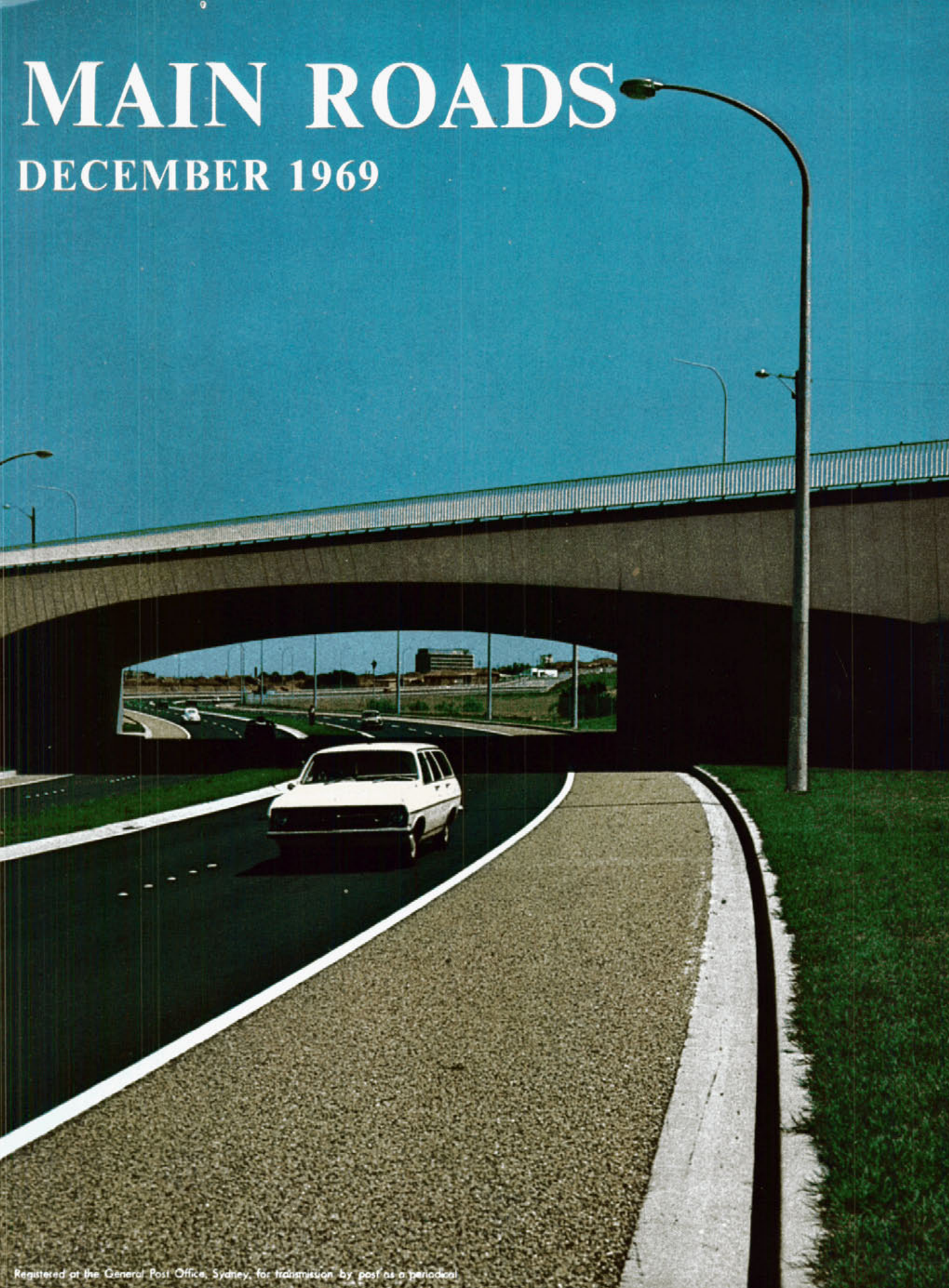
MAIN ROADS

DECEMBER 1969



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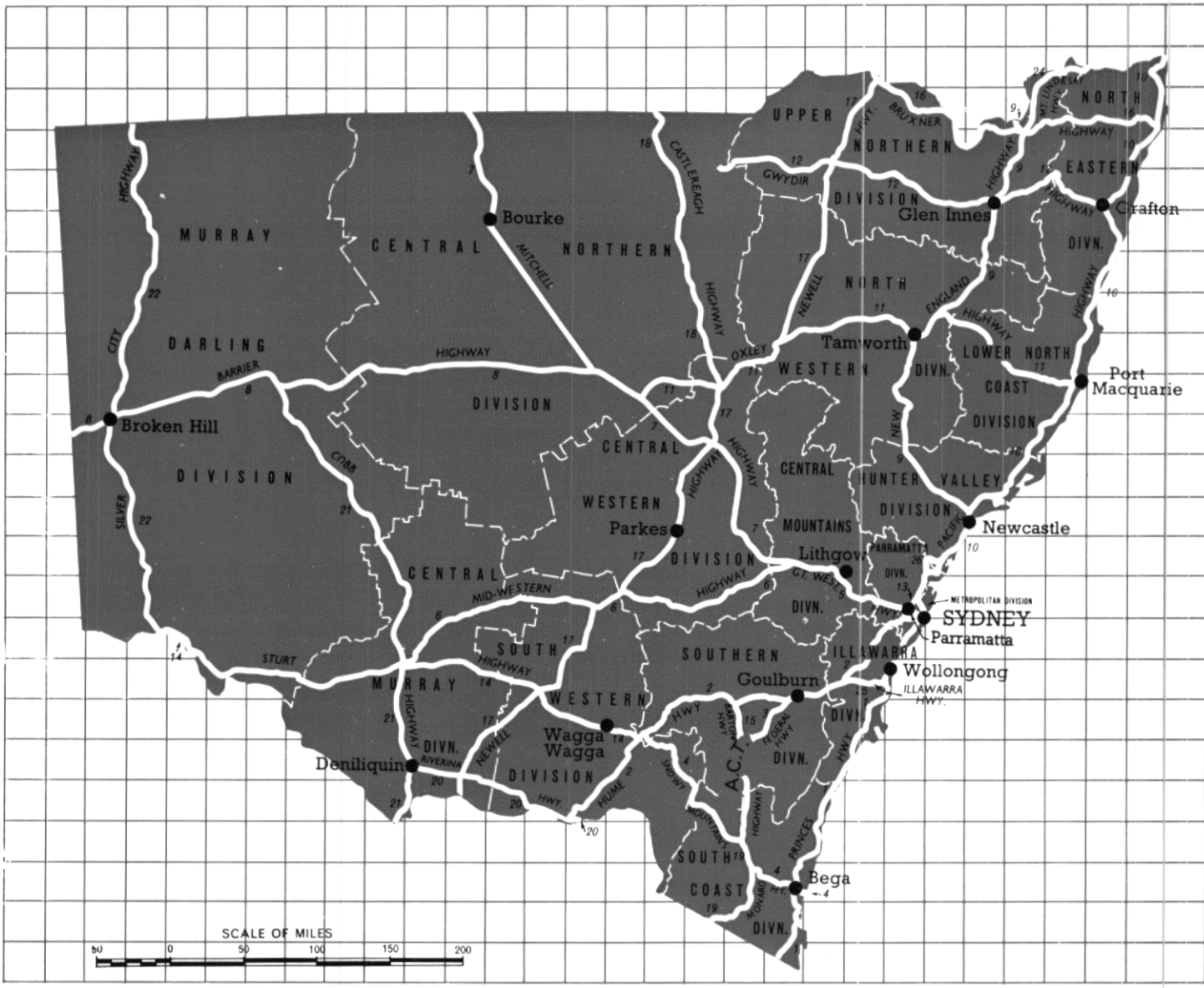

HIGHWAY SYSTEM OF NEW SOUTH WALES

Mileage of Main, Tourist and Developmental Roads, as at 30th June, 1969

Expressways	24
State Highways	6,535
Trunk Roads	4,210
Ordinary Main Roads	11,550
Secondary Roads (County of Cumberland only)	164
Tourist Roads	219
Developmental Roads	2,719
	25,421
Unclassified roads, in western part of State, coming within the provisions of the Main Roads Act	1,572
TOTAL	26,993

Area of New South Wales—309,433 square miles

Length of public roads within New South Wales—131,300 miles

Population of New South Wales at 30th June, 1969—4,474,600

Number of vehicles registered in New South Wales at 30th June, 1969—1,847,597

STATE HIGHWAYS
DIVISIONAL BOUNDARIES
DIVISIONAL OFFICES

MAIN ROADS

Journal of the Department of Main Roads, New South Wales

DECEMBER, 1969

VOLUME 35 NUMBER 2

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Front Cover: Southern Cross Drive, showing the new bridge on Gardeners Road, Eastlakes.

Back Cover: Southern Cross Drive, adjacent to the Australian Golf Club.

Linking our Largest Cities

The coastal corridor of New South Wales has held an attraction for the majority of her population ever since the early days of the colony. For a while, after the barrier of the Blue Mountains had been broken in 1813, settlers spread into the western areas of the State. The need for more grazing land, and later the lure of gold discoveries, drew increasing numbers away from the comforts of the coastal climate. Nevertheless, it is the coastal areas which have had the strongest and most permanent appeal and it is here, within sound of the surf, that the largest cities have developed.

At 30th June, 1969, the population of New South Wales was estimated to be 4,474,800, of which:

□ 2,712,610 persons lived in the Sydney area (including Camden, Campbelltown, Windsor, and the slopes of the Blue Mountains)

□ 342,950 in the Newcastle area (including Greater Cessnock, Maitland, Lake Macquarie and Port Stephens) and

□ 196,330 in the Wollongong area (including Shellharbour and Kiama).

In a land of wide-open spaces it is remarkable to find that over 72 per cent of the population prefer to live in a narrow and almost continuously urban coastal corridor which is only 150 miles in length but which incorporates the State's three largest cities.

To cater for the adequate movement of increasing volumes of traffic between these cities the Department is continuing its programme of providing inter-city expressways. Details are given on the following pages of a recent announcement by the Premier concerning a proposed new tollwork to link Sydney and Wollongong. It is planned that by 1972 the section of the Southern Expressway from Waterfall to the top of Bulli Pass will be in service as a toll road. This work will complement the construction of the Sydney-Newcastle Expressway which is being continued with the building of a new bridge over the Hawkesbury River.

These expressways will play an important role as the arteries on which the continued development of commerce and industry will depend. They will also help to satisfy the motorists' need for fast and safe driving conditions between the State's largest centres of population.

New Tollwork to Link Sydney and Wollongong

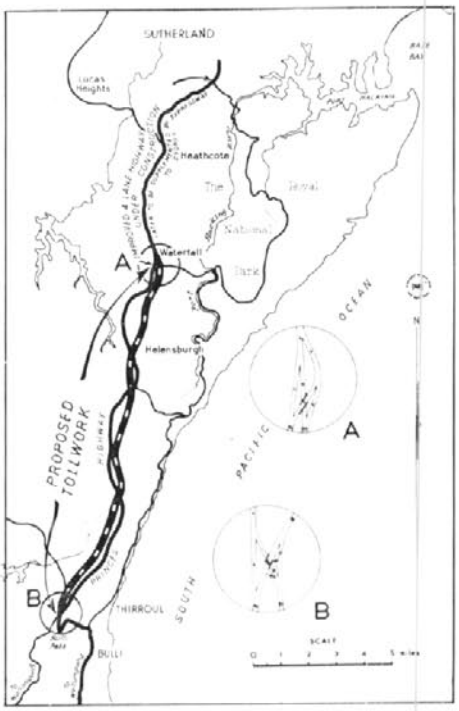
The Premier, the Hon. R. W. Askin, M.L.A., announced on 14th October, 1969, that the State Cabinet, on the recommendation of the Minister for Highways, the Hon. P. H. Morton, M.L.A., had approved the preparation of a Bill to amend the Main Roads Act, 1924–1967, to provide for the construction of a tollwork between Sydney and Wollongong.

Mr Askin said "The Government is acutely aware of the difficulties being experienced by motorists on the Prince's Highway, particularly between Sydney and Wollongong and recognises the pressing need for a more adequate road link than now exists so that development can proceed without restriction. Approval has therefore been given for the Department of Main Roads to undertake construction of a section of the Southern Expressway as a toll road from near Waterfall to the top of Bulli Pass so as to provide vastly improved travelling conditions over a distance of about 14 miles between those two points".

The standard of construction of the new road will be such that not only will it perform its essential function but also will be aesthetically pleasing and a work of which the people of New South Wales will have every reason to be proud.

The proposed tollwork at its northern end will be connected to the Prince's Highway which will be improved and widened where necessary to a minimum of four lanes. At the southern end motorists already have the choice of travelling either on the Prince's Highway down Bulli Pass or on the Mount Ousley Road and the new toll road will be connected to both of these roads. Motorists will, of course, have the use of the Prince's Highway between Waterfall and Bulli Pass as an alternative road.

