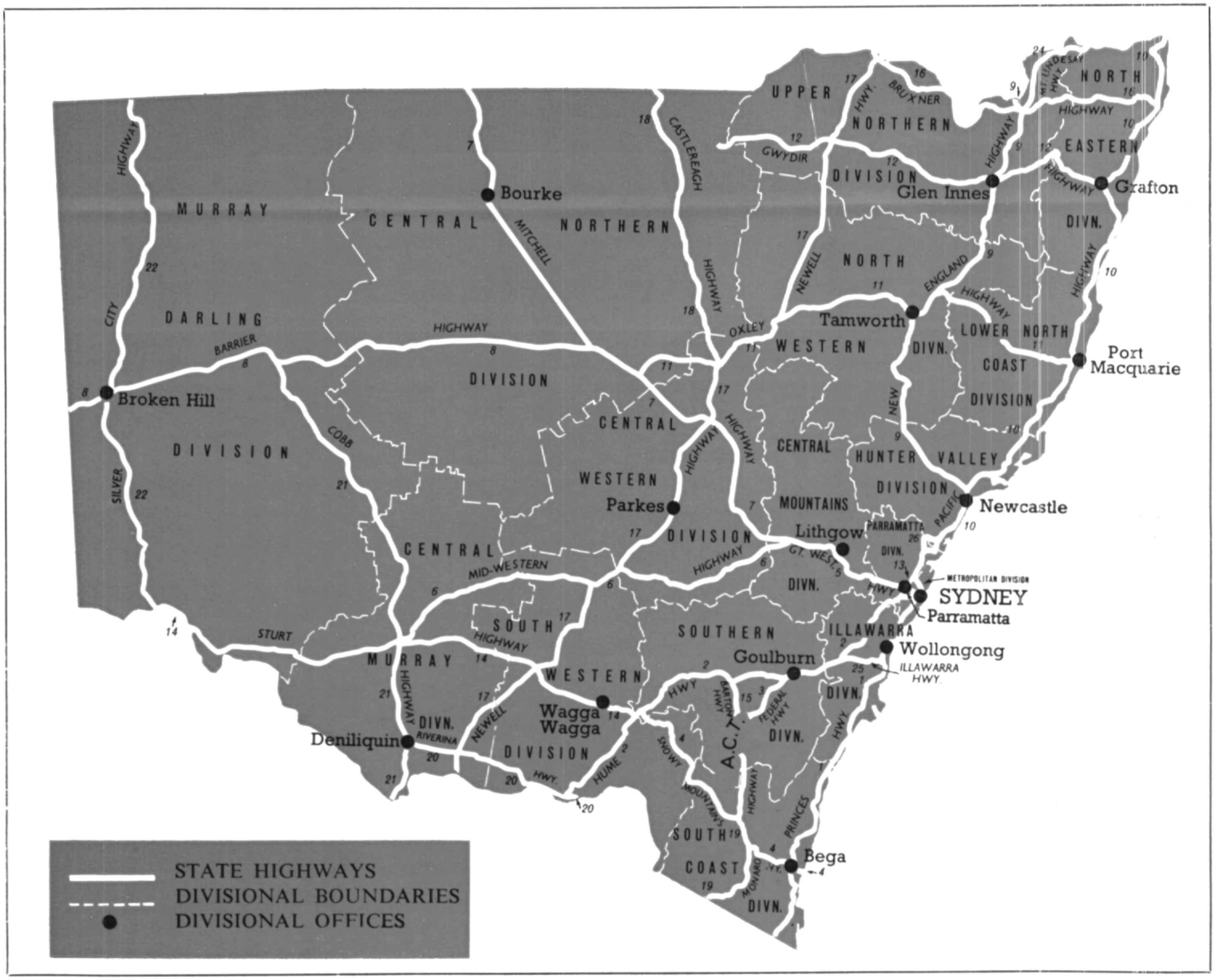
MAIN ROADS

SEPTEMBER
1973



Area of New South Wales—309,433 square miles

Length of public roads within New South Wales—129,715 miles

Population of New South Wales at 31st March, 1972—4,671,800 (estimated)

Number of vehicles registered in New South Wales at 31st July 1972—2,218,451

ROAD CLASSIFICATIONS AND MILEAGES IN NEW SOUTH WALES

Mileage of Main, Tourist and Developmental Roads, as at 30th June, 1972

Expressways	30
State Highways	6,535
Trunk Roads	4,375
Ordinary Main Roads	11,513
Secondary Roads (County of Cumberland only)	177
Tourist Roads	251
Developmental Roads	2,553
	25,434
Unclassified roads, in western part of State, coming within the provisions of the Main Roads Act	1,490
TOTAL	26,924

MAIN ROADS

JOURNAL OF THE DEPARTMENT OF MAIN ROADS, NEW SOUTH WALES

SEPTEMBER, 1973

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Front Cover: The Kings Cross Road Tunnel Project showing the bridges at Craigend Place and Victoria Street which will form the eastern and western portals of the tunnel

MEETING OF THE WAYS

Back in the bad old days of the American Wild West (if we are to believe the movies), a situation called a "mexican standoff" would sometimes arise.

While it is rather hard to find an exact definition of such a colloquial expression, it means, more or less, all parties at a deadlock, or all weapons drawn, so that no move can be made and no resolution of the situation is possible without one party taking a risk. The risk, usual in this type of incident, being a bullet or two.

It's a long way from the American Wild West to the Main Roads of New South Wales but an analogous situation which sometimes occurs at intersections on main roads, given our present road rules, has all the quality of a "mexican standoff". The deadlock—four drivers in vehicles facing each other, one at each side of a square. The advantage—nil to any one as each expects right of way on one side and loses it on the other. The weapons—four high powered steel vehicles each fast off the mark and with proven ability to kill.

One driver will eventually move and after risking a few hesitant feet of forward travel will probably stop, look at the other drivers and gauge their reaction. Is it safe to go further? Eventually, with a number of starts and stops the "standoff" breaks and traffic rolls again.

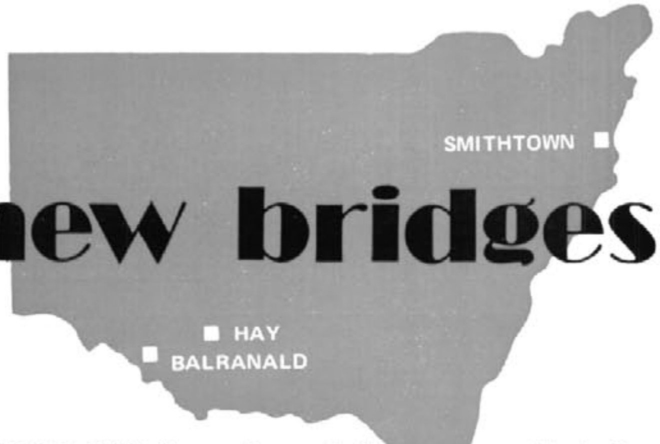
This problem at several intersections can rapidly turn a normally calm, even tempered driver into an angry, impatient menace. Combine this situation with darting pedestrians, right turning traffic and a few "close misses" caused by poor judgement on the part of other drivers and it is easy to see why more driver frustration occurs at intersections than at any other location along the road.

