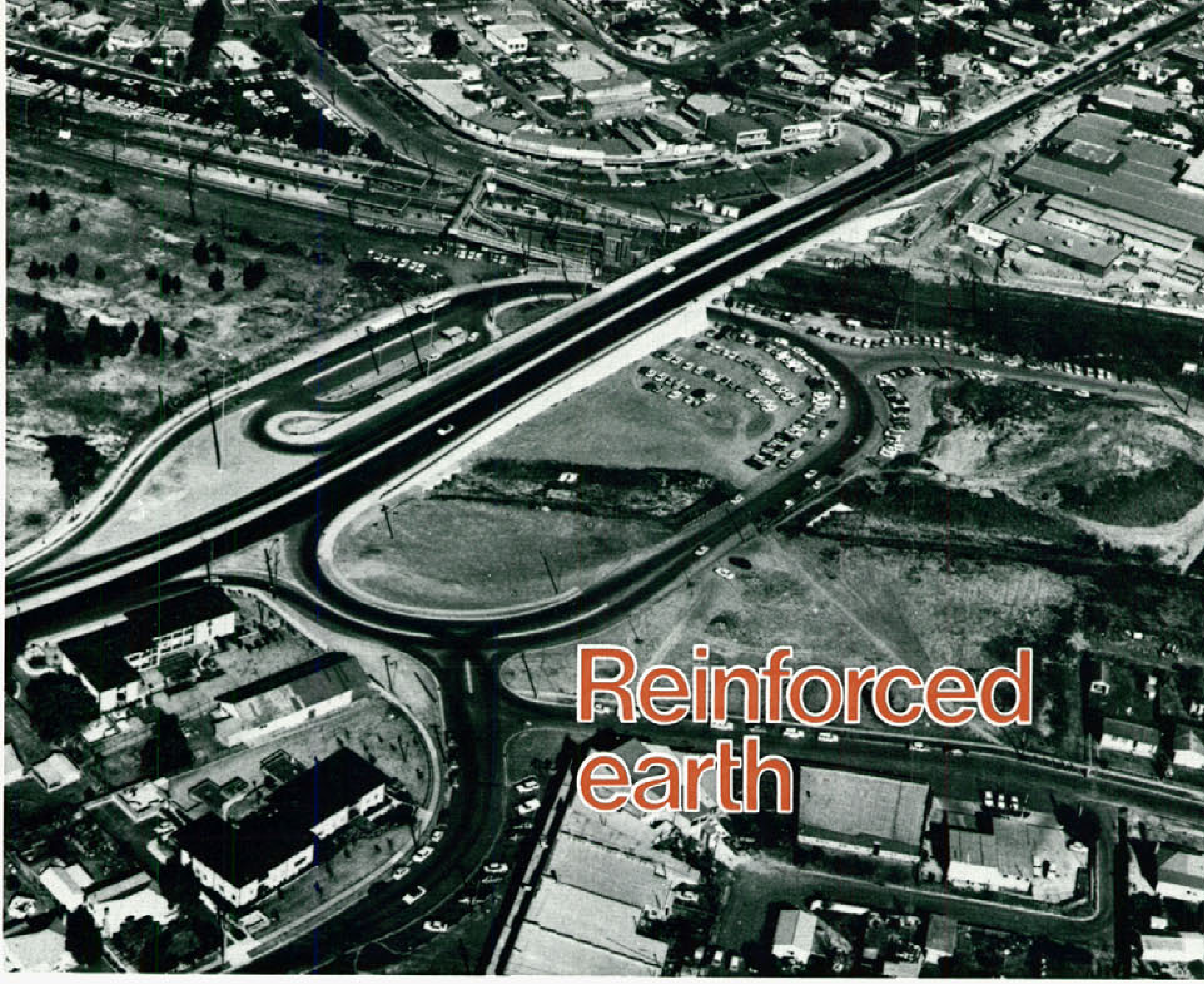
Construction and reconstruction of roads and bridges
Construction and maintenance of local roads
Land acquisition
Maintenance and minor improvements of roads and bridges
Restoration of flood damage (Proclaimed Natural Disasters)
Purchase of land and buildings for works operations
Administrative expenses
Purchase of land and buildings for administration
Planning and research
State Treasury Loans—
  Sinking fund payments
  Interest, exchange, management and flotation expenses
Loan Borrowings under Section 42A of the Main Road Act, 1924—
  Repayment of principal
  Interest
Other

Transfers to reserve for loan repayments
Net transactions of operating and suspense accounts

Total Payments

* Includes $2,990,000 of 1977–78 Loan Allocation received prior to 30 June, 1977.

County of Cumberland Fund	Country Fund	Commonwealth Fund	Traffic Facilities Fund	Total 1976–77	Total 1975–76
$	$	$	$	$	$
29,645,608	73,107,313		3,345,600	106,098,521	85,954,303
3,961,932	15,847,729			19,809,661	20,267,776
56,559				56,559	104,468
1,000,000	7,000,000			8,000,000	7,250,000
6,290,000*	7,700,000			13,990,000	8,000,000
				—	6,000,000
745,267	153,125			898,392	1,130,976
80,950	833,094			914,044	1,119,252
	100,000			100,000	348,679
	11,806,380			11,806,380	13,223,400
	300,000			300,000	—
354,230				354,230	6,711
		1,761,326	24,168	1,785,494	1,597,079
		56,733,883	654,803	57,388,686	49,200,000
		74,800,000	3,391,778	78,191,778	83,605,370
			7,229,609	7,229,609	—
			2,500,000	2,500,000	—
1,055,575	596,271		1,214,997	2,866,843	1,902,643
43,190,121	**117,443,912**	**133,295,209**	**18,360,955**	**312,290,197**	**279,710,657**
16,046,210	33,478,312	90,809,024	6,174,086	146,507,632	142,671,436
	94,809	21,780,891		21,875,700	21,332,098
4,341,084	2,156,537	9,811,895		16,309,516	17,779,776
15,204,631	48,728,304	8,040,381	11,984,140	83,957,456	60,323,486
	12,184,292			12,184,292	13,181,743
223,655	383,695	208,400	200,916	1,016,666	1,093,364
2,308,810	7,897,882	4,640,887	1,125,972	15,973,551	13,770,121
228,981	371,004			599,985	1,131,264
425,457	647,720	2,084,456	36,251	3,193,884	2,226,731
62,760	180,553			243,313	236,383
291,610	1,811,387			2,102,997	1,545,047
241,351	517,144			758,495	515,358
1,397,599	1,824,940			3,222,539	2,320,960
328,615	465,057			793,672	976,767
41,100,763	110,741,636	137,375,934	19,521,365	308,739,698	279,104,534
249,787	230,363			480,150	381,825
1,808,785	1,164,332 *Cr.*			644,453	789,719
43,159,335	**109,807,667**	**137,375,934**	**19,521,365**	**309,864,301**	**280,276,078**



Reinforced earth

pioneered in Australia by DMR

As engineers, architects and other designers well know, there are few low-cost materials which combine both high compressive strength (resistance to crushing forces) with high tensile strength (resistance to stretching forces).

One way to achieve both types of strength at an economical cost is by using combinations of materials, each giving the desired qualities to the total.

A natural invention

Nature has provided us with examples of this "two-phase" principle. Mineral salt crystals, especially those of calcium, embedded in a matrix of the animal matter *ossein*, make up bone. Bone is a "building material" that even present-day engineers find difficult to match. Few metals or metal-composites can match its standard of strength combined with lightness.

Anyone who has ever worked with wood is well conscious of its fibrous reinforcement. With the grain running lengthwise, sawn lengths of wood can be used to construct buildings which can last for centuries.

Man's inventions

Reinforced concrete, with steel rods, cables or mesh embedded in it, has been around since 1875. Fibre-reinforced plastic (usually glass fibres in polyester resin, i.e., "fibreglass") is valued for its versatility and tailored toughness.

Now Reinforced Earth

Anyone who has tried to pull out even a straight piece of fencing wire well embedded in the ground must have been surprised (and no doubt annoyed) by the frictional grip between metal and earth.

Reinforced earth *forms the basis of the embankments which support the approaches of this bridge carrying Seven Hills Road over the Main Western Railway line adjacent to Seven Hills railway station, west of Sydney.*

This frictional grip is the phenomenon that makes the *reinforced earth* process a practical proposition.

First used in France

The *reinforced earth* process of building retaining walls was developed in 1966 by a French architect and engineer, Henri Vidal. The system was first used by the French Highway Administration to build a series of embankments along the Nice-Menton expressway. The results demonstrated the technical and cost advantages of the technique, especially when applied to large-scale works.

Granular earth is a cheap and widely available material but with limited mechanical properties. However, these can be significantly improved with linear reinforcing elements suitably placed and retained within the earth mass. The *reinforced earth* system allows vertical earth-filled retaining walls and embankments to be built without the usual massive (and expensive) concrete structures and footings otherwise required.

Other advantages

Reinforced earth structures can usually be constructed faster than other types. They can be built as high as 30 m even on poor foundation soils since there are no heavy point loadings. They are resistant to vibration damage from live loads and earth tremors. A *reinforced earth* structure can be built close to existing buildings or roads, as all work can be done within the wall. *Reinforced earth* walls are of particular advantage at "difficult" sites. A wall of much less bulk and weight results and due to its flexibility can absorb greater differences in settlement. For similar situations normal walls would require extensive foundations, possibly with piles or piers extending down to a firmer stratum.

What it consists of

A *reinforced earth* wall is basically a simple structure. It is faced with broadly cruciform slabs that interlock at their corners. Onto cast-in lugs or tie strips on the back of each of these facing pieces are bolted a number of steel straps, usually galvanised. These run horizontally back into the earth fill, providing by their tensile strength the needed reinforcement. They are anchored in the earth purely by friction with the granular soil particles bearing on them, just as in the case of the piece of fencing wire mentioned earlier.

Unlike the fencing wire, these reinforcing straps are broad, flat and ribbed to give a greater grip. Usually they are guillotined from 5 mm sheet to suitable widths, generally 40 mm or 60 mm. Naturally, lengths vary according to the widths of the work concerned.

The pre-cast face panels can have their outer surfaces finished in a wide variety of decorative styles. They can be patterned, ribbed, brushed or have an exposed aggregate surface—whatever is needed to suit the design needs of the location.

Construction method

Details vary according to site demands, but *reinforced earth* structures generally follow a fairly standard building process.

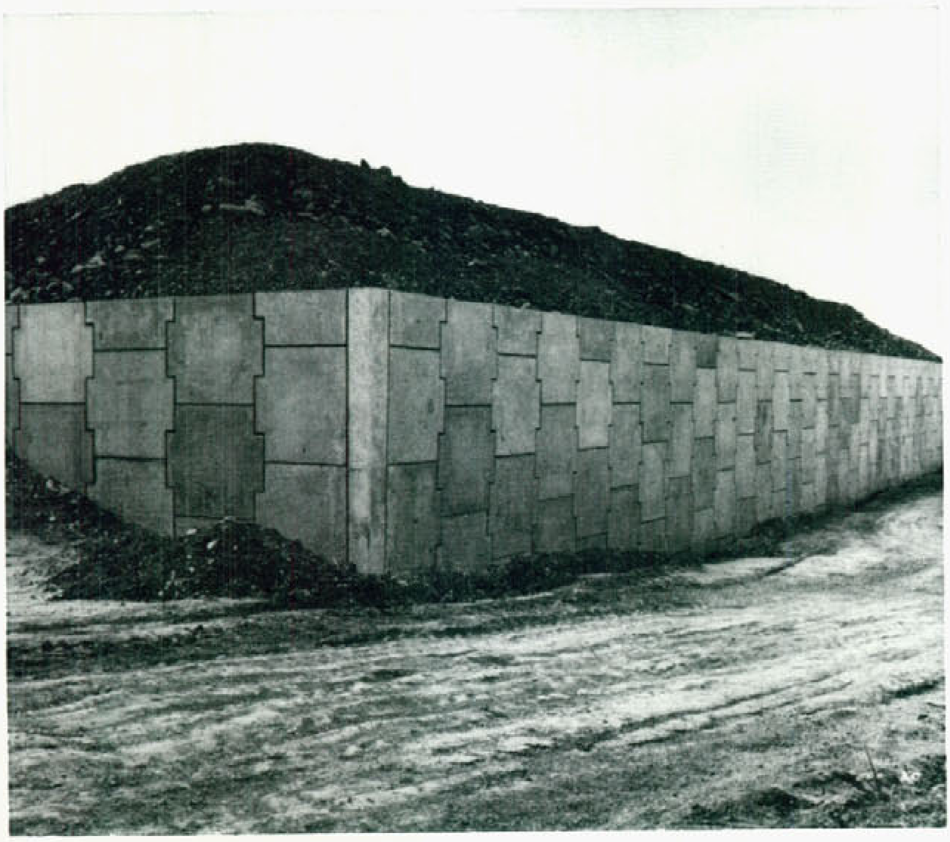
First, a comparatively light concrete footing is cast on a levelled (and sometimes compacted) soil foundation. A row of half-panels is placed along this with spacer bars to ensure correct spacing. Then the first row of full-face panels is placed in position between the half-panels and the units interlocked and temporarily clamped and wedged. Sealing materials are usually used between panels.