The estimated cost of this project is $15 million and it is planned to be in service by the end of 1972.



Southern Cross Drive

New Access Road to Sydney (Kingsford Smith) Airport

For many years, passengers arriving at Sydney (Kingsford Smith) Airport travelled to the city through a heavily congested, predominantly industrial area. In 1967, following discussions with the Commonwealth Authorities, it became clear that, with impending airport developments, improved access roads for the airport were essential. As part of a plan to satisfy this need, it was decided to construct a road which had been included in the County of Cumberland Planning Scheme. This road was to provide an improved and fast link with the city via Wentworth Avenue and South Dowling Street and to join these two roads, a new expressway-type road, subsequently named "Southern Cross Drive", was constructed. This part of the access route is 2 miles long and passes in parkway conditions through and alongside the Lakes and Australian Golf Courses.

At each end of Southern Cross Drive, the new access route follows existing streets which have been improved and widened. This widening included South Dowling Street, Kensington (south of O'Dea Avenue) and Wentworth Avenue, Mascot, as well as Botany Road, Robey and Amelia Streets, in the vicinity of the airport. Some widening is still in progress at the northern end of South Dowling Street. The new route links with the internal road system at the airport to provide access to the passenger terminals and other flight facilities. It also provides improved conditions for southern commuters to the city via General Holmes Drive and from the eastern suburbs in the Pagewood and Botany area.

DESIGN

The route adopted is shown on the locality sketch.

Grades and curves are easy and have been achieved by cuts and fills of up to 30 feet. Retaining walls were used extensively to minimise interference with property. Some width limitations were inevitable where existing streets were followed, but mostly it was possible to provide for 3 traffic lanes in each direction, or for 2 lanes plus a breakdown lane in each direction with a central median. Expressway conditions apply along Southern Cross Drive and parking is not allowed.

Six bridges were constructed along Southern Cross Drive to separate cross traffic while elsewhere on the route traffic control lights have been installed at the main intersections by the Department of Motor Transport. The bridge over the new route on Gardeners Road is noteworthy, having prestressed girders with a span of 222 feet.

The design of the new road, including the bridges, was carried out by the Department. An integral part of the preparation for the work was the redesign of the layouts for two golf courses which were affected. This design work was undertaken by consultants engaged by the respective Golf Clubs.

PRELIMINARY WORK

Work on the new road was commenced in the early part of 1968 but, prior to this, considerable preliminary work was necessary.

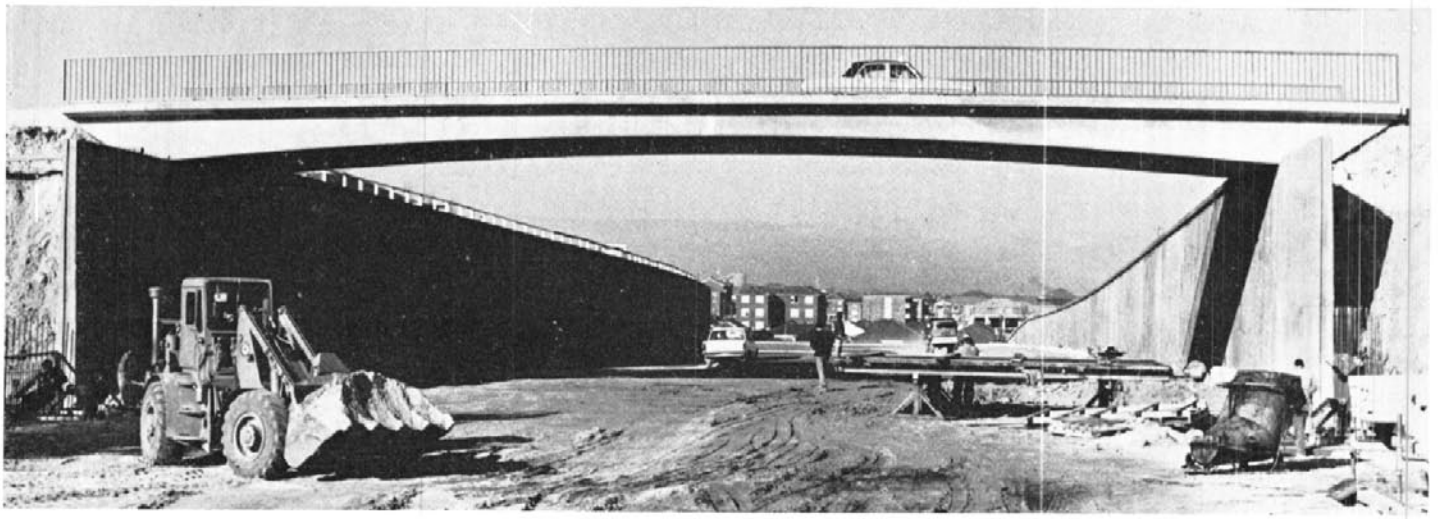
Acquisition of land from 64 properties was necessary, involving the demolition of 16 houses. Approximately 25 acres of land were acquired from the two golf courses and the interference with these was such that considerable course reconstruction had to be arranged. To clear the way for the new road, sewers, large water and gas mains, high voltage cables and telephone cables were relocated.

ROADWORKS

Earthworks

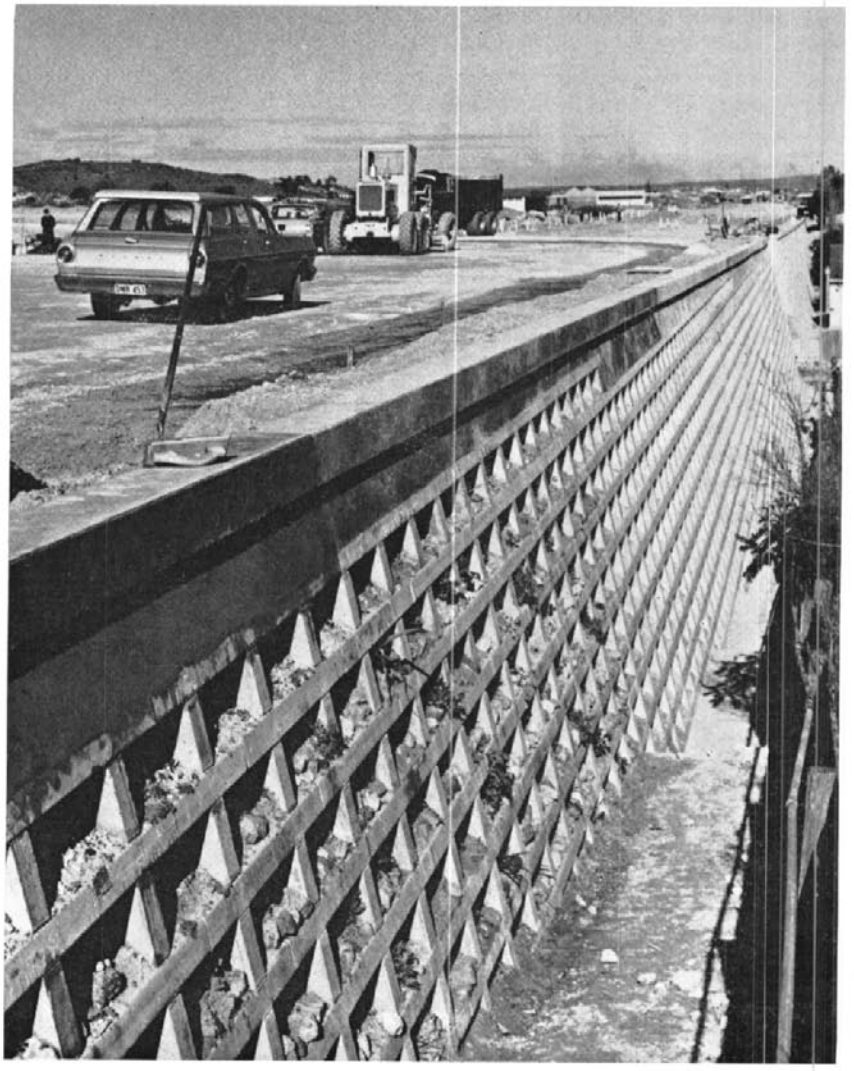
The new road lies in undulating and low lying sandy country characteristic of Sydney's near southern suburbs and, except in one small area where peat was encountered, all excavation was in sand or sandy material.

Earthworks involved 160,000 cubic yards of cut and fill. In addition 200,000 cubic yards of ripped sandstone filling were brought in to the work from outside sources, one such source being the Eastern Suburbs Railway Tunnel at Kings Cross. The magnitude of bridgework in this project, most of which was carried out concurrently, resulted in an inability to maintain efficient transfer of material direct from cut to fill and made stockpiling essential. Movement of material was thus basically by trucks loaded by front-end loaders. Embankments were built up,



Above: Construction work adjacent to the access bridge to the Australian Golf Club.

Below right: Crib walling along the embankment at the rear of properties in Vernon Street, Eastlakes.



using the harder imported ripped sandstone on the outside to contain the sandy fillings in the centre.

All sand fills required layering with ripped sandstone to reduce the nuisance of wind-blown sand in nearby built-up areas. This also facilitated the movement of wheeled vehicles through the work. Compaction of the sandy filling was achieved generally by inundation. However, normal rolling techniques were also employed, using drawn 72-inch vibrating rollers of about 4 to 4½ tons dead weight. These rollers were also used to compact the sandstone filling, which was first broken down, where necessary, with 16-ton grid rollers and 12-ton self-propelled steel drum rollers. In confined spaces, hand operated rammers and small vibrating rollers were used for compaction.

Sand was generally rolled at ambient moisture and sandstone at optimum moisture content. Density testing was carried out as the work progressed to ensure that adequate compaction was achieved.

Retaining Walls

To reduce property interference as much as possible, retaining walls instead of earth batters were used on major cuts and fills.

The biggest cutting on the work is that adjacent to the club house of the Australian Golf Club, where the new road surface is up to 30 feet below the natural surface. Through this cutting, reinforced concrete cantilevered retaining walls were constructed on each side of the road, the total length of wall being 2,500 feet with an average depth of 21 feet. In certain sections, sheet steel piling was initially driven behind the planned positions of the walls so that excavation could be carried out with minimum interference to adjacent property. The walls were constructed of dark grey concrete, with vertical flutings and a concrete coping. A similar concrete wall, 560 feet long, was built near the bridge on Gardeners Road.

Nineteen separate crib retaining walls were constructed, varying in height up to 35 feet and in thickness from 4 feet to 8 feet, the total length being approximately 4,800 feet. These walls consist of precast reinforced concrete units placed together in "crib" fashion with the exposed vertical face generally at a batter of ¼ : 1. As each wall was built up, the interstices were filled with selected, fine, well-compacted sandstone filling. At the same time, sandstone filling was built up behind the wall to give it added stability and to

Naming of Southern Cross Drive

It is appropriate that the new road leading towards Sydney (Kingsford Smith) Airport has been named after the aeroplane which Sir Charles Kingsford Smith used on many of his famous flights.

The following information has been taken from the *Australian Encyclopaedia* by courtesy of the publishers:

"In July, 1927, accompanied by Charles Ulm, Kingsford Smith went to California in search of a suitable aircraft in which to make a trans-Pacific flight. With financial assistance, provided by G. A. Hancock of Los Angeles, Sidney Myer of Melbourne, and the people of New South Wales, he purchased the airframe of a Fokker monoplane that had been used in the Arctic by Sir Hubert Wilkins. This machine was re-equipped and re-engined, and given the name *Southern Cross*.

"On 31st May, 1928 Kingsford Smith, with Ulm and two Americans, took off in the *Southern Cross* from Oakland, San Francisco, for the east-to-west crossing of the Pacific. Between Honolulu and Fiji, a stretch of 2,740 nautical miles, the longest distance flown non-stop up to that time, the *Southern Cross* was in the air for nearly 33 hours. Brisbane was reached on 8th June, 1928.

"Kingsford Smith made three other memorable flights in the *Southern Cross* in 1928: from Point Cook, Vic., to Perth—the first non-stop flight across the continent; from Richmond, N.S.W., to Christchurch, N.Z.—the first trans-Tasman flight; and from New Zealand back to Australia—the first east-to-west crossing of the Tasman.

"The crossing of the Pacific had been regarded by Kingsford Smith as only the first stage of a flight round the world, and in March 1929, once more in the *Southern Cross*, and accompanied by Ulm and two others, he took off from Sydney to fly west to England. The aeroplane encountered a storm and, running out of fuel, was forced down on the flats of the Glenelg River estuary, W.A. The flyers were found 13 days later after an aerial search had been made.

"Kingsford Smith made a fresh start in June, and reached London in the record time of 12 days 18 hours. During June of the following year he ended his circumnavigation of the world by flying the *Southern Cross* from Ireland to New York, by way of Newfoundland, and thence to San Francisco.

