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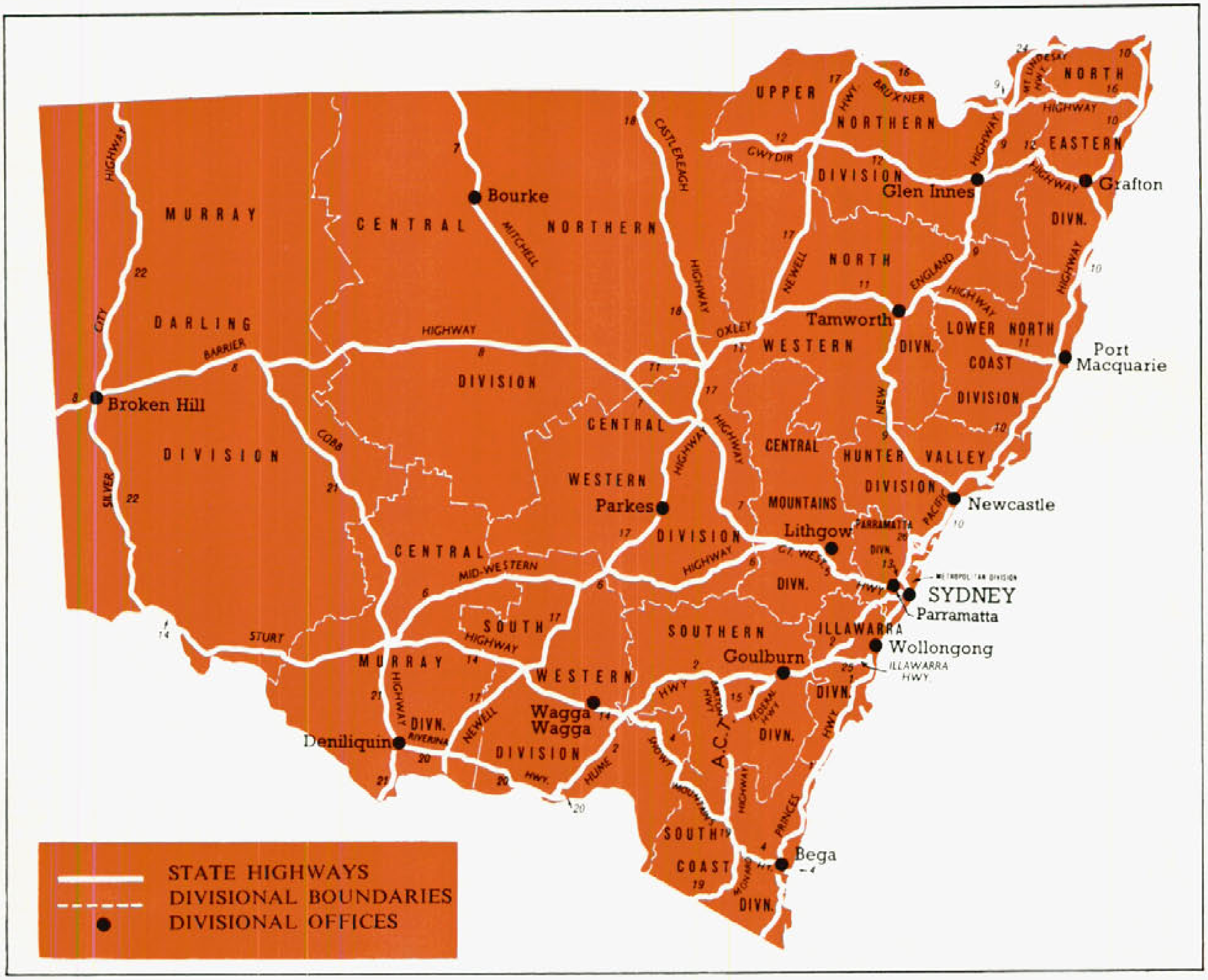
MAIN ROADS



New South Wales

Area—801 428 km^2

Population as at 30th June, 1975—4 793 200 (*estimated*)

Length of Public Roads—208 804 *km*

Number of Motor Vehicles registered as at 30th June, 1975—2 171 900*

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

ROAD CLASSIFICATIONS AND LENGTHS IN NEW SOUTH WALES

Lengths of Main, Tourist, and Developmental Roads, as at 30th June, 1975.

Freeways	91
State Highways	10 492
Trunk Roads	7 081
Ordinary Main Roads	18 316
Secondary Roads	287
Tourist Roads	400
Developmental Roads	3 642
Unclassified Roads	2 477
TOTAL	42 786 km

MAIN ROADS

JOURNAL OF THE DEPARTMENT OF MAIN ROADS, NEW SOUTH WALES

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(*Front Cover*): *The potential driving hazard of fog has been mitigated on the Waterfall–Bulli Pass Tollwork by the installation of the Driver Aid System. Apart from showing safe driving speeds during fog, the System's roadside signs can warn of other traffic hazards.*

(*Back Cover*): *The Sydney Harbour Bridge maintains its magnetic appeal as a symbol of Sydney. This recent photograph was taken from an unusual angle, high up through the arches.*

CAR USAGE

In August, 1974, the Australian Bureau of Statistics* carried out a survey to determine the travelling habits of people going to work and to school. The results of this survey, compared against results of a similar survey made in May, 1970, showed that the percentage of persons travelling to work by car in capital cities had risen from 59·1 per cent in 1970 to 66·2 per cent in 1974. In areas outside capital cities the percentage was higher, but had not risen quite so much —71·0 per cent in 1970 to 77·3 per cent in 1974.

A look at the statistics from an overall point of view reveals that more than two out of three people in Australia travel to work by car.

The percentage of students travelling to educational institutions by car has also increased. In capital cities it has risen from 16·0 to 22·1 per cent while other areas show a rise of 15·3 to 19·1 per cent.

This survey covers only a very small part of the total numbers of vehicles using the road system each day. However, the statistics revealed by the survey highlight the fact that the demand from the motorist for a share of road space is intensifying. Not only do more people in the community take to the roads each year but they are apparently using their vehicles more frequently, many as frequently as twice every working day.

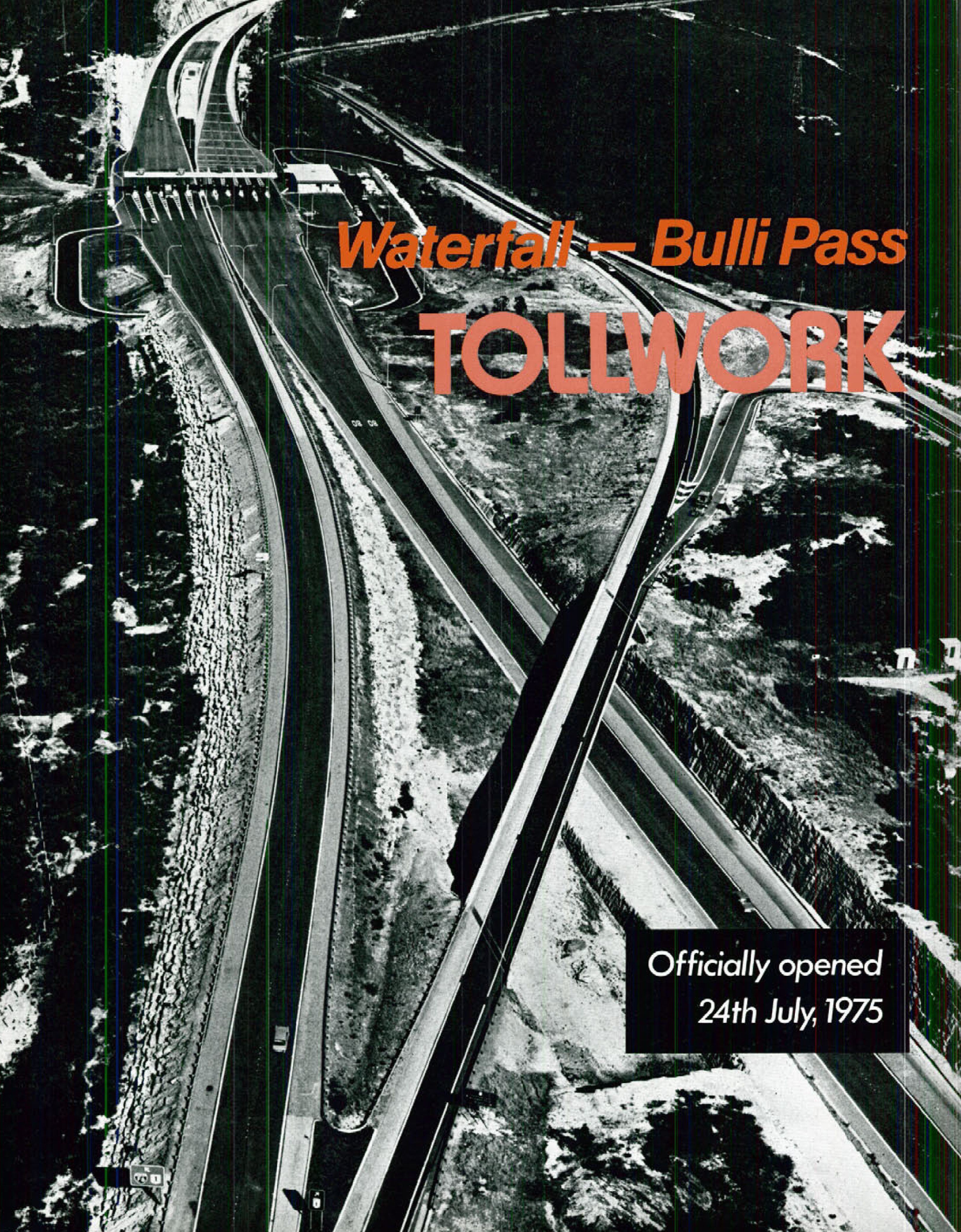
How long can the main roads system, with its present slow rate of development, maintain reasonable travelling conditions for all forms of transport when the use of motor vehicles continues to increase at such a rate? Many of the road users travelling to work are obviously using the roads during peak hours and this twice-daily surge of vehicles along our State road system already approaches maximum capacity at some locations.

Road planners foreshadowed the increase many years ago and made plans to overcome it by the construction of roads of higher capacity, by improvements to existing roads and the creation of new routes. Many of these plans are not yet implemented and the motorist, a word identifying that vast, anonymous, unheeded and heavily taxed group of people in the community, waits for his needs to be considered.

The Department of Main Roads is endeavouring to improve the State's road network in both the rural and urban sectors, but continuing limited finance is imposing restrictions on new activities every year. Roadbuilding, as one part of the total area of public transport of goods and people, is not going backward, but it is not going forward as rapidly as needed to meet the demands imposed by the travel habits of people. It is an elementary fact that as our population increases there is a corresponding need to increase road space as well as such other community needs as hospitals, schools and all public services.●

* Journey to Work and Journey to Scho l, August, 1974.

Waterfall — Bulli Pass TOLLWORK



Officially opened
24th July, 1975

That old saying, "time is money" was in strong evidence on 24th July, 1975, the day of the official opening of the $30·5 million Waterfall–Bulli Pass Tollwork. When the Hon. T. L. Lewis, Premier and Treasurer of New South Wales, cut the ribbon and declared the Tollwork open to traffic, he also cut twenty-eight minutes off the travelling time between Sydney and Wollongong.

The need for such a high standard four-lane carriageway road to link these major cities became increasingly apparent after the proclamation of Wollongong as a city in 1942. As Wollongong expanded in industrial growth and population, so the ability of the Princes Highway to handle the accompanying growth in traffic volumes diminished. This growth is illustrated by the increase in the annual average daily traffic figures between 1968 and 1973. For instance, the number of vehicles at the top of Bulli Pass north of the Appin Road increased from 8 180 to 11 210 during this period and at the Sutherland Shire Boundary the increase was from 8 690 to 10 350 vehicles. Vehicle ownership in Wollongong also increased from 28 000 in 1959 to 50 000 in 1969.

Two additional traffic lanes were necessary, and the choice lay between upgrading the existing route of the Princes Highway to a four-lane road or constructing a new four-lane median-separated road to freeway design standards. The advantages of a new freeway far outweighed those of upgrading the existing route. Although initially more expensive, a freeway would offer safer and more economical travelling conditions for motorists, a traffic capacity adequate for many years to come and minimal interference with established developments along the route.

Financing the Tollwork

The then Minister for Highways, Mr P. H. Morton, presented a Bill to State Parliament to amend the Main Roads Act, 1924–67, so that the road could be constructed as a tollwork. This amendment was passed on 11th March, 1970, but the question of financing such a road posed difficulties.

Being located outside of the Sydney Statistical Division as provided in the Commonwealth Aid Roads Act, the proposed freeway was not eligible for an urban arterial road grant. To allocate rural artierial road grants to the work would have seriously depleted the funds normally used for ordinary rural roads. It was decided that funds for the construction of the road would best be provided by the raising of loans as was the case with the Berowra–Calga Tollwork. The toll revenue would go to meet the loan charges, sinking fund payments and operational and maintenance costs.

The Best Route

The determination of the best route for the road also posed problems. Three major obstacles existed—fog, difficult terrain and the Coal Cliff Colliery's proposed coal dumping area. To avoid as much as possible the particularly dense fogs common to the area around the Bulli Pass escarpment, the Tollwork was kept as far west as possible, without entering the difficult country around the headwaters of the Cataract Dam. To preserve access to the coal dumping site, the southern 11 km of the Tollwork was located to the west of the Princes Highway through Maddens Plains.

Construction Begins

Construction commenced after June, 1970, when the tender from G. Abignano Pty Ltd was accepted for the earthworks, associated drainage and fencing on a 10·8 km length between Waterfall and Darkes Forest Road. When this work was in its final stages, a contract similar to the first but with the addition of two bridges was let to Citra Constructions Pty Ltd for an adjoining 11·2 km length between Darkes Forest Road and Bulli Pass. The work on both sections was supervised by the Department's Divisional Engineer for Outer Freeway Construction.

During the earthworks about 4·1 million cubic metres of sandstone and earth were excavated by blasting and ripping. The excavated material was used for fills—the greatest depth of fill being 34 m located 8·8 km south of Waterfall. The deepest cutting of 20 m occurred at 19·3 km south of Waterfall.

The road pavement was made up of a selected sandstone sub-grade, 300 mm thick, a sub-base, 200 mm thick comprising a mixture of slag and fine crushed rock, and overlaid with a base course and wearing surface of asphaltic concrete 65 mm thick.

Along the route of the Tollwork eleven bridges were constructed at eight sites. Twin bridges cross the Princes Highway at two locations and also at the Bulli Pass Interchange where Appin Road crosses the Tollwork.

Single structures were constructed at the Waterfall Interchange, at Cawley Road and at Darkes Forest. At the Bulli Pass Interchange there are two single structures—one north and one south of Appin Road. A culvert underpass was also constructed at the northern end of the work to give maintenance and service vehicles access to either carriageway.

Engineering Problems

About 6·5 km of the Tollwork route traverses the swampy, treeless Maddens Plains area and this section presented the most serious difficulties. The swampy ground occurs where water is trapped within silty material overlying sandstone bedrock and cannot escape because of the flat terrain. The initial site investigation included the use of piezometers to measure the permeability of the soil (see brief reference in "Main Roads", Vol. 37, No. 2, December, 1971, p. 41).

The method decided upon to construct the Tollwork over the Maddens Plains swamps was to excavate deep open channels along each side of the route. When the area between these channels was sufficiently drained, a layer of free-draining soil, 1 metre thick, was spread over it. This layer provided firm ground on which the construction equipment could operate without bogging.

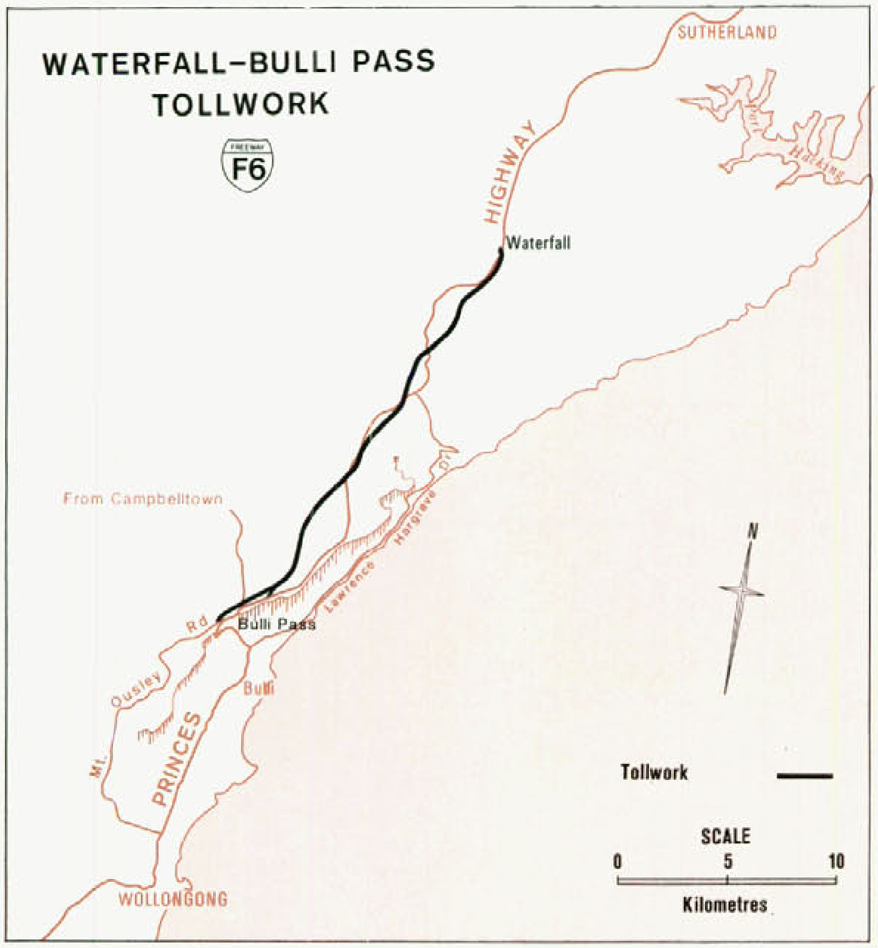
Special Equipment

The success of the project can be attributed not only to the surveying and engineering expertise related to the location of the route, but also to the superior equipment used in its construction. One such piece of equipment was the Dual Lane Automatic Trimmer-Spreader, which is among the most modern and intricate pieces of road pavement building machinery in the world and also the first of its type in Australia. Capable of trimming, spreading or paving up to 4·8 km of dual lane freeway in one day, it works to an accuracy of 3 mm.