Filling and reinforcement

Backfilling then proceeds. In many cases the local soil may have the required frictional characteristics, but sometimes it must be mixed with or replaced by material from another source.

As the backfilling level rises, the reinforcing straps are laid horizontally on the surface and bolted to the face panels. The process of placing face panels, backfilling and attaching reinforcing straps continues until the wall reaches the required height, where a final row of half-panels gives an unbroken horizontal top edge. This can be capped if desired for aesthetic effect.

Although progressive compaction is not always necessary to achieve the required frictional bond between soil and reinforcing straps, it is usually carried out to prevent subsequent settlement of the fill, since in most cases there will be live loads imposed on it.



This reinforced earth retaining wall at Menangle, was the first of its kind to be completed by the Department. The wall is part of the abutment works for the bridge carrying the F5—South Western Freeway—over the Main Southern Railway Line at Menangle, about 56 km south of Sydney.

Curves and corners

By careful placement and attention to jointing, curved embankments can be built of *reinforced earth*, but these are necessarily of fairly long radii.

The more usual practice is to design for right-angle corners, which fit in well with the general square *blockiness* of *reinforced earth* structures. Although pre-cast corner posts can be used, Australian and overseas experience has favoured cast-in-place units, which naturally freely adapt to minor mis-alignments.

Contractors

The *reinforced earth* method of construction is patented world wide, the licensees in Australia and New Zealand being Reinforced Earth Pty Ltd. This company is the design contractor to the Department for the works described in this article.

LOCAL COUNCIL FIRST

The *reinforced earth* method is only a a relatively new technique in Australia, but it has already made a considerable impact. The first *reinforced earth* wall to be built in Australia was erected at Smith Street, Parramatta, by the Parramatta City Council, and was completed in early 1976. The Department of Main Roads has shown a willingness to quickly follow this lead and adopt this innovative construction method at suitable sites. Other State Road Authorities are also building *reinforced earth* walls or are considering applications of the technique.

DEPARTMENT'S WORKS

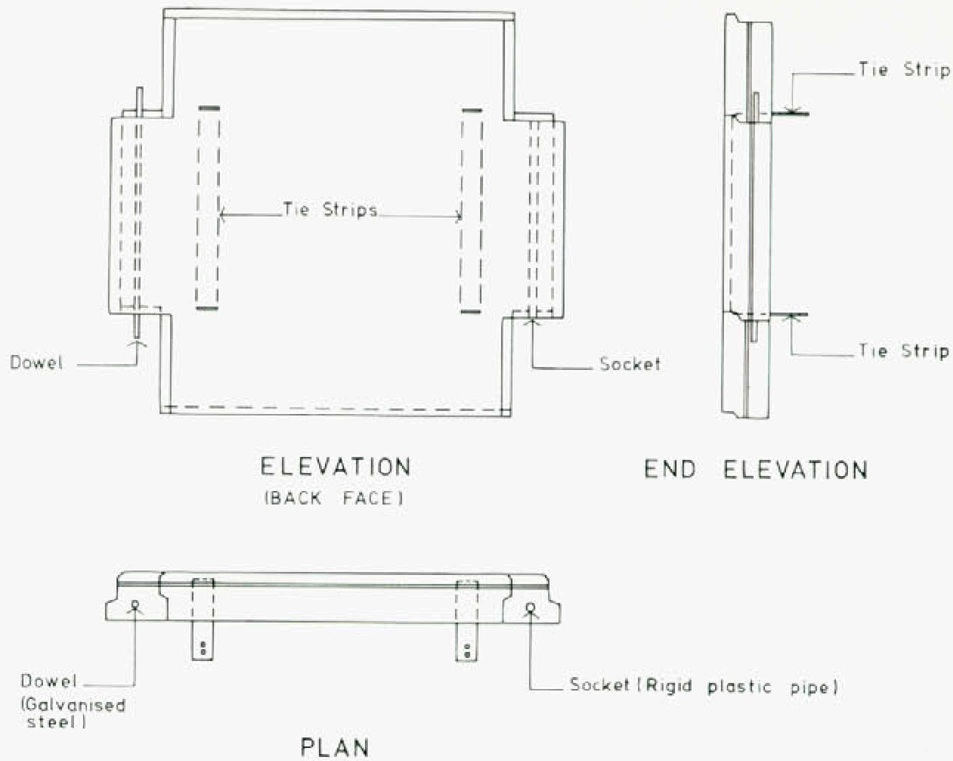
Railway Overbridge at Menangle

The first *reinforced earth* wall built by the Department was completed early in 1976 on the F5—South Western Freeway. The wall retains the spill-through abutment under twin bridges which will carry the F5 over the Main Southern Railway line at Menangle. The wall allows sufficient clearance for future duplication of the railway track.

Railway Overbridge, Beauchamp Road, Botany

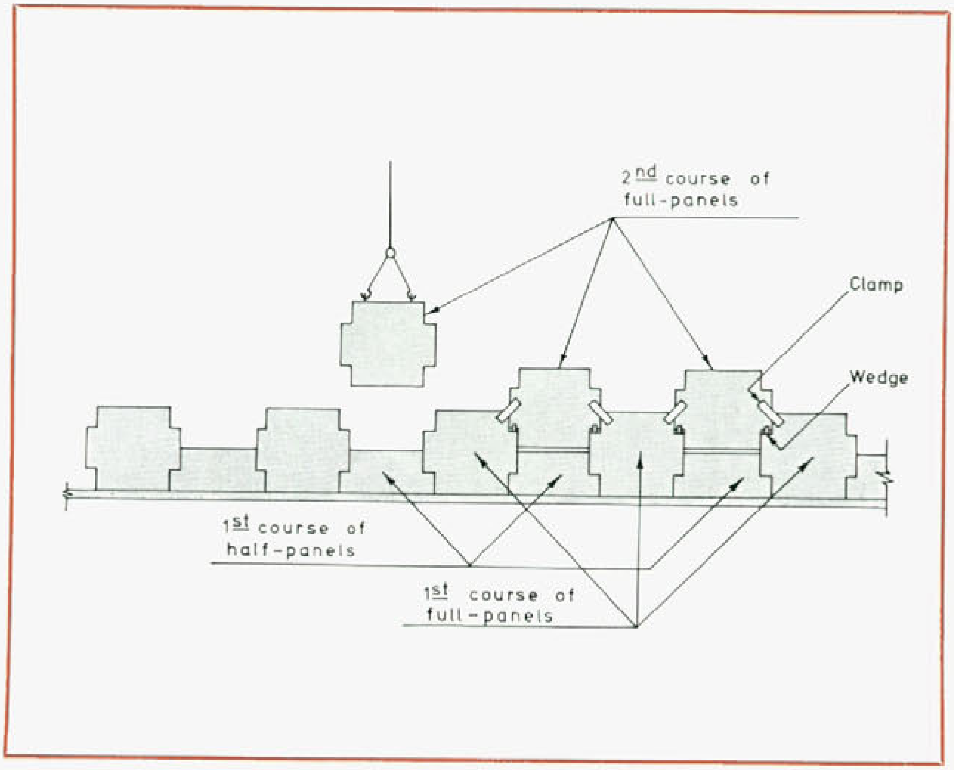
To serve the new container port at Botany a number of roadworks are being undertaken. *Reinforced earth* is a feature of one of these. A new six lane railway overbridge is being built in Botany Road near its junction with Beauchamp Road.

The main feature of the bridge will be the use of *reinforced earth*. A *reinforced earth* wall will retain the fill of the embankment and also, act as the abutment for the bridge—giving a great saving in cost.



Above: Three-view drawings of a typical face panel for a reinforced earth *wall. Details and dimensions vary with the application.*

Below: This diagram shows the assembly sequence for the face panels of a reinforced earth *retaining wall.*



Also by using the wall as the abutment, differential settlement between the bridge and approaches is entirely eliminated. The bridge deck automatically follows the movement of the fill in the approaches.

Railway Overbridge at Seven Hills

Another application of *reinforced earth*, built by Blacktown Council, is in the road approaches and access ramps leading to the railway overbridge adjacent to Seven Hills station, west of Sydney, on the Main Western Railway.

The overbridge carries Seven Hills Road over the railway and eliminates a level crossing. The road at this site crosses a drainage channel and the foundation soils in the vicinity vary from firm to the soft, wet clays typical of the area.

The main advantage of *reinforced earth* in this case was the speed with which the work could be done and the overbridge opened to traffic on this busy Secondary Road.

Approaches to Bondi Junction By-pass

The Bondi Junction By-pass, presently being built, also contains *reinforced earth* walls. The by-pass consists of elevated road approaches leading to a viaduct between Vernon and Adelaide Streets, Bondi Junction. The complete by-pass extends from Ocean Street, Woollahra, to Old South Head Road at Bondi Road.

This new road is located in an old suburb of Sydney which is closely settled and, as a consequence, any reduction of the space required reduced the number of properties affected.

The *reinforced earth* retaining walls with their vertical faces permitted the approaches to the viaduct to be built with less overall width than with an embankment retained by a traditional crib wall or a cantilever retaining wall with a wide base. To blend with the buildings in the area, an exposed aggregate finish was chosen for the precast face panels.