In urban areas particularly, where busy intersections are so numerous, intersection design is constantly being reviewed to accommodate changing traffic patterns and capacity and so eliminate intersection danger and accelerate the flow of vehicles. Regardless of the care taken by road designers, however, safer, more free-flowing intersections are chiefly the responsibility of the individual driver. There is a temptation when green lights can be seen ahead to enter the intersection feeling certain that no hazards exist *because* the lights are green. While the thought which goes into the timing of traffic signals is considerable, this type of driver attitude is foolish because it discounts the additional factor of human error. The possibility of uncontrollable situations such as a vehicle making an illegal turn, a pedestrian stepping out suddenly or another foolish driver attempting to "beat" a red light, is always there.

The design and construction of main roads is a response to a community demand to travel by road. Safety factors are blended into this design to reduce the risk of collisions before they occur. But basically, safety on the roads and safety at intersections in particular all harks back to the individual and his social responsibility to protect himself and others from injury and death.

Reducing speed and giving way at intersections, in other words, good manners at intersections, are *not* the responsibility of the "other" driver. The days of the Wild West are over●

3 new bridges



Within eight days from 8th June to 15th June, 1973, three major new bridges were opened to traffic on Main Roads in New South Wales. Two were located only 80 miles apart at Balranald and Hay, the third at Smithtown on the opposite side of the State. Wherever their location, new bridges such as these are welcome additions to the Main Roads system and many thousands of motorists are now benefiting from the safer travelling and convenience they provide.

BALRANALD

NEW BRIDGE OPENED ON 8TH JUNE, 1973

Situated on the Sturt Highway in the south-western region of New South Wales, Balranald holds the honour of being the oldest settlement on the Lower Murrumbidgee River. Its present population of about 1,350 relies heavily on the wool—veal—wheat economy of the surrounding area.

On 8th June, 1973 a new bridge over the Murrumbidgee River at Balranald was opened in the morning by the Acting Minister for Highways, the Hon. A. H. Jago, M.L.A. It was a busy day for Mr Jago as another bridge at Hay, 80 miles east by the Sturt Highway, was opened by him in the afternoon.

Close by the site of the new bridge at Balranald a previous bridge stood and served the town for 92 years. In the same vicinity, over 110 years ago, a punt began carrying stock across the Murrumbidge River and gave the tiny settlement its start. The river trade grew, particularly that involving wool carrying, and the value of land increased as a consequence, even though life for the settlers had few comforts. Bailliere's Gazetteer of 1866 notes of Balranald, Euston and Maude: "There is no communication with these places by land except on horseback, but the Murray and Murrumbidgee river steamers call at the places on these rivers . . .".

Although gazetted in 1851, the town of Balranald was a little on the shaky side during the 1850's and even by 1873 the population amounted to only 350. By that date, however, the town could boast a public school, several stores, two public houses, a police station with lock-up and a resident police magistrate, Robert B. Mitchell, a son of the early road builder and Surveyor-General, Sir Thomas Mitchell.

Eight years later on 24th June, 1881, Balranald gained another important landmark, the iron bridge over the Murrumbidgee River now superseded by the new structure. The 333 feet long bridge is believed to have been the first of its kind constructed in the colony.

The opening of the bridge by the then police magistrate, Mr Cooke, was the occasion for a public holiday with many private parties, while at the end of the day an amateur concert for charity was held. The opening ceremony itself was a grand affair conducted with full Masonic honours including members of the lodge decked out in full regalia and complete with banners. It was probably the occasion for a good deal of celebration drinking too when you consider that the residents of Balranald, although numbering just 400, had six hotels at their disposal.

The demands of modern traffic eventually required the replacement of the old bridge. The floods of 1951 shortened the life of the bridge and it also suffered from the inherent dangers associated with its narrowness and the fast heavy interstate transports which comprise a major part of the traffic on the Sturt Highway.

The New Bridge

The new bridge now crossing the Murrumbidgee River at Balranald is 470 feet long with seven spans, two of 50 feet, four of 70 feet, and one of 90 feet, 30 feet wide between kerbs with a 4 feet 9 inch wide footway for pedestrians. The main river span of 90 feet between piers has a vertical navigational clearance of 28 feet above normal river levels.

The bridge is of a continuous composite concrete deck and steel girder construction, except that the 90 ft main span contains a 54 ft $8\frac{1}{4}$ in suspended or drop in span, simply supported between the ends of the cantilevers of that span.

The approaches, which have involved construction of embankments up to 22 feet high, add to the elegance of the structure and create a pleasing effect for motorists driving into the town. Lighting has been provided on the bridge and town approach.

The cost of the structure was approximately $385,000 and it is expected that the final cost for the approaches will be about $230,000.

The bridge was designed by Messrs Taylor, Thompson, and Whitting, Consulting Engineers and was constructed by contract under the supervision of the Department by McMillan Construction Pty Ltd of South Australia.

The opening of this new bridge greatly improves traffic conditions at Balranald for local transport and the increasing numbers of tourists and long distance commercial vehicles which use the Sturt Highway for travel between New South Wales, South Australia and Victoria.

HAY

NEW BRIDGE OPENED ON 8TH JUNE, 1973

The town of Hay (population about 3,000) is the meeting point of two major highways, the Sturt Highway, an important arterial east-west route, and the Cobb Highway from Wilcannia in the north to Victoria. The Mid Western Highway from Bathurst terminates at Hay, as does a branch of the main southern railway line from Junee.

This geographical situation gives Hay great importance as a communication and distribution centre for the Riverina district generally, particularly as the locality is a high grade wool growing area.

Even though the present economy of the town owes much to sheep, it was cattle which established the site of the town in the 1850's when thousands of head of stock bound for Victoria forded the Murrumbidgee River at that point. The first mechanical punt was established in 1857, and a pontoon bridge, formed by adding a punt onto the old punt, existed from 1863.

On 12th August, 1858, a surveyor named Adams was instructed to lay out a town at Lang's Crossing, as it was then known, and the "Sydney Morning Herald" at that time predicted that the town "will serve as a port or rallying place in the same manner that Deniliquin does to the Edward River settlers". By Government Gazette of 7th October, 1859, the town of Hay was proclaimed, being named after the then local member of Parliament who later became Sir John Hay.

By 1866, the population of Hay, aided by a series of successful land sales, reached 250, but the new settlers appeared to prefer settling in the vicinity of the local hotel than in the area surveyed by the government. After a few years of prosperity the completion of the railway line to Wagga in 1878 temporarily reduced the importance of Hay as a large centre.

By the 1880's, Hay became one of the most important country centres in the State. The railway line was extended from Narrandera to Hay, the Cobb & Co. office and coach factory was established there, and water and gas was made available to the residents.

The old bridge at Hay was completed in February, 1873 under contract to the Department of Public Works and opened by Mr Henry Parkes on 29th August, 1874.