"In May, 1935, during an attempt to inaugurate a mail service between Australia and New Zealand, the *Southern Cross* developed engine trouble about 600 miles from the Australian coast. A crash into the sea was averted by the action of P. G. (later Sir Gordon) Taylor, who climbed out under the wing several times to transfer oil from one engine to another. This incident, for which Taylor received the Empire Gallantry Medal, became widely celebrated as a drama of the air, and as another instance of Kingsford Smith's skill as a pilot. Shortly afterwards the *Southern Cross*—the 'Old Bus' as it had come to be called—was sold to the Commonwealth Government for £3,000, to become a national relic."

The *Southern Cross* is now on display in a museum at Eagle Farm Airport, Brisbane.

The photograph of the "Southern Cross" is reproduced by courtesy of the Australian News and Information Bureau.

Right: Construction of bridge to carry Gardeners Road over Southern Cross Drive

Below top: Construction of the junction of Southern Cross Drive (left) with Wentworth Avenue (right), showing the bridges over Millpond Creek and the two subways giving access between sections of the Lakes Golf Course.

Below Bottom: The southern end of Southern Cross Drive approaching Wentworth Avenue.

provide access for construction plant. The top of each wall was finished with a concrete coping.

Stormwater Drainage

Some of the area traversed by the new road was flat and low-lying and this presented a drainage problem, because at depths below about 5 feet, the ground was water-charged. Rubber-ringed jointed pipes were used almost exclusively in diameters up to 48 inches, laid on grades as flat as 0·2 per cent and at depths of up to 17 feet below ground level. Twin 10-feet diameter prestressed concrete pipes with rubber-ringed joints were used to provide a culvert in an existing open channel.

Pavement

Earthwork construction was completed with a 12-inch sub-base layer of selected sandstone compacted to 100 per cent of standard Proctor density and trimmed to the correct line, grade and crossfall. Extruded concrete kerbing and guttering was then provided on each side of the carriageway and this was used to control levels for the placing of the asphaltic concrete layers.

Two types of pavement construction were used, viz. "full depth asphalt" and "deep strength asphalt". The "full depth asphalt" consisted of a 5-inch layer of 1½-inch gauge asphaltic concrete, a 2-inch layer of ¾-inch gauge asphaltic concrete and a 1-inch thick surface course of ⅜-inch gauge asphaltic concrete.

The sandstone sub-base proved very susceptible to water damage and during winter months it was extremely difficult to dry out the sandstone. At such times "deep strength asphalt" was used. Firstly a 4-inch thick base course layer of ¾-inch gauge crushed dolerite surface course material was laid on the sandstone sub-base and this was followed by a 3-inch layer of 1½-inch gauge asphaltic concrete, a 2-inch layer of ¾-inch gauge asphaltic concrete and finally a 1-inch thick surface course layer of ⅜-inch gauge asphaltic concrete.

Generally a dense graded mix was used for the final surface course layer, but on Southern Cross Drive (where higher vehicle speeds have been permitted) an open graded mix was used to provide for faster speeds. The surface course layer was placed using two or three paving teams in "echelon" to obtain "hot" and therefore sound longitudal joints.

The breakdown lanes on Southern Cross Drive were subsequently flush-sealed with ⅜-inch crushed river gravel. The pale colour of this gravel provides a visual contrast with the black surfacing of the travelling lanes while the texture of the gravel provides a noise differentiation, which warns the motorist who inadvertently moves off the travelling lanes and onto the breakdown lane.

BRIDGEWORKS

Six bridges were constructed to provide grade separation where Southern Cross Drive intersects major local streets and also to provide access to and within the two Golf Clubs.

To carry the new route over Millpond Creek near the southern end, a new bridge was constructed on the southbound carriageway and an existing bridge on Wentworth Avenue was widened.

Bridge over Epsom Road

This bridge is at the northern end of Southern Cross Drive and carries the Drive across Epsom Road. The bridge has two spans each 102 feet long and is 83 feet wide between kerbs including a median strip 15 feet wide. The bridge is founded on friction piles consisting of open-ended steel tubes 20 inches in diameter and 35 feet high, the upper 15 feet being filled with reinforced concrete.

The abutments are cast-in-situ reinforced concrete retaining walls of the counterfort type and the central pier is a solid cast-in-situ wall, matching the bridge abutment. To improve the appearance, the abutments and pier walls have been given zig-zag faces.

The bridge superstructure consists of 22 precast prestressed concrete girders each 102 feet long with a cast-in-situ deck and diaphragm. Lightweight concrete with a density of 120 pounds per cubic foot was used in the deck and girders and resulted in a 20 per cent reduction in weight with consequent savings in the bridge foundations.

Access Bridge to Australian Golf Club

A new bridge to provide access to the Australian Golf Club at Trevilyan Avenue was constructed across the Drive where it is in deep cutting between retaining walls adjacent to the club house. The bridge is a post-tensioned portal frame with a 98-feet span and is 20 feet wide with a single 5-feet wide footway.

Foundations under each abutment consist of 10 cast-in-situ bulb piles constructed by the Frankipile process with cast-in-situ pile caps below the road level. The portal frame legs are hinged where they connect with the pile caps and the outward horizontal thrust from the legs is carried by steel ties across the road between the pile caps. The legs of the portal frame are finished to match the adjacent dark grey retaining walls whilst the deck is of normal concrete colour.

Bridge over Southern Cross Drive on Gardeners Road

Gardeners Road (Main Road No. 183), an important cross traffic route, is carried over Southern Cross Drive on a six-lane single span prestressed concrete bridge with an overall length of 222 feet and a width between kerbs of 81 feet.

The bridge is on a 53° skew and Southern Cross Drive is on a 1,300 feet radius horizontal curve at the bridge. For traffic safety, a single span structure without central support was constructed. The bridge is supported on 180 driven friction piles consisting of open-ended mild steel tubes 18 inches and 20 inches in diameter, and 30 feet and 40 feet high respectively, the upper 12 and 15 feet in each case being filled with reinforced concrete. The abutments consist of large counterfort walls retaining the road fill on the bridge approaches.

The bridge superstructure consists of 18 precast, post-tensioned, variable depth, I-section girders 222 feet long, with cast-in-situ diaphragms and deck in-fill between the girders. Each girder consists of six precast segments, each weighing from 25 to 35 tons, post-tensioned on site after erection. At the end of each girder is a precast tension tie and compression strut, both hinged at their extremities. The purpose of these is to reduce the positive moment and the depth of girder needed at centre span. Concrete in the girders was specified to reach a strength of 7,000 pounds per square inch at 28 days.

The variable depth girders give the bridge an elegant arched appearance.

A pedestrian underpass under Gardeners Road was constructed in the western approach to the bridge.

Bridge over Access Road to the Lakes Golf Club

The new access to the Lakes Golf Club will be via King Street, Mascot and a bridge has been provided to carry Southern Cross Drive over King Street where it enters the club grounds. The length of the bridge is 32 feet 6 inches and the width between kerbs is 83 feet.

The bridge is a composite type of portal frame consisting of reinforced concrete abutment walls supporting 30 feet long prestressed concrete bridge planks, with a fixed moment connection between the walls and bridge planks. The walls are supported on 30 feet long reinforced concrete piles and the earth pressure on the abutment walls is resisted by steel ties anchored into ground beams buried under the road fill.

Lakes Golf Club Underpasses

The southern portion of the Lakes Golf Club is severed by Southern Cross Drive and access between the two areas is provided by two subways constructed under the Drive, one under each carriageway. Each structure is a two-cell culvert supported on spread footings, each cell being 20 feet wide and 12 feet high to provide a clearance for vehicles used in maintenance of the golf course.

Millpond Creek Bridges

A small bridge was constructed across Millpond Creek on the southbound carriageway of Southern Cross Drive near Wentworth Avenue and a similar bridge across the creek on Wentworth Avenue had to be widened.

These new structures each consist of three spans, 30 feet long and are supported on driven reinforced concrete piles with cast-in-situ piers in spill-through

abutments. The decks on both bridges are of pretensioned precast deck planks, with cast-in-situ topping and kerbs.

ROAD FURNISHINGS AND SAFETY FEATURES

Reflectorised edgelines 6 inches wide are provided on both edges of the travelling lanes to give delineation, while all travelling lanes are separated by groups of white raised pavement markers, as previously used on the Warringah and Sydney-Newcastle Expressways. The end marker of each group is reflective and provides better delineation at night and during wet weather, when normal white-painted lines tend to become indistinct. The markers also give an audible warning when a vehicle wheel runs over them.

Corrugated steel guardrailing has been provided wherever the height or steepness of the embankment warrants its installation.

A comprehensive set of road signs has been provided to guide motorists when travelling over the new route. The more important signs have been illuminated.

Seven new sets of traffic signals were installed by the Department of Motor Transport on the new route and channelised layouts have been constructed at a number of the intersections.

Street lighting, conforming with the current Australian standard, has been provided on Southern Cross Drive.

LANDSCAPING

Careful attention was paid to landscaping Southern Cross Drive so that it harmonises with the surroundings. The median strip, verges and batters were turfed or seeded with grass and groups of trees were planted at selected locations.

CONCLUSION

The bridge over King Street to the Lakes Golf Club was constructed under contract by Wetherill Concrete Constructions. The remainder of the work was carried out under the Department's direct control, with some assistance from sub-contractors on portions of the bridgeworks. All work was supervised by the Department's Metropolitan Engineer.

Southern Cross Drive was opened to traffic on 13th October, 1969.

The total cost of the new road and the widening of existing roads was approximately $9,000,000.

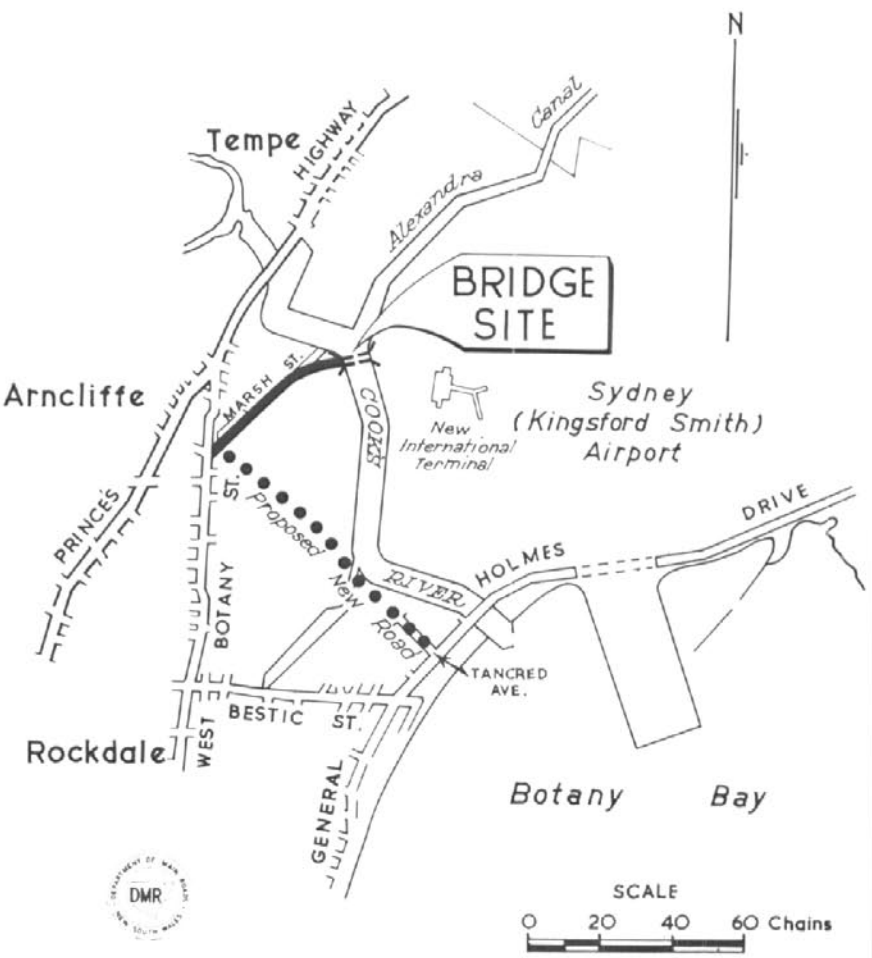
An article entitled "Road Access to Kingsford Smith Airport" appeared in the June, 1969 issue of Main Roads, *Volume* 34, *Number* 4, *pages* 106 *to* 110.

