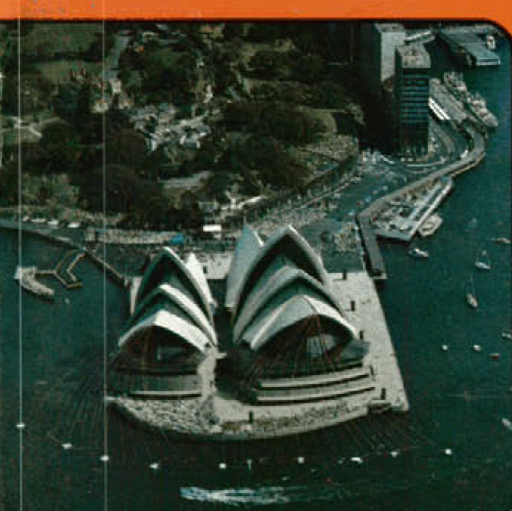
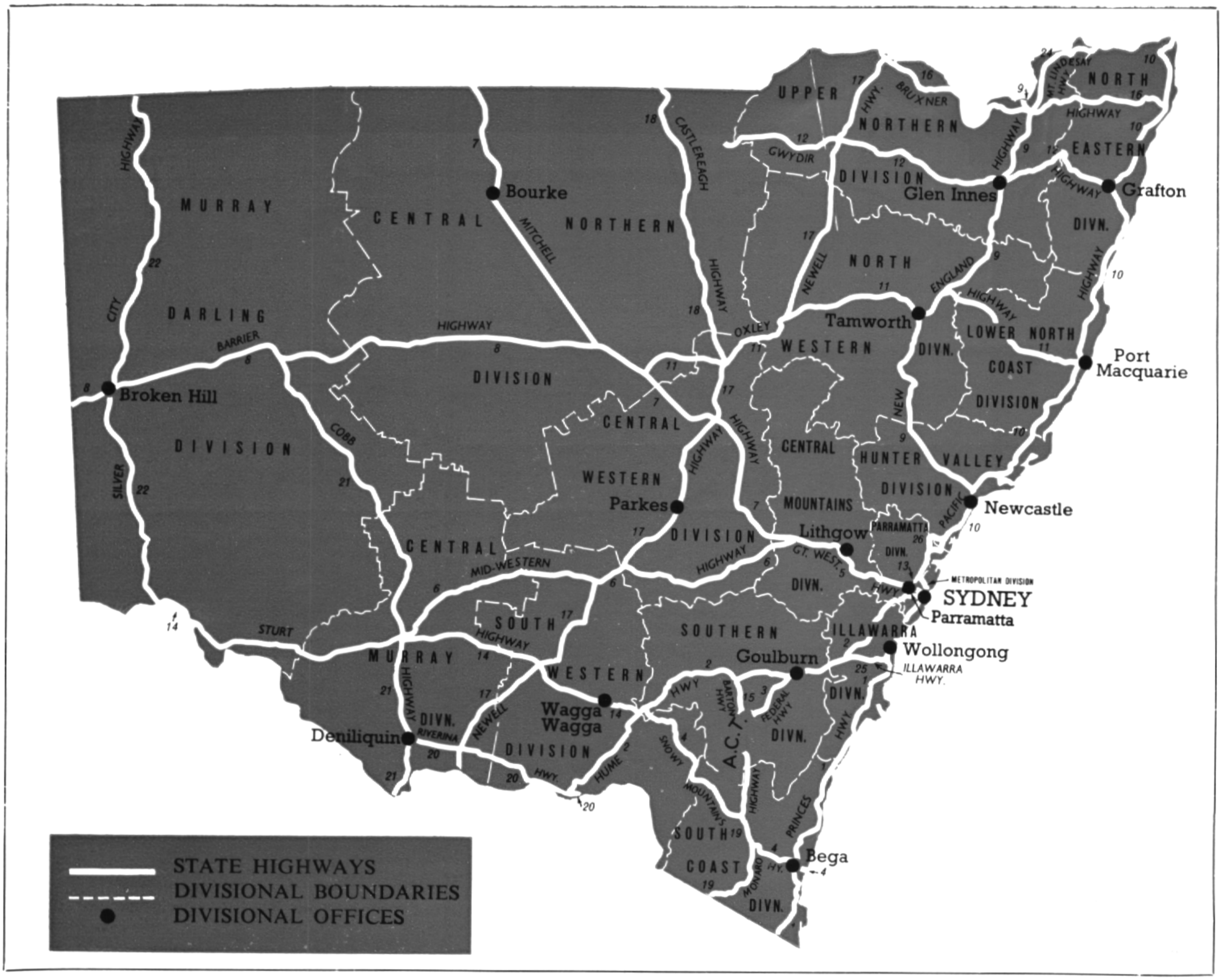
MAIN ROADS

DECEMBER 1973





New South Wales

Area—801 431km² (309,433 sq miles)

Population as at 31st March, 1973—4,715,100 (estimated)

Length of Public Roads—208 890 km (129,745 miles)

Number of Motor Vehicles registered as at 30th June, 1973—2,328,037

ROAD CLASSIFICATIONS AND LENGTHS IN NEW SOUTH WALES

Lengths of Main, Tourist and Developmental Roads, as at 30th June, 1973. (Mileage equivalent shown in brackets.)

Freeways	63	(39)
State Highways	10,509	(6,527)
Trunk Roads	7,042	(4,374)
Ordinary Main Roads ..	18,470	(11,472)
Secondary Roads	290	(180)
Tourist Roads	396	(246)
Developmental Roads ..	3,896	(2,420)
Unclassified Roads	2,476	(1,538)
TOTAL	43 142 km	(26,796 miles)

MAIN ROADS

JOURNAL OF THE DEPARTMENT OF MAIN ROADS, NEW SOUTH WALES

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Front Cover:

(*Centre photograph*) *From one symbol of a city to another—the Sydney Opera House on the day of its official opening by Her Majesty Queen Elizabeth II, Saturday, 20th October, 1973—photographed from the Sydney Harbour Bridge. Since construction of the Opera House commenced in March, 1959, the scene around Sydney's glittering harbour has changed many times. Against this, the harbour and its bridge have remained constants and the Opera House now joins them, in magnificent rivalry, as unique symbols of an exciting city.*

(*Top*) *Thousands of small craft which gathered on the harbour for the opening day looked spectacular from the air.*

(*Bottom—left to right*) *Colourful streamers attached to the Opera House were released to signify its official opening; at night the harbour was lit by a massive display of fireworks; the Royal Visitors arriving in Sydney on the opening day.*

Back Cover: Telegraph Point.

NECESSITY

In relation to the construction and maintenance of an efficient network of main roads, the truth of the old saying, "necessity is the mother of invention" has frequently been proved. The necessity, of course, is the growing volume of traffic on the roads which presses our Engineers to evolve new systems and equipment for its safety and control.

It is necessity, for example, which has prompted the Department to plan the installation of an electronic driver aid and toll registration system for the Southern Tollwork between Waterfall and Bulli Pass. Extensive research overseas combined with the inventiveness of our own staff has produced a system of world standard which will be very necessary to the safety of all drivers using this high speed route through such a fog prone location.

Necessity, again, prompted the introduction of microfilming to the Department a few years ago and an article on microfilming drawings begins on page 57. The invention of microfilming dates back over 130 years—before anyone could have envisaged the mass of paper work humans would produce and accumulate in the 20th century. The first experiments with microphotography are credited to British inventor and scientist John Benjamin Dancer for a miniature photograph of a stone memorial tablet taken in 1839. In France, around the 1860's, microphotography was used as a gimmick for novelties which contained a tiny photographic reproduction of a passage of scripture, a famous painting or a familiar scene, accompanied by a small magnifying glass for viewing. By 1870, during the Franco-Prussian War, the uses of microphotography had advanced to espionage when microfilm messages were dispatched by pigeon post to the defenders of besieged Paris. But for many more years, microfilming did not advance beyond this stage.

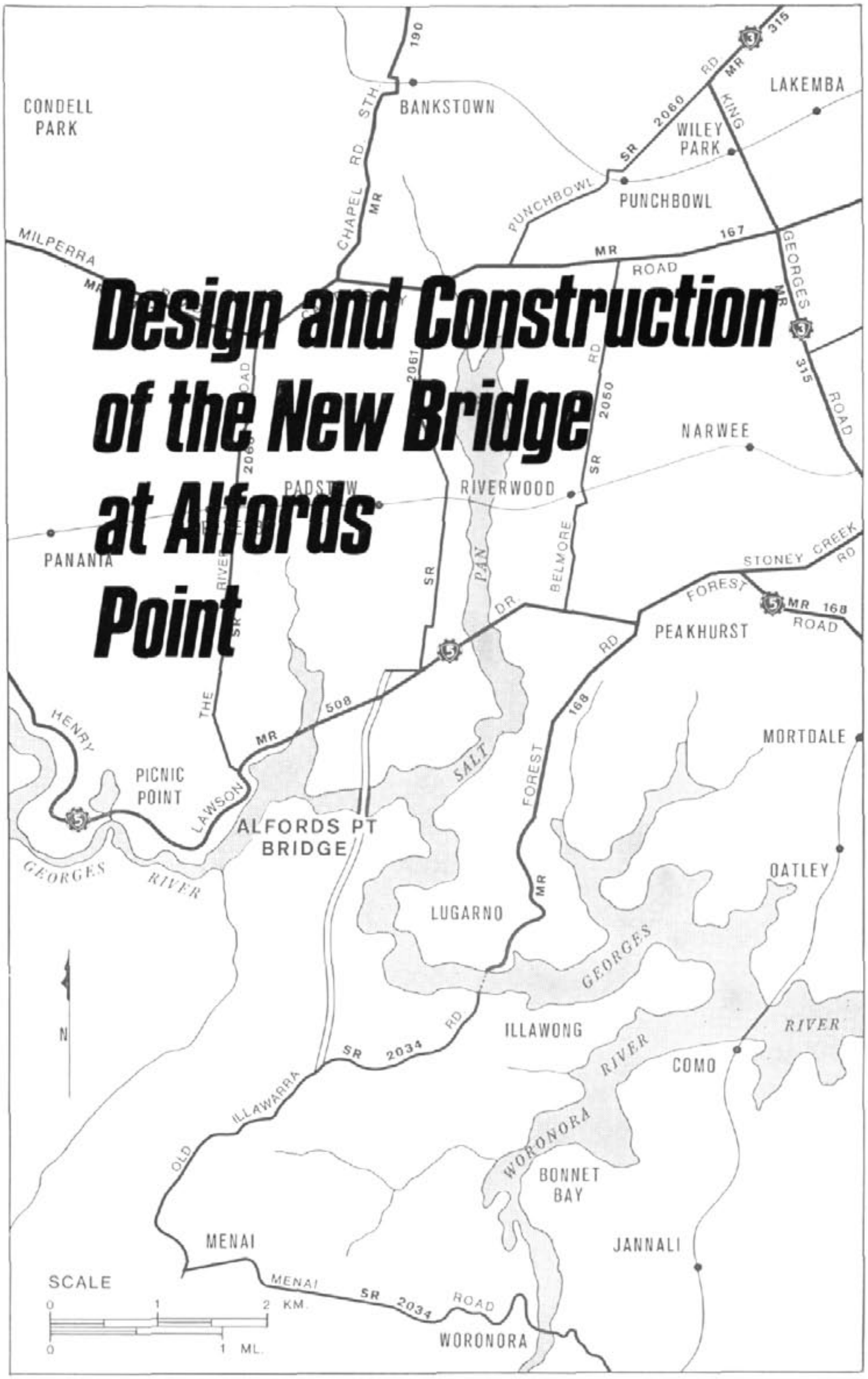
It was necessity, once more, which extracted a greater potential from microphotography. To improve the security on cheques, a young bank clerk invented a microfilm machine called the "Checkograph" which came into use during the late 1920's. After this invention, it quickly became evident that this microfilming technique could be adapted to combat the ever-growing quantities of papers which commerce, industry, science and all fields of human endeavour were producing.

A further development in microfilming occurred in the 1940's and early 1950's with the development of the aperture card which successfully applied microfilms to engineering drawings.

* * *

In this issue of "Main Roads" and the subsequent issue of March, 1974, metric measurements have been stated with Imperial equivalents following in brackets. A basic metric conversion table has been printed on page 37. The issue of June, 1974 will be the first to show metric units only. ●

Design and Construction of the New Bridge at Alfords Point



The Premier and Treasurer of New South Wales, the Honourable Sir Robert Askin, K.C.M.G., M.L.A. officially opened the new bridge over Georges River at Alfords Point on Friday, 7th September, 1973, in the presence of the Deputy Premier and Minister for Highways, the Honourable Sir Charles Cutler, K.B.E., E.D., M.L.A.

The new bridge, with its associated roadworks, forms a freeway type road for about 3·6 km (2·25 miles) between Clancy Street, Padstow and the connection with the Old Illawarra Road at Menai. At Padstow the northern approach roads include a bridge over Henry Lawson Drive.

As another major road crossing of the Georges River, the new bridge and roadworks will relieve traffic conditions at Tom Ugly's Bridge on the Princes Highway. It also permits direct access to Menai where residential development for at least 40,000 people is anticipated and, in addition, it will form part of the planned arterial road from the northern and northwestern suburbs to Sutherland and the South Coast.

The bridge design was prepared by the London firm of Guyon, Schere, Harris and Sutherland, with architectural assistance from Robert Matthew, Johnson, Marshall and Partners. The bridge is being built in two stages. The bridgeworks just completed are the first stage and were constructed under contract by John Holland Constructions Pty Ltd for a tender price of $2,293,942. Stage I consisted of the western bridge, the abutment works (which are common to both bridges) and the piling, pile caps and pad footings for the future eastern bridge. Also included are temporary in-situ concrete caps over the starter bars projecting up out of the eastern pile caps and pad footings.

At present, the bridge has two lanes and a footway. When traffic demands increase and the eastern bridge is constructed, these two symmetrical bridges, 2·7 m (9 ft) apart but supported by a common abutment, will each carry three lanes of traffic and one footway.

DESIGN

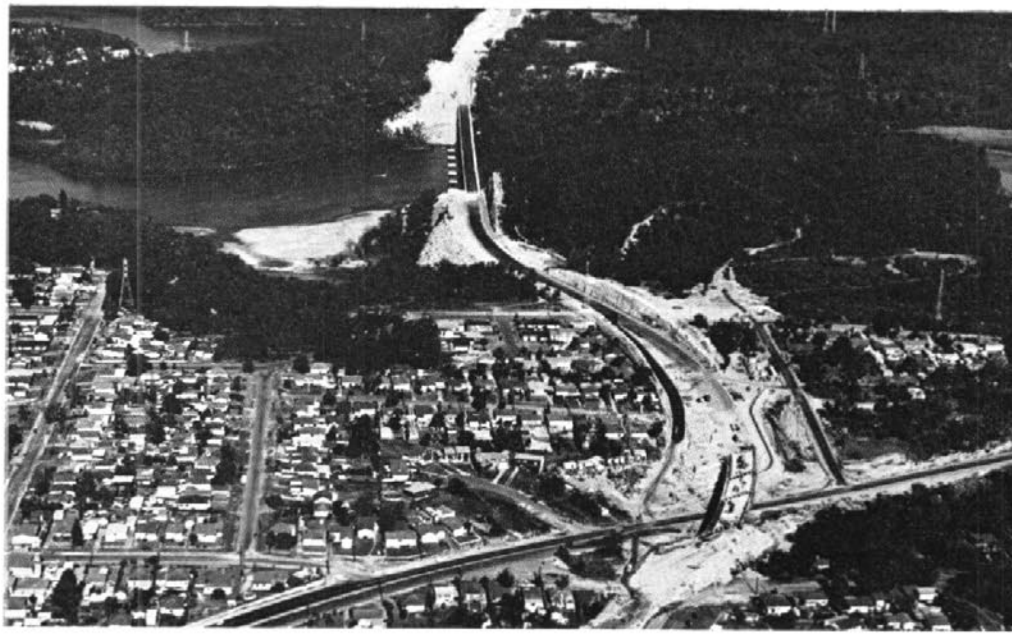
Eleven spans (9 spans measuring 42 m (137 ft 6 in) and two end spans 33 m (109 ft 9 in) make up the western bridge, giving it a total of 444 m (1,457 ft). The bridge is 11·6 m (38 ft) wide between kerbs and has a 1·5 m (5 ft) wide footway.

Two trapezoidal, uniform depth, box girders carried on bifurcated piers, support the superstructure. The seven river piers are constructed on skirted pile caps. Each cap is supported by four large diameter cast-in-situ bored piles which transmit the bridge loading to the hard sandstone sub-stratum. Piers 1, 9 and 10 on the banks of the river are carried on spread footings.

The bridge easily conforms to the required navigational clearance, having a 12·7 m (41 ft 6 in) minimum height above mean water level. This height was determined by the road grading, the road being in deep cut on the northern bank.

While the horizontal alignment of the bridge is straight, the elevation follows a slightly sagging curve which blends well

Two aerial views of the bridge under construction. Right: A general view of the site showing Henry Lawson Drive in the foreground crossed by the overbridge on County Road No. 5016. Below: A closer view of the bridgeworks shows the large, almost vertical cutting and the fill on the northern approaches. Pile caps for the future eastern bridge can be seen on the left of the carriageway.



with the topographical features of the drowned valley landscape.

As the northern approaches pass through natural bushland which is under the care of the Georges River Parkland Trust, a major objective was to design the approaches so that they would cause not only the least disturbance to, but would also blend in with the natural environment.

The services of Professor Spooner of the University of New South Wales, were requested in the early stages of design to examine the proposed alignment and profile which had been prepared for the northern approaches.

Matters considered in the design proposals included the effect of roadwork scars on the topography in the Georges River National Park areas and the control of stormwater and drainage from the road. Particular attention has been given to the landscaping and rejuvenation of affected areas, such as the residues of acquired properties, which are to be grassed and planted with suitable shrubs and trees. (The acquisition of properties and portions of properties was necessary between Churchill Road and Clancy Street.) Approximately 400 trees and shrubs have been planted in areas adjacent to the County Road along with the grassing and seeding and other areas.

THE SUPERSTRUCTURE

A series of 42 m (137 ft 6 in) spans with shorter end spans was found to be the most economical method of meeting the required bridge length. Due to the two stages of construction, the optimum number of five beams for the ultimate width of bridge was reduced to four and this number determined the final girder depth of 2·3 m (7 ft 6 in).

The deck consists of two parallel box girders of precast concrete segmental construction, stressed both in the longitudinal and lateral directions. Up to 14 tendons per girder were used for the longitudinal stressing and the tendons, each comprising twelve 12·7 mm (0·5 in) strands, were stressed generally to 157 t (155 tons). The total force per girder amounted to 2,120 t (2,090 tons).

The footway is formed by the precast concrete slab units which cantilever out from one side of the pair of box girders. Protection at the outer edge of the footway and both edges of the roadway is given respectively by a steel grille handrail and vehicle guardrails on "New Jersey" type concrete kerbs. The deck is finished with a wearing course of 50 mm (2 in) thick asphaltic concrete.

THE EXPANSION JOINT AND BRIDGE BEARINGS

The expansion joint at the southern abutment, which takes all movement of the structure under creep, shrinkage and temperature, is a steel comb-in-neoprene "heavy duty" type of joint. The north abutment is fixed for purposes of longitudinal movement and the bridge superstructure is continuous over its full length.

Teflon and stainless steel sliding bearings support the girders on the piers. These bearings allow for deck movement with negligible longitudinal thrust transmitted to the piers. Wind forces on the superstructure are transmitted to the piers through lateral stops on the stainless steel bearing plates. Demountable metal skirts have been fixed around the periphery of the pier top surfaces to protect the bearings and to prevent birds gaining access to the top of the piers.

THE PIERS

After consideration of models of a number of alternative pier designs, the selection of a bifurcated pier form was made. More visually pleasing than the alternatives, the bifurcation of each pier at the top lightens the visual impact of the piers which might otherwise appear too wide. At the same time, this form complements the twin beam superstructure overhead.

Of hollow section, the piers have a constant taper, thus varying their width on the pile cap by a maximum of 0·8 m (2 ft 6 in).

THE PILE CAPS AND PILES

For the river piers a reinforced concrete pile cap was chosen with a top level of 305 mm (1 ft) above high water level and with precast concrete skirting down to low water level. As the precast skirting slabs were to be used as permanent formwork to the pile cap faces and the soffit shutter was also to be permanent, the soffit level of the pile cap was fixed at 178 mm (7 in) to 203 mm (8 in) above the mean tide level. This left sufficient space above low water for the erection of formwork supports.

