JUNE 1977

MAIN ROADS

New South Wales

Area—801 428 km²

Population as at 30th June, 1976—4 777 103

Length of Public Roads—208 804 km

*Number of Motor Vehicles registered as at 30th December, 1976—2 203 318**

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

ROAD CLASSIFICATIONS AND LENGTHS IN NEW SOUTH WALES

The lengths of roads within various classifications and for which the Commissioner for Main Roads was responsible as at 30th June, 1976 were:

Freeways	114
State Highways	10 476
Trunk Roads	7 080
Ordinary Main Roads	18 317
Secondary Roads	285
Tourist Roads	395
Developmental Roads	3 608
Unclassified Roads	2 480
TOTAL	42 755 km

MAIN ROADS

JOURNAL OF THE DEPARTMENT OF MAIN ROADS, NEW SOUTH WALES

JUNE, 1977

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CONTENTS

Front cover: Progress on the construction by the Department of the Bondi Junction By-Pass can be clearly seen in the informative aerial view, which also shows commercial and residential development around this bustling centre in Sydney's Eastern Suburbs (see article on pages 98–101).

Back cover: Improvements to the route of the Princes Highway at approximately 4 to 6 km south of Bega are being undertaken beside an attractive sweep of the Bega River.

The Unmixer

It is generally conceded that to get on in this world (at least socially) one has to be "a good mixer". This is also true of certain groups of people, such as chefs and wine producers, to name but two, whose reputations depend on their skill in mixing the right proportions of selected ingredients in their own special way.

The Department does its share of mixing, too. It puts together all manner of materials to make stable road foundations and then mixes up some more to make solid road surfaces. But, the Department's responsibilities also include some very important *unmixing*. It builds overbridges to separate different lanes of vehicular traffic, to eliminate railway level crossings and to reduce pedestrian-vehicular conflict.

By-passes are another example of the Department's *unmixing* activities. Over a number of years, local traffic and pedestrians in some towns situated on the State's main highways have been mixed up with through traffic—to the advantage of neither. The same problem applies to many suburban centres.

In an attempt to regain many of the benefits lost by the people who live in such places, the Department has, for some years, been planning new routes to carry through traffic around these centres and thereby unravel the main strands of the problem.

Considerable tension and danger is created by the mixing of local and through traffic. Through traffic inevitably includes a large percentage of heavy vehicles which, with their size, fumes, noise and numbers, can have a detrimental effect in urban situations.

It is far better if local commercial and private traffic, public transport services and pedestrians could go about their business and pleasure independently without the frustration of having to compete with through traffic, which generally does not want to drive down the main street anyway.

Furthermore, by-passes take much of the strain out of road travel by reducing the irritation caused by cross traffic conflict, congestion, parking manoeuvres, traffic signals and the variety of other traffic management facilities faced by drivers in built-up areas.

So, a by-pass helps both groups—by providing a better through route, on the one hand, and a safer and more satisfying town or suburban environment, on the other. The local centre is then free to develop its own particular appeal as a focal point of shopping, business or recreation. Such will be the case soon at Bondi Junction (see article on pages 98–101), at Parramatta (see article on pages 114–6), and at Gundagai (see comments on page 120).

For the Departmental officers involved in planning these improvements, it is nice to know that the *unmixing* process is appreciated and brings such enjoyable and worthwhile benefits to so many people in the community. It is one of our ways of mixing pleasure with business. ●

BONDI JUNCTION BY-PASS

Construction works for the Bondi Junction By-pass and the Bondi Junction Station on the Eastern Suburbs Railway (upper left) are separated by Grafton Street. The main artery at present is Oxford Street, which shows up clearly in the middle of this photograph.

The face of Bondi Junction has changed dramatically over the last decade, not through age, but through the rejuvenation that large-scale commercial developments bring about. Private enterprise has not been alone in this—planned commercial and government developments led to the establishment in 1967 of the Bondi Junction Planning Committee (now The Eastern Suburbs Co-ordinating Planning Committee) to plan for the Junction's changing transport needs.

That Committee included representatives of Waverley and Woollahra Municipal Councils, the State Planning Authority (now the State Planning and Environment Commission), the Departments of Railways and Government Transport (now incorporated into the Public Transport Commission), The Ministry of Transport, The Traffic Authority and the Department of Main Roads.

The Committee's plans for Bondi Junction included a bus/rail interchange, redevelopment of the commercial centre and a By-pass of the commercial centre for through traffic via a major road to the north.

To co-ordinate these various construction projects, a Project Co-ordinating Committee for the Eastern Suburbs Railway was established in 1977. Careful planning of construction schedules has been essential through all stages, with the Bondi Junction By-pass planned for completion in time for the opening of the bus/rail interchange early in 1979.

The major construction project for the Department of Main Roads is the Bondi Junction By-pass which extends from Moncur Street at Centennial Park to the Old South Head Road/Bondi Road junction as shown in the locality diagram on the page opposite.

The shopping and commercial centre at Bondi Junction ranges over an approximate one kilometre length of Oxford Street.

This street has an annual average daily traffic volume of 24 000 vehicles and Edgecliffe Road, which is used as an alternative with some residential streets, 20 000 vehicles. These traffic volumes dictate the need for a By-pass for through traffic. The alternative of widening Oxford Street and/or Edgecliffe Road was unacceptable both economically and because of disruption to the commercial and social life of the community.

General Description

The By-pass deviates from Oxford Street to the west of Bondi Junction at a point where there is an existing six lane divided roadway and proceeds easterly along the alignment of the existing street system to the end of the shopping centre at Bondi Road. At-grade signalised intersections at each end provide the only vehicular access.

Approximately 1.3 kilometres of new road is being constructed of which 0.45 kilometres will be a viaduct. The viaduct, which will carry two lane dual carriageways with breakdown lanes, is adjacent to the area of the proposed railway station.

Pedestrian access over the By-pass will be by a footbridge to be constructed at Nelson Street. This will give residents of the Nelson and Wallis Streets areas easy access to the shopping centre and there will also be ample access beneath the viaduct.

Construction Planning

As the decision to go ahead with the By-pass was not made until late 1976, only a little over two years remained to complete the project in time for the scheduled opening of the bus/rail interchange in early 1979. This construction period was further reduced by the time needed to complete the purchase of the necessary land and to establish a Works Office.

At this time too, the preparation of plans was not well advanced and no public utility adjustments had been made. Every co-operation has been and is being received from the authorities involved.

To accommodate the consequent tight scheduling, a flexible system of construction has been adopted. This is a combination of direct control and contract works and, should delays occur, the number of minor contracts and/or direct control gangs can be increased.

The Bondi Junction Works Office was established at Saber Street, Woollahra.

Design

The Department of Main Roads designed all road and bridge works, except the reinforced earth retaining structures which were designed by Vidal Reinforced Earth Pty Ltd.

The By-pass is being constructed with two 10.4 metre carriageways separated by a 1.2 metre concrete and crashrail median barrier. Lane widths are 3.7 metres and shoulders 3.0 metres wide.

The pavement is being built on a base course of 150 mm of fine crushed rock, a surface course of 200 mm of reinforced cement concrete and a 50 mm asphaltic concrete wearing surface.

The naturally occurring materials in the By-pass area consist of generally free sand overlying sound sandstone. At Nelson Street the maximum depth of cutting is approximately three metres which is expected to yield 10 000 cubic metres of sand filling. The quantity of filling required is 40 000 cubic metres and the 30 000 cubic metres of borrow will come either from the Department's works in other areas or nearby commercial developments.

As the By-pass was designed to interfere as little as possible with the existing street system, the provision of normal batters was not considered practical. Consequently, cut and fill areas will be retained by structures. Conventional mass and cantilever type concrete retaining walls will be used in the cutting and some low fill areas, but the major portion of fill will be construction of reinforced earth.

Public Utilities

Public utility adjustments are extensive and the speed with which they can be completed will have a marked affect on the progress of the whole work. The area in the vicinity of Ocean Street is a focal point for the distribution of water, gas, electricity and telephone services, and great care was taken in the design of the By-pass at this location to reduce utility service adjustments to a minimum.

Reinforced Earth

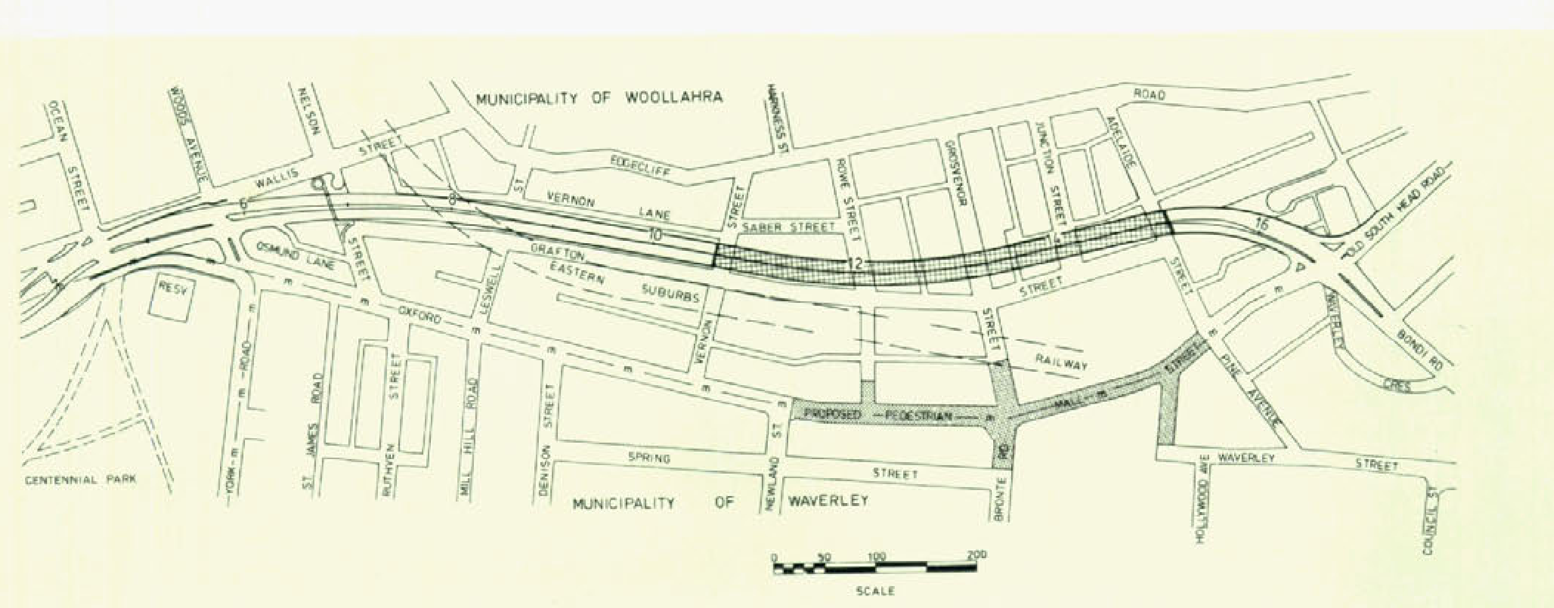
The project requires 3 730 square metres of face area of reinforced earth panelling. Two contracts totalling $358,272 have been let to Vidal Reinforced Earth Pty Ltd for the design of the work and the manufacture and delivery of all materials including panels and galvanized steel strip.

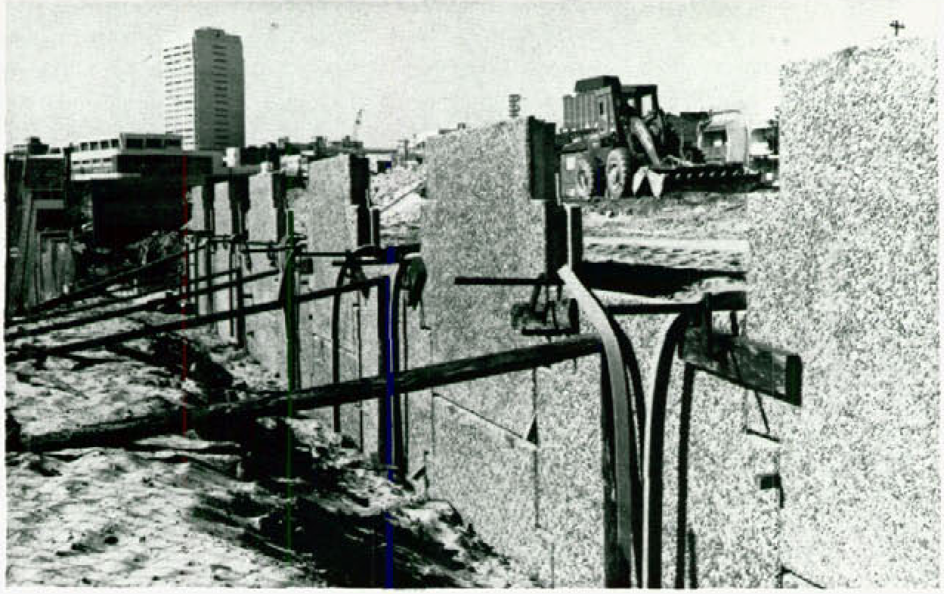
A feature of the panel faces is their exposed aggregate finish. This is the first time that reinforced earth panels with this type of finish has been used in Australia.

This finish will improve the overall appearance of the wall and reduce the amount of formed concrete which is exposed to a predominately residential area. The maximum height of the reinforced earth wall will be approximately nine metres.

Naturally occurring granular material can be used as backfill material in a reinforced earth structure and the sand on site at Bondi Junction meets all of the designer's requirements. Tests on sandstone from the Departments works in other areas have also met with some degree of success.

Crashrailing, identical to that which will be erected along the median on the





An exposed aggregate finish on the panels is a feature of the reinforced earth walls being constructed on the By-pass.

viaduct, will be constructed along the formation edges to maintain a uniform appearance.

Viaduct

The viaduct, a bridge structure 456.4 metres long, will be built between Vernon and Adelaide Streets. Its 18 spans vary in centre line length from 21.8 metres to 28.2 metres. The general pier and superstructure detail is shown in the typical section on the page opposite.

The piers consist of a headstock of inverted "T" shape supported by three circular columns each one metre in diameter, which in turn are supported by square spread footings 2.5 metres wide by 1.2 metres deep. Minimum footing penetration is 150 mm into sound rock with a bearing pressure of 1 650 kPa. Steel design is identical for each of the columns which vary in height from 4.2 metres to 9 metres.

The 414 girders are of precast prestressed concrete and vary in length from 19.8 metres to 27.1 metres (some piers are not normal to the road centreline) with a maximum mass of 29 tonnes. Simply supported on elastomeric bearing pads, each span is transversely stressed to form a cellular unit.

The abutments are cantilever wall types with small wingwalls which will overlap the reinforced earth panels to give a neat joint between the two construction types. Foundations for the abutments will be taken to sound sandstone with a bearing pressure of 200 kPa. The maximum abutment height is 11 metres.

Cost

The total cost of the project is estimated at $20 million. Land acquisition for the project is estimated to cost $10 million and the remainder of the cost will be shared equally between the roadworks and the viaduct.

Funds for construction are being provided by the Department of Main Roads (50%), Public Transport Commission (40%) and the Traffic Authority of New South Wales (10%).