New Bridge to provide Southern Access to International Airport Terminal

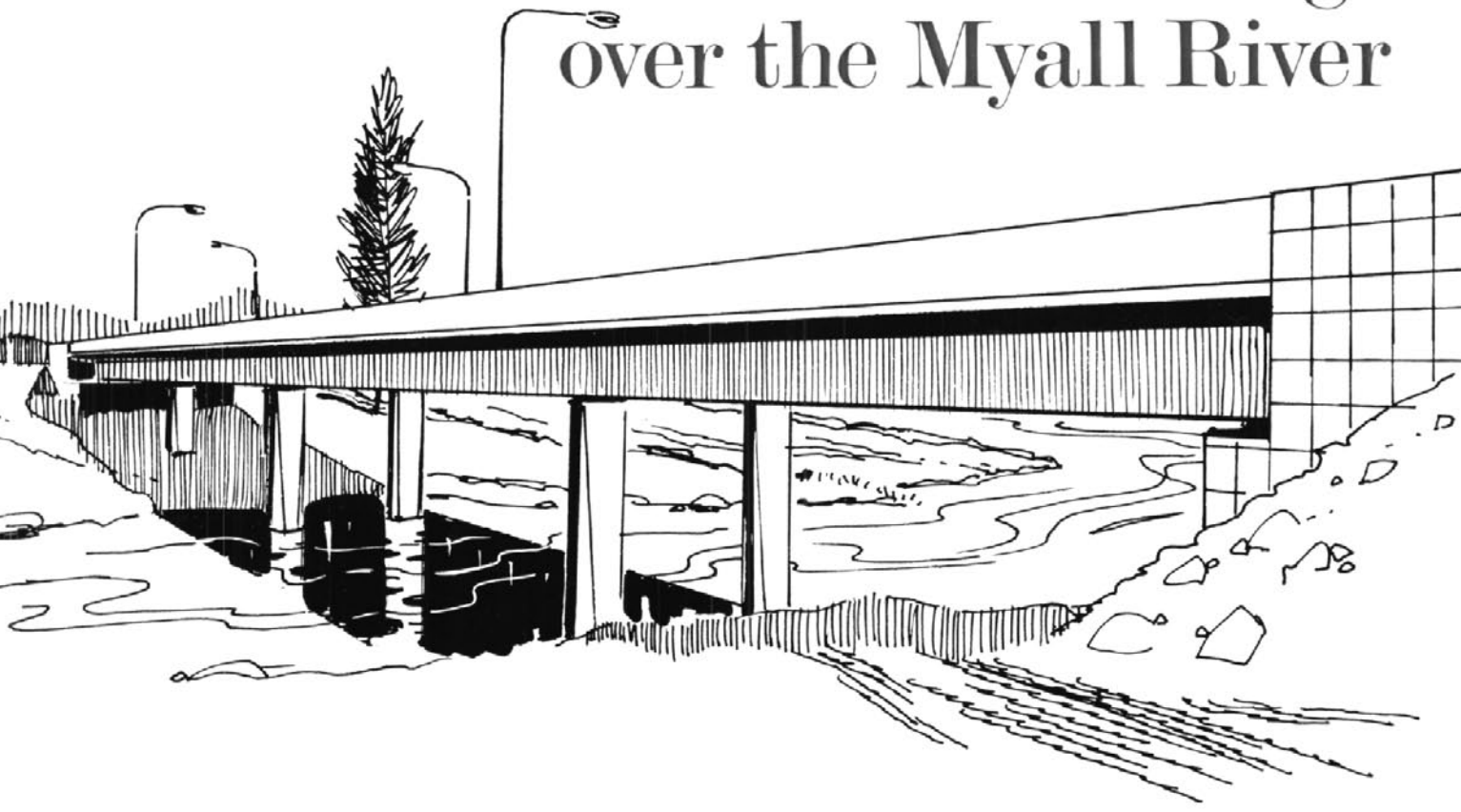
During December, 1969, the Department accepted a tender of $1,262,746 from Central Constructions Pty Ltd for the construction of a new bridge over Cook's River at Arncliffe.

The bridge will provide additional access to the new International Terminal under construction at Sydney (Kingsford Smith) Airport and will be connected with Prince's Highway via Marsh Street and West Botany Street. A new road will later provide a connection to General Holmes Drive at Tancred Avenue, Kyeemagh.

The Department designed the prestressed concrete bridge which will consist of six spans with an overall length of 691 feet and will provide six traffic lanes. Two carriageways, each 35 feet wide, will be separated by a median 4 feet wide, and there will be two footways each 6 feet wide. The new bridge is scheduled for completion in one year and will provide access to the new International Terminal from the south. Greatly improved access to the airport has already been provided from the eastern side of the city by the recent completion of Southern Cross Drive.



New Bridge over the Myall River



at Bulahdelah

On Monday, 24th November, 1969, a new bridge over the Myall River at Bulahdelah was officially opened, on the eve of his retirement, by the Department's Engineer-in-chief, Mr T. M. Coulter, in the presence of the Hon. P. H. Morton, M.L.A., Minister for Highways. The opening ceremony was attended by parliamentarians, councillors, civic leaders and prominent citizens representing a wide cross-section of the local community.

Buladelah is situated on the Pacific Highway about 164 miles north of Sydney and the district is mainly given to dairying, mixed farming and timber milling.

The new bridge is 395 feet long and consists of four spans of prestressed concrete. The carriageway is 28 feet wide and there are two footways, each 8 feet wide. The deck level of the bridge is 10·5 feet above high flood level at the centre of the main span. The approaches to the new bridge are also flood free whereas those to the previous bridge were not.

The Department engaged Messrs MacDonald, Wagner and Priddle, Consulting Engineers of Sydney, to design the bridge which was built by Pearson Bridge Pty Ltd. The use of prestressed hollow box girders has given the bridge a slender appearance. The approach roadworks were carried out by the Department. The cost of the bridge and approaches was approximately $460,000.

G 96010—2

OLD BRIDGE. The previous bridge at this site was a steel truss and timber beam structure, with an overall length of 248 feet and a width between kerbs of 16 feet. It was officially opened on 30th September, 1933 and was described then as being located "on the road between Booral and Wingham (Main Road No. 110)".

In building the bridge the piers of an earlier timber bridge at this crossing were found to be so sound that they were incorporated into the new (1933) bridge and used as the foundation for the steel truss span.

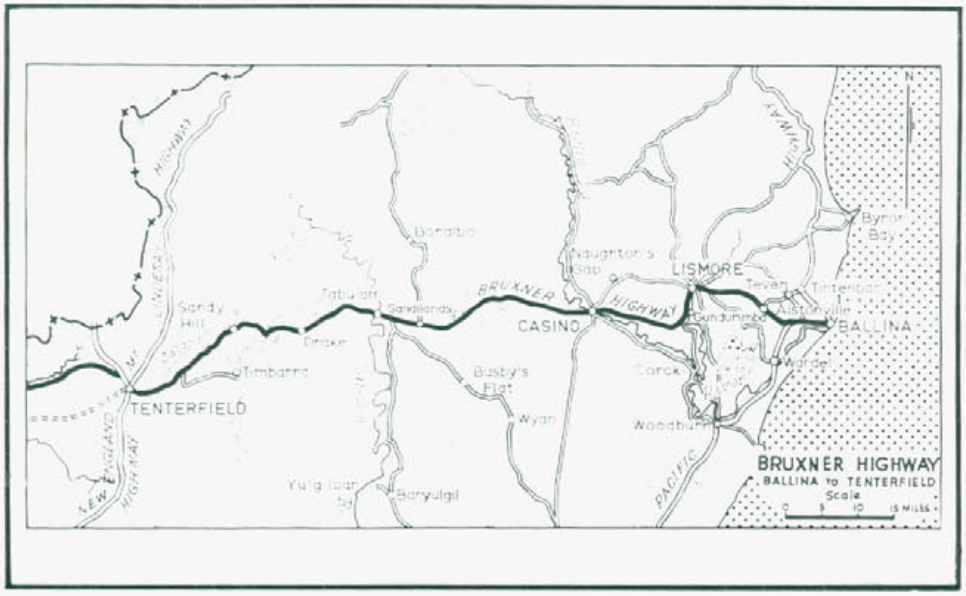
The bridge was constructed by contract at a cost of $4,858 for the bridge and approaches, and $1,406 for the steelwork, making a total cost of $6,264.

Above: The previous bridge over the Myall River at Bulahdelah which was completed in 1933

Below: The new prestressed concrete bridge over the Myall River at Bulahdelah.

The Bruxner Highway is the most northerly of the State Highways which extend from the coast to the interior plains.

The Bruxner Highway



Reconstruction from Tabulam to Drake

The highway is 272 miles long and commences at a junction with the Pacific Highway near Ballina and ends at the border of New South Wales and Queensland near Goondiwindi. The highway passes through farming and grazing country of the Richmond and Clarence Rivers and after leaving Tabulam crosses over the Great Dividing Range to Tenterfield on the New England Tableland. In the late 1930's, work was commenced on the reconstruction and realignment of the whole length between Casino and Tabulam in order to provide a satisfactory outlet to the railway at Casino for the Bonalbo and Tabulam districts and to meet the requirements of through traffic. This work was completed in the early post-war years and a bitumen surface was provided as far as Tabulam. By 1965 there was a bitumen surface from the coast to a point 3 miles west of Tabulam (75 miles from Ballina) and from Drake (90 miles from Ballina) to a point 11 miles west of Tenterfield. The unsurfaced length between Tabulam and Drake is of very poor alignment. In order to improve this length and in keeping with its programme to complete the bitumen surfacing of State Highways, the Department commenced the reconstruction of the length between 77 miles and 90 miles west of Ballina in 1965.

As there was insufficient information available on which to fix a new road location and base a design for the proposed reconstruction, it was decided to obtain photogrammetry over the first 6 miles. This section was likely to be on a deviation away from the existing road. The required photogrammetry was obtained by the Department establishing photo control points, targetting the area and arranging the photography. A commercial firm then compiled photogrammetric sheets of the areas required. Contour plans were produced with a contour interval of 2·5 feet and these contour plans provided the basis for location and subsequent detailed design.

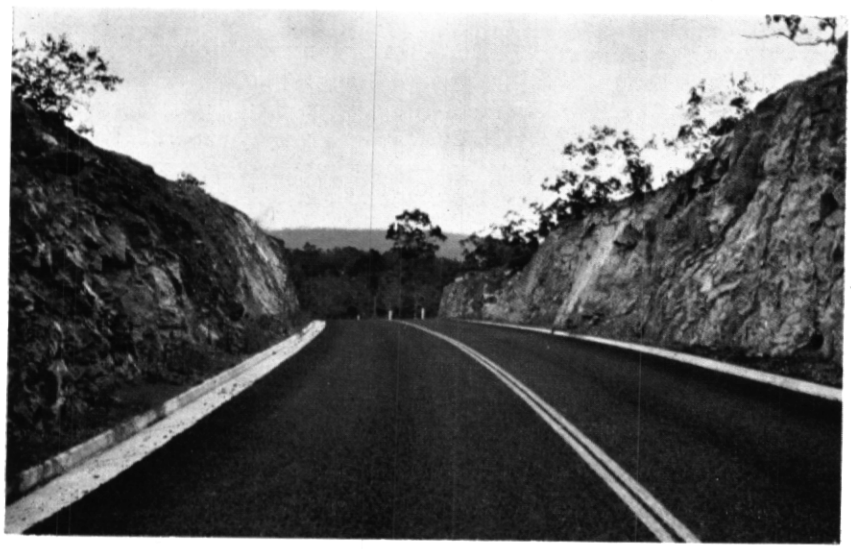
The detailed design was prepared in the Department's Divisional Office at Grafton and provided for a general 60 mp..h. standard. The principal features of the design are a 22-feet wide bitumen surface on a 34-feet wide formation with a minimum curve radius of 1,500 feet and a maximum gradient of 7·7 per cent. The design on the lengths covered by photogrammetry was prepared directly from the photogrammetric contour information. Following this design the centre line was pegged and only a few levels were taken as a spot check on the photogrammetry.

Between Tabulam and Drake the country consists of granite outcrops with sedimentary grits and conglomerates. During the location stages it was considered that some possible alternative lines might pass through country which it would be possible to rip rather than drill and blats with explosives. Accordingly a seismic survey was arranged to determine the relative hardness of the various rock strata. Light explosive charges were

PRESENT HIGHWAY

EARTHWORKS IN PROGRESS

COMPLETED WORK



detonated at selected locations. The velocity of the resulting vibrations through the strata was determined and these velocities indicated the comparative densities and hardness of the materials. This survey showed that there was little difference as far as "rippability" was concerned between the various possible lines. In addition the survey indicated that much of the rock had compression wave velocities in excess of 4,500 feet per second and would not be suitable for ripping. Consequently it was assumed that the plant and equipment for the work should be organised on the basis that a considerable amount of drilling and blasting would be required. While there was some variation within particular road cuttings between the anticipated and actual rock types, the overall conclusion that drilling and blasting would be necessary was correct.