Each pier is carried by four 1·2 m (4 ft) diameter piles at the piers, raked both ways to resist the horizontal forces on the bridge, the line of principal rake of 1 in 5 being at 20° to the road centre line. Varying in length up to 38 m (125 ft), the piles are socketed into hard sandstone and have a maximum working load of 483 t (475 tons)

per pile. The length of rock socket varied from 1·5 m (5 ft) to 3·7 m (12 ft), being based on a skin friction value of 2·5 t per square foot and an end bearing value of 20 t per square foot.

THE ABUTMENTS

The position of the abutments was fixed after careful consideration had been given to the superstructure spans and topographical features, with the minimising of costs in mind.

Abutments with a maximum exposed height of 7·6 m (25 ft) were designed, in spite of the fairly severe slope of the ground at each end of the bridge, by using a small amount of filling around the abutments.

Each abutment comprises two reinforced concrete boxes separated by a one inch joint. The slab roof of each box is supported at mid span by a wall which divides the box into two compartments. All the compartments were filled with clean sand to within 1·8 m (6 ft) of the roof.

In the north abutment, eight stressed cables in the roof restrained the bridge superstructure longitudinally, the bearings being designed to provide only for rotation of the girder ends.

Mass concrete footings and a retaining wall were required at the east side of the south abutment as here the ground falls away sharply.

A ribbed finish gives an attractive appearance to the exposed faces of the abutments and the retaining wall.

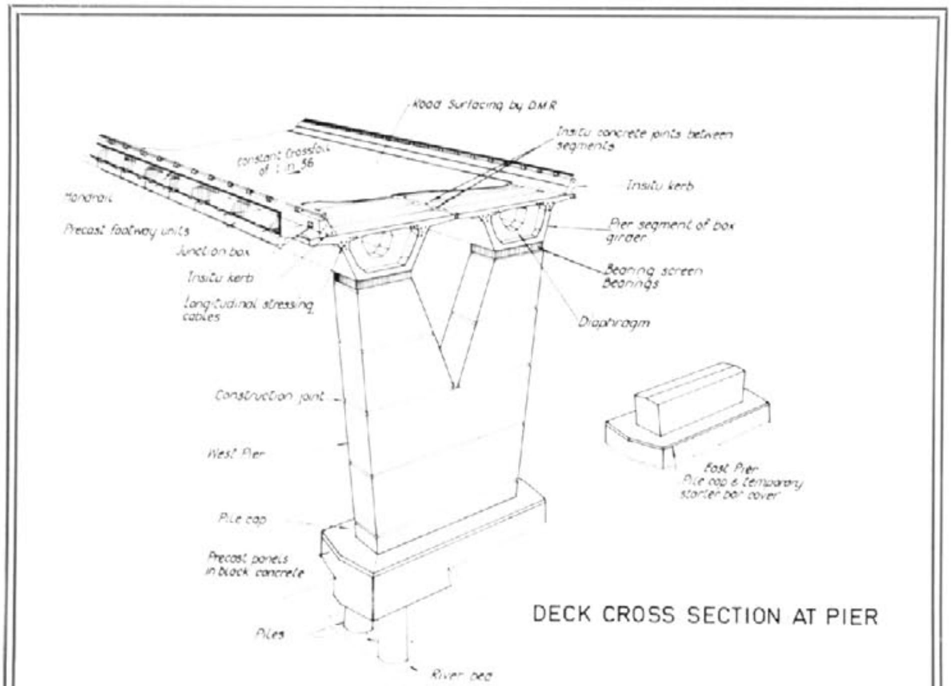
CONSTRUCTION

THE FOUNDATIONS

All the foundations of the bridge extend to solid sandstone which underlies the site at varying depths of up to 36·5 m (120 ft). It was important to ensure that there would be no movement of the foundations, as the bridge deck is continuous over its entire length and so sensitive to the effects of differential settlements.

Both abutments and the land piers (piers 1, 9 and 10), are founded on spread footings underlain by blinding and mass concrete which bears directly on the sandstone. The bulk of the excavation work for the mass and blinding concrete was carried out by ripping with a Caterpillar D9 tractor, while final trimming and shaping was done by hand jackpicking. No special de-watering techniques were required; in the two cases where excavation was required below the water table, the excavation was kept dry by pumping from a sump and formwork was constructed in a conventional manner.

The river piers (piers 2 to 8), are each supported by a group of four bored piles of 1·2 m (4 ft) diameter and raked at 1 in 5. The piles utilize a permanent steel casing 9·5 mm ($\frac{3}{8}$ in) thick to rock and uncased rock sockets in the sandstone. The length of the piles varies from 6·4 m (21 ft) to 38 m (125 ft) and the maximum load on the piles varies from 427 t (420 tons) to 483 t (475 tons).



DECK CROSS SECTION AT PIER

A barge mounted 38·6 t (38·5 tons) stiff leg crane was used for all lifting work over the water. To provide manoeuverability, the barge was equipped with winches to adjust the mooring lines.

The first step in the pile construction sequence was the establishment at the pier location of a temporary pile driving platform 12 m (40 ft) by 6 m (20 ft) supported on four circular steel spud piles.

After the platform was floated into position on two pontoons and anchored to maintain a 150 mm (6 in) tolerance, 0·6 m (22 in) diameter open ended steel tube piles were pitched through circular sleeves in each corner of the platform and driven to a set of two blows to one inch with a Kobe K32 diesel hammer and a set of hanging leaders.

The platform was then lifted to a fixed level clear of the pontoons and spragging plates welded between the spud piles and the platform sleeves.

The 18·5 m (60 ft) high pile driving leaders were positioned on the temporary platform and the 9·5 mm ($\frac{3}{8}$ in) wall thickness permanent casings were pitched and driven in 12 m (40 ft) lengths. Adjacent lengths were butt welded.

The toe of the leading length of casing was stiffened by welding a 16 mm ($\frac{5}{8}$ in) thick ring to the casing to provide a cutting edge of 25 mm (1 in) of overall thickness.

The permanent steel casings were also driven by the Kobe K32 diesel hammer which imparts a kinetic energy of 76 000 joule (56,000 ft lbf) per blow to the casing.

The impact energy of the hammer was limited to produce a driving rate of not more than 100 blows per 0·3 m (per foot) to preclude any possibility of the casing buckling during driving.

The material inside the casing adds to the driving resistance of the casing due to internal skin friction and also tends to form a plug which is taken down with the casing, and effectively increases the end bearing area of the casing. Hence, for the larger piles, the limiting number of blows per foot was reached well before the casing reached rock. Driving was then stopped and the sandy material inside the casing removed with a 150 mm (6 in) diameter airlift, incorporating four 50 mm (2 in) diameter high pressure water jets which aid in breaking up the compacted sand.

In a few isolated cases where heavy clay seams were encountered, a rotary rock drilling rig had to be used to remove material inside the casing before driving could continue. After the casings for the four piles at each pier had been driven to rock and the material from the inside of the casing removed, a diamond coring rig was set up on each pile and a "NM" size (47 mm) test core of the rock (at the base of each casing) was taken to determine the length of rock socket required.

The original specification was for only one core to be taken per group of four piles. However, due to the variable nature of the sandstone encountered, the base of each pile was cored.

In almost all cases, the lengths of rock socket were considerably greater than the estimated values, in order to ensure a satisfactory foundation. The sandstone was generally heavily jointed with heavy weathering and clay inclusions along the jointing planes. In addition, bands of soft weathered sandstone with clay pockets were encountered. Thus, the test cores at the base of each casing enabled a foundation level to be determined and also proved the rock below the founding level. The rock drilling at the base of each casing was carried out by a hydraulically operated rotary drilling rig utilizing a tapered tungsten roller type drilling bit. The reinforcement for the piles consists of a cage of twenty-eight 32 mm (1¼ in) diameter bars to 12 m (40 ft) below the pile cap, and a cage of twelve 32 mm (1¼ in) bars below that depth.

The piles were concreted with a 4K concrete, which was placed under water. A pump was used to feed the concrete up to the top of a 200 mm (8 in) diameter tremie pipe, which was handled by a floating "Favco" stiff-legged derrick crane. This permitted the breaking of the tremie pipe to be kept to a minimum. Before the concrete was placed, the piles were cleaned by the use of an airlift pump and with the assistance of a diver.

The pier shafts are cast-in-situ reinforced hollow boxes of 4K concrete placed in 2·8 m (9 ft 4 in) lifts with a feature construction joint. The sides of the piers taper outwards at 1 in 11·5. The pier bifurcates at the second construction joint from the top, one box girder being supported on each leg. The top lift is of 6K concrete and is solid for the top 1·2 m (4 ft). This area is also transversely prestressed with four 32 mm (1¼ in) diameter high tensile steel bars in each leg. The wall thickness of the pier boxes is 254 mm (10 in) with a centre wall of 304 mm (12 in) thickness.

THE DECK

The segments of the girders were cast and steam cured at the sub-contractor's yard and transported to the site for erection. Weighing approximately 14 t (14 tons), the segments are 1·7 m (5 ft 8 in) long and 2·3 m (7 ft 6 in) deep. The girders were stressed longitudinally after the 6K concrete joints 100 mm (4 in) wide, reached the specified strength. The segments were stressed in span lengths, each section cantilevering 10 m (32 ft 7 in) into the next span. Anchorage pockets are provided in haunches projecting out from the inside of the segments at various points with no coupling of the cables.

A 150 mm (6 in) longitudinal joint separates the two girders. This joint was filled with concrete and stressed transversely after the longitudinal stressing has been completed. A strict sequence was required between the longitudinal stressing of one girder to the other to prevent the concrete between the girders becoming overstressed from differences in creep and shrinkage of the two girders.

A twelve 13 mm (½ in) Freyssinet multi-strand system was used for the longitudinal tendons and a four 13 mm (½ in) C.C.L. system for the transverse stressing. Girder segments adjacent to piers and abutments are also stressed transversely using high tensile bars.

The footway which cantilevers out from the western girder, is precast in sections from 3K light weight concrete. The crash-kerbs are cast-in-situ from 3K light weight concrete. The deck was sealed with a 50 mm (2 in) thickness of asphaltic concrete. Prior to the placing of the asphaltic concrete, all the joints between the segments were treated with bitumen-rubber latex emulsion in order to provide absolute seal from water penetration into the joints.

APPROACHES

The approaches to the new bridge were constructed by the Department, Parramatta Division being the constructing authority for the northern approaches and the Metropolitan Division the authority for the southern. The approaches are contained within a new County Road (No. 5016) between Alma Road, Padstow and Old Illawarra Road, Illawong.

In administering the contract for the construction of the northern approaches, Parramatta Division constructed the County Road between the Georges River and Clancy Street, widened Clancy Street to provide a temporary connection to Henry Lawson Drive and reconstructed the last to dual carriageway standard between Courtney Road and Chamberlain Road.

The contract for the construction of the bridge which carries the County Road over Henry Lawson Drive was also administered by Parramatta Division.

THE CONSTRUCTION OF THE NORTHERN APPROACHES

Over 185 000 m³ (240,000 cubic yards) of solid sandstone and the preparation of 36 000 m² (43,000 square yards) of new pavement were involved in the construction of the northern approaches and associated works.

The road is carved through Hawkesbury sandstone, which allowed the batters in the cuttings to be made almost vertical. Excavation was by a combination of drilling, blasting and ripping. Batters were presplit with explosives. To ensure that no damage was caused to nearby houses or high voltage electric transmission lines the quantity of explosive in each detonation was limited. Where it was necessary to excavate in close proximity to a transmission line tower, a hydraulic rock jack first broke the rock, thus preventing damage to the tower from blasting vibrations.

The roadworks in the vicinity of Henry Lawson Drive affected public utilities and involved the relocation of transmission line towers, water main and sewerage lines, electricity cables and P.M.G. plant.

In designing the six ways intersection at Clancy Street and Henry Lawson Drive, consultations were held with the Department of Motor Transport so that the design could incorporate traffic signals.

Fencing, to separate pedestrians from high speed traffic has been provided along the length of the northern approaches. Pedestrian access has been provided between Henry Lawson Drive and the Georges River, and between the County Road and Henry Lawson Drive pedestrian ramps have been constructed.

A trial system of pavement markers has been introduced on these approaches for better delineation of pavement marking under all types of driving conditions.

The earthworks in preparation for the ultimate southbound carriageway have been completed between the Georges River and Henry Lawson Drive, which will prevent disruption to traffic when the road is eventually duplicated.

Presently, the northern approach provides for three lanes of traffic, two northbound and one southbound. These three lanes form the future northbound carriageway of the ultimate dual carriageway.

A temporary at grade connection is provided to Clancy Street, where in the Second Stage work, the County Road will pass under Clancy Street. Off-loading and on-loading ramps will be provided. Northbound traffic will leave the County Road at Clancy Street and southbound traffic will join the County Road by means of a ramp from Henry Lawson Drive as well as from Clancy Street.

THE BRIDGE OVER HENRY LAWSON DRIVE AT PADSTOW

John Holland (Constructions) Pty Ltd, whose tender price was $442,641, also constructed the bridge which carries the County Road over Henry Lawson Drive at Padstow. The designer of this bridge was Bull, Ferranti and Collier, a Sydney firm of consulting engineers.

A 3 span multi-cell prestressed concrete structure, the bridge is 107 m (351 ft) long and has an overall width of 14·3 m (47 ft), which provides for three traffic lanes and a 1·2 m (4 ft) wide footway. The spans measure 29 m (95 ft), 52 m (169 ft) and 26 m (87 ft).

The structure is on a 460 m (1,500 ft) horizontal curve, has a deck crossfall of 6 per cent and is on a variable skew of 44° to 54°. The bridge is supported on wall type piers founded on spread footings and spill-through type abutments supported on 0·9 m (3 ft) diameter bored piles. The supporting strata is sandstone. All the bearings are laminated neoprene pads.

The multi-cell box superstructure is 1·7 m (5 ft 6 in) deep and consists of 150 mm (6 in) top and bottom slabs, 150 mm external sloping webs and seven internal webs 230 mm (9 in) wide with splays top and bottom. Precast slabs 75 mm (3 in) thick with protruding reinforcement comprise the bottom half of the top slab. At the abutments are 1·2 m (4 ft) wide crossbeams, and at the piers, 1·5 m (5 ft) wide crossbeams.

Two cables in each of the vertical webs prestress the superstructure. Three cables span the length of the bridge. Adjoining lengths are overlapped by 3 m (10 ft) at the approximate one-fifth points of the centre span. Over these 3 m (10 ft) lengths the webs were widened to 1·3 m (4 ft 5 in) and the cables anchored in the end of these enlargements. Single end stressing was required and only the centre span cables required stressing from inside the superstructure. The BBR system was specified and adopted for the structure. The largest end span cable is 97/7 mm (97/0·276 in) diameter wires with a design jacking load of 500 t (490 tons). The centre span cables are smaller, the largest being 68 wires.

To reduce stresses caused by differential shrinkage and creep of various portions of the deck and to minimize possible cracking and distortion from the true form of the

METRIC CONVERSION

m = metre (1 m = 3·28 feet), mm = millimetre (1 mm = 0·0394 inch), km = kilometre (1 km = 0·621 mile), km² = square kilometre (1 km² = 0·386 square mile), ha = hectare (1 ha = 2·47 acres), t = tonne (1 t = 0·984 ton), m² = square metre (1 m² = 1·2 square yards), m³ = cubic metre (1 m³ = 1·31 cubic yards), kg = kilogram (1 kg = 2·2 pounds), l = litre (1 l = 0·22 gallons), kPa = kilopascal (1 kPa = 0·145 p.s.i.)

concrete, a casting period of 28 days for the whole of the concrete in the deck was specified. Furthermore the specification did not permit any construction joint in the bottom slab. Construction joints were permitted for the webs, but not within 3 m (10 ft) of the pier or abutment centrelines, or within 3 m (10 ft) from the centre of span two.

At the commencement of the pouring of the superstructure, the contractor had formed a total area of 1 765 m^2 (19,000 sq ft), (bottom slab and sloping outside faces), and had placed 132 t (130 tons) of reinforcing steel (bottom slab, crossbeams). The top and bottom slabs, 215 and 170 m^3 (280 and 220 cubic yards) of concrete respectively, were placed in single days. Each of the cross girders together with short lengths of web pours were also cast in single pours. The webs were cast in batches of 2 to 4 and in lengths of approximately 23 m (75 ft).

Had the pouring period not spanned the Easter holidays, the specified period of 28 days for the casting of the superstructure would have been achieved. The operation took 32 days.

Two concrete pumps and two cranes with kibbles were used for the pouring of the 215 m^3 (280 cubic yards) of concrete in the bottom slab. This operation started at the northern end and progressively extended to the others.

The 100 mm (4 in) Tor Kret pumps, which had an initial delivery length of 120 m (400 ft), caused some difficulties which were overcome by the use of the two standby cranes, 70 t (70 ton) P & H crawler cranes with 0·75 and 1·50 m^3 (1 and 2 cubic yard) kibbles, to place approximately half of the concrete.

Fifty men were engaged on the pour which commenced at 7.00 a.m. and finished at 6.00 p.m. Finishing and green cutting continued until midnight. The slab was water cured.

There are 920 m^3 (1,200 cubic yards) of concrete in the superstructure. A compressive strength of 41 kPa (6 p.s.i.) was specified. The concrete with slumps varying generally between 75 mm and 125 mm (3 and 5 in) depending on the location of the pour, was placed by crane and kibble except for half of the bottom slab.

The web concrete used 10 mm ($\frac{3}{8}$ in) maximum aggregate size while the concrete for the rest of the superstructure was 20 mm ($\frac{3}{4}$ in). Crushed river gravel was used for all the concrete except the outer sloping webs. Here the specification of the bush hammered surface required crushed basalt. In all the concrete, Low Heat Pozzolith, a water reducing and set reducing agent, was used.

The Second Stage works, which will be constructed when traffic conditions warrant it, provides for duplication of the bridge. To facilitate this future construction, the basic part of the abutments has been built to accommodate the ultimate width.

THE CONSTRUCTION OF THE SOUTHERN APPROACHES

The approximate 2 km (1·3 mile) southern approach road to Alfords Point Bridge generally follows the route of the "old" Alfords Point Road from Menai through Georges River Parklands.

At present this road consists of one carriageway used for two way traffic and a third lane serving as a passing lane. There are two 3 m (10 ft) wide flush sealed shoulders.

The construction of the southern approach road included the earthworks for a second carriageway which will be constructed when warranted by traffic conditions so providing two three lane carriageways separated by a median.

Earthworks totalling 198 783 m^3 (260,000 cubic yards) accounted for approximately two-thirds of the total direct cost of the southern approach road. Material was predominantly sandstone with multiple seams of clay and shale. Removal of material from cuttings was accomplished by presplitting the batters, loosening of rock by ripping and moving the loose material by scrapers and rock buggies.

Jointing of the parent rock in the cut batters required extensive masonry restoration where clay and shale seams occurred. This restoration work was completed as work in the cutting progressed and so eliminated the use of scaffolding.

Batters on the western side of cuttings were constructed with a slope of $\frac{1}{2}$: 1 but because of the type of material encountered on the eastern side of cuttings, batters were laid back at 1 : 1. Presplitting is not often attempted when the slope of the batter is at this ratio but even in the deepest section, 21·3 m (70 ft), drill wander was negligible at the bottom of the cutting.

The bulk of the excavated material was moved by 23 m^3 (30 cubic yards) scrapers but their efficiency was decreased when carrying large rock. A secondary "moving team" of twelve 11·5 m^3 (15 cubic yards) rock buggies assisted by a 1·9 m^3 ($2\frac{1}{2}$ cubic yards) tracked front end loader was brought in and the scrapers seldom moved rock larger than 0·4 m^3 ($\frac{1}{2}$ cubic yard).

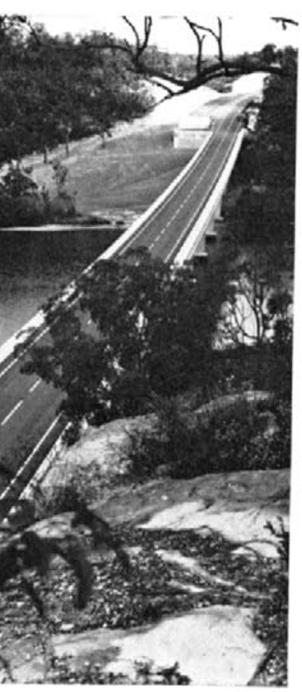
About, 2 675 m^3 (3,500 cubic yards) of material were moved each day and were compacted by maximum size compaction equipment consisting of a team of four rollers.