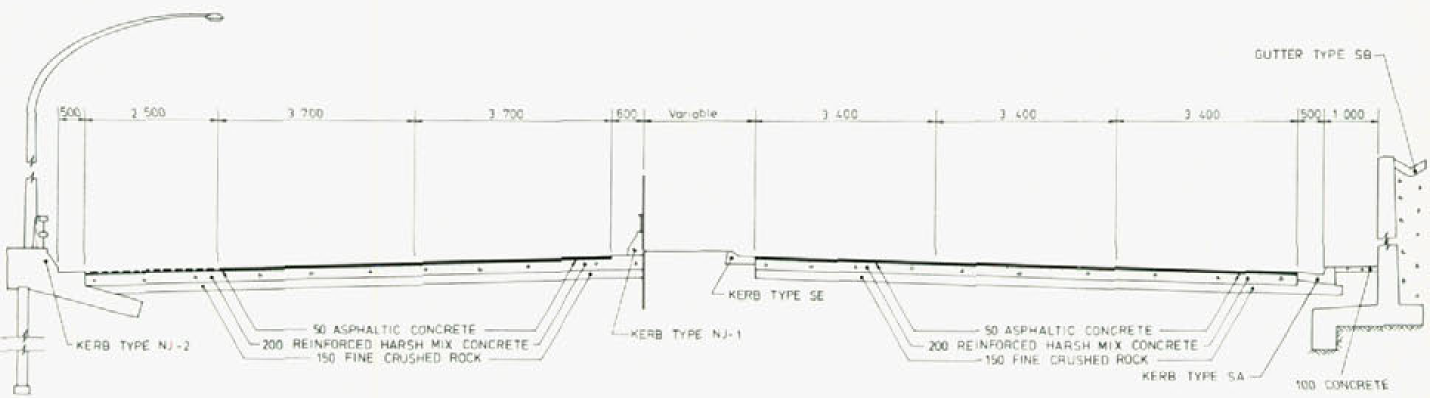
Construction Progress as at June, 1977

Almost all land acquisition has been completed, with sewer adjustments finalised and major street closures effected. Arrangements for adjustment of other public utility services are under way.

Direct control forces have constructed the viaduct footings and are presently constructing the abutments and the retaining walls.

Contracts for 16 of the viaduct piers have been let for a total amount of $359,318 to three contractors—A.A.M.M. Constructions Pty Ltd, McConnell Dowell Constructors Limited and Reservoir Constructions Pty Ltd.

As complete sets of footings became available contracts for either one or two

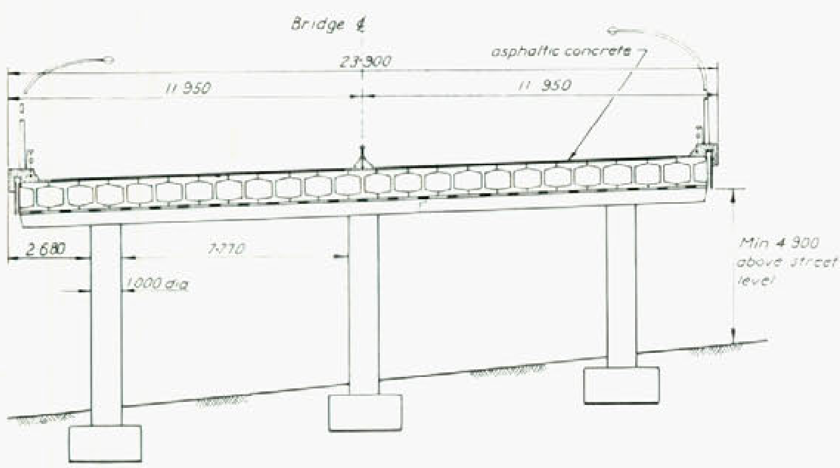


TYPICAL CROSS SECTION OF BY-PASS IN FILL AND IN CUT

The sub-structure of the By-pass viaduct is taking shape overlooked by the city skyline.

piers were called so that work could proceed. The calling of tenders for pier five which had been delayed because of land acquisition problems is expected shortly.

The manufacture and erection of the girders is a major contract and a contract for $1.25 million has been let for this work. Provision for casting on site has been made in the specifications, so that the maximum number of contractors can tender for the work. The contract time for completion is 54 weeks which brings the actual completion date to mid-'78.



TYPICAL SECTION

However, the girders will be erected in sequence from span No. 1 which will enable stressing, handrailing and other superstructure work to commence around the end of 1977.

Direct control forces are involved in excavation works for the viaduct and retaining wall foundations as well as drainage, street closures and minor traffic adjustments. The footing for the reinforced earth panels on the northern side between Leswell Street and the viaduct abutment at Vernon Street is complete together with associated excavation. The placing of panels for the reinforced earth walling has also commenced.

The Future

Bondi Junction is undergoing, and will continue to undergo until early 1979, minor disruptions to local traffic and the initial unsightliness that roadworks of this size inevitably must cause. As work proceeds towards completion, landscaping treatment will become evident and grassed batters and other greenery will gradually expand.

Integrated with the bus and rail facilities, the By-pass will mean quicker and more convenient travel for commuters and through traffic alike. ●

TRAFFIC CONTROL SIGNALS

PART 1—SOME ASPECTS OF THEIR DEVELOPMENT

In bringing order to traffic flow, traffic signals make our roads safer and help to maximise the use we can make of our roads.

This article briefly outlines the growth of traffic control systems from the more sedate 1860's through to the roaring 1920's. It focuses on overseas developments (mainly in the United States of America) but includes some notes on our own State's first set of traffic lights which were installed in Sydney in 1933.

A further article in the September, 1977 issue of "Main Roads" will explain the way traffic signals operate, as well as describe Sydney's present system of traffic control and plans for the co-ordination of signals.

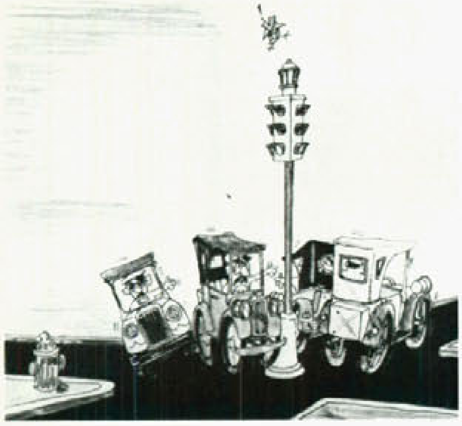
In the Beginning

We're so accustomed to thinking of traffic control signals as part and parcel of our modern motoring world that it may come as a bit of a surprise to some to find that traffic signals were first introduced a considerable time *before* motor cars appeared on the streets in any numbers.

London was the first city to give the "green light" to the concept of traffic control by coloured lights. The first "trend-setting" signal was installed at the intersection of George and Bridge Streets, Westminster in mid-December, 1868. Located near the Houses of Parliament the tall signal protected Members of Parliament and lesser mortals at this

Sydney's first set of traffic signals were at the corner of Kent and Market Streets and began flashing at 11 a.m. on 13th October, 1933—Photograph from Sydney Morning Herald, 14th October, 1933.

Cars, clothes, buildings and lights have all changed over the years and this is how the same site looks today.



"We saw four streams of traffic making left turns at the same time . . . without the scraping of a fender."

busy intersection. For night-time use, it was topped by a gas light. After several mishaps, the gas-operated section finally exploded (some cynics said this was due to an excess of "hot air" from Parliament!) but the principle of traffic control by mechanical device and coloured lights had, at least, been introduced to the travelling public (see illustration and more details on page 105).

Manually-operated semaphores became popular in the early decades of the 20th century, particularly in America, but there was considerable scepticism initially about the ability of a mechanical contraption to replace a competent policeman on point duty.

As early as 1908 semaphores were installed at the centre of various intersections in Toledo, Ohio, U.S.A. These semaphores had red and green lenses, illuminated at night by kerosene lamps. The words "Stop" and "Go" were in white on a green background and the arms were $8\frac{1}{2}$ feet above the pavement. They were controlled by a handle, operated by a police officer, who blew a whistle just before changing them.

During the next few years, manual semaphores came into use in numerous other places. The most common consisted of a base—fixed or portable—supporting a vertical tube in which a longer but smaller-diameter tube could be rotated with the arms or blades set into its top.

In Louisville, the semaphore system was introduced in 1915, prompted by complaints from apartment house dwellers about the disturbing noise of police whistles! In Richmond, Virginia, four-arm semaphores, painted white and red alternately, were installed about 1916. The white arms bore the word "Open" in black letters; the red arms displayed "Closed" in white letters. Each arm was equipped with an electric light, showing through a red lens in the "closed" arm and a white lens in the other. Electricity was furnished by a storage battery.

Semaphores proved to be an appreciable aid to traffic manoeuvres, particularly because their greater visibility attracted the attention of drivers more effectively than the arm movements of a policeman. But there were several deficiencies which were to bring about their gradual disappearance. These included the lack of a distinct neutral position, the lack of uniformity in using lights at night, the high cost of maintaining the moving parts and the difficulty of providing uninterrupted operations during severe winters. Furthermore, because these devices were manually operated, changing the signs interfered with the policeman's other important functions which included, as a law enforcer, reproving or charging people who did not abide by the traffic regulations.

Going Electric

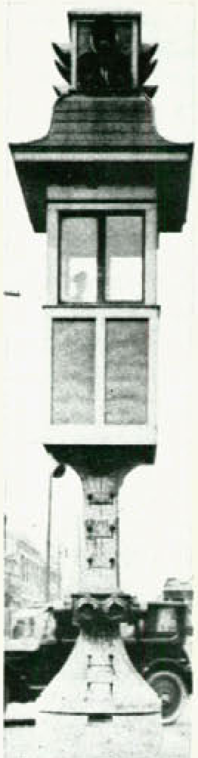
Gradually the semaphores fell out of favour, as electrically-operated signals made their appearance. What was probably the first set of electric traffic lights were set up in 1912 at the corner of 2nd South and Main Streets, Salt Lake City. It was apparently developed jointly by Lester Wire and Charles Reading. The first hand-made model featured a wooden box with a slanted roof so rain and snow would fall off. The lights were coloured with red and green dye and shone through circular openings. The box was mounted on a pole, and the wires were attached to overhead trolley and light wires. It was operated by a policeman.

Widely accepted as the "trail blazer", a more elaborate set was installed on 5th August, 1914 at the corner of 105th Street and Euclid Avenue in Cleveland, Ohio. Made by the American Traffic Signal Company and patterned largely on a design by James Hoge of Cleveland, this signal had the basic components of a modern controller and could be operated either by hand or by an automatic timer.

In this layout there were four red indicators facing onlooking traffic on

This early "manipulating semaphore" in Detroit was clearly one of the simplest of mechanical signals and one of the early moves away from traditional arm and hand movements.

As a "traffic stopper", this trim policewoman in Washington, D.C., U.S.A., in 1918 was probably far more effective than the umbrella and the four-way sign she turned around.



Left: This type of tall traffic tower was in vogue in the United States in the 1920's. This one in Detroit used twelve 250 watt lamps to illuminate the top red, amber and green signals, and eight 96 watt lamps in the lower "driver-eye-level" lights which showed red and green only.

Above: This photograph of the intersection of Fifth Avenue and 42nd Street, New York—taken at 2.30 p.m. on 1st June, 1929—seems to confirm the claim that it was the "world's busiest corner". A highly ornamental and costly bronze traffic tower (top left), with lights conspicuously high above the roadway, helped to regulate traffic.

the near side of the street at the stop line, and four green signals on the far right hand corner. At the time of the change from red to green or vice versa, a bell was sounded to warn traffic of the impending change.

A fire station, a half block distant on 105th Street, had a switching arrangement which permitted firemen to turn all of the signals red in all four directions, thus stopping all traffic and allowing a clear passage for the fire engines.

March, 1917 saw the world's first electrically-interconnected signal system installed in Salt Lake City, U.S.A. The system was designed by Charles Reading, the city electrician and each of its six signals (in State and Main Streets) was interconnected by cable and controlled from a manually-operated switch. The signal lights were mounted on pedestals in the centre of the intersection and were connected in what was later called on "alternate" system (then called a "checkerboard" or "staggered" system). By driving at approximately 20 miles per hour, one could usually proceed through all three signals in either street without having to stop.

William L. Potts of the Detroit Police Department is generally credited as the originator of the three-colour (red, yellow and green), four-way signal, facing each line of oncoming traffic at an intersection. The first of these signals was installed in December, 1920 at the intersection of Woodward Avenue and Fort Street, Detroit. Built of wood and encased in a metal shell, this signal was suspended over the intersection with a panel of lights facing each direction.

All Together, Now

Despite these advances, traffic management still depended a lot on the drivers' own ingenuity. A report in the American magazine "Nations' Traffic" of July, 1927 on the use of standard four-way, three-colour signals explained why. For left-turns, all four sides of the signals would be illuminated by a white light. At the same time, the red and green lights would be dark. In effect, this indicated that all traffic from all four directions could turn left. The author of the report wrote: "*We saw four streams of traffic making left turns at the same time . . . without the scraping of a fender*". The local Chief of Police observed: "*We have taught these people to sort of care for themselves.*"

Faster and Safer—with Fewer Policemen

The main defect of these early devices was a lack of flexibility. Attempts were initially made to co-ordinate traffic signals through the "simultaneous" system. This meant that all the lights on one street would indicate "Go" simultaneously, while all lights on the intersecting streets showed "STOP".

Another method was the "alternate system", where the red and green lenses on alternate signals or alternate groups of signals were reversed.

The most successful was the "flexible-progressive" system which resulted in a smoother traffic flow. A new device, an automatic variable timing switch first marketed in 1923, made this possible. Employed in Chicago in 1926, this system brought about an increase of between 25 to 50 per cent in the speed of traffic moving through an area of seven by nine city blocks. With this system, the total period of the traffic cycle could be varied and the split between the north-south and east-west directions could be varied at every intersection. By the end of the twenties, the "flexible-progressive" system was firmly entrenched as the most efficient and it was being used in 29 American cities.

The wide acceptance of traffic signals as a means of traffic control is illustrated by this quote from a paper presented in 1928 by C. A. B. Halvorson: "*By the end of the year there will be in New York City alone 3,000 intersections controlled at an initial cost of $1,000,000. This would have required 6,000 policemen at an expense of $15,000,000 to accomplish similar results. With the colour signal system, only 500 men will be employed at intersections where trafffc lights are in operation. Accidents have been greatly reduced at the same time vehicular traffic has been speeded up.*"

. . . to be continued.

☆ ☆ ☆

Most of the information ii. this article has been gleaned from the 150-page publication entitled "Traffic Devices. Historical Aspects Thereof" by G. M. Sessions, Principal Writer, published in 1971 by the Institute of Traffic Engineers, Washington.

The courtesy of the publishers is acknowledged in allowing the Department to use material which they have so painstakingly gathered.

This book is a valuable guide for anyone researching the early history of traffic control devices. A copy is available for perusal in the Department's Library, Fifth Floor, Head Office.

WORLD'S FIRST TRAFFIC LIGHTS

The world's first traffic signals set up in London in 1868 are shown by this surviving drawing to have been an imposing hydra-headed contrivance 6.7 metres (22 feet) high. The semaphore arms, when extended horizontally, meant "Stop". When lowered to a 45° angle, they meant "Caution". At night, a green gas-operated light was used with the "Caution" position and a red light with "Stop".

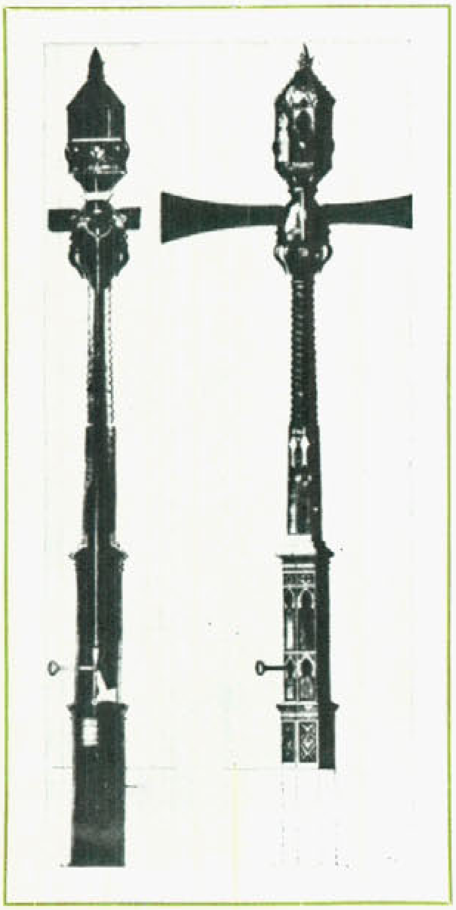
The meaning of the semaphore was set out in a proclamation.