Tabulam and Drake were remote from the Department's existing works organisations and to allow for adequate supervision of the work a construction works office and quarters was established at Tabulam. This office is staffed by a Works Engineer, Cost Clerk, three clerical officers, a typist and a storekeeper. The layout of the office and quarters was prepared by the Department and demountable buildings were erected by contract. There was not a sufficient labour force in the Tabulam-Drake area to supply workmen for the job and it was necessary to establish a camp at Drake.

The area required for roadworks was lightly timbered and trees were generally felled with chainsaws and heaped in the centre of the cleared area where they were burned. The total volume of earthworks was approximately 500,000 cubic yards and, with the generally rugged terrain between Tabulam and Drake, earthworks comprised almost 40 per cent of the cost of the work. Where drilling was necessary this was generally done by hand-held rock-drills but in the latter stages of the work drilling was also carried out by track-mounted drills. All blasting was with Ammonium Nitrate Fuel Oil mixtures. The batters were pre-split by drilling holes at 2-feet centres, charging these holes and firing the pre-split holes separately ahead of the main blast. This technique proved particularly successful in cuttings through sedimentary materials. Excavated material was moved by bulldozers on very short hauls, by drawn scrapers where this was suitable but on the majority of the work it was moved by

trucks. The excavated material was loaded into the trucks by front-end loaders.

A first-class pavement was provided, generally consisting of 12 inches of selected sub-grade material followed by a 4-inch base course of natural material, a 4-inch surface course, which was mechanically stabilised with sand, and a bitumen surface using ¾-inch and ⅜-inch aggregate. The surface course material was the naturally occurring sedimentary grits adjacent to the work but these grits were particularly tightly cemented and it was necessary to win the surface course material by drilling and blasting. This material was then broken up by grid rolling before stabilising.

Drainage was provided on the length by pipe culverts ranging in size from 18 inches to 72 inches, by sub-soil drains, by mountain-type and concrete-lined table drains, by precast concrete drains and by open drains. In addition three large multicell cast-in-situ reinforced concrete box culverts were constructed, two by direct control and one by contract.

Between Tabulam and Drake it was necessary to provide five bridges over Black, Yellow, Little Yellow, Ti-Tree, and Violet Creeks. The bridges at Little Yellow and Violet Creeks are standard types of structure on frame-type piers with prestressed concrete beam or plank decks and were built by direct control. The bridge at Yellow Creek was also built by direct control but had post-stressed concrete column piers, prestressed concrete beams and a continuous deck. The bridge over Black Creek is a four-span continuous structure on post-stressed column piers. The bridge site at Ti-Tree Creek is deeply incised with fractured rock on the eastern approach. The site dictated that the bridge have a long central span and consequently a continuous three span steel structure with 61-feet approach spans and a central span 100 feet long has been designed. The bridge will have oval single column piers and will be constructed by contract.

A total amount of $1,800,000 has been spent on the reconstruction of the Bruxner Highway between Tabulam and Drake and it is estimated that the final cost of the work will be $2,300,000 comprising $1,800,000 for roadworks and $500,000 for bridgeworks. The earthworks are almost complete and 3·6 miles of the length have already received a bitumen surface. The whole work will be completed in 1970.

SUBGRADE ROLLING

PRESPLIT BATTER

COMPLETED WORK

Bulahdelah and the Pacific Highway

Having published in this issue details of the new bridge over the Myall River at Bulahdelah it is an appropriate time to include some information on how Bulahdelah came to be situated on the route of the Pacific Highway.

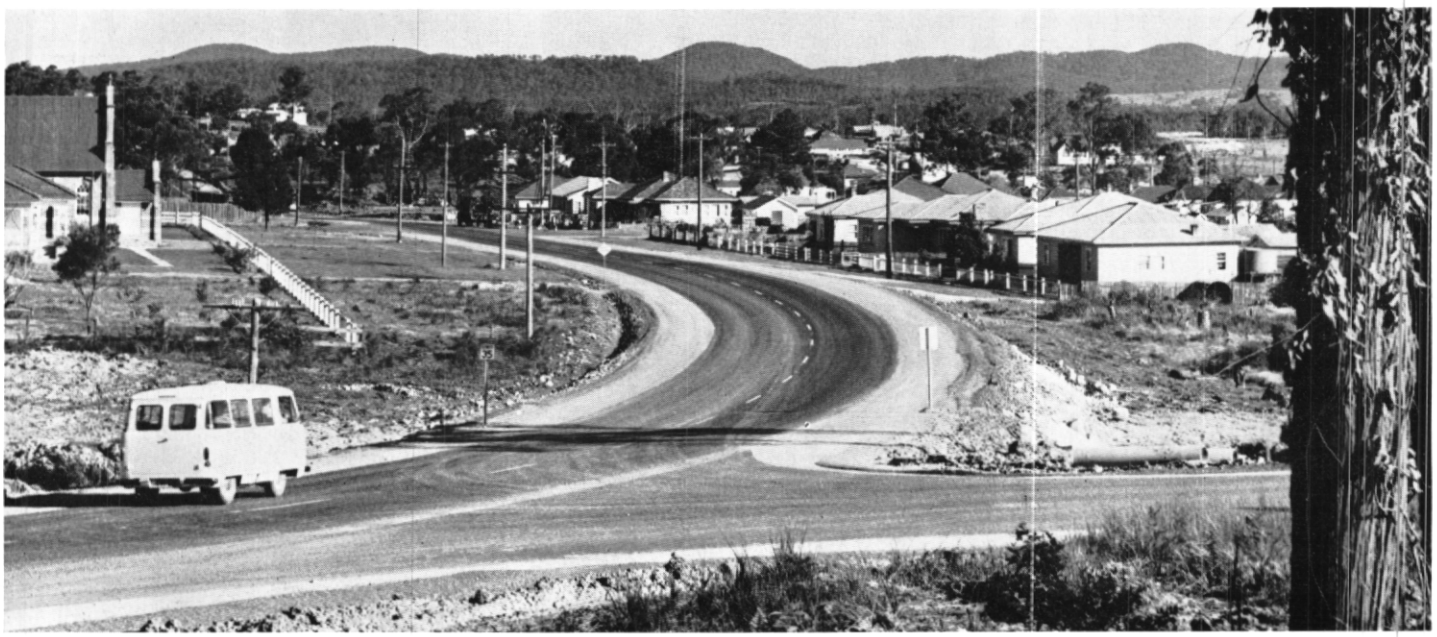
EARLY HISTORY ***"Bulahdelah" is an aboriginal word meaning "Meeting of the waters" and "Good camping place".***

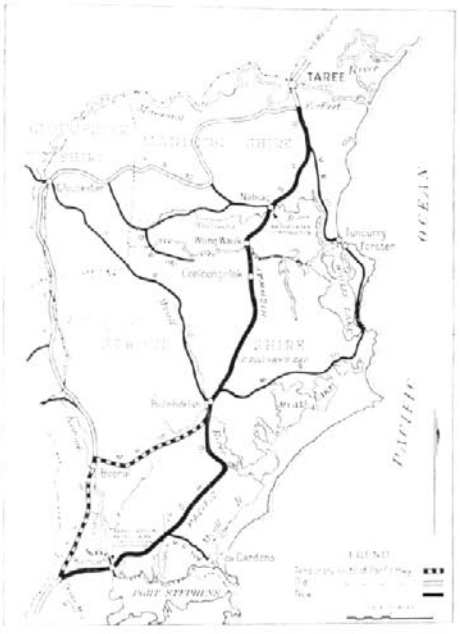
In Bailliere's Gazetteer of New South Wales, 1870 it is recorded under "Bullah Delah" that "The nearest township is Stroud . . . the communication being by bush track only. With Sydney . . . the communication is by coach from Stroud to Raymond Terrace, and thence by steamer".

At this time the easiest means of transport between coastal and near coastal centres was by water. With numerous river estuaries along the north coast providing means for intercommunication by coastal steamers, there was not the same need for constructed roads or railways as in other parts of the State. As a result the Pacific Highway developed as a series of roads connecting various districts along the coast.

Right: The Pacific Highway, 6 miles south of Bulahdelah.

Below: Section of the improved route of the Pacific Highway through Bulahdelah.





creating a dust nuisance in dry weather and quagmires in wet.

When the Main Roads Board (later the Department of Main Roads) was established in 1925, it adopted a policy of ensuring that the highway followed the best route available. This involved deferring the construction of bituminous pavements on sections of road requiring extensive deviation and realignment and continued maintenance of gravel surfaces pending their reconstruction. Concurrently with the relocation of many sections of the road, a vigorous campaign was undertaken to improve existing surfaces on lengths of road which did not require relocation, including the provision of a dustless surface, particularly in and near towns and through areas having intensive agricultural settlement.

On the north coast there were very few lengths of road which could be provided with a dustless surface without extensive realignment and/or pavement construction. Owing to the heavy expenditure involved, reconstruction works could only be carried forward in stages.

NAMING THE PACIFIC HIGHWAY

In 1931 the route from Sydney to the Queensland border at Tweed Heads via Hexham was named the Pacific Highway —Queensland having previously adopted the name for the link from the border to Brisbane. The route between Sydney and Hexham had previously been known as the Great Northern Highway, and between Hexham and the Queensland border as the North Coast Highway.

Above: Pacific Highway, between Twelve Mile Creek and Taree.

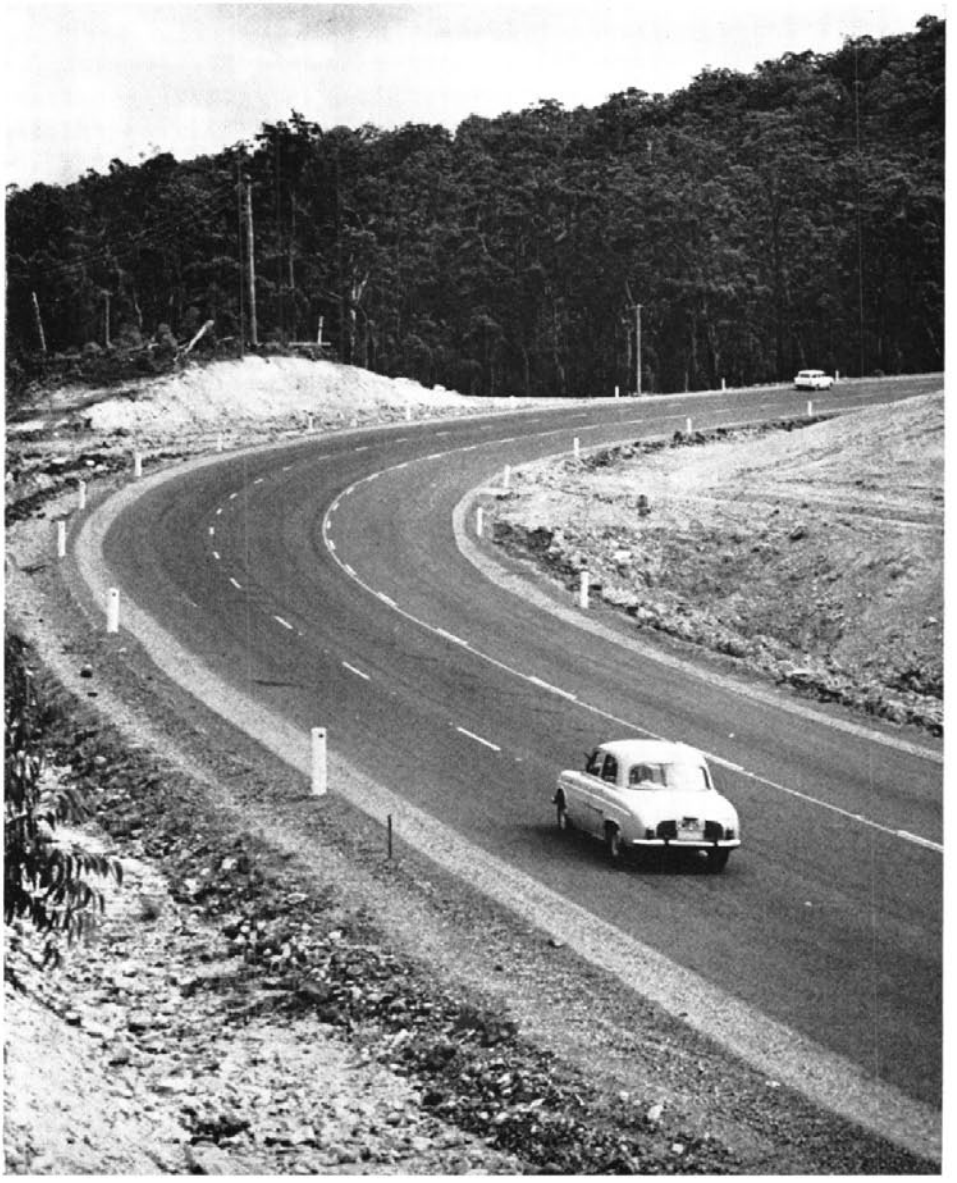
Following the acquisition of land in the Port Stephens district by the Australian Agricultural Company in 1824, a track had been formed from Raymond Terrace north to the Company's headquarters at Stroud and on to outstations at Booral and Gloucester by 1840.