A 13·7 t ($13\frac{1}{2}$ ton) grid roller and a 10·1 t (10 ton) vibrating sheepsfoot roller were used to break down the material and an 18·3 t (18 ton) vibrating smooth drum roller and a 33·5 t (33 ton) pneumatic tyred roller were used for compaction.

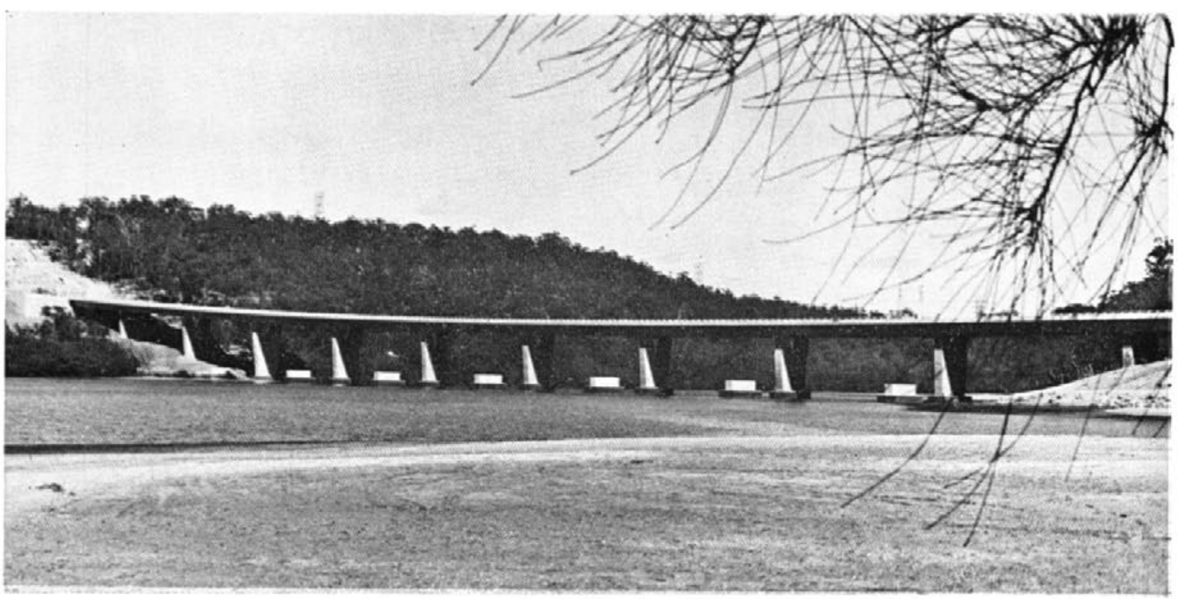
The natural moisture content of the material averaged some 4 per cent below optimum and two water tankers, one of 13 683 l (3,000 gallons) capacity and the other of 3 636 l (800 gallons) capacity, fitted with pressure spray bars were used to supply the additional water at the rate of 114 025 l (25,000 gallons) per day to maintain the optimum moisture content.

Prior to commencement of earthworks the topsoil within the road formation was stripped and stockpiled. On completion of the work this topsoil was spread on earth banks and fills and its use had two major advantages, firstly the elimination of possible damage to plants by the introduction of soils from another area and secondly grasses indigenous to the area were preserved.

After consultation and by agreement with the Georges River Parkland Trust local trees and small shrubs were planted within the road reserve. Some additional species of trees were supplied from the Department's nursery at Yennora. ●



The completed bridge looks striking from any angle—a result of graceful design and a particularly scenic location.



Historical Notes on Georges River and Its Road Crossings

The new bridge at Alfords Point is the fifth site at which a road bridge crosses Georges River. Its history lies ahead, but it takes a place in the saga of all the crossings of this river, which together form a varied and often colourful tale. While touching briefly on the history of each crossing this article concentrates on the story of the nearby Lugarno crossing and Mitchell's direct route south.

Rising in the western slopes of the Illawarra Range near Appin, Georges River follows an erratic course for over 80 km (50 miles) before flowing into the south-western corner of Botany Bay.

The new bridge at Alfords Point is the first crossing at this site and links two districts having close association with the discovery of the eastern coast of Australia. On the northern bank, the Municipality of Bankstown takes its name from Sir Joseph Banks, who was botanist during Captain Cook's voyage of discovery in 1770, while on the southern bank, Sutherland Shire, is considered to be named after Forby Sutherland, who was a seaman on the "Endeavour". Sutherland died at Botany Bay in May, 1770 and, by one of those twists of fate, he thus gained a lasting place in history by becoming the first Briton to be buried in Australian soil.

To early settlers of the Sydney area, a river as broad as Georges River was a tremendous barrier to travel. Captain John Hunter (later Governor Hunter) spent some time exploring and charting Botany Bay and its "West Arm" in 1789 and later officially named the river after King George III. George Bass and Matthew Flinders, with a boy named William Martin, ventured 32 km (20 miles) further upstream during October, 1795. However, very few settlers took up land beside the river in the early years. Compared with districts along the Parramatta River, the Georges River area was relatively rugged and inhospitable and combined with the river barrier—this forced the first southbound travellers to patronise a roundabout route through the settled centres of Liverpool, Campbelltown and Appin.

THE ALFORDS

On the southern side of the river, just downstream from the new bridge, is the point of land which gives its name to the location of the bridge and thereby perpetuates the name of a family that lived in the area early last century. Records show that John Alford was a transported convict who married Jane Camm on 7th March, 1805 at St Phillips Church, Sydney. A prosperous Sydney merchant named Robert Campbell employed John Alford on his farm at Canterbury, where he became farm superintendent in 1809. Governor Macquarie issued a conditional pardon to Alford in 1810, and in the same year granted him land in the vicinity of Cooks River.

The "Sydney Gazette" dated Saturday, 19th December, 1818 reported that in the Criminal Court—"John Alford and Thomas Clure were afterwards acquitted on a charge, one of stealing, and the other receiving cattle knowing the same to be stolen, and directed to be immediately discharged".

In 1828, a census indicated that John Alford was dead and his widow, aged 45, was farming 20 ha (50 acres) in the Parish of Holsworthy, of which a section is now in Sutherland Shire. Mrs Alford's 20 ha probably consisted of a grant of 8 ha (20 acres) for herself and 4 ha (10 acres) for each of the three children (Ellen, John and Jane) then living at home and aged 16, 14 and 10 years respectively. Mary, the eldest daughter, had left home earlier that year to work as a domestic at the "Weavers Arms", a roadside inn on Liverpool Road. At that time the Alfords had 3 ha (8 acres) cleared and 2·5 ha (6 acres) cultivated but the family must have been pioneers in the very real sense as the soil was poor, there were many aboriginals in the area and only a few, widely-scattered white neighbours.

Jane Alford's land grant depended on the water of Deadmans Creek (now more commonly called Tundera Creek, which is an aboriginal term for "place of many killed") and was apparently located in the area shown on today's maps as Sandy Point. On Well's map of 1842, Alfords Point was shown as being at Sandy Point but, today, of course, the area known as Alfords Point is located about 1·6 km (1 mile) downstream from Sandy Point.

After the 1828 census, records of the Alford family are few and two points cause confusion. Although John Alford is thought to have died prior to 1828, there are records of 24 ha (60 acres) of land at Holsworthy being granted to a John Alford in 1831. This could have been a son, although no records have been traced to confirm this. A second reference comes from David Lennox who, when working in the early 1830's on the construction of Landsdowne Bridge (over Prospect Creek near Liverpool), complained that the work was being held up for want of lime. Lennox recommended purchasing that tended by Alford, of Georges River, at seven pence per bushel, claiming that it was "much superior to any lime I have ever seen in Sydney". This makes a tenuous but nevertheless very interesting link between these two beautiful but so dissimilar structures.

MITCHELL'S DIRECT ROUTE TO THE SOUTH COAST

About this time, Surveyor-General Major Thomas Mitchell was still considering his "revolutionary" idea for a direct road to connect Sydney with the Illawarra coastal settlement, instead of depending solely on the circuitous route via Appin.

In 1831, Mitchell had announced that the projected line "would cross the lowest ford at Cook's River, and George's River by a ferry and follow a ridge down the coast mountain". After a further survey in May, 1843 Mitchell was able to report, "I succeeded in marking a line, not only remarkably straight between the two points given, but which does not cross a single watercourse between the head of the navigation of the Woronora and the point of Bulli on the Illawarra Coast . . . the passage of George's River may be established at once by a punt, as I found, at the very best point for this general line to Illawarra old landing places on each side, and a road of access now passable for carts and which leads southward to where I propose to cross the Woronora".

Mitchell was firmly convinced of the benefits that would accrue from the construction of this new road, and claimed that in spite of the "scanty means at the disposal of the Government for opening roads" at this time, it would being into the market "much more land than would cover the expense of making this line passable and the punt at George's River available". In addition it would enable "the mail cart from Wollongong to come to Sydney by a route at least twenty miles shorter than that followed via Appin".

Commencing from Cooks River, Mitchell marked out the course of the new road southwest to Hurstville, south across the Georges River at Lugarno into the Menai area, eastwards across the Woronora River and up to Heathcote (which was at that time called Bottle Forest), then generally southwards to the top of Bulli Pass and on to descend to the coastal plain from Mt Keira.

As soon as Mitchell had traversed the country for himself, he marked out the most suitable course for the new road to follow and sent his son, Assistant-Surveyor Roderick Mitchell, to make an exact survey. In March, 1843, Roderick Mitchell was instructed "to proceed with a small equipment and party up Woronora River, at mouth of which a ferry is about to be established". On 3rd July, 1843, Mitchell Senior advised that ten men of the road party of convicts, under Overseer O'Hara, had been ordered to proceed to Assistant-Surveyor Roderick Mitchell's camp.

It has been suggested that the younger Mitchell failed to measure up to his father's high standards of efficiency and discipline because, in a report to the Colonial Secretary in June, 1843, the older Mitchell referred to "the vigilant superintendence of Assistant-Superintendent Darke, who happens to be working in the George's River locality" while in August he informed Darke that Assistant-Surveyor Mitchell had been placed "on the reduction list". Darke was directed to take charge of the survey and take up residence as near as possible to the Woronora crossing, in view of the sort of men employed under Overseer O'Hara. On the same date, Assistant-Surveyor Roderick Mitchell, was instructed to survey the Woronora River and thereafter disappears from the story of this road. (Ten years later, he was drowned while sailing to Moreton Bay where he was to lead an expedition to search for the lost Leichhardt party.)

It is interesting to note that Assistant-Surveyor Darke was given instructions that


CAPTAIN COOK BRIDGE
TAREN POINT

gravel was to be spread on rough broken stone on one side of the river and that the wharf landing on the opposite side was to be placed so as not to impede any possible permanent work, such as a bridge. Such a bridge at Lugarno has, of course, never eventuated.

THE FERRY AT LUGARNO

A vehicular ferry service commenced operations at Lugarno in 1843 (apparently a waterman's service was available even before this date) and it lays claim to being the longest established service of this kind in New South Wales. It is situated about 3·2 km (2 miles) downstream from the new bridge and conveys traffic from Forest Road (Main Road No. 168) on the north to Old Illawarra Road (Secondary Road No. 2034) on the south.

By 1842, large tracts of land had become available on the south side of the river—about 364 ha (900 acres) in Holsworthy Parish and 242 ha (600 acres) in Sutherland Parish. Consequently, in March of that year a Mr Buddybanks made application to Governor Gipps, stressing the need to connect these areas to the northern shore for the passage of horses and carriages. Mr Buddybanks offered to commence a service on a 14-year lease, using an old punt from the Cooks River service—but his application was refused.

Less than twelve months later, on 6th February, 1842, an advertisement appeared in the "Sydney Gazette" inviting tenders for the operation of a punt at the Lugarno site and the lease of 0·4 ha (one acre) on each side of the punt approaches for a period of three years.

In May, 1843, Charles Rowan successfully applied to the Government to run the Lugarno punt on payment by him of £40 per annum.

From Mitchell's official correspondence we learn that Rowan refused to allow the road gang which was engaged on the formation of the approaches on each side of the river to cross over in the punt without paying the toll. Presumably, he hoped to obtain a reduction in his "rent" on the basis that he would then allow Government officials or gangs to cross free of charge.

MORE ABOUT THE ROAD SOUTH

Construction of the direct route proceeded but problems arose again in May, 1844 when Mitchell directed Assistant-Surveyor Darke to dismiss Overseer O'Hara, apparently because O'Hara did not have sufficient control over his men. About this time the Colonial Secretary was requested to invest Darke with the powers of a District Magistrate, so that he could enforce discipline.

Judging by the instructions sent to Darke from time to time, the actual making of the road was done by contract, whereas Darke and his gang of men were engaged primarily on surveying and clearing the route.

At last on 20th July, 1844 the Sydney Morning Herald could report that: "The new road to Illawarra, via George's River, is opened to within about two miles of the present road down the mountain from Bulli.

The journey from Sydney to Wollongong is a ride of about eight hours, but some have done it in five.

It must be observed however that this road is only opened, not made as a road should be and that there is a necessity for a gang to make the descent good to George's River on each side. The rest of the line is, in general, of the pleasantest kind for a ride, dry and level, leading chiefly over ridges of very poor land although the Bottle Forest and some crests of the Illawarra present splendid exceptions."

"TAKING A PUNT" . . . AND LOSING

The new direct route was evidently not very popular with travellers (via Lugarno) as the following report from the Sydney Morning Herald of 24th August, 1847 confirms.

"It may not be improper to mention the fact that the puntman at George's River, who, poor confiding man, put confidence in the promise of the Government to make the road alluded to passable for travellers, has been miserably disappointed, and is enduring the greatest privations in anticipation of the hopes held out to him by Government being some time or other fulfilled. Delay may not injure the Government, but it is ruinous to him. With the utmost patience and perseverence the puntman may be observed early and late, and at noon day, casting his eyes first to the Sydney, then to the Wollongong side, of the river, in the hope of seeing some traveller who may require his assistance to convey him over the river, from whom he may receive a shilling to enable him to purchase as much food as may "keep base life a-foot". Many days, and sometimes even weeks, elapse without witnessing a human figure to break the monotony of the scenery, or to relieve his necessities. Either a subscription must be got up by the people at Illawarra for the puntman, or the punt must be taken away, and the road abandoned. It is not merely charity towards the individual alluded to, but the interest of every man in Illawarra that should dictate the necessity of doing something for the puntman, to enable him to continue his services in favour of the Illawarra people.

The puntman labours under great disadvantages in not possessing funds enough to enable him to make use of the stream to convey over the vessel, which he might do were he provided with an anchor, &c., whereas at present the physical force is derived from his own body. To make the "head save the heels", is a maxim which, however much admired, cannot be applied to him for want of funds."

In spite of this plea for improving the road, Government work seems to have been tardy and erratic. In February, 1852 the Government Gazette announced that a punt had been established on the George's River in the direct line of road from Sydney to Illawarra, but that the new line of road to head the Woronora was still to be opened (tenders for the roadworks having just been

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"Two Hundred Years in Retrospect—Kurnell-Sutherland 1770–1970," by John Walker.

"From Sails to Atoms," by David R. Kirkby. Published by Sutherland Shire Council, 1970.

Sutherland Shire Historical Society Bulletin, April, 1973 and October, 1973.

"The Story of Port Hacking, Cronulla and Sutherland Shire," by Frank Cridland. Published by Angus & Robertson.

"The Bankstown Story," written and published by Merle Peters.

The following articles containing additional information on bridges over the Georges River have appeared in earlier issues of "Main Roads":

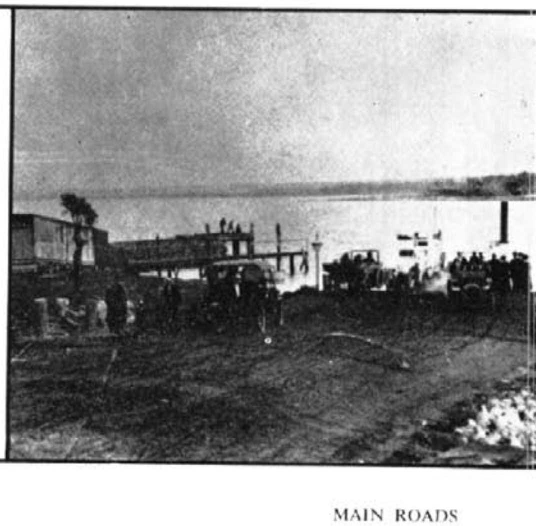
The Princes Highway, March, 1951, vol. 16, pp. 73–84.

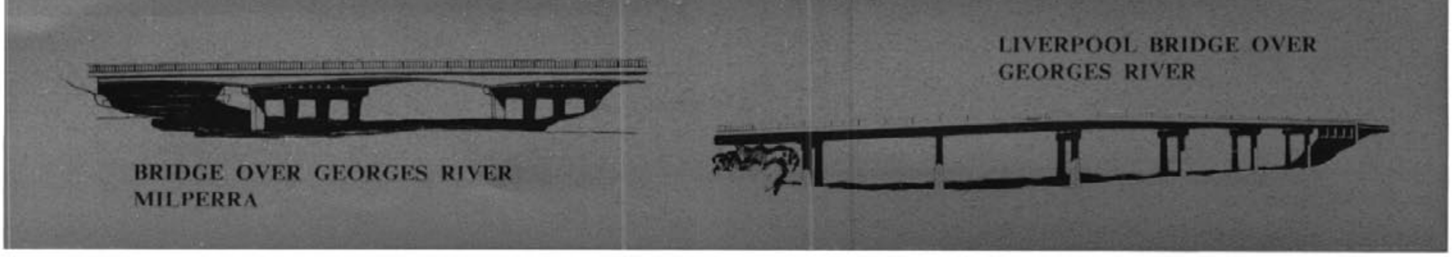
Bridge Over Georges River at Alfords Point—Proposal, September, 1969, vol. 35, p. 5.

New Crossing of Georges River at Alfords Point, September, 1970, vol. 36, p. 22.

Old Photographs of Ferry Crossings

Taren Point





called). This suggests that the ferry service may have been discontinued sometime between 1847 and 1852.

In November, 1864, a new ferry crossing further downstream at Tom Uglys Point threw the Lugarno Ferry and its roads into disuse and necessitated the laying out of a connecting line from Tom Uglys Point to Bottle Forest (Heathcote). This survey was undertaken by Surveyor Parkinson in 1864–65 although it was some years before the road was provided.

CRUISING DOWN THE RIVER

Even by the 1890's, communications by road or rail were not very satisfactory for much of the Bankstown district, particularly the East Hills section near Georges River. Many travellers had to journey by train to Rookwood and then by coach to Bankstown. East Hills was reached by the River Road which was then in a state of disrepair and did little to encourage visitors to return as settlers.

A generally long-forgotten means of access to East Hills commenced about 1894 when Sanbrook Brothers began a paddle-steamer service along the river passing that section now spanned by the new bridge. The steamers ran from Como where tourists and potential settlers could alight from the train and embark for a trip upriver to either the Lambeth Street or East Hills Jetties. These excursions (which continued until World War I) were apparently an excellent example of co-operation between Government and private enterprise, and cheap combined rail-ferry fares made the venture very popular. The steamers also called at Lugarno wharf to off-load or take on passengers and settlers for or from the Menai area.

TWENTIETH CENTURY CHANGES

The Sanbrooks developed a pleasure ground called Parkesvale, complete with a large hall for dances beside the river, directly opposite Picnic Point. In 1907, for obvious business reasons the Sanbrooks suggested to Sutherland Council that another punt was necessary to connect East Hills with Parkesvale, but Council rejected the idea.

In 1928, a six-car diesel-powered ferry vessel, was placed in service at Lugarno. By the 1950's this was too small for the demands of modern traffic and the present 16-car ferry was built at Newcastle and went into service on 12th July, 1961. The cost of £86,000 was met by Sutherland Council, Hurstville Council and the Department of Main Roads.

The Four Other Bridges

AT LIVERPOOL

The first bridge across Georges River was a five-span 138 m (425 ft) long timber truss structure built on Heathcote Road (now Main Road No. 512) at Liverpool in 1894 (although earlier a dam built about 1836 used to give access to the south side of the river). The bridge was constructed under contract by George Weeks at a cost of £12,189/7/5 and was used until a new ten-span 277 m (912 ft) long steel plate girder bridge was built for the Department by Cleveland Bridge and Engineering Co. of England. The new structure was officially opened by the Premier of New South Wales, Hon. J. J. Cahill, M.L.A., on 15th March, 1958 and the cost, including approaches, was approximately £800,000 (see "Main Roads", June, 1958, pp. 105–107).