"*By the signal, 'CAUTION', all persons in charge of vehicles and horses are warned to pass over the crossing with care and due regard to the safety of foot passengers.*

The signal 'Stop' will only be displayed when it is necessary that vehicles and horses shall be actually stopped on each side of the crossing, to allow the passage of persons on foot; notice being thus given to all persons in charge of vehicles and horses to stop clear of the crossing."

Before this, pedestrian protection had been dependent on policemen's hand signals; and, according to a newspaper report of the day, they were "*often a very inadequate defense against accidents*". The new signal had, in fact, been made in response to a suggestion by a Parliamentary Select Committee that railway signal gear be adapted to street traffic.

Londoners came in such numbers to view this novel contribution to their safety that the police had difficulty in controlling the crowds. Enterprising street vendors set up stalls and sold snacks and drinks to the sightseers.



Problems plagued the new device. Horses were frightened by the arm movements and the lights at night and many bolted. During one period, two policemen were unfortunately killed while operating the semaphores. On another occasion, gas from a nearby main filtered into the hollow semaphore pole; and, when a policeman tried to light the lamps an explosion killed him.

But, nevertheless, the signal had won acceptance. In March, 1869, the question, "*whether the structure called a semaphore . . . was conducive to the safety of the public*" was brought up in Parliament. The House of Commons referred it to the Police Commissioner, who, after appropriate investigation, recommended not only its retention but its extension into other parts of London.

An improved semaphore was designed and erected, and the original was dismantled in 1872. It is not clear whether the old signal retained its coloured lights after the explosion and whether the new signals had only semaphore arms.

SYDNEY'S FIRST TRAFFIC LIGHTS

The installation of Sydney's first set of traffic lights was briefly reported in the 1933–34 Annual Report of the Commissioner for Road Transport and Tramways (Page 2).

"*An 'Electromatic' vehicle actuated traffic control installation was placed in commission in October, 1933, at the intersection of Kent and Market Streets, City. The equipment has proved satisfactory, and the extension of the use of this type of automatic traffic control is under consideration*".

The *Daily Telegraph* of 13th October, 1933 reported this important event and explained what drivers were expected to do in response to the signals. This included the now "old-fashioned" procedures for turning right.

New "Silent Cops" give traffic orders in colour

City Start at 11 To-day

"*No longer the Jovian Hand of the policeman, imperiously beckoning—*

Merely the twinkling of coloured lights to give brusque orders to the waiting motorist.

Red, green and amber the lights are the stop and go signals of the new electromatic traffic sign at the corner of Kent and Market Streets. They will commence working at 11 a.m. today.

Following a consultation between the Commissioner of Police, Mr Childs and the Commissioner for Road Transport, Mr Maddocks, the following procedure has been adopted:

As drivers approach the intersection of Kent and Market Streets, coloured light signals erected on posts will be seen on the footpaths near each corner. Broken yellow lines, called 'stop-lines', are painted on the road just short of the intersection.

What Signals Mean

The indications given by the signals with their respective sequence are:

RED means stop at the stop line before entering the intersection, and remain stationary until green appears.

RED AND AMBER indicates an impending change from red to green telling waiting drivers to prepare to start. They must not start, however, until the green sign appears.

This cartoon from the St Louis Post-Dispatch focuses on the tiring task faced by policemen on point duty.

GREEN means that drivers may proceed straight or to the left or right, subject to the safety of others. Green does not imply a right to proceed unless proper precautions are taken.

AMBER means stop at the stop line. If a vehicle is over the stop line when the amber first appears after the green, the driver should proceed through the intersection.

Turning Right

Drivers intending to turn to the right must go into the lane of traffic nearest to the left-hand footpath of the street in which they are travelling, and, when reaching the intersection, pull over to the left as nearly as practicable to the stop line in the roadway into which they propose turning.

In order not to obstruct pedestrian traffic, drivers about to turn must go with the traffic in the street they are entering, when the signal is given for that direction of traffic."

The N.R.M.A.'s Journal *Open Road* of 26th October, 1933 ran a light-hearted front-page article under the heading "We Flirt with Eva".

"*It looks as though our Eva has come to stay, even though the wife looks coldly upon us when this lively lass winks flirtingly. Eva is a girl with a mind, and her flirtations are quite impartial and all in a good cause.*

There can't be many motorists in Sydney now who have not been winked at by this lively lass of the triple eyes who is so well regarded in the whirl of traffic control.

If you are still unacquainted with Eva, meet her at the intersection of Market and Kent Streets, and if you think 'Eva' is too familiar for a first meeting, call her Miss Electromatic Vehicle Actuated Traffic Controller. Quite a mouthful? That's what her makers said when they christened her Eva."

Expansion of the "new-fangled" lights came slowly for it wasn't until 1936–37 that the Commissioner for Road Transport and Tramways reported that the trial installation had *proved very efficient* and during that year similar equipment had been put into operation at four more intersections. These were at York and Margaret Streets, at Erskine and Clarence Streets, at Pyrmont Bridge Road and Booth Street, and at Pyrmont Bridge Road, Wattle Crescent and Jones Street. Arrangements were then in hand for the installation of additional signals at other sites . . .

. . . and that's still the situation today, with a growing emphasis on co-ordination. But, more about that in our next issue.●

F5 NEW SECTION OPENED

A new section of the South Western Freeway, between Yanderra and Aylmerton, was opened to traffic on 24th May, 1977. This 13.5 km section, commenced in November 1973 and constructed at a cost of $21.8 million, brings the completed length of the Freeway to approximately 29.5 km. This length includes 1.2 km of connections to the Hume Highway.

The Freeway is built on a more direct alignment than the Hume Highway and is 2.8 km shorter than the Highway between Yanderra and Aylmerton. It has a minimum curve radius of 1 650 metres and the maximum grade is 6½ per cent. The speed zoning on the Freeway is 110 km/h. On the old section of the Hume Highway there are 42 curves, of which 11 have advisory speeds signs. There are two 25 km/h signs, three 55 km/h signs, two 65 km/h signs and four 75 km/h signs.

It has been estimated that on this small section alone, because of improved road conditions and reduced travelling time, the savings in vehicle operating costs will be at least $2 million each year (see further details below).

The Freeway has been designed to blend with the surrounding countryside and during construction the road reserve was landscaped, grassed and planted with 6 400 trees. Hay-mulching was carried out over a total area of 60 hectares.

The extent of the work involved in the construction of the new section can be gauged from the fact that it involved 2 million cubic metres of earthworks and resulted in 350 000 square metres of road pavement, using 80 000 tonnes of asphaltic concrete.

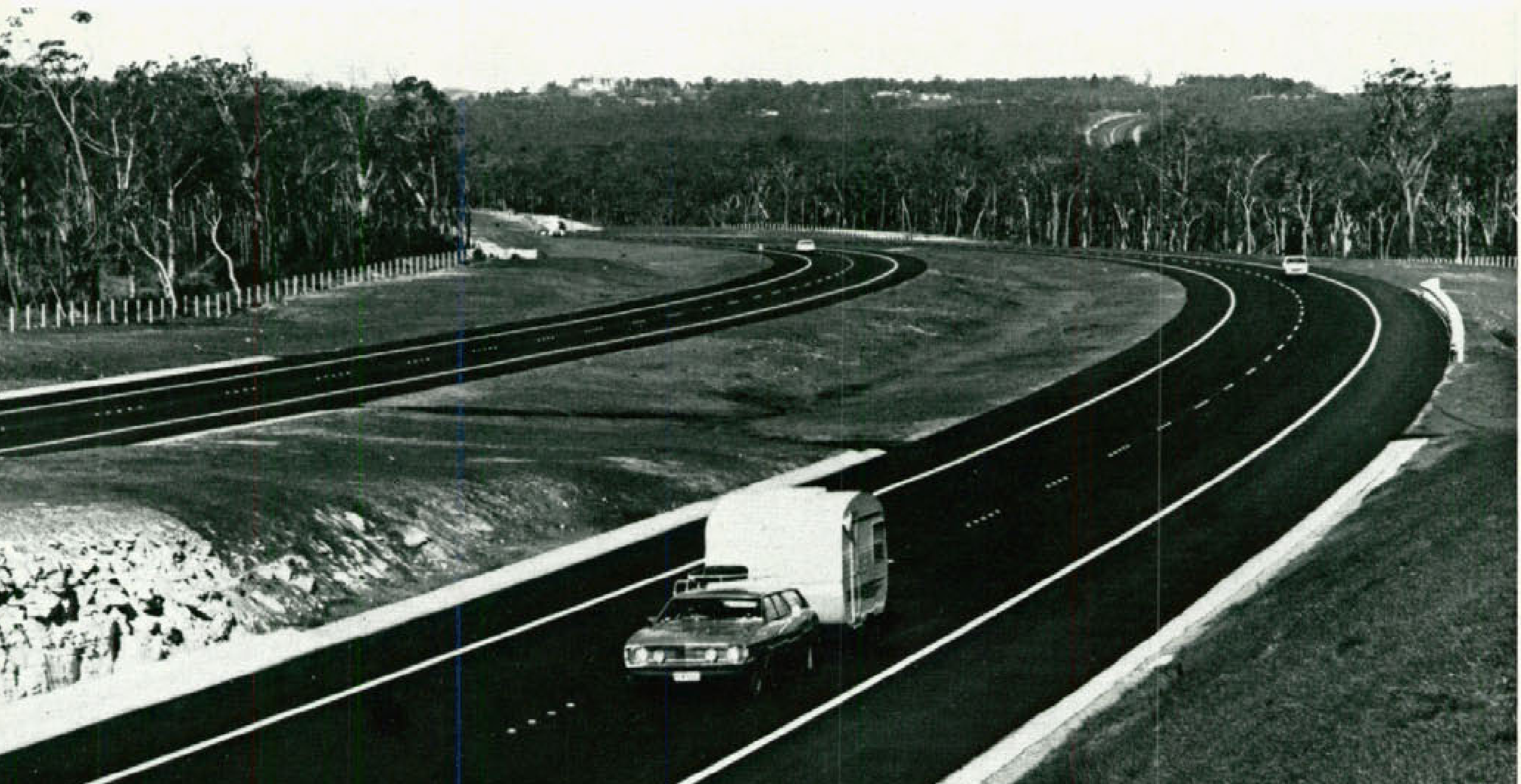
There are eight bridges at five locations on the new section. Dual bridges were constructed to cross the Main Southern Railway Line at two locations, to replace the old and inadequate White Horse and Yanderra overbridges. The new bridges are 22 and 15.4 metres long respectively. Just south of Yanderra, the Freeway is carried over the Hume Highway on dual bridges each 49 metres long. Local traffic is carried over the F5 at Sierra Road, Yerrinbool and at Church Avenue, Aylmerton on structures which are 59 and 64 metres long respectively.

Cost Benefits to Road Users

The Department has undertaken some preliminary studies to give an indication of the value which the new section of the Freeway might be expected to bring to the people who use it.

Firstly, travelling times on both the Freeway and the adjacent section of the

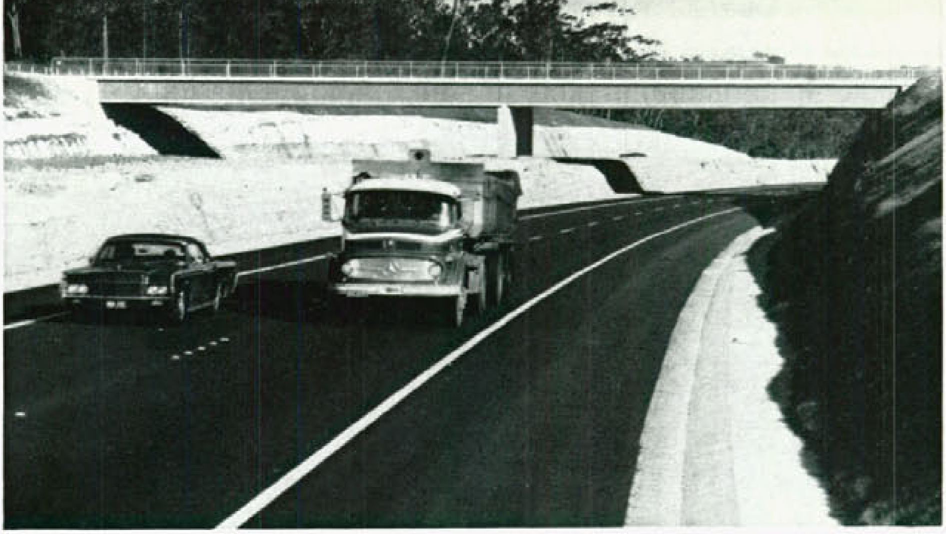
Better alignment and grades on freeways make caravan towing and all types of road travel less of a strain on drivers and vehicles.



Right: Overbridges, such as this one at Sierra Road, Yerrinbool, provide access across the Freeway.

Centre: Taken from the overbridge at Church Street, Alpine, this view looks south towards the end of the Freeway at Aylmerton.

Bottom: Barriers away! The opening of the Yanderra-Aylmerton section of the F5 on 24th May, 1977 was an informal occasion with the removal of the barriers at the Yanderra end. The Commissioner for Main Roads, Mr A. F. Schmidt (on left) and the Department's Deputy Engineer-in-Chief, Mr E. M. Brown carried the last barrier out of the way.



Hume Highway were measured by using a light Departmental vehicle (to represent cars, station sedans and utilities), as well as by timing heavy commercial vehicles (i.e., trucks and semi-trailers, etc.). The average travelling times recorded were:

	Cars minutes	*Heavy Vehicles* minutes
Hume Highway—		
Southbound	12	27
Northbound	12	17
Average	12	22
Freeway F5	7	12
Time saved by using F5 ..	5	10

On the basis of an annual average daily traffic (AADT) volume of 9 000 vehicles, with 15% of these being heavy vehicles, it can be seen that the time saving for vehicles using the F5 for a year would be approximately 315 000 vehicle hours.

This has been calculated as follows:

Number of cars per day (i.e., 85% of 9 000)	7 650
× number of days in year ..	×365
× 5/60th (i.e., 5 minutes saved per car)	× 5/60
	= 232 687.50 vehicle hours per annum
Number of heavy vehicles per day (i.e., 15% of 9 000)	1 350
× number of days in year ..	×365
× 10/60th (i.e., 10 minutes saved per vehicle)	× 10/60
	= 82 125.00 vehicle hours per annum
Total for cars and heavy vehicles	= 314 812.50 vehicle hours per annum

With the opening of the new Freeway section, through traffic no longer has to negotiate these narrow and poorly-aligned railway crossings on the Hume Highway.

The total distance travelled which is saved each year by all vehicles using this section of the F5 is approximately 9 200 000 vehicle km. This has been calculated as follows:

9 000 vehicles per day × 365 days × 2.8 km (being length that F5 section is shorter than Hume Highway section) ..	= 9 198 000

If the following running costs are adopted . . .

	$
Cars	.. 0.10 per km 3.00 per hour
Heavy vehicles (average 10 tonnes)	.. 0.21 per km 8.00 per hour

. . . then the total unadjusted cost benefits exceed $2.4 million each year. The calculations used to obtain this figure were:

	$
Cars—	
7 650 vehicles × 365 days × 2.8 km saved × 10 cents per km ..	781,830.00
232 687.50 vehicle hours saved × $3 per hour	698,062.50
Heavy Vehicles—	
1 350 vehicles × 365 days × 2.8 km saved × 21 cents per km ..	289,737.00
82 125 vehicle hours saved × $8 per hour	657,000.00
Total	$2,426,629.50

This amount of $2,400,000 (in round figures) needs to be adjusted to take account of

	$
☆use of existing highway by some vehicles . . . say 10%	240,000
☆estimated maintenance costs of F5 section . . . say $10,000 per km per annum—for 12 km actual freeway length (not full 13.5 km) ..	120,000
Nett annual benefits =	$2,040,000

If we now extend this benefit over 30 years (i.e., the expected life of the roadway before major reconstruction may be necessary), we should make allowance for

☆ an expected growth in traffic volumes, say 5% per annum, and

☆ a "discount" rate for the "time value" of money . . . to adjust the savings over the 30-year period to present day values, say 10% per annum.

This means a total 5% reduction per annum.