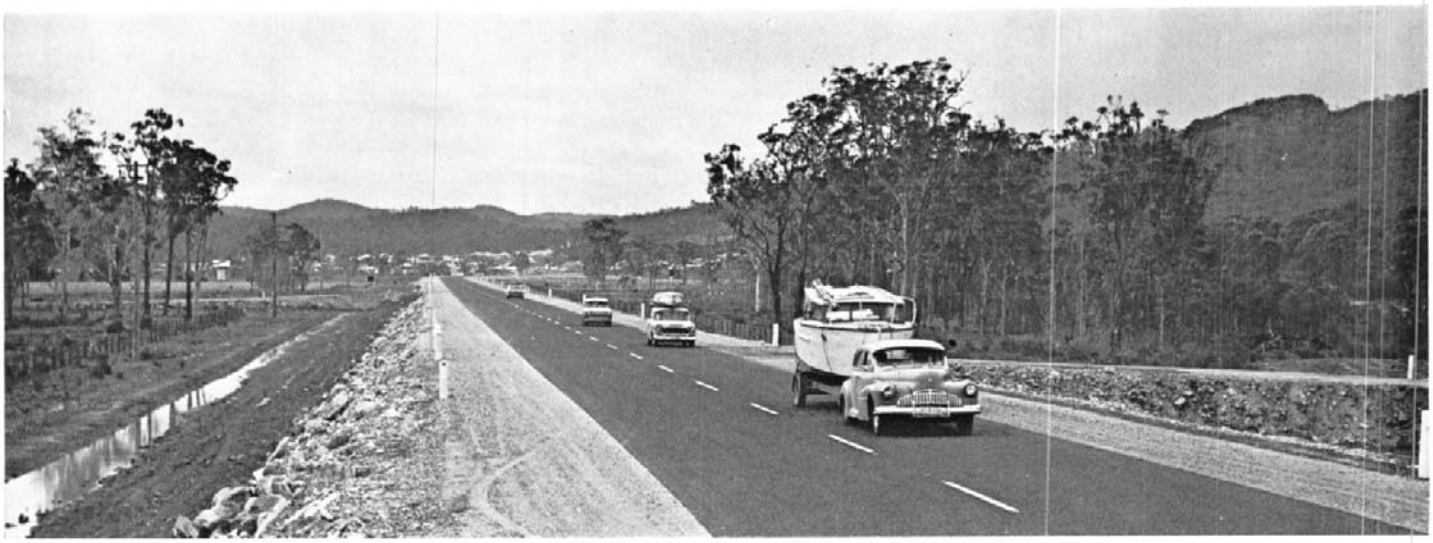
Taree, originally settled about 1831, developed in the 1840's and no doubt a rough track existed between Gloucester and Taree at this time. By 1857, the "road" had been extended to Port Macquarie and Kempsey, the remaining lengths to the Queensland border being developed in the succeeding decades.

In 1909 it was still considered quicker and more comfortable to make the trip from Sydney to the border by sea, although a North Coast Guide of that year states that:
"Upon the whole the roads are good throughout . . . Good horses and comfortable vehicles are available at moderate cost at the many livery stables in all the larger towns along the road".

The stimulus to the development of a through route revolves around the development of the motor vehicle as an efficient means of transport. The arrival of the motor vehicle probably helped to sound the death knell of coastal shipping.

In the early 1920's, when motor vehicles came into general use, many miles of the main north coast road consisted of merely an earth formation,





Section of the Pacific Highway, just south of Bulahdelah, which has been raised to a flood-free level.

RELOCATION OF THE PACIFIC HIGHWAY BETWEEN TWELVE MILE CREEK AND TAREE

At the end of World War II, the proclaimed route of the Pacific Highway north of Newcastle was via Raymond Terrace, Stroud, and Gloucester to Taree, roughly the original route of the 1840's. Following a detailed investigation of various alternatives, the Department decided in 1952 to relocate the Highway to the east to pass along or near existing roads via Karuah, Bulahdelah, Nabiac and Purfleet. This route permitted the eventual development of improved travelling conditions and avoided the extremely difficult terrain on the section between Gloucester and Taree. In addition it opened up areas which previously had a limited access and reduced the distance between Newcastle and Taree by 18 miles. The old route of the highway has been retained as a Trunk Road (No. 90).

Extensive work was required to construct the section of the newly proclaimed route of the highway between Twelve Mile Creek and Bulahdelah and a major bridge had to be constructed over the Karuah River. The Department decided, in the first instance, to provide a bitumen pavement on the old road as far as Booral and to carry out reconstruction and bitumen surfacing of the Main Road between Booral and Bulahdelah to provide a temporary solution.

In 1953 the Department established a Works Office at Bulahdelah to carry out construction within the Shires of Manning and Stroud and by 1955 the length between the Wang Wauk River and Bulahdelah, a distance of 23 miles, had been completed.

By June, 1957, a further section of 11 miles, between Wang Wauk River and Bungwahl Creek was completed. In 1958 reconstruction and bitumen surfacing was completed between Nabiac and Taree to provide a continuous dustless surface from Sydney to the Queensland border via Booral and Bulahdelah. The last load of bitumen was sprayed 11 miles south of Taree on 2nd April, 1958.

Two new bridges were constructed, one over the Karuah River opened on 14th December, 1957, and another over the Wollomba River at Nabiac completed early in 1959.

By 1960 the Department had completed reconstruction of the new route south of Karuah and the section between Karuah and Bulahdelah was all that remained to be done. This section was completed in December, 1963 bringing into use the full length of the relocated highway.

The mileage of the new route from Twelve Mile Creek to Taree is 77·15 miles, compared with 95·32 miles by the old route via Stroud and Gloucester. The map on page 39, originally published in September, 1956, shows the old and new routes.

TRAFFIC VOLUME FIGURES ON THE PACIFIC HIGHWAY NEAR BULAHDELAH

At the Department's traffic counter on the Pacific Highway near its junction with the Booral Road, which is approximately 1 mile south of Bulahdelah, the following figures have been recorded or are anticipated:

Year	Annual Average Daily Traffic Volume (i.e. Number of Vehicles Travelling in Both Directions)
1958	1,230
1959	1,380
1960	1,550
1961	1,680
1962	1,700
1963	1,770
1967	3,040
1969 (estimate)	3,700
1970 (estimate)	4,100

These figures indicate an increase in traffic on the Pacific Highway in this area of 163 per cent in the last 10 years.

RECENT AND CURRENT IMPROVEMENTS

North of Bulahdelah climbing lanes have been completed recently at Coolongolook Gap and over O'Sullivan's Gap. On the section of the highway near Bennett's Bridge two and a half miles of reconstruction have been completed and work is continuing in this area.

Work is proceeding with the widening of the entire length of the highway for the 27 miles between Karuah and Bulahdelah.

RETIREMENT OF DEPARTMENT'S ENGINEER-IN-CHIEF AND APPOINTMENT OF SUCCESSOR

MR T. M. COULTER

On 18th December, 1969, Mr T. M. Coulter, B.C.E., F.I.E.Aust., A.M.Inst.T., retired from the Department where he had held the position of Engineer-in-Chief since May, 1962.

Mr Coulter graduated from the University of Melbourne and in March, 1929 joined the Department of Main Roads. After holding a variety of positions in country and city Divisions, Mr Coulter was appointed to the Metropolitan Division's Design Branch in 1934 and he served there until 1942. He was then appointed to the Lower Northern Division with headquarters at Newcastle where he became Supervising Engineer.

In 1953 Mr Coulter returned to Head Office, initially to the Design and Urban Planning Section. Then followed appointments as Materials and Research Engineer in 1954 and as Advance Planning Engineer from 1959 to 1961. During this period Mr Coulter travelled to the United States of America and studied planning methods at a number of State Highway Departments. In addition, he examined joint arrangements between State Highway Departments and universities in undertaking road research. Mr Coulter also attended the 29th Annual Conference of the Institute of Traffic Engineers in New York and the 11th Congress of the Permanent International Association of Road Congresses in Rio de Janeiro, Brazil.

In March, 1961 Mr Coulter became Assistant Chief Engineer and in May, 1962 was appointed Engineer-in-Chief. In 1964 he visited Pakistan to inspect construction work being carried out at a hydro-electric and irrigation scheme on the Jhelum River at Mangla. This inspection was primarily to evaluate the work of a "Mole", a large tunnel boring machine.

During recent years Mr Coulter has represented the Department on a number of committees, including the Principal Technical Committee of the National Association of Australian State Road Authorities; the Australian Road Research Board Pavement Design Committee; the University of New South Wales Highway Engineering Committee; the Crown Employees (Professional) Conciliation Committee and the Local Government Engineers Examination Committee.

MR G. V. FAWKNER

Mr G. V. Fawkner, B.E., F.I.E. Aust., A.M. Inst.T., has been appointed Engineer-in-Chief to succeed Mr Coulter.

Mr Fawkner joined the Department in 1934 after graduating from the University of Sydney as a Bachelor of Engineering. He also holds a Local Government Engineers Certificate.

His service with the Department has been carried out in both country and city areas. Mr Fawkner has served in the Department's Parkes, Parramatta, Grafton, Wollongong, and Metropolitan Divisions. His field service includes work in the Bega, Glen Innes, Goulburn, Grafton, Tamworth, Wagga Wagga, and Newcastle districts. During the war years he was for some time based in the Northern Territory and engaged on the construction of the road from Alice Springs to Darwin.

Mr Fawkner has held the position of Assistant Metropolitan Engineer and has occupied the position of Supervising Engineer, Design and Urban Planning Engineer and Assistant Bridge Engineer, Investigations, at the Department's Head Office.

In 1962 he was appointed Assistant Chief Engineer and prior to assuming his present position had been Deputy Engineer-in-Chief since 1963.

Mr Fawkner travelled to the United States of America, England and the Continent in 1963 to observe and investigate contract administration, and the organisation and control of expressway construction.

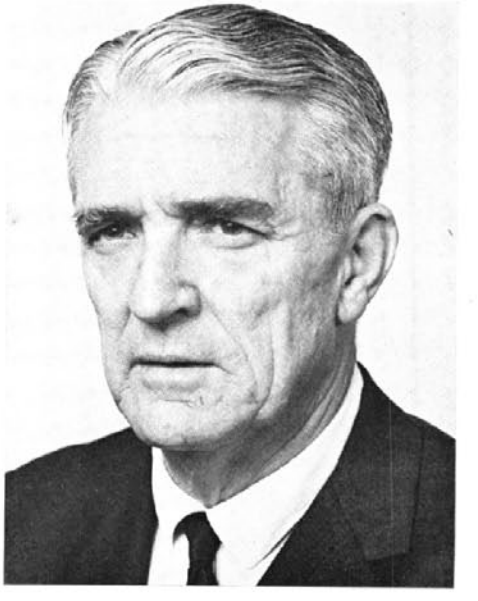
In 1967 he attended a road symposium held by the Road Research Unit in New Zealand. This was followed by a study of expressway construction in that country.

Last year he accompanied the Commissioner for Main Roads, Mr R. J. S. Thomas, to Japan where they examined expressway construction methods.

During recent years Mr Fawkner has represented the Department on the Interdepartmental Level Crossing Committee and the Construction and Maintenance Committee of the National Association of Australian State Road Authorities. He is now a member of the Principal Technical Committee of that Association.

Mr T. M. Coulter

Mr G. V. Fawkner



FIFTH BIENNIAL CONFERENCE OF THE AUSTRALIAN ROAD RESEARCH BOARD

The Fifth Biennial Conference of the Australian Road Research Board will be held in Canberra from 23rd to 28th August, 1970.

The Board was established in 1960 by the National Association of Australian State Road Authorities. Its function is to co-ordinate, encourage and arrange for research work into such problems as cheaper and better road surfaces, traffic flows, road safety, planning to meet future needs and the economics of road transport.

The Board arranges periodical conferences for the presentation and discussion of papers on road research and related topics. These conferences attract many eminent engineers, researchers and planners, not only from within Australia, but also from overseas. In presenting papers of significant interest on road engineering and related subjects they contribute indirectly towards the development of a high standard road communications system in Australia.

The Department of Main Roads, like other road authorities throughout the Commonwealth, is vitally concerned with the scientific advancement of road engineering technology whether it be in the field of advance planning, location, surveying, design, materials testing, traffic and safety matters or road and bridge construction techniques.

These conferences, therefore, provide for the sharing of knowledge gained in particular fields. They afford officers of this and similar authorities an opportunity to learn of new procedures and the results of research.

At the forthcoming conference some of this Department's officers will be presenting papers on special projects that have been undertaken within the Department. At the present time, nineteen papers, covering a wide variety of subjects, are being prepared. Some of these will be submitted for presentation at the conference while the remainder may be presented at other conferences or symposia or published in technical journals.