AT TOM UGLYS POINT

A hand-operated ferry service was established between Tom Uglys Point (on north) and Horse Rock Point (on south) on 7th November, 1864. This was superseded by a steam-operated punt just prior to 1900 and in December, 1923 an Act was passed enabling the Sutherland Shire Council to borrow money to build a bridge on what had become the Prince's Highway and levy tolls to repay the capital cost. Subsequently, a nine-span steel bridge, 500 m (1,641 ft) long was built by State Monier Pipe and Reinforced Concrete Works, supervised by the Department of Public Works. The final cost was about $620,000 and on 11th May, 1929 the bridge was officially opened by the Governor, Sir Dudley de Chair, K.C.B. Toll charges were discontinued as from 31st May, 1952 (see "Main Roads", June, 1952, pp. 110–111).

AT MILPERRA

In 1931, a timber bridge was constructed over Georges River at Milperra and was replaced by a new three-span concrete structure, 86·5 m (284 ft) long, opened on 25th February, 1966. The new six-lane bridge was built for the Department by E. C. Clemenston at a cost of $500,000 and is a link between Milperra Road and Newbridge Road (Main Road No. 167).

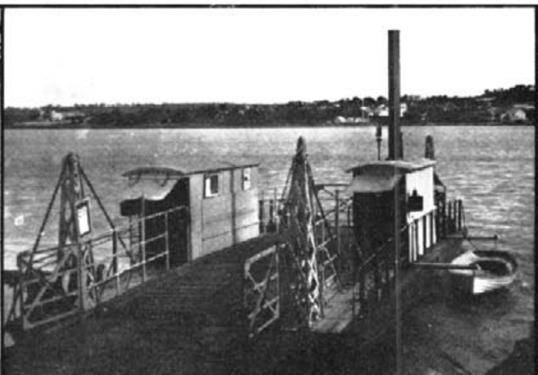
AT TAREN POINT

Following a private launch service which commenced in the early 1900's, a vehicle ferry was begun between Rocky Point Road (on north) and Taren Point (on south) in 1916. As traffic increased rapidly after World War II a new bridge was designed to form part of the future South Freeway and to relieve congestion on the bridge at Tom Uglys Point. A seven-span concrete structure, 505 m (1,662 ft) long was built for the Department by John Holland (Constructions) Pty Ltd and opened on 29th May, 1965 by the Governor, Sir Eric Woodward, K.C.M.G. The bridge and its approaches cost $4·7 million and it was officially named Captain Cook Bridge (see "Main Roads", Vol. 27, June, 1962, p. 121 and Vol. 30, March, 1965, pp. 110–115).

The new bridge at Alfords Point is thus the fifth road bridge to be built across Georges River in less than fifty years and is another attractive addition to the means provided for motorists to cross this wide waterway. ●

Lugarno

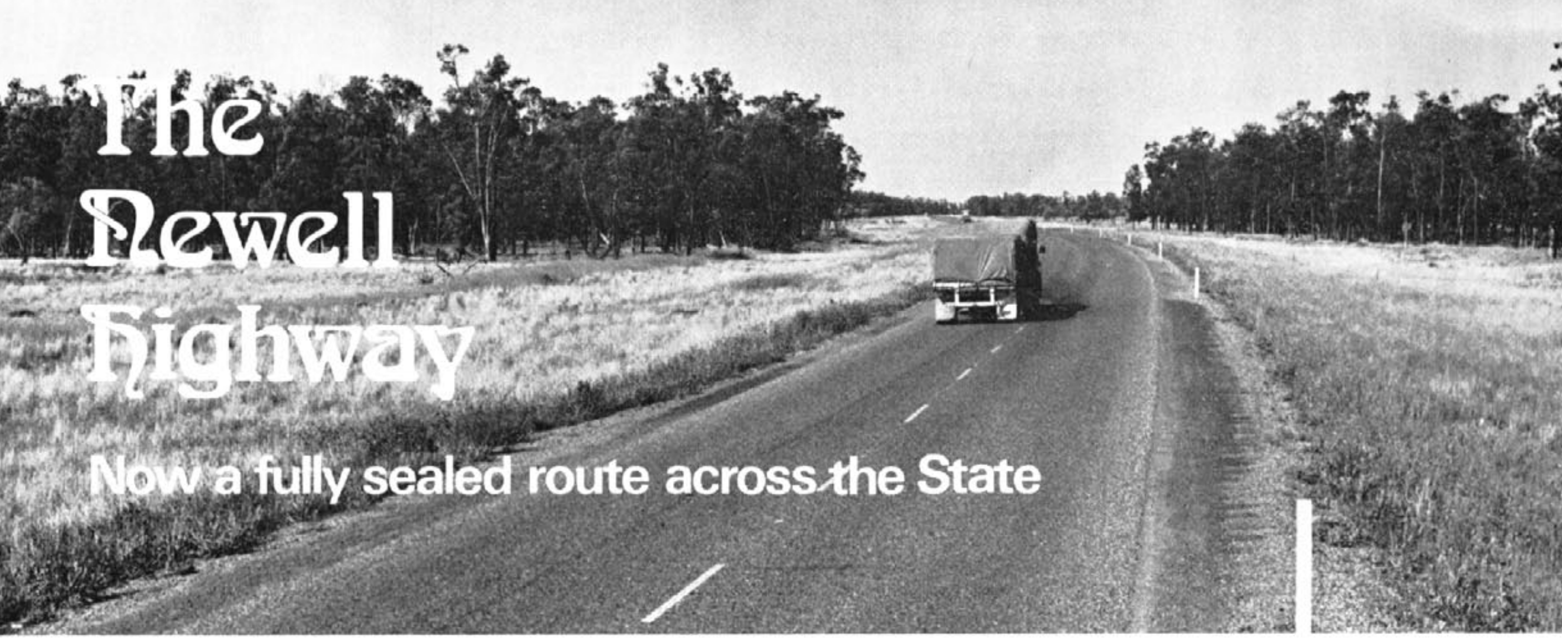
Tom Uglys Point



Bridge at Tom Uglys Point

The Newell Highway

Now a fully sealed route across the State



Looking south along a chemically stabilized section of the Newell Highway 74 km (46 miles) north of Moree.

The Newell Highway (State Highway No. 17) is 1 050 km (653 miles) long and extends from the Murray River at Tocumwal to the Macintyre River at Boggabilla, forming an important link between Victoria and Queensland. For about 60 km (37 miles) it is common with Mid Western Highway (State Highway No. 6) between West Wyalong and Marsden and for about 97 km (61 miles) common with Oxley Highway (State Highway No. 11) between Gilgandra and Coonabarabran.

Proclaimed a highway in 1938, the Newell Highway was named after the first Commissioner for Main Roads, Mr H. H. Newell, who held office from December, 1932 to March, 1941.

With the completion of reconstruction work in the North Western and Upper Northern Divisions, the Newell Highway is now sealed over its full length. Details of the final work are featured in this article.

NORTH WESTERN DIVISION

The Newell Highway traverses the North Western Division from its junction with the Oxley Highway 5·5 km (3·5 miles) northeast of Coonabarabran northerly through the Shires of Coonabarabran and Namoi and Municipality of Narrabri to the Namoi/Boolooroo Shire Boundary 54·5 km (34 miles) north of Narrabri.

The total length of the Highway in the North Western Division is 170 km (106 miles), of which 165 km (103 miles) in the Shires of Coonabarabran and Namoi are maintained by the Department's direct control organization centred at Coonabarabran Works Office.

The length between Coonabarabran and Narrabri crosses the Warrumbungle Range immediately north of Coonabarabran and then passes through the undulating country of the Pilliga Scrub. Between Narrabri and Moree to the north the Highway crosses the black soil plains paralleling the railway line linking Sydney and the North West of New South Wales.

The reconstruction and bitumen surfacing of the Highway in the Shires of Namoi and Coonabarabran was carried out by the Department's own forces operating from a Works Office established at Narrabri in 1959, this Works Office being subsequently transferred to Coonabarabran in 1969 where a permanent office has been established and from which maintenance operations on the Oxley and Newell Highway are directed.

The work of reconstruction was undertaken on two sections; firstly, the section northerly from Narrabri to the Namoi/Boolooroo Shire Boundary and secondly, southerly from Narrabri to the Oxley Highway immediately north of Coonabarabran. When completed in 1972 a bitumen pavement 6·7 m (22 feet) wide on a 10·4 m (34 ft) formation linked Coonabarabran and Moree via Narrabri.

NARRABRI TO NAMOI/BOOLOOROO SHIRE BOUNDARY

Prior to 1959 the maintenance and construction of the Newell Highway north of Narrabri was carried out by Namoi Shire Council. The Highway at that time for the most part consisted of black soil strengthened with river gravel and/or plastic conglomerate gravel to

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provide a running course. A short section through Edgeroi had been sealed, however, by Namoi Shire Council using a mechanically stabilised surface course of conglomerate gravel from Bellata.

Early in 1959 the Department considered that the improvement and reconstruction of the Highway at a much greater rate than was previously practicable was desirable and survey and design work was commenced together with preliminary investigations for gravel deposits by the Department's staff. The design was undertaken on the basis of providing a 6·7 m (22 ft) bitumen seal on a 10·4 m (34 ft) formation and involved problems in coping withflood-water in creeks fed from the steep country of the Nandewar Ranges to the east of the Highway.

Work commenced in 1959 from the Narrabri Works Office operating under the control of a Works Engineer. The Works Office, completed in September, 1959, was of a prefabricated design and was constructed by Cleveland Engineering Co. of Tamworth. In addition the Department purchased five residences for the use of its staff, two of the residences still being retained for maintenance personnel.

The work was progressively completed in a northerly direction from Narrabri in five basic sections terminating at

12 km (7·4 miles), 17·5 km (11·0 miles), 24 km (15·2 miles), 45 km (28·3 miles) and 54·5 km (34·4 miles) north of Narrabri. By 1964 a dustless surface had been provided for the full length of the highway north of Narrabri.

The final cost of the roadworks was $975,000 with an additional cost of $650,000 for bridge sized structures including major bridges over Spring Creek, Bobbiwa Creek, Ten Mile Creek, Bulldog Creek, Boggy Creek, Myall Hollow Creek, and a Railway Overbridge north of Bellata.

Generally road construction comprised a raised formation of naturally occurring black soil placed using scoops and dozers. Base material used between Narrabri and Bellata was obtained from sandy loam deposits in the Killarney State Forest whilst cement stabilized conglomerate gravel was used in the work north of Bellata.

Over the period of reconstruction the minimum traffic volume between Narrabri and Moree has risen from about 200 vehicles in 1959, to 1,150 vehicles in 1972.

COONABARABRAN TO NARRABRI

Prior to 1962 this section of the Highway was maintained by Namoi and Coonabarabran Shire Councils. The Highway at that time consisted for its full length of a sandy loam pavement which was prone to produce dusty and corrugated pavement conditions during dry periods. The road was reasonably direct in alignment and catered for a minimum traffic volume of approximately 20 vehicles per day which has now risen in 1972 to exceed 500 vehicles per day.

The survey and design for the new work was commenced in 1962 and the design with high standards of alignment and grading with a 6·7 m (22 ft) bitumen pavement on a 10·4 m (34 ft) formation provided for high speed traffic.

Construction work commenced in 1963 and continued without interruption south from Narrabri Works Office until 1969 when a permanent Works Office was established at Coonabarabran to cater, not only for the completion of the construction work, but to handle the future maintenance activities on the Oxley and Newell Highways.

The new Works Office at Coonabarabran was designed by the Department's Architectural Section and constructed by contract with E. J. Jenner & Co. Pty Ltd, Tamworth, the total cost of the office and store being of the order of $110,000.

It is understood that the Works Office is established on land which formed part of the original Coonabarabran aerodrome from which Butler operated a charter service in the early days of aviation in rural New South Wales.

By December, 1972 construction, which had commenced at 4·5 km (2·8 miles) south of Narrabri, had been completed to the Oxley Highway 114 km (71·3 miles) south of Narrabri and a dustless surface provided for the full length of the Newell Highway in the North Western Division.

The final cost of the roadworks on this section was of the order of $3,000,000. New bridge sized structures, strengthening of timber bridges at Station Creek and Tunmallallie Creek and a major 15/10·5 m (15/35 ft) span concrete bridge over Bohena Creek cost in the order of $650,000.

Elevated road with grassed verges, 93 km (58 miles) north of Coonabarabran looking north.

Road construction between Narrabri and 43·5 km (27 miles) south through the Pilliga Scrub consisted of a raised formation constructed using elevating graders and scoops, together with a sandy loam sub-base and base, the base being stabilized with bitumen emulsion.

Southerly from the 43·5 km (27 mile) peg the terrain becomes more hilly, extending to heavily timbered country and eventually crossing the Warrumbungle Range between 96·5 km (60 miles) and 114 km (71·3 miles) south of Narrabri. Earthworks were not heavy and material was obtained from cuttings and adjacent borrow areas using motorised scrapers. Base and surface course materials were generally available close to the site of the work and cleated rollers were used to break down the material to provide an acceptable pavement prior to bitumen sealing operations being put in hand.

Throughout construction full pavement material testing and density-in-situ checks were completed by testing personnel to ensure the Department's specifications were maintained prior to bitumen surfacing.

In addition to traversing the Pilliga Scrub the highway links two important but vastly different centres—Coonabarabran and Narrabri.

Coonabarabran, which has a rainfall of 711·4 mm (28 inches) per year, is situated on the edge of the Warrumbungle Range and adjacent to the Warrumbungle National Park, the fourth busiest National Park in New South Wales with annual visitors now totalling 60,000 and increasing by 20–25 per cent. This park has some of Australia's most spectacular mountain scenery and a cluster of the world's rarest extinct volcanoes. The park also abounds in wildlife and contains 30 miles of walking trails. On Siding Spring Mountain the Siding Spring Observatory has been established with 1·0160 m, 0·6604 m and 0·4064 m (40 inch, 26 inch and 16 inch) telescopes in operation and a 3·8100 m (150 inch) telescope under construction.

Narrabri is one of the principal towns of the Namoi Valley which is a large beef, fat lamb and wheat producing area. In addition a great cotton industry is thriving westerly to Wee Waa and Merah North. To the east the Nandewar Ranges provide excellent scenery, particularly from Mt Kaputar.

(Top left) The spectacular Warrumbungle Range located near Coonabarabran attracts an increasing number of tourists each year.

(Top right) Before reconstruction - a section of the Newell Highway 63 km (39 miles) north of Coonabarabran in 1961.

(Above) By contrast, a reconstructed section of the Newell Highway today, 59 km (37 miles) north of Coonabarabran.

(Left) Bridge over Bohena Creek, 105 km (65 miles) north of Coonabarabran.

(Below) Two bridges north of Moree – at 69 km (43 miles) bridge over Cropper Creek (left) and at 98 km (61 miles), Whalan Creek bridge.

UPPER NORTHERN DIVISION

Moree to Boggabilla

The 116 m (72 mile) section of the Newell Highway between Moree and Boggabilla passes through black soil plains, utilized as grazing country for both sheep and cattle and extensive cultivation of wheat and sunflower crops. On this section of the Highway heavy traffic exceeds 45 per cent of the total.

Reconstruction along this length of Highway has cost $4·5 million and the bitumen surface was completed on 3rd September, 1973.

The greater part of the work was undertaken by the Works Organization located at Moree under the control of the Upper Northern Division with headquarters at Glen Innes. A camp was established at 42 km (26 miles) north of Moree and later at 92 km (57 miles) north. A mobile laboratory was also located at 48 km (30 miles) and 92 km (57 miles) north of Moree for testing and control of materials. In addition the Department provided four residences for the use of its staff, two of the residences still being retained for maintenance personnel.

Over this 116 km (72 mile) length of Highway the difference in level is 12 m (39 ft). The detailed design for the reconstruction was prepared in the Department's Divisional Office at Glen Innes.

The minimum radius curve on this length is 365 m (1,200 ft), the curve location being at 11 km (6·8 miles) north of Moree, whilst the maximum grade of 2 per cent is located at 85 km (52·8 miles) north of Moree.

The design features sweeping curves of large radii.

Most of the earthworks were located on flat black soil plains and fill was obtained from the roadside. The only significant cuttings are 1·2 m (4 feet) at 88·5 km (55·7 miles) and 2·4 m (8 feet) at 95 km (59·3 miles) through undulating red clay and ironstone deposits.

A Raygo Ram Roller was used for earthworks compaction at 93·3 km (58 miles) north of Moree and although this produced fairly satisfactory results it was found that a 10 t (10 ton) vibrating sheepsfoot roller gave the most satisfactory compaction.

Dense brigalow scrub was encountered north of 75·5 km (47 miles) which involved 4·8 km (3 miles) of heavy clearing.

In many cases the provision of base-course and surface course gravels involved very long hauls. The materials used included prior stream gravels and loams, siltstone, ironstone, sandstone, sand and pebbles. The sources of supply were grazing and cultivation properties in Boolooroo and Yallaroi Shires, the Macintyre and Gwydir Rivers and Whalan Creek.

To avoid wasting time with opening and closing gates where lorries travelled through a number of properties to gravel deposits for pavement materials fences were left open and dogs were used to prevent stock straying.

Delays were caused when the blacksoil tracks to gravel deposits became impassable in wet weather.

During the course of the work both drought and flood conditions were experienced. Early in 1970, floods caused considerable damage to the construction and floodways had to be restored and cement stabilized between 12·8 km (8 miles) to 14·5 km (9 miles), 46 km (29 miles) to 75·5 km (47 miles) and at 108 km (67·6 miles) north of Moree.

Base and surface courses usually required two or three ingredients mechanically stabilised to provide a pavement acceptable for sealing. Mixing was carried out by the Department's Rotomobile and Pulvimixer.

Chemical stabilization of selected trial lengths of pavement between 62·7 km (39 miles) and 75·5 km (47 miles) north of Moree was carried out using lime and cement. As early failures and excessive cracking occurred, the lime stabilised lengths were restabilised with cement. Cement stabilising was also carried out between 75·5 km (47 miles) to 78·8 km (49 miles) north of Moree and over shorter lengths at floodways between Moree and Boggabilla.

The bridge over the Gwydir River at Camurra, 11 km (6·9 miles) north of Moree is now the only timber structure remaining on the Newell Highway north of Moree.

Of the bridgeworks built along this section of highway the largest was the bridge over Whalan Creek 98 km (61·1 miles) north of Moree consisting of seven 17·3 m (56 ft 8 in) spans each 7·3 m (24 ft) wide on steel beams. Other significant bridges included that over Marshall Ponds, 15 km (9·6 miles) north of Moree, over Wallon Creek 30 km (18·7 miles) north of Moree and the bridge over Nee Nee Creek 46 km (28·8 miles) north of Moree.

A single railway level crossing constructed 11·2 km (7·1 miles) north of Moree replaced two level crossings on the previous route.

A reinforced concrete box culvert at 37 km (23·5 miles) north of Moree and four precast concrete box culverts over Tackinbai Creek, Mungle Creek, Mungle Back Creek and Morella Watercourse were amongst other bridge size structures along the route.

In addition to the major bridges, reinforced concrete pipes and precast concrete box culverts were placed where necessary over the full distance. During the later stages of the work precast concrete box culvert crown sections were laid on monolithic cast-in-place concrete slabs in lieu of bedding each culvert section individually and to control differential settlement.

Earthworks in the approaches to Whalan Creek Bridge at 98 km (61·1 miles) north of Moree were carried out under contract to the Department by Mr G. T. Muggleton. Other earth-moving was carried out by the Department's Domor elevating grader and Wabco scraper and a hired self-loading scraper, tractors and water tankers. Other Departmental plant used for earthworks included graders, loaders, scoopmobile, crawler tractor dozers, rubber tyred tractor dozer, sheepsfoot and vibrating sheepsfoot, smooth vibrating and pneumatic tyred rollers.

At one stage the water tank capacity was three tankers of 13,640 litres (3,000 gallons) each, all of which made numerous trips per day. The main sources of water were the Gwydir River at 11 km (6·9 miles) north of Moree and Whalan Creek at 98 km (61·1 miles) north of Moree.

Hired plant also used included loaders, trenchers and rollers. A grid roller was used to break-up hard ironstone material.