Powered by a 298 kW V8 diesel engine, the basic machine weighs 34 000 kg. Although 11·6 m long and 8·5 m wide, it is easily dismantled into readily transportable components. Six electrically operated sensors trace the pre-set stringlines set along the road formation and automatically control steering, depth of cut and alignment through solenoid-operated valves in the hydraulic system (see "Main Roads", Vol. 36, No. 3, March, 1971, p. 79).

Another eye-catching piece of equipment used on the Tollwork was a huge crawler tractor, operated by G. Abignano

Left): The toll plaza is at the northern end of the Tollwork, near Waterfall, where an interchange also gives access to the Princes Highway.



Pty Ltd. Also the first of its type to be used in Australia, this tractor weighed 71 tonnes and had a 5·2 m wide blade and a 391 kW V12 diesel engine (see "Main Roads", Vol. 36, No. 2, December, 1970, pp. 34–5).

Design

The design of the Waterfall–Bulli Pass Tollwork incorporates all those features which go together to create a road with both maximum safety and comfort for motorists and a pleasing appearance. At present, the Tollwork provides dual two-lane carriageways and will be extended to three-lane carriageways when traffic volumes warrant it. The Tollwork has been designed to an ultimate traffic volume capacity of 40 000 vehicles per day.

Each carriageway consists of an outer shoulder 3·1 m wide, two traffic lanes each 3·7 m wide and an inner shoulder 2·4 m wide. The medians have a generally uniform width of 17·7 m. A depressed median was used in the fills, and a raised rock median in the cuttings.

The grades, which vary from a minimum of 0·5% to a maximum of 6%, permit comfortable, fast travel on the Tollwork. It was possible to reduce the grades to these low levels by means

(Below and right): During construction of the Freeway, millions of dollars worth of plant was engaged on the job.

(Top): The final result is a freeway standard road incorporating all the features which make this type of road safer, more suitable for the economic movement of goods and people and environmentally acceptable.

(Above): The regeneration of natural vegetation along the Freeway has been accelerated by various methods, including use of this Hay Mulcher which is towed by a truck carrying supplies of bitumen emulsion and hay. The hay is fed along a conveyor to be mulched and mixed with seed and fertilizer and then treated with emulsion before being ejected from the spraying cannon.

of the cuttings, which eliminated sharp crests. There are only six curves, ranging from 1 524 m to 3 657 m in radius, along the whole length of the Tollwork, all of which are easy for drivers to negotiate.

The excellent alignment, minimum grades and the wide road reserve (having an average width of 100 metres) have the desirable effect of keeping traffic noise to an absolute minimum. The Tollwork also has the effect of reducing the noise levels along the Princes Highway by removing traffic from the built-up areas along the route of the Highway.

Safety features, standard to every freeway the Department builds, include protective guardrailing; the delineation of lane and edge lines with raised and reflective pavement markers; the external illumination of the most significant of the direction signs and special lighting at traffic merging areas, such as the Waterfall Toll Plaza, and the Waterfall and Bulli Pass Interchanges.

Landscaping

Landscaping is one design feature more easily discernible to the motorist's eye. The Waterfall–Bulli Pass Tollwork passes through countryside marked by three types of topography. The first 15 km south of Waterfall traverse well-wooded sandstone country, which supports vegetation ranging from small shrubs to large trees. This gives way to more exposed, swampy and undulating land characterized by heath-like scrub, until the larger and denser growth of the rain-forest appears towards the Bulli Pass end. Care and planning by the Department's landscape officers ensured that only plants indigenous to each area were chosen for use in the revegetation programme, and this has ensured not only a natural appearance for the restored areas but also a quick and healthy growth rate. The Soil Conservation Service gave valuable advice and assistance concerning plant regeneration and erosion problems.

The hydroseeding process, quite new in Australia and excellent for covering construction scars, was used on the road reserves. Hydroseeding accelerated the natural regeneration over large areas ensuring retention of the sparse top soil. In all, 48 hectares were hydroseeded with grass and nine varieties of native seeds.

The hydroseeding was carried out from a truck-mounted cannon with an effective firing range of 37 metres. The mixture consisted of seeds, wood fibre mulch, water, fertilizer and a bitumen emulsion used a a binding agent. The proportions of each in the mix were, per hectare: seeds—492 kg; wood fibre mulch—411 kg; water—51 000 to 58 900 litres; fertilizer—123 kg; bitumen emulsion—3 550 litres. Ample use of a rich fertilizer was necessary because of the sparsity of top-soil. Some of the species planted included banksias, tea-trees, bottle-brush, she-oaks and eucalypts.

On the medians, where well over 4 000 shrubs were planted, landscaping was used as a safety as well as a beautification device. The shrubs act as anti-glare barriers at locations where headlight glare would normally be troublesome to motorists. The grass cover on the medians is a mixutre of couch, bent, rye and clovers. The contoured lawns and more than 800 trees and shrubs attractively landscape the Toll Plaza.

HISTORICAL NOTES: The Road South

The road south as it is today is very far removed from the "*roads*" of 160 years ago. A cattle track from Appin to Bulli cut by a Dr Charles Throsby in 1815 was the only overland route to the Illawarra until "O'Brien's Subscription Road", near Mt Keira, became the official route in 1822. Cornelius O'Brien, quite an enterprising settler, had advertised for subscribers to put in £10 each to "*make a Cattle Road from Illawarra to the District of Appin by the new track*". Six men and £60 later, the shorter and less steep track was ready to make the fertile Illawarra land more accessible.

Under pressure from settlers south of Bulli (where disputes and claims of trespass were common) because of the lack of any official road, the Colonial Secretary early in the 1830's ordered the construction of a road as soon as possible. This job fell to the Surveyor-General of the time, Major Thomas Mitchell, who already had his own ideas on the best route for a new road.

Contrary to the view that a direct route between Sydney and the Illawarra coast was impossible because of the steep coastal escarpment, Mitchell had a plan for a road which "*. . . would cross the lowest ford on Cook's River, and George's River by a ferry, across a breadth of* 250 *yards, to a point whence a continuous ridge leads in a very good direction to the heights over O'Brien's land at Illawarra . . . a descent down the coast mountain might be made, similar to those at Mount Victoria and Wiseman's and the road continued forward by either shore of the Illawarra Lake*".

But this road had to wait, for in 1834 Governor Richard Bourke, on seeing that little progress had been made on the road via Appin, instructed Mitchell "*to lose no time in marking out the road as formerly desired*". By October that year, Mitchell had done this.

Convicts, eighty of them from Goat Island, were sent to work on this road from Sydney to Illawarra after a contractor, George Brown, had cleared the roadway to a width of 4 chains. An interesting description of the road was provided by Rev. James Backhouse who journeyed south in 1836. "*We descended by a rough track, called the Bulli Road. This road is difficult for horses and impracticable for carts except by the assistance of ropes passed round conveniently situated trees by means of which they have been got down.*" Little wonder that the road had fallen into disrepair by 1839.

Meanwhile, after Mitchell's "revolutionary" idea of a direct road from Sydney to Illawarra had been looked into, Mitchell was instructed to carry out a survey of his route. From Cook's River, where in 1833 Mr Prout had set up a punt, Mitchell marked a course southwest to Hurstville, south across the George's River into the Menai area, eastwards across the Woronora River, up to Heathcote (then called Bottle Forest), southwards to the top of Bulli Pass and then descending Mt Keira to the coastal plain.

Mitchell sent his son, Assistant Surveyor Roderick Mitchell, to make an exact survey, but five months later (August, 1843) placed him "*on the reduction list*". Assistant Surveyor Darke then took charge of the surveying and clearing of the road and the next year was invested with the powers of a District Magistrate to help him keep discipline among the convict workers. It appears that the actual making of the road was done by contract.

By May, 1845, the road had reached Bulli but the new direct route did not supplant the Appin route as Mitchell had expected, primarily because the older route connected the established towns of Parramatta, Liverpool and Campbelltown. Following the expansion of settlements at Kogarah and Rockdale, the river crossing at Lugarno (established by Charles Rowan in 1843) was moved to Tom Ugly's Point. This change threw into disuse the section of Mitchell's Road as far south as Heathcote.

Further complicating the issue was the discovery, at the southern end, of a new pass down the coastal escarpment by Captain R. M. Westmacott in 1836. This route was first known as Westmacott's Pass and later as Bulli Pass. In 1857, Westmacott's route was decided upon as the best road and a tender from Thomas Heywood of £13 10s. per mile for its improvement was accepted. In 1864, Rev. Carruthers remarked that "*the mountain ascent or descent at Bulli was too steep and dangerous for vehicles of any description to attempt with impunity*".

Another four years and the situation was decidedly optimistic, according to a local correspondent of the *Sydney Morning Herald* of 20th June, 1868, who reported that "*During the past week a resident of our township drove the first vehicle to the summit and returned*".

Six more years and the road had been cleared to a width of 1 chain and a carriageway of 25 feet had been formed. Improvements and the shorter distance of the direct route attracted more and more traffic, until it eventually did replace the Appin route as the main road between Sydney and the Illawarra District.

Earlier articles in "Main Roads"—giving further historical information—include:

- "*The History of the Princes Highway*", *March*, 1951, *Vol.* 16, *No.* 3, *pp.* 73–84 (*available in reprint form*).
- "*Turnpikes in Early New South Wales*" (*about early tollworks*), *June*, 1951, *Vol.* 16, *No.* 4, *pp.* 107–11 (*available in reprint form*).
- "*Historical Notes on George's River and Its Road Crossings*", *December*, 1973, *Vol.* 39, *No.* 2, *pp.* 39–41.
- "*Wollongong—A Summary of Main Road Progress in the Area*", *June*, 1974, *Vol.* 39, *No.* 4, *pp.* 123–7.

OTHER ROADWORKS IN THE AREA

Elsewhere on the F6

Other sections of the F6—Southern Freeway completed and in use by traffic are the Captain Cook Bridge over the George's River and its approaches, and the length between the Mt Ousley Road, near North Wollongong, and Northcliffe Drive, Kembla Grange (which provides a by-pass of Wollongong, Fig Tree and Unanderra).

Construction of the F6 is continuing south of Northcliffe Drive and construction of an interchange at Northcliffe Drive has commenced. It is planned that the F6 will eventually provide dual carriageway access as far south as Kiama.

Apart from the F6

The Princes Highway has been upgraded over recent years to four through lanes from Loftus to Waterfall and on 16th September, 1975, the Sutherland By-Pass (which extends 1·7 km from President Avenue, Sutherland, to the Princes Highway at Loftus) was opened to traffic. In effect, this means that motorists can now travel on a dual carriageway road from Sutherland through to Bulli Pass.

Over the last five years the Department has expended more than $11·6 million on the Princes Highway within the Illawarra Division. One of the more significant works recently completed was the 3·8 km deviation around Mullet Creek between Northcliffe Drive and Dapto. Another major work which will do much to improve travelling conditions is the current construction of a 3·4 km deviation south of Nowra, a work which involves the building of a new bridge over Currembene Creek.

With such significant works as these being undertaken on the main roads system in the Illawarra Division, it is not difficult to see how the Department has need to spend the estimated amount of $113·5 million in this Division over the five-year period from 1970–71 to 1974–75.

One project in the late stages of planning is the Wollongong Northern Suburbs Distributor, which will extend northwards for approximately 11 km from the F6 at Gwynneville to Thirroul. When this new route is built, the northern suburbs of Wollongong will then be directly connected to the commercial and industrial centres of the city and Port Kembla by the Distributor and a short section of the Southern Freeway.

On Mt Ousley Road, the Department recently completed upgrading work which provided four lanes between Bulli Pass and Bellambi Creek, a length of approximately 8·8 km. Carried out in conjunction with the Tollwork, this work brought the northern section of Mt Ousley Road to a standard well capable of accommodating southbound traffic from the Tollwork.●

Waterfall to Bulli Pass Tollwork

DRIVER AID SYSTEM

The following three pages are adopted from a brochure which is intended to familiarize motorists with the functioning of the Driver Aid System. Copies of the brochure, "An Introduction to the Driver Aid System", are available from the Department's Public Relations Section, Head Office.

The 22·9 km Waterfall–Bulli Pass Tollwork, the longest length of freeway to be built at any one time in Australia, has another unique feature—its electronic driver aid system. Installed to provide motorists with as near to a "fail-safe" system as possible, it was designed, supplied and installed for the Department by Plessey Telecommunications Pty Ltd. Acted upon correctly, this driver aid system adds considerably to the safety and convenience of motorists.

Fog is likely to occur about 31 days each year between Darkes Forest Road and the Bulli Pass Interchange. Mostly of the orographic type, these fogs are caused by warm, moist sea air rising up the nearby escarpment and condensing and settling as fog on contact with the cooler air. They may last from half an hour to more than a week.

During fog or when traffic lanes on the Tollwork are blocked or closed for any reason, advisory speeds and other directions to drivers are displayed on roadside signs. These signs are activated by a traffic supervisor who directs the operations of the system from a computerised control centre at Waterfall. The computer is a dual Argus 700–E.

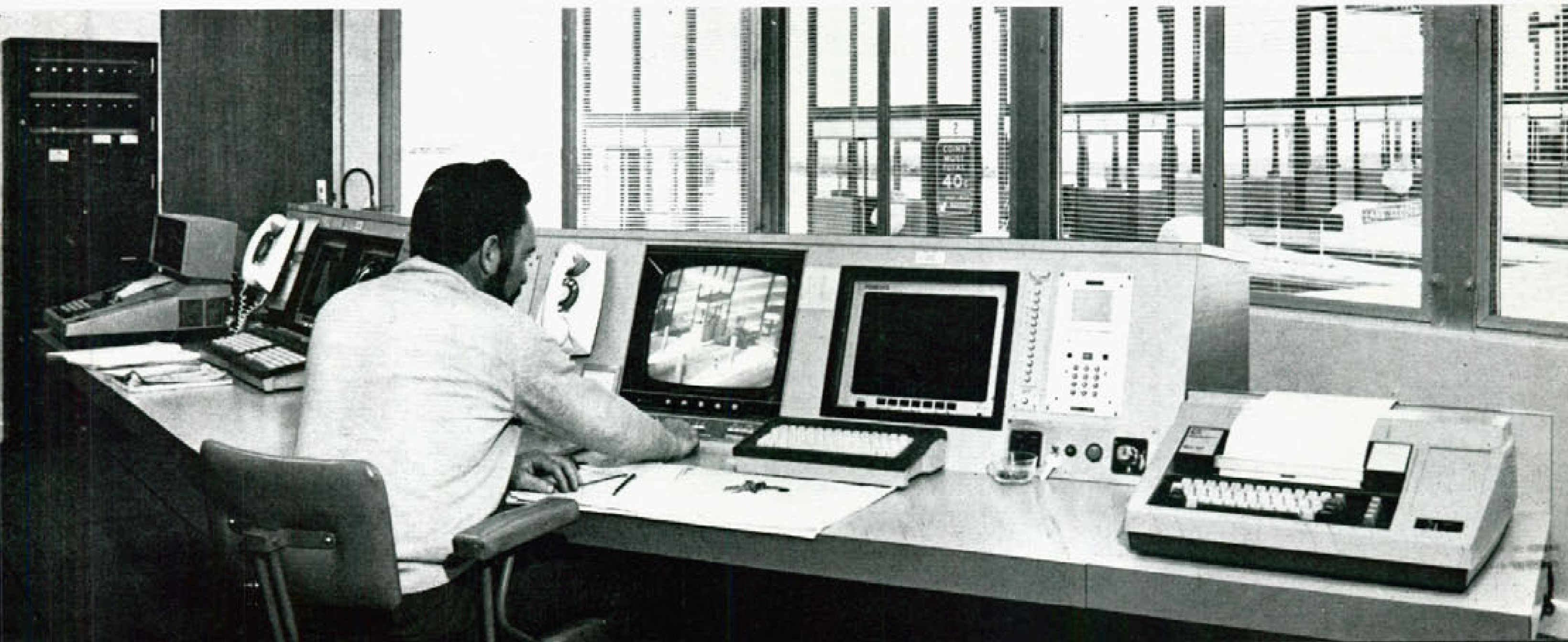
A supervisor at the console in the central centre for the Driver Aid System. Messages advising drivers of conditions on the Tollwork are keyed into the computer by means of the typewriter keyboard.

