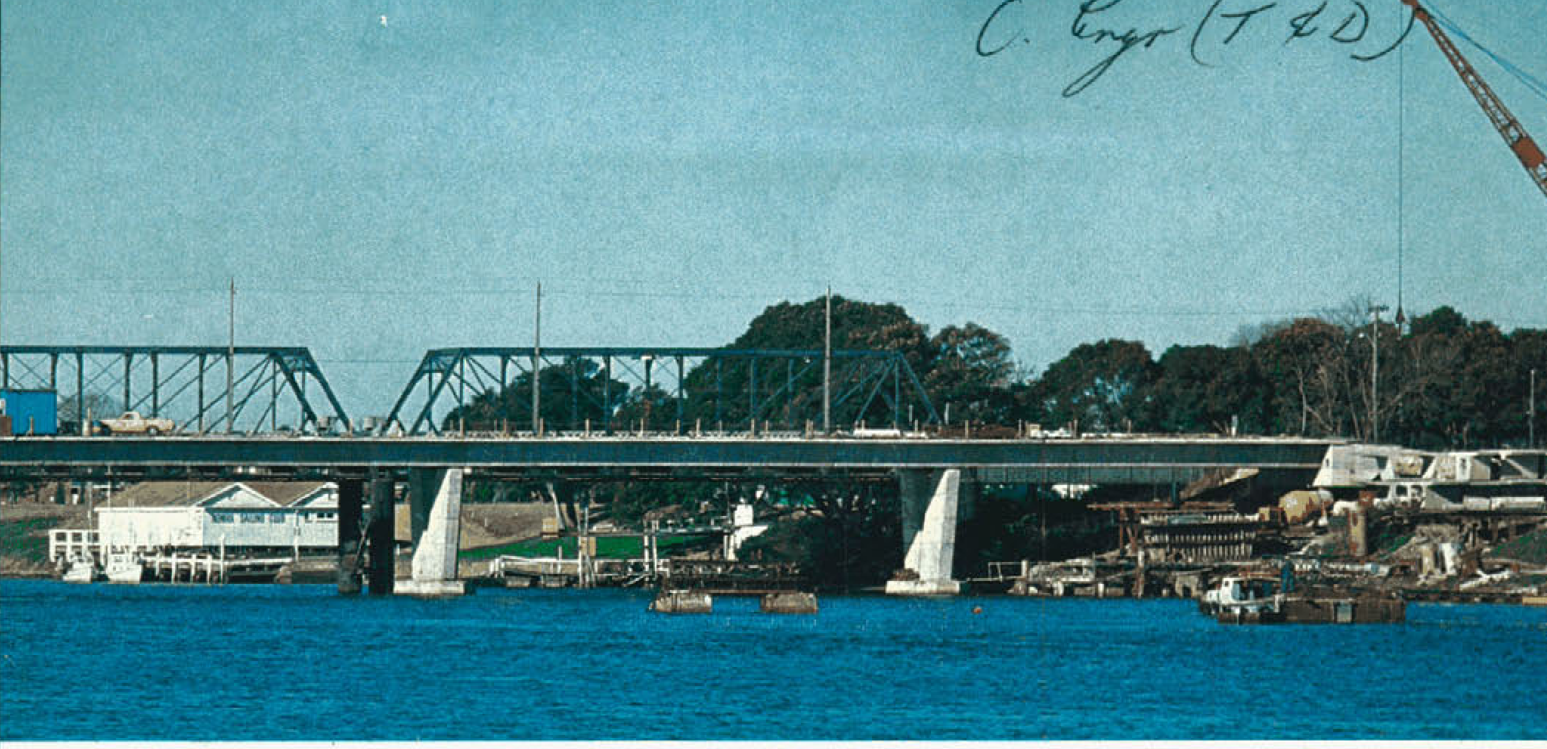
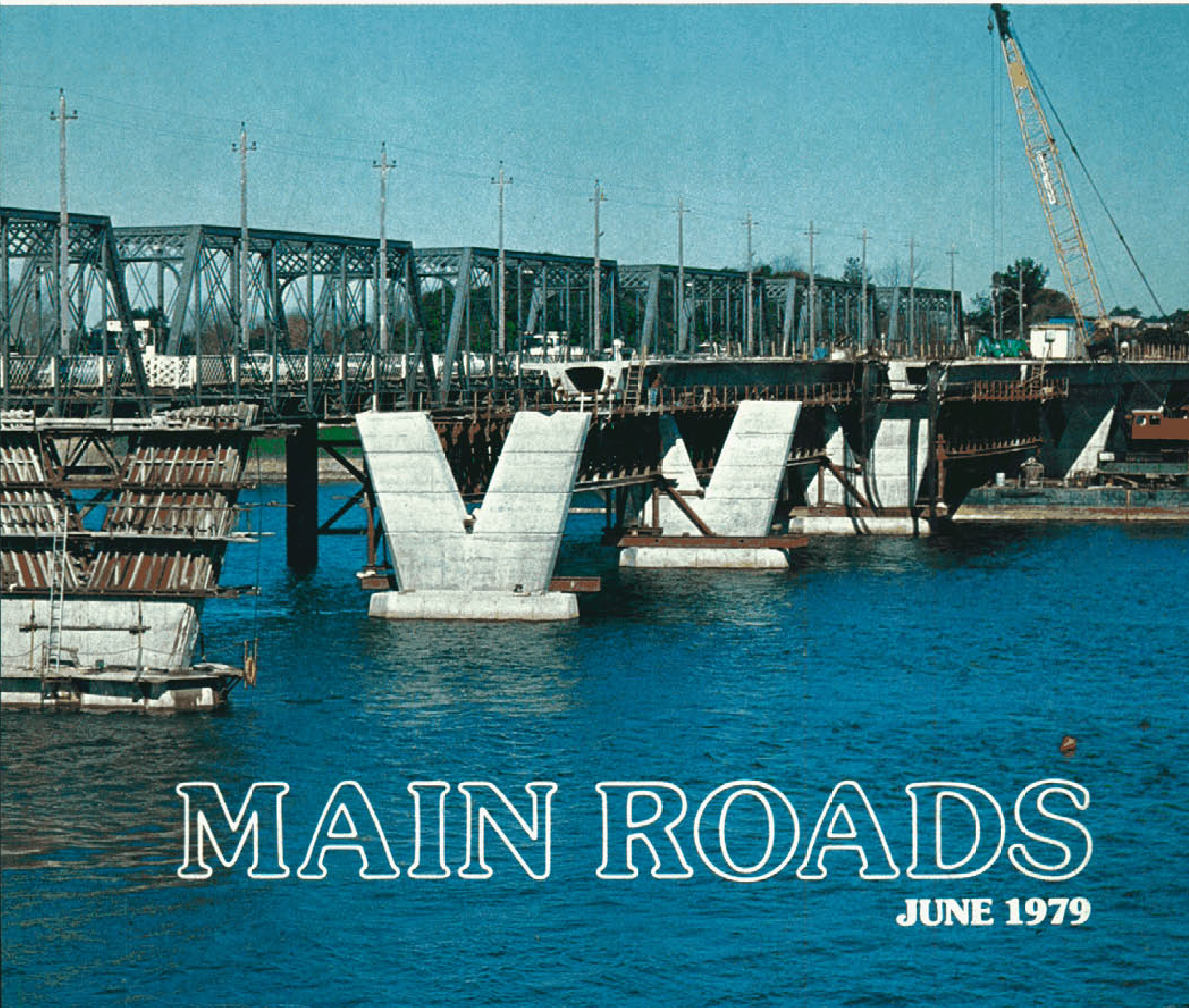
C. Engr (T&D)





MAIN ROADS

JUNE 1979

Aerial view looking south towards Nowra, showing construction of the new bridge over the Shoalhaven River in April 1979

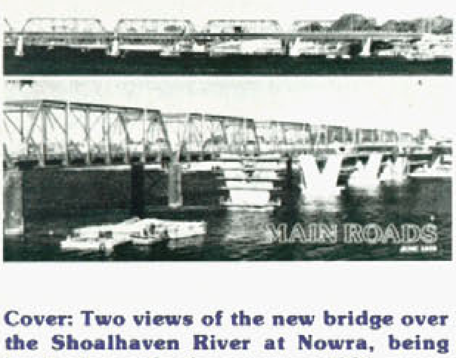
MAIN ROADS

JOURNAL OF THE DEPARTMENT OF MAIN ROADS, NEW SOUTH WALES

JUNE 1979 VOLUME 44 No. 4

ISSN 0025-0597

CONTENTS



Cover: Two views of the new bridge over the Shoalhaven River at Nowra, being built alongside the existing 1881 structure. (See feature article on pp.98-106).

FIRST TO LAST

Ten years ago on 21 July 1969, U.S. astronaut, Neil Armstrong became the first man on the moon when he stepped off the ladder of the Apollo 11 spacecraft onto the lunar surface.

In this issue, we repeat (on p. 125) the observation that the flight by Armstrong, together with Edwin Aldrin and Michael Collins was roughly equivalent, in distance if nothing else, to a trip over every road and street in Australia. Considering the condition of some of those roads, you'll probably agree that, for all its hazards, their journey would be more comfortable (and certainly faster) than having to ride over every road link across the length and breadth of our vast continent. Our "down-to-earth" problems in improving journeys across the varied landscape of our State are still as formidable as NASA's were ten years ago — and we don't have the dollars they did!

While taking giant leaps, unfurling flags and collecting samples of moonstones, the astronauts certainly looked impressive in their shiny silver suits — a special case of "First up — best dressed". Our *firsts* are less spectacular but on pp. 120-124 we've mentioned some of them relating to bridge building.

Although most of us have been urged since childhood to strive to be No. 1, being first is not really so important. To *endure* is equally, if not more, noteworthy. Construction of a steel truss bridge at Nowra was commenced 100 years ago in July 1879, completed 20 months later, and is still going strong as a *lasting* link across the Shoalhaven River (see p. 98).

This journal itself has an *enduring* quality about it. It's been going since September 1929 and has recorded the activities of the Department for almost fifty years.

The last item in each issue is usually the rather dull, unattractive lists of tenders accepted for road and bridge works over $20,000. This is not a very appealing feature but nonetheless it is a very helpful and informative reference (both for today's readers and tomorrow's researchers) of what's going on where and for how much.

The works included in these lists over the years add up to a vast range of construction and maintenance projects in all of which, from first to last, we've endeavoured to do our best. In many, we've also tried to be *first* with new techniques, but more importantly we have set out to ensure that all our roads and bridges have the quality and capacity to *last*.●

PRICE Fifty cents

ANNUAL SUBSCRIPTION
Two Dollars Post Free

Editors may use information contained in this Journal unless specially indicated to the contrary, provided the exact reference thereto is quoted

Issued quarterly by the Commissioner for Main Roads
B. J. Sexton

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

Typeset by Keyset Phototype Pty. Ltd.

Printed by Blake and Hargreaves Pty. Ltd.

NEW BRIDGES AND DEVIATION AT NOWRA

The important south coast town of Nowra is situated on a wide, picturesque stretch of the Shoalhaven River. Originally Nowra was confined to the southern bank of the river and Bomaderry to the northern bank. However, both towns have grown rapidly over the past decades and, though separated by the river, have virtually become one community. The overall population is now over 17,000, distributed roughly 70:30 between the southern and northern parts.

The Princes Highway crosses the river by a narrow two-lane bridge built in 1881. It is a steel truss structure 340 m long and only 5.8 m wide between kerbs. South of the bridge, the Highway passes through the commercial centre of Nowra, via Kinghorne Street. With numerous cross streets, two right-angle turns and conflicting traffic movements, this section of the Highway is often congested.

Four peaks and long queues

The commercial, industrial and civic activities of the towns are well distributed. For example, on the northern side, there is the Nowra railway terminal, as well as the two largest industries (i.e. paper manufacture and dairying). On the southern side, there is the main commercial centre and most of the State and local government offices as well as large new industrial areas. This results in constant high volumes of local traffic across a narrow bridge. During week-days, there are four daily traffic peaks; morning and evening, and two in the middle of the day, during lunch time.

As well as *local* traffic, there is an appreciable volume of *through* traffic. Overall traffic has been increasing steadily over the years and the average daily traffic volume would now be of the order of 23,000 vehicles. The movement of through traffic during peak periods is hampered by an influx of local vehicles from the side roads, the limitations of the bridge and the congestion in the commercial centre. During school holiday periods, conditions can become chaotic and queues over a kilometre long on each side of the bridge are common.

These delays have long been a source of frustration for motorists and a matter for concern both to the Department and local organisations, particularly the Shoalhaven Shire Council. Proposals for improving these conditions have been under consideration for many years but implementation has been delayed by lack of funds.

Seeking a solution

So the problem was basically two-fold. Firstly, to increase the capacity of the river crossing and, secondly, to reduce congestion and consequent delays by improving conditions for Highway traffic passing through the township.

The solution was likewise two-fold. Firstly, to build a duplicate bridge, with an improved northern approach and, secondly, to build a 3.6 km long deviation to take through traffic away from the busy commercial centre of Nowra. By judicious planning the Department has managed to co-ordinate these two projects and thereby bring maximum benefits to road-users.

The work south of the river, known generally as the East Street Deviation, has been planned for many years. It deviates from the present Highway immediately south of the bridge to join East Street, which parallels the present route through the town centre.

From the southern end of East Street, the new route again deviates to rejoin the Highway south of the town at Browns Creek, where a new two cell box culvert is to be constructed.

Although dual carriageways are proposed ultimately, the initial construction will provide dual carriageways from the Shoalhaven River to Plunkett Street, then a four lane road to Kalandar Street, and two lanes with shoulders from Kalandar Street to the Highway. North of the river, the Highway is being upgraded as far as Bolong Road.