Plant items were hired from Boolooroo and Boomi Shire Councils and the Public Works Department.●

The following articles on the Newell Highway have appeared in earlier issues of "Main Roads"—

Newell Highway Improvements, December, 1956, *Vol.* 22, *p.* 42.

Newell Highway Reconstruction, March, 1966, *Vol.* 31, *p.* 87.

Historical Notes and Sealing Programme, September, 1970, *Vol.* 36, *p.* 30.

Newell Highway, December, 1972, *Vol.* 38, *p.* 52.

TAKING A BREAK

Almost every driver has experienced the temptation to keep driving just a little further after symptoms of weariness become apparent. Good drivers are those who resist and pause to rest, knowing that weariness frequently, and sometimes tragically, leads to accidents.

The network of roadside rest areas which is now growing along the state's major roads has been developed to encourage motorists to take proper pauses for rest and refreshment along the way. Two new rest areas which recently came into use are located on the Pacific Highway (State Highway No. 10) just north of Bangalow Creek, 13 km (8 miles) north of Gosford and near the summit of Razorback Mountain on the Hume Highway (State Highway No. 2).

The completion of these rest areas brings the total in use to 50, while 14 other sites in the State are currently being planned or developed as rest areas.

These rest areas are being made available to the motoring public by the Department of Main Roads with the co-operation of several other authorities, principally the Department of Local Government, Shire and Municipal Councils and the Department of Lands. Considerable planning and work lies behind the establishment of a rest area site and its subsequent use by motorists. The Bangalow Creek and Razorback Rest Areas are no exceptions as illustrated in these short descriptions of their development.

BANGALOW CREEK REST AREA

By mid 1971, the several Council parks or parking areas in towns close to the route of the Pacific Highway between Sydney and Newcastle had been gradually by-passed as a result of the development of the Sydney-Newcastle Tollwork and provision of restricted access conditions on sections of the Highway. There had never been an authorised roadside rest area along this section of the Pacific Highway although the Department proposed to establish an extensive service centre and restaurant complex at Mooney Mooney (see page 51).

A site for construction of a rest area was approved in July, 1971, at a location on the western side of the Pacific Highway, just north of Bangalow Creek, 13 km (8 miles) north of Gosford. A rest area at that site had the advantage of virtually serving three roads, being in the general area between the junction of the Pacific Highway with both State Highway No. 26 and with the proposed Tollwork between Ourimbah and Doyalson.

At that time, reconstruction of the Pacific Highway between Burns Road and Ourimbah Creek, 11 km (6·9 miles) to 13 km (8 miles) north of Gosford was under way and the site of the rest area was possible where this new work had by-passed a section of old road and left a small area of land between. Access to the rest area was available from the old road and traffic control from the new dual carriageway of the Highway was satisfactory as turning and storage lanes had been provided.

The construction work necessary to convert the area to a convenient and useful rest area was carried out during 1972.

Landscaping of the rest area was designed to blend with the existing natural bush located at the southern end of the site and to give aesthetic appeal from the roadway. The success of this rest area is confirmed by the many motorists using it each day for a pause from the weariness of miles of driving.

RAZORBACK REST AREA

From the top of the Razorback Range, 74 km (46 miles) southwest from Sydney on the Hume Highway, magnificent and wide ranging views open out on both sides of the road.

During reconstruction of the highway on Razorback Range a few years ago, engineers responsible for the work considered the possibility of locating a rest area there and arranged the works so that a suitable residue area would be available for this purpose. Approval was given to the establishment of a rest area near the summit of the mountain in July, 1971.

Final work was completed early this year by the Department's forces under the supervision of Picton Works Office.

The rest area is located at the junction of the Hume Highway with Cawdor Road. Access is from Cawdor Road and not directly from the highway. Motorists turning to use the rest area do not present a traffic hazard at this location where climbing lanes have been constructed on each side of the summit.

Razorback rest area is now freely used by travellers and in addition to the normal rest area facilities of fire-places, tables, seats and shelters, a "look out" has been established at the eastern end of the area. On a clear night the lights of Sydney are visible from this point while the day time view is also fine enough to attract many visitors.

This rest area is another example of these attractive roadside facilities which are now being carefully designed and constructed to a high standard at convenient locations along the main road system in this State.

A detailed map "New South Wales showing Roadside Rest Areas on State Highway and Main Roads" is included in a recent publication by the Department called "Roads and the Environment". This 16-page colour brochure is available free of charge on application to the Department.●

NEW REST AREAS ON MAIN ROADS AT BANGALOW CREEK AND RAZORBACK

(Below) Beside the Pacific Highway near Bangalow Creek, 13 km (8 miles) north of Gosford the new rest area is situated between the old and new routes of the highway.

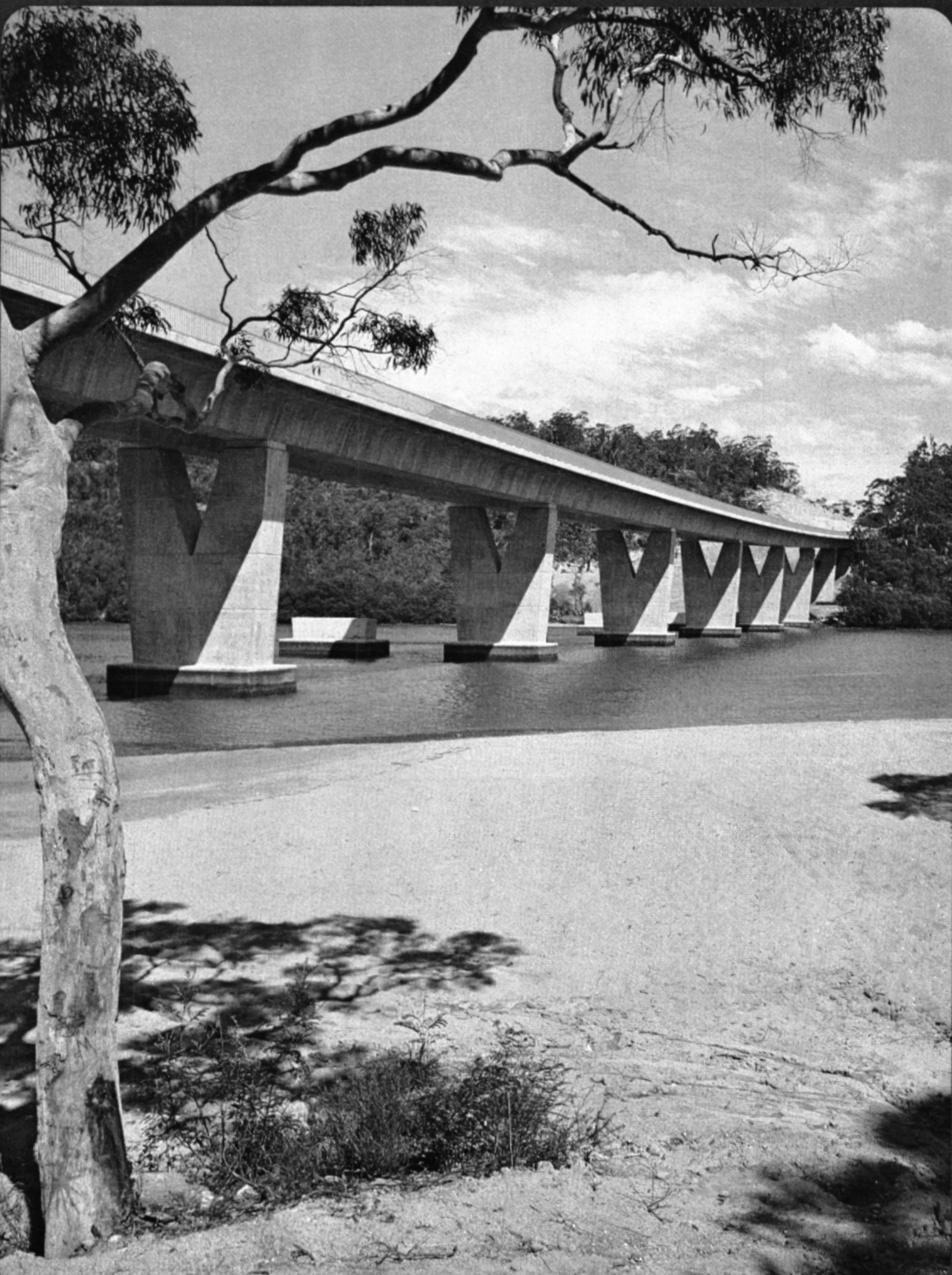
(Top) The rest area on the Hume Highway at Razorback includes a small "lookout" at the eastern end where travellers enjoy the panoramic views.

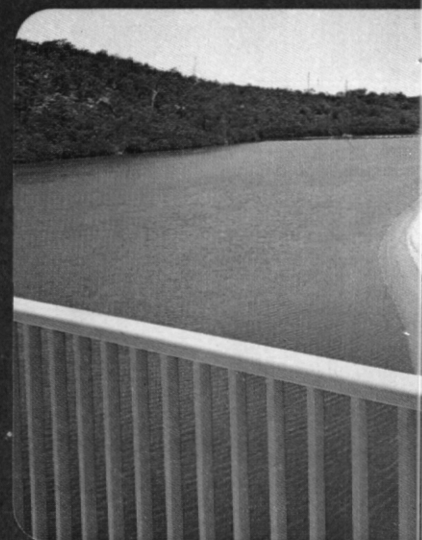
(Centre) A number of large trees, which were growing at the site of the rest area at Bangalow Creek, remain to give shade to motorists and increase the attractiveness of the area.

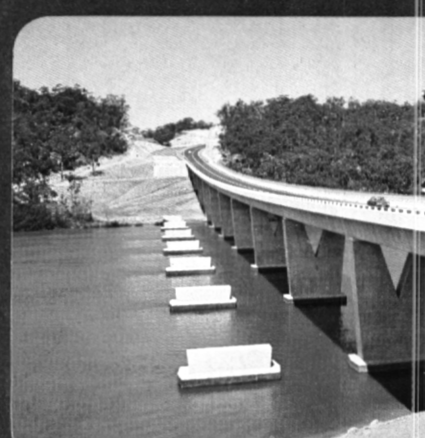
- From the northern shore of the river.
- Looking upstream from the deck.
- Bridge crossing Henry Lawson Drive on the northern approaches.
- On both banks landscaping has commenced to replace natural vegetation cleared during construction.
- The southern approach road which links to Old Illawarra Road.
- The view south emphasises the beauty of bridge and location.

Sweeping curves of r
blend into rounded hi

ALFO



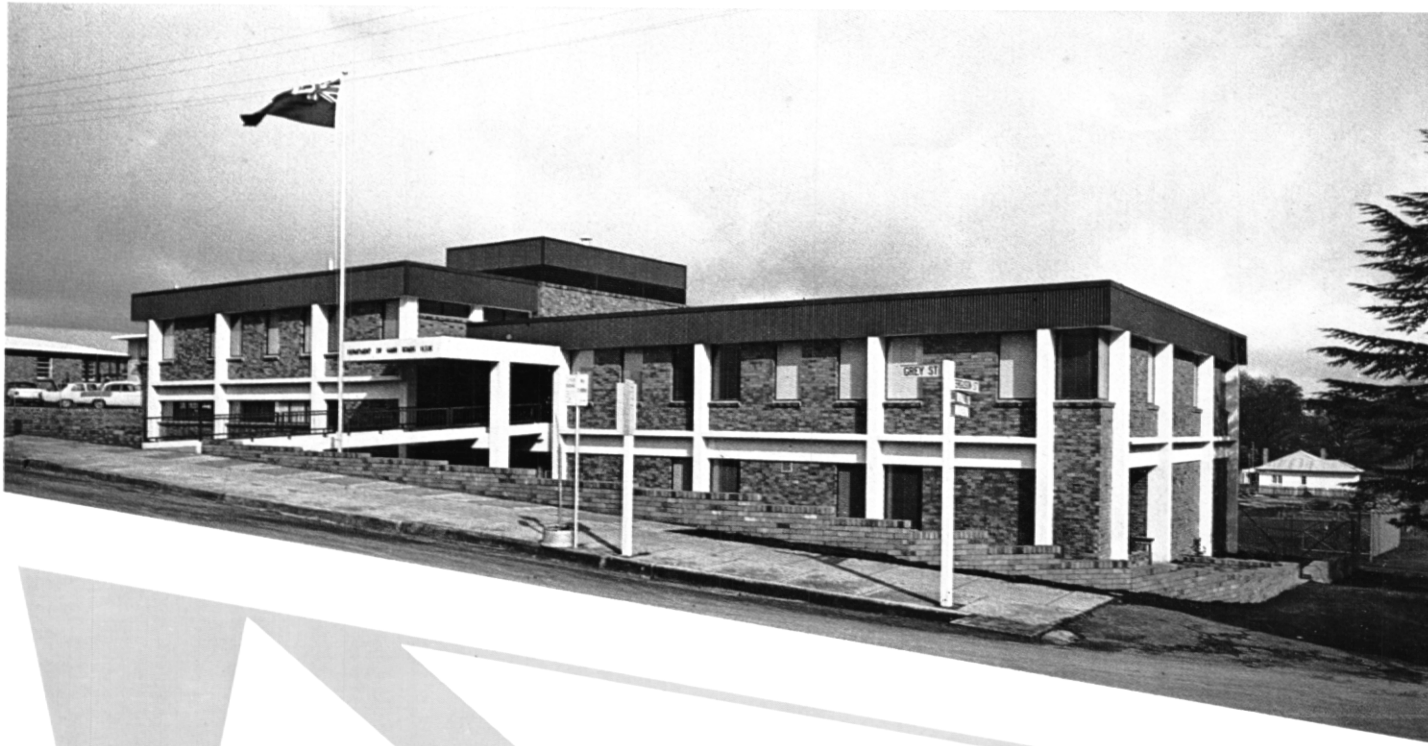




d and bridge
of natural bushland where Georges River is crossed by a new bridge at

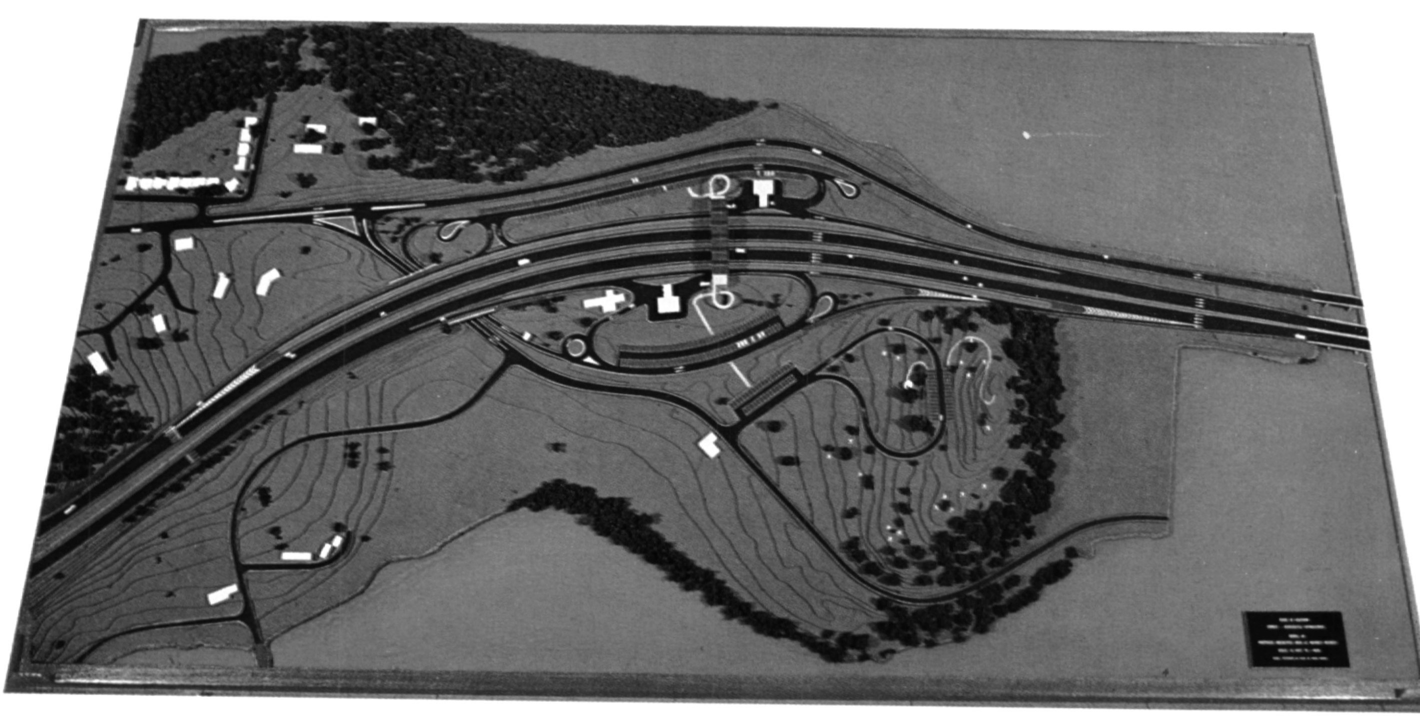
RDS POINT

on County Road 5016.



At Glen Innes — a new Divisional Office

At Mooney Mooney — model of a Service Centre



Openings

New Headquarters for Upper Northern Division

The Honourable J. C. Bruxner, M.L.A., Minister for Housing and Minister for Co-operative Societies, opened the new Divisional Office at Glen Innes on Friday, 17th August, 1973.

The two-storey, air-conditioned brick and reinforced concrete building has approximately 1 765 m² (19,000 square feet) of space for offices, laboratories, drawing offices, engineering sections and garages. The previous Divisional Office building, located in Meade Street, was no longer adequate for departmental needs.

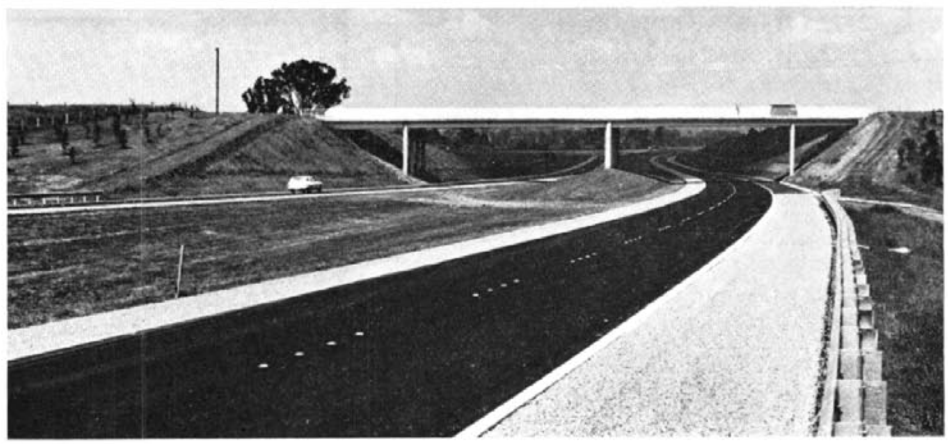
Hardy Marr Constructions Pty Ltd of Glen Innes was awarded the contract for construction of the new building in April, 1972, at a tender price of $370,000.

South Western Freeway

The Deputy Premier and Minister for Highways, the Hon. Sir Charles Cutler, K.B.E., E.D., M.L.A., arriving to inspect the South Western Freeway before it was opened to traffic on Friday, 26th October, 1973.

Extending from Cross Roads near Liverpool to near Raby Road, Minto, the 10 km (6¼ mile) section of freeway required the construction of nine bridges and cost approximately $13·1 million. The bridge carrying Brooks Road over the freeway is seen in the illustration below.

An adjoining 5·6 km (3½ mile) section of the South Western Freeway is expected to be completed during the first half of 1974.



Service Centre and Restaurant on the Berowra–Calga Tollwork

Prior to the opening of the new bridge over the Hawkesbury River at Mooney Mooney, the Berowra-Calga Tollwork was divided into two toll sections—north of the river to Calga and south to Berowra.

The toll plaza dividing these sections has occupied a site just north of the Hawkesbury River crossing and at this location a Service Centre and Restaurant complex will be constructed.

Late in 1972, pre-qualified tenderers were invited to submit tenders for the long-term lease and building of catering and petrol servicing concessions at this amenities area. The tender was awarded in August this year to Golden Fleece Petroleum Limited whose proposal complied generally with that of the Department with a few variations to be negotiated and agreed upon.