A small weather station established by the Department at the top of Bulli Pass continually measures humidity, wind direction and wind speed. When a combination of these three factors indicates a likelihood of fog developing, equipment at the weather station automatically relays a warning to the control centre. Radio-equipped patrol vehicles on the Tollwork are then called on to give regular reports of existing conditions. Later, it is intended that fog detectors along the Tollwork will automatically switch on an alarm in the control centre as soon as fog occurs.

When fog or other weather conditions reduce visibility, the traffic supervisor transmits appropriate messages to the roadside signs, by means of a central computer and a number of field stations. Automatic electronic switching apparatus at the back of the signs allows certain words, numbers and symbols to be displayed. The signs advise drivers to reduce speed, change lanes or stop. Examples of typical messages are shown on page 8.

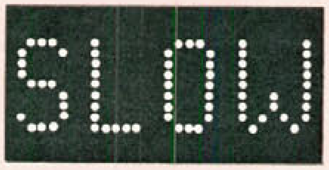
There are thirty-six signs spaced about 1·6 km apart along the whole length of the Tollwork. All the signs (which measure 2 metres wide by 1 metre high) are cantilevered over the left-hand shoulder of each carriageway. Each sign gives directions to motorists in both lanes. To attract drivers' attention, amber lights at each corner of the signs flash whenever a message is displayed. Red flashing lights and a red STOP sign are shown if conditions become too hazardous for travel. The brightness of the messages displayed can be varied in intensity depending on the time and conditions. They are clearly legible from a distance of 200 metres in clear weather, day or night while the flashing lights give advance warning at 500 metres.

When operating the system the traffic supervisor chooses the advisory speed or other directions most appropriate to the circumstances. The computer then transmits a predetermined series of directions to the roadside signs. Special sequences have been developed so that the speeds displayed on consecutive signs approaching the fog-affected area or accident zone give motorists adequate time to slow down gradually. This helps to avoid accidents which could occur if the desired direction (such as "STOP") was displayed immediately, without prior warning, and drivers braked suddenly.



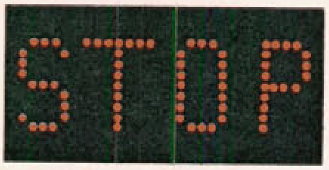
- FOG AHEAD
- SLOW DOWN TO THE SPEED INDICATED (in this case, it's 25 km/h)
- DO NOT STOP, UNLESS VEHICLES AHEAD OF YOU HAVE STOPPED
- WATCH FOR NEXT SIGN

If you have not already done so, switch on your vehicle's head lights (low beam) and tail lights so that it can be seen clearly by other drivers, especially those following.



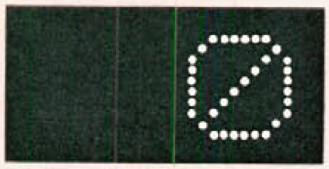
- HAZARD AHEAD
- SLOW DOWN
- WATCH FOR NEXT SIGN

When electronic devices along the Tollwork warn that too many vehicles are exceeding the advisory speeds already displayed, this SLOW sign is usually brought into use to try to reduce the speed of approaching traffic. It should therefore be regarded as a serious warning and not treated lightly.



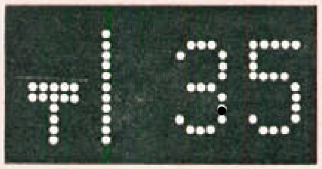
- ROADWAY AHEAD IS BLOCKED
- BOTH LANES ARE CLOSED
- YOU MUST STOP

If possible, pull over onto the road shoulder (i.e., "breakdown" lane) nearest to you. Keep your lights on and face the sign. Await further directions. Do not overtake vehicles already parked on the road shoulders. This sign will always be preceded some distance back by signs warning you to reduce speed.



- ROADWAY IS NOW CLEAR AHEAD
- YOU MAY RESUME YOUR NORMAL SPEED UP TO THE LIMIT APPLICABLE ON THE TOLLWORK (i.e., 110 KM/H)

Please do not increase your travelling speed or move off from a stopped position until this sign indicates that it is safe to do so.

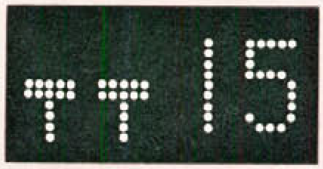


- THE LEFT-HAND LANE AHEAD IS CLOSED
- THE RIGHT-HAND LANE AHEAD IS OPEN
- SLOW DOWN TO THE SPEED INDICATED
- YOU MAY PROCEED IN EITHER LANE AT THIS STAGE UNLESS VEHICLES AHEAD OF YOU HAVE STOPPED

Watch for traffic merging from left lane into right lane. Watch for next sign which will probably display the "change lane" legend shown below.
A similar legend |T 35 is displayed when the right-hand lane ahead is closed and the left-hand lane is open.

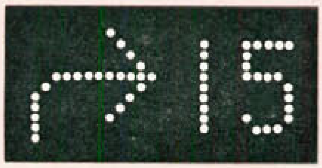
- THE LEFT-HAND LANE AHEAD IS CLOSED
- THE RIGHT-HAND LANE AHEAD IS OPEN
- SLOW DOWN TO THE SPEED INDICATED
- MOVE CAREFULLY INTO THE RIGHT-HAND LANE
- IF YOU ARE ALREADY IN IT, WATCH FOR MERGING TRAFFIC

A similar legend ↙ 25 is displayed when the right-hand lane ahead is closed and you are required to move into the left-hand lane.



- ROADWAY AHEAD IS BLOCKED
- BOTH LANES ARE CLOSED
- SLOW DOWN TO THE SPEED INDICATED
- DO NOT STOP, UNLESS VEHICLES AHEAD OF YOU HAVE STOPPED

Watch for the next sign (which will probably display the STOP sign, shown opposite, or the message shown below).



- ROADWAY AHEAD IS BLOCKED
- BOTH LANES ARE CLOSED
- PREPARE TO CROSS THE MEDIAN TO THE OPPOSITE CARRIAGEWAY, WHEN DIRECTED BY POLICE OR OTHER TRAFFIC OFFICIALS

Do not cross the median, and do not enter any traffic lane usually used by vehicles moving in the opposite direction, unless traffic in it has been stopped and you have been clearly directed to do so by police.

WHEN YOU ARE INVOLVED IN AN ACCIDENT OR BREAKDOWN ON THE TOLLWORK

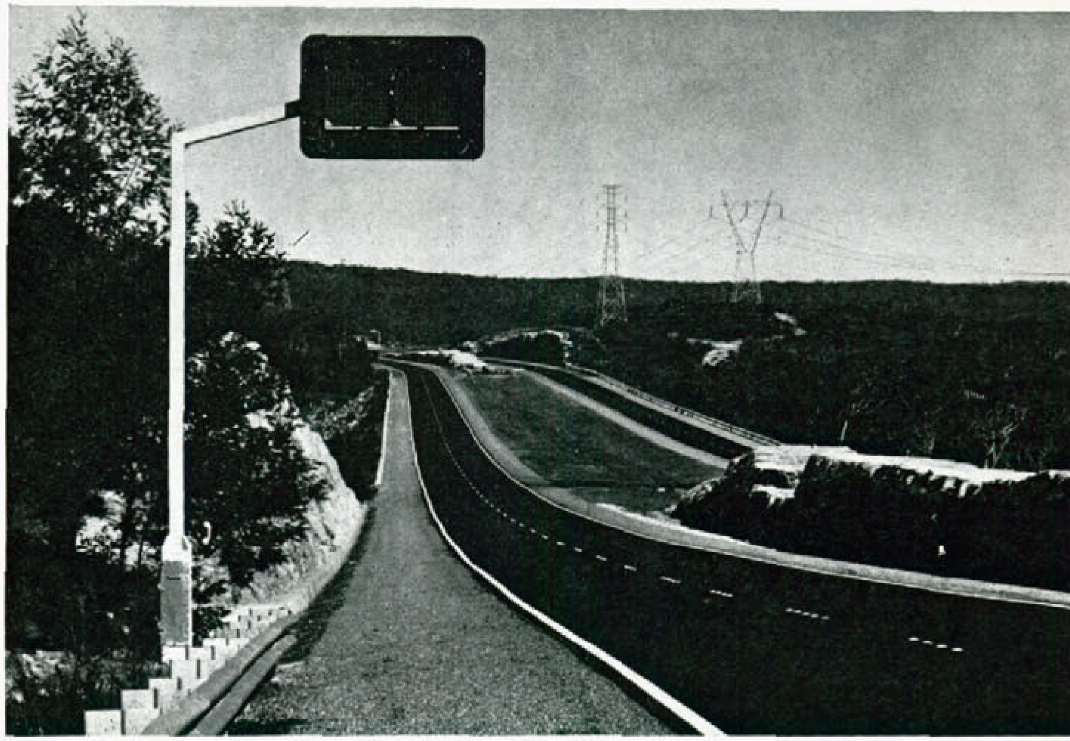
As well as giving guidance during fog the *driver aid system* is, of course, of vital importance in warning drivers when any lane of the Tollwork ahead is blocked. This could be due to an accident, a breakdown, a spilt load, or because road maintenance is being carried out. In such cases, the traffic supervisor can display advisory speeds, lane closed signs, change lane signs, slow signs or stop signs, depending on the circumstances.

If *your* vehicle has broken down or been involved in an accident, you should endeavour, as soon as possible to move it off the "through" lanes on to the sealed breakdown lanes provided on both sides of the carriageway. It is also important, for your own safety as well as for the safety of other travellers, that you ring the control centre as soon as possible, especially if your vehicle cannot be moved and is blocking the roadway.

Emergency roadside telephones can be found along the left-hand side of each carriageway, in blue painted boxes, usually attached to the poles supporting the *driver aid system* signs. Simply lift the receiver and you will be connected automatically to the traffic supervisor on duty at the control centre. It should be noted that there in no dial tone on these telephones—so don't think the line is "dead". You will hear a recorded message if other emergency calls prevent the traffic supervisor answering you straight away. Please remember to hang up the receiver when you have completed your call.

On receiving your message, the traffic supervisor will be able to pinpoint your position immediately on a large electronic mimic diagram of the Tollwork. He can then warn approaching motorists to slow down and to change lanes when necessary. He can also call in police or ambulance service, if required, and direct a radio-controlled service vehicle to give you assistance. This service is provided 24 hours a day on every day of the year.

The illustrations on the opposite page show typical words, symbols and numbers which can be displayed on the signs. Adjacent to each one is an explanation of the message which the sign is intended to convey and what you are expected to do. In all cases, the numbers relate to advisory speeds in kilometres (not miles) an hour.



One of the 36 signs along the Tollwork which carry advisory messages for drivers in fog conditions or when there are lane closures due to accidents or maintenance works.

WHEN YOU ARE DRIVING ALONG THE TOLLWORK

At all times and particularly in fog, watch out on your *left*, not on your right, for messages displayed on the signs erected along the Tollwork. Having seen one and followed its directions, keep an alert eye open for any vehicles stopped ahead of you. Also watch out for the next sign approximately 1·6 km further on. The messages displayed will change and become even more important as you approach the area of fog or the location of the breakdown or accident. It should be noted that the signs apply to drivers travelling in both traffic lanes: there are *not* separate signs for each lane.

Another safety feature of the *driver aid system* is the vehicle detection devices installed along the Tollwork. These devices calculate the percentage of vehicles exceeding the advisory speed. At the control centre, the computer monitors this information and warns the supervisor when a significant proportion of motorists are not heeding the direction. From the information supplied by the detection devices, the supervisor is also alerted of abnormal traffic flow such as an accident would cause. The supervisor can then adjust the advisory speed or take other appropriate action.

Toll Collection

The computer is also linked to the toll collection system and carries out toll accounting. As at 2nd November, 1975, tolls collected amounted to $353,350. The schedule of tolls payable on the Tollwork are listed below.

	$
*Motor cycles and motor scooters	0.20
*Panel vans (whose tare weight is under 2 tonnes), cars, utilities and station sedans	0.40
*Cars with caravan, cars with trailers and buses	0.60
*Vehicles (for which no separate charge is made) whose tare weight is under 2 tonnes	0.60
*Vehicles (for which no separate charge is made), including panel vans, whose tare weight is 2 tonnes or more but not more than 4 tonnes	1.00
*Vehicles (for which no separate charge is made) whose tare weight is more than 4 tonnes	1.60

NEW MINISTER FOR HIGHWAYS

While this issue of "Main Roads" was in production, the announcement was made of a new appointment to the Ministry of Transport and Highways.

The Hon. Wal Fife, M.L.A., who had been Minister since 3rd January, 1975, resigned from State politics with the intention of contesting a Federal seat. To replace him as Minister for Transport and Highways, the Premier of New South Wales, the Hon. T. L. Lewis, M.L.A., appointed the Hon. M. S. Ruddock, M.L.A.

The Hon. M. S. Ruddock, M.Ec., M.L.A.

Mr Ruddock's appointment as Minister for Transport and Highways took effect on 10th October, 1975. He has been a member of State Parliament for over 13 years since having first been elected member for The Hills electorate in March, 1962.

Mr Ruddock obtained his early education at Fort Street Boys' High School, Sydney. He went on to study at the University of Sydney where he took a Master of Economics Degree in 1938. Two years later he graduated with top honours in Accountancy (A.A.S.A.).

After teaching at Penrith High School for 5 years, Mr Ruddock went to Canberra in 1942 as Assistant to Professor Copland. By 1948 he became Deputy Commissioner (Prices).

Then followed a period in his career when he obtained experience in private industry. He also became General Secretary of the Wheat and Wool Growers' Association and Secretary of the New South Wales Wheat Industry Research Committee.

Mr Ruddock has had a long record of community work. He was a Councillor of Hornsby Shire for 12 years and Shire President for 2 years. Mr Ruddock is also a Trustee of Ku-ring-gai Chase, and Lane Cove River Park, and has been President since inception of the Elouera Bushland Natural Park.

During his Parliamentary career, Mr Ruddock has been Member and Chairman, variously, of the Public Accounts Committee. In January, 1975, he was appointed Minister for Revenue and Assistant Treasurer, a position which he held until appointment as Minister for Transport and Highways.

The Hon. M. S. Ruddock

Details of Mr Fife's Parliamentary career were recently published, in the March, 1975, issue of "Main Roads".

NEW CHIEF ACCOUNTANT

Leo Marlin

Mr E. L. Marlin

On 21st August, 1975, the Department's Chief Accountant, Mr Leo Marlin, A.C.I.S., retired from duty. Mr Marlin had held this position since February, 1974.

Much of Mr Marlin's 46-year career with the Department was contemporary with the formulative years of Main Roads. Commencing as a Junior Messenger in March, 1929, he became a Junior Clerk in Plant and Purchasing a few years later and then a Clerk in numerous Head Office Sections, Rosehill Depot and Central Workshop. In 1951 he was attached to the Internal Audit Section and in November, 1956, became Paymaster and served in other capacities in the Pay Section before being appointed Senior Examiner of Claims in November, 1959.

In May, 1962, Mr Marlin was appointed Senior Inspector of Accounts and, at the end of that year, Officer-in-Charge of Financial Control. During 1963 he attended the Administrative Staff College at Mt Eliza.

Mr Marlin became Accountant in February, 1965, and then held the position of Assistant Chief Accountant from June, 1966, until appointment as Chief Accountant in 1974.

Mr Marlin was one of the founders of the Main Roads Christian Fellowship in the early 1950's, and until his retirement he occupied positions of leadership therein from time to time. His wise counsel has meant a great deal to those many staff members who have sought to avail themselves of fellowship with this group over the years, free of any denominational barriers. Following the 1959 Billy Graham Crusade in Sydney, Mr Marlin became a member of a Central Committee which sought to set up similar Christian Fellowships in business houses throughout the city.

Mr E. C. Cooper

The Department's newly appointed Chief Accountant is Mr E. C. Cooper, A.S.T.C., who commenced duties in this capacity on 22nd August, 1975.

Mr Cooper began his career with the Department in 1938 as a Junior Clerk in the Records Section. He remained in this section until he joined the AIF in 1942 and progessed to Staff Sergeant in the Australian Army Canteen Services.

He returned to duty with the Department in 1946 and for the next 5 years worked in the Accounts Branch. During this time he recommenced and completed his accountancy studies at the Sydney Technical College under the Commonwealth Reconstruction Training Scheme.

In 1951 Mr Cooper became a Cost Clerk at Port Macquarie and moved to Yass in 1954. He was Senior Clerk at Central Workshops in 1957 and then shortly after became an Inspector of Accounts. He moved to the Chief Engineer's Branch in 1962 as the Senior Clerk. He became Staff Officer in 1964 and this was followed by his appointment to the Financial Control Section in 1967, as Paymaster in 1969 and by his appointment as the Department's Auditor in 1971.