This bridge was constructed 788 feet long, had a swing span opening to allow the passage of river traffic, an important aspect of Hay's economy in those days. The bridge has had a long life and has withstood the many floodings of this river, particularly the 1931 floods which severely scoured and eroded the banks of the river. The last occasions on which the bridge was opened for river traffic were on 25th August, 1936 for the steamer "Ulonga" and early in 1937 when the steamer "Adeline" brought in a load of timber, after which river traffic of such size ceased.

The New Bridge

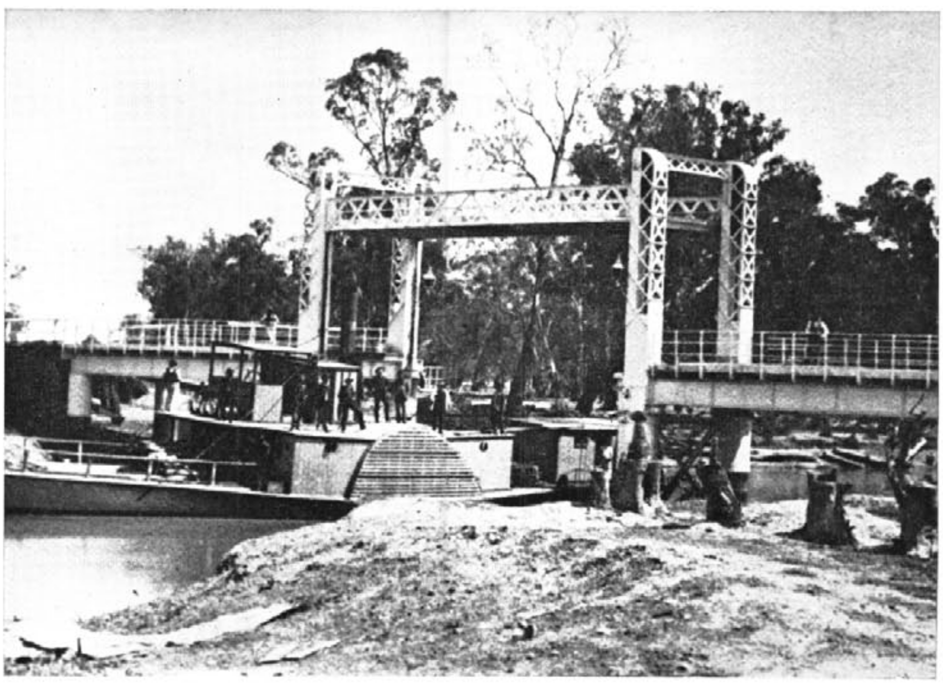
The opening of the new bridge over the Murrumbidgee River at Hay by the Acting Minister for Highways, The Hon. A. H. Jago, M.L.A. marks the end of life for the old structure which will now be demolished.

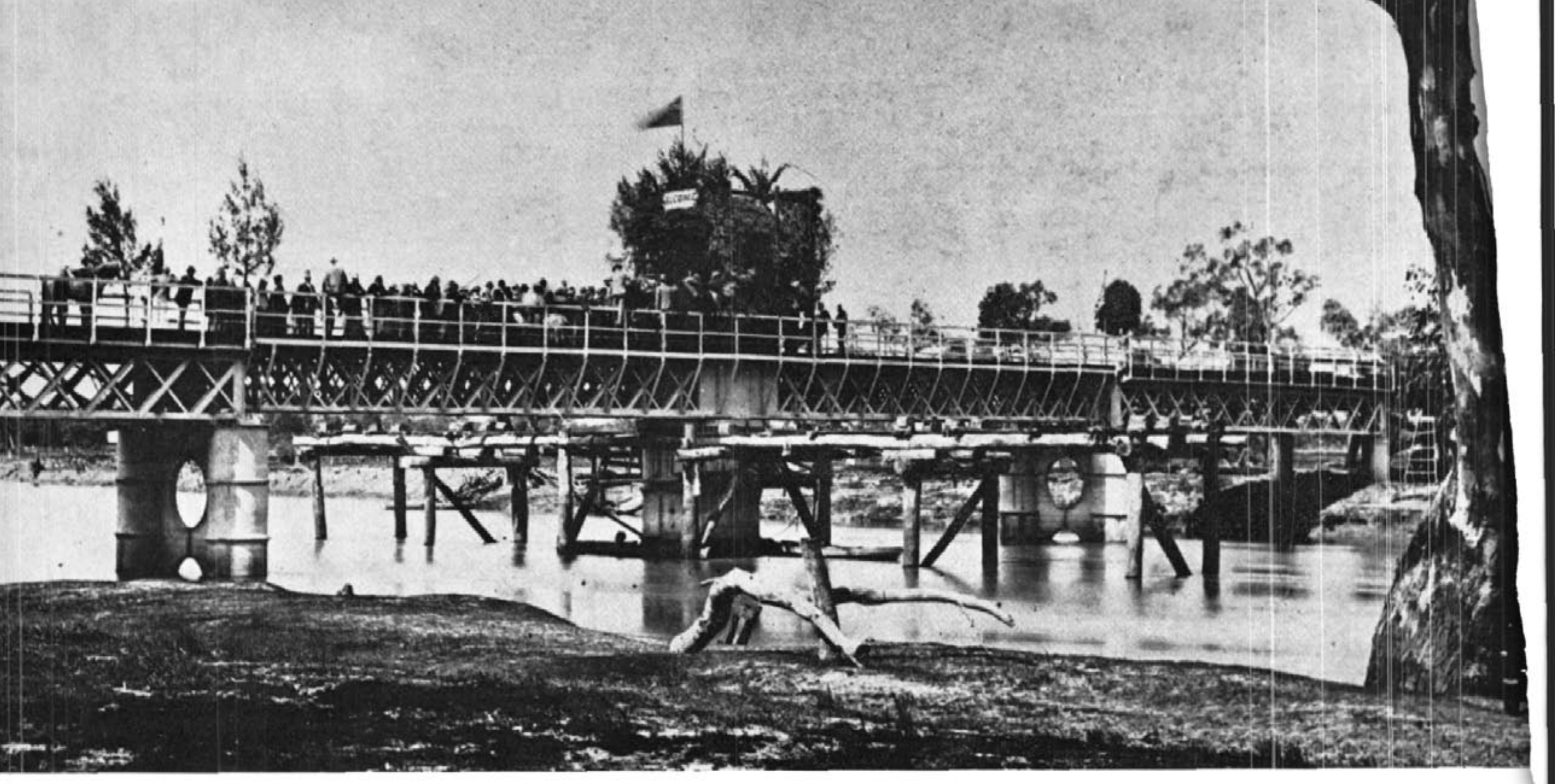
The new bridge is a six span, reinforced concrete and steel box girder structure supported on steel piles and slender concrete piers. It has an overall length of 638 feet with two 97 feet spans and four 105 feet spans, and is 30 feet between kerbs. A five feet wide footway has been provided for pedestrian use.

Each box girder is made up of five cells each six feet wide and three feet three inches high. The base and walls of each cell are steel plates and the reinforced concrete deck forms the top section. A feature of the design is the cantilever construction of the girders which is illustrated in the photograph (on next page) of the placing of the last girder in position. This allows a greater distance between piers than a simply supported span design.