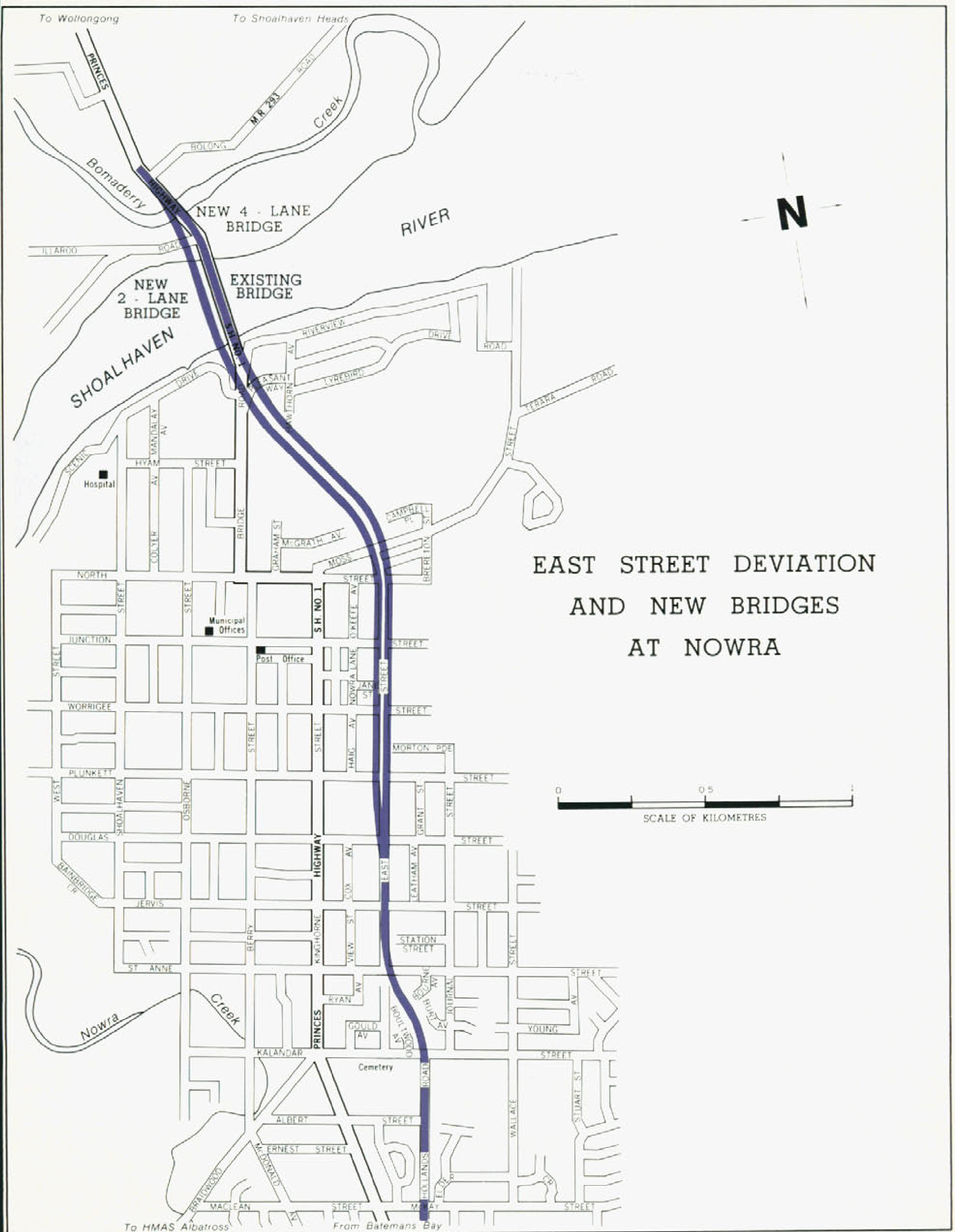
This work involves a new six lane bridge over Bomaderry Creek and the improvement to the intersections with Illaroo Road and Bolong Road.

Choosing a location

The central feature of the whole scheme is the proposed new bridge over the river. It is being constructed alongside and immediately upstream of the existing bridge, and will carry all northbound traffic, while the existing bridge will carry all southbound traffic. Whereas the existing bridge is a steel truss bridge, the new bridge will be a prestressed concrete girder bridge supported on distinctive V-shaped piers.

The existing bridge, despite its 98 years, is in reasonably good condition, except for its deck. On completion of the new bridge, the old one will be closed temporarily to traffic and redecked. Following this, it will be used to carry southbound traffic for many years to come.

Eventually, the original bridge will have to be replaced and obviously, the present site would be ideal for its replacement. However, due to predicted traffic build-up


EAST STREET DEVIATION
AND NEW BRIDGES
AT NOWRA
To Wollongong
To Shoalhaven Heads
NEW 4 - LANE BRIDGE
EXISTING BRIDGE
NEW 2 - LANE BRIDGE
SHOALHAVEN
RIVER
Bomaderry Creek
Nowra Creek
Hospital
Municipal Offices
Post Office
Cemetery
SCALE OF KILOMETRES
To HMAS Albatross
From Batemans Bay

to have one half of the crossing capacity out of action during demolition and new construction. Therefore it is probable that when the time comes the new bridge will be sited upstream of the one now being built. The latter will then have its traffic flow reversed, i.e. from northbound to southbound. But, this is looking a long way into the future.

Nevertheless, the planning outlined above will no doubt require some approach adjustments. This contingency has been taken into account in the present scheme so that any future disturbance to the roads each side of the river will be relatively minor. Furthermore, as mentioned below, the possible later change from north to southbound traffic flow and subsequent movement of the footway has been considered in the design of the new bridge.

New bridge design

The new Shoalhaven River bridge has been designed by the Department's own Bridge Design staff. The superstructure consists of twin prestressed concrete hollow box girders. The top flanges of the girders, and an *in situ* concrete strip between them, form the deck surface. The girder/deck components will be supported by eight V-shaped piers and spill through abutments at each end of the bridge.

The clean-lined simplicity of the new bridge will be in sharp contrast to the visual complexity of the century-old steel truss structure, which will remain alongside it for some time. As is so often the case when bridges are duplicated or replaced, the result is a contrast in styles which well illustrates the engineering progress achieved in this field in the intervening years.

The bridge now being built will be 360 m long, 19 m more than the present one, and over water for virtually its total length. It will have six central spans of 38.5 m, a northern span of 31.6 m and spans at the southern end measuring 31.6 m and 24.7 m. All piers and both abutments will be supported on piles founded on rock.

The northern abutment is located on top of a steep bank and is set approximately 15 m behind the existing abutment. The southern abutment is located on a low, gently sloping bank, approximately in line with the existing abutment.

The 38.5 m spans were determined by lining up the piers of the new bridge with

Perspective sketch of section of the new bridge at Nowra.

the piers of the existing bridge, both for reasons of appearance and safer navigation. The shorter spans at the ends were determined by the abutment positions and the need for reasonable proportions between adjoining spans for a continuous superstructure.

The bridge width provides for a two-lane carriageway and a footway on the upstream side. Clearance under the new bridge will be approximately the same as that under the existing bridge. Due to the different types of superstructure, the deck level of the new bridge will be approximately 1 m higher than the existing structure.

As mentioned above, there is a long-term possibility of this bridge being converted from northbound to southbound carriageway and the footway moved from upstream to downstream. Consequently, the design has taken account of the necessary adjustments to the barriers. In addition, a two-way crossfall, with an offset crown, has been adopted as it best meets the requirements of both cases.

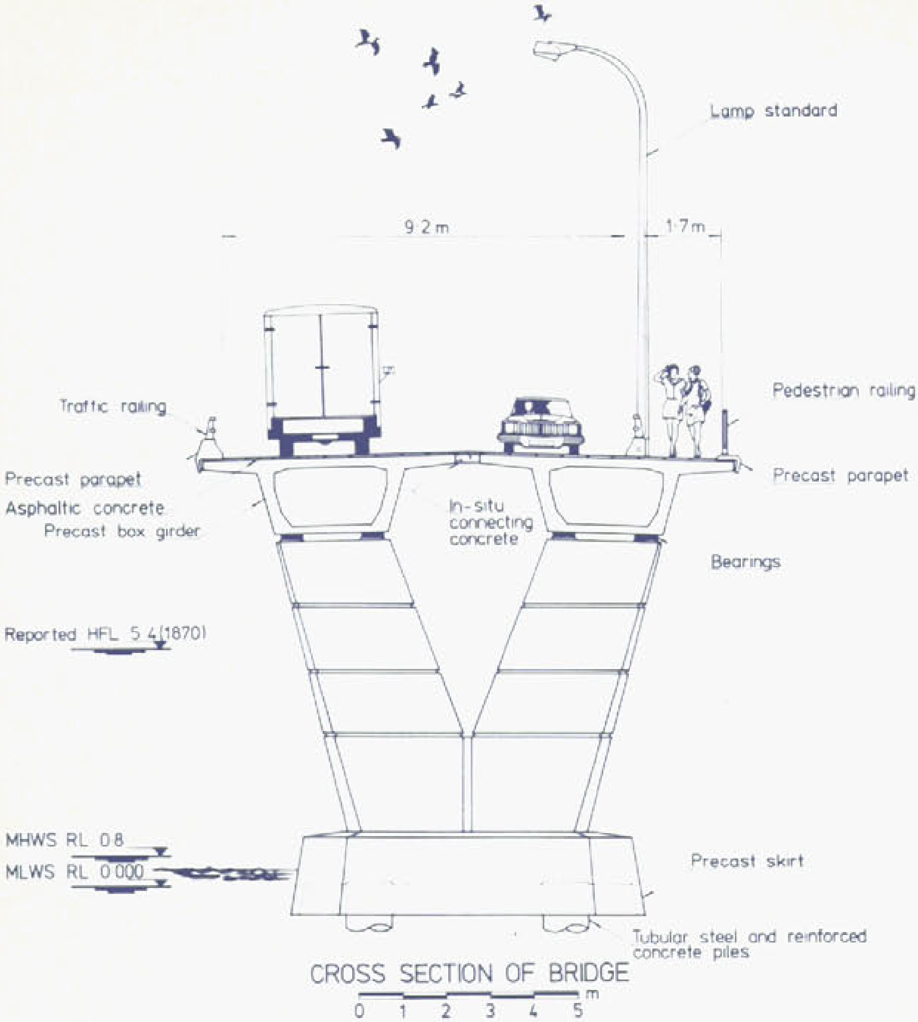
Apart from carrying pedestrian and vehicular traffic, the bridge will provide a crossing for a large number of public utility services. Small ducts for power and telephone cables will be carried inside the box girders. The larger water, sewerage and gas mains will be suspended between the two girders.

Foundation problems

The northern bank of the river immediately upstream of the existing bridge is composed largely of sandstone cliffs. Foundation drilling along the line of the bridge indicated that the sandstone dipped steeply from the bank in a southerly direction to a maximum depth of 53 m below the river bed level at midstream. Thereafter it rose slowly t a depth of approximately 40 m at the southern bank. The sandstone is overlai by mud and silt with occasional boulders and buried timbers.

At the northern bank and under the mai channel, there is some shelving in the sandstone. At the northern abutment position, a seismic survey was carried ou to find the reason for major differences in rock levels between nearby adjacent bores. The survey indicated a deep narrow gully running into the river just downstream of the abutment position. This had been filled over the years with various wastes and filling and was no longer visible.

The bed of the river consists of soft sand and silt susceptible to scour. Scour hole



up to 4 m deep occur around the 1.5 m and 2.1 m diameter cylinders of the existing bridge piers.

A recent survey was carried out for the Shoalhaven Shire Council on flooding in the Lower Shoalhaven River. This indicated that the river is generally silting up from some distance upstream of the town to its mouth. Over the past four years, silting up to 1.3 m deep has been measured over the southern half of the crossing. Scouring up to 1.7 m deep has been measured in the vicinity of the main river channel near the northern bank.

Pile design

The abutments and piers of the new structure will be supported on piles founded on rock. Piles of the two different types, however, have been found necessary due to the variable conditions and the depths to the rock. All the piles are 1050 mm in diameter.

Because of the appreciable depths to rock, tubular steel piles driven to refusal in rock have been specified for most of the foundations. Such piles have been used for Piers 2 to 9 (i.e. numbered from north to south) and for the southern abutment. They vary in length from 43 m to 55 m. Their tops will be filled with reinforced concrete to increase the bending capacity of the piles and also to provide a major connection to the pier base.

Cast-in-place reinforced concrete piles have been adopted for the northern abutment and Pier 1. This type of pile was specified to comply with the configuration of the rock at the northern bank and at Pier 1 because of the shallow depth of river mud overlying the rock.

Pier piles

Each of the nine piers will be supported on four raked piles. The pile layouts for all of the piers are identical and consist of two rows of two piles, spaced 4.5 m tranversely and 2.0 m longitudinally at the pile cap level. The piles will have a very small rake (1 in 20) in the longitudinal direction to reduce the size of the pile caps while maintaining the minimum spacing for maximum support at the critical levels in the silt and sand.

The pile design allows for the existing bed levels to scour to a depth of 6 m. The piles have been designed for an equivalent point of fixity 6 m below the scoured bed level. The depth to fixity has been determined from U.S. Navy design charts assuming poor fixing qualities for the soft silt and sand.

The same depth to fixity has been adopted for all the driven pier piles in spite of the variable water depths. This allows for any shifting of the main channel across the river bed and also for possible dredging of a central navigation channel, a possibility suggested by the Maritime Services Board. Both are unlikely, but this decision simplifies the design and there is little extra cost.

Steel plate 12 mm thick is specified for all of the piles. Reinforced toe sections 25 mm thick are required to withstand heavy driving forces. Allowance has also been made for corrosion losses. This varies from 2 mm at a considerable depth below river bed level (after 100 years) to 6 mm in the salt water below the "splash zone". In the "splash zone" (which ranges from just above high water level to just below low water level), a general loss of up to 10 mm can be expected because of greater interaction between the water, air and metal. Pitting would increase this loss and accordingly complete loss of steel has been allowed for. The steel tube has therefore not been anchored to the pile cap and the top of the pile has been designed as a reinforced column.