The nett present value of $2,040,000 savings per annum over 30 years, incorporating the above-mentioned 5% reduction per annum, is $31,258,880. Compared with the construction cost of $21,800,000, this gives a benefit/cost ratio of 1.4.

Next Section Under Construction

Construction of the F5 for another 35 km between Camden Road (near Campbelltown) and Yanderra is continuing. When completed in about 1981, an uninterrupted 64 km length of freeway will provide the community with enormous savings in vehicle operating costs.

The line has been cleared and contracts totalling almost $11 million have already been let to provide for the construction of bridges and for earthworks, drainage and fencing.

It has been calculated that the cost of construction from The Cross Roads to Aylmerton will total about $100 m. While this amount may appear to be extremely high, it has been estimated that the savings in costs to the community will be of the order of $10 m each year. This huge saving will be brought about by the reduction in vehicle operating costs made possible by shorter distances and improved road conditions which result in reduced travelling times. These savings have been calculated on a similar basis to those included earlier in this article and do not include savings from less vehicle wear and improved fuel economy.

Further South

At the end of the Freeway section at Aylmerton, the Department plans to build a further extension of the F5 southwards to near Exeter Road (which is south of the junction of the Illawarra and Hume Highways). This section will by-pass Mittagong and Berrima and will be the subject of an article in a forthcoming issue of "Main Roads".●

Two recent articles on the F5 appeared in the September, 1976 issue of "Main Roads" (Vol. 42, No. 1):

- *"More About the F5", pp. 2–4, including four sectional maps from The Cross Roads to Aylmerton.*
- *"Environmental Impact Study—from near Campbelltown to Yanderra", pp. 5–7.*

An aerial colour photograph of construction at Church Avenue, Alpine, near Aylmerton, appeared on the back cover of the June, 1976 issue (Vol. 41, No. 4).

Colour photographs of the new section appear on page 111 of this issue.

Temporary footbridge over Hume Highway at Aylmerton

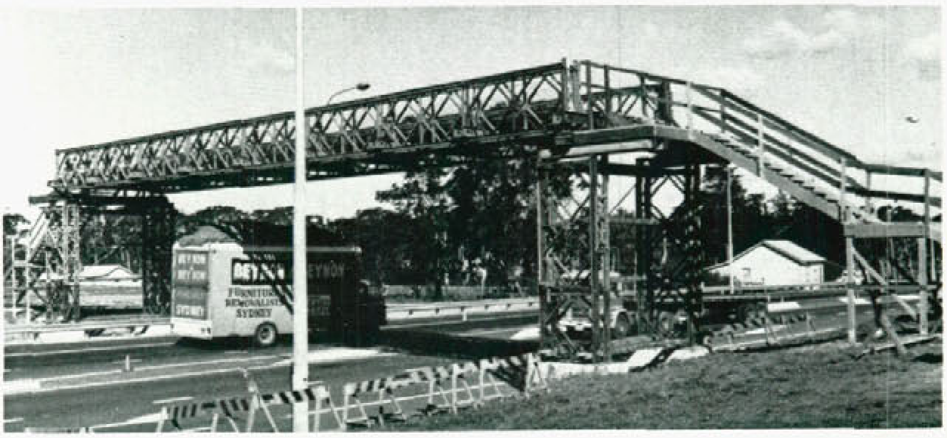
On completion of the Yanderra-Aylmerton section of the South Western Freeway, a bailey bridge was erected over the Hume Highway at its intersection with Wilson Drive (which leads to Colo Vale). The bridge was erected primarily for the use of school children crossing the Highway on their way to and from the nearby Aylmerton Public School.

The pedestrian overbridge was considered necessary because southbound traffic on the Highway at this point has just left the southern end of the Freeway and is generally travelling at higher speeds than were usual before the Freeway was opened.

The temporary bridge was erected to meet the needs of pedestrians until the construction of the next section of the F5 south of Aylmerton is completed, at which time a permanent crossing will be provided.

The structure is officially described as a double single reinforced bailey truss. The main span is 24.4 m long, 3 m wide between trusses and weighs 20.3 tonnes, including decking. It was lifted into position using a mobile crane on Saturday, 21st May, 1977.●

These photographs show the "look" and location—but not the bright orange colour—of the temporary footbridge built over the Hume Highway at Aylmerton.



WORK ON THE HUME HIGHWAY SOUTH OF CROSS ROADS IN THE LATE 1920's

Fifty years ago, the Main Roads Board was in the process of undertaking major work on the Great Southern Road (now the Hume Highway) between Cross Roads and Narellan. The following extracts are from a report published in the February, 1931 issue of "Main Roads" (Vol. 2, No. 6, pp. 87–90). They make interesting reading (especially the calculations of cost-benefits and the emphasis on the national character of the work), echoing as they do more recent calculations and comments about the latest section of the South Western Freeway (see previous article on pages 106–8).

"In the first years of the colony, the main southern route from Sydney Cove and Parramatta ran by way of Prospect, Carne's Hill, and Narellan to Camden, as those localities came to be called, and took its name from the Cowpastures. While the road between Carne's Hill and Narellan remained a portion of the main southern route, after a comparatively brief era the importance of the portion between Prospect and Carne's Hill waned with the discovery of what appeared to be more inviting lands west and north, and with the adoption of the southern route through Liverpool, Cross Roads, and Carne's Hill. This then remained the chief avenue for traffic southward till the reconstruction of the longer route via Campbelltown, shortly before the passing of the Main Roads Act.

In April, 1925, representations were made to the Board by the Nepean Shire Council to have that section of the Great Southern Road between Cross Roads and Carne's Hill reconstructed, in order that adequate connection should be made between the heart of the Nepean Shire and Liverpool. Arrangements were made for the survey, and preparation of plans, specifications, and estimate for this purpose . . .

At a conference of Interstate Road Authorities held in Melbourne in February, 1926, it was decided . . . that, with a view to the adoption of common principles and standards on main road works throughout the Commonwealth, the width of metalling or gravelling on the great trunk highways throughout the Commonwealth should be 20 feet. The road which had been constructed prior to the commencement of the Main Roads Act, via Campbelltown, and round which the southern traffic was being by-passed, had a width of pavement of only 18 feet, and would have required to be widened to conform to the standard. As the Great Southern road proper was also 3 miles shorter than the road via Campbelltown, the Board decided on the 27th May, 1926, that, instead of confining the construction of the pavement on the Cross Roads-Carne's Hill road to that which would be suited to farm traffic, it should be built to a width of 20 feet and in a class of construction suited to carry main highway traffic . . .

The saving to through traffic in operating costs to road users, when the whole section from the Cross Roads to Narellan was completed, promised to be large, due to the reduction in distance of 3 miles from the longer route via Campbelltown. For example, if the through traffic between Camden and Sydney using the shorter route was 400 vehicles per day, the annual saving to traffic at 6d. per vehicle mile would be £30 per day, or £10,950 per year. In actual fact, however, the traffic on all the main roads was then increasing rapidly, and the through traffic between Sydney and Camden—neglecting that which proceeds to Appin and Bulli—had by 1929 reached an average of nearly 600 vehicles per day.

A commencement of the work was made at the Cross Roads on 10th November, 1926, the class of construction adopted being a Telford foundation of sandstone 8 inches thick, covered by a wearing course of 3 inches of premixed bituminous macadam. Timber edge pieces were added at a later stage to reduce the cost of edge maintenance . . .

With the signing by the State of the agreement on the 17th June, 1927, a new phase was entered upon. The emphasis laid in the agreement on the development of a scheme of road improvement that would be national in character, and serve not only the State but the Commonwealth, indicated that the completion of the work between the Cross Roads and Narellan via Carne's Hill was one of the projects that would come under this category.

Accordingly proposals were submitted to the Commonwealth for this purpose, and the project approved as a Federal Aid road work. The national character of the work also suggested that an endeavour should be made to overcome the obstacle of Carne's Hill (maximum grade of 1 in 13), and as this was possible by the adoption of a deviation which reduced the grade to 1 in 21 and shortened the route by 1,200 feet, this deviation was adopted . . .

The country which had been passed through from the Cross Roads, and which is similar to that extending to Narellan, consists of clay of the Wianamatta series, and is of a particularly plastic nature. Difficulty had been experienced with it in wet weather on this and other roads owing to its unstable character. The Board therefore decided that, notwithstanding the higher initial cost, it would be preferable to continue the pavement to Narellan in some form of construction which would form a raft and spread the load as widely as possible. The ideal pavement for this purpose was cement concrete, which was therfore adopted.

During the collection of the materials for this pavement, the unstable character of the clay was demonstrated. While dry weather prevailed no serious difficulty was experienced, but after heavy rains, during which the subgrade became saturated, portion of the completed bituminous pavement yielded, due to the failure of the foundation. This was specially marked on the deviation, which had had less time to consolidate than the earlier section. Repairs were effected at a cost of £1,331, and the road has since given satisfactory service. The failure was purely a subgrade failure, and was in no sense due to faulty workmanship. This experience further demonstrated the importance of tests being made of subgrade soils to assist in determining the class and thickness of pavement to be adopted. Prior to the establishment of the Board's testing laboratory it had not been possible to do this, but this is now an important phase of the laboratory work . . .

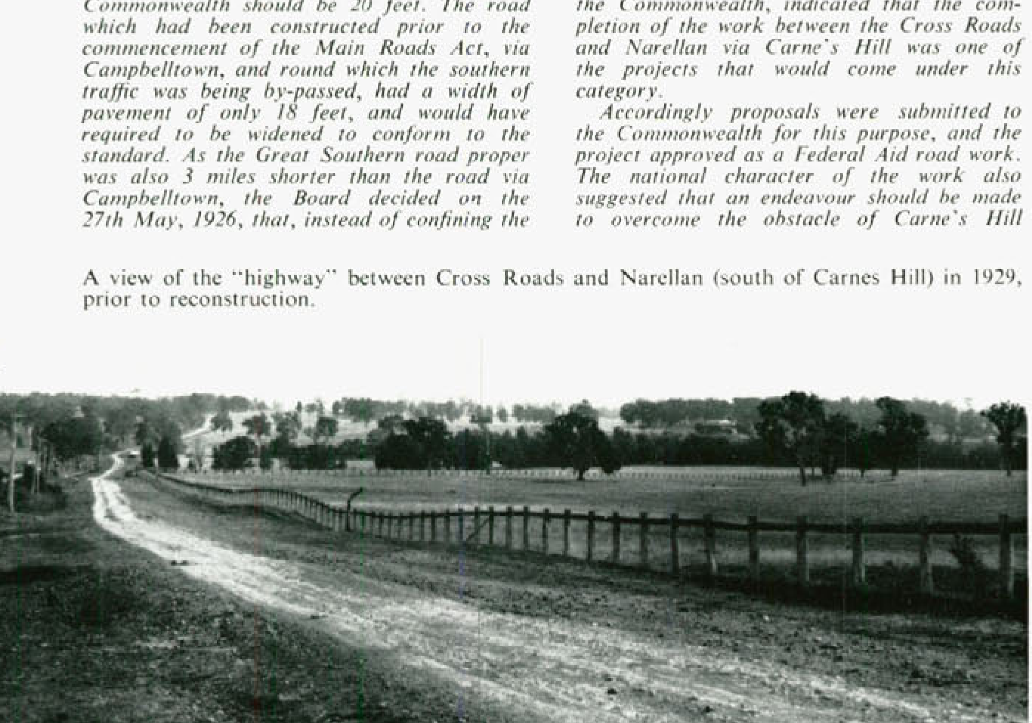
The construction work consisted of a central cement concrete pavement 20 feet wide, flanked by 4 feet shoulders. The pavement was 7 inches thick, with edges thickened to 9 inches, the mix being 1-2-3½. Crushed gravel was used for 4½ miles and round gravel for the remaining 3½ miles. The mixer used was Rex paver No. 4 of 27 cubic feet capacity. The pavement was reinforced with edge bars throughout and with bar mat on the fills, the area reinforced with bar mat being about 18,000 square yards of a total area of concrete laid of 89,093 square yards.

Barber Greene loaders were used for loading the 1½ inch and ¾ inch metal into batches. The sand for the concrete batches was hand loaded into the lorries for haulage to the mixer, as a mechanical loader could not be made available for the purpose . . .

The average output of the concrete paver per available working day throughout the work was 326 square yards. Some very high "peak" outputs, however, were obtained, viz., 2,334, 2,000, 1,999 2,001, 1,900, 1,888, 1,889 and 1,880 square yards per day, and the average per day worked was maintained at a high level, viz., 1,451 square yards . . .

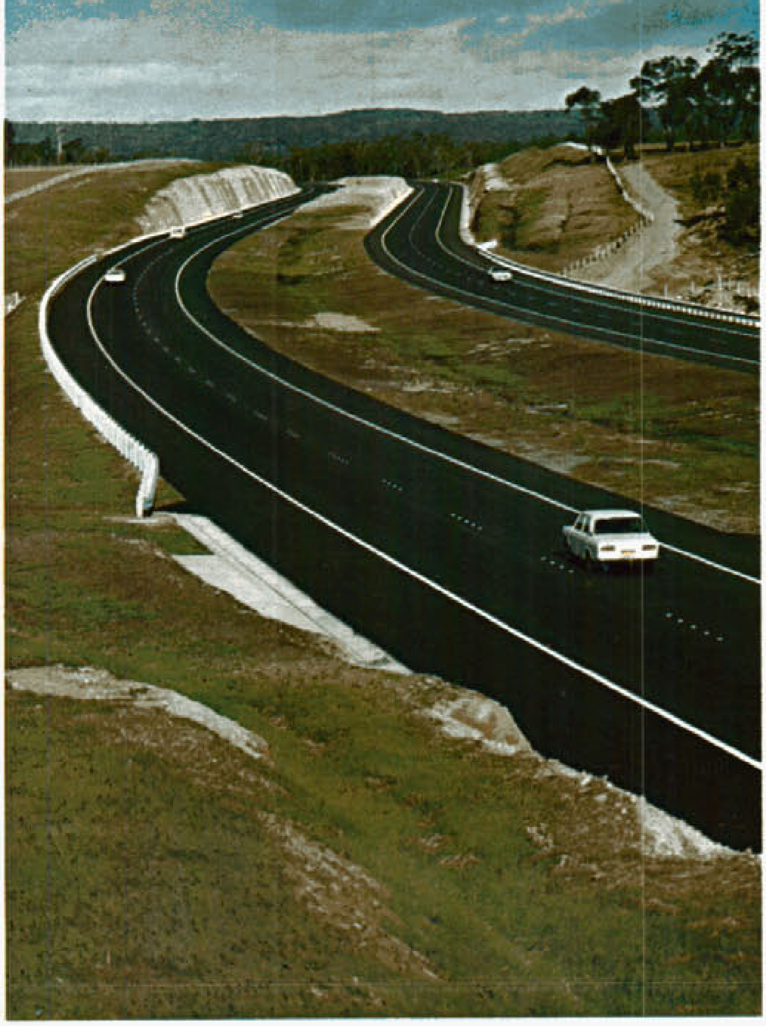
The concrete pavement complete (including edge bars and dowel bars) was laid at a cost of 13s. 7d. per square yard."

A view of the "highway" between Cross Roads and Narellan (south of Carnes Hill) in 1929, prior to reconstruction.



Continued on page 127.