Hay is located on the Western Plains where the clay and silt deposit can be up to 1,500 feet in depth. Due to the complete absence of rock in this deposit, 10 in x 10 in rolled "H" section steel piles have been used for the foundations. These vary from 51 feet to 81 feet in length.

The elevated lift span of the old bridge at Balranald was a distinctive feature of its design. When river trade flourished on the Murrumbidgee, many vessels such as the one in this photograph taken during the 1880's, passed beneath the span. In later years the lift span was used infrequently and it was last opened to river traffic for the transport of wool by paddle steamer from Wangorah Station during the 1956 floods





Above: This photograph of the first Hay bridge opening was taken on 29th August, 1874, when Mr Henry Parkes, Premier and Colonial Secretary, carried out the opening ceremony. To quote the "Riverine Grazier" of Wednesday, 2nd September, 1874:

"THE PROCESSION was headed by the children of Mr Murray's school who turned out in holiday attire with banners flying, looking full of health, happiness, and hope. Nearly all the respectable inhabitants fell into line, and a great crowd marched on to the centre of the bridge where an arch of green boughs had been erected . . ."

The swing span of the old bridge at Hay was rather unique for that area of the state where lift spans in bridges were usual. Arrangements have been made for the operating mechanism of the swing span to be handed over to the Hay Historical Society for installation in the proposed Pioneer Park and Museum at Hay

Upstream section of girder No. 3 being lifted into position on the new bridge on 1st March, 1973

Coffer dams of steel sheet piling were constructed in the river to enable the construction of the two pile caps and the lower portions of the two piers in the river.

The steel girders were manufactured at Sydney in pairs 15 feet wide, transported by road to Hay and bolted together after having been placed in position on falsework. The longest sections handled were 65 feet, end to end, and each weighed 24 tons.

The bridge was designed by Gordon Bull and Associates, Consulting Engineers and was constructed by contract to and under the supervision of the Department by Central Constructions Pty Ltd of New South Wales. The approaches were designed and constructed by the Department. The total cost of the bridge and approaches was $890,000.

The completion of this bridge by the Department, together with the channelisation of the intersection of State Highways Nos 14 and 21 immediately south of the bridge and the reconstruction of Lachlan Street, State Highway No. 21, Cobb Highway by Hay Shire Council, immediately north of the bridge, will ensure a smooth flow of traffic through the township of Hay.

Previous articles on the new bridges at Balranald and Hay appeared in "Main Roads"—Vol. 36, No. 3, p. 73, March 1971.

SMITHTOWN

NEW BRIDGE OPENED ON 15TH JUNE, 1973

The new bridge at Smithtown over the Macleay River was built at a cost of over $1¼ million. It is 1,125 feet long and has ten spans, one of which can be modified into a lift span later if necessary. The width between kerbs is 28 feet providing two traffic lanes and there is a 7 feet 6 inch wide footway on the upstream side. The design also allows for a maximum clearance of 16 feet above the highest recorded flood level, and a navigation clearance of 30 feet above mean high water.

The bridge eliminates a vehicular ferry service and links the townships of Smithtown and Gladstone. Travellers to the popular tourist resort of South West Rocks can now connect directly from the Pacific Highway at Main Road No. 556 at Sevenoaks about 8 miles north of Kempsey as well as at Main Road No. 198 in Kempsey.

There are now only 12 ferry services operating on Main Roads in New South Wales. Prior to Smithtown the previous ferry service to be replaced was over the Hunter River at Stockton (near Newcastle)

The Ferry Service

Ferries may be considered colourful and quaint by some travellers, but on busy roads they become an exasperating inconvenience. In recent years, the ferry master of the Smithtown ferry had a difficult task in maintaining the timetable particularly when large milk lorries from a nearby factory limited the number of other vehicles which could be carried in a single trip. At flood times, when the ferry was unable to run at all, local residents were forced to make lengthy detours to cross the Macleay River.

Attitudes change, and just as today the new bridge pleases, back on 12th February, 1842, when the first ferry crossing commenced, the local residents were similarly contented. At that time, settlement extended along the river at such locations as Frederickton, Smithtown (which was named in 1877, in honour of Robert Smith M.L.A.), Gladstone, Kinchela, Jerseyville and Stuart's Point and because road communications were virtually non-existent, most transportation was by water.

Design of the New Bridge

The new bridge is founded on composite concrete and steel piles up to 125 feet long, driven to refusal into weathered mudstone. The top portion of each pile is made of a 19 inch x 19 inch reinforced concrete section and extends below mud level and the bottom portion is made of a rolled steel "H" section 10 inch x 10 inch. The pile caps supporting the twin rectangular pier shafts incorporate pre-cast concrete skirting units thus eliminating the need for coffer dam construction.

The superstructure is unusual in that maximum use has been made of precast components. This has resulted in a very good finish being obtained for a minimum amount of falsework used during construction.

Twin rectangular prestressed concrete box girders, simply supported on the pier shafts, carry the precast "waffle" slab deck on nibs projecting from the inside face of each box girder. As there is no other cross connection between the box girders for the entire length of the bridge, the pattern formed by the underside of these "waffle" slabs is an attractive innovation.

The footway is composed of precast slabs cantilevered from the top of the upstream box girder and is rigidly connected to it by means of the in-situ reinforced concrete traffic kerb.

Similarly on the down stream side of the bridge the in-situ traffic kerb connects the precast outer kerb to the top of the box girder. Grill type handrails and a 2 inch thick asphalt wearing surface complete the structure.

Construction Techniques

During the course of construction a yard was set up adjacent to the bridge for casting the piles and superstructure components. Steam curing of products enabled a high output rate to be obtained.

Each box girder was made of segments approximately 9 feet long and stressed into a complete span by cables threaded through the segments. An erection truss supported these segments over a full span until they were stressed together. After this operation the erection truss was lowered and moved sideways to construct the other box girder of the span.

The "waffle" slabs were made in bays 8 feet 10 inches long and stressed together with longitudinal cables over each span. The slabs were temporarily supported on galvanised steel packers on the girder nibs until stressed together when in-situ mortar was then packed in and around the steel packers to give bearing over the full length of each supporting girder nib.