The subjects of the papers currently being prepared by the Department's officers are as follows:

"Progress with Research in Photogrammetric Technology in New South Wales for Road Location, Planning and Design Purposes."

A report on a number of developments that have been brought about by members of the Department's photogrammetric organisation. Although none of the research projects is complete the paper serves as an up-to-date report on the advances made so far.

"The Effect of Kerbed Median Strips on Accident Rates on Urban Roads."

An analysis of the immediate and long-term effects of narrow medians on accident rates in the urban areas of Sydney and Newcastle. It is an extension of the work reported upon at the first Australian Road Research Board Conference in 1962.

"An Analysis of Three Years Record of Fatal Accidents on Rural State Highways in New South Wales."

Presenting conclusions reached from an analysis of fatal accidents on rural State Highways in New South Wales over a 3-year period.

"Sectional Analysis of Road Accident Data."

A report on a computer analysis of all accidents on State Highways in New South Wales during 1968 by dividing each highway into sections to determine the lengths which appear to be accident prone.

"Journey Time as a Means of Comparing Level of Service."

This paper discusses how in planning road improvements to relieve traffic congestion it is desirable to list in order of priority the locations at which the most relief related to journey time can be obtained per dollar spent.

"Usage of Auxiliary Lanes for Slow Vehicles on a Rural Expressway."

A report on the speeds and lateral distribution of several classes of vehicles on a 6 per cent grade on a rural expressway where an auxiliary lane has been provided for both uphill and downhill traffic.

"The Effect of Age and Mileage on Depreciation of Cars and Station Wagons."

This paper gives the results of a short pilot study. Data was collected on only one make of vehicle but an attempt is made to extend the findings to the average car in the vehicle population.

"Crystallisation of Soluble Salts under Primer-Seals."

This paper deals with the deleterious effect on the bituminous primer caused by the formation of salt crystals. The phenomenon resulted from the unavoidable use of saline water for compaction in the western areas of New South Wales.

"Recovery of Bitumen for the Study of Deterioration of Binders in Road Surfacings."

This paper describes the use of an ultra-fine filtering device in the recovery of bituminous binders from road surfacings so that realistic assessment on the change in rheological properties of the binders is made possible.

"Stabilisation of Crushed Blast Furnace Slag with Iron Oxide Dust for Pavement Construction."

The successful use of crushed blast furnace slag stabilized with iron oxide dust for pavement top course construction (both materials being industrial waste from steel works) has resulted in worthwhile savings to the Department in the Wollongong area.

"Thick Lift Asphaltic Concrete."

In this paper an attempt is made to analyse the design and laying technique of 1½-inch gauge asphaltic concrete in a single layer of 5 inches to 6 inches compacted thickness.

"Selection of Suitable Cutter Oil based on its Compatibility with Bitumen."

This paper describes the compatibility of cutters with bitumen used for cutback bitumens. The dispersing properties of the different cutters are assessed by means of modified heptane-xylene equivalent test.

"The Grading of Cationic Bitumen Emulsions."

A case for realistic grading of cationic bitumen emulsion is presented, based on precise conditions of "breaking" rather than on the arbitrary method of the mixing test or the stone coating test.

"Some Aspects of Pavement Investigation carried out by the Department of Main Roads."

Tests were carried out on 602 samples (from both subgrade and various pavement layers from 233 different sample points) from 86 sites on sealed pavements with a minimum of 6 years service in arid regions of the State. Correlations between these test results, traffic, rainfall, period of service and the existing pavement condition are reported.

"Chemical Agents in the Compaction of Soil for Roadworks."

The effect of chemical agents on the properties of soil in the road base is evaluated mostly with respect to moisture-strength relations using a standard laboratory compaction procedure.

"Properties of Cationic Emulsions."

Bitumen emulsion of the "cationic" type has certain unique properties which can be usefully applied to roadwork. Simple experiments have been devised to illustrate some of the important chemical and physical properties of cationic emulsion and its reaction to aggregate and soil substrates.

"The Effective Use of Adhesion Agents in Bituminous Surfacing."

The use of certain classes of organic chemicals as surface active "adhesion" agents in bituminous surfacing is well established. To make the most effective use of the agents in bituminous surfacing it is necessary to appreciate the influence of the type of surfacing, properties of binder and characteristics of the aggregate, on the performance of the work. Experiments have been designed to study the reactivity of adhesion agents in varying circumstances simulating typical field conditions.

"Some Aspects of the Performance of Nuclear Density Meters."

A series of field measurements of soil moisture and density in road pavements was carried out in the Sydney area using two commercial nuclear moisture-density gauges. A laboratory study was also carried out to determine the instruments variability.

"Soil Particle Size Distribution by a Centrifuge Method."

This paper concerns a method of isolating particles of soil in the sub-micron range and is the initial step in a comprehensive study of colloidal behaviour in gravels as road making materials.

INSERVICE TRAINING OF PLANT FOREMEN

The Department's Plant Supervisors fall into two general categories—Plant Foremen, who are in charge of the mechanical workshops belonging to the various Departmental Works Offices, and Plant Inspectors. The function of the latter is to give direction and assistance to Plant Foremen in the field. Plant Inspectors report back to Head Office to the respective Area Mechanical Engineers.

The Department introduced inservice training for its Plant Foremen in 1966 and has continued the courses in subsequent years. Approximately 70 participants have attended sessions of one week's duration each year. To ensure that each member is able to take an active part in the discussion and question periods each class is limited to a maximum of ten. This means a series of seven classes, which for reasons of administrative convenience have been held every second week, with longer breaks when school holidays have intervened. In the first 3 years the classes ran from February to June, while in 1969 they ran from July to November. Those who attended included all the Department's Plant Inspectors and Plant Foremen, and also some Leading Hand Fitters. The lectures and demonstrations have been given by the Department's Mechanical Engineers.

The classes have been held at the Plant School Lecture Room, Granville. This is adjacent to the Department's Central Workshops where adequate plant testing and overhaul facilities are available for demonstration purposes.

The subjects covered to date are:

Course No. 1—1966
Workshop Administration
Personnel and Industrial Matters
Repair Policy and Planning
Lubricants and Servicing
Motor Transport Regulations
Special Tools and Equipment
Electrical Systems
Safety and First Aid

Course No. 2—1967
Hydraulic Systems,
including practical training
Torque Converters
Power Shift Transmissions,
including troubleshooting

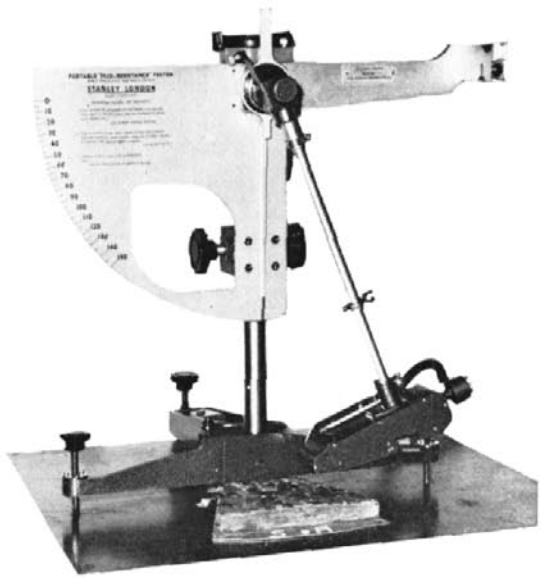
Course No. 3—1968
Welding,
including practical demonstrations
Track Systems
Air Cleaners
Turbochargers

Course No. 4—1969
Diesel Fuel Systems
Tyres
Two Way Radio Procedures
Cooling Systems
New Developments in Plant

The inservice training for Plant Foremen has proved advantageous to the Department in the running of its field workshops, and consideration is being given to its continuation in 1970.

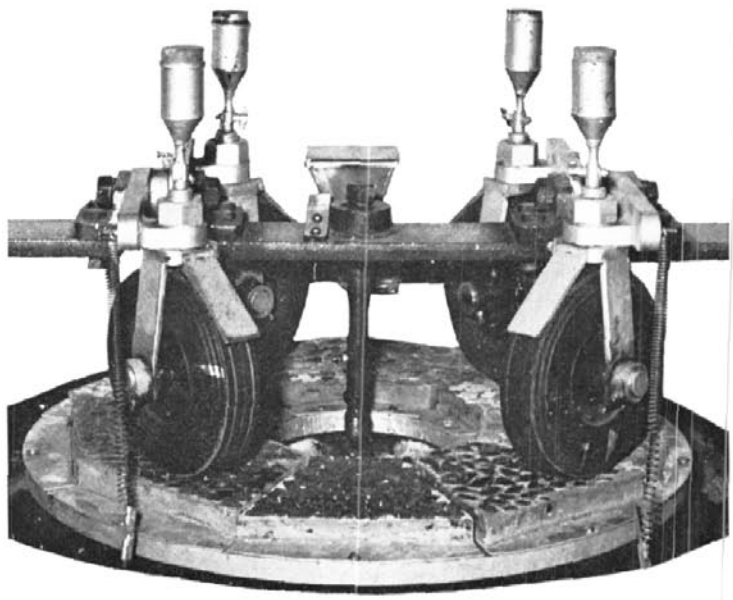
PORTABLE SKID RESISTANCE TESTER

For some years the Department has been measuring the skid resistance of road pavements using the Stanley Skid Resistance Tester which is illustrated in photograph No. 1. It is a pendulum type device which is portable, simple to operate, and causes little inconvenience to traffic when used in the field. It can be used on all types of road surfaces, as well as on laboratory test panels, and it can be positioned on relatively steep grades and crossfalls. The instrument was designed by the Department of Scientific and Industrial Research in England. Details are given in British Standard No. 812-1960 and in the American Society of Testing Materials Designation E303-66T. The principle on which it operates is the retardation of the swing of a pendulum with a spring loaded rubber heel as it sweeps across a measured distance of the surface being tested. The



No. 1. Pendulum type skid resistance testing device with test panel in place.

No. 2. Accelerated pavement wear machine with test panels in place.



influence of temperature is taken into account.

If skidding is to be avoided the texture of the pavement surface must be such that a substantial amount of frictional force is developed between the rubber tyres of a vehicle and the road surface, both when the surface is wet and when it is dry. Bituminous surfaces provided by the Department fall into one of two distinct classes; the sandpaper textured plant-mixed asphaltic concrete and the coarse textured bituminous surface treatment ("flush seal") used in the less intensely trafficked rural regions of the State.

When asphaltic concrete exhibits slippery characteristics it is usually due to the bitumen content being too high for the particular aggregate grading used in the mix. In the case of bituminous surface treatments rock aggregate particles, usually of half-inch or three-quarter-inch gauge, stand proud above the bitumen mat and carry the tyre on their bare upper surfaces.

An excess of bitumen can lead to it working up the sides of and over the top of the aggregate particles, so developing a slick pavement. Loss of aggregate particles from the bituminous mat produces a similar effect.

Slickness in bituminous surface treatments due to excess bitumen being sprayed simply means faulty workmanship. A more subtle cause of a slippery flush seal is the polishing of the aggregate. Some types of rock are prone to acquire a polish under the action of rubber tyred traffic. This is a fundamental surface property of the rock in question; for instance it does not automatically follow that because an aggregate is rounded it will become slippery under traffic. The Department uses the Skid Resistance Tester to assess the polishing characteristics of particular aggregates in order to determine their suitability as cover stone on bitumen surfaces. For this purpose the accelerated pavement wear machine shown in photograph No. 2 is used to produce accelerated polishing of small specially made panels of pavement surface. It is used to simulate wear on the road and the change in the skid resistance, as determined by the Skid Resistance Tester, is a measure of the susceptibility of the aggregate to the development of a slick surface. Judgment is exercised in interpreting the results; for example a propensity to polish which might rule out an aggregate from use on a relatively heavily trafficked highway might still let it rate as adequate for a lightly trafficked route.