He was appointed Assistant Chief Accountant in 1974 and shortly after became Deputy Chief Accountant, which position he held until his present appointment as Chief Accountant.

In 1973, Mr Cooper attended the Advanced Course at the Australian Administrative Staff College, Mt Eliza. For 5 weeks earlier this year he travelled overseas with the now Engineer-in-Chief, Mr T. S. Hope, and examined road costing and allied financial procedures adopted by various authorities in Europe, Great Britain and the United States of America.

Ted Cooper

ENGINEER-IN-CHIEF RETIRES

Mr R. E. Johnston

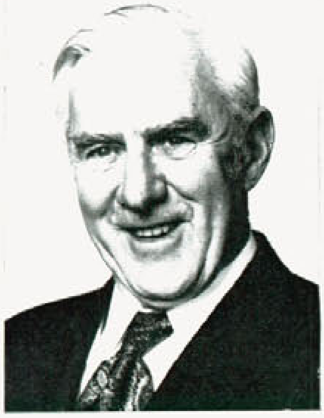
On 18th June, 1975, Mr R. E. Johnston, B.E., C.H.T. (Yale), F.I.E.Aust., F.C.I.T., M.A.I.T.T., retired from the Department after holding the position of Engineer-in-Chief since September, 1973.

Prior to this, Mr Johnston had been Deputy Engineer-in-Chief since December, 1969.

During his 40 years of service with the Department of Main Roads, Mr Johnston gained wide experience of the Department's work in both country and city areas.

Mr Johnston joined the Department in 1935 as a graduate from the University of Sydney where he had gained a Bachelor of Engineering Degree. In the war years, Mr Johnston served with the Department in the Northern Territory in 1942 on the construction of defence roads and airstrips. He was with the RAAF in Morotai and Borneo from 1944 to 1946, with the rank of Flying Officer in No. 6 and No. 7 Air Field Construction Squadrons.

On returning to the Department in February, 1946, he was at first stationed at Grafton Divisional Office, leaving there in January, 1947, upon transfer to Head Office. He took up duties at Head Office as First Assistant to the Construction Engineer and remained in this position until 1955.



Earle Johnston

In February, 1955, Mr Johnston became Traffic Service Engineer. While holding this office 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. In May, 1962, he became Executive Engineer.

Promotion to Assistant Chief Engineer occurred in December, 1962, an office which he held for 7 years until appointment as Deputy Engineer-in-Chief.

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.

Mr Johnston included in his other activities a 6-year membership of the Advisory Council, Australian Road Research Board. He spent some years as a part-time lecturer at the University of New South Wales. For many years Mr Johnston was active in the Institution of Engineers, Australia, being Chairman of the Sydney Division in 1972. In addition to his other qualifications, Mr Johnston holds a Local Government Engineer's Certificate.

The Department's Social and Recreation Club has been a very active interest of Mr Johnston; he has been a Chairman and Vice-President. In addition he has been President of the Main Roads Bowling Club.

As a Foundation Director of the Main Roads Credit Union, Mr Johnston served in such capacity for a period of 9 years.

APPOINTMENT OF SUCCESSOR

Mr T. S. Hope

The new Engineer-in-Chief for the Department of Main Roads, Mr T. S. Hope, A.S.T.C., F.I.E.Aust., F.C.I.T., took up his appointment on 19th June, 1975.

During his almost 38 years of service with the Department, Mr Hope has served in many areas of the State. He joined the Department in 1937 and at first worked in the Metropolitan, Illawarra and Blue Mountains area before being transferred to Tumblong, then Bulahdelah, Upper Colo and Frenchs Forest.

During 1942 he worked on the construction of the Stuart Highway and was also engaged on some airstrip construction in the Northern Territory.

For the next 3 years he served with the AIF then recommenced service with the Department at Dorrigo Works Office before being moved to Coffs Harbour and later to Yass. In 1951 he was transferred to the then Outer Metropolitan No. 1 Division, and was involved in the restoration of the Hume Highway at Razorback, following the extensive slippages which occurred early in the year. Over the next 7 years he served in Head Office on administration and supervision of construction and maintenance activities throughout the State.

In January, 1959, Mr Hope was appointed to the newly created position of Engineer for Field Organization and Methods. This position involved advice to young engineers on their works organizations and methods of construction and maintenance.

In 1961 Mr Hope attended the inaugural course on Construction Management at the Institute of Administration, University of New South Wales. He completed the Advanced Course at the Administrative Staff College, Mt Eliza in 1967.

He was appointed Divisional Engineer of the then Outer Metropolitan No. 2 Division, which became the Parramatta Division when the organization moved from Chatswood to a new Divisional Office at Parramatta. That Division was then engaged in the construction of the first section of the Sydney–Newcastle Tollwork from the Hawkesbury River to Mount White.

In 1965 Mr Hope became the Divisional Engineer at Newcastle and for the next 4½ years was responsible for many major road and bridge works in the area. He returned to Head Office in 1969, as Engineer for Programmes and Budgets, a position created for the rational programming of maintenance and construction. He held this position until becoming Deputy Engineer-in-Chief in 1973.

Tom Hope

For many years Mr Hope has held a Local Government Engineer's Certificate. He has acted as the Department's liaison officer with the Army and the Civil Defence Authorities (now Emergency Services) and has been a part-time lecturer in road engineering at the University of New South Wales and Sydney Technical College. For many years he was the examiner in road and street engineering for Local Government Engineers. He is a Vice President of the Department of Main Roads Social and Recreation Club, and is a Past President of the Main Roads Bowling Club.

From 26th April, 1975, Mr Hope was overseas on a 5 weeks visit to Europe, Great Britain and the United States of America, for discussions with Senior Technical Officers of road authorities and associated organizations in those countries, and to see at first-hand the latest trends in road and bridge construction.

EDP progress

The Department of Main Roads has always endeavoured to make the greatest use of machine accounting procedures in recording its expenditures. In 1925 the Main Roads Board was established and hand written ledgers were the order of the day. From that time, over the years, improved accounting machines have been used until today the whole commercial aspect of the Department's activities has been converted to E.D.P. Operation.

During the past 20 years there have been several major changes in the manner in which financial accounting transactions have been processed.

In 1957 a punchcard system was installed to record Employees Group Tax records. Following its successful operation a 40-column Powers-Samas Tabulator, together with ancillary equipment, was installed in Head Office early in 1959. Much of the Department's financial accounting work was transferred to this punchcard system prior to its being replaced during 1965 by a hired 80-column punchcard Data Processor supplied by I.C.T. (Aust.) Pty Ltd. The programming of the Data Processor incorporated a change to decimal currency. The converted systems were implemented several months in advance of the official currency changeover date in 1966.

The new equipment had several advantages over the previous installation in that the 80-column cards could hold a greater volume of data, the plug-board system of progamming was more flexible and card reading and printing speeds were greatly increased. Most of the systems then in use were expanded to provide information not previously available.

Programming for the new machine was carried out by the Department's staff after training by I.C.T. personnel.

It was intended, however, that the new installation would only be an interim step towards a full computerised system. By 1967 the increasing work volume, together with card storage problems and the need to implement new accounting systems too complex for the existing equipment, made it necessary to consider installing a full computer.

Up to this time the accounting system provided for a considerable volume of documents which orginated in field offices to be mailed to Head Office for examination and entry into the General Ledger system. A delay of some weeks between the raising of a financial transaction in the field and its entry into the ledger in Head Office was inherent in the system. In addition, a proposed system of centralized stock control was not practical under the then existing stores system which did not make use of a standardised inventory catalogue.

In conjunction with the consideration of new data processing equipment it was also decided to investigate systems of data transmission with the object of speeding up the processing of financial transactions into the General Ledgers and reducing the volume of calculations required to be made by field office staff.

The system best suited to the Department's requirements needed to provide:

1. Transmission of low to medium volumes of data between field officers and the computer at reasonable speed and cost.
2. An inter-office communications system for the transmission of general messages.
3. Transmission of data to and from the computer through unattended terminals.
4. Send/receive terminals in each of the Department's field offices for a reasonable capital outlay, maintenance to be provided by the supplier.

Telex was chosen as being the system which came nearest to complying with all the requirements. This system, however, has two undesirable aspects, namely, a low transmission speed of 6½ characters per second together with a lack of error detection and correction facilities.

The low transmission speed has been partially offset by installing two terminals in each of the larger offices. A satisfactory degree of error detection has been achieved by the use of check digits, hash totals and the double transmission of some critical data which cannot be verified by other means.

Line errors during transmission, although of considerable concern during development of the system, are not a serious problem.

It was decided that the machine most suited to the Department's requirements was a Honeywell Series 200 Model 1200 computer with 48K characters of main memory and a typewriter console together with the following peripheral equipment:

- Card Reader—800 C.P.M.
- Line Printer—132 print positions, 950 L.P.M.
- 2/259 Disk Drives—9 million characters storage capacity.
- 4 Tape Drives—20 K.c.
- Paper Tape Strip Reader—1 000 frames/sec.
- Telex Interface capable of handling eight post office exchange lines.

The need to provide additional processing capacity and back-up equipment when the data transmission system had been proved and implemented was foreshadowed.

The new equipment was installed in February, 1968.

Programming of the new machine had commenced during the previous year. Much of the work being processed on the old equipment had been transferred to computer prior to June, 1968, thus enabling the hired I.C.T. machine to be released in July.

The Telex communications system used for data transmission was originally developed to make use of two exchange lines. After successful testing the system was expanded, first to five, then to eight and finally to twelve exchange lines. This expansion enabled transmission to be made to or from twelve terminals simultaneously.

A stores inventory system was developed and progressively implemented in the field offices as Telex terminals became available.

A Honeywell Series 200 Model 125 computer, compatible with the H.1200 machine already installed and with similar peripherals, was ordered late in 1968 and installed in the first half of 1969. A system of switching was also installed which enabled the Telex Interface to be connected to either machine thus providing the flexibility necessary to maintain communications during periods of hardware malfunction.

During the ensuing 5 years, systems were expanded to meet the needs of management for additional and more up-to-date information. As the processing load increased, shiftwork was introduced and additional shifts were rostered as the need arose.

By early 1974 it was obvious that the volume of batch processing work, combined with the need to dedicate the computer system to data transmission for several hours each day, would not permit the implementation of new systems on the existing equipment.

The solution was seen in having machines with a multi-programming capacity which would permit communications and batch processing to be performed simultaneously. Such equipment would also provide the facilities necessary to make the development of on-line systems feasible. These systems, to operate through terminals installed in the user-Sections, were proposed in respect of salaries, personnel records, weight of loads and plant records.

It was decided to install two Honeywell Series 2000 machines and eight Model 277 disk drives together with Datanet 2000 communications processors, and an order was placed for the first system. However, because of the inability of the H.1200 machine to support the new Model 277 disk drives it was necessary to hire smaller capacity Model 275 disk drives as an interim step. Installation of the first central processor was completed in October, 1974, and in the following months computer operators received instruction in the use of the new operating system (OS.2000) through short courses conducted by the supplier and by on-the-job training.

Some delay has been experienced with the installation and development of the Datanet communications system which is now expected to be operational early in the 1976 year. Telex Interface software is being developed by the supplier and it will then remain for the Department to develop its own software to link the Datanet to the existing systems. In the meanwhile, full back-up for the communications system will be maintained by retaining the existing interface equipment until both Datanets are fully operational.

The installation of the second of the Series 2000 machine, a H.2040A central processor (replacing the H.1200 machine) was made early in August, 1975. Eight Model 277 disk drives (64 million character capacity) were placed on site at the same time but will not come into operation until a new air-conditioning system has been commissioned early in 1976.

When the changeover of equipment is complete, the commercial E.D.P. installation will consist of the following:

Two Honeywell Series 2000 Model 2040A computers, each having 196K characters of main memory; with typewriter console and peripheral equipment as follows:

4/277 Mag. Disk Drives, each of 64 million character capacity.

5/½" Mag. Tape Drives, 44 K.c. transfer rate.

Card Reader—800 C.P.M.

Line Printer—950 L.P.M.

Paper Tape Strip Reader, 1 000 frames/sec. (this item applies only to the first computer system and is non-switchable).

Datanet 2000 Communications Processor with 28K memory and capable of handling up to 24 transmission lines. Sixteen lines, four of which are not yet connected, will be switchable in blocks of four between systems. These sixteen lines will service sixty field offices via Siemens Model 100 Teleprinter send/receive terminals, each of which is equipped with unattended answer-back, paper tape reader and punch and remote control start transmitter.

The following is a summary of the main applications currently in production:

Wages Payroll

This comprehensive system covers wages employees throughout the State and provides for:

Pay calculations and the printing of vouchers.

Wages receipts and coinage analysis.

Automatic collection of Group Tax, Payroll Tax, Workers Compensation and Retirement Fund information.

Cost dissections.

Statistical information.

Automatic recoupment of field office Advance Accounts through the Daily Abstract system.

The console typewriter of the Honeywell computer is the communications link between the operator and the system.

Stores Inventory

A centralized system to stock control which covers:

Automatic collection of information when orders are placed by the Supply Section.

Receipts and issues at field offices.

Stock-on-hand and progressive stock-taking reports. "Count-after-issue" is an optional feature of the system.

Cost dissections.

Statistical information relating to total usage and the quantities and geographical locations of stock-on-hand of individual stock lines.

General Ledgers

Financial transactions are processed through the Daily Abstract and Expenditure sub-systems to produce Creditor's Payment Advices, Paymasters Cash Sheets and Daily Expenditure and Fund Balance reports.

On the last working day in each month the General Ledgers and Receipts and Payments Statements are printed.

Following the running of the General Ledgers several types of records are extracted and fed into the following sub-systems:

Rents received.

Property acquisition payments.

Plant and motor vehicle operating costs.

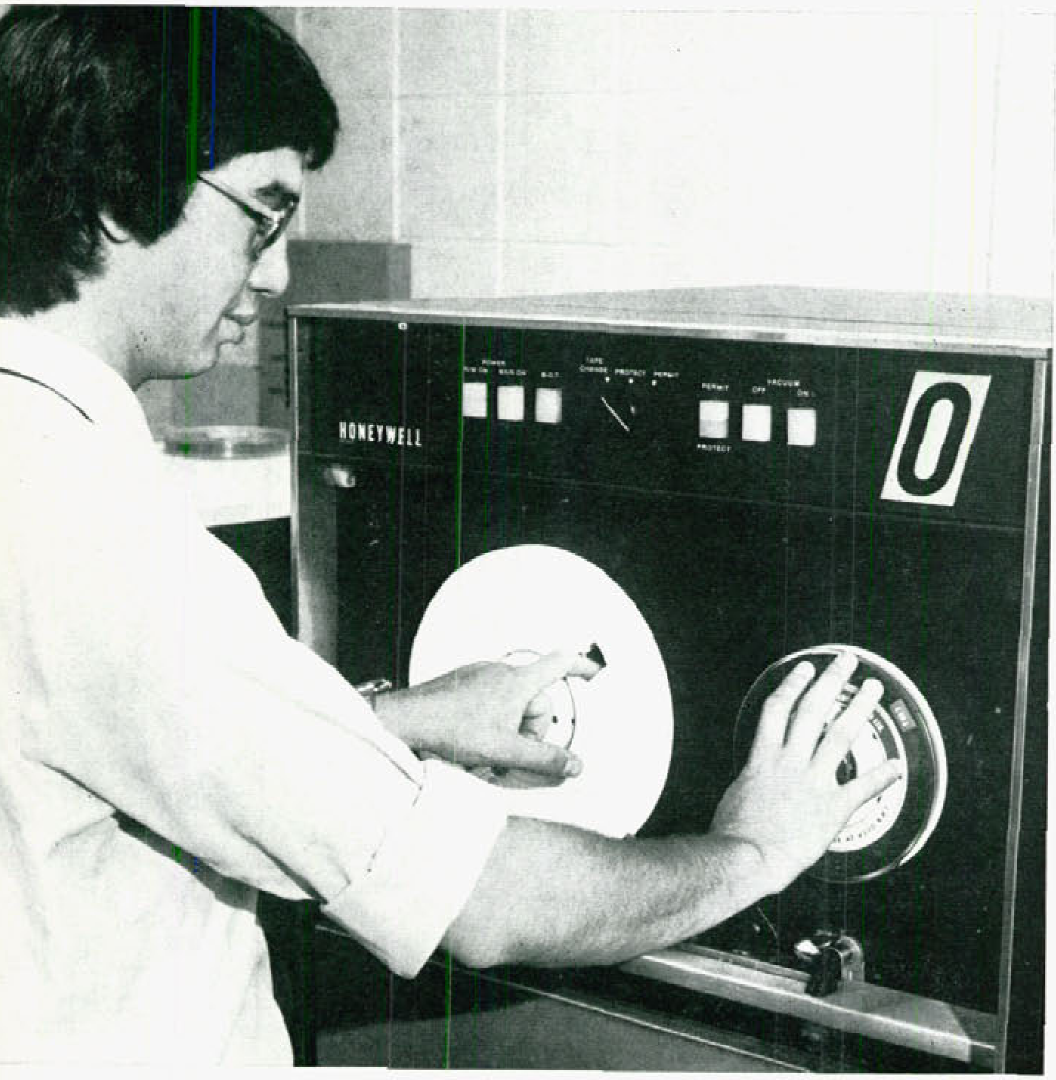
Sundry debtors—receipts.