On a bridge over the tollwork, a high quality restaurant with full facilities will be established. Patrons will be able to enjoy the extensive natural views of this scenic district. Other amenities provided by the centre will include a cafeteria, a "take-away" food bar and service stations which will cater for both north and southbound traffic on the tollwork. An attractive grassed picnic area will also be available to motorists.

The design and construction of the bridge over the tollwork is the responsibility of the Department of Main Roads which is also undertaking the landscaping and maintenance of the area.

The natural surroundings of the location are expected to be only slightly affected by construction work. A great deal of emphasis in this project will be given to landscaping and any changes in the area brought about by construction will be quickly remedied. Included in the Department's plans for landscaping will be the laying of lawns, the provision of a watering system and the planting of shrubs and trees native to the area.

While the construction of the amenities centre is underway, motorists will be able to use a first class rest area with full amenities which the Department will establish at the site. Eventually, the catering establishments at the centre will be connected by covered walkways to the rest area and the large parking areas.

All these facilities will be readily accessable to motorists driving along the tollwork. Those using the Pacific Highway will have a rest area and parking facilities outside the boundary of the tollwork on the eastern side with additional pedestrian access into the entire amenities complex.●

Design of the Freeway Bridge over Hawkesbury River

This open steel trough girder bridge, designed in the Department of Main Roads, is believed to be the first of its type constructed in the world. The unusual procedure has met the requirements of the bridge site and achieved economy and a smooth and slender bridge outline.

The following article describes this design, apart from the foundation design which was detailed in previous issues of "Main Roads".

The design had to be prepared for a 6 lane freeway bridge spanning the 600 m (2,000 ft) wide estuary of the Hawkesbury River about 30 m (110 ft) upstream from the existing Pacific Highway bridge which has steel beam spans varying from 12 m (40 ft) in length to steel truss spans 135 m (450 ft) in length. The freeway carried by the new bridge is graded at 2½ per cent from 21 m (70 ft) above water level at the southern bank to 7 m (23 ft) above water level at the northern bank of the estuary. Sandstone bed rock was located at a maximum depth of 85 m (280 ft) below water level, resulting in a maximum structure height of 100 m (330 ft) measured from lowest bed rock to the bridge deck.

The aesthetics and economy of construction asked for practically uniform span lengths with the bridge piers lining up with piers on the existing bridge as closely as possible. This resulted in slightly varying span lengths with an average of 55 m (180 ft). Longer spans (such as the 135 m (450 ft) maximum spans of the existing bridge) were not required for navigation clearance and if used would have resulted in a heavier superstructure and, consequently, costlier foundations.

A prestressed concrete girder superstructure would have weighed 60 per cent more than a steel girder superstructure and would have increased the foundation loads and the foundation cost by 40 per cent. Since the deep foundations needed for this bridge represent a large part of the total bridge cost, increased foundation costs had to be avoided.

The bridge is subdivided into three self contained sections separated by transverse expansion joints. The subdivision is arranged in such a way that the sections can resist external forces acting horizontally on the bridge, but are flexible enough not to be distressed by internal forces caused by changes of temperature in the superstructure and shrinkage and creep in the concrete deck slab.

The bridge is 615 m (2,030 ft) long made up of a 350 m (1,160 ft) long southern section, a 220 m (720 ft) long central section and a 45 m (150 ft) long northern section (figure 1).

The first two sections have been designed as three dimensional frames, rigid transversely and longitudinally (figures 2 and 3). Longitudinal forces from vehicle braking and wind and transverse wind forces are distributed over the bridge supports in accordance with their stiffness so relieving the longer, more flexible piers at the expense of the shorter stiffer piers and the southern abutment. Rigid framing of the pier columns into the superstructure reduced the effect of lateral loads on the deep pile foundation. As a result, very little extra foundation load is produced by lateral forces acting on the bridge superstructure, in spite of the tallness of the piers. The third or northern section is merely a suspended span tied to the northern abutment and supported on the cantilevered end of the previous span but otherwise separated from the rest of the bridge. The reason for this arrangement was the possible instability of the northern bridge approach which is placed on soft ground liable to move southwards into the river estuary over a long period. Any tendency of the northern bridge abutment to move is expected to be resisted by 83 m (270 feet) long prestressed concrete anchors which tie the abutment to firmer ground (figure 4).

As a result of the rigid frame design few movable bearings are required in the bridge. Fixed bearings at the abutments allow rotation but no horizontal movements, while expansion bearings between the three bridge sections allow rotation and longitudinal movements. The expansion bearings are placed at cantilever points of the bridge girders away from the piers where the bearing loads are comparatively light and where the expansion rollers of 125 mm (5 in) diameter stainless steel are easily accessible for inspection and maintenance from inside the bridge girders (figure 5).

With the exception of these few movable joints, all elements of the bridge are joined together in three different ways, by studs welded to steel girders transmitting shear forces to the concrete, by steel reinforcement running across construction joints in the concrete and by prestressing tendons joining structural steel and concrete and preventing tension in the deck above the piers. The fully integrated rigid bridge frames could in this way be assembled from prefabricated steel girders and in-situ cast concrete, without the customary use of field welds, rivets or bolts to join the girders, with the additional benefit of joining the superstructure rigidly to the piers.

Each shop welded trough shaped steel girder unit consists of a lower flange plate 2·43 m (8 ft) wide varying in thickness from 22 mm (⅞ in) to 32 mm (1 5/16 in), two inclined web plates 9·5 mm (⅜ in) thick giving a total trough depth of 2·13 m (7 ft) and two 0·46 m (18 in) wide upper flange plates varying in thickness from 22 mm (⅞ in) to 51 mm (2 in). The trough girder plates are made rigid by a system of transverse stiffeners

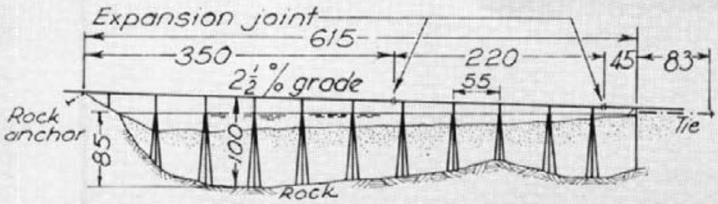


Figure 1.

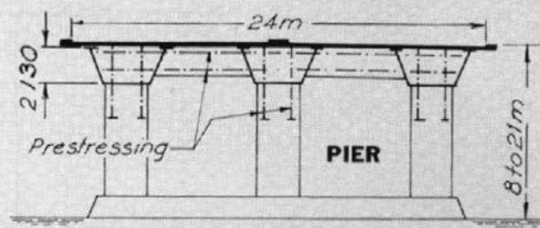
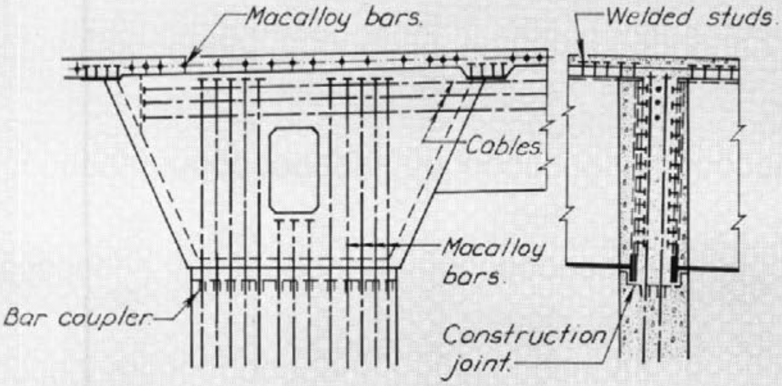
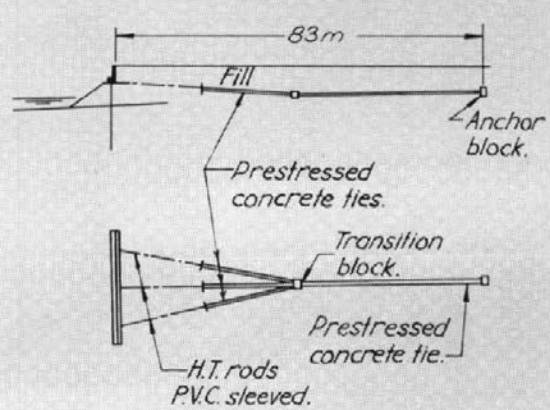


Figure 2.



FRAMING
Figure 3.



NORTHERN ABUTMENT-ANCHOR
Figure 4.

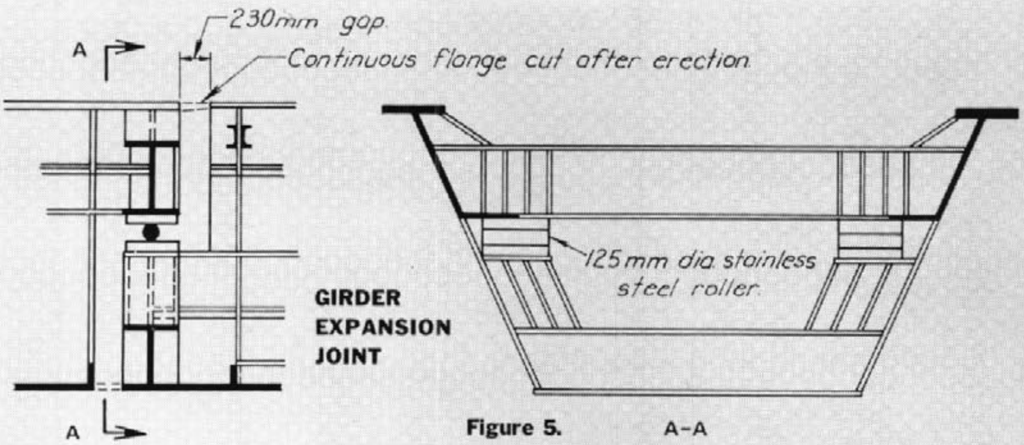


Figure 5. A–A

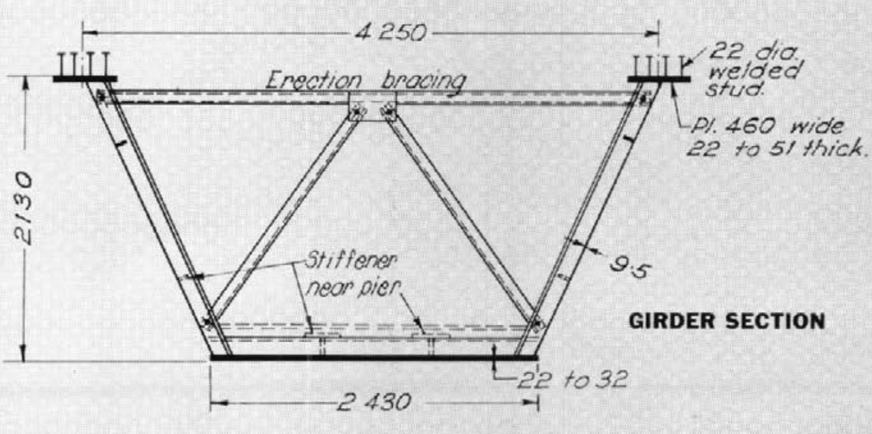
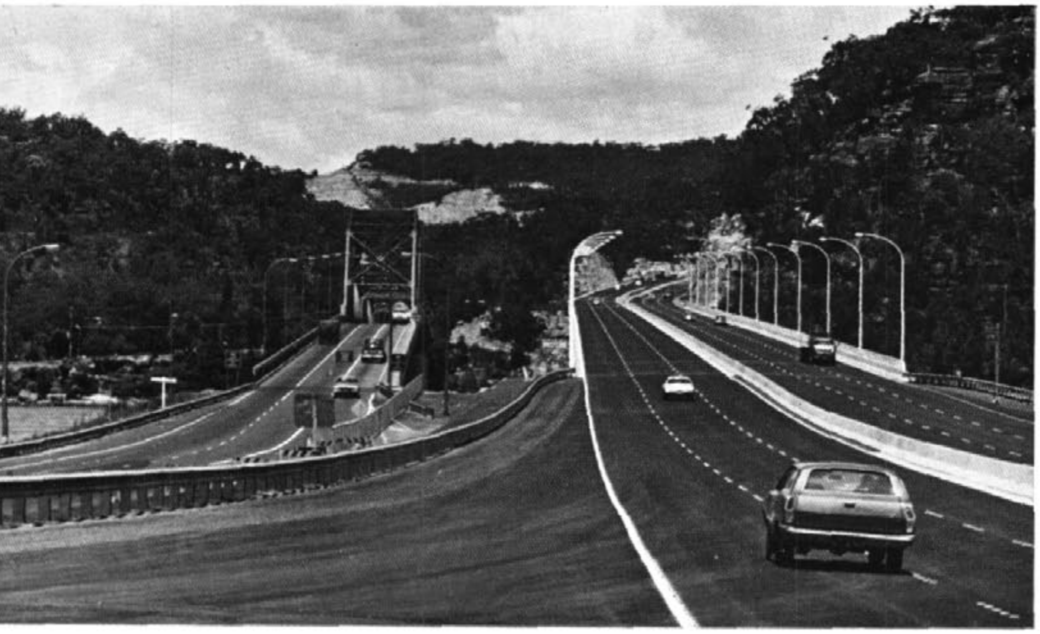


Figure 6.



The freeway bridge over the Hawkesbury River was opened in two stages, the first being the northbound carriageway which came into service on 10th August, 1973. With the opening of the southbound carriageway on 26th October, 1973, the two sections of the Sydney-Newcastle Freeway have been joined to give motorists an uninterrupted drive of 16 miles from Berowra to Calga with toll payable once only at Berowra.

throughout, continuous longitudinal web stiffeners near the upper flanges and longitudinal lower flange stiffeners near the girder supports only. Internal diagonal bracing was applied to the trough shaped steel girders during transport and erection only (figure 6).

Three girders weighing 80 t (approximately 80 tons) each make up one span. They were placed as simply supported beams on the three columns making up each pier. Columns 2·3 m (7½ ft) wide vary in thickness from 0·6 m (2 ft) in low piers to 1·05 m (3½ ft) in tall piers.

Concrete placed over the piers between the transverse girder end plates, and the concrete deck placed above the upper girder flanges tied the girder ends in adjacent spans rigidly to each other longitudinally and transversely. The girders are also tied rigidly to the pier columns by the use of longitudinal and vertical prestressing rods and transverse prestressing cables.

The 200 mm (8 in) thick concrete deck slab acts compositely with the steel girders. Longitudinal deck prestressing prevents tensile stresses in the deck. Composite action and deck prestressing over piers reduced the steel requirements for the girders considerably. The average requirement was 172 kg (380 lb) of girder steel per square metre of deck area.

Reinforced concrete of 20 M Pa (1½ tonf/in^2) and prestressed concrete of from 30 (2 tonf/in^2) to 50 M Pa (3¼ tonf/in^2) cylinder strength has been used. Structural steel used has been Grade 250 generally and Grade 250 LO in girder bottom flanges only.

The girders were designed for the following erection stages:

(1) Placing of girders: The girder self weight is resisted by the steel girders only, acting as simply supported beams.

(2) Placing of concrete in the cross beam above pier columns and between girder ends and in a strip of deck slab 21 m (70 ft) long, over piers: The bending moment caused by the weight of the deck slab strip is resisted by the steel girders only, acting as simply supported beams.

(3) Longitudinal prestressing of the deck slab over the piers: This makes the composite girders continuous over the pier. The prestressing force acting above the common axis of the composite steel girder and concrete deck produces a span uplift which reduces the bending moment in the steel girders.

(4) Placing of deck concrete between piers: Bending moments caused by the weight of the deck concrete are resisted by the continuous steel girders acting compositely with the deck near the piers but as non-composite girders under the new concrete between piers.

(5) Finishing of deck, bituminous pavement and crash barriers: These loads and the traffic loads are resisted by composite action of the fully continuous composite steel girder and concrete deck.

Vehicles on the inner traffic lanes only or on the outer lanes only produce transverse bending moments in the deck system which are resisted by prestressed concrete cross girders placed about 12 m (40 ft) apart between steel girder webs. The stiffened lower flanges and webs of the steel trough girders and the concrete deck slabs form torsionally rigid units reducing the transverse bending moments caused by traffic loads in the deck slab which spans 4·25 m (15 ft) between the upper girder flanges.

The possible development of transverse shrinkage cracks in the long continuous concrete deck slab was minimised by the provision of shrinkage gaps not further than 10 m (33 ft) apart in those parts of the deck which were not longitudinally prestressed. These 0·6 m (2 ft) wide gaps, in which the longitudinal deck steel overlapped, were only permitted to be concreted after a period of at least one week after the adjacent deck sections had been poured so that much of the concrete shrinkage would have then developed.

The cost of the bridge based on tender prices was $85 per sq m for the substructure and $195 per sq m for the superstructure, i.e. an overall cost of $280 per sq m.●

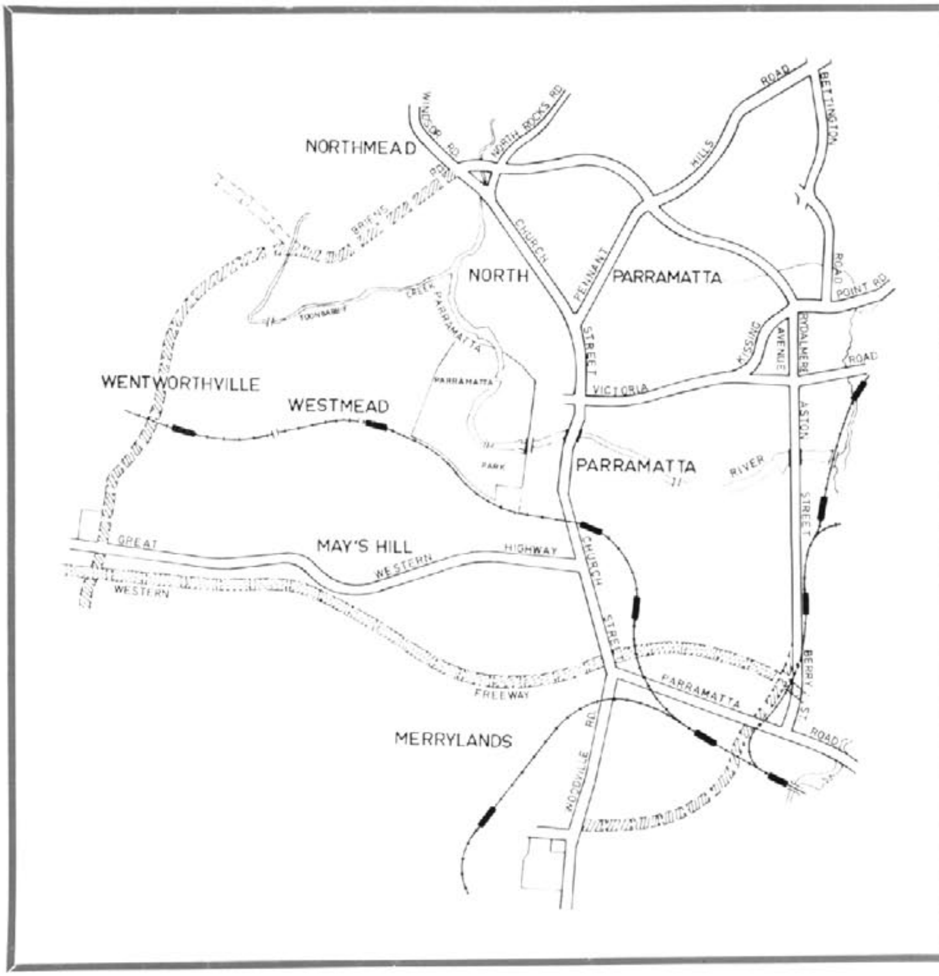
Previous articles on the new bridge over Hawkesbury River have appeared in these issues of "Main Roads"—

Design of Foundations, March, 1970, Vol. 35, pp. 66–67.

Construction of Expressway Bridge over Hawkesbury River, December, 1971, Vol. 37, pp. 54–58.

New Bridge over the Hawkesbury River (Construction), June, 1973, Vol. 38, pp. 115–119.

TWO NEW TRAFFIC RELIEF ROUTES



Parramatta North

Tenders have been called for the construction of a bridge over Belmore Street, East Dundas, to carry the new County Road which is currently being constructed to provide a by-pass around Parramatta. The 28·6 m (94 ft) long single span prestressed concrete bridge will have six traffic lanes and was designed by engineers of the Department of Main Roads.

The new by-pass will ease the heavy volume of traffic now using the main roads network in the City of Parramatta and form part of a more direct fast route to Sydney and the coast from the rapidly expanding outer western suburbs.