The reinforced concrete section of each pile is 18 m long and extends a minimum of 2 m below the design point of fixity. Below this point the steel casing itself has a considerable capacity to cope with any residual bending. The reinforcing steel at the top of the pile extends into the pile cap and consists of forty-two 32 mm bars, in bundles of three. Below the "splash zone", the reinforcement is curtailed in steps of 14 bars. The concrete portions of the piles are designed as spiral reinforced columns because of the confinement provided by the steel casing.

To check the validity of the pile design, the specification requires lateral test loading of a number of piles. The tests consist of jacking apart pairs of piles before construction of the pile caps. Pile deformation is measured for several cycles of incremental loadings and the results compared with the design calculations.

The Pier 1 piles, although appearing to be similar to the tops of the others, are, in fact, cast-in-place reinforced concrete piles with permanent steel casings. Because of the shallow overburden, these piles will be socketed into sound rock a minimum of 1 m. The contract lengths of the piles are 14 m but, based on six rock cores taken at the site, these could easily vary from 10 to 14 m. There may be shelving of the sandstone at this location. To avoid any likelihood of piles being founded on a shelf near a vertical face, the piling at each pier must be carried out in a specific order. The contract documents also make provision for rock coring at the pile toes, both inside and outside the tubes.

Permanent steel casings identical to the driven tubular piles and including the reinforced toes, have been specified for the piles for Pier 1. Some form of casing is required for the concreting of the piles as they pass through water. Apart from the benefits of uniformity, the use of the 12 mm casing has allowed the concrete piles to be designed as spiral reinforced columns without the use of very heavy spiral reinforcement. The longitudinal reinforcement extends for the full length of each of these piles and is identical to that at the tops of the concrete sections of the piles supporting the other piers.

Abutment piles

At the northern end of the bridge, a narrow peninsula of rock forms the river bank and separates the river from the filled-in-gully. The abutment location just clips the buried face of this rock. Because of the possibility of encountering sloping faces of rock and because of shelving in the sandstone, vertical cast-in-place piles were considered the only practical foundation for this abutment.

The abutment will be supported on four 1050 mm diameter piles. The design length of the piles is 18 m and they will be embedded for the full length. No permanent casing has been specified for the piles and only nominal rock sockets of 200 mm depth are required.

The southern abutment is on almost level ground at the top of the southern bank and will be supported on three driven tubular piles 48 m long. The piles will project 2 m above the natural surface to the elevated headstocks. The top 12 m of each is to be filled with reinforced concrete. The piles will be raked at 1 in 6, the two outer piles towards the river and the central one away. The head of the central pile will be offset 0.8 m from those of the outer piles.

Pier design

Because of the prominent location of the new bridge, it was considered that it should be of striking appearance. This will be achieved through the distinctive design of the piers.

The bold 'V' shape for the piers was determined by the Department's Principal Architect in conjuction with design engineers in the Bridge Section. Each leg of the 'V' will support a box girder through two bearings. The resulting pile caps are appreciably smaller than would have been the case for vertical columns.

The grooves in the pier column are designed to break up the large surface areas and to conceal the construction joints.

The lower edges of the pilecaps are just above low tide level so that casting of the concrete can be done between tides. To conceal the tops of the piles at low tide, precast skirting units form the sides of the pilecaps and project 0.7 m below them.

The abutments

The abutments themselves are of identical design and will consist of headstocks with rear walls which retain the embankment fill opposite the ends of the girders. The overall height of the abutments, excluding the railing and parapets will be 3 m. The northern abutment will be partly in excavation, whereas the southern abutment will be elevated 2 m, with the embankment fill spilling under the headstock. Wingwalls are being provided at the ends of the abutments.

Each box girder will be supported off the headstock by two bearings. The abutments will also provide restricted access into the girders through their ends and will accommodate facilities for draining the deck joints, which run between the ends of the superstructure and the rear walls.

Transversely, the abutments will be quite stiff compared to the piers. To avoid transverse loads on the piers being transferred to the abutments through the continuous superstructure, the abutments will allow the superstructure to move up to 25 mm transversely without restraint.

Superstructure

The overall width of 12.4 m provides for a 9.2 m two-lane carriageway and a 1.75 m footway. Steel traffic railing mounted on modified "New Jersey" parapets will flank the carriageway and a steel grille type pedestrian railing will be provided on the outside of the footway.

The bridge will be lit from a single line of lamp standards mounted on the parapet immediately behind the railings. Both the carriageway and the footway wi be paved with 50 mm thick asphaltic concrete.

The superstructure will consist basically of two trapezoidal concrete box girders of constant depth. These box girders, including 1.2 m cantilevers at the top slab, are to be precast in short segments The girders will be formed by stressing the segments together, longitudinally, by four tendons placed in ducts cast into the webs. A cast-in-place slab 0.55 m wide wi connect the two girders.

The superstructure will be continuous fo the full length of the bridge and anchore at the central pier. Construction of each girder will be carried out in ten stages, commencing with a 1¼ span length at th southern end. It will proceed thereafter in whole span lengths, maintaining the ¼ span cantilever until the end span, where the final stage will be a ¾ span length. The prestressing tendons of each stage will be coupled to the already stressed tendons of the previous stage, all at the one vertical faces.

The girders

The girders will be divided into 454 separate segments and all but 20 of these will be precast. The segments are to be generally 2.21 m long and their mass will vary from 13.5 to 25 tonnes. The only segments to be cast-in-place wi be the trailing-end segments of each construction stage, where large *block-outs* are required to accommodat the tendon couplers. The two girders wil be identical, except for the projecting reinforcement required for the connecting slabs and the parapets.

There will be six different types of segments with each having the same external dimensions. The boxes are reinforced transversely for all local effects. The segments will be 1.7 m deep with a bottom slab width of 2.6 m and a top slab width of 5.8 m. The top slab thickness will vary between 200 and 300 mm and the bottom slab will be 180 mm thick.

The web thickness for the majority of segments will be 300 mm. An increased thickness of 700 mm will be required for the end segments of each stage, to accommodate the tendon anchorages and couplers. The segments on each side of these and the pier segments will have an intermediate web thickness of 500 mm.

The segments over the piers and abutments are to be 1.27 m long and will be solid, except for 950 x 1200 mm access holes. There will be no cross girders between the longitudinal girders, either at the piers or the abutments. At the abutments, the deck slab will be thickened to accommodate the deck joint and provide edge stiffening.

Stressing tendons

Each girder is to be stressed longitudinally by four tendons, in ducts cast inside the webs of the segments. When assembled in the bridge, the segments will be joined by 110 mm wide cast-in-place joints. These will be poured after the ducting has been made continuous across the gaps. These joints will not be reinforced and will be recessed 10 mm on the outside face to give them prominence and to hide minor misalignment of adjoining segments. The ducts will be 118 mm in diameter.

The tendon profiles within the webs consist of a series of parabolas. Generally, there will be two per span; a long sag curve in the midspan section and a short crest curve over the piers, with common tangent points 2.4 m each side of the piers. The tendons range in the plane of the web centrelines and will be spaced 200 mm apart vertically, except in the vicinity of each stressing point where the tendons will be much further apart to accommodate the large individual anchorage plates. Transition in profile, in both plan and elevation will take place over two segment lengths and will generally involve reversed S-curves. The minimum tendon curvature will be 14.5 m radius.

Each tendon will consist of forty-two 12.5 mm diameter low relaxation strands. The jacking force for each tendon is to be 6030 kN. The maximum calculated friction loss for any stage is 196 kN. Because of the use of couplers, all stressing will be from one end. Simultaneous stressing of two tendons per girder, one in each web, is specified.

Following stressing of each stage, the ducts will be grouted and the falsework removed.

Construction of the approaches to the bridge over Bomaderry Creek as at April 1979. The new bridge being built over the Shoalhaven River can be seen in the background.

The specified strength of the girder and joint concrete is 40 MPa at 28 days, but a transfer strength of 32 MPa for the joints and all segments, other than the anchorage segments, is specified.

There is no restriction on the order of construction of the two girders. However, once the two girders have been connected by the cast-in-place slab, construction of one girder ahead of the other will be limited to a maximum of two stages. This prevents temperature effects from twisting the superstructure on the bearings.

Partial prestressing

One problem associated with the method of construction outlined above is the longitudinal and vertical movement of the cantilever due to temperature variations. To overcome this, partial prestressing of the girders between 12 and 24 hours of casting the closing joint has been specified. The concrete strength at this age is to be 5 MPa. This requirement means concrete curing, setting and stressing should take place between late afternoon and early morning, when the temperature is comparatively stable.

Internal access

Access into the completed girders is required for maintenance inspections and also for work on the public utility services which the bridge will carry. This access will be provided through the ends of the girders at the abutments and through manholes in the bottom slabs of the girders at five intermediate locations. These manholes will be located in areas of relatively low stress, some distance from the piers.

Bearings

The girders will be supported at the piers and abutments on bearings under each web. Fixed bearings are to be provided at the anchor pier (Pier 5) while the rest are all to be expansion bearings. Each of these latter bearings will be a confined elastomer "pot" bearing, which has a stainless steel surface sliding on a PTFE sheet. Rotation will be controlled by a piston cylinder arrangement which will confine the rubber at high stresses. Horizontal forces will be resisted by steel runner bars.

During all stages of construction, each girder has to be fixed longitudinally at approximately its midlength. Accordingly, with construction commencing at the southern abutment temporary fixing of the bearings at Piers 9, 8, 7 and 6 will be required progressively. The bearings on Pier 5 will be required to act as expansion bearings until fairly late in the construction period, when they are to be permanently fixed. These fixed bearings will be similar to the expansion bearings except that they have runner bars preventing both longitudinal and transverse movement.

The maximum vertical load on each of the pier bearings will be 2400 kN and on the abutment bearings 1100 kN. All of the bearings (except those at Pier 5) will have to accommodate longitudinal movements, due to thermal expansion and contraction, as well as shrinkage and creep of the concrete. At the abutments, where maximum movement will occur, the bearings can move ± 100 mm. All bearings will be provided with transverse restraints, although the abutment bearings will be able to ± 25 mm transversely before being restrained.

Parapets and railings

Relatively large parapets will flank the carriageway and a low parapet will be provided at the outside edge of the footway. The two outer parapets are to be provided with overhanging skirts to conceal the edges of the deck slab, which will be irregular due to construction tolerances.

Each parapet has been detailed in the drawings for both cast-in-place and precast construction. Parapets on the Department's bridges are usually cast-in-place. On this occasion, the overhanging outside skirts, and the need to allow for the possible removal of the central parapet in the future, made precasting an economic proposition. The central parapet will be precast solid and bolted to the deck slab. The other parapets are to be precast, with blockouts to receive projecting reinforcement from the girder segments.

The traffic railing will consist of hollow rectangular steel rails welded to posts fabricated from steel plates. The railing is to be fabricated in lengths up to 10 m, and joints between lengths will consist o pinned sleeve connections. The pedestrian railing will be a steel grille consisting of hollow rectangular rails anc 24 mm diameter solid rounds as balusters.

Deck expansion joints

Since the superstructure of the bridge is continuous, the only deck expansion joints will be at the abutments. These will allow movement of ± 100 mm at each abutment and will accommodate therma expansion and contraction, as well as shrinkage and creep of the concrete.

The expansion joint will be between the moving ends of the superstructure and the rear walls of the abutments. A proprietory joint, consisting of a steel comb set in synthetic rubber, has been specified. Although the joint is not an "open" one, it will, nevertheless, not be waterproof and there will be a synthetic rubber drainage gutter below the joint.

Materials

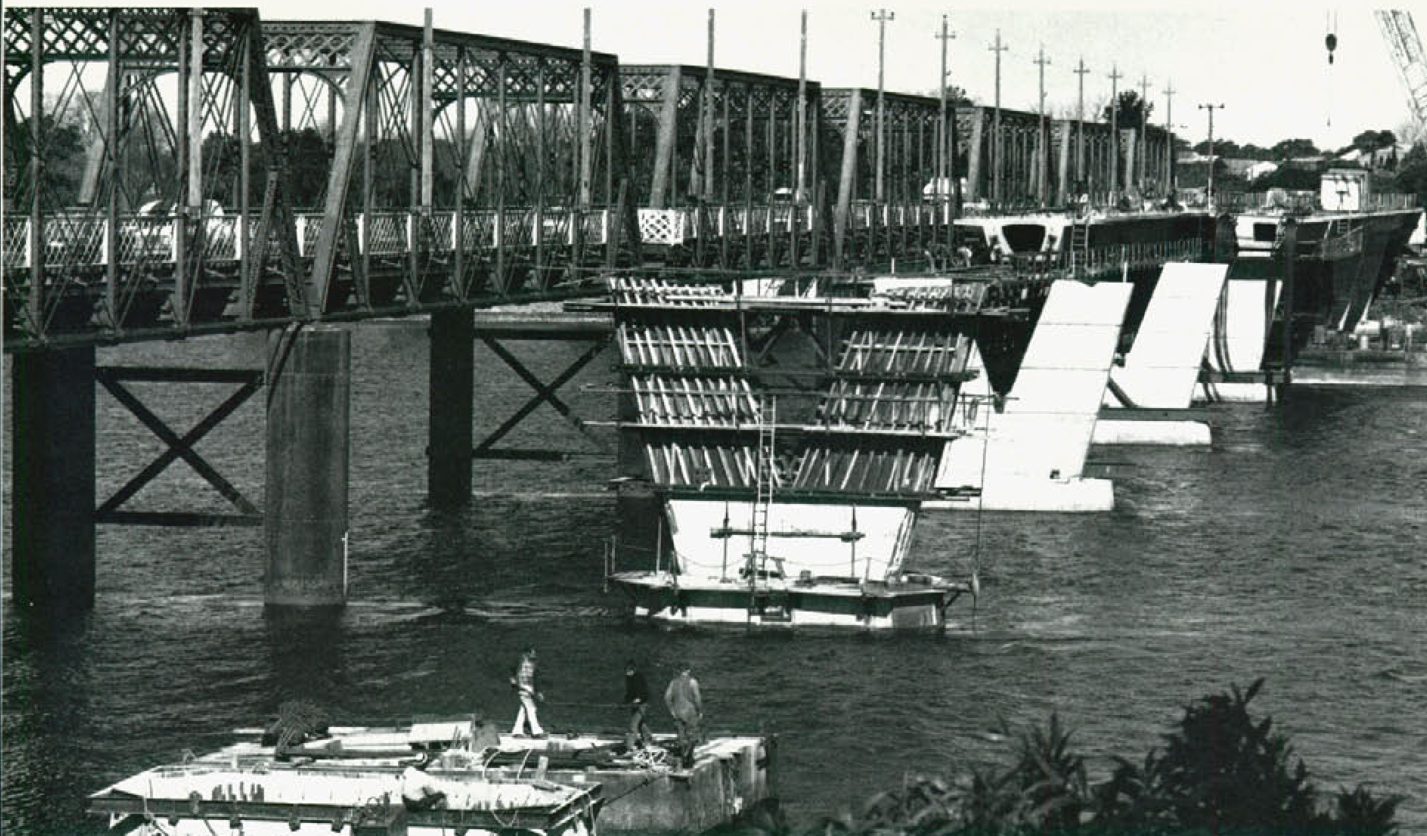
The approximate quantities of materials to be used in the construction of the bridge are:

Cast-in-place piles	72 m
Driver tubular steel piles	1770 m
Concrete Class 40 MPa in girders	2130 m
All other concrete including piles	1620 m
Reinforcing steel	700 tonn
Prestressing tendons	94 tonn

On with the job

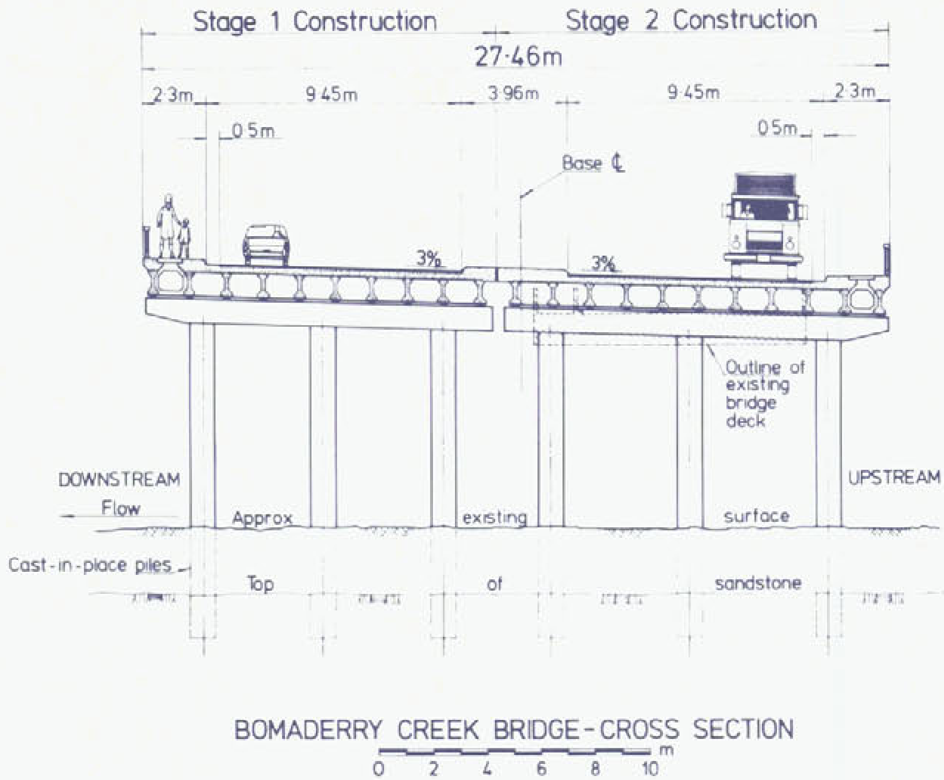
The construction of the new bridge over Shoalhaven River is well advanced and the construction of the bridge over Bomaderry Creek, as well as the roadworks has also been commenced. The deviation of the Highway should be completed early in 1981. The total estimated cost of the deviation including the two new bridges is $6.2 million.

A contract in the amount of $2,645,000 was awarded on 17 November 1977 to the firm of Codelpha and Codgefar Pty Ltd for the construction of the new bridge. Construction of the bridge is expected to be completed early in 1980.



The distinctive V-shaped piers will be an attractive feature of the new bridge and will give added impact to riverside views at this picturesque location.

Traffic congestion often occurs along the Princes Highway as it passes through Nowra, but soon the new East Street deviation will remove through traffic from the main commercial centre.



BOMADERRY CREEK BRIDGE-CROSS SECTION

New bridge over Bomaderry Creek

The existing two-lane bridge over the Princes Highway at Bomaderry Creek was built in 1902 and has a timber deck supported on timber piers and masonry abutments. This structure is not suitable for widening and is being replaced by a concrete structure. The new bridge will be 47.6 m long, with spans of 14.5 m, 17 m, and 14.5 m. The overall width of the bridge will be 27.5 m and it will have two carriageways of two-lanes each, a 4 m wide median and footways on both sides.

The new bridge will be built in two halves because its location overlaps that of the existing bridge. The cross-section of the existing bridge deck relative to the new bridge can be seen on page 106. The two halves of the new bridge are being made completely independent of each other. The downstream half is being built first and after the road approaches to it have been built, traffic will be allowed onto it and the present bridge closed. The existing bridge will then be demolished and the second half of the new structure will be constructed.

The superstructure of the new bridge will consist of precast concrete I-girders made composite with a reinforced concrete deck slab. The girders will be made continuous for live load through reinforced concrete cross girders at the piers. The girders are to be 0.9 m deep and will be pretensioned with either twelve or nineteen 15.2 mm diameter strands, which follow draped profiles.

The relatively close 1.34 m spacing of the girders will permit the use of compressed asbestos cement sheeting as the permanent formwork for the deck slab. Reinforced concrete cross girders will be provided at the piers and abutments. The superstructure will be supported on elastomeric pad bearings.

This new bridge will also have to carry a large number of public utility services. These will be accommodated mainly under the footways with a few minor ducts through the kerbs. In order to give access to these services from the bridge deck, removable precast slabs, in lieu of the continuous reinforced concrete deck slab are provided between the outside pairs of girders.

The piers and abutments will consist of simple headstocks supported by cast-in-place concrete piles. The piles will be 0.9 m diameter and are to be socketed 1 to 2 metres into sound sandstone rock. The rock slopes steeply along the length of the new bridge and the pile lengths will therefore vary from 10 m to 27 m (at the northern end). These piles will have permanent steel casings and they are to be vertical, with the exception of four abutment piles which are to be raked at 1 to 6. The design pile load is 225 tonnes.

On 13 January 1979, a contract in the amount of $523,758 was awarded to the firm, Citra Constructions Pty Ltd, for the construction of the bridge. Both carriageways of the bridge are expected to be in service by mid-1980. ●

An article on the existing bridge at Nowra, together with some paintings of the bridge, and other scenes around the town by Samuel Elyard, appeared in the September 1971 issue of "Main Roads" (Vol. 37, No. 2, pp. 18-22 and back cover).

A colour photograph of a scale model of the bridge at Nowra appeared on page 114 of the June 1978 issue (Vol. 43, No. 4).

LIME STABILISATION
— A Special Application

In the interests of economy the practice of road building makes use of naturally occurring materials from within or adjacent to the project where possible.

However, naturally occurring materials can be, and often are, deficient in important physical and structural properties which are necessary to provide a sound, stable base for the upper layers of the road pavement.

To improve the natural materials along the route of the F5 — South Western Freeway, the top layer of the locally available shale and sandstone used in the earthworks was stabilised with lime.

The F5

Freeway construction around Sydney in more recent years has been concentrated on the F5 — South Western Freeway, which will form part of the national highway linking Melbourne with Sydney.

The F5 will extend from the planned F6 — Southern Freeway at Tempe in a westerly direction to The Cross Roads near Liverpool. It then turns south west and proceeds past Campbelltown, Menangle and Douglas Park towards Mittagong.

Sections of the F5 have been progressively opened to traffic since October 1973 providing two lengths, from The Cross Roads to Camden Road (near Campbelltown), 15.6 km long, and from Yanderra to Aylmerton, 13.5 km long. Construction of the intermediate link, 35 km long, between Camden Road and Yanderra is in progress.

The lengths of the F5 on which lime stabilisation has been used are between Camden Road and Yanderra and between Yanderra and Aylmerton.

The age old problems

Most people are aware, at least in a visual sense, of the effects of moisture changes on naturally occurring materials such as soils. Clays, partially decomposed rock and even shales and other rocks of similar origin, which are quite hard and strong when dry, can become soft and weak when wet, as well as being difficult, if not impossible, to compact. Shrinkage and swelling induced by moisture changes also cause disruption.

In designing the thickness and composition of road pavements, it is assumed that the preconceived conditions of compaction and moisture in the underlying materials or subgrade, as well as in the pavement layers, will be achieved in the actual construction.

If wet weather persists, however, during the crucial periods when the embankment or pavement layers being placed are still unprotected, the work may be severely inhibited by the need to dry out before proceeding (particularly if water has penetrated into lower layers). In freeway type construction, involving major items of mechanical equipment and a substantial work force, delays of this kind can be very costly.

There is also the problem of infiltration of water through the pavement both during and after completion. Unfortunately, while an impermeable surface is aimed for, in reality the possibility of some water penetration is far from remote. Indeed, some of the surfacing systems once thought to be relatively impermeable are now recognised as being quite porous.

This 8 tonne hopper-spreader, drawn by a tractor, delivers the lime to the subgrade at a uniform spreading rate.

Water which penetrates the surface can be expected to gravitate until it is effectively dissipated or until it reaches a relatively impermeable layer. If this water does not evaporate or is not able to drain away, a "perched water table" can be cumulated. Moreover, if this layer should consist of a material which softens readily when wet, such as a clay subgrade, a weakened plane develops and the performance of the pavement may fall short of expectations.

Counter measures

To overcome some of the moisture induced problems, it is customary, where subgrade materials which weaken when wet are encountered, to consider incorporating a "working platform" to facilitate the resumption of work after rain and to provide a firm foundation on which to build the pavement.

To counter the effects of infiltration, porosity and subsequent weakening of "water susceptible" subgrades, an impermeable layer is included. This layer is composed of material not affected much by water and protects the subgrade from avoidable moisture, thereby minimising the total pavement thickness required. This "watershed" allows any water which does penetrate to drain away.

Multiple advantages

A "working platform" may consist of better quality material superimposed on the subgrade, or it may sometimes be provided by stabilising, in-situ, the top layer of the existing subgrade. In this regard, stabilisation of locally abundant but relatively poor quality materials is a technique which can be used to conserve the more valuable materials and thereby save on road construction costs.

Stabilisation may also be the most effective way of achieving the sound impermeable layer being sought after as a "watershed". Rationally then, stabilisation of the top layer of the subgrade may perform the dual purpose of a "working platform". There are other advantages which may be exploited, in that a subgrade layer so treated is sometimes regarded as a pavement layer and thus may make a significant contribution to the stiffness of the pavement if that is desired.

A further advantage of subgrade stabilisation is that it may offer more versatility in the choice of pavement materials. For example, the presence of a stabilised subgrade may permit the use in the pavement of porous materials such as macadams, which are usually compacted with the aid of excess water. It may also lessen the traditional problem of clay migrating from the subgrade and overfilling the voids in a macadam, thus avoiding the consequent loss of stability and subsequent distortion.

The use of subgrade stabilisation in the construction of the F5 provides a good example of the application of these philosophies of working platforms, rational pavement composition and the economic utilisation of materials.

Two views of one of the Department's Fowler-Rex pulvimixers. This machine mixes the lime into the natural material, prior to watering and compaction.

Choosing the additive

On the particular sections of the F5 where stabilisation has been employed, the embankment and subgrade layers largely consist of shales and sandstones which are quite variable and not renowned for their wet strength capabilities. However, these particular materials have been found to respond well to stabilisation with lime.

Quicklime (calcium oxide) was adopted as being generally the most effective and economical additive. In wet conditions, quicklime will draw water from the soil and thus accelerate the drying out process required to establish the working platform. On the other hand, if the work is undertaken in dry conditions, water is readily available to slake the quicklime and this is more economical than hauling in the heavier hydrated lime (calcium hydroxide). Laboratory testing indicated that the optimum proportion of quicklime was about 2% by mass for the sandstone and between 3% and 4% for the shales.

Construction procedures

The surface of the layer to be stabilised and consolidated to a specified thickness must be accurately trimmed. On most of the F5 work to date, this layer thickness is specified as 150 mm. If the surface level is too high, then stabilised material must be cut to waste. This is not only extravagant, but also reduces the thickness of stabilised layer remaining. If the surface level is too low, then additional imported pavement material is required to overcome the deficiency. This again is costly.

Compaction is critical both in degree and time. F5 Specifications called for 100% of standard compaction to be achieved within 24 hours of mixing. To fulfil this requirement, close control of the moisture content and careful selection of compaction equipment was necessary.

Unless the required moisture content was maintained the target compaction could not be achieved.

Should density not be achieved, then it may be necessary to rip up the stabilised material in order to adjust the moisture content. However, this can seriously damage stabilised layers by breaking up aggregations formed by the pozzolanic and flocculation actions of the lime and this in turn causes strength reduction and increases in permeability. These are both undesirable.

In the F5 pavement design, the layer stabilised was the top of the earthworks. This layer was stabilised for the full width of the formation (12.8 m) with subsoil drains constructed along both edges.

Level controls were established at 25 m intervals and on both sides of the formation, allowing string lines to be used to check both the shape and finished level of the completed stabilised surface. These were also used to carry out checks regarding the depth of mixing during operations.