Payments in respect of public utility alterations.

Expenditure information used to prepare Appendices to the Annual Report.

Officer's residences—rates and repairs payments.

Information can be fed into the computer from punch cards, paper tape, magnetic discs and tapes. An operator is loading a magnetic tape onto a drive.



Cash payments to councils.

Bridge construction expenditure.

Expenditure on direct control and contract works.

Miscellaneous Systems

Motor vehicle drivers' weekly reports.

Road and Bridge Tolls.

Staff Superannuation.

Three new systems are currently being developed:

Staff Salaries

This system, which has reached the design stage, will cover all aspects of salaries and superannuation, and is being developed as the initial stage of a personnel records system. It is proposed to operate the system through a terminal (to be located in the Staff Section) which will be on-line to the computers during normal working hours.

The system is currently expected to be ready for implementation during the first half of 1976.

Haulage and Hired Plant

This system has reached the design stage and will provide a means of automatic recoupment of haulage expenditure to field office Advance Accounts as well as cost dissections and a considerable amount of statistical data concerning hired trucks and hired plant.

Implementation is expected about the middle of 1976.

Plant Recording

Being developed to replace several existing small systems, this system will cover hire raising, costing operating hours and costs, stocktaking, insurance and allocation of resources. The system is being designed in two stages, the second of which will require the installation of an on-line terminal in the Mechanical Section. This system has also reached the design stage.

The new projects, together with the effort required to maintain and expand existing systems, have generated a considerable volume of systems and programming work for the E.D.P. staff. In addition there is the effort required to modify existing systems to run efficiently on the new equipment recently installed. However, the effort and expenditure promises to be justified by the results which the new equipment and systems will achieve by providing management with accurate, up-to-date information to be used in the decision making process.

NEW

Asphaltic Concrete Mixing Plant

A new asphaltic concrete mixing plant commenced production at Central Asphalt Depot in 1975. The plant is rated at a capacity of 400 tonnes per hour and will provide a variety of plant mix products to several paving gangs within a radius of 100 km of Sydney.

The plant is designed for manual, semi-automatic or fully automatic operation.

The plant can be supplied with aggregate at a rate of up to 500 tonnes per hour by conveyor belt from the 24,000 tonnes aggregate storage complex.

An insulated storage bin has been installed for holding up to 400 tonnes of hot mixed products for one or two days.

(Top): General view of the aggregate storage area consisting of twelve bins each capable of holding 2,000 tonnes of various sized aggregates and sand. The material is transferred from road vehicles by way of one or two under road hoppers and a conveyor belt system at the rate of 500 — 600 tonnes per hour.

(Above, left and right): Sand and 20 mm aggregate being transferred from under road hoppers to storage bins.

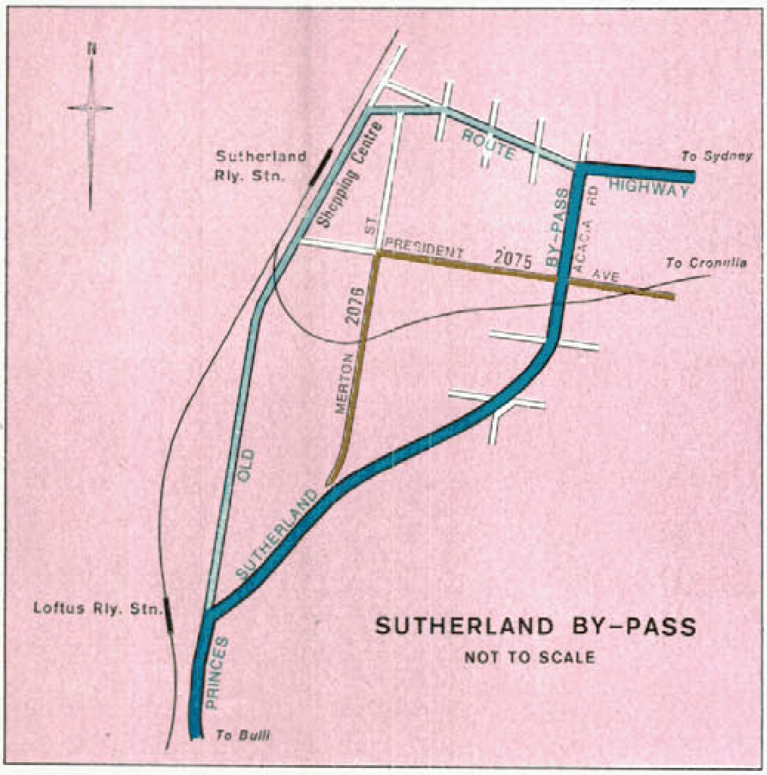
(Above): Aggregate being transferred from storage bins to the mixing plant by underground conveyor belts located in a tunnel running the full length of the aggregate storage bins.

Sutherland By-pass

Traffic began to flow along the 1.7 km Sutherland By-pass on Tuesday, 16th September, 1975.

Constructed as part of total improvements in the approach roads to the Waterfall to Bulli Pass Tollwork on the F6 – Southern Freeway, this By-pass will further reduce the time taken to travel between Sydney and Wollongong.

The Sutherland By-pass, extending from the Princes Highway at Acacia Road, Sutherland to the Princes Highway at Loftus, provides numerous community benefits in safety and convenience. The By-pass eliminates through traffic from the Sutherland shopping centre and other local streets. By taking through traffic out of the shopping centre the By-pass has contributed to an improved shopping and parking environment in this area.



The construction of a pedestrian footbridge over the By-pass is planned so that residents and school children seeking access to the shopping centre and local sporting facilities will gain a safer and more convenient route.

Photographs show views of the new road and the bridge where the Sutherland to Cronulla railway line is crossed.

NEWCASTLE

Today, visitors and Novocastrians can enjoy this peaceful park in the city centre, far away from the busy Newcastle industrial areas.

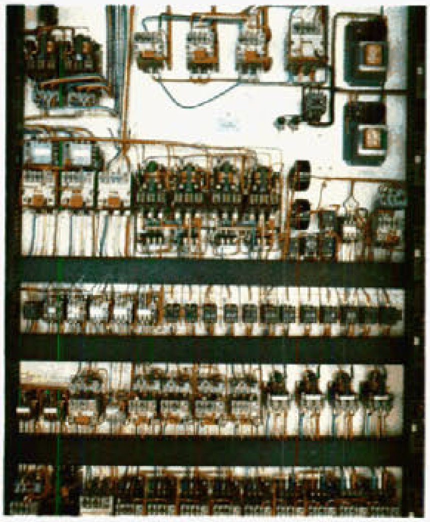
"Inner View of Newcastle", attributed to Joseph Lycett, and dating from about 1818. Reproduced with permission of Newcastle City Art Gallery.

Nobby's Lighthouse has been operating since 1st January, 1858. It glows through the evening light now as a symbol of modern technology, long removed from the day 174 years ago when Lieut-Colonel William Paterson and his party landed there and named it Coal Island, before setting off on their voyage of exploration up the Hunter River.

For many years this rock pool was known as the Commandant's Bath. Major James Morisset who was Military Commandant in Newcastle from 1819 to 1822 had the hole cut in the rocks for his personal bathing. It is now known as the "Bogey Hole".

(Left): General view of the mixing plant. The main elements consist of the cylindrical dryer drum (centre), the hot aggregate storage bins, (top centre) and the mixing plant below (mid centre). The associated portions of the plant are the control house (left), the binder storage tanks (lower left), the hot plant mix storage bins (far left) and the dust extracting system and exhaust stack (back right).

(Below): Part of the motor starting and relay panel in the control room.



(Below): The console in the control room from which all operations in the production of plant mix are controlled and monitored.

(Below): Aggregate dryer drum (right) and discharge hopper beneath the batching and mixing pug mill. Plant mix is being discharged into haulage trucks. The dryer drum burner is capable of drying 400 — 500 tonnes of aggregate per hour.

and the Hunter Valley Division

Main Roads Progress

The Department's Hunter Valley Division extends over nearly 23 900 sq km and comprises the Local Government Areas of the Cities of Newcastle, Singleton and Muswellbrook and the Shires of Denman, Dungog, Great Lakes, Lake Macquarie, Patrick Plains, Port Stephens and Wyong. This region is possibly one of the most diverse in the State and contributes significantly to primary and secondary industry production. It also has a growing income from the development of tourism.

The Headquarters of the Hunter Valley Division are situated in Darby Street, Newcastle, and direct control operations are administered from Works Offices in the Newcastle suburb of Waratah and at Singleton.

The present boundaries of the Division were defined on 27th June, 1966, at the time of the establishment of the Lower North Coast Division with headquarters at Port Macquarie. Prior to this date, the Division based at Newcastle had been known as the Lower Northern Division, which together with the Local Government Areas detailed above, included the Municipalities of Kempsey, Port Macquarie, Taree and Wingham, and the Shires of Macleay, Hastings, Manning and Gloucester.

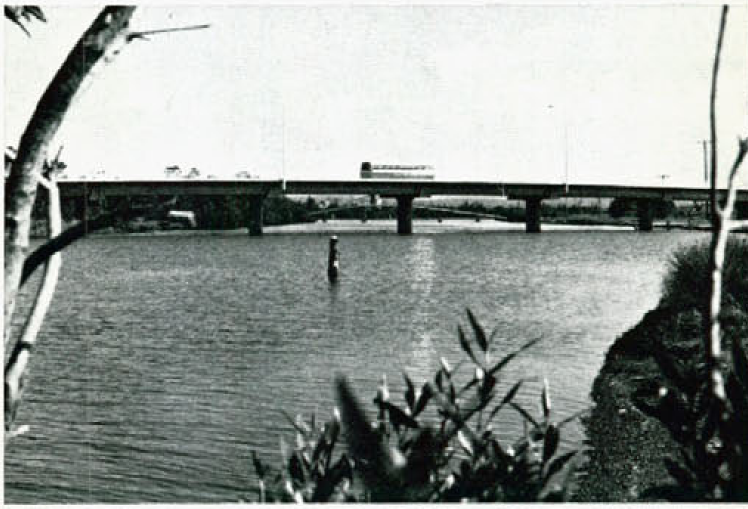
The Division is responsible for the most heavily trafficked sections of two of the most important Highways in the State. The Pacific Highway (State Highway No. 10) from Cut Rock Creek (8·6 km north of Gosford) to Wang Wauk River Bridge (37·4 km north of Bulahdelah); and the New England Highway (State Highway No. 9) from its intersection with the Pacific Highway at Hexham (16 km north of Newcastle) to near Aberdeen (10·5 km north of Muswellbrook). A map appears on page 21.

Travelling Back in History

Free settlement of the Hunter River Valley and the Newcastle area did not begin until the early 1820's. The port of Newcastle was a penal settlement until 1823 and therefore the colonial authorities did not encourage land exploration to or through the area, and all communications were by sea.

An exploration of the Hunter Valley in 1801 had revealed that it was a fertile region suitable for cultivation and grazing, and as the desire for land grew amongst the new settlers at Sydney, the first adventurers began to make their way north. In 1819, a party led by John Howe explored a track from Windsor through to the Hunter Valley. Originally the authorities tried to control use of this track by issuing permits to its travellers. However, so many unauthorized persons and escaping convicts began to use it that by 1823 it had become a contributing factor to the removal of the penal settlement further north to Port Macquarie.

Once the Hunter Valley was open to free settlers, they found their way to its rich plains by a variety of rough tracks. The early spread of roads and settlement through the Valley was boosted by the coming of the Australian Agricultural Company in 1825. The Company's interests in the development of pastoral land and mining gave sufficient prominence to the area for a road of carriage standard to be built from Windsor in 1831. This followed a much shorter route than Howe's track, crossing the Hawkesbury at Wiseman's Ferry, and at first only extending as far as Maitland. It became known as the Great North Road.



On the route of Main Road No. 217 two bridges, identical in size, cross Cockle Creek where it enters Lake Macquarie. This bridge over the North Arm has been named Watkins Bridge to commemorate the named bridge which these two bridges replaced. Improvements to main roads in this part of the Division include this new deviation between Cockle Creek Railway Station and Second Street, Boolaroo, on Main Road No. 217.

However, travellers proceeding to Newcastle itself had to leave the main route near present-day Maitland and follow a track south-east along the high land beside the Hunter River and negotiate two swamps and the unbridged Ironbark Creek. It is not hard to understand then why most travellers to the town of Newcastle chose to make the entire voyage from Sydney by sea.

As settlement spread northward from the lower Hunter Valley, the Great North Road was extended and improved until by 1865 it was metalled from Maitland to Morpeth, had a gravel surface from Morpeth to Singleton and was generally gravelled on its continuation to Muswellbrook.

This section of the old road now forms part of the New England Highway—the main inland route running north through New South Wales into Queensland.

While progress was being made on the inland connection between Sydney and the northern areas, the possibility of a more direct coastal route was receiving attention. Peat's Ferry near the present day crossing of the Hawkesbury River at Mooney Mooney, was established in 1844. A route was then opened on the northern side of the river, from the Ferry to Wollombi and the Great North Road. This was never properly constructed and was little used. The railway, which was opened between Sydney and Newcastle in 1889, followed the coastal route and reduced patronage on the road to such an extent that Peat's Ferry ceased operating.

As a result of these circumstances, the old inland route remained the major road connection to Newcastle and the Hunter Valley for many years, so that as late as 1926, the Main Roads Board observed, in its Annual Report, "although 129 years have passed since the discovery of what is now Newcastle, no *direct road* yet links the two cities—that is, Sydney and Newcastle".

The construction of a direct road was one of the first tasks confronting the Main Roads Board when it was constituted in 1925; and the work, which was completed in 1930, was named the Great Northern Highway. This was later proclaimed to be part of the Pacific Highway.

In the Main Roads Journal (September, 1969), it was observed "at the end of the First World War, the road system in the Hunter Valley region was in a very undeveloped state . . . . In 1919 there were barely 30 miles of road provided with a dustless surface in the whole of the Hunter Valley region. Sealed pavements consisted mostly of conglomerate gravel although wood blocking had been laid down on a number of streets in the inner Newcastle Area."

Today, in the Hunter Valley Division the classified roads consist of over 344 km of sealed State Highway, 67 km of sealed Trunk Roads, 1 217 km of substantially sealed Ordinary Main Roads, 17 km of Tourist Roads which are almost completely sealed and a system of Developmental Roads totalling 57 km.

Geology and Physiography

The geology and physiography of an area has great influence on the planning, design and construction of modern roads. Not only does it reveal the type of land use which roads must serve, but also the availability of local materials for road construction.

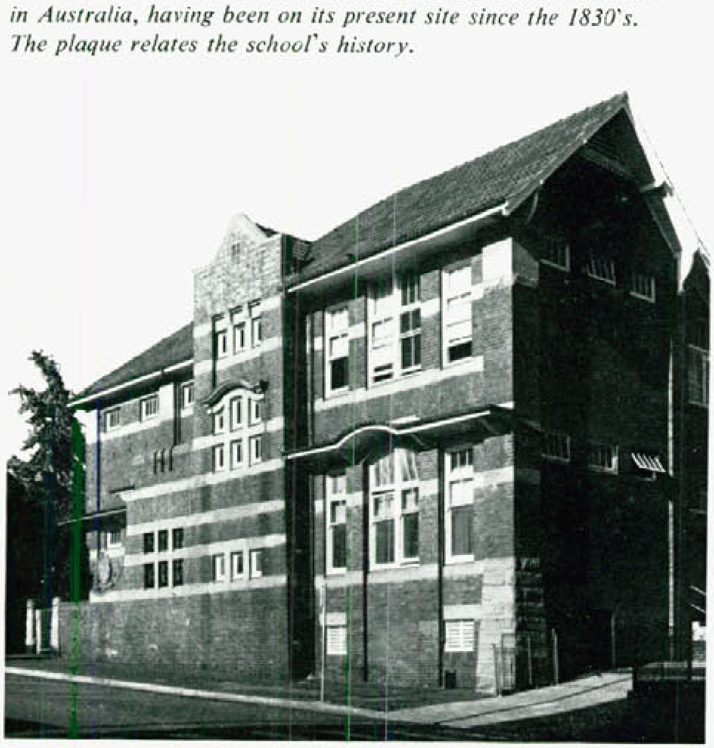
The greater portion of the Division lies within the Sydney Basin while the remainder lies within the New England Fold Belt. Geologically both are well known and important regions of the State.