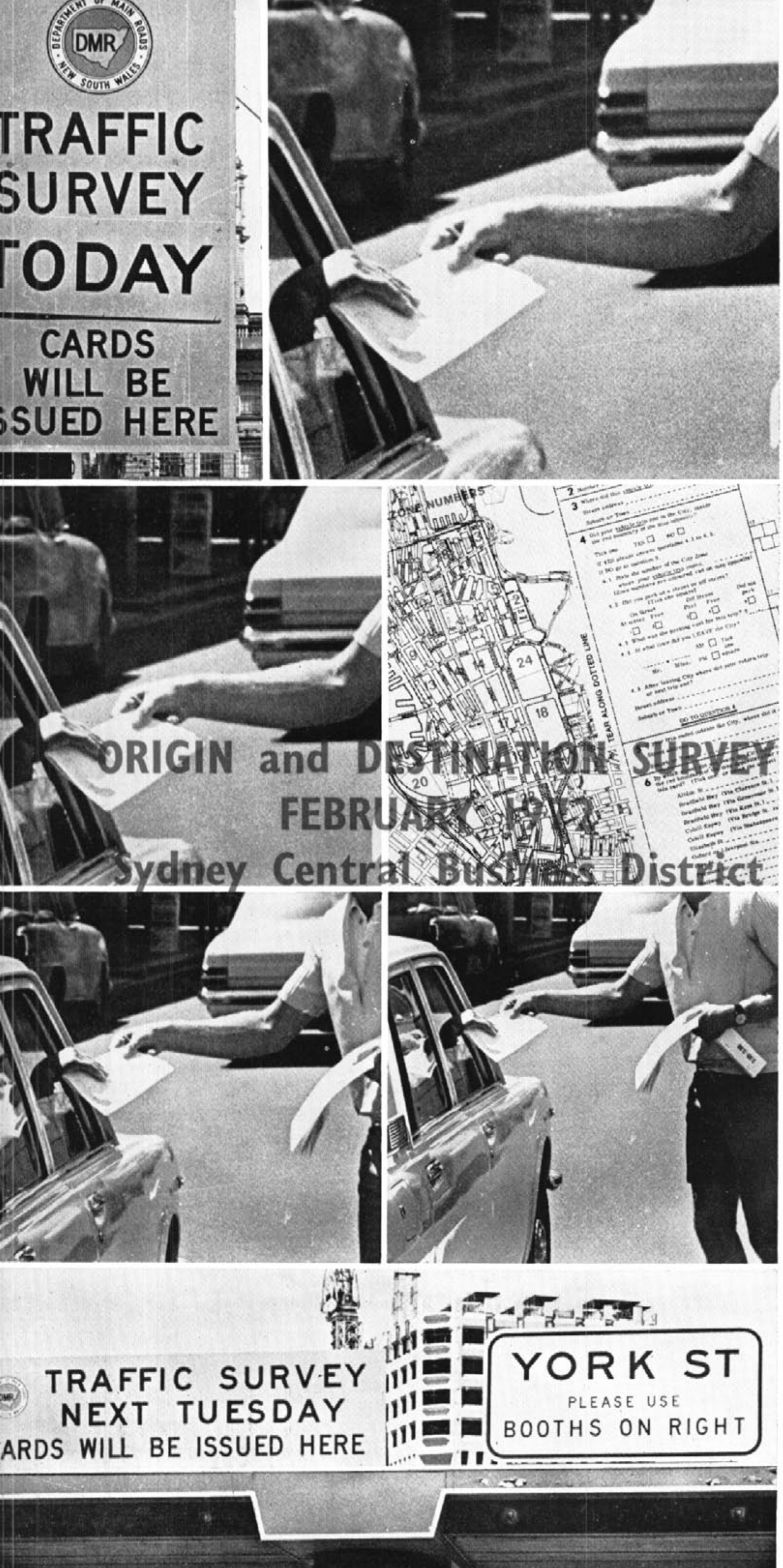
The cantilever footway segments were temporarily held by bolts until the in-situ kerb was cast and considerable care was required to achieve good alignment between segments.

The bridge was designed by Messrs Sir Alexander Gibb and Partners, Australia, Consulting Engineers and was constructed by contract to and under the supervision of the Department by John Holland Constructions Pty Ltd. The approaches to the bridge were designed and constructed by the Shire of Macleay and the final cost for both bridge and approach will be approximately $1,280,000.

* * * * *

Previous articles appeared in "Main Roads"—Vol. 36, No. 4, p. 106, June 1971 and Vol. 37, No. 3, p. 94, March 1972.

The original Smithtown Ferry, photographed in March, 1909



ORIGIN and DESTINATION SURVEY FEBRUARY 1972 Sydney Central Business District

On Tuesday, 15th February, 1972, an Origin and Destination Survey of the Central Business District of Sydney was undertaken by the Department of Main Roads, with the co-operation of the Department of Motor Transport, the Sydney City Council and the New South Wales Police Traffic Branch.

The survey was aimed at determining vehicle and person trips, by origin and destination, to, from and through the Central Business District (C.B.D.) in the morning, evening and off-peak hours. Other data obtained included the occupancy of private vehicles entering the C.B.D., the distribution of parked vehicles and their average parking costs. Average weekday and weekend-day traffic volumes on the major street network were also recorded during and after the survey together with hourly distributions of traffic volumes at some selected sites.

Why

The major reason for conducting this survey was to determine travel patterns then used by drivers to and from the city and by analysis of the data how these travel patterns might change with the opening of the Western Distributor between the Sydney Harbour Bridge and Day Street (opened in September 1972). With this information the Department was able to plan and arrange modifications to the existing traffic management on nearby city streets to obtain the maximum benefit from the new work.

The survey also gathered information on parking in the C.B.D. as part of the Sydney Area Transportation Study.

The Survey

To conduct the survey, a questionnaire in the form of a post card (illustrated at left), was handed to drivers entering the C.B.D. at 18 survey stations bordering the C.B.D. This was done between the hours of 7.30 a.m. and 6.30 p.m. and, of a total of 113,739 cards issued, 44,571 (38 %) usable cards were returned.

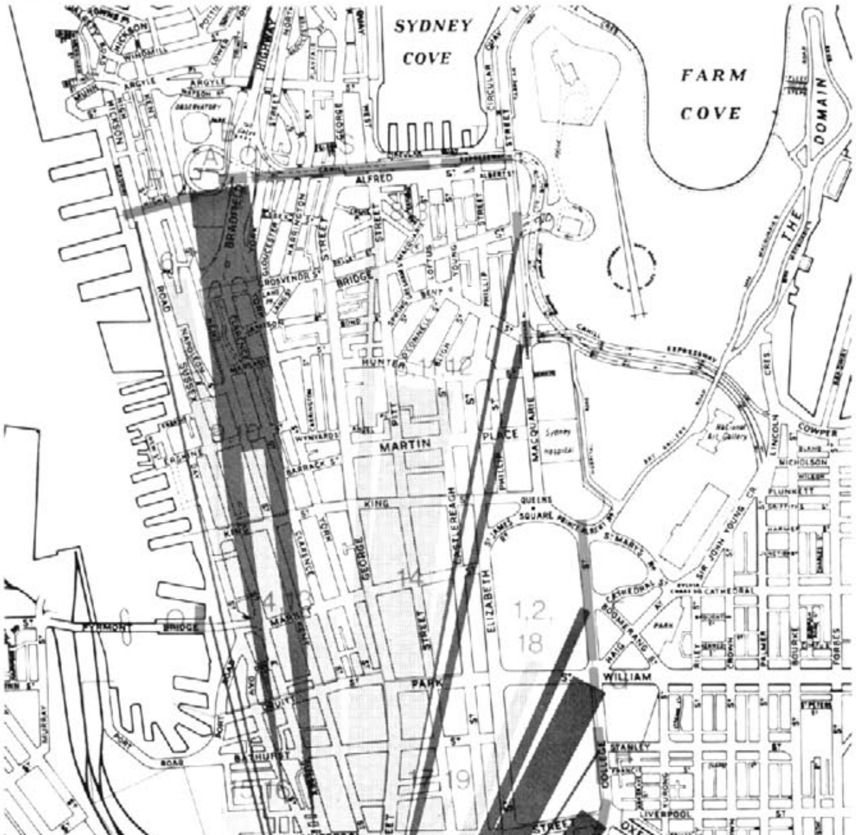
To determine origins and destinations the County of Cumberland was divided into traffic districts numbered 2 to 77. Additionally, the roads across the C.B.D. cordon were grouped to form 20 traffic corridors while the C.B.D. itself was sub-divided into 23 City Zones. Each reported trip was expanded by vehicle type and hour to agree in total with manual counts taken at each station, while any duplication due to vehicles which passed through more than one station between their origin and destination was eliminated.