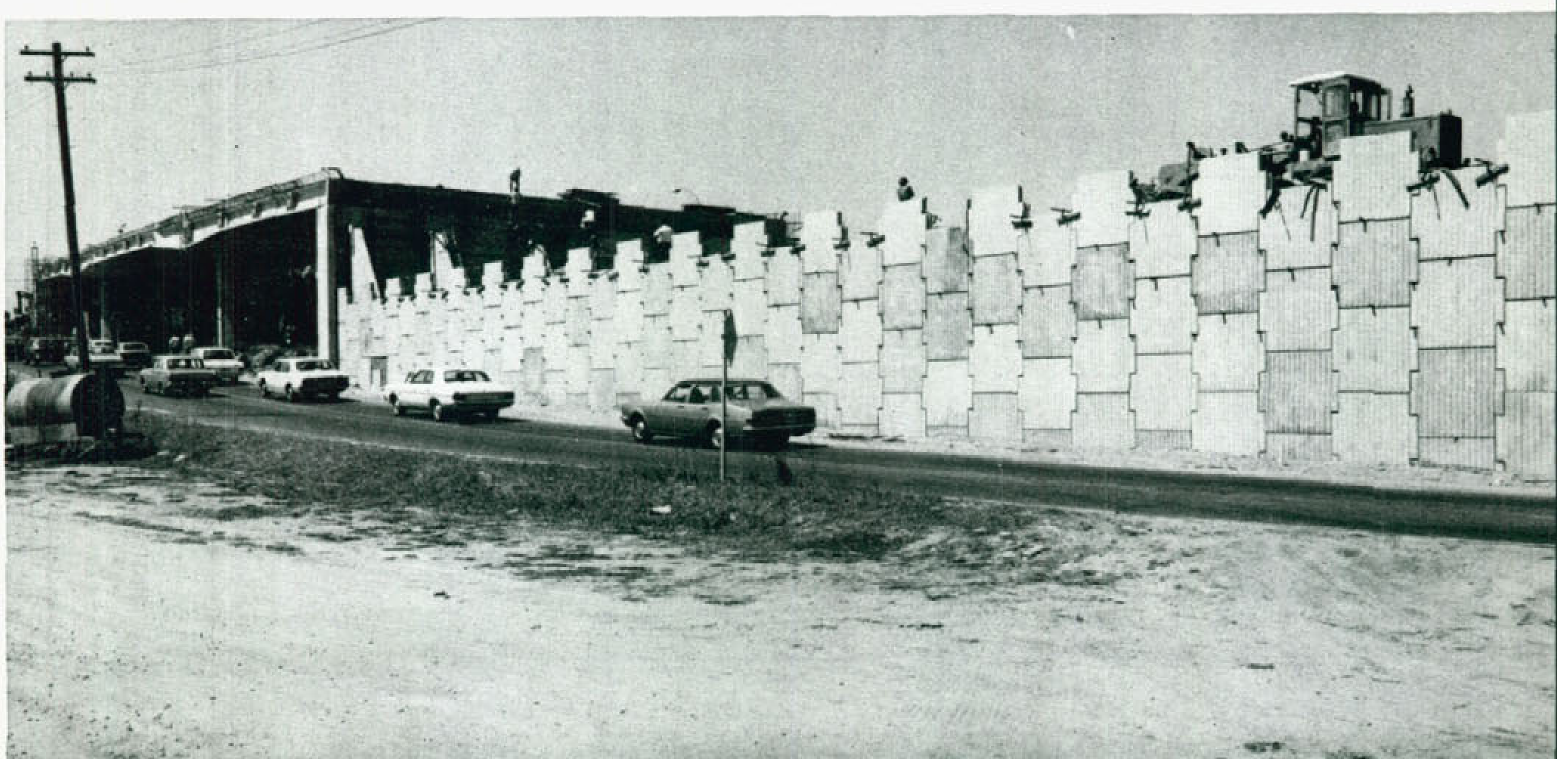
North Parramatta By-pass

Another example being constructed by the Department occurs on part of the North Parramatta By-pass. A portion of this road, between the bridges over North Rocks Road and Darling Mills Creek, is elevated on an embankment and *reinforced earth* walls have been used to reduce the width of the embankment and the cost of land acquisition.

Epping Road Overbridge, North Ryde

A partial grade-separated interchange at the intersection of Lane Cove Road and Epping Road is presently being constructed. Epping Road will cross over Lane Cove Road and the raised approaches are being retained by the *reinforced earth* technique. The foundation material at this site contains some weak points which would require more extensive foundation for a normal wall. ●

Construction in progress at the Epping Road—Lane Cove Road intersection. The photograph shows the decorative effects made possible by using face panels of different textures.



Warringah Freeway Future

Here we look into the *not-too-distant* future to see how the next section of the F1 Warringah Freeway will appear from the air. This impression is among the many adaptations of aerial photographs prepared each year by the Department's Artist-Draftsman, Mr Wal Willott of the Urban Investigations Section.

The overbridge at Miller Street, Cammeray is shown at the bottom left while above it is the bridge which carries West Street over the Freeway. Near the centre of the illustration, the Freeway can be seen crossing over Brook Street and then under Merrenburn Avenue, before it joins Willoughby Road at Naremburn.

This section of the F1 should be completed and available to traffic in 1978. Following the recent Government announcement on inner-urban freeways, proposals for the continuation of the Warringah Freeway beyond Willoughby Road have now been cancelled. However, the Gore Hill Freeway, to link the Warringah Freeway at Willoughby Road to the Pacific Highway at Longueville Road, Lane Cove, will be retained as a long-term proposal, with low priority.

SNOW—

Great on the Slopes but Treacherous for Traffic

Department faces special problems in keeping roads cleared of snow

A winter wonderland but a possibly deadly trap for the unwary and those inexperienced in driving in snow conditions. Most road users in the snow country would fit that description. This photograph was taken on the Alpine Way in June, 1977.

Although the length of Australian roads needing snow clearing can be measured in hundreds of kilometres, compared to the many thousands in North America and Europe, they present some problems which are peculiar to this country.

Strangely enough, the comparative mildness of our snow country climate creates problems. In much of North America and Europe, wintertime temperatures range from $-40°$ C to $0°$ C. In our snow areas the range is generally from $-16°$ C to $5°$ C. Periodic partial melting is followed usually by night-time refreezing. This makes it impossible to hold a snow base on the road for any length of time, so the use of sand or other fine aggregate to give traction is very limited in effectiveness. The problem is accentuated by the fact that normal Australian snow is heavier, wetter and subject to occasional rain storms between snowfalls.

Just heaping up the snow cleared off the road in windrows along the sides as is customarily done in the northern hemisphere is impractical in Australia. Meltwater would simply run over the road and freeze into a dangerous ice slick overnight.

Only two Works Offices in Australia carry on full-time snow clearing. These are the Country Roads Board's establishment at Benalla (Vic.) and the Department's at Cooma. The Department is directly responsible for the Snowy Mountains Highway, Monaro Highway and Kosciusko Road. It also undertakes certain works on behalf of the National Parks and Wildlife Service for the construction and maintenance of roads within the Kosciusko National Park.

Snow clearing is a vital safety measure and the Department is responsible for keeping the roads clear and as safe as practical for road users. Most of these would be tourists with little or no experience of driving in snow conditions.

National Park rangers are responsible for the control of traffic in the Kosciusko National Park. Close liaison between the two groups ensures that snow clearing is co-ordinated with traffic movement.

The Department's snow clearing organization operates from three sub-depots located at Wilson's Valley, Kiandra and Jindabyne. All depots provide accommodation for the work crews, fuel and full workshop facilities.

At Kiandra during the 1977 winter, with the heaviest falls since 1968, there were six consecutive mornings with temperatures below $-20°$ C, cold enough to solidify the distillate fuel for the generators and heating plant. The next fortnight produced heavy snowfalls with 2 m drifts along the Snowy Mountains Highway and the Guthega Road and a continuous snow cover from Brown Mountain through Cooma to Talbingo Mountain. During the peak of the snowfall, all plant worked for 120 straight hours, a fine tribute to sound original choice and excellent care and maintenance.

The Department's snow clearing plant operating out of the three sub-depots include the following:

- ☆ Three truck-type snowploughs (currently being replaced by new units at an approximate cost of $300,000).
- ☆ Four Swiss blower-type snow-ploughs.
- ☆ Two 6x6 graders.
- ☆ Four 4x4 graders.
- ☆ One Class Four dozer.
- ☆ Two 4-tonne 4x4 trucks with blades.
- ☆ Four Epoke salt/sand spreaders.

In action, the most spectacular of these are the Swiss-made Rolba R1500 rotary or blower-type ploughs, which are featured among the illustrations. A total of 375 horsepower is produced by the two rear-mounted engines, one for traction and the other providing power for the rotary blades and blower section. All four main wheels are driven and steering is by the rear pair.

At each pass the Rolba gives a 2.44 m wide clear path, throwing the snow 20 m to 30 m away, depending on its density and other variables.

An unusual feature of this type of plough is the passenger cab just forward of the engine compartment. This can be used for general passenger transport or by a relief driver when the equipment must be kept on the job for long periods.

Left: Rolba demonstrates its throwing ability, clearing windrows along the Snowy Mountains Highway in late July, 1977.

Bottom left: Another view of a Rolba in action, this one at Perisher Creek in June, 1977. The action of the machine is here being critically watched by Plant Instructor J. Gardiner.

Right: A view of a Rolba at rest, clearly showing the rotary blades that chew through the snow and feed it to the blower, and the rear wheel steering.

Below: A driver's eye-view of the Snowy Mountains Highway near Sawyer's Hill, cleared of snow and ready for traffic.

THREE BRIDGES BACK O' BOURKE

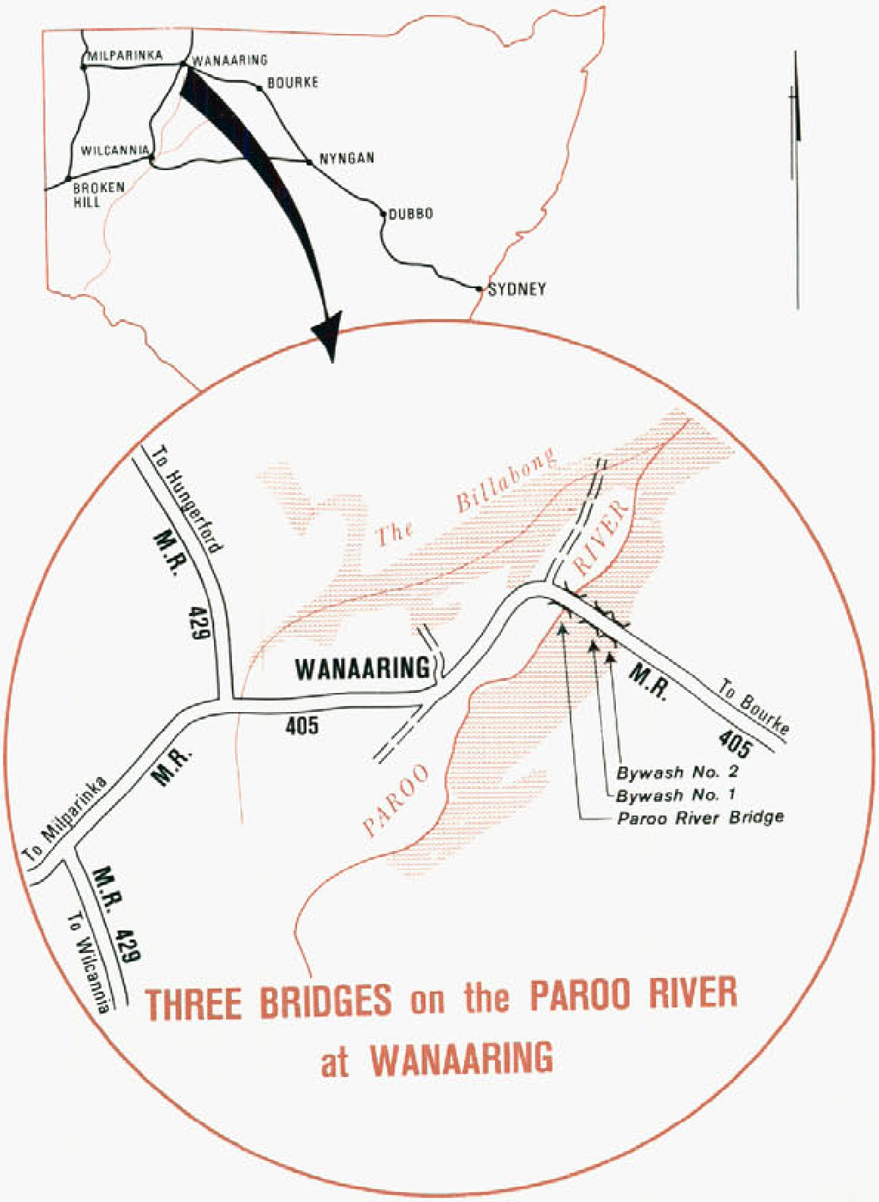
Flood-free crossing of Paroo River at Wanaaring

About 100 km from the Queensland border and almost 200 km west of Bourke, is the "town" of Wanaaring.