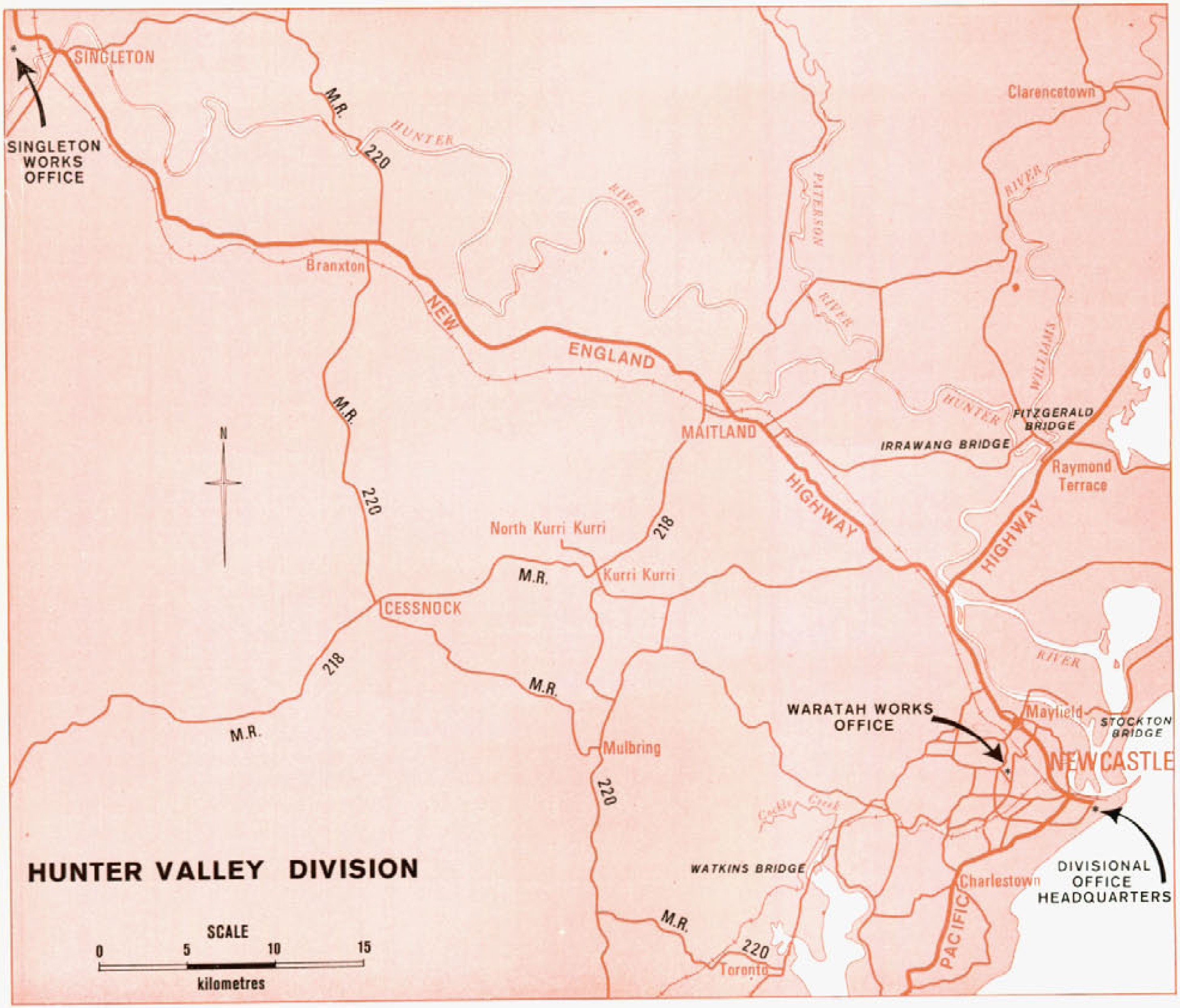
The area can be divided into four main geological zones with related physiography.

Zone 1. The Carboniferous Formations of the New England Fold Belt outcropping along the north-eastern margin of the Sydney Basin are located in the hilly to mountainous north-eastern part of the Division. The rocks consist of marine and terrestrial sediments and acid to intermediate volcanics subjected to considerable folding and faulting. They have been slightly metamorphosed and are relatively resistant to weathering with resultant shallow soils.

Zone 2. The Permian Coal Measures to the south-west and lying conformably on the rocks of Zone 1 are probably the

Newcastle East Public School is the oldest school in existence in Australia, having been on its present site since the 1830's. The plaque relates the school's history.





best known geological sequence in the Division. The rocks consist of marine and freshwater sediments with numerous coal seams and some basic to intermediate volcanics. The rocks are less weather-resistant than those of Zones 1 and 3, resulting in undulating topography and deeper soils. The soils are often of low fertility, but some of the sandy soils are suitable for grapes, which produce a proportion of Australia's better quality wines.

The most notable feature of the Zone is the coal measures. The seams of the Greta, Muswellbrook, Newcastle, Tomago and Singleton Coal Measures contain large quantities of coal ranging from low grade steaming to high grade coking varieties.

Since explorers discovered the coal measures outcropping along the coast, mining of coal has been a major economic feature of the area. Both underground and open cut mining have been extensive.

The low grade steaming coals are used in three major and a number of minor electric power generating stations within the Division.

The coking coals are also used locally, for the iron and steel industry. Coal of all types, but mainly the coking varities, is exported through the port of Newcastle.

The coal industry should remain a major economic force in the foreseeable future and might expand if extraction of oil from coal is developed.

Zone 3. The Mesozoic Sandstones of the south and south-western part of the Division form a dissected plateau which can be readily seen as an escarpment when looking south and west from the New England Highway. These sandstones conformably overlay those of the coal measures. Hard massive sandstones predominate, but siltstones, shales and basic volcanics are present.

Soils on the ridges are sandy and infertile, but some agricultural development has occurred in recent years. Soils in the valleys are more fertile and considerable agricultural development has taken place in some areas.

Zone 4. The final Zone comprises the unconsolidated Sediments of the Coast, the bays and estuaries and the floodplain of the Hunter River and its tributaries. The age of these sediments ranges from tertiary to recent.

The Zone is mainly flat, although sand dunes up to 15 metres in height are present and many other areas are swampy and have been little developed. Much of Newcastle's port area is located on swampy estuarine areas of the Hunter River where major industrial development has occurred. Extensive reclamation of the Kooragang Island area is taking place for the extension of Newcastle's heavy industry.

The main agricultural soils are located on the floodplain of the Hunter River and tributaries. These alluvial soils are suitable for the cultivation of maize, vegetables and other crops. The floodplain carries extensive dairy herds and many famous studs have been established in the area.

The sand beds of the Tomago area provide part of Newcastle's water supply and in recent years the coastal sands have been mined for rutile, zircon and other minerals.

This Zone provides the Division's main recreational areas and there are numerous sandy surfing beaches. Bays such as Tuggerah Lakes, Lake Macquarie, Port Stephens, the Myall Lakes and the Hunter River are famous for swimming, fishing and boating.

Road Construction Materials

All geological zones provide material suitable for road construction. *Zone* 1 provides crushed aggregates and road bases together with friable clayey conglomerates.

Zone 2 provides friable clayey conglomerates and A1 ridge gravels.

Zone 3 provides sandstone gravels and crushed aggregate and road base.

Zone 4 provides river gravel and sand for coarse and fine aggregates. The coarser aggregate reserves are much greater along the Hunter River upstream of Singleton. There are many more road and bridge construction problems in Zone 4 than in the other zones because of the depth of the unconsolidated estuarine muds (generally 5 to 6 metres) and the considerable depth to rock for bridge foundations (up to 50 metres).

Climate

The general climatic environment of the Hunter Valley Division is that of the sub-tropical zone. Characteristic of this climatic type are equable temperatures with a yearly average summer temperature of about 23° C and a yearly average winter temperature of 11° C.

Total annual rainfall decreases from 1 270 mm in the north-east corner of the Division to below 792 mm in the extreme west and south-west of the Division.

The spring season (September to November) is usually the driest period, while the heaviest rainfalls occur during the autumn and early winter period (March to June).

Frosts are virtually non-existent in the coastal zone, except in the vicinity of Cessnock, the Upper Hunter Area and to the south-west along the floor of Wollombi Brook.

Demography

The population in this region is increasing but the growth rate is less than for the State as a whole. In the 17-year period 1947 to 1974, figures released by the Australian Bureau of Statistics show that the Statewide population growth was 59·29 per cent, while the Hunter Valley areas, listed in the table below, increased their population by only 56·25 per cent.

Examination of the statistical table shows the shift in population emphasis. Some areas, for example Lake Macquarie, Port Stephens and Wyong, show growth well above the average, reflecting their attraction as places to live and work. By comparison there has been a relatively static or falling population in areas where a decline in work opportunities has occurred, such as Cessnock and Dungog.

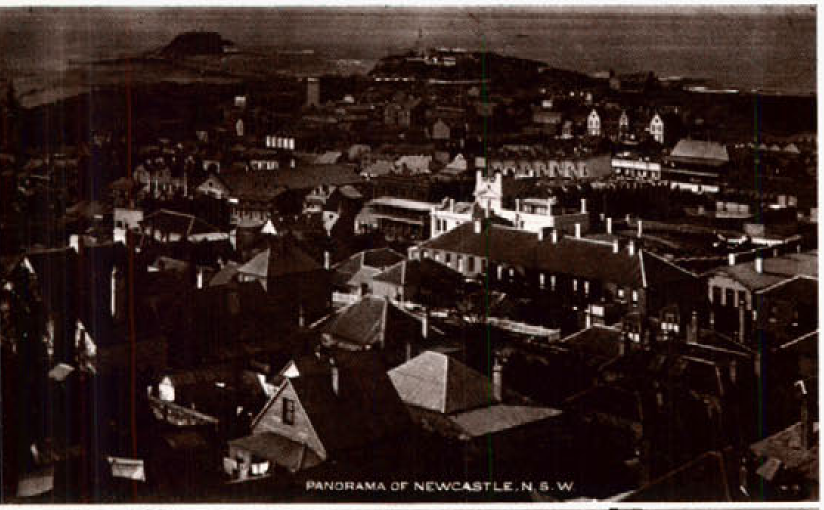
Population shifts are one of a number of sociological factors which are taken into account in planning road needs and which can lead to a change in emphasis in planning road construction priorities.

Steady residential growth in Newcastle's outer suburbs, and adjacent shires has been offset by a population decline in inner areas associated with commercial and industrial re-development. Muswellbrook's population has been stimulated by the establishment of the Electricity Commission's Power Station at Liddell.

Local Government Area	1947	1974	Absolute Increase	Absolute Decrease	Percentage Increase	Percentage Decrease
Newcastle City	129 477	146 710	17 233	..	13·31	..
Lake Macquarie ..	42 288	127 920	85 632	..	202·50	..
Cessnock	37 510	35 050	..	2 460	..	6·56
Maitland	23 621	32 750	9 129	..	38·65	..
Singleton	5 070	7 510	2 440	..	48·13	..
Port Stephens	5 907	18 180	12 273	..	207·77	..
Patrick Plains	4 381	4 400	19	..	0·43	..
Muswellbrook	4 039	8 270	4 231	..	104·75	..
Denman	3 491	3 690	199	..	5·70	..
Dungog	6 875	5 500	..	1 375	..	20·0
Wyong	10 195	38 700	28 505	..	279·60	..
Great Lakes	6 540	7 860	1 320	..	20·18	..
Totals	279 394	436 540	157 146	..	56·25	..

(Above): Dual carriageways on the Pacific Highway at Belmont South.

(Below): Two views of Newcastle in 1895. At the top, the entrance to Newcastle harbour showing Nobby's lighthouse and breakwater. The lower photograph shows a section of Newcastle markets where road improvements were underway.



(Above): Reconstruction on the New England Highway, 3.5 km south of Muswellbrook, where this winding section will be eliminated on completion of a new section on an improved alignment and grading.

(Below): A section of the Deviation between Fern Bay and Williamtown on Main Road No. 108, which now improves access to Stockton Bridge.

(Below): This reconstructed section of the New England Highway north of Long Bridge, Maitland, is part of the improvements recently completed between Long Bridge and Rutherford.

Recent Roadworks

Some works of major significance which have been completed in recent years are:

(1) *State Highway No. 9—New England Highway*

Construction of dual carriageways between 23·4 and 25·9 km west of Newcastle in the approaches to the City of Maitland. This work included the construction of the approaches to the new bridges at Four Mile Creek. (*Cost* $972,000.)

(2) *State Highway No. 9—New England Highway*

Reconstruction and bitumen surfacing from Long Bridge, Maitland to Farley Road, Rutherford, 0·8 to 2·7 km west of Maitland. (*Cost* $628,000.)

(3) *State Highway No. 10—Pacific Highway*

Reconstruction and bitumen surfacing of divided carriageway, Burns Road to Ourimbah Creek 12·6–14·2 km north of Gosford. (*Cost* $326,000.)

(4) *State Highway No. 10—Pacific Highway*

Construction of dual carriageway between Naru Street, Marks Point, and Robert Street, South Belmont, 21·7 to 24·1 km south of Newcastle. (*Cost* $670,000.)

(5) *State Highway No. 10—Pacific Highway*

Reconstruction and bitumen surfacing from Balickera Channel to Twelve Mile Creek, 12·5 to 17·9 km north of Raymond Terrace. (*Cost* $1,244,000.)

(6) *Main Road No. 108—Stockton to Nelson Bay*

New limited access deviation of the road between Fern Bay and Williamtown to complement the Stockton Bridge. (*Cost* $500,000.)

(7) *Main Road No.* 181

Reconstruction to improve alignment, grading and bitumen surfacing, 4·8 to 6·4 km south of Wollombi. (*Cost* $91,000.)

(8) *Main Road No. 217—Boolaroo to Fennell Bay*

Construction between Boolaroo and Fennell Bay, including deviations between Cockle Creek Railway Station and Second Street, Boolaroo; via the new bridges over Cockle Creek, and between Fennell Bay and Booragul. (*Cost* $820,000.)

(9) *Main Road No. 220—Cessnock to Toronto*

Reconstruction of the northern approach to "The Gap" south of Mulbring, 24 km south of Cessnock, to provide a climbing lane for slow vehicles. (*Cost* $85,000.)

(10) *Main Road No. 316—Industrial Route*

Completion of construction from Bull Street to the intersections of Werribi Street and Maitland Road (State Highway No. 10—Pacific Highway), Mayfield. (*Cost* $385,000.)

(11) *Developmental Work No.* 3222

Construction, East Maitland to Buchanan, 6·34 to 8·05 km west of State Highway No. 9 at East Maitland. (*Cost* $145,000.)

Other works which are in progress or planned are:

(1) *State Highway No. 9—New England Highway*

Construction between 25·9 and 28·1 km west of Newcastle, thus extending the dual carriageways to Mitchell Drive, East Maitland. (*Estimate* $750,000.)

(2) *State Highway No. 9—New England Highway*

Reconstruction and bitumen surfacing from Farley Road to Anambah Road, Rutherford, 2·7 km to 4·8 km west of Maitland. (*Estimate* $589,000.)

(3) *State Highway No. 9—New England Highway*

Reconstruction from about 1 km to 7·6 km south of Muswellbrook, including the Muscle Creek Road intersection. (*Estimate* $1,254,000.)

(4) *Main Road No.* 218 *and State Highway No.* 9

Construction of inner City bypass from High Street Overbridge (State Highway No. 9) to Mount Pleasant Street. (*Estimate* $500,000.)

(5) *State Highway No. 10—Pacific Highway*

Construction of dual carriageways from Oakdale Road to Oxford Street, Gateshead, 12·6 to 13·7 km south of Newcastle. (*Estimate* $662,000.)

(6) *Main Road No. 325—Speers Point to M.R. 217 at Cockle Creek*

Construction between the Esplanade at Speers Point and the approaches to the new bridges over Cockle Creek. (*Estimate* $255,000.)

Grants and Allocations

The grants to councils and allocations made in recent years to the Hunter Valley Division to carry on the various Construction and Maintenance Programmes are summarised on page 25.

Bridges

In addition to those bridges on State Highways there are 38 bridges in the Hunter Valley Division which are also under the care of the Department. A large number of these are constructed of timber.

Some of the better known (and perhaps renowned) bridges in the Division are those at Stockton and The Entrance, the Fitzgerald Bridge over Williams River near Raymond Terrace, the Irrawang Bridge over Hunter River near Raymond Terrace, the Forster–Tuncurry Bridge over Wallis Lake and the Twin Bridges over Cockle Creek at Teralba.

Some details of bridges built in the Division within the last 10 years are:

(1) *Stockton Bridge*—Costing approximately $6·5 million, it was opened on 1st November, 1971. The 1 023-metre long structure spans the North Arm of the Hunter River, north of Newcastle. It replaced the Newcastle–Stockton Vehicular Ferry Services which carried an average daily traffic volume of 4 060 vehicles, with up to 5 000 vehicles per day during holiday peaks. The Annual Average Daily Traffic Volume on the bridge is currently assessed as being in excess of 7 300 vehicles per day.

(2) *Twin Bridges over Cockle Creek at Teralba*—Costing in the order of $720,000, these two bridges (identical in size and similar in design) were opened on 23rd February, 1973. The name "Watkins Bridge" has been dedicated to the northern bridge, and the two bridges replace the original Watkins Bridge which had been opened on 19th December, 1899, and had been named in honour of David Watkins, one of the few men who had held a seat simultaneously in the State and Commonwealth Parliaments.

The new bridges over the North and South Arms of Cockle Creek are prestressed concrete structures of eight spans, with an overall length of 175 metres, a width between kerbs of 8·5 metres and a 2·7-metre footway.