Every precaution was taken in the planning of the survey and its questionnaire to ensure that the material received would be accurate and meaningful and yet confidential. One major consideration in designing the survey was to avoid traffic congestion due to the handing out of survey cards. It was decided to issue cards only to a sample of inbound vehicles crossing the cordon line (which marked the boundaries of the survey) and to obtain information about their outbound journey by questions on the cards.

This system posed a problem in that the outward journey of vehicles whose first origin was within the C.B.D. or in an area north of Circular Quay, was not recorded. Another problem which arose from the analysis of answers was that many drivers may have quoted the time they desired to leave the City rather than the actual time of departure. Considerations of these problems meant some adjustments to the analysis and to the total of the outbound trips crossing the cordon line during the a.m., p.m. and off-peak hours.

Results of Survey

The full results of the survey have now been issued by the Department of Main Roads in a publication called "Origin and Destination Survey—Feb. 1972 Sydney Central Business District". Copies may be obtained from the Department at a cost of $10 each. The publication includes table statistics and many detailed maps and figures one of which, "Through and Citybound Vehicular Traffic Movements from stations 13 and 14 (George Street), 8.00–9.00 a.m." is reproduced here.



Through and City Bound Vehicular Traffic Movements from stations 13 *and* 14 (*George Street*), 8.00–9.00 *a.m. Dark grey = through traffic, light grey = city-bound traffic. Flow scale* 1 *cm* = 400 *vehs.*

The total number of vehicles which passed each of the card-issue stations was counted manually and classified into vehicle type. The resulting figures showed the classifications to be 113,470 (67%) cars and station wagons, 14,618 (9%) taxis, 19,745 (12%) utilities and vans, 11,560 (7%) trucks, 2,367 (1%) semi-trailers and 6,107 (4%) other vehicles.

Expanded figures calculated from the questionnaire cards produced the following figures on vehicles entering and leaving the C.B.D. and vehicle occupancies:

	Total trips to, from and through the C.B.D.		
Period	*Vehicle*	*Person*	*Person/Vehicle*
8 a.m. to 9 a.m.	28,748	49,067	1·7
5 p.m. to 6 p.m.	29,558	46,214	1·6
Off-peak hour average ..	23,375	35,446	1·5

During the morning peak hour, 20,787 vehicles entered the C.B.D. Of these 11,793 (57%) had destinations in the City while 8,994 (43%) merely passed through having destinations outside the C.B.D. Over the same hour 4,480 vehicles originating in the City travelled to destinations outside the C.B.D. A similar arrangement applied during the evening peak hour. Corresponding figures being 20,709 left C.B.D., 12,305 (59%) originating from the City and 8,404 (41%) passing through; 5,047 vehicles entered the City.

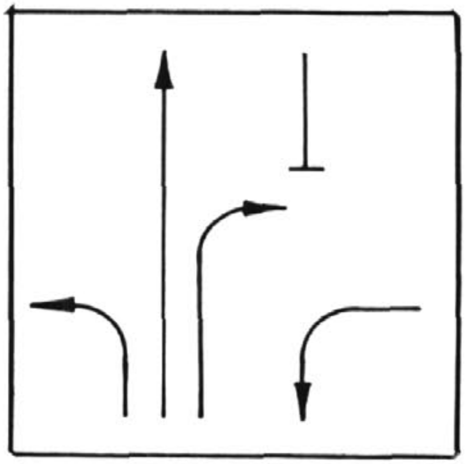
In a typical off peak hour 7,419 vehicles entered the C.B.D. and remained there, 4,839 passed through the C.B.D. and 8,822 left.

Statistics regarding parking of vehicles with destinations in the C.B.D. and between 7.30 a.m. and 6.30 p.m. were:

- Vehicles which sought on street parking at parking meters totalled 11,446 and paid an average of 20 cents. Those obtaining free on street parking totalled 22,805.
- A total of 16,700 vehicles parked off the street and paid an average of $1.56 each, while 16,242 had free off street parking.

A total of 67,193 vehicles parked in the city and 14,353 did not park at all●

Previous articles on Origin and Destination Surveys appeared in "Main Roads"—Vol. 25, No. 3, pp. 84–94, March 1960, and Vol. 25, No. 4, pp. 116–122, June 1960.



Some Aspects of Intersection Design

Intersections form an important part of road design and construction. In 1971–72, 53% of all reported road accidents in New South Wales occurred at intersections. Intersections also form the key metering points in a road network, restricting the volume of traffic which can be handled through the system. During the 1972 Road Needs Survey over 1,100 intersections of Class 6 (arterial) and Class 7 (sub-arterial) roads were identified in the County of Cumberland. In addition there are several thousand minor intersections of residential streets with arterial roads and residential streets with residential streets.

In the design of intersections it is necessary to give consideration to possible vehicle conflicts. Intersections may also pose problems with drainage particularly if one road is on a steep grade. The need to match the grading of the cross streets at an intersection often establishes the control points for longitudinal grading of the through road. Historically cross roads have always been the site for hotels and shops and in more recent times for service stations. Land acquisition in the vicinity of major intersections can often be more expensive than elsewhere along a road. The additional pavement width required for turning traffic at intersections can lead to problems in the design of street lighting.

Pedestrian concentrations are often heaviest around intersections, intersections are favourite locations for bus stops. At intersections drivers may be looking for direction signs and therefore be less attentive to other aspects of the driving task.

This paper is intended to give some indication of the principles and standards applied in the Department of Main Roads in the geometric design of intersections.

Basic Principles

Two streams of traffic can interact in three basic ways, i.e. merge, diverge or intersect, figure (1).

There is also a more complex manoeuvre called the weave which is in effect a merge followed by a diverge, figure (2).

In both the intersecting and merging manoeuvres it is necessary for drivers in one stream to find gaps in the other stream of a suitable size for their vehicle to enter. Two common failures occur:

(i) drivers misjudge either the length or location of a gap resulting in an accident; or

(ii) insufficient gaps of sufficient size are actually available in the traffic stream for all vehicles wishing to enter or cross, leading to congestion.

The design of intersections is concerned with solutions to both these problems.

Common reasons for drivers misjudging gaps are:

(i) acute crossing angles;

(ii) multiple manoeuvres; and

(iii) lack of spatial guidance, figure (3).