The route of the new road will extend from Victoria Road along Rydalmere Avenue, which is currently being reconstructed to Kissing Point Road. From this point a new road will be constructed to cross Belmore Road and Pennant Hills Road with new crossing of Hunts Creek and Darling Mills Creek, it will then connect with Windsor Road at Briens Road, Northmead.

Hartley

A tender of $161,666 has been accepted for the construction of a bridge over the River Lett on a new minor deviation of the Great Western Highway (State Highway No. 5) at Hartley. The successful tenderer was Simon-Carves Pty Ltd.

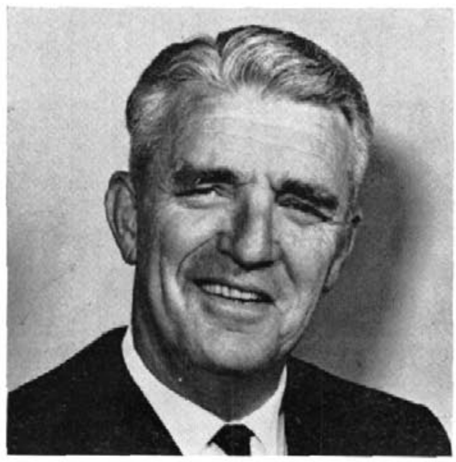
Designed by engineers in the Department of Main Roads, the flood-free bridge will be a 2 span, 61 m (200 ft) long structure, 8·5 m (28 ft) wide between kerbs with two safety kerbs, each 0·6 m (2 ft) wide.

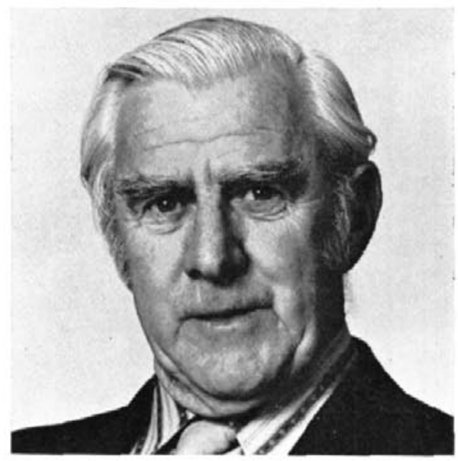
After completion of the new bridge and its approaches, the junction of the Jenolan Caves Road with the Great Western Highway will be altered so that the existing bridge will then be located on the Jenolan Caves Road.

Apart from the obvious improvement to travelling conditions on this section of the Great Western Highway, the new route will by-pass Hartley which was proclaimed an Historic Site on 18th October, 1972. The removal of through traffic from Hartley will assist in the preservation of its historic significance.●

Old drawing of Hartley Courthouse and Church (Mitchell Library).

Retirement of Department's Engineer-in-Chief and Appointment of Successor


Mr Fawkner


Mr Johnston

MR G. V. FAWKNER

On 26th September, 1973, Mr G. V. Fawkner, B.E., F.I.E.Aust., M.C.I.T., retired from the Department where he held the position of Engineer-in-Chief since December, 1969.

Mr Fawkner joined the Department of Main Roads in 1934 after graduating from the University of Sydney as a Bachelor of Engineering. He also holds a Local Government Engineer's Certificate. During his 39½ years' service with the Department he held a variety of positions in both country and metropolitan Divisions and in Head Office. He had two periods of duty in the Northern Territory during the war years, where he was engaged on the construction of defence roads and aerodromes.

Mr Fawkner attended the Advanced Course of the Australian Administrative Staff College in 1959. He was appointed Assistant Chief Engineer in 1962 and Deputy Chief Engineer the following year. During his time as Deputy Chief Engineer he travelled to the United States of America, England and Europe to observe and investigate contract administration and the organization and control of freeway construction. He attended the New Zealand Road Symposium in 1967 and again in 1971. In 1969 he accompanied the Commissioner for Main Roads, Mr R. J. S. Thomas, to Japan where they examined freeway construction methods.

In recent years Mr Fawkner represented the Department on the Local Government Engineering Examination Committee and the Principal Technical Committee of NAASRA. He was also a member of the Visiting Committees for the School of Civil Engineering and the School of Highway Engineering at the University of New South Wales and served on the Selection Committee for the Local Government Engineers' Foundation. As Engineer-in-Chief, Mr Fawkner was a member of the Association of Chief Engineers of Government Departments in New South Wales since 1969.

MR R. E. JOHNSTON

Mr R. E. Johnston, B.E., C.H.T. (Yale), F.I.E.Aust., M.C.I.T., M.A.I.T.T., has been appointed Engineer-in-Chief to succeed Mr Fawkner.

Mr Johnston joined the Department of Main Roads in 1935 after graduating from the University of Sydney as a Bachelor of Engineering. He also holds a Local Government Engineer's Certificate.

Mr Johnston has had wide experience on the Department's work in both country and city areas. During the war years he served with the Department in the Northern Territory in 1942 on the construction of defence roads and air strips and with the R.A.A.F. in Morotai and Borneo in 1944–46 with the rank of Flying Officer in No. 6 and No. 7 Air Field Construction Squadrons. He returned to the Department in February, 1946 and was stationed at Grafton Divisional Office until January, 1947, when he was transferred to Head Office as First Assistant to the Construction Engineer, remaining there until 1955.

In February, 1955, Mr Johnston was appointed Traffic Service Engineer, retaining this position until his appointment as Executive Engineer in May, 1962. While Traffic Service Engineer he attended the Bureau of Highway Traffic at Yale, U.S.A., in 1955–56 and the Advanced Course at the Australian Administrative Staff College in 1960.

Mr Johnston was promoted to Assistant Chief Engineer in December, 1962 and became the Deputy Engineer-in-Chief on the appointment of Mr Fawkner as Engineer-in-Chief in December, 1969.

During a holiday abroad in 1971 Mr Johnston attended for the Department the Round Table Conference on Overseas Highway Problems in London and the Institute of Traffic Engineers' Third World Conference in Montreal. He chaired one of the sessions at the latter Conference.

In addition to his activities with the Department, Mr Johnston was for some years a part-time lecturer at the University of New South Wales. He was a member of the Advisory Council, Australian Road Research Board. He has also for a period of 6 years been active in the Institution of Engineers, Australia, and was Chairman, Sydney Division, in 1972.

Mr Johnston is actively interested in the Department's Social and Recreation Club; he is a Past Chairman, and at present is a Vice-President. In addition he is a Past President of the Main Roads Bowling Club. Mr Johnston was also a Foundation Director of the Main Roads Credit Union, serving in this capacity for a period of nine years.●

MICROFILMING DRAWINGS

The term "microfilm" was originally applied to the actual films used to produce miniaturised images of drawings or documents, the film sizes usually being 70 mm, 35 mm, 16 mm, and smaller. Today, it encompasses the whole process, from the technique of filming, the procedures involved and the equipment, chemicals and photographic materials used. Microfilming is now considered separate from photography because the range of automated and semi-automated equipment has increased to the point where the need for expert photographic skill in the process is minimal.

Initially, microfilm has two major reasons for existence—space saving and security. For paper records the reduction in volume can amount to 98 per cent but 95 per cent is the general reduction achieved. Security in modern microfilming is provided by a "master" set of microfilmed records held in a fire-resistant air conditioned area. These films require little or no retrieval at all and their life span is indefinite. A duplicate set of microfilms in a different location are the "working" films referred to frequently with a life span of approximately 50 years, but this may be shortened in the case of those films to which reference is made frequently.

As a system which simply saved storage space microfilming was not completely satisfactory for the Department of Main Roads until recent years when new developments made quick and efficient retrieval possible.

Originally, microfilming records were stored in rolls of film in a manner which required considerable time and effort for retrieval. The development of the "aperture card", a standard tabulating card in which an aperture or a number of apertures is cut to a size for one or more frames of microfilm, has now made retrieval of records fast and efficient. Information from microfilmed records is obtained by viewing the screen of a Reader, or from a paper copy produced by a magnifying Printer. Both viewing and printing are possible on a single machine, a Reader-Printer, from which a paper copy can be obtained within one minute at the touch of a button.

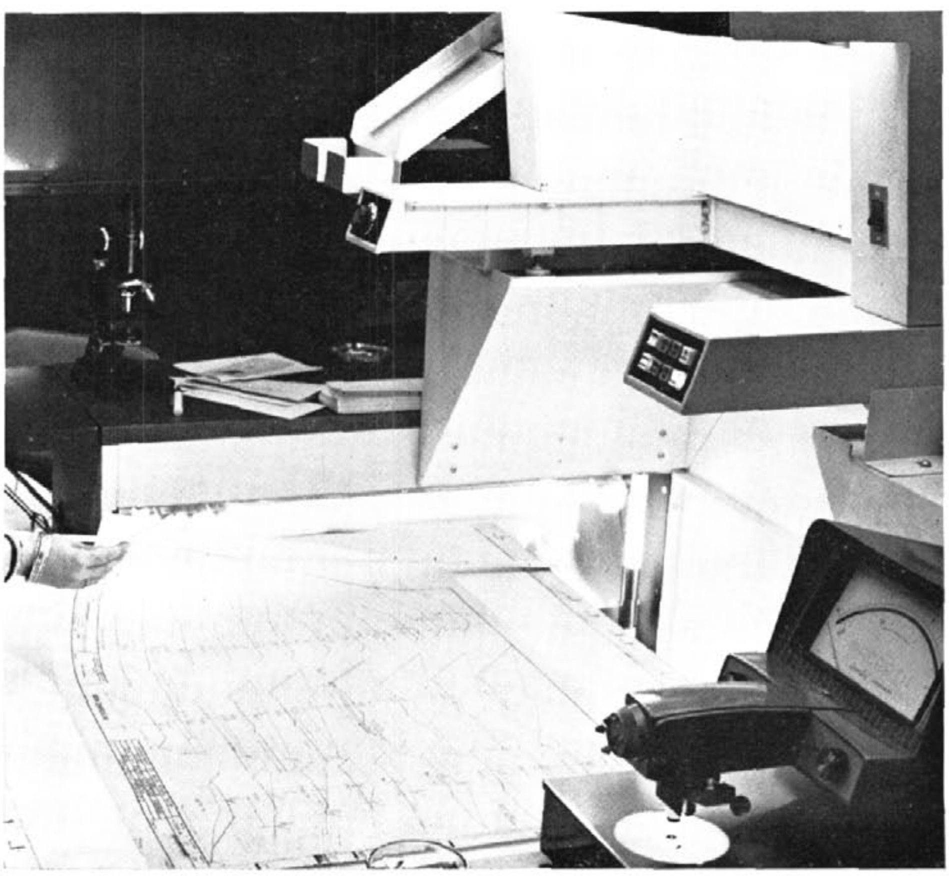
The Department of Main Roads first considered installing microfilming equipment in 1955 for accounting records and plans of completed works. At that stage of its development, microfilming was found to be unsuitable for the Department's purposes. Investigations into new developments continued and in 1961 a 120 mm Statfile Recorder 3 was installed and used for plan copying. However 120 mm film provides only a moderate reduction in size and does not fit into the modern concept of microfilming so that today this camera is in use for routine enlargements and reductions in general photographic work.

Although there was a continuing investigation of microfilming possibilities generally, the use of the system by the Department stayed in doubt because of the unsatisfactory standard of resolution of the available film and the lack of clarity in reducing large drawings to the 35 mm size.

The decision to microfilm the Department's engineering drawings was made in 1970 following an extensive inquiry. Drawings are best microfilmed in 35 mm size which was chosen by the Department while 16 mm is more suitable for documents. These sizes require two separate systems using different equipment which cannot be intermixed.

MICROFILMING OF DRAWINGS

Since January, 1972, the Department has been microfilming Engineering Drawings on 35 mm film. To do this, a



This processor Camera is designed for use on new standardized drawings but can be also used for work where continual camera adjustment is necessary.

In the Department's Plan Room, an over-the-counter service to the public, using this Reader-Printer, has commenced.

Processor Camera, Planetary Camera, Card-to-Card Copier, Reader and Reader-Printer were installed at Head Office.

Processor Camera

This camera automatically develops and stabilizes the exposed film. Unexposed film is pre-mounted in "aperture cards" and the exposure and processing is completed in about 45 seconds although this rate of output is controlled by the standard, size and condition of the plans being filmed. Designed primarily for use on new drawings drafted to a standard which gives optimum results in microfilming, it was first used in the Department to copy non-standard drawings which made continual camera adjustment necessary.

Planetary Camera

This camera has a higher speed of filming than the Processor Camera as its roll film is progressively exposed to sheets of drawings placed one by one on the filming table. The exposed film is developed by a specialist service company in lengths of about 100 feet and on return this film is put through a Card-to-Card Copier to produce an aperture card. Old drawings which are stored in rolls in pigeon holes and those where the variety and diverse quality of drawing require flexibility are ideally suited to the Planetary Camera.

Card-to-Card Copier

The aperture cards produced in the Processor Camera and the roll film from the Planetary Camera are required for archival purposes and are not intended for general use. Copies known as duplicards are made in a Card-to-Card Copier which can also produce a copy from the roll film.

Diazo film is used for the duplicards produced in the Card-to-Card Copier. This material is tougher than the original film and is more suitable for general use. The Head Office Plan Room will issue second generation duplicards whenever copies of plans are requested for internal use unless hard copies are specially requested. Viewing facilities are provided at the counter of the Plan Room and hard copy is available on request, if required.

Reader and Reader-Printer

The Reader and Reader-Printer, briefly mentioned before, provide the means to retrieve the microfilmed information in an enlarged form.

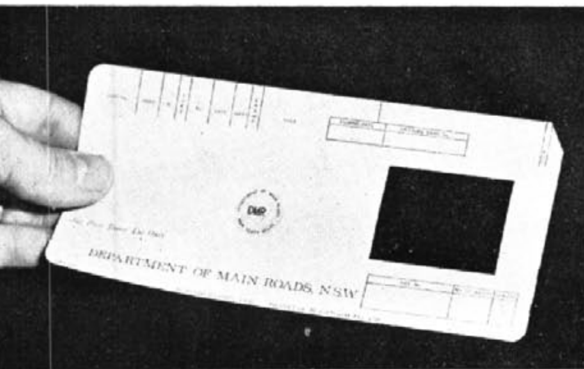
Readers display the enlarged image (15 x enlargement of a 35 mm film produces an image measuring 0·59 m x 0·41 m (23½ in x 16½ in) on a screen, from which the required information is taken by inspection. The screen image gives high legibility and a printed copy is not generated therefore assisting to combat the "paper war"—one of the principal reasons for microfilming.

Reader-Printers, in addition to displaying the enlarged image on a screen allow for the production within about 10 seconds of hard copy which can be taken away. The legibility of such a print is not as high as the screened image and the cost per copy is approximately 18 cents.

Readers and Reader-Printers will be progressively installed in all drawing offices throughout the State within the next few years. Divisions and Head Office Sections will then retain their own store of drawings on microfilm and it is anticipated that calls on the Plan Room will lessen as a result.

Full scale enlargements can be provided through the services of the Head Office Print Room or an outside firm when absolutely necessary. Sometimes, to avoid complete re-drafting on further work, original drawings still need to be retained and carefully marked "Do Not Destroy" or the production of enlargements from microfilmed copies will be necessary later.

Commencing with the drawings from Head Office and Parramatta Division, filming is being done for one Division at a time. On completion, first generation copies of the aperture cards, and a Reader-Printer, will be forwarded to the Division thereby incorporating it as part of the total microfilm system.



(*Above*): *An aperture card.*

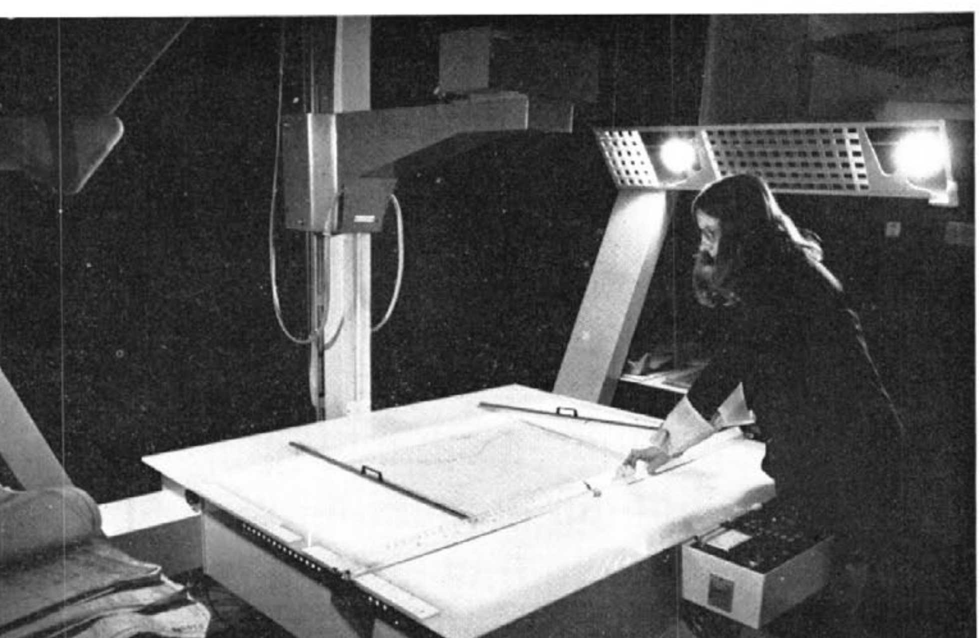
(*Right*): *This Card-to-Card Copier produces duplicards for general use.*

QUALITY CONTROL

A high standard of quality control has been set to ensure an archival life of 100 years for the microfilm. Tests are made several times daily to check resolution, density of negative and amount of residual hyposulphite on the film. The latter test is particularly important as too high a percentage of residual hyposulphite will lead to early deterioration of the microfilm. All tests are carried out by Department's staff.

PREPARING DRAWINGS

Draftsmen have found that a slightly different technique is required to prepare drawings for microfilming. An education programme has been commenced emphasizing the requirements of evenness of line width, high density of lines and letters, uncluttered detail and lettering of adequate size and openness.



The versatility of the Planetary Camera makes it ideal for the variety of older drawings of differing quality.

COMPUTERISED NUMBERING

To allow for the preparation of a Plan Room Index by computer a new system of numbering drawings has been implemented.

The new number system includes the Local Government Area number and has made possible the use of the computer to select and print suitable indices on the aperture cards. This system has overcome the deficiencies of the old system where blocks of numbers were overlapping and causing many problems. The use of the computer for sorting and printing the Drawing Index has also made it unnecessary to film in any fixed order.