(3) *Irrawang Bridge over Hunter River at Raymond Terrace.* A special ceremony was held on 20th March, 1970, to open

and name this bridge. It replaced a ferry service across the Hunter River, and its cost together with approaches approximated $878,000.

(4) *The Fitzgerald Bridge at Raymond Terrace.* Has an overall length of 263 metres, a 7·3-metre carriageway and a 1·8-metre wide footway for pedestrians. Its cost, with approaches, was $906,000 and it was opened to traffic on 16th October, 1965.

This bridge provides a permanent link between Raymond Terrace and the Nelson's Plains area and replaces a ferry which had been operating at this site since 1830.

Progress

From the primitive early tracks of 150 years ago, the determined settlers of the Hunter Valley region built up the basis of the network of roads existing today. Most of the great improvements to this road system have occurred in the past 50 years. Instead of narrow, winding, unsealed roads, high standard highways and connecting roads now give superior travelling conditions to the community and aid the movement of the agricultural, industrial and mining products which are so important to the wealth of the Hunter Valley Division and to the welfare of its population.

Programme	1971–72 $	1972–73 $	1973–74 $	1974–75 $
1. State Highway Road Construction—				
(a) Department	1,775,000	1,837,000	1,835,000	1,746,000
(b) Council	120,000	209,000	†247,000	†220,000
2. State Highway Maintenance and Improvement—Roads—				
(a) Department	630,260	721,560	779,360	867,200
(b) Council	27,200	30,100	35,395	64,000
3. Full Cost Bridge Construction—				
(a) Dept. Direct Control ..	1,775,700	372,000	65,000	104,000
(b) Dept. Contract	528,000	544,000	360,000	356,000
(c) Council Direct Control ..	250,000	82,000	50,000	†15,000
(d) Council Contract	..	32,000	43,000	†121,000
4. Maintenance and Improvement of Bridges, Ferries, Docks and Special Subsidiary Works by the Department	651,950	298,100	331,000	407,000
5. Trunk, Tourist and Ordinary Main Roads Construction—				
(a) Other Councils	360,000	336,000	†483,000	†555,000
(b) Newcastle Urban Councils ..	345,000	†500,000	†566,000	†650,000
6. Trunk, Tourist and Ordinary Main Roads Maintenance and Improvement—Council Direct Control	*824,500	*866,000	*851,351	*997,390
7. Tree Planting — Council Direct Control	..	..	..	19,000
8. Ordinary Main Roads Bridge Construction Council contributing—				
(a) Council Direct Control ..	21,000	48,000	†52,000	†108,200
(b) Council Contract	..	35,000	†20,000	†30,000
9. Level Crossing Improvement—				
(a) Council Direct Control ..	13,400	113,700	14,500	†18,000
(b) Public Transport Commission	20,000	186,700	15,000	..
10. Rest Areas—Department ..	..	..	..	22,380
11. Depot Establishment—				
(a) Dept. Direct Control ..	32,100	..	9,000	5,500
(b) Dept. Contract	132,800	26,000	34,000	26,500
12. Developmental Road and Works Construction—Council Direct Control	40,000	90,000	†260,000	†172,000
13. Flood Damage Restoration Work by Councils on Trunk, Ordinary, Main and Tourist Roads ..	..	..	..	37,500
Total	7,547,210	6,027,160	6,050,606	6,541,670

* Calendar Years.
† Denotes Permissible Expenditure.

km A Successful

In the programme of conversion associated with the adoption of the metric system as the only system of measurement in Australia it was envisaged that the changeover from imperial to metric measurement on road signs and in road maps would occur in July, 1974.

The Department of Main Roads was responsible for planning and implementing the alterations to road signs in New South Wales to show distances in metric measurement. This highly complex operation was completed, with few exceptions, over the designated one month period—July, 1974.

In preparation for conversion almost 50 000 signposting units were manufactured. These comprised approximately 22 000 complete signs, more than 12 000 overlay plates which fitted over imperial distances on existing signs and over 13 000 stickers bearing the symbol "km" for attachment to signs as they were converted.

In addition, during the two year period which preceeded July, 1974, all signs showing distances or speeds were manufactured to display metric distances in units and an overlay plate showing the imperial equivalent then pop-riveted to the sign face. Conversion of these new signs simply involved the removal of the imperial cover plate.

Of the 50 000 signposting units, 44 000 were manufactured at the Department's Central Workshop at Granville and 6 000 were manufactured, under contract, by sign manufacturers. As well as the signs and overlay plates, hundreds of steel posts for the erection of new signs were cut to size and sign-mounting brackets were manufactured and distributed to the Works Offices and to Councils throughout the State.

Also associated with the metric conversion of road signs was the erection of 17 000 new speed limit signs by the Department of Motor Transport and it was necessary for that Department's work to be co-ordinated with the work of this Department.

While advisory speed signs now bear the legend km/h whereas formerly they carried the legend "m.p.h.", the appearance of say 65 km/h and 65 m.p.h. are not greatly different. It was recognized that an inattentive motorist might misinterpret a metric advisory speed sign for an imperial one.

In contrast the new speed limit signs were distinctive with the speed in black letters on a white ground inside a red annular ring.

To minimize any possible confusion to motorists it was arranged that speed limit signs and advisory speed signs would be converted on each length of road concurrently. Care was taken during this operation to ensure that a metric/imperial mixture of signs did not occur along the same length of road.

Speedy Speed Sign Change

Priority was given to the changeover of speed signs and this was generally accomplished within a few days of the start of the changeover period. Conversion of the various distance signs was accorded a lower priority than that of speed signs but even so, by the end of July, 82% of the metric conversion had been completed and by the middle of August well over 90% of the conversion was complete.

From the onlooker's viewpoint, the conversion went well but in practice it was not without problems behind the scenes. When field erection of signs began on the 1st July, 1974, there were 2 500 signs still being manufactured. As their production rate was approximately 400 per week it was apparent that the last sign would be manufactured and despatched to its destination for erection shortly after the target date for completion —31st July, 1974.

In addition, once field conversion started, it was found that there were signs which, for various reasons, had been overlooked in the initial inventory and a small but steady trickle of requisitions for metric signs started to flow into the Department's Central Workshop. During the next few weeks the sign shop was in the unenviable position of being within sight of its goal while receiving orders for new signs. Over the next few weeks almost 1 000 additional signs were ordered. While this may seem a large number of signs to overlook, it represents only a minute fraction of the number of signs converted. Two more events occurred at this stage to frustrate the completion of the sign conversion programme.

Firstly, with the expiry of the 1972/74 CAR Act on 30th June, 1974, the position regarding the Department's income over the next few months became uncertain and an embargo was placed on all overtime within the Department and this seriously affected the output of the sign shop at a critical stage. Not only did the embargo on overtime restrict the number of signs which could be produced each week, it also extended the period of manufacture of metric signs. This created an overlap in the programme for the manufacture of signs for other works nearing completion including the opening of the second stage of the South Western Freeway. This resulted in further delay to the metric signs programme. The last

Metric Conversion

metric conversion sign was manufactured on 13th November, 1974.

Secondly, the Public Transport Commission drastically reduced the number of goods trains operating to country centres because of shortage of fuel and deliveries were disrupted. A further complication arose because of the heavy rain and extensive flooding which took place over large areas of New South Wales in mid-1974. Several unclassified roads which the Department maintains in the unincorporated areas of the State were impassable and the signs could not be converted. Also, in many areas the Local Engineer, (Departmental or Council) logically decided that the restoration of flood damaged pavement took precedence over other work including the conversion of signs.

Almost all signs were converted by mid August but because of these various reasons, isolated signs still remained unchanged at the end of December, 1974. Prior to this date, however, where it was obvious that there would be delay in converting a particular sign, the imperial measurement was temporarily blanked out to avoid confusion.

Some comment received has been related to the new kilometre posts which replaced the old concrete mile posts. The new posts, which are more conspicuous than mile posts, have been initially placed at 10 km intervals. This is only a temporary arrangement as a study is currently being undertaken to determine whether ultimately they should be placed at closer intervals or whether different spacings should be adopted for different roads. Meanwhile there has been some comment that, by comparison to the old mile posts, these markers at 10 km spacings are too far apart.

Other comment relates to the use of a single initial letter to denote the next place name on a kilometre post. With metric conversion the opportunity was taken to rationalize the system of towns to which major direction signs and kilometre posts related. As a result some instances have occurred where it is necessary to add the second letter of a town name to a kilometre post. As such anomalies arise they are corrected.

There were in excess of 50 000 road signs in New South Wales to correct to metric measurement and major logistics were involved to encompass the inventory, design, manufacture, transport and erection of this vast number of signs in such a relatively short period.

Considerable credit for the smooth progress of the operation must go to the staff of the Department's Central Workshop and the various Divisional and Works Offices throughout the State, as well as to the staff of the Shire and Municipal Councils who carried out the erection of signs on Main and local roads as required.

Metric Conversion Elsewhere

Away from the sight of motorists, other aspects of the Department's function have been undergoing metric change.

In general, the conversion to use of metric units is proceeding well. The Department has encountered no great difficulties of organization. Personnel in all sections have adapted well to metric measurement.

Legislation, including Weight of Loads

Ordinance 30C of the Local Government Act was amended to metric units in January, 1974, and enforced in its amended form, from 1st February, 1974. Portable weighing machines (loadometers) and weighbridges have been converted. In legal action taken under Ordinance 30C reference is made only to the metric units.

Materials and Research

New metric test sieves have been purchased and gauges and dials on major items of testing equipment have been fitted. Materials specifications are being converted progressively, and at the same time are being revised. Test procedures and report forms have been converted.

Workshops and Stores

Most materials and stores are now purchased and supplied in metric sizes. Stores still supplied in imperial units, such as some nuts and bolts, will be supplied in metric size when the manufacturers equipment is converted.

Surveying and Site Investigation

All measurements, computations and plotting are in metric units, both for land and engineering surveys.

Road Design

Both metric and imperial units are used, depending on the units used in the engineering survey.

Bridge Design

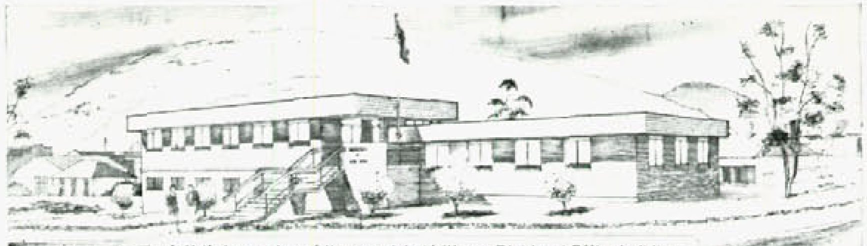
Since August, 1973, all bridge designs, including those prepared by Consulting Engineers, have been prepared in metric units.

Construction of Roads and Bridges

Both systems of units are in use on construction works, as most materials, and stores are supplied in metrict units whilst plans are largely in imperial units.

New Bridge Over Swan Creek, North of Grafton

The construction of a new bridge over Swan Creek, 5·8 km north of Grafton on the Pacific Highway, began in July this year. The new structure will replace two existing timber bridges which have nearly outlived their usefulness. The contract was awarded to Bridge and Civil Pty Ltd, Tamworth, at a tender price of $964,138. The bridge will be a five span prestressed concrete structure with an overall length of 128·6 metres and a width between kerbs of 8·6 metres. It was designed by engineers within the Department of Main Roads.


Artist's impression of the completed Lithgow Divisional Office building.

New Divisional Office Building at Lithgow

A tender was accepted in May this year for the construction of a new office building at Lithgow.

The successful tenderer was Chartron Constructions Pty Ltd at a price of $215,947. The contract involves the construction of a split-level, two-storey building with provision for off-street car parking. It is also intended to landscape the surrounds of the completed building.

The Lithgow Office will house the Central Mountains Division, one of 16 decentralized Divisions of the Department of Main Roads. This Division administers all work on the main roads system from the Blue Mountains to as far west as Bathurst.

· IN GENERAL · IN GENERAL · IN GENERAL · IN GENERAL ·

P.I.A.R.C.

Conference in

Mexico

The Commissioner for Main Roads, Mr A. F. Schmidt, and the Advance Planning Engineer in the Department of Main Roads, Mr B. N. Loder, will be representing New South Wales at the 15th World Congress of the Permanent International Association of Road Congresses (P.I.A.R.C.) next month. The Congress is to be held in Mexico City between the 11th and 24th October, 1975.

Numerous papers have been submitted to the Congress by Australia, including several by engineers within the Department of Main Roads. Topics for discussion at the Congress will include urban roads, the road within the environment, roads and motorways in rural areas, and planning and construction of highways.

P.I.A.R.C., established in 1908, is a world-wide association of national governments with the objective of providing a focal point for the exchange and dissemination of information on current practises in member countries on all matters relating to roads and road transport. By means of its World Congresses held every four years, P.I.A.R.C. provides a forum for presentation and discussion of developments in the broad spectrum of road technology.

Every effort is currently being made to ensure that Australia hosts the 16th Congress in 1979, with the venue in Sydney. If this invitation is successful the Department of Main Roads will be deeply involved with the organization of the Congress.

Overbridge at Kissing Point Road, North Parramatta

The overbridge to carry Kissing Point Road over Rydalmere Avenue, North Parramatta, is expected to be completed and opened to traffic by mid-November, 1975. The work forms part of the North Parramatta By-Pass route from Victoria Road to Pennant Hills Road and Windsor Road at Northmead.

The prestressed concrete portal framed bridge, 36·3 metres long, was designed in the Department of Main Roads, and constructed by E. M. Moore Pty Ltd. It has a width of approximately 18 metres between kerbs and has two 2·5-metre wide footways.

The new by-pass will ease the heavy volume of traffic now using the main road network in the City of Parramatta and also provide a supplementary and more direct route to Sydney and the coast from the rapidly expanding outer Western Suburbs. The section of of the new route from Kissing Point Road to Pennant Hills Road should be available to traffic about Easter, 1976.

New Rest Area at Sandigo

In recent years the Department of Main Roads has been developing roadside rest areas along the State's major roads. They are intended to provide the motorist with a pleasant roadside spot where he can relax or perhaps enjoy a picnic lunch during his journey. Consequently, it is anticipated that rest areas will encourage the motorist to take proper pauses from the fatigues of long distance driving. By taking advantage of these pleasant roadside rest areas, the motorist can return to the road refreshed, relaxed and more assured of a safe journey.

Another rest area has recently been completed at Sandigo, 25 km east of Narrandera, for the convenience of motorists using the Sturt Highway (State Highway No. 14).

The rest area contains sheltered seats and tables, barbeque facilities, water supply and litter receptacles.

Four New Bridges Over Darling River Flood Plain

The replacement of temporary causeways over the Darling River Flood Plain on the Barrier Highway east of Wilcannia by four new bridge structures, will be another big step towards making the Barrier Highway a flood-free route. L. M. Robertson Construction Co. has been the successful tenderer for the construction of the bridges at a price of $365,533.

Designed by the Department of Main Roads, the 24, 30 and two 48-metre long bridges will be located respectively at 1·7, 3·7, 5·9, and 6·4 km east of Wilcannia. Each bridge will be 8·6 metres wide between kerbs with 0·6-metre wide safety kerbs.

N GENERAL · IN GENERAL · IN GENERAL · IN GENERAL ·

Old, narrow bridges on busy roads are a traffic hazard and are being replaced, as quickly as possible, by a whole new series of bridges constructed to modern road standards. Examples of this vital task of replacement, which aims to construct bridges of sufficient size to meet traffic requirements for many years to come, are shown in the photographs above. On the left is the new bridge over Nacka Nacka Creek, while the other photograph shows part of the substructure for the new bridge which will replace the Fitzroy Bridge at Goulburn (details given below).

New Bridge Over Nacka Nacka Creek

The old single lane timber bridge over Nacka Nacka Creek, 28·2 km west of Tumut on the Snowy Mountains Highway, will soon be replaced. The new flood-free structure which is being constructed by Siebels Concrete Constructions Pty Ltd for a tendered price of $142,805, is 57·9 metres long and 8·5 metres wide and was designed by engineers within the Department of Main Roads. Included in the construction of the approaches is a 1·7 km long realignment of the Snowy Mountains Highway.

Replacement for Fitzroy Bridge at Goulburn

Construction is progressing on a new bridge over Mulwaree Ponds adjacent to the old Fitzroy Bridge, 1·9 km north of Goulburn. The contract for the construction of the bridge was awarded in October, 1975, to Transbridge Pty Ltd whose tender price was $554,565. The work involved in the up-grading of this part of the Hume Highway involves construction to dual carriageway standard and the construction of two other new bridges, one over the Main Southern Railway Line and the other over the branch line at Crookwell.

Designed by engineers within the Department of Main Roads, the 107·3 metre long bridge over Mulwaree Ponds will be a 5 span steel and concrete structure equipped with two traffic lanes in each direction, a 1·2-metre wide raised median and a 1·5-metre wide footway.

It will replace the 92 year old Fitzroy Bridge which will be demolished after the project is completed. Constructed in 1883, the old Fitzroy Bridge has a carriageway width of only 6·49 metres and has become totally unsuitable for modern traffic requirements on the Hume Highway.