These situations can be corrected by:

(i) making conflicting streams cross at more obtuse angles;

(ii) replacing complex manoeuvres with successive simple ones; and

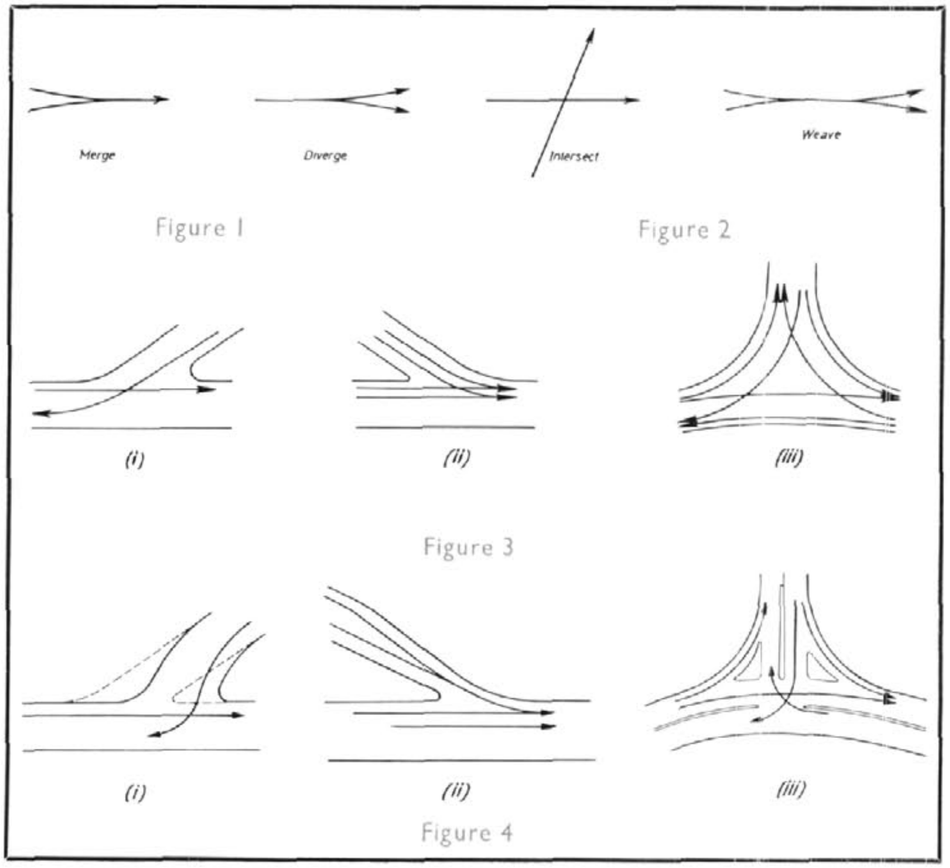


Figure 1

Figure 2

Figure 3

Figure 4

(iii) insertion of channelising islands, figure (4).

In order to improve capacity at intersections it may be possible to remove some of the conflicting traffic streams from the area. For example in figure (5), streams A and B must wait for suitable gaps in stream C but not in Stream D.

In figure (6), Stream A does not need to wait for gaps in Stream B.

Alternatively by widening the approaches to an intersection as shown in figure (7) it is possible to increase capacity. Two vehicles (in Streams A and B) can make use of the same gap in Stream C.

Pavement widening should be used with caution unless traffic signals are provided because of the possibility of confusion in the large open areas created.

Rural T. Junctions

One of the simplest forms of intersection is a T junction between two 2 lane roads. However the volumes of traffic using such a junction may range from 100 or so per day up to 10–12,000 per day. For the low volume roads little treatment is required other than to ensure that all approaching drivers have an adequate view of the intersection. For the high volume situations however it becomes necessary to add extra pavement width so that vehicles turning out of the through road do not cause undue interference to through vehicles. Some investigation has recently been carried out in the Department into the design of rural T junctions.

When a vehicle decelerates to turn into the side road, unless the following vehicle is sufficiently distant it will also have to decelerate or else overtake the turning vehicle. The frequency of this occurrence will depend both on the volume of turning traffic and the volume of through traffic. If such incidents occur more frequently than once during the peak hour some pavement widening is suggested. If these incidents occur more frequently than once every ten minutes during the peak hour a full deceleration lane would be desirable.

For right turning vehicles it is also necessary for the turning vehicle to wait in the centre of the road for a gap in the opposing traffic stream. In this position it is vulnerable to rear end collision. It is suggested that if the probability of a straight through vehicle finding the preceding vehicle waiting in the centre of the road to turn right is greater than 0·01 then a sheltered right turn lane should be provided.

These principles are being applied in the development of a guide for the Design of Rural T Junctions. It should be possible to similarly develop methods of treatment for four way junctions of two 2 lane roads and also for T junctions on rural dual carriageways.

However, when urban multi-lane roads are considered the mathematics involved in calculating the capacity of an unsignalised intersection become extremely complex and it is usual to assume that an intersection has traffic signals so that use can be made of various empirical methods which have been developed to deal with the flow of traffic through traffic signals.

The system used in the Department for calculating the capacity of urban intersections is that developed by the Australian Road Research Board and described in its Bulletin No. 4 "The Australian Road Capacity Guide" (1). To understand the application of this method of intersection design it is necessary first of all to understand some of the basic features of traffic signals.

Operation of Traffic Signals

Early traffic signals were of the "fixed time" type, that is, they operated on a cycle of say 90 seconds allocating say 60 seconds to the main road and 24 seconds to the cross road regardless of the traffic demand (the remaining 6

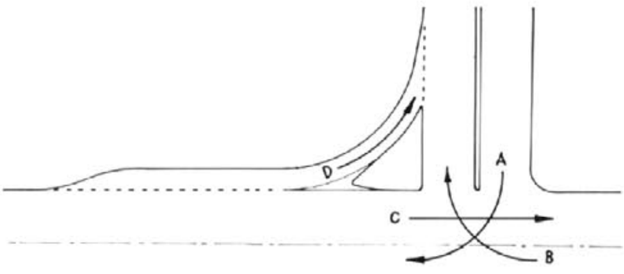
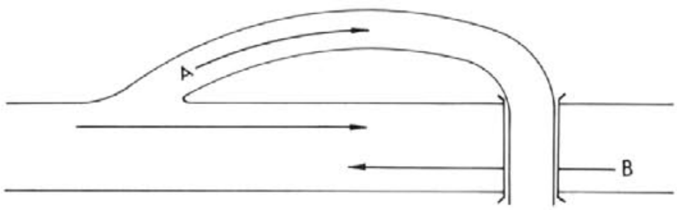


Figure 5



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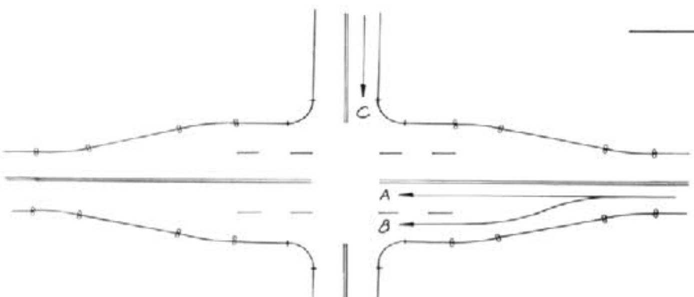