Wanaaring (the name rhymes with "starring") is located close to the Paroo River, a typical inland river. That is, a river that isn't always all there, yet sometimes is all *too* present, spreading across the flat countryside, kilometres wide in times of flood.

The Paroo River rises in the Moriarty Hills west of Charleville in southwestern Queensland. It flows in a southerly direction into New South Wales and usually peters out in a series of swamps and billabongs, somewhere south of Wanaaring. Although topographically a tributary of the Darling River, it seldom reaches that far, except in extremely wet seasons. Besides its main channel, the Paroo River at Wanaaring also pours its waters along two by-washes or flood channels. Before these three channels were first bridged at the turn of the century, even a moderate river high would cut off a considerable stretch of the country to its west from access to Bourke, which was and still is the nearest railhead.

The origins of Wanaaring reflect the pattern of development of many similar Australian towns. Few dependable records exist to date its actual beginnings and historians have been forced to make some well-founded surmises. As in so many similar cases, the local cemetery and its headstones provide useful data. One records the death in 1884 of pioneer James Stephenson who had been born in Scotland in 1799.



Left: The flatness of the country around Wanaaring is evident in this 1951 photograph taken from the approach to By-wash No. 2 bridge.

Top right: The steelwork of the abutment of the new Paroo River bridge immediately after welding was completed in October, 1975.

Bottom right: Abutment framework at By-wash No. 2 bridge is enclosed in forms, while protective concrete encasement cures around them. October, 1975.

Below: Wanaaring—196 km back o'Bourke. A bend of the Paroo River can be seen in the lower right quarter of the photograph, taken in August, 1977.

From other evidence it has been assumed that Wanaaring began to be recognised as a teamsters' centre in the late 1870's. It continued to flourish until the end of the first World War. At its peak, Wanaaring reached the status of a "three-pub town".

In 1897 it was described as "*a post town, 616 miles W of Sydney, with money-order, telegraph and government savings bank facilities, county Urana, electorate and police district of Bourke, connection with the Metropolis by coach to Bourke, 113 miles distant, thence rail; coaches also ply to Wilcannia, Hungerford, Brewarrina Downs and Bourke. Stock returns: 1,824 horses, 3,115 cattle, 608,250 sheep. There are two hotels (Royal and Victoria), a public school, average attendance 20; police barracks, several general stores, and a population of about 240*". (from "The Australian Handbook and Shippers' and Importers' Directory" for 1897, published by Gordon and Gotch).

With the growth of motor traffic in the earlier part of this century, Wanaaring's importance declined, as did its population which is currently somewhat under 200. The "pub count" is now down to one. But Wanaaring still retains its function as a service and communications centre for the district, a supply depot and social gathering place.

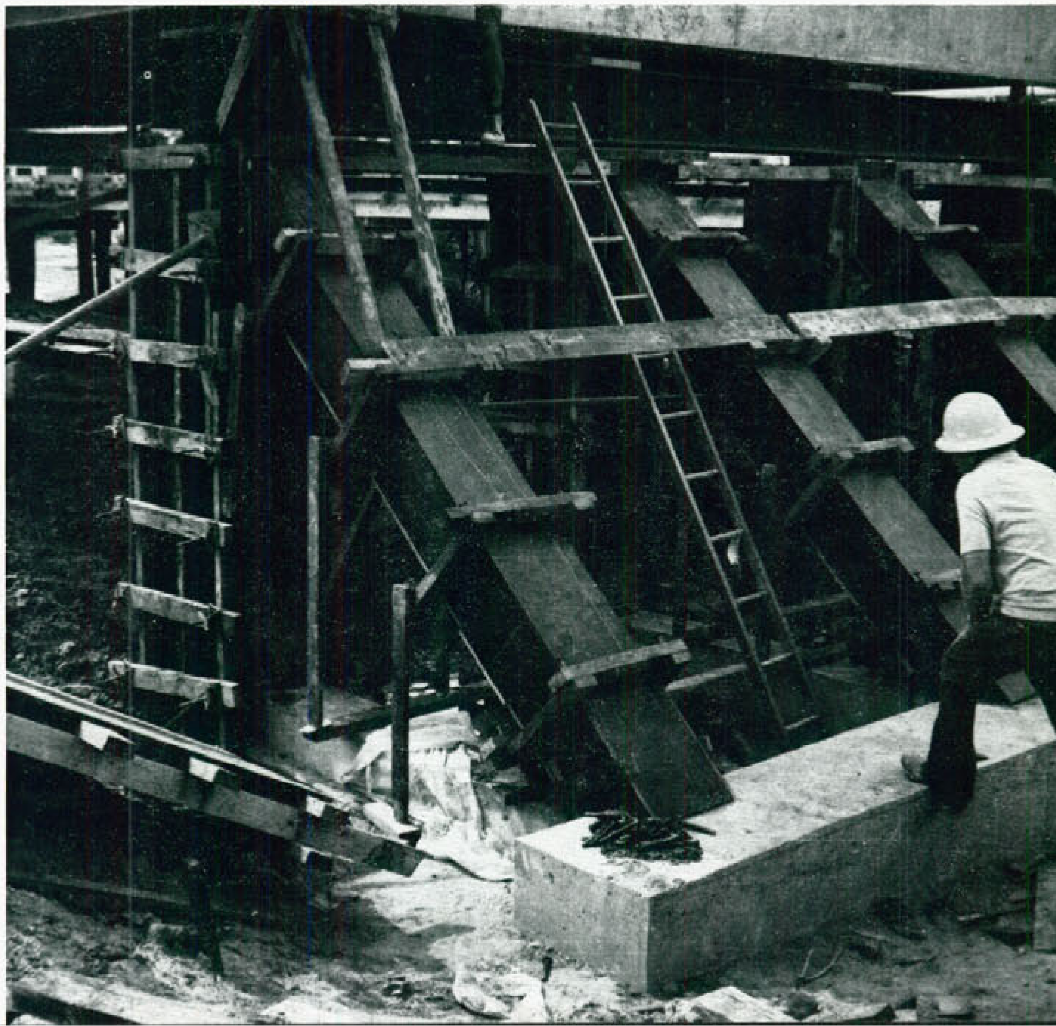
ROADS AND ROAD-USERS

Wanaaring stands at the intersection of two long outback roads. The east-west route is Main Road 405, which runs from Bourke (on the Mitchell Highway) to Milparinka and onto the South Australian border at Hawker Gate. The north-south route is Main Road 429, which runs from the Barrier Highway at Wilcannia to the Queensland border at Hungerford. West of Bourke, Main Road 405 has an improved gravel surface for 105 km. West of Wanarring to Milparinka the road is formed only, with an unformed length of about 50 km approaching the South Australian border. The entire length of Main Road 429 is formed only.

Main Road 405 is not exactly a busy road but, to an average of about 60 drivers a day (the 1970 Annual Average Daily Traffic figure), it is an important route.

The Old Structures

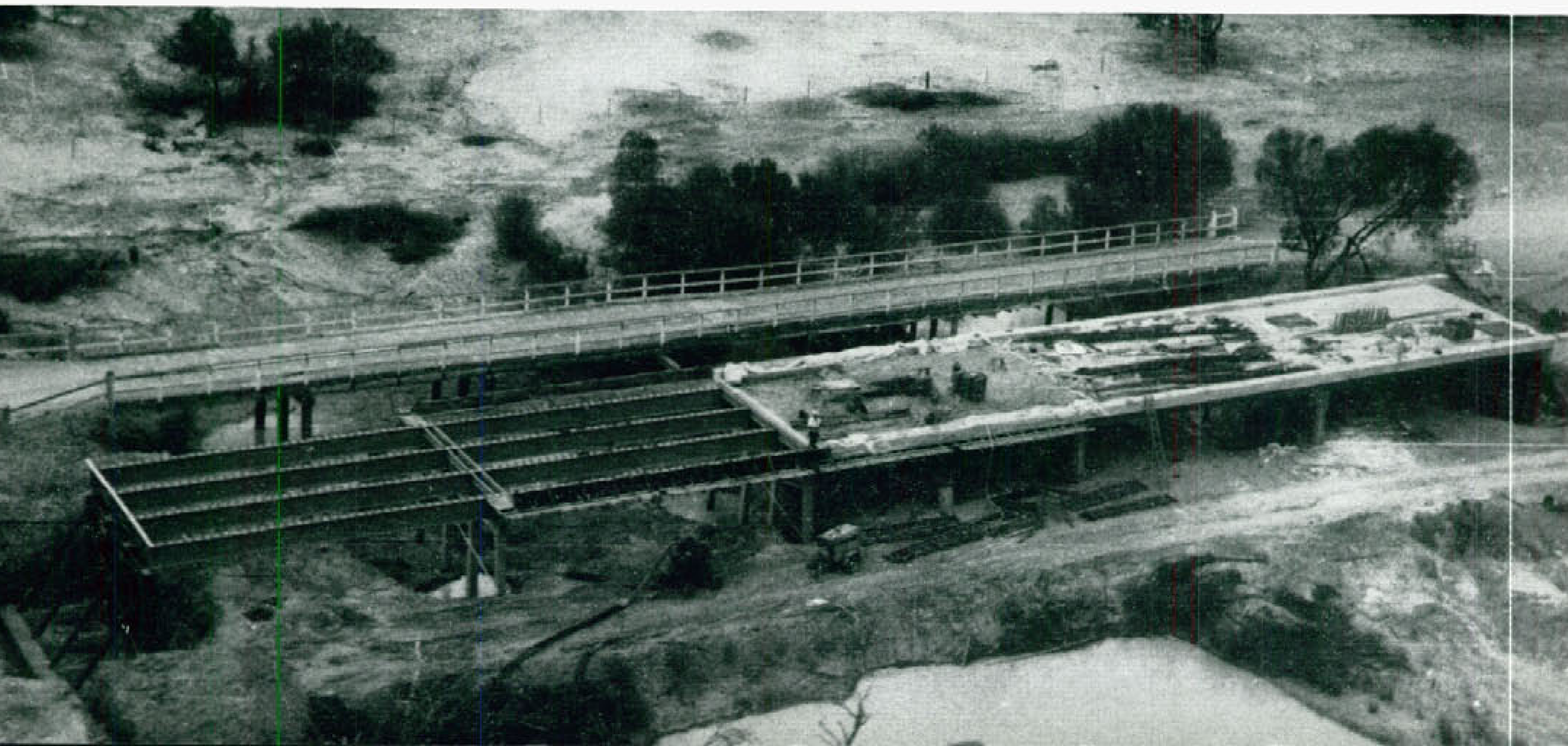
According to early Department of Public Works Annual Reports, the original three bridges over the Paroo River and its by-washes were built in 1899



Above: The Paroo River in a tranquil mood in 1951. In the background is the original Paroo River bridge, here well above water level.

Left: After the 1964 flood. Scouring damage to the abutment is clearly evident in this photograph.

Below: The new By-wash No. 2 bridge under construction in October, 1975. The contrast in width compared with the old bridge is already very obvious.



and were of timber construction. The fact that they had been in service for over three quarters of a century, surviving fierce floods and storms, is a tribute to the craftsmanship and skills of the early engineers and workmen who built them.

The highest flood reliably recorded at the site occurred in 1942, when water covered the decking by as much as 0.3 m. Local legend and some historical sources claim a greater depth for a flood in 1890, but there are no accurate records to verify this possibility.

The only basic alteration to any of the bridges was in 1953, after floods scoured out the approaches to the By-wash No. 2 bridge. The structure itself was still sound, so the scoured-away approach portion was bridged by timber-decked steel extensions which brought the original 22.9 m length to 53.3 m. By-wash No. 1 bridge remained at its original 61 m length and the main Paroo River bridge stayed at 103.6 m.

The original bridges were single-lane structures 4.6 m wide between kerbs—sufficient for the traffic of the early days of their life. Flooding in 1964 severely eroded the approaches and scoured the abutments, further emphasising the need for improvement.