SOUTH WESTERN FREEWAY



New section opened between Yanderra and Aylmerton

LONG, SLENDER NEW BRIDGE AT GUNDAGAI

May 1976

July 1976

July 1976

July 1976

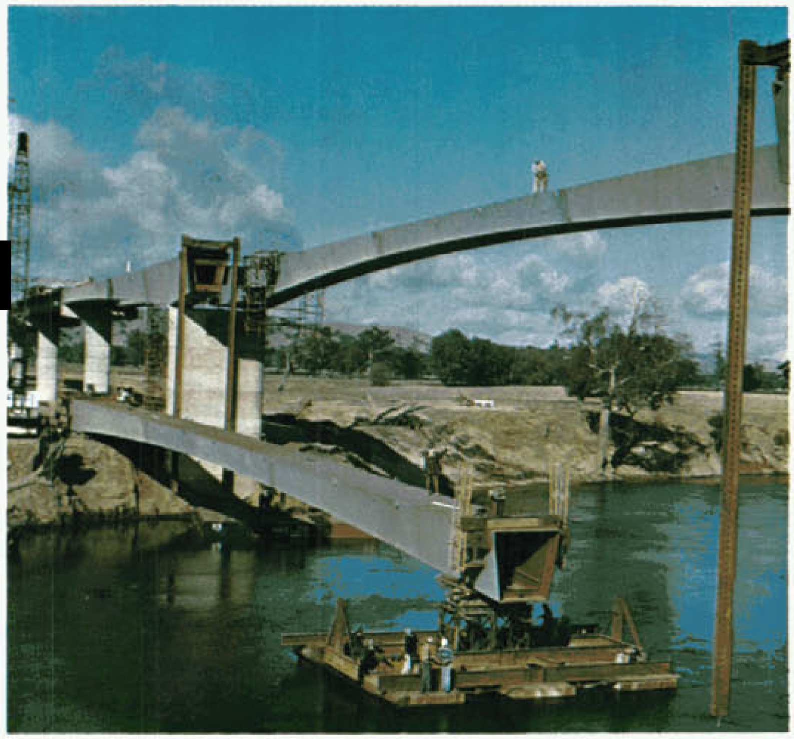
AND ELEGANT

The appeal of bridges, like most architectural structures, is measured firstly by their usefulness and secondly by their attractiveness. That is, they are judged by the way they do their job and by the way they complement or add to the beauty of their surroundings. Both of these aspects are a reflection of the skill of the engineers who design and build them.

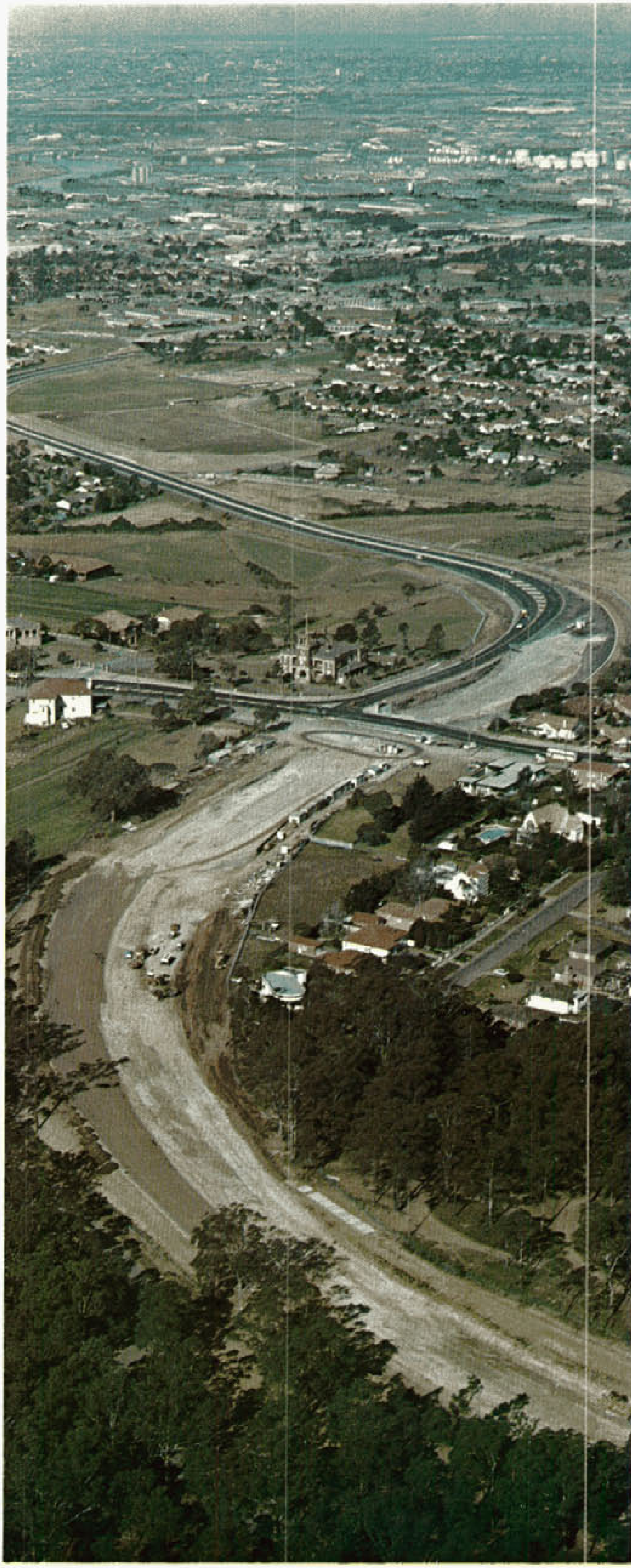
In terms of the all-weather access provided for road-users across the wide flood plain of the Murrumbidgee River at Gundagai and in terms of the visual impact of such a long structure, the new Sheahan Bridge measures up to the highest standards.

As these photographs show, even while the bridge was being built, it looked impressive — especially reflected in the quiet waters below. It is an outstanding example of the art of Departmental engineers and of the contractors for its construction.

See article on pages 117–120.



August 1976



PARRAMATTA BY-PASS NEW SECTION OPENED

Church Street, Parramatta forms part of State Highway No. 13, which is an (as yet) unnamed highway running from the Hume Highway at Lansdowne to the Pacific Highway at Pearces Corner, Wahroonga. This highway in turn forms part of Ring Road No. 5 which is a very popular circumferential route.

For some years it has become increasingly clear that Church Street (which runs right through the busy commercial centre of Parramatta) has been battling to adequately cope with the ever-increasing traffic volumes which seek to use it. There are only four lanes through the main shopping area and these are invariably reduced to two, by vehicles parking in the kerbside lanes. The need for a by-pass of this route has become more and more pressing as areas to the north and west have been developed. This residential development has resulted in an excessive amount of traffic using Church Street on both business journeys and pleasure trips.

The 1975 annual average daily traffic volume (in both directions) in Church Street north of Phillip Street, near Lennox Bridge, was 26 100 vehicles. Such a high volume of traffic (much of which does not wish to stop or shop in Parramatta) inevitably means that some drivers begin to look for alternative routes. Unfortunately, they sometimes choose roads which have not been designed or accustomed to deal with through traffic.

Opposite page:

Left: Looking south over the new section of the Parramatta By-pass, showing the overbridge at Kissing Point Road (in the centre) and the intersection with Victoria Road (in the background).

Right: This view shows (in the foreground) the continuation of the construction of this final new route north of Pennant Hills Road (in the centre).

In order to alleviate this situation, the Department has planned for a number of years to construct a by-pass around Parramatta, specially designed and built to cater for through traffic. It is hoped that such a by-pass will reduce delays through the business centre and will also allow other roads to revert to their proper role as residential streets for local traffic, rather than as overflow channels for excess through traffic.

The by-pass is part of a proposed County Road, which will eventually form a circumferential route to the east of Parramatta from Woodville Road (State Highway No. 13) near Merrylands Road, Merrylands to Windsor Road (Main Road No. 184) near Briens Road.

Work was begun back in the 1960's with the construction of a new six-lane bridge over the Parramatta River to link Aston Street, Camellia on the south to Rydalmere Avenue, Rydalmere on the north. Both of these roads form part of Main Road No. 309.

The new bridge was opened to traffic on 22nd June, 1966 (see details in the September, 1966 issue of "Main Roads", Vol. 32, No. 1, p. 24). As part of this initial project, the approaches to the bridge were widened to six lanes as far south as Hassall Street and as far north as Victoria Road (Main Road No. 165).

The traffic signals allowing the first vehicles to use the new section of the Parramatta By-pass, between Rydalmere Avenue, Rydalmere and Pennant Hills Road, North Parramatta were switched on by Mr B. Wilde, M.L.A., Member for Parramatta (centre), watched by Mr B. Butcher, Divisional Engineer, Parramatta (left) and Mr A. Short, District Traffic Engineer (North) of the Department's Parramatta Divisional Office.

The first major section (1.5 km) of the by-pass road from Rydalmere Avenue at Victoria Road to Pennant Hills Road (State Highway No. 13) at North Parramatta was opened to traffic on 6th June, 1977, although traffic had been using the short length to Kissing Point Road (Main Road No. 574) for some time before. The cost of this section was, in round figures, $3 million and included the construction of overbridges at Kissing Point Road (opened on 13th November, 1975) and Belmore Street, East Dundas. At Kissing Point Road, a pedestrian bridge over the southbound loading ramp has also been provided adjacent to Macquarie High School (see details in the December, 1976 issue of "Main Roads", Vol. 42, No. 2, pp. 38–9.

Work on the next 1.5 km section from Pennant Hills Road to Windsor Road is continuing and is expected to be completed by mid-1979 at an estimated cost of $4.75 million. Construction of the by-pass is being supervised by the Department's Parramatta Divisional Office under the Divisional Engineer, Mr B. H. Butcher.

On completion of the second section road-users will be able to appreciate the full potential of the by-pass and to travel on a high standard road, without interruption due to cross traffic, from the traffic signals at Victoria Road, Rydalmere through to Windsor Road, Northmead. To achieve this objective without interfering with the existing street system, the construction of a number of new bridges is required.

These include a grade-separated interchange at Pennant Hills Road and bridges over Lackey Street, Hunts Creek, North Rocks Road and Darling Mills Creek. A second interchange will be constructed at Windsor Road and an underpass will be provided at Lake Parramatta Reserve.

The second section of the by-pass affects the southern portion of Lake Parramatta Reserve (which is under the care and control of Parramatta City Council). This has inevitably led to some criticism of the Department. However, after consideration of a number of alternatives, it is considered that this route provides the least disruption and the maximum benefit to the community as a whole while still satisfying anticipated traffic needs.

Detailed investigations were carried out into the practicable alternatives. These studies determined that the relocation of the road to the northern and eastern side of the Lake would have discouraged its use by much of the traffic on the existing street system. Relocation of the road further to the south would have necessitated the acquisition and demolition of a number of residences. Either relocation would have added considerably to the cost of the work.

During construction, the Department is taking every measure to safeguard as much as possible the natural beauty of the Reserve. It is considered the by-pass will not seriously affect any of the existing conditions or future development of the Lake Parramatta Reserve. In fact, it is more likely to generate interest in an enjoyment of the Reserve rather than detract from it.

Extension of the by-pass beyond Windsor Road in the future will depend on further funds becoming available. However, it is intended to continue, as soon as possible, with the construction of the County Road along Briens Road to join with Old Windsor Road near Hammers Road. Later, this road will be continued on to link with the Great Western Highway near Emert Street, Wentworthville.

Work by the Department is also proceeding on the reconstruction of Aston Street between Hassall Street and Eleanor Street, Rosehill. This work will extend the six-lane construction of the by-pass which at present only goes as far south as Hassall Street. The reconstruction covers a length of just under 1 km and the estimated cost is $750,000. The work is expected to be completed by the end of 1977.

As the *Parramatta Advertiser* said in an editorial on 11th March, 1971 (when it reported the "*momentous news*" that work was about to begin on the by-pass); "*It looks at last as though things are starting to pop around here . . . Now the first moves have been made . . . We want this movement to continue at speed . . .*"

So does the Department, but . . . speed depends on finance and, unfortunately, limited funds mean priorities have to be established. With the many other Main Roads works urgently needed elsewhere in the County of Cumberland, it is not possible to concentrate entirely on one project, no matter how worthy it is.

But the next section of the Parramatta By-pass will be well worth waiting for. Again let us quote from the *Parramatta Advertiser* of 11th March, 1971 when the then Mayor of Parramatta stated, in words that are even more relevant today:

"*It is a mammoth construction plan, and will bring Parramatta's roadways into comparison with the best through roads in the world.*

The Church Street-North Rocks bottleneck will be gone forever. So, too, will the tedious drive through Church and O'Connell Streets, seeking a way to and from work, or a possible parking spot while the shopping is done.

This will be the greatest thing ever to happen to Parramatta." ●

A brief outline of the Parramatta By-pass, together with a map, appeared in the December, 1973 issue of "Main Roads", Vol. 39, No. 2, p. 55. An aerial colour view of construction in progress appeared on the back cover of the March, 1975 issue, Vol. 40, No. 3.

A scale model showing the route of the by-pass from Rydalmere to Northmead is on display in the foyer of the Department's Parramatta Divisional Office at 111–113 George Street, Parramatta (tel. 635 4044).

State's Second Longest Road Bridge

SHEAHAN BRIDGE GUNDAGAI CONSTRUCTION COMPLETED

25th March, 1977 was a busy day for traffic on the new Sheahan Bridge following the official opening.

On Friday, 25th March, 1977, the Premier, the Hon. N. K. Wran, Q.C., M.L.A., officially opened the "Sheahan Bridge" over the Murrumbidgee River at Gundagai. The new bridge, which is 1 143 m long, is the second longest road bridge in New South Wales and the longest ever built by the Department. (Sydney Harbour Bridge, is the longest road bridge—being 1 149 m long). The new structure supersedes the existing Prince Alfred Bridge, completed in 1866, as the Hume Highway's Murrumbidgee River crossing.

The new bridge is named in honour of the late Hon. W. F. "Billy" Sheahan, LL.B., Q.C., M.L.A., who represented the district in the Legislative Assembly from May, 1941 to October, 1973, a continuous period of over 32 years. (More biographical notes are given on page 121).

The Sheahan Bridge is a composite steel and concrete structure of 27 spans, three over the main channel and 24 spans forming a viaduct across the flood plain on the southern side of the river.

The main spans, supported on reinforced concrete piers, are two variable depth closed steel box girders with a concrete deck. The viaduct spans, supported on prestressed concrete piers, are two open steel trough girders, trapezoidal in shape, with a concrete deck.

The northern abutment is a counterfort retaining wall with subsidiary retaining walls and the southern abutment is an open spill through frame. The foundations are mainly cast-in-place piles.

Location and Foundations

The new bridge lies on a 7.4 km deviation of the Hume Highway (still under construction) which by-passes the central portion of Gundagai, but permits adequate access to the town. The deviation will eventually be a four-lane divided motorway. A second bridge will be constructed at a later date alongside the new structure and will be used for southbound traffic only. At that time, the present bridge will be used solely for northbound vehicles.

The route of the new deviation was chosen after extensive investigation and was designed to provide the Highway with an improved alignment, above the highest known flood level reached by the Murrumbidgee River at this site. The new location and design were also planned to ensure that the construction of the bridge and its approaches would not result in the raising of flood levels in Gundagai.

After the route was selected, test bores were taken along the line of the bridge and these showed that shale occurred approximately 24 m below ground level. The shale was overlaid by gravel and soil.

The Department's own piling organisation placed a total of 106 piles, 980 millimetres in diameter, using a Benoto Super EDF pile boring machine. This machine forms the piles by forcing a steel drilling tube into the ground with an oscillatory motion, the loosened material inside the tube is removed and a reinforcing cage lowered into the empty tube. Finally, concrete is placed through a tremie and the steel tube withdrawn.

Before calling tenders to construct the bridge, four of the foundation piles were test loaded with a load 50% higher than the maximum design pile load, to ensure they could carry the imposed load either by end bearing, friction or both. The test loading proved satisfactory and a contract was let with Transbridge Pty Ltd to construct the bridge.

Pile Caps and Column Segments

Prior to letting the contract, a short section of the concrete at the top of each pile was stripped to expose the reinforcement. This exposed reinforcement provided anchorage with the reinforced concrete pile caps which were poured to join the piles rigidly and provide a base to support the piers.

Short lengths of high-strength bars were also anchored in the pile caps using a template to position them accurately. After the concrete had set, the full length bars to stress the pier segments together were attached to these short projecting lengths.

The pier columns were then built up from precast segments which were approximately elliptical in shape. Each segment was lifted by crane, the high-strength bars were fed into the ducts provided and the segment lowered into position. A mortar joint was placed between each segment so that they could be levelled and the height adjusted.