STATEMENT OF RECEIPTS AND PAYMENTS

RECEIPTS

Motor vehicle taxation
Charges on commercial vehicles under the Road Maintenance (Contribution) Act, 1958
Levy upon Councils in accordance with Section II of the Main Roads Act, 1924
State Government Loans—Repayable
Loan Borrowings under Section 42A of the Main Roads Act, 1924
Contributions by Councils towards maintenance and construction of Main and Secondary Roads
Contributions by other departments and bodies towards maintenance and construction of Main and Secondary Roads
Commonwealth/State Government Grant for Relief of Unemployment
Commonwealth/State Government Grant for restoration of flood damage
Sydney Harbour Bridge Account for freeway approaches
Commonwealth Aid Roads Act, 1969
Transport (Planning and Research) Act, 1974
National Roads Act, 1974
Roads Grants Act, 1974
Commonwealth Government Grants
Other

Total Receipts

PAYMENTS

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

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

Total Payments

for the Year Ended 30th June, 1975

County of Cumberland Fund	Country Fund	Commonwealth Fund	Total 1974–75	1973–74
$	$	$	$	$
23,803,997	59,702,711		83,506,708	79,599,223
4,153,899	16,615,594		20,769,493	19,694,834
155,903	—		155,903	167,237
2,000,000	—		2,000,000	1,500,000
7,931,513	68,487		8,000,000	5,000,000
318,245	117,490		435,735	380,533
23,922	601,037		624,959	640,509
226,046	285,520		511,566	118,531
—	8,267,000		8,267,000	1,500,000
3,039			3,039	6,560
				77,778,240
		1,240,843	1,240,843	
		35,200,000	35,200,000	
		72,354,998	72,354,998	
29,047	12,953		42,000	500,000
1,416,865	444,921		1,861,786	1,040,572
40,062,476	86,115,713	108,795,841	234,974,030	187,926,239

County of Cumberland Fund	Country Fund	Commonwealth Fund	Total 1974–75	1973–74
14,015,032	30,487,372	72,452,678	116,955,082	98,192,623
—	—	9,915,798	9,915,798*	1,149,801
4,059,978	2,568,141	14,958,115	21,586,234	25,654,687
9,838,434	33,634,666	6,990,385	50,463,485	35,332,704
—	7,094,557	—	7,094,557	1,763,522
334,849	440,306	23,560	798,715	907,200
2,906,183	5,922,760	3,975,061	12,804,004	11,183,658
227,944	324,619		552,563	240,093
393,446	607,883	974,218	1,975,547	1,768,710
19,390	201,524		220,914	211,131
219,650	971,626		1,191,276	1,164,339
197,712	212,799		410,511	407,195
764,836	1,118,692		1,883,528	1,803,635
213,900	864,465		1,078,365	703,938
33,191,354	84,449,410	109,289,815	226,930,579	180,483,236
24,375	—	—	24,375	943,539
1,512,289	2,897,659	—	4,409,948	767,673 *Cr.*
34,718,018	87,347,069	109,289,815	231,364,902	180,659,102

* Includes Unclassified roads in the unincorporated area of the Western Division, Developmental Roads and Councils Local Roads taken over from the Public Works Department on 1st Febuary, 1975.

TENDERS ACCEPTED BY THE DEPARTMENT OF MAIN ROADS

The following tenders (in excess of $20,000) for road and bridge works were accepted by the Department for the three months ended 30th June, 1975:

Road No.	Works or Service	Name of Successful Tenderer	Amount
			$
Warringah Freeway	Municipalities of North Sydney and Willoughby. Constuction of new bridge over Brook Street at Naremburn.	McConnell Dowell Constructors Ltd	760,544.00
State Highway No. 2	Hume Highway. Shire of Gundagai. Supply, laying and spreading of asphaltic concrete 18·8 km to 20·4 km south of Gundagai.	Pioneer Asphalts Pty Ltd	40,275.00
State Highway No. 2	Hume Highway. Municipality of Yass and Shire of Goodradigbee. Supply, laying and spreading of asphaltic concrete 1·8 km to 6·6 km south of Yass.	Pioneer Asphalts Pty Ltd	137,280.00
State Highway No. 10	Pacific Highway. Shire of Wyong. Construction of an extension to a reinforced concrete box culvert, 12·7 km north of Gosford on the southern approach to Ourimbah Creek.	Concast Pty Ltd	38,440.00
State Highway No. 10	Pacific Highway. Shire of Macleay. The supply of formwork for the construction of concrete pavement 14·0 km to 19·5 km north of Kempsey at Clybucca Flat.	Squeez-Crete (Aust.) Pty Ltd	46,430.00
Trunk Road No. 74	Shire of Nymboida. Construction of new bridge over Blick's River near Dundurrabin, 86 km from Grafton.	M. & E. Firth Civil Constructions (Tamworth) Pty Ltd	533,240.00
Main Road No. 162	Municipality of Ryde. Erection of masonry and mass concrete wall.	V. & G. Gigante	38,652.00
Main Road No. 309	City of Parramatta. Construction of new foot-bridge over on-loading ramp from Kissing Point Road to Rydalmere Avenue at Rydalmere.	E. M. Moore Pty Ltd	29,951.00
Main Road No. 318	Municipality of Strathfield. Construction of new bridge over Main Suburban Line at Marlborough Road, Homebush West.	Pearson Bridge (N.S.W.) Pty Ltd	495,667.00
Main Road No. 503	Shire of Colo. Construction of new bridge over Currency Creek.	E. M. Moore Pty Ltd	87,368.00
County Road No. 5037	Construction of overpass for access road to Lake Parramatta at North Parramatta.	Reynolds Constructions Pty Ltd	88,869.84
Various	Within Parramatta Division. Supply and lay thermo-plastic roadmaking material at various locations.	Spraypave Pty Ltd	70,830.00
Trunk Road No. 51	Shire of Tallaganda. Construction of the Warri Bridge over Shoalhaven River at 13·4 km west of Braidwood.	Pearson Bridge (N.S.W.) Pty Ltd	838,667.00

TENDERS ACCEPTED BY COUNCILS

The following tenders (in excess of $20,000) for road and bridge works were accepted by Councils for the three months ended 30th June, 1975:

Council	Road No.	Works or Service	Name of Successful Tenderer	Amount
				$
Cessnock	M.R. 218	Manufacture and delivery of 36 precast prestressed concrete deck planks for new bridge over Black Creek, Cessnock.	North-West Pre-Stressed Pty Ltd	26,748.00
Great Lakes	D.W. 3218	Construction of reinforced concrete bridge over Deep Creek, 10 km north of Bulahdelah.	Civilbuild Pty Ltd	148,790.00
Hornsby	M.R. 332	Operation of ferry at Berowra Waters	D. Cox	33,859.00
Imlay	T.R. 91	Construction of new bridge over Honeysuckle Creek at 24·5 km from Princes Highway.	Nelmac Pty Ltd	185,643.20
Lismore City	S.H. 16	Supply and laying of asphaltic concrete.	Bitupave Ltd	35,310.00
Macleay	T.R. 75	Construction of new bridge over Hickeys Creek at Willawarrin, 31·8 km west of Kempsey.	Williams Civil Pty Ltd	225,817.94
Tamarang	T.R. 72	Construction of 5/14·9 m span concrete bridge over Quipolly Creek at Lower Quipolly.	Emoh Ruo Court Pty Ltd	160,535.61
Wakool	M.R. 319	Construction of new bridge over Yarrein Creek, 62·6 km north of Barmah.	Danckert Constructions Pty Ltd	81,840.88
Walgett	S.H. 12, T.R. 68, and M.R. 426.	Bitumen surfacing between 0·37 km and 5·34 east of Collarenebri on Gwydir Highway; on T.R. 68 in town of Collarenebri and between Castlereagh Highway and Lightning Ridge on M.R. 426.	Shorncliffe Pty Ltd	49,315.55

MAIN ROADS STANDARD SPECIFICATIONS

Note: Imperial drawings are prefixed by letter A, metric drawings by letter SD; instructions are so described; all other items are specifications or forms. All forms other than those shown (Metric) are Imperial.

ROAD SURVEY AND DESIGN

	Form No.
Design of two-lane rural roads (Instruction) (1964)	355
Data for design of two-lane rural roads (1973)	892 (Metric)
Flat country cross sections—bitumen sealed pavement (Instruction) (1972)	A 6132
Standard grading at drainage structures in flat country (Instruction) (1972)	A 6161
Standard grading at approaches to culverts (Instruction) (1972)	A 6162
Design of subsoil and subgrade drainage (Instruction) (1973)	513 (Metric)
Standard cross sections for bitumen surfaced two-lane rural roads (1973)	SD 6056

STREET DRAINAGE

Concrete converter	A 1418
Gully grating (1969)	A 190
Gully pit with grating	A 1042
With kerb inlet only	A 1043
With grating and extended kerb inlet	A 1352
With extended kerb inlet only	A 1353
With grating for mountable kerb	A 4832
Perambulator ramp	A 3491
Vehicle gutter crossing (1974)	SD 6247
Kerb and gutter shapes (1975)	SD 6246
Waterway calculations for urban drainage (Instruction) (1963)	371B
Concrete work other than bridges	738 (Metric)

CULVERTS

(a) Cast in place reinforced concrete box culverts—	
Box culvert with wearing surface	SD 6270
Single cell box culvert under fill from 1 m	SD 6271
Single cell box culvert under fill from 0·3 to 1 m	SD 6272
Multiple cell box culvert under fill from 1 m	SD 6273
Multiple cell box culvert under fill from 0·3 to 1 m	SD 6274
(b) Precast reinforced concrete box culverts—	
Supply of precast concrete box culverts	138A (Metric)
Erection of precast concrete box culverts	138B (Metric)
(c) Pipe culverts—	
Construction concrete pipe culverts (1974)	25 (Metric)
Design concrete pipe culverts (1974)	25A (Metric)
Supply and laying of asbestos cement drainage pipes (1972)	861
Headwalls for pipe culverts—	
Single row—	
600, 750, 900 mm dia.	SD 139
375, 450, 525 mm dia.	SD 143
1 075 mm dia.	SD 172
1 200 mm dia.	SD 173
1 350 mm dia.	SD 174
1 500 mm dia.	SD 175
1 800 mm dia.	SD 177

BRIDGES

	Form No.
Concrete work for bridges (1974)	350 (Metric)
Concrete end posts for concrete bridges	A 279
Concrete end post and handrailing for prestressed concrete bridge units (1959)	A 4932–33
Data for bridge design (1973)	18 (Metric)
Erection of precast, prestressed concrete bridge units and planks (1974)	557 (Metric)
Erection of precast, prestressed concrete piles (1966)	558
Erection of precast, prestressed concrete bridge girders	561 (Metric)
Extermination of termites in bridges (Instruction) (1958)	326
Excavation for bridges (1974)	563 (Metric)
Supply of high strength steel bolts (1968)	261
Erection of steelwork using high strength steel bolts (1975)	262 (Metric)
General notes on Assembly of bridge construction specifications (Instruction) (1962)	599
Manufacture of precast or cast-in-place, prestressed concrete bridge members (1970)	556
Manufacture of elastomeric bearings for bridge units and girders (1967)	562
Preparation and pretreatment of metal surfaces prior to protective coating or painting—Method Selection Guide	1032 (Metric)
Proforma specification for bridge construction (Instruction) (1962)	599A
Protection of steelwork by metal coating in shop (1961)	579
Protective treatment (Field) of steelwork—metal spraying and painting (1961)	584
Protection angles for bridges or culverts with concrete wearing surfaces (1960)	A 1272
Prestressed concrete bridge drawings—	
(a) Bridge units for square and skew crossings, 25 ft to 35 ft spans (1963)	A 4910–12
(b) Bridge girders pretensioned or posttensioned, 40 ft to 70 ft spans (1964)	A 5540–49
(c) Reinforced concrete deck for precast, prestressed concrete bridge girders 24 ft and 28 ft between kerbs 40 ft to 70 ft spans (1963)	A 5550–59
(d) Formwork slabs for prestressed concrete bridge girder	A 5560
(e) Details of cast-in-place deck for prestressed concrete bridge units 25 ft to 35 ft spans (1967)	A 4931
(f) Prestressed concrete piles—	
12 in x 12 in—35 tons	A 4764
14 in octagonal—45 tons	A 4943
16 in octagonal—50 tons (1963)	A 4944
(g) Test load diagrams for prestressed concrete piles—	
12 in x 12 in	A 5601
14 in and 16 in octagonal piles	A 5828
(h) Test loads for prestressed concrete bridge units (1964)	A 5514
(i) Flexural tension test loads for precast prestressed concrete bridge girders (1964)	A 5538
(j) Principal tension for precast, prestressed concrete bridge girders (1964)	A 5539
Reinforced concrete piles 35 and 45 tons (1963)	A 1207–8
Reinforced concrete piles for bridge foundations (precast)	564
Standard bridge loading (Instruction) (1957)	A 4
Superstructure for bridges	568
Timber for Bridges (1966)	140
Timber bridge drawings—	
(a) Timber beam bridge, 24 ft between kerbs (1961)	A 5593
(b) Timber beam bridge, details of construction (1961)	A 5594
(c) Longitudinal deck sheeting (1961)	A 5576
Waterway diagram (0 to 200 acres)	A 26

BITUMINOUS SURFACES

Bituminous emulsions (cationic) (1973)	304 (Metric)
Bituminous emulsion (anionic) (1973)	305 (Metric)
Residual bitumen (1974)	337 (Metric)
Supply of prepared cutback bitumen for sealing purposes	740
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Supply and spraying of bitumen (1973)	898 (Metric)
Sealing and resealing with bitumen (1974)	93 (Metric)
Cutback chart for bitumen seal costs (1973)	466 (Metric)
Bituminous surfacing daily record (1974)	400 (Metric)
Sprayer loading slip (1974)	401 (Metric)
Bituminous surfacing job summary (1974)	1011 (Metric)
Standard performance requirements for mechanical sprayers for bituminous materials (1973)	272 (Metric)
Supply and delivery of cover aggregate for bitumen seal coats (1973)	351 (Metric)
Supply and laying of asphaltic concrete paving mixtures (1974)	612 (Metric)
Supply and delivery of asphaltic concrete (1974)	953 (Metric)

FENCING

	Form No.
Chain wire guard fencing (1974)	144 (Metric), SD 149.
Corrugated guard rail (1971)	A 5595
Protection fencing using corrugated steel guardrail (1973)	A 5829
Warrants for use of guard fences (Instruction) (1973)	246 (Metric)
Erection of guardrail protection fencing (1971)	680
Ordnance fencing	143, A 7
Post and wire fencing (1974) Drawings: Sheep SD 494 (1974); Rabbit-proof SD 498 (1974); Cattle SD 1705 (1974); Floodgate SD 316 (1974)	141 (Metric
Removal and re-erection of fencing (1974)	224 (Metric)

FORMATION, INCLUDING EARTHWORKS AND RURAL DRAINAGE

Earthworks and formation (1974)	70 (Metric)
Shoulders and table drains (1973)	827 (Metric)
Standard rubble retaining wall	A 114
Standard mass concrete retaining wall (1959)	A 4934
Standard cantilever retaining wall (1959)	A 4935
Subsoil drains (1973)	528 (Metric)
Corrugated PVC subsoil drainagage pipe (1972)	907 (Metric)
Installation of lateral drains	1013 (Metric)

PAVEMENTS

Cement concrete pavement (1960)	A 1147
Preformed expansion fillers (1962)	610
Supply and delivery of ready mixed concrete (1973)	609 (Metric)
Construction of natural gravel or crushed rock road pavement (bitumen surfaced) (1975)	743 (Metric)
Supply of natural gravel or crushed rock for road pavements (bitumen surfaced) (1975)	744 (Metric)
Construction or resheeting of natural gravel or crushed rock road pavement (not to be bitumen surfaced) (1975)	800 (Metric)
Supply of natural gravel or crushed rock for road pavements (not to be bitumen surfaced) (1975)	801 (Metric)

ROADSIDE

Roadside fireplace (1974)	SD 4671
Roadside litter bin	A 5841

TRAFFIC PROVISION AND PROTECTION

Floodway information sign (1966)	A 5752
Manufacture of warning signs (1968)	682
Motor grid 12 ft (A 5769); 24 ft (1964)	A 5770
Control of traffic at Roads and Bridgeworks (1975)	121 (Metric)
Guide posts—supply (1973)	252 (Metric)
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Roadmarking paint (1966)	671

CONTRACTS

Bulk sum tender form, Council contract (1966)	39
Bulk sum contract form, Council contract (1975)	38
Cover sheet for specifications, Council contract	342
Caretaking and operating ferry	498
General conditions of contract, Council contract (1966)	24B
Schedule of quantities form (1966)	64

MANUALS

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

BOOKLETS

Guide to Main Roads Administration.
General Conditions of Assistance to Councils.
Miscellaneous Activities on Main Roads.
Schedule of Descriptions of Classified Roads and Works.
Duties and Responsibilities of a Superintending Officer.

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

Guide to Publication and Policies of N.A.A.S.R.A.
Policy for Geometric Design of Rural Roads*.
Highway Bridge Design Specification*.
Highway Bridge Construction*.
Full list of publications and prices.

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

G 3829 D. West, Government Printer, New South Wales—1976