The New Bridges

Three years ago it was decided that the existing bridges had reached the end of their useful economic life and would be replaced by three flood-free crossings. On 6 December, 1974, a tender from M. & E. Firth Civil Constructions (Tamworth) Pty Ltd was accepted for construction of three new bridges and demolition of the old ones.

The new bridges have been designed to provide at least 0.3 m clearance above the highest recorded flood level, that of 1942. This, together with the raised approach levels adopted, should ensure that this formerly vulnerable section of Main Road 405 should remain flood-free and trafficable even during the worst "wets" in the Paroo River's southwestern Queensland catchment area.

Because of the nature of the stream and the variations possible on the channel profiles, it was not possible to determine the necessary bridge waterway sizes by "rational" methods of exact measurement. Accordingly, a 50 per cent addition over the old waterway lengths was planned to allow for such unpredictable future changes.

The new bridges are on a straight alignment approximately 13.7 m downstream (south) of the older structures which were kept in service during construction. A new alignment was adopted to avoid construction of temporary side tracks and consequent indefinite traffic delays which could have resulted from even minor flooding during the construction period.

All three new bridges are of identical modular design, varying only in number of support substructures and number of spans, and therefore in length. The main channel bridge consists of nine 12.2 m spans to give a length of 109.8 m. Each of the by-wash bridges has five similar spans and is 61 m long.

Kerb-to-kerb width for all three bridges is 7.3 m, providing for one lane of traffic in each direction. No footways have been provided and the traffic rails on the kerbs consist of steel posts with corrugated steel guardrails topped by steel angle.

The superstructure of each bridge is of composite steel universal beam and reinforced concrete slab construction. The supporting substructures consist of driven steel universal bearing piles in trestles and steel-framed abutments braced by steel angles. The outer piles of each set of four are angled at 1 to 8 to resist lateral forces.

This type of bridge construction was chosen to reduce the amount of concrete in the total structure, as cement is fairly expensive in the remoter western areas of the State. A similar bridge built at Quondong near Broken Hill had already proven the advantages of this type of structure, being rapid in construction, economical in first cost and low in maintenance costs. Corrosion of steelwork is much less of a problem in these arid regions than it is in the damper coastal regions.

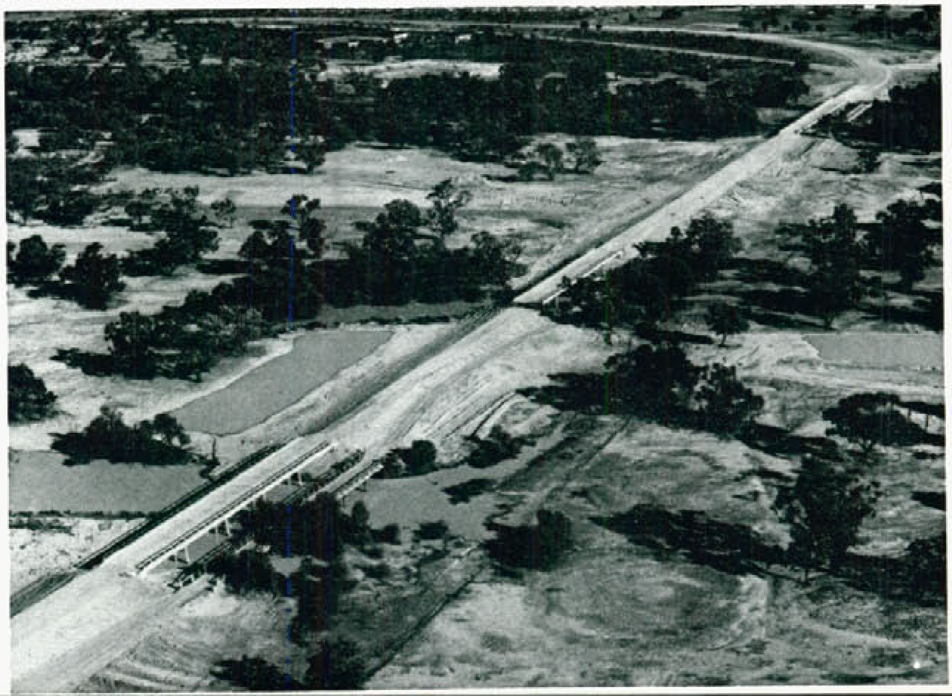
The concrete that was needed for on-site pouring was batched on the site using sand from the Paroo River itself and aggregate from a quarry at Byrock, about 260 km away.

The abutments at the ends of the bridges are of the spill-through anchor beam type consisting of a steel frame mounted on two rows of four vertical steel piles. All frame members which were to be buried in the fill of the approaches were encased in concrete as a protection against corrosion, as these members would be inaccessible for maintenance after the approaches were constructed. As a protection against the flood-time scouring which proved such a problem with the original bridges, the slopes of the approach embankments at the abutments are protected by sandbag revetments using a weak sand/cement mix in hessian sacks.

All exposed steelwork and the piling members down to 1.5 m below ground surface level have been given special protective treatment. After grit blasting to remove scale and surface oxidation, a two-part solvent-borne inorganic zinc silicate primer was applied. This was followed by a finishing coat of chlorinated rubber paint in a bamboo colour that blends well with its surroundings.

Following completion of approach roadworks, the new bridges over the Paroo River and its by-washes were opened to traffic on 10 August, 1977. The contractors then began the demolition of the three old structures which had served so long, if not always so well. ●

The completed bridges the Paroo River and its by-washes, taken just before demolition of the old bridges was begun. The bridge over the main channel is the one furthest from the camera. August, 1977.
A similar view of the bridges surrounded by floodwaters appeared on page 18 of the September, 1976 issue of "Main Roads".



DMR-Designed traffic control system selected for Kuala Lumpur

In Malaysian cities such as Kuala Lumpur, road traffic tends to be a heterogeneous mix with a greater variety of vehicles than are generally found on Australian thoroughfares. Besides the usual cars, trucks, buses, etc., there are large numbers of two-and even three-wheeled vehicles, motorcycles, scooters, mopeds, pushbikes and a variety of small delivery and passenger units. As most people may have noticed, mixing different kinds of traffic on a road is a good way to both slow down the flow and at the same time increase the accident rate.

As in most of the world's great cities that are undergoing rapid development, Kuala Lumpur is meeting a common problem. Road traffic is growing at a rapid rate and the city's "arteries" are becoming clogged. This results in loss of time and money, wear and tear on machines and men, increased air and noise pollution and general inefficiency all around.

Most cities are fighting hard just to stay abreast of their current problems. Up-dating existing traffic control systems usually means high capital expense, not just from the cost of the new installation, but from the removal and scrapping of the outmoded equipment, which may have been originally planned for a much longer service life.

Just some of the variety of Kuala Lumpur traffic is shown in this photograph. Besides cars, three different types of two-wheel vehicles can be seen here.

In this respect, Kuala Lumpur is in the fortunate position of not having a great deal already invested in traffic control equipment. So when the Government of Malaysia determined to install a modern traffic control system in that city, they could afford to decide on the most modern available, with reserve capacity and the ability to be expanded to meet projected future needs.

The area traffic control system to be installed in Kuala Lumpur is the first to be financed by the World Bank. From the beginning it was a condition that the client (the Malaysian Government) retain consultants up to the time of awarding the contract. To date these consultant firms have been Wilbur Smith, Kuttner Collins, and Valentine, Laurie and Davies. The Kuala Lumpur authorities had little traffic engineering and electronic expertise. Consultants generally, although strong in civil and transportation engineering, are not necessarily familiar with sophisticated electronics, especially as applied to computer-operated, co-ordinated traffic signal systems. The consultants therefore retained the Department of Motor Transport to offer technical advice and share its expertise during the preliminary specification stage in 1975. On 30 June, 1976, the Department of Main Roads took over responsibility for traffic signals and other traffic management facilities from the Department of Motor Transport (see article in September, 1976 issue of "Main Roads", pp. 8–10) and many officers, including Mr Sims, were transferred to this Department.

Tenders closed on 26 May, 1977, and Valentine, Laurie and Davies requested further technical assistance in the evaluation of the tenders received. The Premier of New South Wales, the Hon. Neville Wran, and the Commissioner for Main Roads, Mr A. F. Schmidt, approved that Mr A. G. Sims, the Department's Traffic Systems Manager should attend to provide this assistance at the cost of the consultants.

The full evaluation period started one week before Mr Sims arrived in Kuala Lumpur on 9 June, 1977, and lasted until 28 June.

As well as the consultants already mentioned, the authorities in Kuala Lumpur retained an English firm to act as their advisors and to oversee the work of Valentine, Laurie and Davies. The Consultant Engineer in charge was Mr D. Overton, who has had wide experience in area traffic control and was involved with both the London and Glasgow systems and had further experience in the

Arthur Sims with one of the installations that have helped to give New South Wales one of the world's most advanced traffic control systems. This remote-controlled TV camera keeps its eye on traffic on Sydney Harbour Bridge.

U.K. Department of the Environment and the Traffic and Road Research Laboratory.

A total of six tenders were submitted, including two from Philips TMC Pty Ltd. One was based on the system designed by the Department in conjunction with Philips and generally referred to as the Sydney Department of Main Roads system. It is the type currently in use in Sydney, Newcastle and Wollongong and is considered by many world authorities to be the most advanced available anywhere.

Philips also submitted a proposal entirely their own, which originated with the parent company in the Netherlands.

In the week before Mr Sims arrived in Kuala Lumpur, two tenders were rejected on legal grounds. They were also the most expensive and were given no further consideration. Thus there were finally four tenders to be given full technical and financial evaluation—the two already mentioned and one each from General Electric Corporation and Sumitomo.

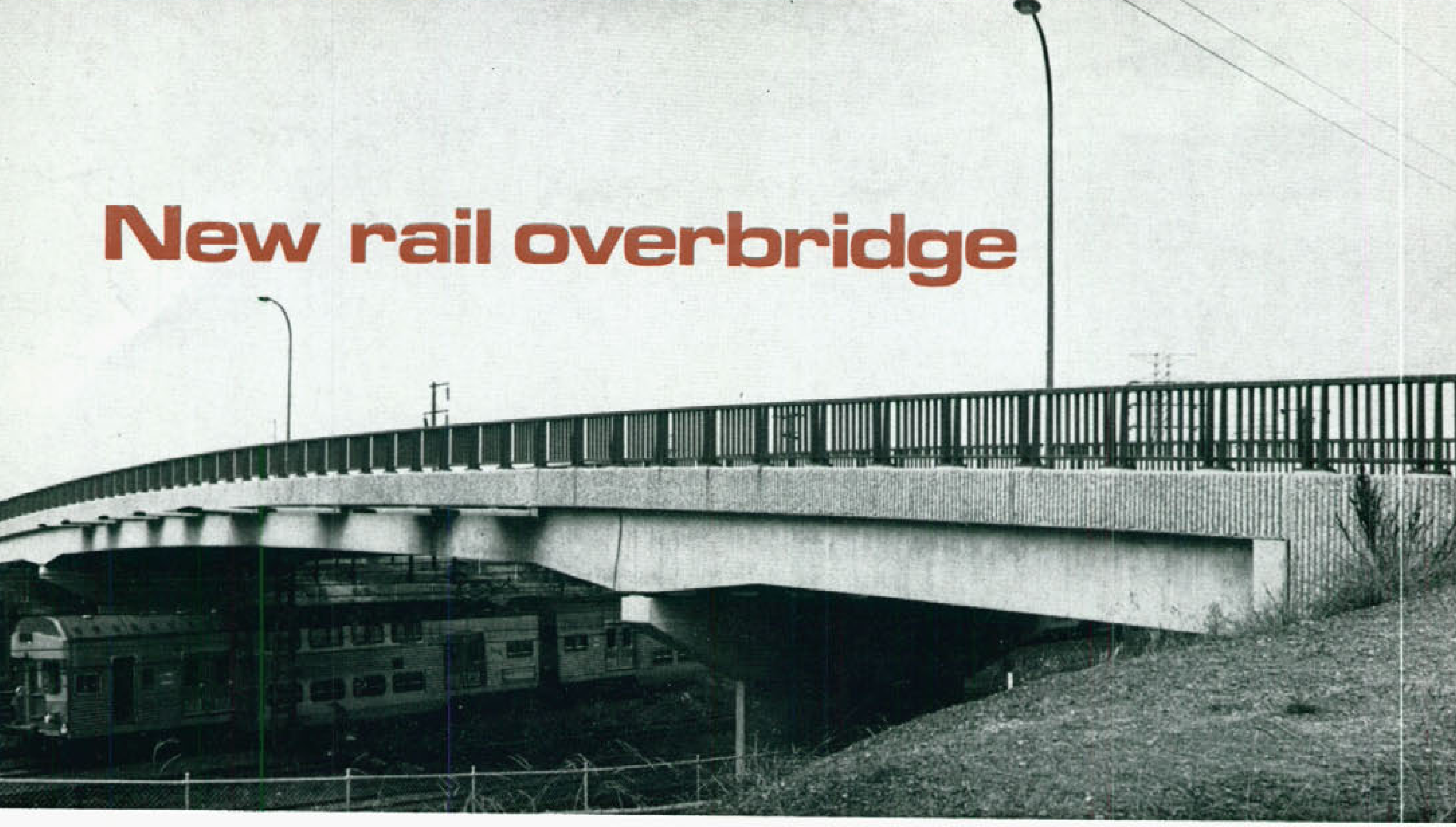
The total evaluation programme by a team which included Mr Sims lasted for over three weeks, with the final report being printed on 27 June, 1977, the day before Mr Sims returned to Sydney.