The height of the pier columns vary from 5.5 m to 11 m. A prestressed concrete design was chosen because of the relatively small cross section of the column. Three bar patterns were used in the columns, 16 bars at piers with fixed bearings and either 8 or 10 in the remainder.

Precast segments were chosen because it was economical for the large number of piers and suited their varying height. The segments were precast by Monier Pty Ltd in Wagga Wagga and transported to the bridge site by road.

Headstock Segments and Bearings

The headstock segments weigh 40 tonne each and were cast adjacent to each pier. After gaining sufficient strength they were lifted into position over the high-strength bars protruding from the pier columns. These bars stress the column and headstock and bind the segments together.

To strengthen the headstock transversely each segment is post-tensioned with bars similar to those in the pier. The stressing took place in two stages, the first stage after the concrete had reached a strength of 40 MPa, the second after the steel girders were erected and the deck poured.

The bearings at the abutments are steel fixed bearings which only permit rotation. The viaduct structure is also anchored by fixed bearings at the centre pier of each four-span continuous length. The remaining bearings are rubber "pot type" bearings which permit rotation and which incorporate polished stainless steel and PTFE (teflon) surfaces and allow the structure to slide when expansion and contraction occurs.

On 25th March, 1977, the Premier, Mr Neville Wran, cut the ribbon to officially open the structure, named it Sheahan Bridge and unveiled a plaque at the northern abutments. Watching Mr Wran are (from left) the Commissioner for Main Roads, Mr A. F. Schmidt; the Member for Burrinjuck, Mr Terry Sheahan; and the Minister for Transport and Highways, Mr Peter Cox.

Steel Box Girders

The steel girders for the viaduct spans were fabricated by Transfield Pty Ltd in Sydney and transported to the site in sections. The sections of girder were then lifted on to falsework.

The ends of joining sections were then levelled and aligned and the mating ends held together by tack welding. Finally the joint was fully field welded around the entire joint.

The three variable depth main span girders were fabricated partly by Transfield Pty Ltd in Sydney and partly by McAuleys Pty Ltd in Newcastle. The girders were fabricated in sections and taken by road to the site. The two spans adjacent to the main channel were erected in a similar manner to the viaduct girders and on completion each cantilevered 7.6 m into the main span across the river channel, leaving a gap of 64 m.

This gap was closed by a 64 m girder made up from three sections which were welded together on the adjacent bank. This girder was then launched into the river and supported at each end by a pontoon. The girder was attached to ties hanging from frames supported on the cantilevers and jacked into position. After levelling and alignment the central girder and cantilevers were joined by welding.

Concrete Deck

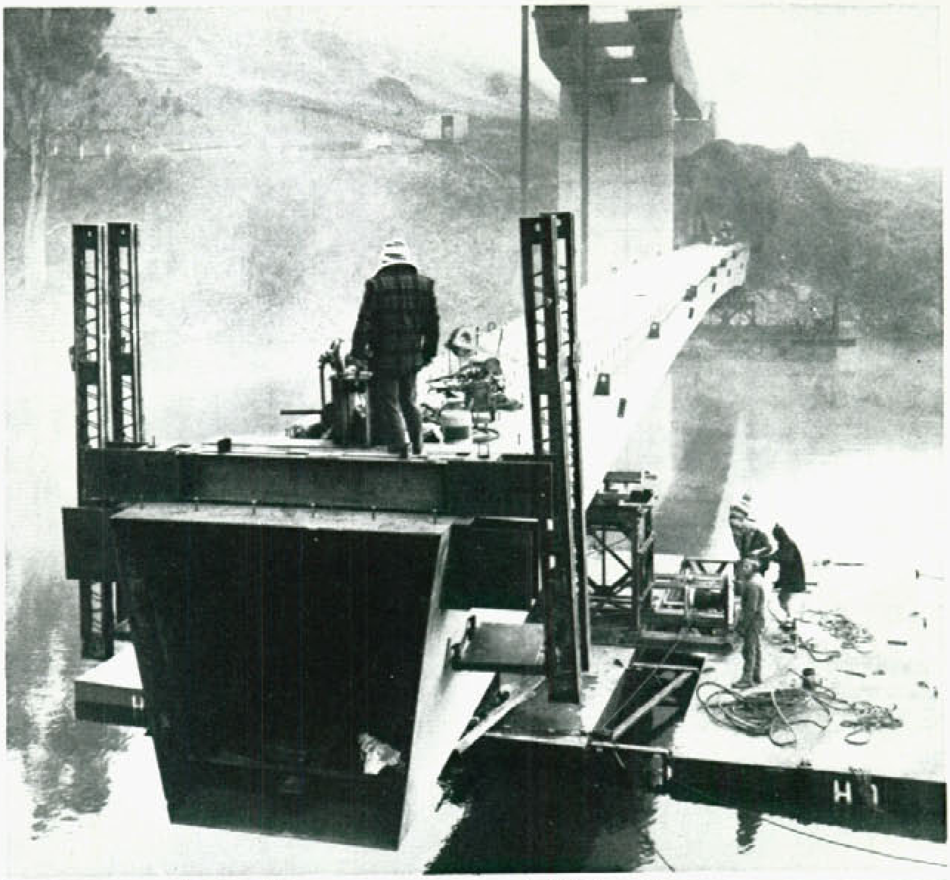
In the viaduct spans, formwork for the base of the deck was required between the girders and between the open trough girder flanges. The formwork between the girders was supported from above by ties hanging from light frames which were, in turn, supported on legs sitting on the top flanges of the girder. The formwork in the open trough of the girders was supported by longitudinal timber stringers seated on transverse steel angles attached to the girder webs. A similar method was adopted for the formwork between girders in the three main spans.

After the deck reinforcement was positioned, the concrete was placed. The initial concrete pours were placed in the midspan either side of the pier and then over the pier. This pattern was adopted to produce the tensile stresses over the pier. A similar sequence was adopted for the three main spans.

The stud shear connectors welded to the top flange of the girders project into the concrete deck and were bonded with the concrete when it set to form a composite steel girder and concrete deck structure. In this way, the girders and the deck act as one unit to support subsequently applied loads.

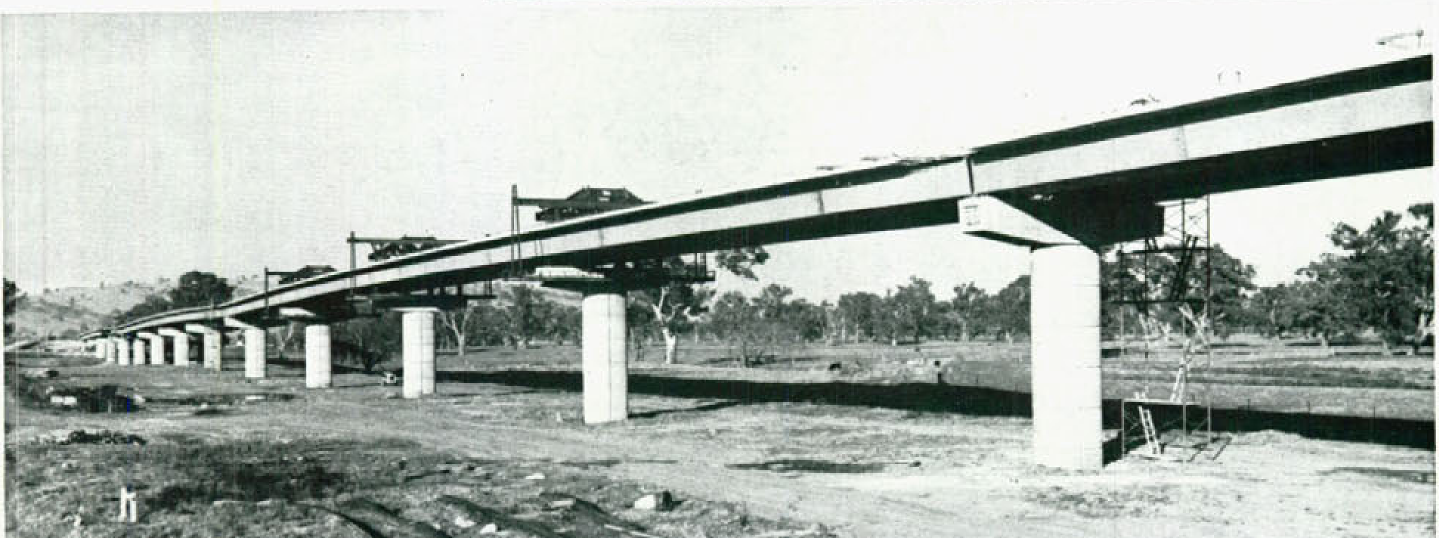
Lowering of Deck Superstructure

In the viaduct structure, each four-span continuous length was initially erected on raised temporary supports to introduce a camber. After the concrete deck had cured the superstructure was slightly raised, the temporary supports removed, and the superstructure carefully lowered onto the final bearings. This method redistributed the stresses in the girder,



Right: The first of the two 64 m long girders which formed the main span of the river channel being manoeuvred into position—while supported on two pontoons. August, 1976

Centre: The second girder of the main river span being moved into position for launching onto the pontoons. August, 1976



Bottom: Two sections of four-span continuous lengths as initially erected on raised temporary supports, showing the camber prior to controlled lowering onto the final bearings. August, 1976

reducing them at the pier and increasing them in the midspan. This technique avoided large changes in the girder cross-section and in addition produced a slight initial compression in the concrete deck. That, in turn, reduced cracking resulting from shrinkage. The cost to lower the structure is offset by the saving in steel.

To lift the superstructure of each four-span section, heavy truss type double frames were placed over each intermediate pier, supported by column legs passing through voids cast in the deck and resting on the headstock.

The double frames were connected by four short girders and on each of these a jack was seated. The jacks held a high-strength bar anchored to a steel connector block located above the deck surface. From the connector block, two more high-strength bars passed through voids in the deck and were anchored against two plates welded to stiffeners in the girder.

Through this jacking arrangement the girders and deck were initially raised to allow the temporary supports to be removed and then the deck was gradually lowered on to the final bearings.

With the superstructure completed, the bridge crash railing and the asphaltic concrete running surface could be placed.

Summing It Up

The bridge and its associated roadworks will cost in excess of $6 million. The contract price for the bridge was $3,296,000 and the cost to build and test the piles was $330,000.

Construction of the bridge commenced on 9th April, 1974 and took place during a period when high rainfalls were experienced locally. In fact, flooding of the Murrumbidgee River occurred at the bridge site on eight occasions during the construction period.

Opening Ceremony

It was a glorious sunny morning on 25th March, 1977 when an estimated crowd of 3 000 people (including busloads of children from nearby schools) gathered at the northern approach of the new bridge to watch the official opening ceremony. A special guest was Mrs Ellen Sheahan, widow of the late "Billy" Sheahan, after whom the structure was named.

Proceedings were chaired by the Commissioner for Main Roads, Mr A. F. Schmidt. The speakers were Alderman J. A. Lindley, President, Gundagai Shire Council; Mr T. W. Sheahan, B.A., LL.B., M.L.A., Member for the State Electorate of Burrinjuck; Mr S. A. Lusher, M.P., Member for Federal Electorate of Hume; the Hon. P. F. Cox, M.L.A., Minister for Transport and Highways; and the Hon. N. K. Wran, Q.C., M.L.A., Premier of New South Wales.

In his address, Mr Cox made the following remarks.

"*This new bridge is certain to prove advantageous both as a highly effective bypass route for capital city traffic using the highway and for residents of the township itself. In both respects it was an inevitable development and the Sheahan Bridge, together with the subsequent deviation of this crucial road link, will mean immeasurably improved conditions for Hume Highway travellers . . .*

The Hume Highway deviation will mean a number of plusses for Gungagai itself as a result of a significant reduction of through traffic. The cutback in through traffic will mean reductions in noise levels, air pollution from exhaust emission and damage to street pavements which is particularly exaggerated by the large number of heavy and often overloaded vehicles using the Hume Highway. More importantly, it will have a marked effect on the incidence of road accidents in the town and its surrounds by removing competition between local and through traffic . . .

I am aware that there has been some concern expressed in Gundagai about the potential loss of business in the township when the bypass is opened to traffic. Surveys conducted in the United States do not support this feeling and studies in California have shown in fact that towns bypassed by a freeway invariably increase there business. Admittedly after an initial loss in the early stages. And if I could give you an example in New South Wales, Port Macquarie is a typical example of a town that has continued to flourish after the highway bypassed that particular centre . . ."

Before proceeding to cut the ribbon and unveil a commemorative plaque, the Premier, Mr Wran declared:

"*Gundagai . . . is part of Australia's history. It is a symbol. It's been made a symbol through the 'Dog on the Tucker Box' and perhaps the song 'On the Road to Gundagai'. This bridge will continue that symbolism of the importance of Gundagai to the State and to Australia. . . as a great tourist centre.*

It is a great privilege to be associated with all the people who have contributed so much to make this great bridge a feasible and real undertaking and to bring it into the reality that it is right now." ●

With the first girder of the river span already jacked up into position, the second girder is about to be attached to the ties hanging from frames supported on the cantilevers—ready for its turn to go up. August, 1976

An article on the design of the new bridge at Gundagai appeared in the March, 1974 issue of "Main Roads", Vol. 39, No. 3, pp. 66–9.

A detailed description entitled "Design of the Bridge over the Murrumbidgee River at Gundagai" by J. R. Anderson, B.E., M.Eng.Sc., M.I.E.Aust. (who was the Department's Resident Engineer during construction of the bridge) appeared in the Australian Road Research Board Conference Preprints, Vol. 8, Session 14, 1976, pp. 21–31.

An earlier article on design investigations using a model to simulate flood conditions appeared in the June, 1964 issue of "Main Roads", Vol. 29, No. 4, pp. 118–9.

Back in the February, 1932 (Vol. 3, No. 6) issue, there is an article on the old bridge, outlining some of the work undertaken between 1865 and 1932.

HON. W. F. ("BILLY") SHEAHAN, LL.B., Q.C., M.L.A.

Above: The late Mr W. F. Sheahan, photographed in 1958.
(By courtesy of N.S.W. Government Printer)

Right: In 1959 Gundagai Shire Council obtained permission to informally name the section of the Hume Highway from the corner of Sheridan and West Streets, Gundagai to the Pioneer Monument ("The Dog on the Tucker Box") as The Sheahan Drive. The gazetted name Hume Highway still formally applies to this section.

Striking black metal signs were subsequently erected by Council at each end and Sheahan Drive was officially "dedicated" by the then Premier of New South Wales, Hon. R. J. Heffron, M.L.A. on 3rd November, 1961, which was opening day of Gundagai's Golden Corroboree Festival. The signs are made of mild steel on angle iron supports and stand approximately 8 m high. They were designed for Council by a Sydney sculptor, Mr Owen Shaw of the National Art School.

Lower right: In jovial mood, Mr Sheahan proceeds to cut the ribbon to officially open the bridge over the Murrumbidgee River at Jugiong (between Yass and Gundagai) on 3rd July, 1965. This bridge was built by the Department as Developmental Work No. 3096 and is described in an article entitled "The Jugiong Bridges" in the September, 1965 issue of "Main Roads", Vol. 31, No. 1, pp. 18–19, in which other photographs of Mr Sheahan appear.

It is interesting to note that the nearby Jugiong Hotel, an historic inn on the Hume Highway, was built by Mr Sheahan's grandfather in 1855.

When the Premier, Hon. Neville Wran, Q.C., M.L.A., officially opened Sheahan Bridge on 25 March this year, he said that it was a fitting tribute to name the bridge after a great man who was a fighter for great causes. Mr Wran added that "Billy" Sheahan's name was synonymous with parliamentary honesty, and that he was a man who gave valuable service to his country, to his State and to his electorate.