In order to speed up the mixing and as

A water tanker hydrating lime on a section of the F5 — South Western Freeway

an aid to obtaining uniform distribution of the lime, the formation was tyned up as the first operation in the process. This was done using graders with rear mounted multiple shank rippers. The length chosen was based on the mixing and compaction capability of the plant. A normal day's operation covered 400 m of full width carriageway, which required some 35 tonnes of quicklime.

The lime was delivered in bulk tankers and pneumatically transferred to a drawn 10.5 tonne capacity hopper spreader. This spreader was capable of laying the lime uniformly in widths of between 0.3 m and 2.4 m, in 0.3 m increments. The rate of spread was essentially independent of the speed of the spreader unit. Spread rates were checked by weighing trays of known area laid in the path of the spreader.

Slaking of the spread quicklime was achieved using 13 500 litre water tankers fitted with pressurised distribution bars. The cloud of steam generated during the hydration process was somewhat disconcerting to the casual observer.

Mixing on the F5 was achieved using either Rex SPDM or Bomag MPH100 stabilising units. These machines travel at speeds of 1-2 km / h and mix to a width of 2.3 m and 2.0 m respectively. Generally three passes are necessary to achieve the degree of mixing specified. Both machines were equipped with facilities to incorporate water while mixing and great care was taken in this regard to ensure that correct moisture content for compaction was maintained.

The compaction fleet consisted of a static weight tamping foot roller (such as a Hyster 450B), followed by a smooth drum vibrating roller (such as a Raygo 600). For final rolling, 20 tonne multi wheel rubber tyred rollers were used.

Safety precautions

Quicklime, or hydrated lime for that matter, can cause irritation or burns to the skin and safety measures are necessary. Precautionary actions include the use of pressurised cabs for the operators of mixers, or full face respirators where these cabs are not available. Disposable nose masks are used by others working near the lime.

First aid facilities on site must include plentiful supplies of water in order to wash lime dust quickly off the skin.

The benefits

From the point of view of the construction team, the most obvious benefit which has accrued has been the ability to maintain the flow of work, particularly after rain. For the travelling public, it means that construction times can usually be kept within the programmed dates.

The performance of these stabilised layers to date has been up to expectations and the use of this technique is now an accepted part in the total freeway construction programme.●

Recent articles on the F5 have appeared in the June 1977 (Vol. 42, No. 4) and September 1976 (Vol. 42, No. 1) issue of "Main Roads".

An article on Stabilisation on the Newell Highway, north of Moree, appeared in the March 1978 issue, (Vol. 43, No. 3, pp. 74-79).

Lime stabilisation on F5. Information on this process and on the equipment used is presented in the preceding article.

A BACKWA

Above Left: A recent aerial view of the bridge over the Tweed River
Pacific Highway, north of Murwillumbah. This steel and concrete
spans and a bascule lift span, and was opened on 11 July 1936. It i
coastal crossings designed and built by the Department in this er

Left: Two views of the construction of the bridge to carry the Pacif
Hawkesbury River at Peats Ferry. The top scene shows the second
floated into position in June 1944. The lower photograph shows t
in its initial coat of pink primer, not long before the official openi
1945.

Both of these views were taken from the Department's own 16 mm colour sound r
the bridge. A copy of the film is in the Department's Film Library and loans can be
Relations Section.

Two paintings of our more recent bridge building styles appear inside the back cov

GLANCE AT YESTERDAY'S
IDGE STYLES

In our last issue and on pages 120 to 124 of this issue, we've been reminiscing about the role of the Department's Bridge Section over the last fifty years. Here are some examples of the *craft* of our bridge designers. Although they don't have the slim lines of today's structures, they were, nevertheless, very important achievements in their time.

Left: This bridge over Cockle Creek at Bobbin Head is in an attractive setting within Ku-ring-gai Chase National Park. Opened on 1 September 1956, it is noteworthy as the first prestressed concrete bridge superstructure designed by the Department.

Below: The Spit Bridge, which crosses Sydney's beautiful Middle Harbour, was completed on 19 November 1958. It features an electrically operated single-leaf bascule lift span, seen here as it opens to allow a yacht to pass.

t on the
truss
similar

he
s being
lendent
n 5 May

ing of
Public

Operations were commenced at the Department's modern complex at Lane Cove in May 1974.

NORTH METROPOLITAN WORKS OFFICE

Prior to 1974, construction and maintenance of Main Roads throughout the Department's Metropolitan Division were carried out by the Metropolitan Construction Office and the Metropolitan Maintenance Office. Both of these offices were based in Berry Street, Granville adjacent to and near where the Central Workshop, Central Asphalt Depot and Supply Section are now.

Following a decision to decentralise operations into two areas, generally north and south of Sydney Harbour, the North Metropolitan and South Metropolitan Works Offices were established.

The former began operations in May 1974 at a newly built complex at Lane Cove. The second continued to operate from Granville, until moving to Rockdale in February 1978. These locations were chosen to place the Works headquarters roughly central to their areas of responsibility, and so achieve greater flexibility and efficiency.

Each office assumed responsibility for both road construction and road maintenance in its particular area. On 1 July 1976 the responsibility for traffic signals and traffic facilities was transferred to them from the Department of Motor Transport (D.M.T.). The responsibility for bridge maintenance still rests with the Metropolitan Bridge Maintenance Office at Annandale, except in the case of Sydney Harbour Bridge, which is the responsibility of a separate maintenance office, located in the Bridge's south west pylon.

This article outlines the work of the North Metropolitan Works Office and an article in our next issue will similarly describe the operations of the South Metropolitan Works Office.

Building buildings

The North Metropolitan Works Office complex is situated at 710 Mowbray Road (West) Lane Cove not far from its junction with Epping Road (Main Road No. 373). The site is on the edge of a well developed residential area and overlooks bushland beside the Lane Cove River to the north.

An article on the location, design, construction and landscaping of the main office — laboratory and other buildings in this complex has already been published in the December 1974 issue of "Main Roads" (Vol. 40, No. 2, p. 61).

Following the transfer of D.M.T. personnel to this office, it was necessary for an existing garage building to be modified to accommodate Traffic Facilities crews. The petrol, oil and lubricant store also had to be extended and an additional open store building and a new building to accommodate the Signals Organisation were erected. It has also been necessary to extend the car park to cater for the extra personnel now operating from this Works Office.

The plans for the new Signals Building — mentioned above (which incorporates air-conditioned office space, a meal room for shift crews and undercover parking for the signal vehicles) were prepared by Departmental Architectural Officers and the building constructed by contract at a cost of approximately $106,000.

Currently, two Traffic Facilities crews still operate from the Department of Motor Transport premises at Five Dock. Investigations are in hand to purchase a site and develop a new sub-depot in this locality. At Warriewood Sub-depot, a new building has been erected to accommodate two Traffic Facilities crews which operate in that area.

Organisation overview

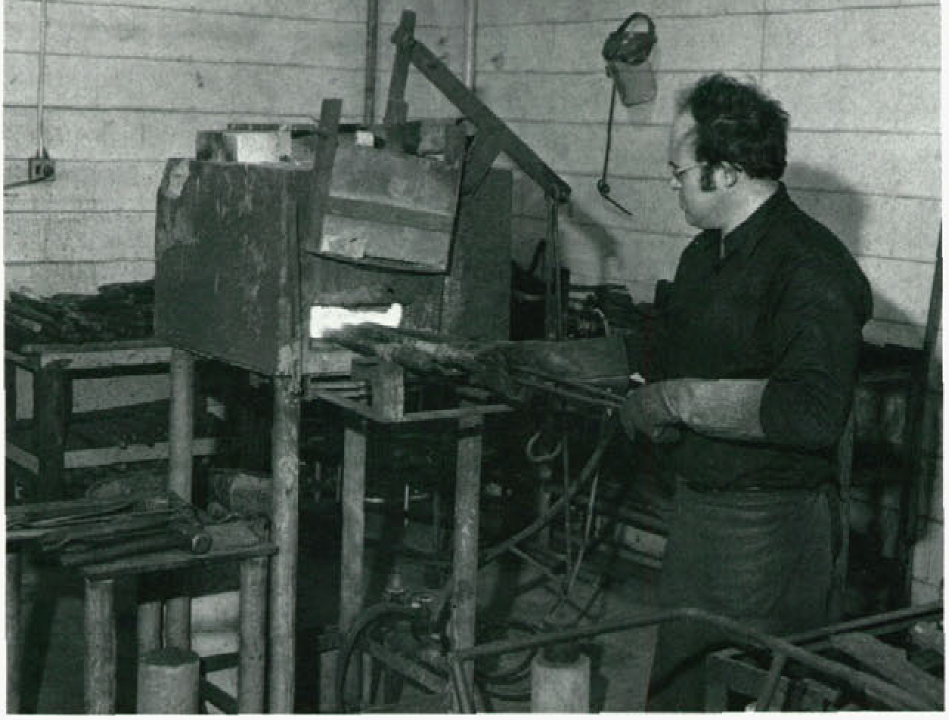
The North Metropolitan Works Office is a diversified organisation which is built on the skills techniques and procedures inherited from the previous Metropolitan Construction and Maintenance Offices and the Department of Motor Transport. It is dedicated to maintaining a high level of service for all road-users through its road maintenance, road construction and traffic management programmes. These programmes are implemented by the various works groups described below.

But first, here is an overall view of the numbers of groups of personnel.

Engineering and clerical supervision is provided by six engineers, one cost clerk, sixteen clerks, two office assistants, one switchboard operator and five stenographers. The store (holding stock to the value of $515,000) is operated by three storemen.

The total organisational strength is usually about 475, made up as follows:

Engineers	6
Clerks and typists	22
Foremen	11
Traffic Supervisors	4
Supervising technicians	2
Men	381
Lorry owner drivers (average number)	32
Hired plant operators	20



The blacksmith's role in the community has diminished considerably with the introduction of new technology and techniques, but there is still a real need in the work of the Department for a modern "smithy".
One of two blacksmiths employed at the North Metropolitan Works Office is pictured here working with a gas fired forge on jackpick points.

A passage sensing device used in traffic signals being taken from the stock of supplies and replacement equipment held in the store.

To undertake all necessary road maintenance operations, two foremen control eleven gangers, one field assistant, 65 men, eleven contract trucks and four Departmental trucks operating from sub-depots at Gore Hill and Warriewood.

This maintenance work extends over,

- Multi-lane Heavily Trafficked Roads — 75 km
- Bradfield Highway (Sydney Harbour Bridge) and Freeways — 77 km
- Two-lane Heavily Trafficked Roads — 48 km
- Two-lane Lightly Trafficked Roads — 31 km

Total 161 km

The work of these groups has the prime objectives of controlling the rate of deterioration and maintaining a high level of serviceability and safety. The tasks undertaken consist of —

- Routine Maintenance of Concrete Pavements: including . . .
  - Slab Replacements
  - Slab stabilisation by mudjacking
  - Asphaltic concrete overlays
- Routine Maintenance of Flexible Pavements: including . . .
  - ★ Pavement patching
  - ★ Pavement resheeting
- Maintenance of Roadsides: including . . .
  - ★ Shoulder maintenance and resheeting
  - Roadside drainage
  - ★ Repair and replacement of Road Furnishings, such as guardrails
  - Embankment stabilisation

Maintenance of medians, freeway environs and vacant land

Operating from the North Metropolitan Works Office one foreman controls four gangers, 22 men and six contract trucks in the maintenance of medians on multi-lane roads, the landscaped environs of the Cahill Expressway and the Gladesville Bridge Complex as well as vacant land acquired for future roadworks. This foreman also controls one ganger, six men and one contract truck operating from the garage at the north pylon of the Sydney Harbour Bridge, in the maintenance of the landscaped environs of the Warringah Freeway.

Road construction

For road construction projects, three foremen control a workforce consisting of seven gangers, ten leading hand tradesmen, 21 tradesmen, three field assistants, 103 men, 15 contract trucks, and 170 major plant items (both Departmental and Contract). One foreman with five leading hand tradesmen, 13 tradesmen and 26 men are also engaged exclusively on property adjustment works and retaining walls associated with major roadworks.

The roadworks undertaken range from large scale construction to provide six traffic lanes, to the provision of additional lanes at intersections to implement new traffic management arrangements. The property adjustment tasks consist of the building of high class property walls, driveways, the adjustment to or rebuilding of garages and the restoration of gardens and lawns. An article describing the work done on Ryde Road — Mona Vale Road appeared in the June 1976 issue of "Main Roads" (Vol. 41, No. 4, pp. 107-111).

Tradesmen from this group also undertake depot maintenance works and the maintenance of road furnishings including major directional signs. They also manufacture and maintain office furniture and fittings and fit out new vehicles for the Traffic Management Group.

A concrete precasting yard at the North Metropolitan Works Office produces gully pit lids, temporary median kerbs, batter drainage units, barrier weights, and median kerb gully inlets with grill and wall cappings, for use on construction and maintenance works.

Traffic management

The traffic management organisation consists of:

- The Sydney Harbour Bridge Tow Trucks comprising one foreman, four traffic supervisors, 20 drivers, 24 attendants and eight trucks. This group provides tidal flow arrangements on the Sydney Harbour Bridge and on Gladesville, Iron Cove and Spit Bridges, as well as on Sydney Road at Balgowlah, Military Road at Neutral Bay, Miller Street at Cammeray and Longueville Road at Lane Cove.