In the preliminary stages of the tender examinations, many departures from the given specification were unearthed by the evaluation team. Mr Sims' specialised knowledge was particularly useful in the clarification and elimination of these anomalies; in some cases through correspondence with the tenderer involved, in others through a series of meetings with the technical representatives of the relevant organisations. This aspect alone fully justified the decision to allow Mr Sims to be present in Kuala Lumpur during the investigations.

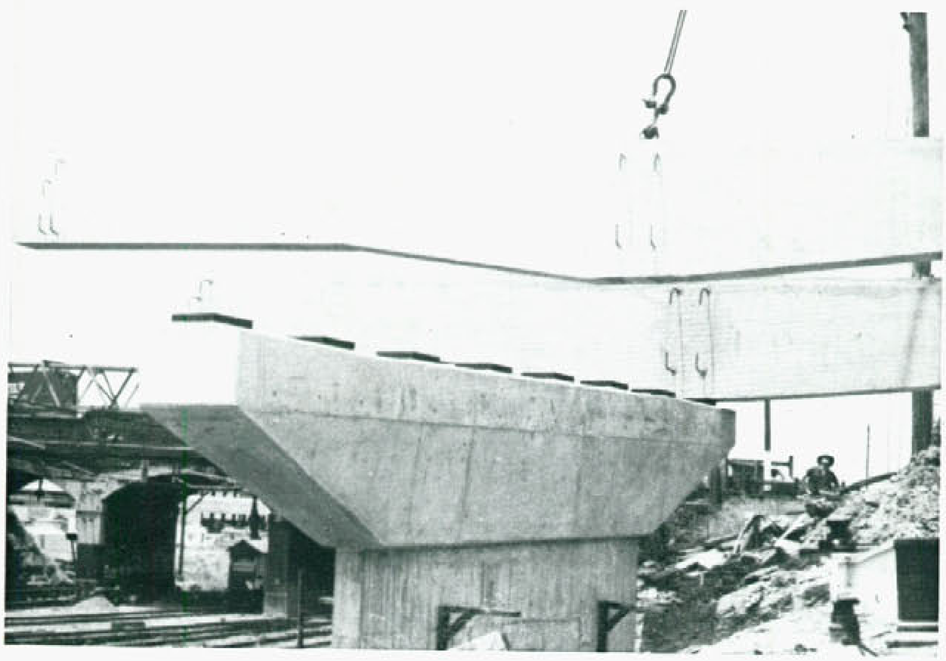
The final decision of the evaluation team was in favour of the Philips system known as the Sydney Department of Main Roads system. In this regard it is noteworthy that the selected system was the only one whose design was principally carried out by a government authority. The others were all of commercial origin in their entirety.

As a result of this tender, it can be expected that the commercial interests involved in area traffic control will in future attempt to include in their designs many of the advanced features and principles that are already standard in the New South Wales installations. This is certain to reflect favourably on the State of New South Wales in general and the Department of Main Roads in particular. ●

New rail overbridge



to ease traffic flow around Flemington Markets



Lifting one of the cantilever end span girders into position on one of the narrow wall-type piers. In the background can be seen portion of the old bridge, with its narrower between-pier spacing.

As part of a traffic improvement plan for the Flemington Markets area, the Department in November, 1976, brought into service a bridge spanning eight sets of rail tracks at Marlborough Road, Strathfield. In order to eliminate piers close to or between the tracks, the bridge was designed with a large central span supported by shorter end spans cantilevered out from piers partly recessed into the embankment.

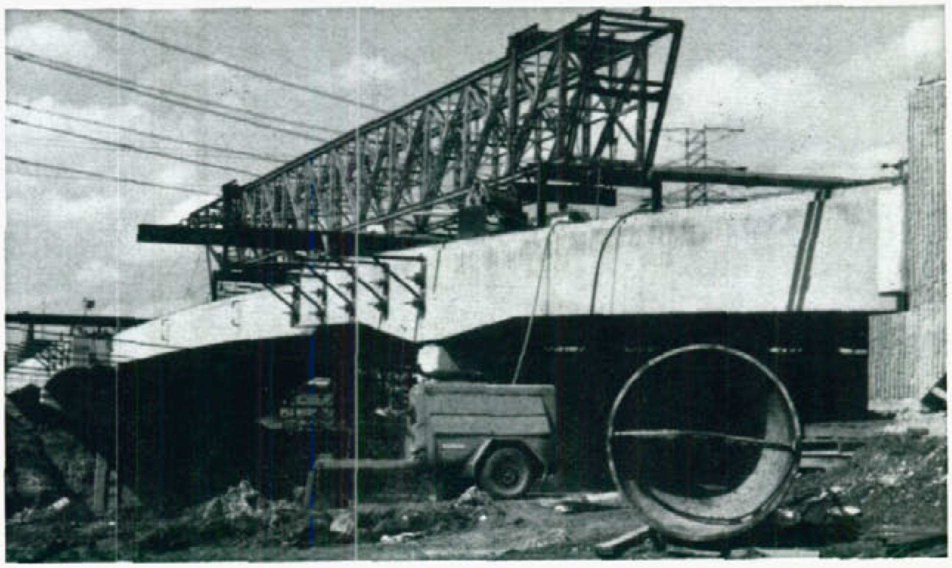
The problem of balancing the upward thrust on the abutments caused by the load of the central span on the short end spans was overcome by using abutment ground anchors. This is a comparatively new principle in bridge work, but one which is now finding wider application.

The consulting engineers, Bull, Ferranti and Collier Pty Ltd, designed the bridge, using pre-cast pre-stressed concrete girders to support a cast in-situ concrete deck. The pre-cast girders obviated the need for temporary support work near the rail tracks and so avoided interfering with normal day-to-day rail traffic over this busy section of the line.

Left: A general view of the Marlborough Road railway overbridge. The photograph emphasises the wide between-pier clearance achieved by supporting a long centre span between shorter cantilevered end spans.

Right: A close-up of one of the piers set into the embankment.

Below right: The aluminium launching truss used to position the centre span girders. The transverse rails on which it tracked sideways can be seen projecting out from the cantilever span.



The end-span girders are cantilevered over the tracks for 8 metres from the piers, which are set back 4.3 metres from the centre of the outside lines of the tracks.

FOUNDATIONS

Foundations for the slim wall-type piers are rectangular concrete footings cast directly onto hard shale. Each abutment is supported on four cast-in-place reinforced concrete piles. The piles are belled at the toes to provide additional resistance against uplift.

The 40 mm bar tendons for the ground anchors, which provide the main resistance to the upthrust from the mass of the 46 metre central span, are taken through the piles and 6 metres into the shale below. The tendons, complete with end plates, were lowered into 200 mm diameter bored holes (which were continuous with holes formed through the centre of the piles) and were grouted for a length of 3.5 metres at the lower end.

A capping beam across the top of the four piles incorporates the upper anchor plates for the ground anchors. In addition, 40 mm bolts to hold down the girders were cast into the capping beam.

After the vertical tendons were stressed and grouted, the end span girders were placed in position by mobile cranes with a capacity of up to 125 tonnes. The ends of the girders were then anchored to the pile capping beam by steel plates 60 mm thick spanning the top of each girder and secured to the lower pile capping beam by the 40 mm high-tensile bolts.

ERECTION

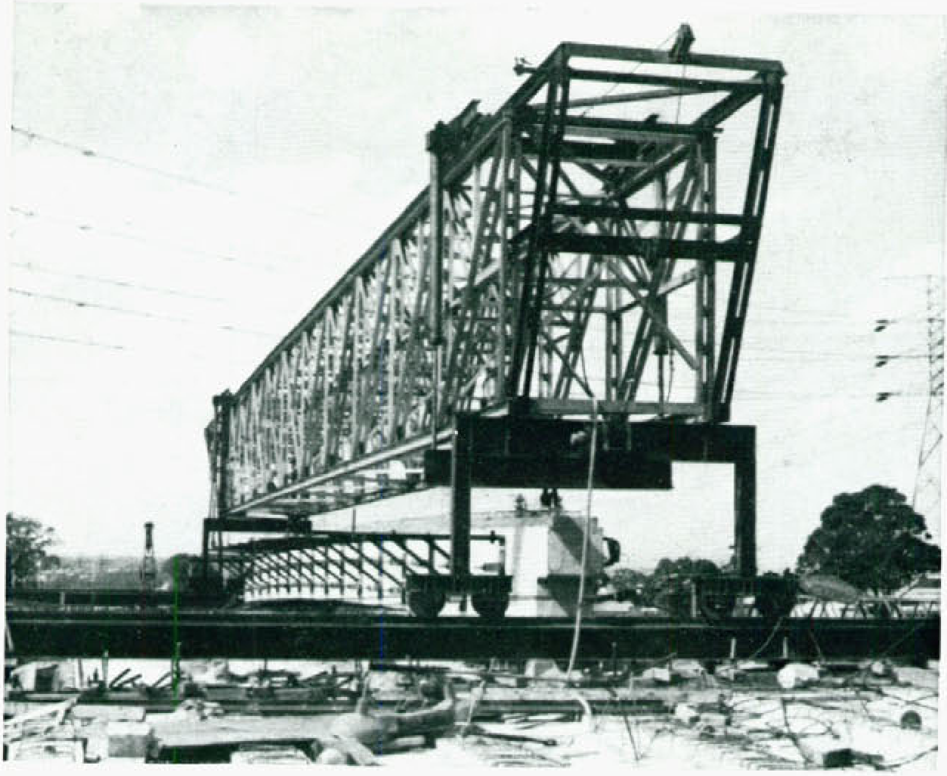
The eight central 30 metre long "drop-in" girders were positioned with a lightweight aluminium launching truss. Weighing approximately 8 tonnes, the truss has been used for the erection of several road bridges in the Sydney region and has clearly demonstrated its ability to assist in the placement of heavy girders.

To minimise disruption to road and rail traffic the girders were erected at night. The truss was cantilevered 27 metres out over the rail tracks by counter-balancing one end with concrete weights and winching the truss forward until the leading end reached the far pier. The centre span girders were lowered into position by hydraulic rams supported by trolleys running along the top of the truss, at the rate of one a night.