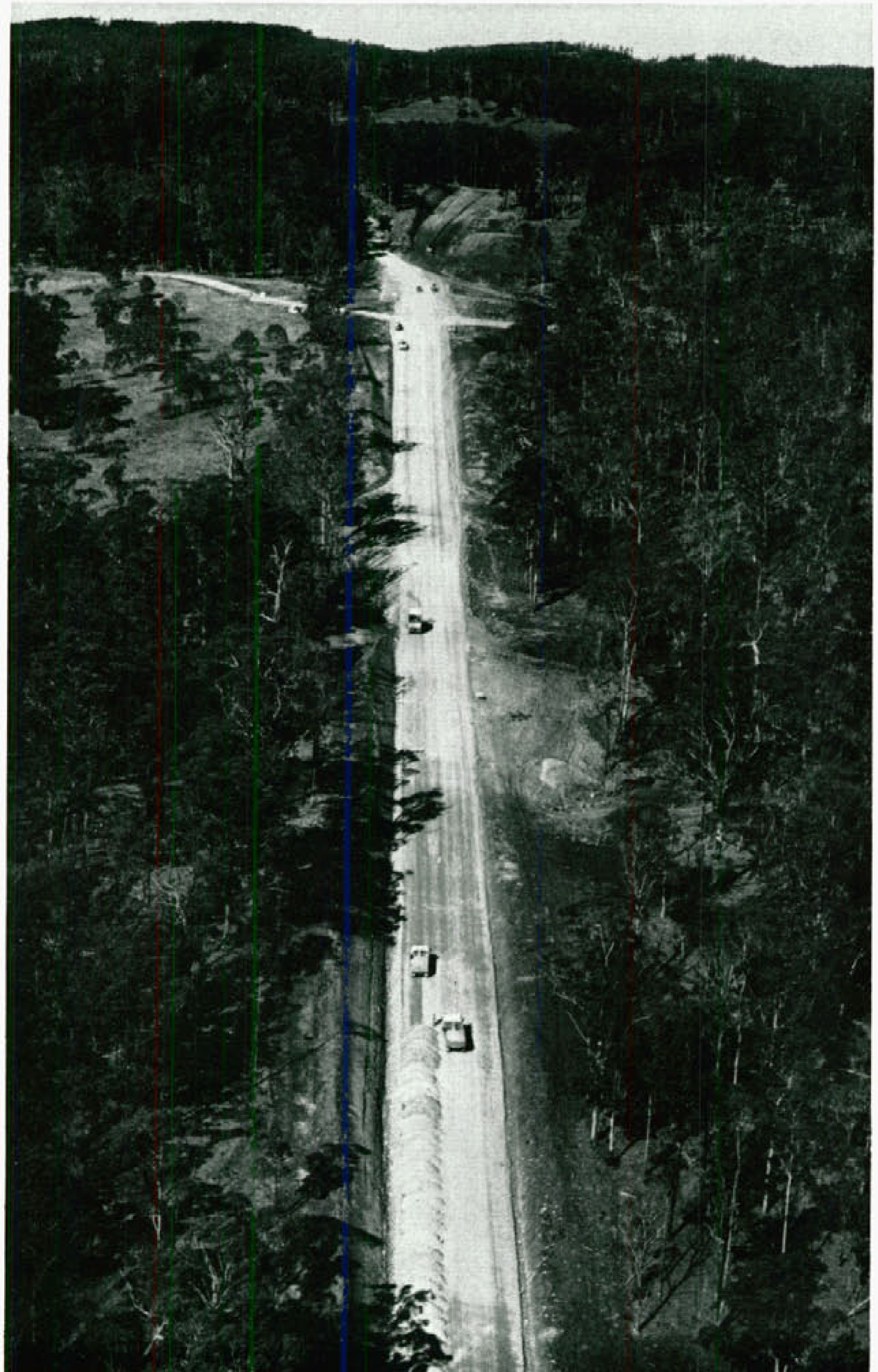
William Francis Sheahan was born on 3rd September, 1895 at Tumut. He was educated at St Patrick's College, Goulburn, and the University of Sydney where he obtained a Bachelor of Laws Degree. During World War I, he served in the 17th Battalion of the first AIF and then until 1930 he worked in the State Crown Law Department. After joining the Australian Labor Party he became a member of the Federal Executive. He was elected State Member for Yass from 1941 to 1950 and Member for Burrinjuck from 1950 to 1973.

During his long parliamentary career, Mr Sheahan was Minister for Lands (1947–1950), Minister for Transport (1950–1953), Attorney General (1953–1956) and Minister for Health (1956–1965). As Minister for Transport from 29th June, 1950 until 22nd February, 1953, he was responsible for the administration of the Main Roads Act. He was associated directly with the work of the Department during the period when Mr A. E. Toyer was Commissioner for Main Roads.

Mr Sheahan was active in Gundagai's community affairs and initiated a number of beneficial projects in the district. Some of the activities with which he was involved were the soldier settlement scheme, the modernisation and enlargement of Gundagai District Hospital, the establishment of the high school, the rebuilding of the court house, and assistance to the home for the aged.

Mr Sheahan retired from politics in 1973, when his son Terry took over as Member for Burrinjuck. He died on 27th December, 1975.●

Oxley Highway



The Oxley Highway extends for just under 660 km from the Mitchell Highway at Nevertire through Warren, Gilgandra, Coonabarabran and Gunnedah to the New England Highway at Tamworth, then from the New England Highway at Bendemeer, through Walcha to the Pacific Highway near Wauchope and on to Port Macquarie.

On 7th June, 1977 bituminous surfacing of the entire length of the Oxley Highway was completed, thus providing road-users with a dustless surface on this important major route across the northern tablelands to the coast. This was the culmination of a programme of reconstruction commenced in 1963 to seal those sections of the Highway in the Shires of Hastings and Walcha which still had only a gravel surface—and to make available improved travelling conditions between Port Macquarie and Bendemeer.

By 1971 most of the work in the Hastings Shire had been completed, including a difficult section where the road climbs the escarpment of the Great Dividing Range from Ralfe's Creek to near Mount Seaview on the Shire boundary (but excluding a short length west of Yarras). The bituminous surface had, by then, also been extended east from Walcha for approximately 35 km as far as the Tia River.

Left: Aerial view taken near Yarrowitch in August, 1976 showing construction in progress on section of a deviation from 44 to 51 km east of Walcha.

Right: The reconstructed highway passing through open rolling hills, east of Walcha.

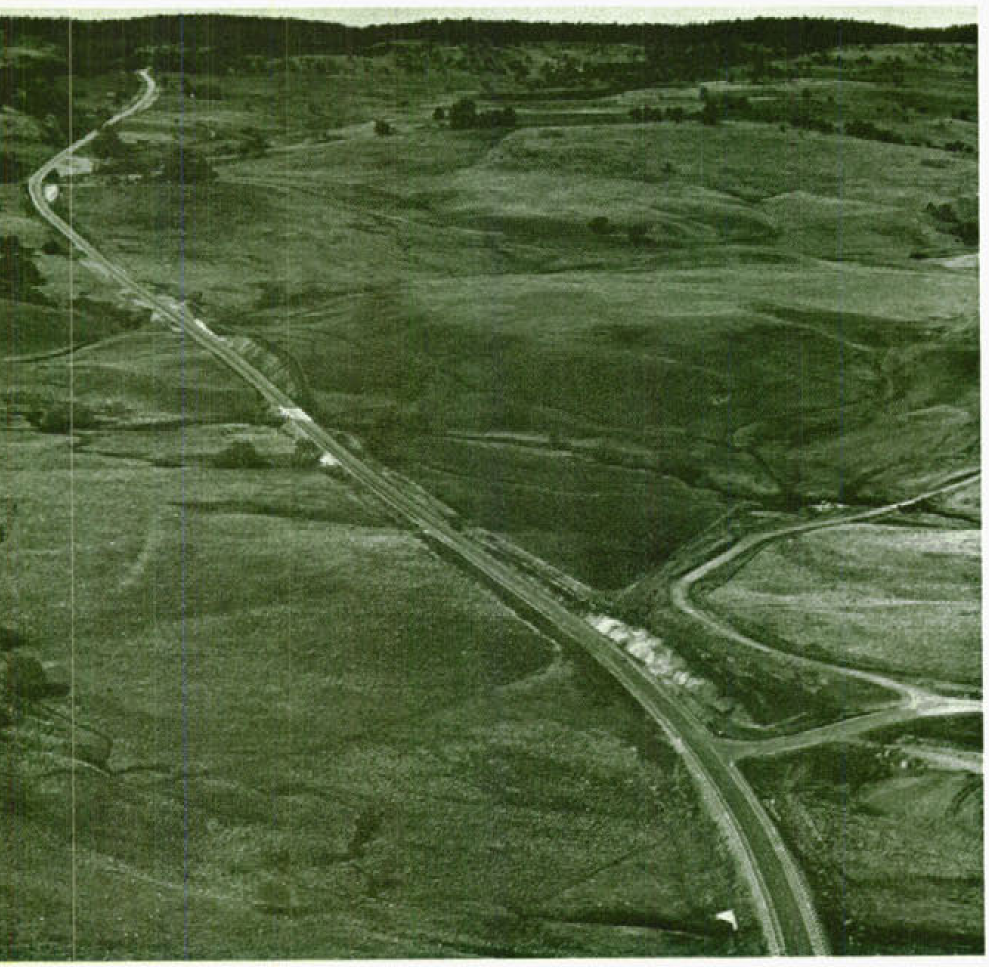
Sealing Completed

Over the last six years, the intermediate section of about 45 km centred on Yarrowitch has been reconstructed and sealed, and a number of new bridges and culverts have been built. This has meant the provision of a road between Walcha and Port Macquarie which is built with a high standard of grading, alignment and surface along its entire length.

Standard of Design

From Walcha to approximately 55 km east of the town, the road passes through gently sloping, sparsely timbered tableland country used mainly for grazing, at an elevation of up to 1 130 metres. The open views, sparseness of timber, easy grades and absence of deep road cuttings on this section are an inducement to high speed travel, and it was considered necessary to adopt a 100 km/h design standard.

At about 55 km east of Walcha, near the settlement of Yarrowitch, there is a marked change from open grazing to dense forest country, most of the land being a State Forest with only isolated cleared areas. The descent from the plateau starts at about 60 km, with grades increasing towards the east.



A transition section from a design standard of 100 km/h down to a 55 km/h standard was introduced over a distance between 55 and 58 km east of Walcha. From there to the Hastings Shire boundary near Mount Seaview, the existing alignment was maintained and, because of the terrain, it is necessarily of a lower speed standard than the section near Walcha.

The formation was widened to 7.9 metres, with a bitumen seal 6.7 metres wide. While this information width should be adequate for a considerable time, it is likely that the road will need to be widened in the future and so, in the initial construction, culverts were provided which can accommodate a 9.8 metre wide formation.

Bridges

Several major new bridges have been built on the Highway as part of the reconstruction programme.

☆ In 1972 a new bridge over the Tia River was opened. The five-span prestressed concrete bridge is 50.3 metres long and was constructed at a cost of $77,000.

☆ A 100.6 metre long five-span prestressed concrete girder bridge over the Ellenborough River (34 km west of Wauchope) was completed in August, 1974, at a cost of $235,000. (See colour photographs in December, 1974 issue of "Main Roads", Vol. 40, No. 2, p. 49).

☆ At Yarrowitch, a 42.7 metre long four-span prestressed concrete plank bridge and a 26 metre long seven-cell reinforced concrete box culvert were constructed over the Yarrowitch River. These structures were completed in 1974 at a cost of $126,000.

☆ In 1975 a new bridge over the Apsley River at Walcha was completed. The 61.9 metre long four-span prestressed concrete plank bridge was constructed at a cost of $262,000.

Looking down on part of Walcha, showing the new bridge which was built over the Apsley River in 1975.

Earthworks and Drainage

On the section from 58 km east of Walcha to the Hastings Shire boundary (where the old alignment was followed), earthworks were not extensive.

Further west, where the road was realigned, there was a large volume of earthworks and a number of relatively large drainage structures. Excessive wet weather in the autumn months of both 1974 and 1975 made construction work difficult. Plant was bogged frequently, and fill material became over-moist and had to be rolled each afternoon to seal the surface so that it would not be adversely affected by overnight rain.

Numerous underground springs were encountered and subsoil drains were provided in all cuts in which underground water problems were experienced during the execution of earthworks, or where problems were considered likely to occur in future.

Pavement Construction

Pavement material was obtained from pits excavated along the route. Surface gravelling operations were carried on throughout the year, but the extremely low winter temperatures experienced in the area restricted bituminous sealing to dry weather periods from late spring to early autumn. The final section sealed was a length of 0.9 km about 57 km east of Walcha.

Organisation and Cost

Since 1966 work on the Oxley Highway in Walcha and Hastings Shires has been supervised by the Divisional Engineer (currently Mr D. F. Watson) at Port Macquarie, the headquarters of the Department's Lower North Coast Division.

The reconstruction of the section from Mount Seaview to Walcha was undertaken by the Walcha Works Office which was established in 1966. With the completion of the job, the Works Office is to be closed.

Since the commencement of the current reconstruction programme in 1963, expenditure has amounted to more than $14.5 million.

Roadside Rest Area

The distance between the Pacific Highway near Wauchope and the New England Highway at Bendemeer is 223 km and the drive takes about three hours. The Department has constructed a roadside rest area at Stockyard Creek (approximately 46 km west of Ellenborough). Here, in a rugged and isolated mountain location about halfway between the two towns, travellers have an opportunity to enjoy the scenery as well as take a break from driving.

Benefits for Tourism and Commerce

The completion of bituminous surfacing of the Oxley Highway will induce more tourist traffic to use the road, as well as contributing to the easier and faster movement of goods. With further development of the area's tourist potential, it is likely that by the year 2000 it will be necessary to provide additional lanes on the Highway.

Now that reconstruction and sealing of the Highway is completed, this improved communication route will become a valuable commercial and tourist asset —not only for the large area it passes through, but also for traffic coming from further afield within New South Wales and from interstate.●

The following articles are some of the many reports on the Oxley Highway which have appeared in earlier issues of "Main Roads".

—*"Reconstruction between New England Plateau and Port Macquarie" and "Notes for Tourists" . . . with colour photographs, June, 1971, Vol. 36, No. 2, pp. 115–121.*

—*"The Story of the Oxley Highway", March, 1953, Vol. 18, No. 3, pp. 66–75.*

—*"Locating the Tobin's Creek Deviation", May, 1934, Vol. 5, No. 3, pp. 62–4.*

—*"The Reopening of the Oxley Highway from the New England Plateau to Port Macquarie", August, 1933, Vol. 4, No. 12, pp. 170–183.*

—*Colour photographs of construction in progress also appeared on the back covers of the June, 1972 and June, 1973 issues.*

APPRECIATION APPRECIATED

Under the heading "Historic Highway is a Super Effort", the *Port Macquarie News* of 9th June, 1977 published a very detailed feature article on the completion of the *all-black-top* Oxley Highway. As can be seen in the photograph below the newspaper also carried a full page expression of congratulations to the State Government and the Department.

Some comments in the article were quite flattering and—as it is not often that the press praises government departments in general and roadworkers in particular—we would like to make the most of it and reprint a segment here.

"The Department of Main Roads, and particularly the men hwo have worked on the road, are to be commended and complimented on their skills and perseverance, for 'life has not been easy for them' in the conditions so often prevailing along the highway.

Indeed, only last winter, men working at the Walcha end couldn't keep warm even if they sat on the roadside fire.

Constant rain in the mountain areas, constant dust from timber lorries and the like, and constant land slides were but some of the difficult and exasperating conditions the road-makers had to overcome to bring Oxley Highway to its speedy, safe and completely sealed state."

On behalf of the men on the road, we would like to say *"Thanks"* to the reporter and to the editor concerned and in reply add . . .

"It is a pleasure to play our part in worthwhile work for the community in the area and for the benefit of all who pass this way."

The newspaper also organised a small gathering at the site of the final sealing for representatives of local government councils in the surrounding region. Their reported comments underline the improved business and social aspects which flow from the better travelling times and better travelling conditions that better roads always bring. It is not often so widely publicised that roads make such a significant contribution to our overall community wealth and welfare, while at the same time bringing "bread and butter" benefits to us all as individuals and as families. We are therefore happy to reproduce some of their comments here.

The Mayor of Port Macquarie (Alderman K. Stevenson) stated . . .