  During off-peak periods, this group also provides traffic layouts for some road maintenance operations, pavement testing operations and at some works in progress. It also provides a towing service on the Sydney Harbour Bridge and its immediate approaches. At present, the towing service is provided seven days a week between 5.00 a.m. and 8.00 p.m. This is soon to be extended to provide a 24-hour towing service seven days per week.
- The Traffic Signals Group, based at North Metropolitan Works Office consists of one supervising technician, eleven technicians, eleven technician's assistants, one field assistant and three labourers. This group is engaged on the maintenance of traffic signals, repairs to damaged signals, minor reconstruction and the co-ordination of traffic signals.
- The Traffic Signals Construction Gang consists of one supervising technician (who also supervises contract signal installations), two technicians, two technician's assistants, one ganger and six labourers. This gang is engaged on major signal reconstructions and some direct control signal installations.
- Nine Traffic Facility Crews, operate from the North Metropolitan Works Office (five), Warriewood Sub-depot (two) and Five Dock Motor Registry Office (two). As mentioned above, a new sub-depot is to be provided in Five Dock soon. These crews are under the control of two foremen and have a total strength of nine leading hand painters, eleven painters and one field assistant. These crews erect and maintain all regulatory signs, information and warning signs, and provide and maintain regulatory road markings.
- A signwriter is employed full time on the maintenance and production of regulatory traffic signs.
- The Major Directional Signposting Gang consists of a leading hand tradesman and two labourers with a specially fitted Departmental truck. They undertake the erection of major directional signs and currently operate under the direction of one of the road construction foremen.

Maintenance of plant items

A "services group" is responsible for the maintenance and repair of the Department's many plant items and motor vehicles. The group has two centres — at Lane Cove and Milsons Point.

Firstly at the workshop at the North Metropolitan Works Office there is one foreman, one leading hand plant mechanic, five plant mechanics, one plant ganger, two field assistants and one labourer. This team services and maintains 156 major plant items and 72 motor vehicles and trucks attached to the Office. A contract fuel truck servicing Departmental plant also operates under the control of the Plant Foreman.

Secondly, at the garage situated in the base of the north pylon of the Sydney Harbour Bridge, there is a team of one foreman, one leading hand plant mechanic, three plant mechanics, one plant operator, two field assistants, two labourers. This group services and maintains five plant items, and 12 trucks and motor vehicles attached to the Landscaping Organisation at Yennora and the Sydney Harbour Bridge Tow Truck Organisation. This group also services 15 plant items, and 78 trucks and vehicles attached to the Sydney Harbour Bridge Maintenance Office, the Traffic Counter Workshop, Materials and Research Laboratory, and the Metropolitan Divisional Office.

A team of three street sweepers also operate from the North Pylon Garage. These operate at night and cover the whole of the Metropolitan and Parramatta Divisions. The team consists of one ganger and five sweeper operators.

Emergency arrangements

To cater for road emergencies which occur outside normal working hours, a "call-out" gang, drawn from the Road Maintenance Group at Gore Hill, is placed on standby on a weekly rostered basis. This gang is contacted by the Department's Emergency Centre at 1 Oxford Street, City in the first instance and then responds to the particular emergency. If the gang cannot handle the problem, the next officer in a set priority order from foreman through to works engineer, is contacted by the "call-out" ganger.

The gang consists of a ganger, two men and a contract truck with a trailer which is fitted out and used exclusively for emergencies. This gang can handle most situations which arise. However, when additional men or machines are required, these are contacted from lists which are included in an emergency folder. This folder also contains details of procedures to be followed in the event of road blockages and oil spills; the current location of plant, equipment and materials; contacts for obtaining cranes urgently; names and telephone numbers of appropriate personnel in each Council area, etc.

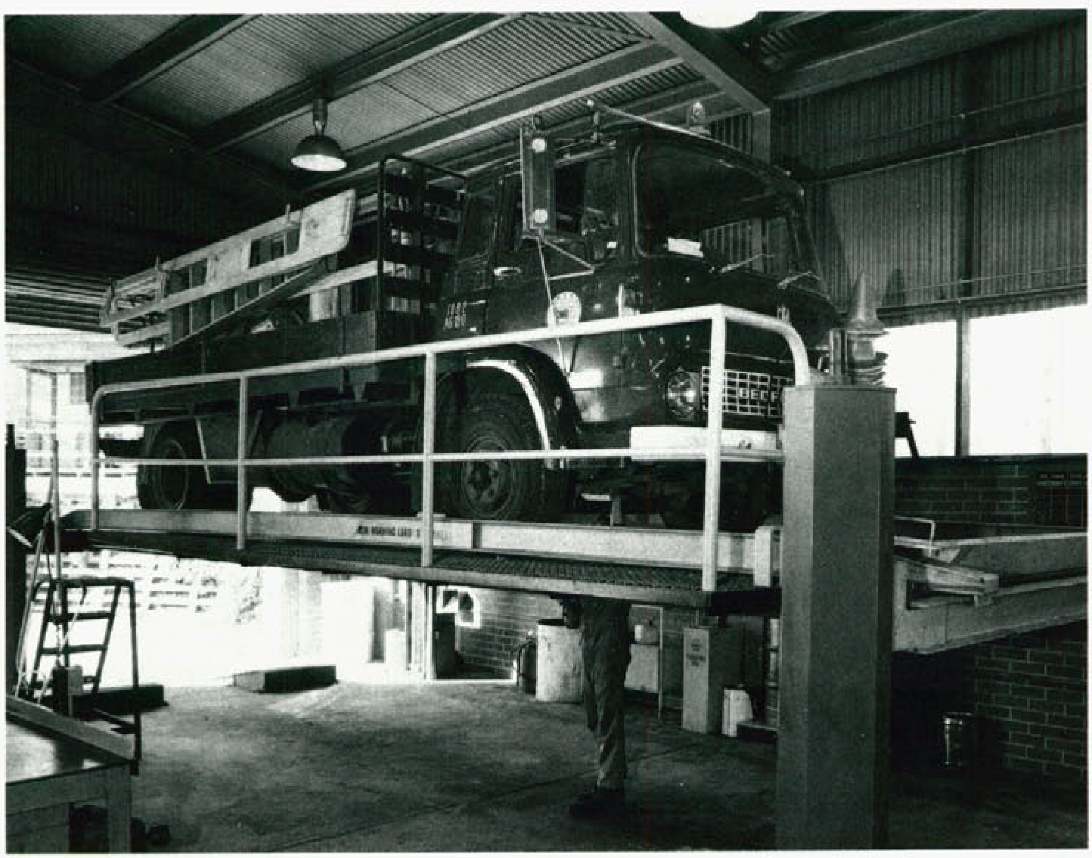
To cater for traffic signal faults, an Emergency Signal Maintenance Crew is available 24 hours a day and responds to calls from officers of the Department, police and the public regarding signal faults. This crew consists of one technician and one technician's assistant using a panel van fitted out with all the necessary material and equipment. If the Crew has difficulty with a particular fault, it can contact the supervising technician or engineer by radio telephone to seek advice.

Contract works

A number of contract works are supervised from the North Metropolitan Works Office. These include such works as road markings, erection of guardrails, erection of buildings, erosion control, etc.

Range of responsibility: The Works Office at Lane Cove undertakes tasks throughout the Municipalities of Ashfield, Drummoyne, Hunters Hill, Ku-ring-gai, Lane Cove, Leichhardt, Manly, Mosman, North Sydney and Willoughby; and in the Shire of Warringah. The roads maintained by this Office, and on which major roadworks are undertaken, are . . .

- F1 — Warringah Freeway — from Lavender St. Milsons Point to Willoughby Rd, Naremburn.
- F3 — North Western Freeway — Gladesville Bridge Complex. (See under Main Road No. 165 below).
- F6 — Western Distributor — from Grosvenor St. to Day St.
- F7 — Cahill Expressway — from Bradfield Highway to Sir John Young Crescent.
- Bradfield Highway, Sydney Harbour Bridge (Roadway).
- State Highway No. 2 — Hume Highway — within Ashfield Municipality.
- State Highway No. 5 — Great Western Highway — from City of Sydney boundary at Mallett St. to Lucas Rd, Croydon.
- State Highway No. 10 — Pacific Highway — from Bradfield Highway, North Sydney to Abbotsleigh Rd, Wahroonga (near Pearces Corner).
- Main Road No. 162 — Ryde and Mona Vale Rds. — from De Burghs Bridge, North Ryde to Mona Vale.
- Main Road No. 164 — Military and Spit Rds. — from F1 — Warringah Freeway to Spit Bridge.
- Main Road No. 164 — Pittwater and Barrenjoey Rds. — from Narrabeen Bridge to Palm Beach.
- Main Road No. 165 — Victoria Rd. — from Bowman St., east of Glebe Island Bridge to Pittwater Rd.,



Departmental vehicles undergo routine servicing and regular mechanical checks to maintain safety and efficiency.

Construction work by North Metropolitan Works Office in progress on the widening of MR 162 — Mona Vale Road opposite the St. Ives Showground.

Gladesville (including F3 — North Western Freeway complex at Gladesville Bridge).

- Main Road No. 166 — Tarban Creek Bridge, Fig Tree Bridge, Burns Bay Rd., and Centennial Ave. — from Victoria Rd. to Epping Rd., Lane Cove.
- Main Road No. 174 — McCarrs Creek Rd — from Mona Vale Rd., Terrey Hills to McCarrs Creek.
- Main Road No. 328 — Warringah Rd. — from Pacific Highway, Chatswood to Pittwater Rd., Dee Why.
- Main Road No. 373 — Epping Rd., — from Pacific Highway at Lane Cove to Lane Cove River.
- Main Road No. 397 — Wakehurst Parkway — from Pittwater Rd. at Narrabeen to Montauban St., Seaforth.
- Main Road No. 525 — General San Martin Drive from McCarrs Creek Rd. at Terrey Hills to McCarrs Creek Rd. at McCarrs Creek.
- Main Road No. 599 — Strathallen Ave., Sailors Bay Rd and Eastern Valley Way — from Northbridge to Boundary St., Roseville.
- Tourist Road No. 4005 — West Head Rd. — from General San Martin Drive to West Head.

Annual expenditure

In 1978-79 just over $12 million was allocated for works undertaken by the North Metropolitan Works Office. This amount was allocated through the following programmes.

County of Cumberland Road Construction Programme, for works on State Highways and Main Roads — $4,881,000; County of Cumberland State Highways and Main Roads Maintenance and Improvement Programme — $1,790,000; Traffic Management Programme — $4,328,000; Sydney Harbour Bridge, Circular Quay Elevated Roadway and Warringah Freeway Approach Maintenance and Improvement Programme — $310,000; Freeways Maintenance and Improvement Programme — $227,000; County of Cumberland Maintenance of land acquired for future roadworks — $180,000; County of Cumberland Bridge Construction Programme (Approach works) — $76,000; County of Cumberland Works Offices and Sub-depots Programme — $10,000; and Property adjustments (No specific allocation but costs charged to Property Fund) — $200,000. ●

For those who may have to do business with this office, the postal address is Box 195 P.O., Lane Cove, N.S.W. 2066; the telephone number is 428-5088; and the present Works Engineer is Mr. Bob Harris

BRIDGE BUILDERS OF THE DEPARTMENT

This is the second part of a two-part feature on the work of the Department's Bridge Section. The first part appeared in the March 1979 issue of "Main Roads", (Vol. 44, No. 3, pp. 88-91).

In this part, we publish some brief biographical notes about the six officers who, over the last 50 years, have held the Section's most senior position — originally titled Bridge Engineer and now known as the Chief Engineer (Bridges).

We have also included some more illustrations and details of some of the many bridges for which they have been responsible — and which were specifically mentioned in the first part of this feature.

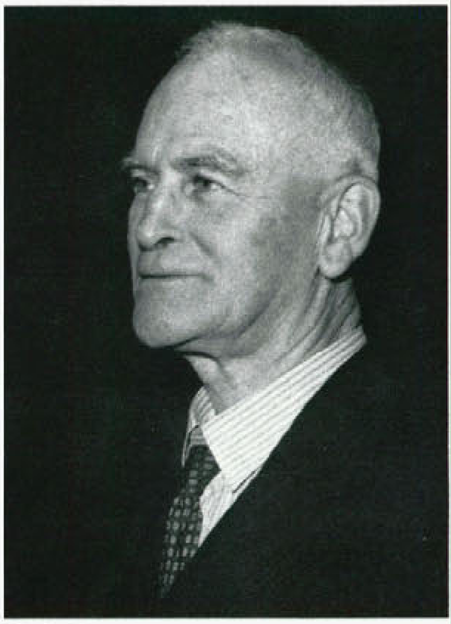
Mr. S. Dennis

Mr. Dennis was born on 4 October 1886 and educated at Fort Street School. He graduated from Sydney University, in Mechanical and Electrical Engineering in 1909.

He commenced his employment with the Department of Public Works in August 1909 as a draftsman earning £150 a year. He resigned in September 1910 to take up a position with the Queensland Water Supply Department, returning to the service of the Department of Public Works in 1913 as a Designing Engineer on the Sydney Harbour Bridge project. In 1916 he was appointed Designing Engineer of the National and Local Government Works Branch, then Supervising Engineer for Bridge Construction and later Inspecting Engineer.

In September 1928 Mr. Dennis was transferred to the Main Roads Board as Bridge Engineer.

At the time of this transfer Mr. Dennis was supervising construction of the bridge over the Georges River at Tom Uglys Point, which was being constructed by Sutherland Shire Council. He was allowed to continue this supervision after his transfer until the bridge was completed in May 1929.



Mr. S. Dennis

In 1931 Mr. Dennis was asked by the Public Service Board to sit on a committee to report upon applications for the position of Teacher of Bridge Construction, at Sydney Technical College. Along with other officers of the Department (including Mr. F. Laws), Mr. Dennis received a special bonus payment for advice given to Ryde Council in 1934 regarding construction of a bridge across the Parramatta River between Ryde and Concord.

In 1942, during World War II, Mr. Dennis was appointed as a member of the Sydney Harbour Bridge Emergency Committee. In the same year, a Central Advisory Committee and State Advisory Committee was formed to assist the Department of Labour and National Service on all matters affecting the transfer or enlistment of engineers. Mr. Dennis was nominated to give advice to the Sydney Sub-Committee.

In 1945 at the request of the Tasmanian Government, Mr. Dennis gave evidence in a court case regarding the acquisition of the bridge over the Derwent River in Hobart.

Mr. Dennis retired on 29 June 1951 and died three years later on 12 July 1954, aged 67 years.