Bearing pads to support the girders and allow for expansion of the bridge were of the laminated elastomeric type. Eight cross diaphragm stiffening beams were cast between the girders, and the open deck space between the girders was closed in by 30 mm thick pre-stressed concrete panels to serve as permanent formwork. The deck and kerbs were then concreted.

DESIGN

A feature of the kerb work on the bridge is the rope finish on the exterior faces of the kerbs, which creates a vigorous vertical ribbing effect in striking contrast



Left: A centre span girder being lowered into position.

Below: An aerial comparison of the old bridge with the new one, while the latter was still under construction. July, 1976.

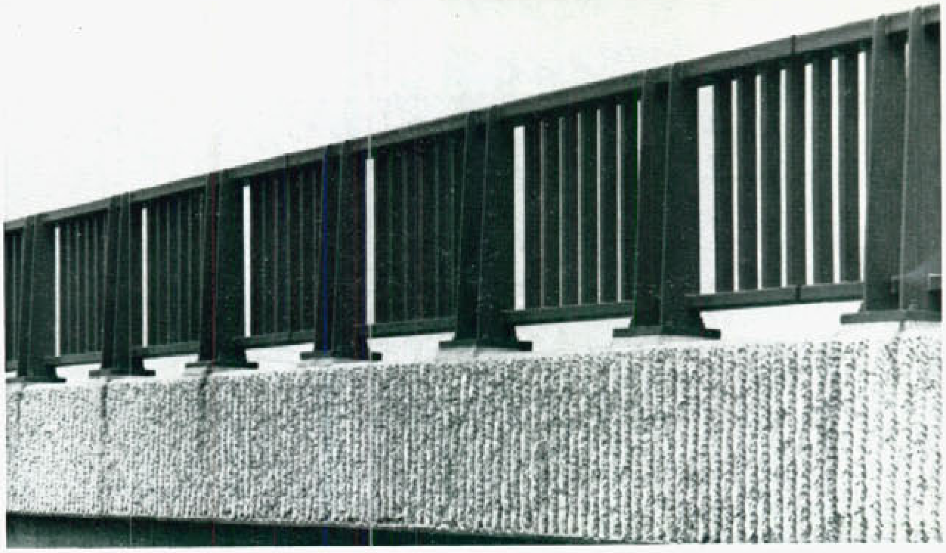
to the smooth-sided girders below. The finish was achieved by simply nailing lengths of rope inside the formwork it was carried through onto the abutments themselves, to give a strong unifying effect.

The hollow rectangular section girders were manufactured at the EPM casting yard at Blacktown. They were cast with foam polystyrene cores and have sharp exterior corners, resulting from the use of special mortar-tight steel forms. The sharpness of the edge so formed adds crispness to the finished lines of the structure.

The hand railing for the bridge is of a design which accentuates the horizontal lines of the bridge and at the same time provides an interesting pattern of vertical bars. The "Flemington" green chosen for the handrails was selected to harmonise with the colour of many of the new market buildings.

The 72 metre bridge, with a 46.2 metre centre span and two 13.2 metre end spans carries two lanes of traffic, a footpath and a service duct. It was completed within ten months from the commencement of construction work on site and was opened to traffic on 29 November, 1976. The contractor was Pearson Bridge Pty Ltd, whose contract price was $495,667.

Additional concrete work associated with the bridge construction included the retaining walls along the approach embankments constructed by the Department's forces. The sandstone facing work to the abutments, and the approach road works were completed by the Strathfield Municipal Council. ●



Top right: A close-up of the handrail design. The varied spacing of vertical bars and support members provides an interesting interplay of light and shade.

Centre: One of the abutments, showing how the rope finish to the cast concrete has been carried down as a unifying feature.

Right: It doesn't take them long! Shortly after the bridge decking was completed, graffiti appeared on the still-exposed face of one of the piers facing the railway line.

Flemington Markets:

their effect on road use and roads planned for the area

In 1975 the new Sydney markets at Flemington were opened. They replaced the old markets at the Haymarket and are located roughly in the centre of the metropolitan area, a fact that may surprise many people. The site, approximately 41 hectares in area, is easily accessible to producers and suppliers and has its own rail facilities, as well as being served by road.

On the site there is a combination of a wholesale farm produce market and associated commercial development, including a shopping/office complex and a hotel/motel. Parking space caters for about 3 000 motor vehicles and in addition grower-sellers may park their vehicles in one of the market buildings.

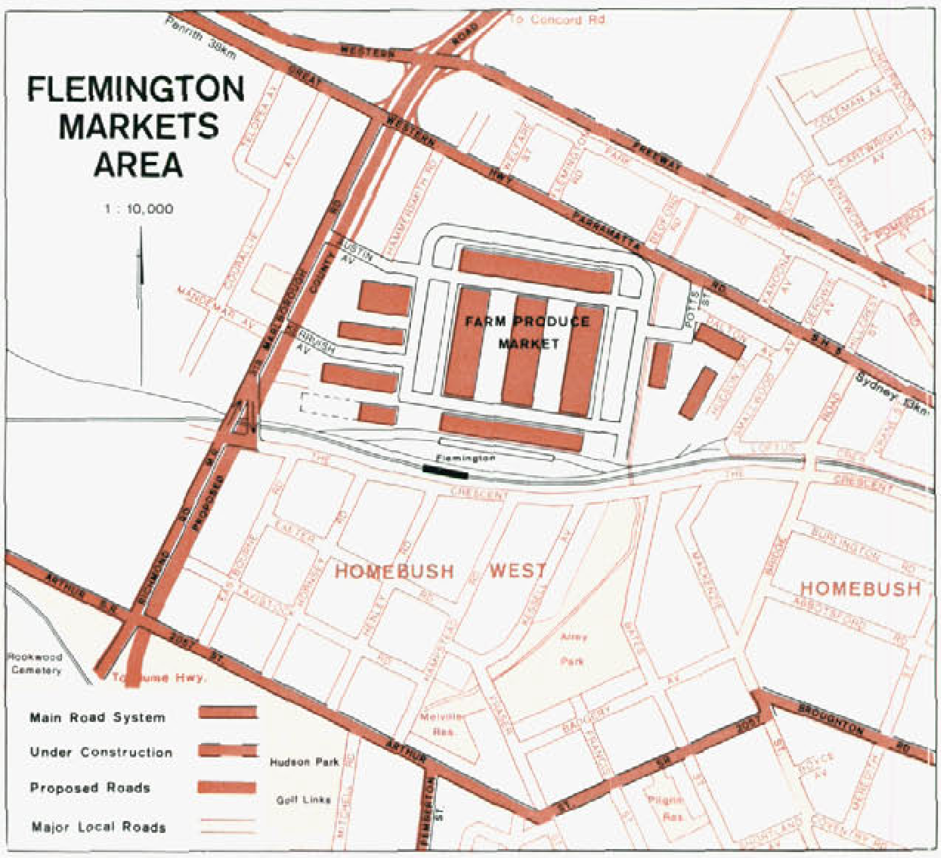
The new markets reflect modern layout ideas in building design and arrangement already proven in many similar markets serving large cities in other countries. In the 1960's the Paris markets were moved from Les Halles to a new site at Rungis 15 km south of Paris, and since then the market has developed into the largest of its kind in the world. It is linked to a transport complex which includes rail, road and air facilities allowing easy access for distribution not only to other areas of France, but also throughout Europe. Although not serving as many people, Flemington serves an area of the same order. London also has transferred its markets from the centre of the city at Covent Garden to a more outlying area.

Since the Flemington Markets were opened, traffic patterns in the area have changed quite significantly. The main arteries leading to the markets are Parramatta Road from the east and west and Concord Rd from the north. From the south, some market traffic tends to use residential streets through Strathfield and Homebush to the detriment of the residents and their environment. A proposal by the Department to construct a diversion of Ring Road 3 from Rhodes past the western side of the markets to Liverpool Road will rectify this situation. This diversion, a County Road, as well as serving the markets, will help to relieve the congestion on Concord Road and The Boulevarde and provide a much needed north-south link between busy Parramatta and Liverpool Roads.

The new Marlborough Street overbridge forms part of this north-south link. The entrances to the markets, at Austin Avenue and Kerruish Avenue, lead off Marlborough Road, while there is another entrance at Potts Street which leads off Parramatta Road. Traffic signals have been installed on Parramatta Road at the Marlborough Road and Potts Street intersections as these have become very busy intersections with market traffic moving in and out.

Pemberton Street between Liverpool Road and Ada Street is being reconstructed and widened to four lanes, and a new culvert over Cooks River is planned as part of this upgrading work.

The other major work in the vicinity of the markets is the 6 km section of the F4 Western Freeway between Homebush and Clyde. This work is at present in abeyance because of lack of funds. When completed, there will be freeway interchanges which will serve traffic using the market complex. ●



TENDERS ACCEPTED BY COUNCILS

The following tenders (in excess of $20,000) for road and bridge works were accepted by Councils for the three months ended 30 June, 1977.

Council	Road No.	Work or Service	Name of Successful Tenderer	Amount
				$
Blacktown	S.R. 2085	Construction of new bridge over Eastern Creek, Plumpton.	R. Ryder Construction Pty Ltd.	120,900.00
Goobang	Rural Road	Construction of new bridge over Bogan River at 8 km from Peak Hill.	Steve Parry Manufacturing Pty Ltd & Gand E. M. Tinchnell.	85,467.00
Gosford	Main Road 349	Construction of new bridge over Coorumbine Creek	J. Parkinson	107,256.00
Great Lakes	Trunk Road 90	Construction of 4 x 9.17 m span prestressed concrete plank bridge over Camerons Creek, 59.1 km north of Newcastle.	Civilbuild Pty Ltd	113,998.00
Kyogle	Rural Road	Construction of a 3 span prestressed, reinforced concrete bridge over Gradys Creek.	F. E. Marsh & Co. Pty Ltd	133,850.00
Taree	S.H. 10	Duplication of bridge over railway line at Chatham	Quadrant Constructions Pty Ltd.	83,861.00
Taree	S.H. 10	Duplication of bridge over Browns Creek	Geoffrey Stewart Constructions Pty Ltd.	147,575.00
Yarrowlumla	Main Road 268	Construction of two bridges over Deep Creek	Habali Pty Ltd	272,580.00

TENDERS ACCEPTED BY THE DEPARTMENT OF MAIN ROADS

The following tenders (in excess of $20,000) for road and bridge works were accepted by the Department for the three months ended 30 June, 1977.