"I must certainly pay tribute to those who were responsible for the construction of the road. The civil engineers, the foremen and the gangers and other workers.

They've done a wonderful job. They have established for us—for all time, quick communication with the tableland.

I'm sure that the tourist potential our forefathers saw in Port Macquarie will become more attractive to Tamworth and the hinterland, because of its accessibility . . .

I see an interchange of commerce developing between our towns . . .

Port Macquarie currently buys 90 per cent of its primary products—that is, green vegetables generally, from the Newcastle area. As I see it, this road link with Tamworth will open up avenues through Tamworth, and conversely I am hoping that the fishing industry will be able to sell a great deal of its produce to the hinterland—especially to the people of Tamworth and Walcha."

The Mayor of Tamworth (Alderman N. McKellar) added these views:

"It's a vast continent. Communications have always been a problem . . . It is very important to us that a swift form of all weather communication should be provided—such as this highway.

I am delighted that we have reached this stage in the provision of quick communication between Port Macquarie and Tamworth.

The benefits will not only be in tourism but in the ownership of property. There are many people of Tamworth and district who own property at Port Macquarie.

One other thing I believe Port Macquarie people will gain from this all weather road is the use of the facilities at our base hospital at Tamworth. We find that the extent of these facilities is drawing more and more people from the coast." ●

21 Construction Regiment

ROYAL AUSTRALIAN ENGINEERS (SUPPLEMENTARY RESERVE)

The year 1977 is the Silver Jubilee year of the reign of Queen Elizabeth II who ascended the throne on 6th February, 1952, following the death of her father King George VI.

During the year 1976 the 21 Construction Regiment RAE (SR) passed a similar milestone when it celebrated the Silver Jubilee of its foundation.

In 1950 the Commonwealth Government proposed the raising of supplementary Army Engineer units on an active reserve basis. The State Government agreed to the proposal and certain State Government authorities agreed to sponsor units. At that time, ex-servicemen from World War II (who had returned to their civil occupation) were available to provide the necessary military knowledge and the base on which to form the units. In general, the members of the units were recruited from personnel whose civil occupations were readily adapted to military engineering.

The sponsoring bodies for the 21 Construction Regiment were the Department of Main Roads, the Department of Public Works and the Metropolitan Water, Sewerage and Drainage Board. These sponsoring bodies have actively and enthusiastically supported the Regiment for 25 years and continue to do so. Since formation, the Regiment has served the dual roles of providing an active reserve to Regular Army engineer units and as a unit for training skilled civilian personnel.

The Department now sponsors a Construction Squadron, a Plant Troop of a Plant Squadron (Heavy) and part of the Regimental Headquarters. Departmental engineers at present fill the posts of Regimental Commanding Officer and Officers-in-Command of 101 Construction Squadron and 108 Plant Squadron (Heavy). On 15th March, 1976, Lieutenant Colonel A. Tinni of the Department's Outer Freeway Construction Division was appointed Commanding Officer of the Regiment to succeed Lieutenant Colonel R. B. Allen who had filled the posting since 1972.

"We make and we break."

The conditions of service in the Regiment include . . .

- ☆ engagement for two years;
- ☆ attendance at a 14-day camp of continuous training each year;
- ☆ optional attendance at other weekend training parades and full-time courses, with plenty of opportunity for promotion; and
- ☆ tax-free pay for all attendances and the payment of a travel allowance, where applicable, to allow personnel to attend camp.

The Regiment includes engineers, foremen, draftsmen, carpenters, plumbers, fitters, painters, electricians, riggers, plant operators, drivers, typists and clerks. Activities include work on roads, airfields, helipads, hardstanding areas, buildings (construction and demolition), various types of bridges, pontoon rafts, ferries, water supplies, and field defences. Assignments may involve the use of helicopters, Caribou or Hercules aircraft, landing craft, assault boats, armoured personnel carriers, infantry weapons and mines.

The first camp of the Regiment was held at Middle Head back in April, 1951 with 29 officers and 163 other ranks attending. The current strength of the Regiment is approximately 550.

A major highlight of these annual camps was in 1975 when the Regiment was tasked to supplement Regular Army units at Darwin to assist in restoration after damage by Cyclone Tracy. The main body of 350 all ranks moved to Darwin within 24 hours of marching into camp. The majority spent three weeks in Darwin, while a very necessary rear link stayed at Ingleburn.

The 1977 Annual Camp was held at the School of Military Engineering, Casula (near Liverpool) over a four-week period—with Departmental personnel attending from 5th to 18th March, 1977. Regular Army instructors from the

An air portable bridge constructed for use as a raft at a water crossing.

School provided a nucleus of instructors for this training—as well as guiding instructors from the Regiment.

Activities undertaken by the Regiment while in this camp included military field engineering training and participation in manoeuvres involving close co-operation with Regular Army troops. The operation of earthmoving equipment, the handling of explosives and "watermanship" (which involves any exercise associated with the crossing of water) were some of the skills practised.

Engineers in the Army use many techniques to cross water. Moveable (equipment) bridges, ferries and pontoon bridges or improvised fixed-type structures are some of the miscellany of methods used to ensure that the movement of troops and supplies can proceed unhindered across all sorts of open obstacles, whether wet or dry.

Bailey bridging, so long in use by the Army for crossings over rivers, is now being supplemented by a new lightweight medium girder bridge. Besides its lightness and compactness, it can be erected in a fraction of the time required for Bailey bridging. A large part of the 1977 camp was taken up in instructions in the handling and erection of this type of structure.

Training was inspected by the Commissioner, Deputy Commissioner and senior officers of the Department together with senior officers of the Metropolitan Water, Sewerage and Drainage Board and the Department of Public Works, which are the other sponsoring authorities. Some bridging training was also provided for 1 Port Construction and Repair Team which is sponsored by the Maritime Services Board.

Service in the Regiment provides training in management for Departmental personnel and contributes significantly to overall Departmental morale. The co-operation with regular soldiers has always been friendly and efficient with opportunity for each to share civil and military skills in a practical situation. The Reserve provides a bridge between the civil and military sections of the community with personal contacts extending beyond training parades.●

Other articles on the activities of the Unit have appeared in the following issues of "Main Roads":
—June, 1974, Vol. 39, No. 4, p. 110,
—September, 1971, Vol. 37, No. 1, pp. 29–30,
—December, 1970, Vol. 36, No. 2, pp. 58–61,
—December, 1958, Vol. 24, No. 2, pp. 57–8,
—June, 1952, Vol. 17, No. 4, pp. 123–5.

Continued from page 110.

"The total earthworks amounted to 31,875 cubic yards, of which approximately 40 per cent, was carried out by the Board's skimmer shovel; 1,800 cubic yards were in rock, requiring the use of explosives, and the balance was taken out by tractor and plough, back filler and Barber Greene loaders. The unit cost throughout the work was 6s. 4d. per cubic yard.

Considerable work was carried out in the renewal of culverts and small bridges, the cost of these being approximately £6,180.

Excavation was begun in July, 1929, and the pavement was completed and opened to traffic by the 16th December, 1930.

The costs per mile of the various parts of the work were therefore:

(a) Earthworks, culverts, fencing, and bridges, i.e. all work other than pavement, of which one-third represents the cost of providing culverts and bridges—£3,630.

(b) Pavement of Telford foundation and premixed bituminous wearing course—£9,721.

(c) Pavement of Telford foundation and penetration bitumen wearing course—£8,421.

(d) Cement concrete pavement—£9,271.

The higher costs of the earlier section of the bituminous macadam work compared with those later attained were due in a large measure to the early difficulties of obtaining skilled road workmen, the permanent gang having to be trained. This same gang afterwards carried out work on the Princes Highway at a cost greatly below the prices obtained by public tender. In judging the costs of this section of work, therefore, the substantial benefits which have accrued from it as a training ground for other works should not be lost sight of."●

TENDERS ACCEPTED BY COUNCILS

The following tenders (in excess of $20,000) for road and bridge works were accepted by Councils for the three months ended 31st March, 1977.

Council	Road No.	Work or Service	Name of Successful Tenderer	Amount $
Abercrombie	Rural Local Road No. 21—Rockley—Newbridge Road.	Construction of composite steel and reinforced concrete bridge.	M. F. and A. A. Brien and N. A. Rogers.	68,222.32
Ashford	Main Road No. 137.	Construction of 7-cell 1.8 m x 1.2 m reinforced concrete box culvert at 17.6 km north of Ashford.	Peter Cropp Construction.	21,972.55
Bibbenluke	Various	Priming and sealing	Emoleum (Aust.) Pty Ltd.	49,572.38
Blaxland	Rural Local Road—Browns Gap.	Construction of 2-span 21.3 m reinforced concrete bridge over Blackmans Creek.	Dalland and Sleeman	55,978.75
Camden	Main Roads Nos 154 and 178.	Maintenance and improvement	Boral Asphalt	52,500.00
Coolah	Developmental Road, No. 1304.	Supply, heat and spray R90 bitumen between 24.6 km and 34.2 km east of Trunk Road No. 55.	Emoleum (Aust.) Ltd	22,828.00
Coolah	Developmental Road No. 1304.	Supply of 10 mm and 20 mm cover aggregate to stock piles between 28.4 km and 32.5 km east of Trunk Road No. 55.	T. & F. Concrete and Gravel.	21,493.00
Coolah	Trunk Road No. 77.	Construction of 64.6 m steel and reinforced concrete bridge over Merrygoen Creek at Mendooran.	Bridge and Civil Pty Ltd	115,915.00
Crookwell	Various	1976/77 bitumen sealing and resealing programme	Canberra Asphalters Pty Ltd.	24,106.83
Nundle	Rural Local Road.	Construction of bridge over Oakenville Creek	Clarena Engineering Services.	54,491.00
Scone	Rural Local Road.	Construction of bridge over Kingdom Ponds	Beijemen Constructions	34,995.81
Wollongong	Main Road No. 602.	Construction of bridge over South Coast Railway Line and Australian Iron and Steel railway siding at Masters Road deviation, Coniston	Bass Civil Engineering Pty Ltd.	639,294.80

TENDERS ACCEPTED BY THE DEPARTMENT OF MAIN ROADS

The following tenders (in excess of $20,000) for road and bridge works were accepted by the Department for the three months ended 31st March, 1977.

Road No.	Work or Service	Name of Successful Tenderer	Amount
			$
F3 North Western Freeway.	City of Sydney. Construction of Deck ENW7	Pearson Bridge (N.S.W.) Pty Ltd	996,180.00
F5 South Western Freeway.	City of Campbelltown and Shire of Wollondilly. Construction of twin bridges over Nepean River, 61.3 km south of Sydney.	Transbridge Pty Ltd	3,096,485.34
F5 South Western Freeway.	Shire of Wollondilly. Earthworks drainage, fencing, etc. between Pheasants Nest and Avon Dam Road.	G. Abignano Pty Ltd	2,302,843.97
F5 South Western Freeway.	Shire of Wollondilly. Construction of bridge over Freeway at Moreton Park Road, 63.9 km south of Sydney.	Pearson Bridge (N.S.W.) Pty Ltd	333,605.00
F5 South Western Freeway.	Shire of Wollondilly. Construction of twin bridges over Nepean River at Douglas Park, 70.3 km south of Sydney.	White Industries Ltd	4,052,577.00
F6 Southern Freeway	City of Wollongong. Construction of twin bridges over Northcliffe Drive, Berkeley, 90.5 km south of Sydney.	Allied Constructions Pty Ltd	483,690.19
State Highway No. 1, Princes Highway.	Municipality of Kogarah. Repainting three approach spans on Tom Uglys Bridge.	Kada (N.S.W.) Pty Ltd	25,980.00
State Highway No. 1, Princes Highway.	City of Wollongong. Reconstruction of Greens Pinch, Bulli Pass. Application of pneumatically applied concrete.	Ottac	35,466.00
State Highway No. 2, Hume Highway.	Shire of Gundagai. Supply and delivery of ready-mixed concrete for approaches to new bridge.	Gundagai Sand & Gravel	29,275.00
State Highway No. 7, Mitchell Highway.	Shire of Molong. Construction of bridge over Molong Creek at Eurambie, 5.6 km south of Molong.	Bridge and Civil Pty Ltd	328,458.00
State Highway No. 9, New England Highway.	Shire of Parry. Extension of existing 2-cell 3.1 m x 2.7 m reinforced concrete box culvert over Masons Gully, 35.2 km north of Tamworth.	R. Bruno & M. Campese	30,868.00
State Highway No. 9, New England Highway.	Shire of Parry. Construction of 3-cell 2.4 m x 2.4 m reinforced concrete box culvert over Moonbi Creek, 26.28 km north of Tamworth.	R. Bruno & M. Campese	93,370.00
State Highway No. 9, New England Highway.	City of Maitland. Haulage of up to 20 000 tonnes of slag products from B.H.P. to construction site between 25.9 and 28.5 km west of Newcastle.	F. & L. Ball	28,000.00
State Highway No. 10, Pacific Highway.	Shire of Hornsby. Construction of pedestrian overbridge over Highway at Mt Kuring-gai.	Hornibrook Group	83,000.00
State Highway No. 10, Pacific Highway.	Shire of Lake Macquarie. Supply and lay up to 1 450 tonnes of 10 mm asphaltic concrete to construction site between Oakdale Road and Oxford Street, Gateshead.	Bitupave Ltd	47,850.00
State Highway No. 10, Pacific Highway.	Shire of Ulmarra. Supply and delivery of up to 6 000 m^3 of Class "A" pavement material for use on southern section of approaches to Harwood Bridge, 50 km north of Grafton.	McGeary Bros	38,400.00
State Highway No. 10, Pacific Highway.	Shire of Coffs Harbour. Winning, crushing and stockpiling of up to 10 000 m^3 of conglomerate rock at Taylors Pit for strengthening and bitumen surfacing at 19.4 to 20.1 km, 20.8 to 21.0 km, and 35.1 to 35.5 km north of Coffs Harbour.	M. & M. Quarries	35,400.00
State Highway No. 10, Pacific Highway.	Shire of Ulmarra. Winning, crushing and stockpiling of up to 5 000 m^3 of sandstone at Woodford North State Forest Pit for strengthening and bitumen surfacing at 21.1 to 22.6 km and 41.3 to 44.8 km north of Grafton.	Irvington Engineering Co.	29,500.00
State Highway No. 26, Calga to Ourimbah.	Shire of Wyong. Widening of bridge over Ourimbah Creek Road, 32 km north of Calga.	Arthur Boyd Constructions	88,597.00
Trunk Road No. 51	City of Queanbeyan. Cement rendering of piers and abutments on bridge over Queanbeyan River at Queanbeyan.	E. M. Moore Pty Ltd	24,840.00
Trunk Road No. 95	Shire of Wollondilly. Construction of bridge over Main Southern Railway Line, 5.2 km east of Picton.	Pearson Bridge (N.S.W.) Pty Ltd	198,882.00
Main Road No. 321	Shire of Murrumbidgee. Construction of two bridges over Murrumbidgee River and flood channel at Darlington Point.	Siebels Concrete Constructions Pty Ltd.	1,077,459.00
Main Road No. 503, Putty Road.	Shire of Colo. Construction of bridge over Howes Creek, 11.3 km north of Windsor.	Empro Constructions Pty Ltd	170,222.00
Main Road No. 609, Horsley Drive.	Municipality of Fairfield. Widening of bridge over Main Southern Railway Line.	Pearson Bridge (N.S.W.) Pty Ltd	886,230.00
Secondary Road No. 2081, Rutledge Street.	Municipality of Ryde. Construction of bridge over Main Northern Railway Line.	Pearson Bridge (N.S.W.) Pty Ltd	837,378.00

MAIN ROADS STANDARD SPECIFICATIONS

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

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Concrete converter	A 1418
Concrete work other than bridges	738 (Metric)
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Gully pit with grating	A 1042
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Single cell box culvert under fill from 1 m	SD 6271
Single cell box culvert under fill from 0.3 to 1 m	SD 6272
Multiple cell box culvert under fill from 1 m	SD 6273
Multiple cell box culvert under fill from 0.3 to 1 m	SD 6274

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D.M.R. BOOKLETS

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

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

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

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

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