During his service with the Department of Public Works and this Department, Mr. Dennis was associated with the design and construction of over 1,000 bridges of all types, including many large projects such as the bridge over the Georges River at Tom Uglys Point, the bridge over the Hawkesbury River at Peats Ferry and the new concrete arch built to support the old suspension bridge at Northbridge. Large bridges with which Mr. Dennis was associated and which were being built at the time of his retirement, included the bridges over the Hunter River at Hexham, over the Clyde River at Batemans Bay and the new bridge over Iron Cove, Sydney.

Mr. Dennis was a Member of the Institution of Civil Engineers (London) and an Associate Member of the Institution of Engineers, Australia. He was Chairman of the Sydney Division of the Institution in 1937-38.

Mr. Dennis' retirement was recorded in the September 1951 issue of "Main Roads" (Vol. 17, No. 1, p. 26). Mr. Dennis was the author of Journal articles on a number of bridges, including those over the Gwydir River at Gravesend (November 1929, pp. 40-2) over the Murrumbidgee River at Taemas (February 1930, pp. 117-8) and the Belmore Bridge, West Maitland (October 1930, pp. 22-5).

The Department commemorated its first Bridge Engineer by naming the new structure over the Hastings River on the Pacific Highway near Port Macquarie as the "Dennis Bridge". The Bridge was officially opened by the Hon. P. D. Hills, M.L.A., Minister for Highways on 21 December 1961. At this ceremony Mr. Dennis' son Ivan unveiled a plaque which records his father's 23 years of service as the Department's Bridge Engineer and his association with the selection of the site for this particular bridge. (See article in March 1962 issue of "Main Roads", Vol. 27, No. 3, pp. 80-4).

Mr. F. Laws

Mr. Laws was born on 13 May 1897. In World War I, he served with the 4th Engineers AIF in France.

In 1922 he graduated from Sydney University as a Bachelor of Engineering (Honours). From April 1922 to November 1926 he was employed on design work by the Metropolitan Water Sewerage and Drainage Board.

Mr. Laws commenced employment with the Main Roads Board in 29 November 1926 as Assistant Designing Engineer (Bridges) working under the Designing Engineer, Mr. H. M. Sherrard.

Early in 1930, he acted briefly while the Bridge Engineer fulfilled other commitments and in July 1930 he was reclassified as Assistant Bridge Engineer.

In December 1930 Mr. Laws presented a definitive paper on "Types of Highway Bridges" at the Local Government and Highway Engineering Branch of the Sydney Division of the Institution of Engineers, Australia. This address was reproduced in the January 1931 issue of "Main Roads" (Vol. 2, No. 5, pp. 69-78). In March 1932, he followed this up with a paper on the "Application of Timber and Concrete to Moderate Span Highway Bridges" — presented to the same audience and again recorded for posterity in "Main Roads" (Pt. 1, March 1932, pp. 100-5, and Pt. 2, April 1932, pp. 122-7).

In March 1942 Mr. Laws was appointed Acting Metropolitan Engineer and was permanently appointed to the position in December 1945. For a short period in 1942, he was sent to the Northern Territory to inspect bridge sites along the Stuart Highway.

As with Mr. Dennis, Mr. Laws was nominated in 1942 to give advice to a committee assessing the wartime transfer or enlistment of engineers.

In the mid 1940's, he was appointed as a member of the Ferries (National) Conciliation Committee.

From August 1949 to July 1951 Mr. Laws was Assistant to the Chief Engineer, and then, on the retirement of Mr. Dennis, he was appointed Bridge Engineer from 2 July 1951.

Mr. F. W. Laws

In September 1953 Mr. Laws was appointed as Assistant Chief Engineer. With the growth of the Department's activities, it was decided to appoint him as Deputy Chief Engineer in December 1957, in order that he could relieve the shoulder a greater measure of responsibility.

Mr. Laws retired on 11 May 1962. In his time with the Department, he was involved in the design of approximately 200 bridges, including the bridges at Narooma, Swansea, Raleigh, Peats Ferry and Iron Cove.

the Institution of Civil Engineers (London), an Associate Member of the Institution of Engineers (Australia), an Associate Member of the American Society of Civil Engineers, and a foundation member (in the late 1930's) of the Town and Country Planning Institute.

the author of a number of other Journal articles, including the bridge over the Wagonga Inlet at Narooma (September 1929, pp. 19-20), Crossing of the Hawkesbury River (December 1929, pp. 64-7), Maryland River and Koreelah Creek Bridges (April 1930, pp. 164-5, 167) and Hawkesbury River Ferry Docks (September 1930, pp. 10-11, 13).

Mr. A. Clinch

Mr. Clinch was born on 1 December 1898.

He gained a Bachelor of Science degree at the University of Tasmania, a Bachelor of Civil Engineering degree at the University of Melbourne, and was a Rhodes Scholar (2nd class honours) in Engineering Science at Oxford University in England.

After working as an engineer in England and in the Sudan for a number of years, Mr. Clinch returned to Australia. He was appointed to the Main Roads Board on 2 August 1928 as an Assistant Engineer at Adamstown, (Newcastle). Two months later at the end of September, he was transferred to Tamworth.

In May 1932, Mr. Clinch was transferred back to Newcastle and in August 1937 he was promoted and transferred to Bega. While at Bega he was reclassified as Supervising Engineer.

Mr. Clinch enlisted in the R.A.A.F. in January 1941 and was posted to the Administrative and Special Duties Branch. He recommenced with the Department in November 1945 as Acting Divisional Engineer at Bega and a year later he was appointed to the position of Assistant Bridge Engineer, in the Bridge Section at Head Office.

In 1949-50 Mr. Clinch spent almost six months as Acting Metropolitan Engineer. On 28 September 1953 he succeeded Mr. Laws as Bridge Engineer.

In 1954 Mr. Clinch travelled through Europe and the United States of America inspecting various types of bridge construction. His report entitled "Bridge Design, Construction and Maintenance — Overseas Practice and Developments" was published in "Main Roads" (Pt. 1, March 1955, pp. 80-90 and Pt. 2 June 1955, pp. 99-109). His address to the 1958 Annual Conference of the Local Government Engineers' Association of N.S.W. entitled "Some Aspects of Post War Bridge Design on Main Roads" was also published in "Main Roads" (June 1958, pp. 108-116).

Mr. Clinch retired from the Department on 20 December 1962 and died only recently on 24 March 1979 at the age of eighty.

The following bridges are but some of the many which were completed during his term as Bridge Engineer . . . Iron Cove (1955), Batemans Bay (1956), Karuah (1956), Liverpool (1958), The Spit (1958), Casino (1959), Forster-Tuncurry (1959), Albury (1961), Jackadgery (1961), Tempe (1962) and Silverwater (1962).

This bridge on the Clyde River at Batemans Bay was opened on 21 November 1956 and replaced the last vehicular ferry on the Princes Highway between Sydney and the Victorian border. The structure has four steel plate girder spans, five steel truss spans and one steel truss vertical lift span (see article in December 1976 issue of "Main Roads", Vol. 22, No. 2, pp. 45-6).

Mr. F. C. Cook

Mr. Cook was born on 16 November 1909. He graduated as a Bachelor of Science with Class II Honours at Sydney University in 1933. Two years later he gained a degree in Engineering.

Mr. Cook was appointed to the Department as an Assistant Engineer in the Bridge Section on 25 February 1935.

Following the outbreak of World War II, he joined the R.A.A.F. as a Pilot Officer in January 1941 and attained the rank of Squadron Leader in 1943. After his discharge, Mr. Cook rejoined the Bridge Section in 1946.

Following his rise to the classification of Engineer Class I in 1948, Mr. Cook was transferred to the Metropolitan Division as Officer-in-charge of construction of the new bridge over the Cooks River Diversion Channel (as part of the extensions to Sydney Airport). Not long after, in 1950, the contractors for the construction of a new steel truss vertical lift span bridge at Hexham asked to be relieved of their contract. Consequently in September 1950, Mr. Cook was transferred to Newcastle Division to take charge of construction of the bridge, which was completed in 1952.

Mr. Cook was again transferred to the Metropolitan Division in April 1953 and, in December of the same year, he was reclassified as a Supervising Engineer.

In February 1954, three spans of the bridge across the Richmond River at Casino were washed away in a severe flood. Mr. Cook and Mr. A. S. Middlehurst (later to become his successor as Chief Engineer (Bridges)) were sent to Casino to supervise the erection of a temporary 40 m long span of Bailey bridging and thereby restore communications. With typical determination, they had the replacement span erected and opened to traffic within 12 days of the washaway.

In June 1954 Mr. Cook was transferred back to the Bridge Section at Head Office.

In September 1956 Mr. Cook was sent overseas by the Department for three months to inspect the steelwork and machinery being manufactured in England for the new bridge over Middle Harbour at The Spit. He also inspected various types of bridges on the continent.

In November 1959 Mr. Cook was appointed as Assistant Bridge Engineer (Construction) and then, on 21 December 1962, he was promoted to the position of Bridge Engineer (the title of this position changed to Chief Engineer (Bridges) in December 1969).

Mr. Cook retired on 27 June 1974, having acted as Deputy Engineer-in-Chief, for five months in 1971.

During his period as Chief Engineer (Bridges), the construction of major bridges at the following locations was completed. In 1963 at Fig Tree; in 1964 at Gladesville and Nelligen; in 1965 at Kiah, Taren Point (Captain Cook Bridge), Raymond Terrace and Tarban Creek; in 1966 at Milperra, Ramornie, Roseville, Camellia, Harwood, Moruya, West Pymble (De Burghs Bridge); in 1967 at Bargo; in 1968 at The Entrance; in 1969 at Wentworth, Deniliquin and Dubbo; in 1971 at Stockton; in 1973 at Camden (Macarthur Bridge), Hay, Balranald and Alfords Point; and in 1974 at Telegraph Point and The Rip.

In a well deserved acknowledgement of almost forty years of service with the Department, Mr. F. C. Cook (on left) is congratulated by the then Commissioner for Main Roads, Mr. R. J. S. Thomas, following the official opening by Mr. Cook of the bridge on Newee Creek on the Pacific Highway, just north of Macksville. Mr. Cook was invited to perform the opening — on 25 June 1974 — on the eve of his retirement, as a tribute to his longstanding dedication to the Department's bridge building tasks.

Mr. Arthur Middlehurst was born on 10 January 1916. He graduated at Sydney University as a Bachelor of Engineering in 1936. On 11 January 1937, he joined the Department as an Assistant Engineer attached to the Bridge Section.

Like so many others, Mr. Middlehurst left his career to take on military duties (January 1942) and subsequently enlisted in the A.I.F. in February 1943. After the War, he returned to the Department in May 1946, again joining the Bridge Section.

By December 1953, he had become a Supervising Engineer, by October 1959 he was Assistant Designing Engineer for Bridges and by February 1965 he was Designing Engineer for Bridges.

(Bridges) on 28 June 1974 and remained at the head of the Bridge Section until his retirement on 27 May 1977. With the exception of four years on military duties, he spent his entire service with the Department — from 1937 to 1977 — in the Bridge Section.

Unfortunately, only shortly after his retirement, Mr. Middlehurst died suddenly on 28 November 1977.

In his years as Chief Engineer (Bridges), many important structures were completed, at the following sites . . . at Ellenborough in 1974; at Bega and Hartley in 1975; at Goulburn, Flemington and Braidwood in 1976; and at Menindee, Seven Hills, Yass, Wanaaring and Gundagai (the longest bridge ever built by the Department) in 1977.

Mr. Lyn Evans

Mr. Lyn Evans was born on 25 June 1918. He gained a degree in Engineering at Sydney University in 1939. On 6 February 1940 he joined the Department and was appointed to the Bridge Section as an Assistant Engineer.

From September 1942 to April 1943, Mr. Evans joined the team of Departmental officers who went to Queensland to urgently build a strategic defence road (including 33 bridges), 650 km from Duaringa to Charters Towers for the Allied Works Council.

In June 1943, he enlisted in the R.A.A.F. and was on wartime duties until he rejoined the Bridge Section in April 1946.

From June 1948 to April 1954, Mr. Evans worked in the Department's Outer Metropolitan No. 2 Division, centred at Chatswood and, after a short spell back in the Bridge Section, he went to Newcastle Divisional Office in September 1954, where he became Supervising Engineer in January 1957. Returning to the Bridge Section in February 1957, Mr. Evans became Construction Engineer, Bridges in November 1962, Assistant Bridge Engineer (Construction) in January 1963, Bridge Engineer (Operations) in December 1970, Assistant Chief Engineer (Bridges) in September 1974 and Chief Engineer (Bridges) in May 1977. •

A recent example of a modern structure designed in the Department's Bridge Section is the new bridge over the Wilson River at Telegraph Point, on the Pacific Highway between Taree and Kempsey. This beautiful 555 m long bridge was opened on 17 April 1974 and replaced a narrow structure (seen in the background), which was completed on 9 April 1902 and featured a bascule lift span (see article in June 1974 issue of "Main Roads" Vol. 39, No. 4, pp. 98-101, 114).

SHOWING OFF

Each year the Department participates as an exhibitor in Sydney's famous Royal Easter Show and a number of other local agricultural shows and trade fairs throughout the State. These shows give the Department an excellent opportunity to present to large numbers of people information about the value of better roads in general and about certain projects in particular. They are also a means whereby the Department can both affect and assess public attitudes to works which are in the embryo planning stage, about to commence, or already under construction.

In presenting a display about a specific project, the benefits to the whole community can be exhibited in detail, without the all-too-usual overtones of irrational and parochial attitudes which are so often at the centre of reports in the media, clouding information with emotion. These displays can take the form or artists' impressions or scale models of future works as well as photographs or short movie sequences of works in progress.