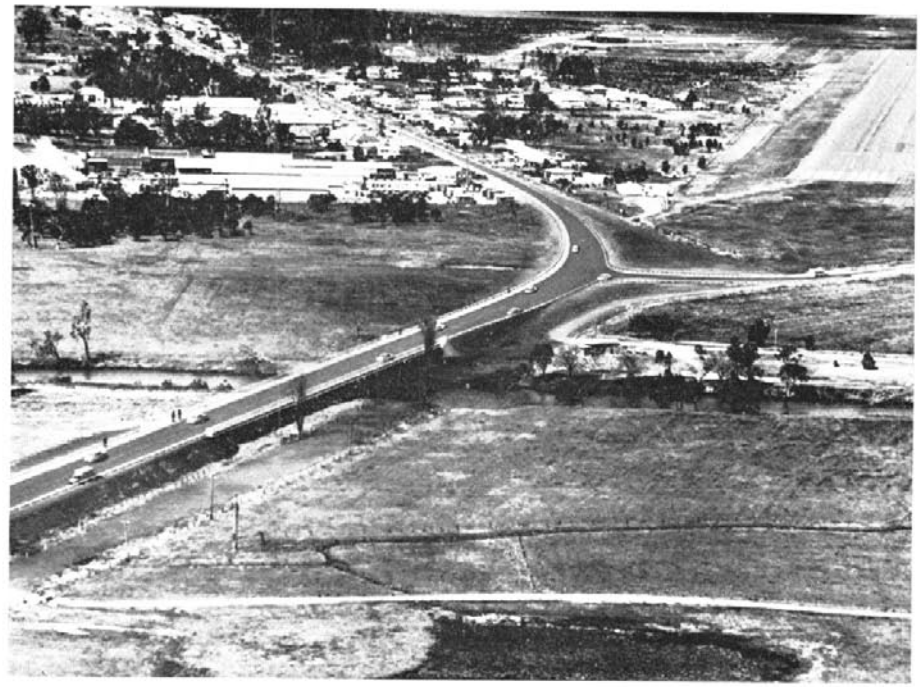
PROPOSED NEW BRIDGE OVER MACQUARIE RIVULET NEAR ALBION PARK

The Department proposes to replace the present narrow timber bridge over Macquarie Rivulet on the Prince's Highway, near Albion Park, with a new five span composite prestressed concrete girder and reinforced concrete slab bridge.

The new bridge will be 377 feet long, 28 feet wide between kerbs and will have a footway 5 feet wide on the downstream side of the bridge.

The approaches to the bridge will consist of a deviation of the highway which will be approximately half a mile long and located to the east of the existing road and bridge.

The bridge site is located on the boundary between the City of Greater Wollongong and the Municipality of Shellharbour.



Artist's impression of Proposed New Bridge—Looking South

MAIN ROADS FUND

Receipts and Payments for the period 1st July, 1969 to 30th September, 1969

	County of Cumberland Main Roads Fund	Country Main Roads Fund
Receipts	$	$
Motor Vehicle Taxation (State)	1,822,528	7,290,114
Charges on heavy commercial goods vehicles under Road Maintenance (Contribution) Act, 1958 (State)	811,509	3,246,037
Commonwealth Aid Roads Act, 1969	6,135,000	3,300,000
From Councils under Section 11 of Main Roads Act and/or for cost of work	4,042,947	19,634
Other	295,659	264,517
Total Receipts	**13,107,643**	**14,120,302**
Payments		
Maintenance and minor improvements of roads and bridges	2,486,769	5,207,286
Construction and reconstruction of roads and bridges	2,991,899	5,819,225
Land Acquisitions	829,159	225,468
Administrative Expenses	402,877	878,209
Loan Charges, Payment of Interest, Exchange, Management and Flotation Expenses—State Loans	46,780	216,590
Interest and provision for Repayment of Loan Borrowings under section 42A of the Main Roads Act	179,029	48,335
Miscellaneous*	473,064	853,991
Total Payments	**$7,409,577**	**$13,249,104**

* Includes transfer to Special Purposes Account, in respect of finance for Operating Accounts, Suspense Accounts and Reserve Accounts.

SYDNEY HARBOUR BRIDGE ACCOUNT

Receipts and Payments for the period 1st July, 1969 to 30th September, 1969

Receipts	$
Road Tolls	1,140,610
Contributions—Railway Passengers	69,305
Omnibus Passengers	6,243
Rent from Properties	38,713
Miscellaneous	—
Loan Borrowings for the Warringah Expressway Approach	—
Total Receipts	**$1,254,871**
Payments	
Cost of Collecting Road Tolls	141,492
Maintenance and Minor improvement	154,207
Alteration to Archways etc.	43
Provision of traffic facilities	44,012
Administrative Expenses	15,501
Loan charges, payment of interest exchange, management and flotation expenses—State Loans	297,550
Interest and provision for repayment of Loan Borrowings under Section 7 of Sydney Harbour Bridge Administration Act	174,935
Miscellaneous	3,497
Transfers to Expressway Fund	—
Total Payments	**$831,237**

TENDERS ACCEPTED BY COUNCILS

The following tenders (in excess of $10,000) for Road and Bridge Works were accepted by the respective Councils for the three months ended 30th September, 1969.

Council	Road No.	Work or Service	Name of Successful Tenderer	Amount
				$
Ashford	M.R. 187	Construction of a 12 cell reinforced concrete box culvert 8 feet wide by 4 feet high over Graman Creek 26·25 m. north of Inverell.	Enpro Constructions Pty Ltd	15,726.90
Bibbenluke	S.H. 19	Reconstruction to subgrade level between 8·17 m. and 10·12 m. south of Bombala.	M. Mittendorfer	35,683.00
Bibbenluke	T.R. 91	Reconstruction to subgrade level between 6·55 m. and 8·40 m. from Bombala.	Ack Wilton Pty Ltd	59,786.00
Central Darling	M.R. 433	Construction between 30 m. and 37 m. west of Darnick	Silverton Road Transport Pty Ltd	18,833.20
Coolah	T.R. 77	Construction of a 4-span reinforced concrete bridge with precast, pretensioned bridge planks 140 feet long over Ukebung Creek 17 m. west of Dunedoo.	S. Turner and Sons	34,887.00
Coonamble	M.R. 129	Bitumen surfacing between 6·50 m. and 13·50 m. east of Coonamble.	Boral Road Services Pty Ltd	19,028.71
City of Dubbo	S.H. 7	Construction of approaches to the bridge over the Macquarie River at Dubbo.	Bituminous Pavements Pty Ltd	55,420.00
Dumaresq	T.R. 74	Construction of a 4-cell reinforced concrete box culvert 10 feet wide by 9 feet high over Bullock Creek 43·24 m. east of Armidale, and construction of a 2-cell reinforced concrete box culvert 11 feet wide by 6 feet high at 43·83 m. east of Armidale.	K.A. Constructions Pty Ltd	34,179.38
Dumaresq	T.R. 74	Formation to subgrade level between 43·6 m. and 45·7 m. east of Armidale.	Dayal Singh Constructions Pty Ltd	68,756.60
Forbes	S.H. 17	Supply and placing of fill material for the construction of approaches to the new bridge over Lake Forbes at Forbes.	Jemalong Shire Council	56,000.00
Kyogle	T.R. 83	Construction of a 3-span reinforced concrete bridge with precast, pretensioned bridge planks 135 feet long over Fairymount Creek 17·9 m. north of Casino.	Kennedy Bros.	52,666.50
Kyogle	T.R. 83	Bitumen surfacing between 28·41 m. and 32·41 m. on the South Grafton, Woodenbong Trunk Road.	Boral Road Services Pty Ltd	11,031.93
	M.R. 361	Bitumen surfacing between 1·0 m. and 4·0 m. on the Sandilands, Woodenbong Main Road.		
	M.R. 544	Bitumen surfacing between 21·09 m. and 24·24 m. on the Cedar Point, Lismore Main Road.		
Macintyre	S.H. 12	Extension of a 2-cell reinforced concrete box culvert 10 feet wide by 10 feet high 5·83 m. west of Inverell.	Momesso and Ward Constructions	17,943.45
Manning	T.R. 90	Bitumen resurfacing between 11·6 m. and 13·9 m. and between 14·3 m. and 15·95 m. Strengthen and seal section between 13·9 m. and 14·3 m. west of Purfleet.	Shorncliffe Pty Ltd	11,285.50
	M.R. 111	Curve elimination at McCann's Corner 6·5 m. from the junction of Main Road No. 111 and the Pacific Highway.		
	M.R. 112	Construction of approaches to bridge over Bo Bo Creek 1·4 m. north of the Twelve Mile Creek, Taree-Trunk Road (T.R. 90).		
Tamarang	T.R. 72	Reconstruction and bitumen surfacing between 5·5 m. and 7·0 m. south of Quirindi.	Boral Road Services Pty Ltd	16,926.56
	M.R. 129	Reconstruction and bitumen surfacing between 16·4 m. and 19·0 m. west of Quirindi.		
Wade	T.R. 80	Reconstruction and bitumen surfacing of sections between 1·67 m. and 2·74 m. east of Griffith.	Ces Hill Pty Ltd	48,405.56
Wakool	M.R. 319	Construction of a 5-span prestressed and reinforced concrete bridge 175 feet long over Murrain Yarrein Creek 37 m. north of Barham.	Danckert Constructions Pty Ltd	46,198.04
Walgett	D.W. 3207	Construction of a 2-span reinforced and prestressed concrete bridge 61 feet 8 inches long over Pian Creek on the Bugilbone–Rawena Road.	A. Goor Pty Ltd	12,518.40

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, 1969.

Road No.	Work or Service	Name of Successful Tenderer	Amount
			$
Western Distributor	City of Sydney. Construction of first section of the Western Distributor from Sydney Harbour Bridge to Day Street, Sydney.	Dillingham Constructions Pty Ltd	4,253,253.00
State Highway No. 8	Barrier Highway. Shire of Central Darling. Supply and delivery of aggregate between 19 m. and 33 m. west of Wilcannia and between 49 m. and 65 m. east of Broken Hill.	The Ready Mix Group (S.A.)	42,298.15
State Highway No. 8	Barrier Highway. Shire of Central Darling. Supply, delivery and unloading of precast box culvert crown sections and concrete pipe sections between 12·36 m. and 22·0 m. east of Wilcannia.	Dyson-Holland Concrete Pty Ltd	11,210.20
State Highway No. 9	New England Highway. City of Newcastle. Construction of a dual 5-span reinforced concrete bridge with precast, pretensioned bridge units 175 feet long over Weakley's Flat Creek.	Dawsett Engineering (Aust.) Pty Ltd	165,726.00
State Highway No. 10	Pacific Highway. Shire of Nambucca. Construction of a 6-span post-tensioned concrete bridge 752 feet long over Lower Warrell Creek 2 m. South of Macksville.	Central Constructions Pty Ltd	628,144.60
State Highway No. 10	Pacific Highway. City of Newcastle. Supply and delivery of up to 1,300 cubic yards of ready mixed concrete for reconstruction from Ida Street, Charlestown to Newcastle City Boundary.	Newcastle Lime and Cement Co. Ltd	18,095.00
State Highway No. 10	Pacific Highway. Shire of Woodburn. Manufacture, supply and delivery of 96 precast, pretensioned bridge units 35 feet long for construction of a bridge 10·5 m. south of Woodburn.	Humes Limited	13,824.00
State Highway No. 16	Bruxner Highway. Shire of Ashford. Construction of a double 3-cell reinforced concrete box culvert 96 feet 8 inches long over Bentley Springs Creek 6·5 m. east of Bonshaw.	K.A. Constructions Pty Ltd	28,105.70
State Highway No. 17	Newell Highway. Shire of Coonabarabran. Construction of a 3-cell reinforced concrete box culvert 15 feet wide by 14 feet high over Billy Creek 51 m. south of Narrabri, and construction of a 3-cell reinforced concrete box culvert 9 feet wide by 9 feet high over Cusack Creek 55·8 m. south of Narrabri.	Enpro Constructions Pty Ltd	36,120.80
State Highway No. 22	Silver City Highway. Shire of Wentworth. Construction of a 5-span steel and reinforced concrete bridge 362 feet long over Tuckers Creek 0·3 m. east of Wentworth.	MacMillan Constructions Pty Ltd	240,340.18
State Highway No. 22	Silver City Highway. Shire of Wentworth. Supply and delivery of aggregate between 1 m. and 11 m. north of Wentworth.	A. G. Leech Pty Ltd	20,560.00
Trunk Road No. 78	Shire of Jindalee. Construction of a 2-span composite steel and reinforced concrete bridge 80 feet long over Cootamundry Creek 1·37 m. south of Cootamundra.	Siebels Concrete Constructions Pty Ltd	47,874.60
Main Road No. 199	Municipality of Kogarah. Supply and lay asphaltic concrete on Rocky Point Road between Fitzgerald Avenue and Hastings Road.	Bituminous Pavements Pty Ltd	20,305.12
Main Road No. 315	Municipality of Kogarah. Supply and lay asphaltic concrete on King George's Road between Greenbank Street and Jaffre Street.		
Secondary Road No. 2043.	Municipality of Ku-ring-gai. Reconstruction and widening between Grosvenor Street and the municipal boundary.	Bituflex Pty Ltd	38,487.00
Access Road to Sydney Airport.	Municipalities of Botany and Rockdale. Construction, delivery and stacking of composite steel and prestressed concrete piles for the bridge over the Cooks River near the International Airport Terminal.	Humes Limited	132,800.00
Southern Cross Drive	Municipalities of Randwick and Botany. Supply and erection of manproof boundary fencing between Epsom Road, Rosebery and Wentworth Avenue, Mascot.	Sydney Gate and Fence Co. Pty Ltd	15,697.50