The volume of work already microfilmed in the Department amounts to:

Progress to date	*No. of Aperture Cards*
Work-as Executed Plans ..	6,500
Parramatta Plans	6,900
Head Office Plans	7,400
Average rate of filming (per day):	
Processor Camera ..	120
Planetary Camera ..	250

Statement of Receipts

FOR THE YEAR ENDED

RECEIPTS	County of Cumberland Fund $	Country Fund $	Commonwealth Fund $	Total 1972/73 $	1971/72 $
Motor vehicle taxation	21,145,953	53,268,645	....	74,414,598	55,950,201
Charges on commercial vehicles under the Road Maintenance (Contribution) Act, 1958	3,663,187	14,652,750	....	18,315,937	17,686,959
Levy upon Councils in accordance with section 11 of the Main Roads Act, 1924	311,130	....	....	311,130	5,890,275
State Government Loans—Repayable	750,000	750,000	....	1,500,000	2,000,000
Loan Borrowings under section 42A of the Main Roads Act, 1924	6,275,000	800,000	....	7,075,000	6,800,000
Contributions by Councils towards maintenance and construction of Main and Secondary Roads	335,506	89,141	....	424,647	645,300
Contributions by other departments and bodies towards maintenance and construction of Main and Secondary Roads	91,297	559,489	....	650,786	775,775
Commonwealth/State Government Grant for Relief of Unemployment	276,300	1,609,958	....	1,886,258	655,000
Sydney Harbour Bridge Account for freeway approaches ..	334,315	....	....	334,315	56,883
Commonwealth Aid Roads Act, 1969—					
Urban Arterial Roads—Schedule 2	....	....	46,520,000	....	39,060,000
Rural Arterial Roads—Schedule 3	....	....	14,780,000	....	12,410,000
Other Rural Roads—Schedule 4	....	....	3,493,632	....	3,326,617
Planning and Research—Schedule 5	....	....	1,280,000	66,073,632	1,120,000
Other	1,115,947	219,695	....	1,335,642	1,020,309
Total Receipts	**$34,298,635**	**$71,949,678**	**$66,073,632**	**$172,321,945**	**$147,397,319**

and Payments

30TH JUNE, 1973

PAYMENTS	County of Cumberland Fund $	Country Fund $	Commonwealth Fund $	Total 1972/73 $	1971/72 $
Construction and reconstruction of roads and bridges	14,304,780	29,745,774	51,784,054	95,834,608	82,267,202
Construction and maintenance of unclassified roads in the unincorporated area of the Western Division	....	....	162,605	162,605	195,783
Land acquisition	7,055,670	1,779,912	9,154,630	17,990,212	15,116,415
Maintenance and minor improvements of roads and bridges ..	5,817,945	24,137,917	....	29,955,862	26,364,308
Restoration of flood damage	....	....	....	....	475,456
Purchase of land and buildings for works operations	542,848	309,628	....	852,476	1,061,851
Administrative expenses	3,762,122	6,187,337	....	9,949,459	9,413,473
Purchase of land and buildings for administration	88,684	484,358	....	573,042	211,969
Planning and research	169,831	223,616	1,280,000	1,673,447	1,741,592
State Treasury Loans—					
Sinking fund payments	17,000	181,823	....	198,823	188,200
Interest, exchange, management and flotation expenses ..	201,370	949,127	....	1,150,497	1,115,980
State Treasury—Repayment of temporary advance	....	....	....	....	200,000
Loan Borrowings under section 42A of the Main Roads Act, 1924—					
Repayment of principal	197,479	186,916	....	384,395	348,584
Interest	694,857	1,124,976	....	1,819,833	1,758,074
Other	244,016	469,305	....	713,321	862,318
	33,096,602	65,780,689	62,381,289	161,258,580	141,321,205
Transfers to reserve for loan repayments	290,850	338,176	....	629,026	309,188
Net transactions of operating and suspense accounts	*Cr.* 390,168	*Cr.* 2,448,045	....	*Cr.* 2,838,213	1,272,212
Total Payments	**$32,997,284**	**$63,670,820**	**$62,381,289**	**$159,049,393**	**$142,902,605**

Henry Lawson Drive and Henry Lawson Way

THE MAN BEHIND THE NAME

The monument to Henry Lawson in the Domain, Sydney

Henry Lawson Drive (M.R. 508), bordering the southwestern suburbs of Sydney, commences at the Hume Highway (S.H. 2), Landsdowne, and continues to Forest Road (M.R. 168), Peakhurst via Milperra, East Hills, Picnic Point and the bridge over Salt Pan Creek.

Construction of the route generally along the eastern banks of Prospect Creek and Georges River from Landsdowne to Salt Pan Creek was commenced in December, 1938 as an unemployment relief job under the direct supervision of the Bankstown Municipal Council with the advice and general assistance of the Department of Works and Local Government. It was principally intended to be a scenic drive and a connection between the Hume Highway at its junction with Woodville Road and Forest Road, Peakhurst. From September, 1939, the Department of Main Roads assumed supervision of the work on behalf of the State Government. By Government Gazette of 27th October, 1939, it was proclaimed Main Road 508.

The route was generally known as "Georges River Feeder Road" until gazettal of the name Henry Lawson Drive on 2nd July, 1948. Although the man, Henry Lawson, had no particular link with the locality traversed by Henry Lawson Drive in Sydney, the naming of this road is a small tribute to a man who received so little public appreciation or understanding during his lifetime. Today, Henry Lawson Drive has taken on additional importance as an access route to the crossing of Georges River by the new bridge at Alfords Point. Associated roadworks in the construction of the bridge involved provision of an overpass across the Drive itself.

Henry Lawson Way, in the mid western area of New South Wales, comprises Main Road 236 and Main Road 239 and runs in a north-south direction to partly connect the town of Forbes, Grenfell and Young. Main Road 236 branches from Trunk Road 56 at Forbes and continues to the Mid Western Highway (S.H. 6) joining it west of Grenfell. Main Road 239 commences at the Mid Western Highway, Grenfell, and runs via Tyagong to the Olympic Way (Trunk Road 78) near Young. Following agreement by Councils and the Department, Henry Lawson Way was named by proclamation on 5th April, 1963.

The route of Henry Lawson Way was formed many years ago from a track which thousands of migrating gold diggers followed during the early 1860's as they trekked to and from the diggings at Lambing Flat (Young) and Lachlan Fields (Forbes). Thousands of pounds in sovereigns and gold dust changed pockets on this historic road which was the hunting route of several notorious bushrangers, including Frank Gardiner, Ben Hall and John Gilbert.

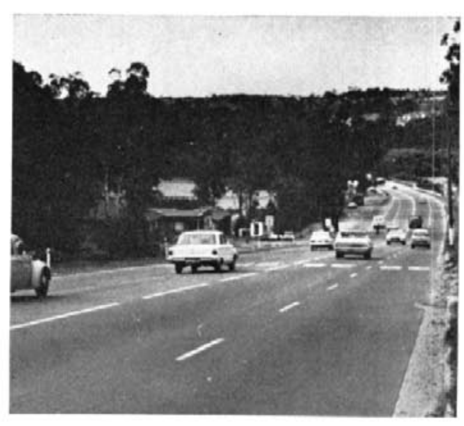
The naming of Henry Lawson Way has particular significance as the route is centred at Grenfell, the place of Lawson's birth. He was born there in a tent amongst the gold diggings on 17th June, 1867, the son of Peter and Louisa Larsen who changed their name to Lawson when the birth was registered. His young life was spent in hardship and near poverty at Eurunderee, New South Wales and this, combined with an unhappy home life and early signs of deafness, contributed to the development of his introverted, melancholy personality.

Louisa Lawson was probably the driving force behind Henry's development as a writer, at the same time adding to his personal distress by provoking arguments and unhappiness in the home which reacted painfully on the emotions of a hypersensitive boy.

At about 16 years of age, Lawson started work as a painter but soon commenced his roving pattern of life spending only a short length of time at any one employment. Many of his occupations were influenced by his lack of education, but the passion he had always held for reading prepared him for his true vocation, writing poetry and short stories.

He tried poetry first and the "Bulletin" published some of his verse and in the issue of 22nd December, 1888, a short story called "His Father's Mate". He was on the roam once more the following year and this included carrying a swag around western New South Wales doing odd jobs, a period in his life from which he drew many of the subjects of his later writings.

Although only in his twenties, Lawson's depressive temperament increasingly gained a hold over him and he found a continuing escape in alcohol leading to a deterioration of his health by his late twenties. Lawson's mother published his book "Short Stories in Prose and Verse" in December 1894 which although praised, did not sell. The following year the Sydney publisher George Robertson published "In the Days When the World



Henry Lawson Drive near Salt Pan Creek, Padstow

Was Wide and Other Verses", which was both acclaimed by critics and sold well. His writing continued to be published sporadically and the popular collection of stories "While the Billy Boils" was a product of this period.

In 1896 Lawson married and soon after travelled to Western Australia on an advance from his publisher, Angus and Robertson. The trip was not a success and his wife Bertha found it increasingly difficult to control his drinking. A visit to New Zealand and a period of teaching there did not improve Lawson's drinking habits and from the time of his return to Sydney in 1898, Lawson's health declined more quickly. In 1900, accompanied by his wife and two children, he travelled to England with the financial help of one of his greatest admirers, Earl Beauchamp, Governor of New South Wales.

In spite of his immediate recognition in English literary circles, his health continued to fail and he returned to Sydney in 1902. He separated from his wife soon after.

His final 20 years were spent mostly in Sydney. They were his worst years with periods of depression growing deeper and longer. He begged money and spent it on drink. He went to prison for failing to pay maintenance for his children. It would be a pity if memories of Lawson recalled only these bad times and not the power of his writing which did so much to enrich Australian literature. The heartache and poverty, the humour, the violent changes and the contrasts in Australia during the period of his life span, are all conveyed in his poetry and prose in a spirit which less tortured souls could never convey.

For a few years prior to his death on 2nd September, 1922, he roamed the streets—a hopeless and pathetic drunkard. He died alone in a cottage at Abbotsford and the man who gave so much to Australian literature, receiving so little in return, was given a state funeral and buried in Waverley Cemetery, Sydney. Lawson's life had dropped to a low ebb so many times that perhaps he found in death a reward he had long waited for.

"But now I only wish to be
Beyond all signs of carin'.
Past wearyin' or carin',
Past feelin' and desparin';
And now I only wish to be
*Beyond all signs of carin."**

* "Past Carin' "—"The Poetical Works of Henry Lawson" (Angus and Robertson).

* * *

This is the third in a series on famous people after whom roads have been named. The subjects of other articles were General Holmes and Lawrence Hargrave.

TENDERS ACCEPTED BY COUNCILS

The following tenders (in excess of $10,000) for road and bridge works were accepted by the Department for the three months ended 30th September, 1973.

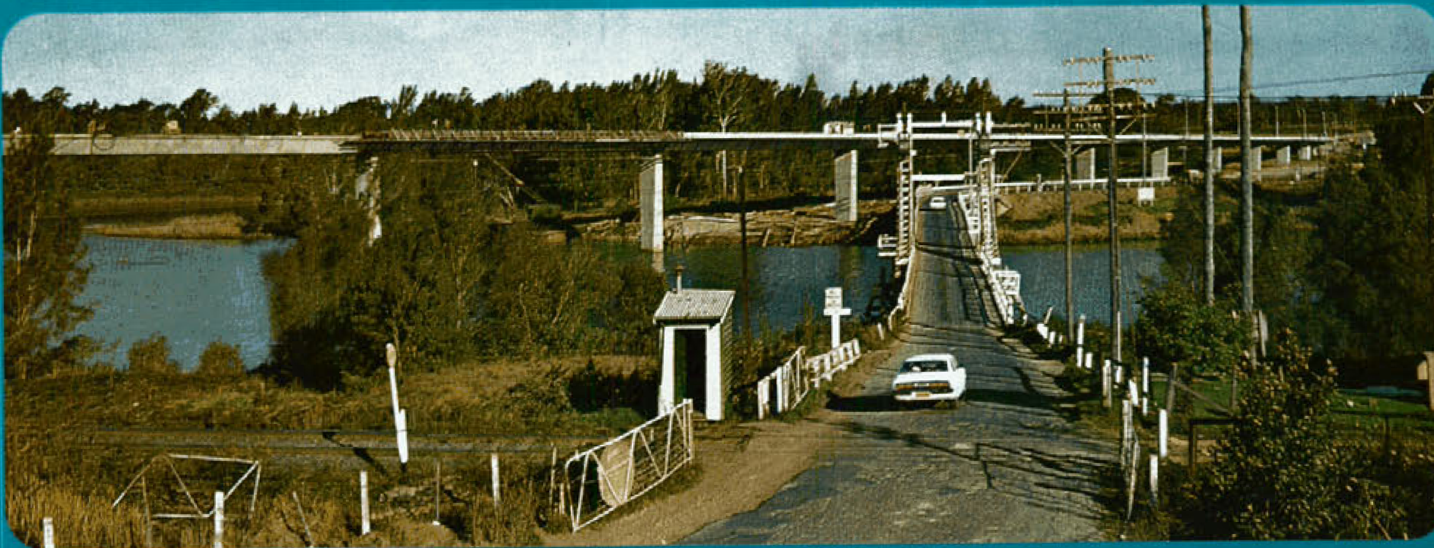
Council	Road No.	Work or Service	Name of Successful Tenderer	Amount
				$
Narrabri	State Highway No. 17	Newell Highway. Construction of a 7-span prestressed and reinforced concrete bridge 139·4 m (457 feet) long over Narrabri Creek at Violet Street, Narrabri.	Emoh Ruo Court Pty Ltd	86,009.00
Peel	State Highway No. 11 and M.R. 130	Oxley Highway. Supply and spray 123 245 m² (147,904 sq yd) bitumen and aggregate at various locations.	Shorncliffe Pty Ltd	10,993.31
Wakool	M.R. 319	Construction of a 5-span prestressed and reinforced concrete bridge 53·4 m (175 feet) long over Yarrain Creek 62·6 km (38·9 miles) north of Barham.	Danckert Constructions Pty Ltd	63,741.45
Wingecarribee	State Highway No. 25	Illawarra Highway. Construction of a 3 cell 2·7 m x 2·1 m (9 feet x 7 feet) reinforced concrete box culvert over Wells Creek 7·6 km (6·2 miles) west of Moss Vale.	T. Kirmanen	42,310.00

TENDERS ACCEPTED BY THE DEPARTMENT OF MAIN ROADS

The following tenders (in excess of $10,000) for road and bridge works were accepted by the Department for the three months ended 30th September, 1973.

Road No.	Work or Service	Name of Successful Tenderer	Amount
			$
Warringah Freeway	Municipality of Willoughby. Construction of a 2-span prestressed and reinforced concrete bridge, 87·2 m (286 feet) long over Merrenburn Avenue at Naremburn.	Central Constructions Pty Ltd	415,200.00
Southern Freeway	City of Wollongong. Construction of an open channel to divert Byarong Creek at Fig Tree.	Transbridge Pty Ltd	517,560.77
Southern Freeway	City of Wollongong. Construction of Toll office at Waterfall Interchange.	Graham Evans and Co. Pty Ltd	162,488.00
Southern Freeway	City of Wollongong. Installation of an electronic driver aid and toll registration system on the Waterfall-Bulli Pass Tollwork.	Plessey Telecommunications Pty Ltd	639,096.00
State Highway No. 1	Prince's Highway. Shire of Shoalhaven. Widening of existing reinforced concrete bridge over Abernathy's Creek, 4·4 km (2·8 miles) north of Nowra.	Campbell Developments Pty Ltd	26,947.60
State Highway No. 2	Hume Highway. Shire of Wingecarribee. Construction of a 3-span prestressed and reinforced concrete bridge, 46·4 m (152 feet) long over Medway Rivulet, 4·5 km (2·8 miles) south of Berrima.	Graham Evans and Co. Pty Ltd	75,820.00
State Highway No. 4	Snowy Mountains Highway. Shire of Snowy River. Supply and delivery of up to 21 900 m³ (25,000 cubic yards) of aggregate for premix bitumen surfacing and resurfacing 20·3 km (12·6 miles) west of Adaminaby.	Queanbeyan Quarries Pty Ltd	119,220.00

State Highway No. 4	Snowy Mountains Highway. Shire of Snowy River. Supply and delivery of up to 1 530 tonnes (1,500 tons) of mineral filler for use in bituminous plant mix at 20·3 km (12·6 miles) west of Adaminaby.	Bega Valley Distributors Pty Ltd	38,700.00
State Highway No. 5	Great Western Highway. Shire of Blaxland. Construction of a 2-span prestressed and reinforced concrete bridge, 61 m (200 feet) long over the River Lett at Hartley 129·6 km (80·5 miles) west of Sydney.	Simon-Carves (Australia) Pty Ltd	161,666.00
State Highway No. 5	Great Western Highway. Shire of Blaxland. Construction of a 4 cell, 2·7 m x 2·7 m (9 ft x 9 ft) reinforced concrete box culvert over Boxes Creek on western approach to the new bridge over the River Lett at Hartley.	Simon-Carves (Australia) Pty Ltd	70,511.00
State Highway No. 9	New England Highway. City of Maitland. Win, load and haul up to 18 896 m^3 (24,700 cu yd) of rock and earth fill for construction of dual carriageways between 23·3 and 25·9 km (14·5 and 16·1 miles) west of Newcastle.	Hunter Valley Earthmoving Co. Pty Ltd	11,115.00
State Highway No. 9	New England Highway. Shire of Dumaresq. Construction of a 2 cell 3·4 m x 3·0 m (11 ft x 10 ft) reinforced concrete box culvert at 8·7 km (5·4 miles) north of Armidale.	William Civil Pty Ltd	16,487.50
State Highway No. 10	Pacific Highway. Shire of Lake Macquarie. Supply and delivery of up to 1 748 t (1,713 tons) of 20 mm (¾ in) asphaltic concrete with R90 binder for construction of dual carriageways between Robert and Neru Streets, Belmont North.	Boral Road Services Pty Ltd	23,720.00
State Highway No. 10	Pacific Highway. Shire of Coffs Harbour. Construction of a 2 cell, 3·0 m x 2·4 m (10 ft x 8 ft) reinforced concrete box culvert on approach to new railway underpass 1·5 km (0·85 miles) north of Coffs Harbour.	M. O. and P. J. Kautto	12,303.56
State Highway No. 10	Pacific Highway. Shire of Nambucca. Supply of up to 15 291 m^3 (20,031 cu yd) of non-plastic granular fill material to reconstruction work between 0 and 3·2 km (0 and 2 miles) north of Macksville.	Collins and White Pty Ltd	28,000.00
State Highway No. 11	Oxley Highway. Shire of Walcha. Supply and delivery of 1 590 m^3 (2,083 cu yd) of 20 mm (¾ in) aggregate and 499 m^3 (574 cu yd) of 10 mm (⅜ in) aggregate to bitumen surfacing work between 66·7 and 78·7 km (41·4 and 48·9 miles) east of Walcha.	Hastings Sand and Gravel Pty Ltd	21,826.30
State Highway No. 11	Oxley Highway. Shire of Walcha. Supply and delivery of sealing aggregate to bitumen surfacing work between 39·5 and 45·9 km (27·0 and 28·5 miles) east of Walcha.	Hastings Sand and Gravel Pty Ltd	11,293.60
State Highway No. 11	Oxley Highway. Shire of Walcha. Supply and delivery of up to 1 500 m^3 (1,965 cu yd) of sand to reconstruction work between 38·7 and 48·3 km (24·0 and 30·0 miles) east of Walcha.	Money's Sands	12,000.00
State Highway No. 11	Oxley Highway. Shire of Walcha. Construction of a 5 cell 2·4 m x 2·4 m (8 ft x 8 ft) reinforced concrete box culvert over Staces Creek, 48·5 km (30·1 miles) east of Walcha.	Enpro Constructions Pty Ltd	41,468.40
State Highway No. 11	Oxley Highway. Shire of Walcha. Construction of a 7 cell 3·4 m x 3·4 m (11 ft x 11 ft) reinforced concrete box culvert and a 4-span, prestressed and reinforced concrete bridge, 42·7 m (140 feet) long over the Yarrowitch River 49·3 km (30·6 miles) east of Walcha.	Enpro Constructions Pty Ltd	125,506.00
State Highway No. 11	Oxley Highway. Shire of Coonabarabran. Construction of an 8-span prestressed and reinforced concrete bridge, 120·7 m (399 feet) long over Belar Creek, 14·5 km (9·1 miles) south of Coonabarabran.	M. and E. Firth Civil Constructions (Tamworth) Pty Ltd	193,961.00
Trunk Road No. 68	Shire of Walgett. Construction of a 6-span prestressed and reinforced concrete bridge, 128·1 m (420 feet) long over Mooni River at Gundablouie 50 km (31 miles) north of Collarenebri.	Herbert Constructions Pty Ltd	192,254.95
Main Road No. 173	City of Sydney. Manufacture and delivery of precast pretensioned concrete planks for second stage construction of Victoria Street bridge at Western portal of Kings Cross Road Tunnel.	Peter Verhaul Pty Ltd	24,115.00
Various	Supply and lay asphaltic concrete on various classified roads.	Bituminous Pavements Pty Ltd Pioneer Asphalts Pty Ltd Emoleum Ltd Asphalt Concrete Ltd	116,769.00 45,878.00 55,568.00 36,115.00
Various	Supply, heat, haul and spray of R90 bitumen with the incorporation of cutter oil at various locations.	Shorncliffe Pty Ltd	15,547.31
Various	Supply, heat, haul and spray of R90 bitumen with the incorporation of cutter oil at various locations.	Boral Road Services Pty Ltd	17,102.48
Various	Supply and delivery of up to 1 300 tonnes (1,274 tons) of hot mixed, cold laid bituminous plant mix at various locations.	Bituminous Pavements	18,655.00 and freight
Unclassified	Shire of Patrick Plains. Construction of a 3-span prestressed and reinforced concrete bridge, 33·2 m (109 feet) long over Glennies Creek at Upper Falbrook, 20·1 km (12·5 miles) north of Singleton.	Graham Evans and Co. Pty Ltd	144,630.00



The old bridge over the Wilson River on the Pacific Highway at Telegraph Point and the adjacent railway level crossing (above) will be replaced by a new bridge and approaches (below) now under construction.

Telegraph Point