Over recent years, the Department has moved into a more general field of "marketing", in which we've publicised the overall benefits of roadworks much more than before. Considerable emphasis has been placed in our displays on encouraging a greater awareness of the importance of good roads to the community. Our quality of life is enhanced by our ease of mobility, and better roads contribute greatly to this enrichment. Our "centrefold" in the September 1976 issue of "Main Roads" (Vol. 42 No. 1 pp. 16-17) entitled "Roads — The Everyday Asset for Everybody" reflected the sort of message we've been *selling* to our *customers*.

It is undeniable that more community and government attention must be given to the problems posed by such things as excessive energy consumption and disturbing levels of vehicle emissions and noise pollution. The continuing challenge also faces us all to reduce the recurring roadside tragedies and needless waste caused by countless accidents that bring death and lasting injury to so many.

At the 1979 Royal Easter Show, we again drew attention in our display to some matters which are often overlooked when the topic of discussion turns to *roads*. We'd like to reproduce two of them here.

Firstly, a few comments about reductions in travelling times and secondly a look at our big (and lucky) country.

TAKING TIME OFF

"The times, they are a-changin' "

The most obvious signs of the times are the vehicles we use to transport ourselves and our goods from place to place.

Vehicles are travelling faster, with bigger loads, going further between stops and with far more comfort for the passengers.

But, just as the world's most advanced railway trains are limited by the tracks they run on, motor vehicles are restricted by road conditions.

". . . and so are our roads"

Within the limit of funds that have been made available for road construction over the last twenty years, the Department has made considerable improvements to the State's roads.

Better vehicles on better roads — together they add up to faster and safer travel.

The time you save could be your own. To the ordinary road user faster travel means less time on the road, more time for other, more rewarding, activities.

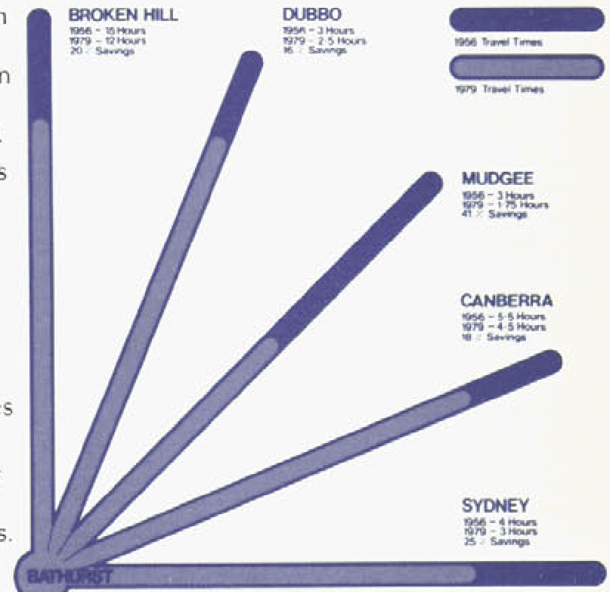
It also means savings to the whole community. A 1972 study by the Commonwealth Bureau of Transport Economics showed that each vehicle delay cost $1.47 per hour. With today's inflated costs, the figure is now nearer $3.00 per hour.

These figures add considerable meaning to the old adage that "time is money" and show that for the whole community "time saved is money saved".

A BIG COUNTRY

"Why can't we have a decent road system?"

This is a question often asked by critics of Australia's road system who compare, in an unfavourable light, our roads with



NOTE: Travel times and percentage time savings are average figures under favourable conditions

those of other countries such as Germany, France and Italy.

Anybody with some imagination, a few old maps, a paste-pot and a pair of scissors can easily expose the fallacies in this negative kind of appraisal. With a bit of juggling around, *all* the countries in Western Europe — not only Germany, France and Italy — would fit comfortably within the mainland of our nation, with room left over to fit in Japan and a few other island groups. Our own Apple Isle would not even get splashed.

But, no-one has to go to that much trouble. A glance at a globe should make it quite clear that, when looking at Australia, "A Big Country" is not just the title of a T.V. programme but an accurate description of our situation.

From Sydney to Perth is over 3580 km whereas from London to Moscow is about 2500 km as the crow flies — not much further than from Sydney to Broken Hill and back. And, if the crow had to drive through an arid, rugged, thinly populated land, the contrasts with European conditions would become even more obvious.

More people — better roads

Germany, Italy and France alone have a total population of over 170,000,000 — a whole order of magnitude greater than

SIZE COMPARISON
EUROPE AND AUSTRALIA

Australia's 14,000,000 and, no matter what financial complexities are involved, roads have to be paid for through direct and indirect taxes, by the people they serve.

Everything else being equal, the simple equation is: "The more people — the more, and better, roads".

From here to the moon and back

Figures compiled during 1976-77 showed that Australia had 866 000 km of roads and streets. This distance is equivalent to more than 20 times around the circumference of the earth or further than from here to the moon and back.

In that year, Commonwealth, State and Local Government authorities spent more than $1,580 million on these vital avenues of trade and development. This amount was just less than 20% of all capital expenditure by public authorities in Australia. It represented only $2 per week per person and less than $36 per km per week.

All things considered

While it cannot be denied that there is room for improvement in Australia's road system, it must be remembered that Australia is a very "young" country and, all things considered, the standard and development of our road network compares more than favourably with those of other western countries. This Department is well aware of the needs of the people of the State it serves and it is constantly planning and undertaking road programmes to cater for these needs. ●

More comparisons of the Australian road situation with those in other countries are given in the NAASRA brochure "Roads and National Development", which was reproduced in the March 1975 issue of "Main Roads" (Vol. 40, No. 3, pp. 70-75). A new December 1978 edition of the brochure has recently been released (including updated statistics) and copies are available from the Department's Public Relations Section.

Two colour photographs of the Department's exhibit at the 1978 Royal Easter Show appeared on the back cover of the September 1978 issue (Vol. 44, No. 1).

Tenders Accepted by Councils

The following tenders (in excess of $20,000) for road and bridge works were accepted for the three months ended 31 March 1979.

Council	Road No.	Works or Service	Name of Successful Tenderer	Amount
Baulkham Hills	Annangrove Road	Construction of bridge over Cattai Creek.	Christie Civil Contracting.	$268,519.00
Bombala	State Highway No. 19 (Monaro Highway)	Construction to subgrade level between 10.9 and 15.1 km south of Bombala.	M.R.C. Plant Hire Pty Ltd.	$113,889.75
Bombala	State Highway No. 19 (Monaro Highway)	Construction of bridge over Rock Flat Creek, 12.6 km south of Bombala.	K. E. Bottom	$87,461.88
Hay	Various	Supply of bitumen	Emoleum (Aust) Ltd.	$41,416.25
Jemalong	Various	Bituminous sealing and resealing on classified roads.	Allen Bros. Asphalt Ltd.	$56,785.89
Mulwaree	Main Road No. 268	Reconstruction and bituminous surfacing between 1.5 and 5.1 km south of Tarago.	Colless Bros. Holding Pty Ltd.	$239,305.94
Nundle	Main Road No. 105	Bituminous sealing of deviation around Chaffey Dam.	Spraypave Pty Ltd	$21,575.95
Parry	State Highway No. 11 (Oxley Highway)	Construction of ¾ cell 2.0 m x 2.0 m reinforced concrete box culvert over Onus Creek, 35.6 km west of Tamworth.	M. & P. Campese	$63,118.08
Waugoola	State Highway No. 6 (Mid Western Highway)	Supply and spray bitumen for reseals	Allen Bros. Asphalt Ltd	$112,954.67
Wollondilly	Various	Supply and spray bitumen for maintenance and improvement programme.	Boral Asphalt Ltd	$31,752.50

Tenders Accepted by the Department of Main Roads

The following tenders (in excess of $20,000) for road and bridge works were accepted for the three months ended 31 March 1979.

Road No.	Work or Service	Name of Successful Tenderer	Amount
F4 — Western Freeway	City of Parramatta and Municipality of Auburn. Construction of bridge over Duck River, Auburn.	Citra Constructions Ltd	$2,930,141.00
State Highway No. 1	Princes Highway. Shire of Shoalhaven. Construction of bridge over Bomaderry Creek, Bomaderry.	Citra Constructions Ltd	$523,758.30
State Highway No. 2	Hume Highway. Shire of Gundagai. Supply of ready mixed concrete.	Spencer and Elvin	$44,200.00

The following tenders (in excess of $20,000) for road and bridge works were accepted for the three months ended 31 March 1979.

Road No.	Work or Service	Name of Successful Tenderer	Amount
State Highway No. 2	Hume Highway. Shire of Mulwaree. Supply and delivery of up to 1750 m³ of 100-250 mm rock for construction of Gabion retaining wall.	Boral Resources (N.S.W.) Pty Ltd	$24,115.00
State Highway No. 2	Hume Highway. Shire of Gundagai. Supply and delivery of quicklime.	Blue Circle Southern Cement Ltd	$24,828.00
State Highway No. 7	Mitchell Highway. Shire of Wellington. Construction of bridge over Bell River at Newrea, 14.5 km south of Wellington.	Nelmac Pty Ltd	$231,948.60
State Highway No. 8	Barrier Highway. Shire of Central Darling. Construction of two bridges over Talyawalka flood plain, 9.2 km and 10.8 km east of Wilcannia.	Murray Constructions (Deniliquin)	$464,565.90
State Highway No. 9	New England Highway. City of Maitland. Construction of Stage 1 bored piles for the bridge over Lochinvar Creek 11.4 km west of Maitland.	Vibropile (N.S.W.) Pty Ltd	$34,920.00
State Highway No. 9	New England Highway. Shire of Tamarang. Widening of bridge over Quirindi Creek at Wallabadah.	Tamenco Pty Ltd	$71,064.00
State Highway No. 9	New England Highway. City of Maitland. Supply and lay up to 1,100 t of 20 mm asphaltic concrete to reconstruction work between Verge Street and Anambah Road, Rutherford.	Bitupave Ltd	$39,600.00
State Highway No. 10	Pacific Highway. Shire of Ulmarra. Construction of bridge over Coindi Creek and two reinforced concrete box culverts.	M. O. & P. J. Kautto	$228,729.20
State Highway No. 10	Pacific Highway. Shire of Nambucca. Construction of bridge over the Pacific Highway at Bowraville Road, 14.8 km north of Macksville.	Wrightson Contracting Pty Ltd	$217,270.00
State Highway No. 10	Pacific Highway. Shire of Nambucca. Construction of bridge over Bellwood Creek, 2 km south of Nambucca.	Gervay and Libera Constructions Pty Ltd	$280,939.00
State Highway No. 10	Pacific Highway. Shire of Nambucca. Supply and delivery of non-plastic granular fill material to a site at Boggy Creek, 0.3 km west of the Pacific Highway.	A. D. & G. I. Monro	$47,640.00
State Highway No. 10	Pacific Highway. Shire of Wyong. Load and haul up to 1500 m³ of selected sub-grade material for reconstruction work between Saliena Road and Elizabeth Bay Road, Lake Munmorah.	D. & J. Constructions Pty Ltd	$22,200.00
State Highway No. 11	Shire of Gilgandra. Supply, fabrication, protective treatment and delivery of steel top chord bracing frames for bridge over Castlereagh River at Gilgandra.	Kevin Paix Welding Works	$21,260.00
State Highway No. 16	Bruxner Highway. Shire of Ashford. Construction of two bridges over Macintyre River and floodways at Yetman.	L. M. Robertson Construction Company	$1,207,890.00
State Highway No. 17	Newell Highway. Municipality of Narrabri. Construction of bridge over Eather's Creek, Narrabri.	Bridge and General Pty Ltd	$162,617.00
Main Road No. 170	Beauchamp Road. Municipality of Botany. Manufacture, supply and delivery of 50 precast pretensioned bridge planks for the bridge over Bunnerong main drain, Banksmeadow.	E.P.M. Concrete Pty Ltd	$60,812.00
Main Road No. 259	Shire of Wollondilly. Construction of bridge over Mount Hunter Rivulet at 6.7 km from the Hume Highway at Camden.	Ripma Constructions	$193,810.00
Main Road No. 503	Putty Road. Supply and delivery of up to 10,000 m³ of sub-grade gravel to reconstruction work between 81.0 and 90.0 km south of Singleton.	G. J. Pierce	$40,000.00
Main Road No. 537	Muncipality of Blacktown. Construction of bridge over South Creek on the eastbound carriageway at Clydesdale.	McConnell Dowell Constructions Ltd	$494,725.00
Main Road No. 537	Municipality of Windsor. Construction of bridge over Rickabys Creek.	Hornibrook Group (Southern Division)	$485,319.00
Secondary Road No. 2071	Municipality of Fairfield. Construction of bridge over Orphan School Creek, 2.1 km from Cabramatta.	Gida Pty Ltd	$154,487.00
County Road No. 5017	Municipality of Bankstown. Construction of bridge over County Road at Clancy Street, Padstow.	White Industries Ltd	$387,609.00
County Road No. 5037	Parramatta By-pass. City of Parramatta. Construction of pin crib wall.	United Crib Block Constructions	$59,758.00
County Road No. 5037	Parramatta By-pass. City of Parramatta. Construction of New Jersey median barrier.	Seovic Holdings Pty Ltd	$45,430.00
Alpine Way	Kosciusko National Park. Shire of Snowy River. Supply delivery and laying of up to 2,200 t of 10 mm asphaltic concrete between 40.9 and 43.0 km west of Jindabyne.	Canberra Asphalters Pty Ltd	$89,100.00
Unclassified: Harris Street	City of Parramatta. Repainting Gasworks Bridge.	Jerali Pty Ltd	$42,435.00
Unclassified	Shire of Wakool. Repainting of steelwork on bridge over Murray River at Gonn Crossing.	Mondello Bros.	$23,310.00

Above: The Stockton Bridge on the north arm of the Hunter River, linking Kooragang Island and Stockton Peninsula, was opened on 1 November 1971. This is portion of a painting by Mr. G. W. Willott, who was, until his recent retirement, the Department's artist — draftsman.

Below: This 1965 painting by artist Rhys Williams shows the sweeping arch of the impressive new Gladesville Bridge not long after its opening on 2 October 1964.


9