Road No.	Work or Service	Name of Successful Tenderer	Amount
			$
Southern Freeway	City of Wollongong. Construction of new bridge over the Freeway at Kanahooka Road, Dapto—92.7 km south of Sydney.	Allied Constructions Pty Ltd	584,012.40
State Highway No. 2	Hume Highway. Shire of Mittagong. Construction of new bridge over Braemar Creek, 3.4 km north of Mittagong.	Winnett Bros	98,842.00
State Highway No. 2	Hume Highway. Shire of Gundagai. Manufacture, supply and delivery of precast pretensioned bridge planks for construction of bridge over Jones Creek, Gundagai.	Concrete Industries (Monier) Ltd	50,129.00
State Highway No. 2	Hume Highway. Shire of Gundagai. Manufacture, supply and delivery of precast pretensioned bridge planks for construction of twin bridges over Punch Street, Gundagai.	Dyson-Holland Concrete Pty Ltd	88,900.00
State Highway No. 2	Hume Highway. Shire of Kyeamba. Construction of new bridge over Kilgowlah Creek, 13.2 km south of Tarcutta.	W. A. Winnett and Sons	94,903.00
State Highway No. 2	Hume Highway. Shire of Kyeamba. Construction of new bridge over MacIntyre Creek, 11 km south of Tarcutta.	W. A. Winnett and Sons	59,979.00
State Highway No. 2	Hume Highway. Shire of Kyeamba. Supply and delivery of up to 21 000 tonnes of fine crushed rock pavement material to road formation between 3.5 km and 7.7 km south of Tarcutta.	F. A. Delaney and Co. Pty Ltd	112,980.00
State Highway No. 2	Hume Highway. Shire of Gundagai. Supply and delivery of up to 31 300 tonnes of fine crushed rock pavement material to road formation between 3.5 km and 7.7 km south of Tarcutta.	F. A. Delaney and Co. Pty Ltd	179,036.00
State Highway No. 5	Great Western Highway. City of Greater Lithgow. Pressure grouting and stabilisation of reinforced concrete pavement 3 km east of Lithgow to 1 km west of Lithgow.	Concrete Industries (Monier) Ltd	39,893.00
State Highway No. 7	Mitchell Highway. Shire of Molong. Construction of new bridge over Molong Creek at Erambie 5.6 km east of Molong.	Bridge and Civil Pty Ltd	328,458.00
State Highway No. 7	Mitchell Highway. Shire of Abercrombie. Widening of existing structure over Rocks Creek No. 4, 18.4 km west of Bathurst.	Dolland and Sleeman Pty Ltd	34,724.00
State Highway No. 8	Barrier Highway. Broken Hill District. Construction of two bridges over Willa Willyong Creek at 6.6 km and 8.4 km east of Broken Hill.	Herbert Bros Pty Ltd	202,332.64
State Highway No. 9	New England Highway. Shire of Tenterfield. Construction of new bridge over Browns Creek at 9 km north of Tenterfield.	A. R. Dickinson Construction Co. Pty Ltd.	99,708.10
State Highway No. 9	New England Highway. Shire of Uralla. Construction of new reinforced concrete box culverts over Rocky Creek at 90.3 km and 90.4 km north of Tamworth.	Enfro Constructions Pty Ltd	155,382.00

Road No.	Work or Service	Name of Successful Tenderer	Amount
			$
State Highway No. 9	New England Highway. Shire of Parry. Construction of a 4 cell 3 m x 2.2 m reinforced concrete box culvert at Lahey's Creek 27.4 km north of Tamworth.	R. Bruno and M. Campese	96,206.90
State Highway No. 9	New England Highway. City of Maitland. Supply and lay up to 1 520 tonnes of 20 mm dense graded asphaltic concrete to construction of dual carriageways between 25.9 km and 28.5 km west of Newcastle.	Boral Resources (N.S.W.) Pty Ltd	49,324.00
State Highway No. 9	New England Highway. City of Maitland. Supply and lay up to 1 400 tonnes of 10 mm dense graded asphaltic concrete to construction of dual carriageways between 25.9 km and 28.5 km west of Newcastle.	Bitupave Ltd	46,620.00
State Highway No. 9	New England Highway. City of Maitland. Supply and lay up to 1 300 tonnes of 10 mm dense graded asphaltic concrete at construction site between 8.2 km and 10.0 km west of Maitland.	Bitupave Ltd	42,744.00
State Highway No. 10	Pacific Highway. City of Newcastle. Surface preparation and painting of steelworks of bridge over Hunter River at Hexham.	I. Mondello (Mondello Decorating Specialists).	92,670.00
State Highway No. 10	Pacific Highway. Shire of Tweed. Protective treatment of steelworks on the Boyds Bay bridge over Terranora Inlet at Boyds Bay.	I. Mondello (Mondello Decorating Specialists)	20,500.00
State Highway No. 10	Pacific Highway. Shire of Manning. Repainting of the Martins Bridge over the Manning River at Taree.	Kada Painting Contractors Pty Ltd	119,847.00
State Highway No. 10	Pacific Highway. Shire of Wyong. Supply and delivery of up to 650 tonnes of 10 mm and 140 tonnes of 20 mm dense graded asphaltic concrete to reconstruction between Wallarah Creek and climbing lane at Wallarah Hill.	Bitupave Ltd	27,306.00
State Highway No. 10	Pacific Highway. Shire of Great Lakes. Supply and delivery of up to 1 260 tonnes of 10 mm dense graded asphaltic concrete through town of Bulahdelah between 96.3 km and 98.2 km north of Newcastle.	Bitupave Ltd	44,314.00
State Highway No. 10	Pacific Highway. Shire of Wyong. Supply and lay up to 800 tonnes of 10 mm dense graded asphaltic concrete for resheeting pavement between 96.4 km and 98.5 km north of Sydney at Tuggerah.	Bitupave Ltd	27,128.00
State Highway No. 10	Pacific Highway. Shires of Lake Macquarie and Wyong. Supply and lay up to 970 tonnes of 10 mm dense graded asphaltic concrete for various reseals between Belmont North and Goldies Corner, south of Wyong.	Bitupave Ltd	37,081.00
State Highways Nos 10 and 11.	Pacific Highway and Oxley Highway. Various Shires. Supply and delivery of bituminous cold mix to various sites.	K. V. & G. Urquhart	42,474.60
State Highway No. 14	Sturt Highway. Shire of Kyeamba. Extensions to reinforced concrete box culverts at Coreinbob Creek and Mates Gully Creek, at 29.9 km and 30.2 km east of Wagga Wagga.	Siebels Concrete Constructions Pty Ltd.	64,528.80
State Highway No. 14	Sturt Highway. Shire of Kyeamba. Construction of new bridges over Kyeamba Creek and flood plain at 14 km and 13.4 km east of Wagga Wagga.	Siebels Concrete Constructions Pty Ltd.	432,852.58
State Highway No. 16	Bruxner Highway. City of Lismore. Repainting of bridge over Richmond River at Ballina Street, Lismore.	I. Mondello (Mondello Decorating Specialists).	77,033.00
State Highway No. 17	Newell Highway. Municipality of Parkes. Reconstruction of Clarinda Street, Parkes. Provision of asphaltic concrete between Chamberlain Square and Victoria Street.	Bitupave Ltd	71,417.00
State Highway No. 18	Castlereagh Highway. Shire of Walgett. Construction of new bridge over the Big Warrambool at 56 km north of Walgett.	Allco Steel Erectors (N.S.W.) Pty Ltd	204,188.21
Trunk Road No. 95	City of Wollongong. Reconstruction between 17.5 km and 19.3 km from Wollongong. Supply and laying of up to 9 000 tonnes of asphaltic concrete.	Pioneer Asphalts Pty Ltd	261,720.00
Trunk Road No. 95	Shire of Wollondilly. Construction of bridge over Nepean River at Maldon.	John Holland (Constructions) Pty Ltd	2,032,593.00
Main Road No. 177	City of Campbelltown. Construction of new bridge over Bow Bowing Creek at Campbelltown.	Thiess Bros Pty Ltd	157,426.00
Main Road Nos 184 and 516.	City of Blue Mountains and City of Greater Lithgow. Replacement of cable fencing on section of Main Road No. 184—Berambing to Mount Victoria and on section of Main Road No. 516—Bell to Scenic Hill.	N. & R. McCook & R. & S. Calvert	38,191.20
Main Road No. 515	City of Liverpool. Construction of new bridge over Cabramatta Creek at 2.0 km from Liverpool.	G. Abignano Pty Ltd	625,862.00
Unproclaimed Road	Municipality of Botany. Supply and delivery of 64 precast reinforced concrete box culvert sections for structure over Springvale drain at Banksmeadow.	Humes Ltd	30,751.70

MAIN ROADS STANDARD SPECIFICATIONS

Note: Imperial drawings are prefixed by letter A, metric drawings by the letters SD, instructions are so described, all other items are specifications.

ROAD SURVEY AND DESIGN

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Design of two-lane rural roads (Instruction—1964)	355
Data for design of two-lane rural roads (1973)	892 (Metric)
Flat country cross sections—bitumen sealed pavement (Instruction—1972)	A 6132
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Standard cross sections for bitumen surfaced two-lane rural roads (1973)	SD 6056

URBAN DRAINAGE

Concrete converter	A 1418
Concrete work other than bridges	738 (Metric)
Design of subsoil and subgrade drainage (Instruction—1973)	513 (Metric)
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With kerb inlet only	A 1043
With grating and extended kerb inlet	A 1352
With extended kerb inlet only	A 1353
With grating for mountable kerb	A 4832
Kerb and gutter shapes (1975)	SD 6246
Perambulator ramp	A 3491
Vehicle gutter crossings (1974)	SD 6247
Waterway calculations for urban drainage (Instruction—1963)	371B

CULVERTS

(a) Cast in place reinforced concrete box culverts—

Box culverts with wearing surface	SD 6270
Single cell box culvert under fill from 1 m	SD 6271
Single cell box culvert under fill from 0.3 to 1 m	SD 6272
Multiple cell box culvert under fill from 1 m	SD 6273
Multiple cell box culvert under fill from 0.3 to 1 m	SD 6274

(b) Precast reinforced concrete box culverts—

Erection of precast concrete box culverts (1975)	138B (Metric)
Supply of precast concrete box culverts (1975)	138A (Metric)

(c) Pipe culverts—

Construction of concrete pipe culverts (1974)	25 (Metric)
Design of concrete pipe culverts (1974)	25A (Metric)
Headwalls for pipe culverts— Single row—	
600, 750, 900 mm dia.	SD 139
375, 450, 525 mm dia.	SD 143
1 050 mm dia.	SD 172
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1 500 mm dia.	SD 175
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Supply and laying of asbestos cement drainage pipes (1972)	861

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Manufacture of precast or cast-in-situ, prestressed concrete bridge members (1976)	556 (Metric)
Manufacture of elastomeric bearings for bridge units and girders (1967)	562
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Prestressed concrete bridge drawings— (a) Prestressed concrete piles—	
14 in octagonal—45 tons	A 4943
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Reinforced concrete piles 35 and 45 tons (1963)	A 1207–8
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Supply of high strength steel bolts (1976)	261 (Metric)
Supply of ready mixed concrete (for bridgeworks and roadworks) (1977)	895 (Metric)
Timber for bridges (1976)	140 (Metric)
Waterway diagram (0 to 200 acres)	A 26

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Bituminous emulsions (cationic) (1973)	304 (Metric)
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Cutback chart for bitumen seal coats (1973)	466 (Metric)
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Supply and delivery of residual bitumen (1977)	337 (Metric)
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Supply and laying of asphaltic concrete (1975)	612 (Metric)
Supply and laying of dense graded tar plant mix (1975)	954 (Metric)
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Supply of prepared cutback bitumen for sealing purposes (1966)	740
Supply and delivery of cover aggregate for sealing and resealing with bitumen (1975)	351 (Metric)
Tar for plant mix, supply and delivery (1976)	870 (Metric)

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Chain wire guard fencing—erection (1974)	144 (Metric) SD 149
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Corrugated steel guard rail—supply—(1976)	SD 5595
Corrugated steel guard rail—erection (1976)	680 (Metric) SD 5829
Corrugated steel guard rail—anchor plates (1976)	SD 6264
Corrugated steel guard rail—steel posts (1976)	SD 6277
Delineators for attachment to guard rails (1976)	SD 6280
Drawings: Sheep fence (1974)	SD 494
Rabbit-proof fence (1974)	SD 498
Cattle fence (1974)	SD 1705
Floodgate (1974)	SD 316
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Post and wire fencing (1974)	141 (Metric)
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Standard mass concrete retaining wall (1959)	A 4934
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General conditions of contract, Council contract (1976)	24B
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MANUALS *

Manuals, No. 1—Plant; No. 3—Materials; No. 4—Roadside Trees; No. 5—Explosives; No. 6—Bridge Maintenance; No. 7—Road Maintenance.

D.M.R. BOOKLETS

Guide to Main Roads Administration.
Duties of a Superintending Officer.

N.A.A.S.R.A. BOOKLETS

Guide to Publications and Policy of N.A.A.S.R.A.
List of current publications.

All standards may be purchased from the Plan Room at the Department's Head Office, 309 Castlereagh Street, Sydney. Single copies are free to Councils except those marked*. A charge will be made for sets of standards.

47009A D. WEST, GOVERNMENT PRINTER, NEW SOUTH WALES—1978