Figure 7

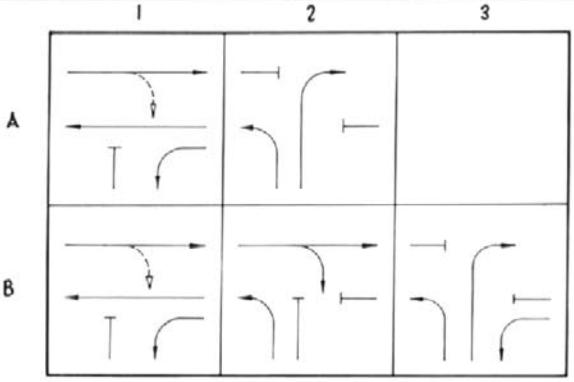
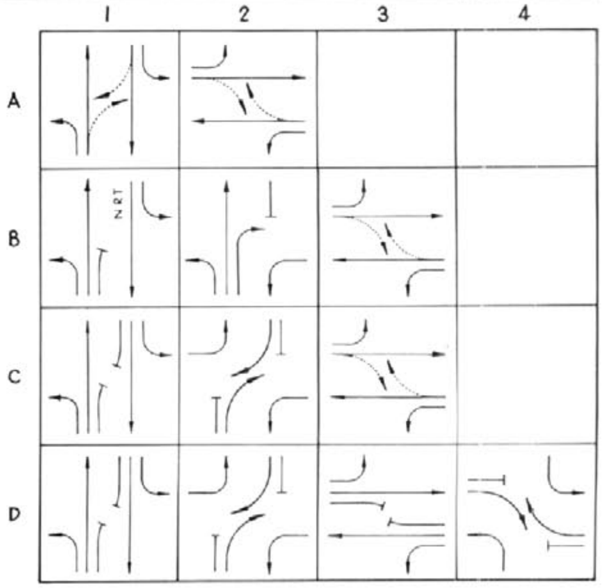


Figure 8



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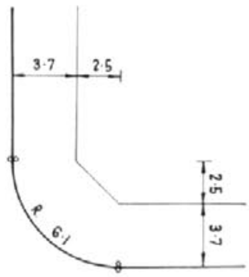


Figure 10

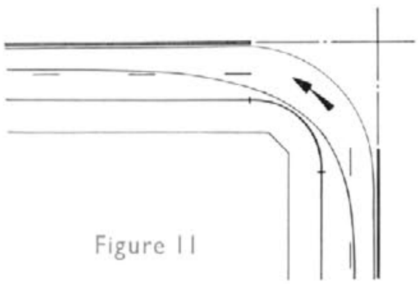


Figure 11

seconds being amber time). Signal design has progressed a long way since then and, in New South Wales at least, all traffic signals are of the vehicle actuated type. A series of magnetic detectors in the road pavement on each approach records the passage of approaching vehicles and continually allocates "green-time" in proportion to the demand. The most modern systems such as are located in parts of downtown Sydney consist of a series of signals all connected to a central computer which continually modifies the operation of each of the signals connected to it in response to real-time data collected from in-the-road sensors.

For the purpose of computing intersection capacity it is usually sufficient to ignore these sophisticated systems and consider the operation of a fixed time signal which has been correctly adjusted for the traffic offering.

There are many variations in signal phasing which can be adopted to get the very last milligram of capacity out of an intersection. However, for the purpose of checking the capacity of an intersection for design it is usually sufficient to assume that one of the phasing arrangements drawn in figure (8) and (9) will operate. It is also usual to assume that the simplest phase diagram will apply. Adopting more complex phases requires either an increase in the cycle time and consequent increase in delay to vehicles or allocating a higher proportion of each cycle to clearance or "lost" time.

Intersection Capacity

For a detailed presentation on the calculation of intersection capacity it is suggested that the Australian Road Capacity Guide be studied.

However, in outline, the steps normally followed in the Department in evaluating an intersection for capacity are as follows:

(i) Obtain a peak hour count for a design year. Unless the traffic pattern is expected to change a current count is suitable. Both morning and evening peak periods need to be considered separately.

(ii) Choose the simplest phase arrangement.

(iii) For the first phase compute the approach volume q on each approach which runs in that phase in "through car units" (using the conversion factors given in Bulletin 4 for commercial vehicles and turning vehicles).

(iv) Compute the saturation flows for each approach using the lane saturation flows given in the Bulletin.

(v) Compute $y = \frac{q}{s}$ for each approach.

y should be a number between 0 and 1·0 and represents the proportion of the available time which that particular flow requires.

(vi) Choose the largest value of y. This is the representative y which determines the amount of time to be allocated to that phase.

(vii) Repeat the process for each phase.

(viii) Sum the representative values of y to get Y. This represents the degree of saturation of the intersection, or in other words the proportion of the available time which must be used to clear the available traffic.

Some comments need to be made about Y. For existing traffic counts and existing conditions Y should not exceed 1·0 as this signifies that the intersection is at present handling more than 100% of its maximum possible volume. Values of Y greater than 1·0 can however be obtained from considerations of hypothetical volumes and hypothetical designs

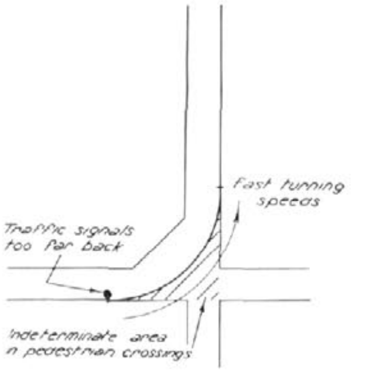


Figure 12

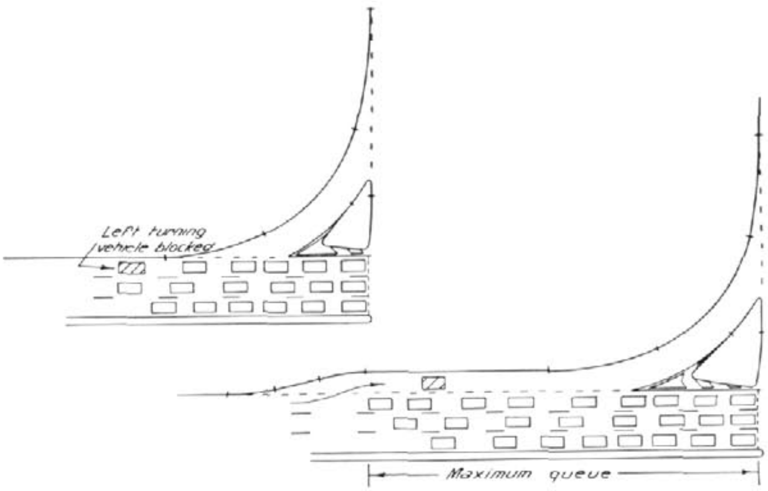


Figure 13

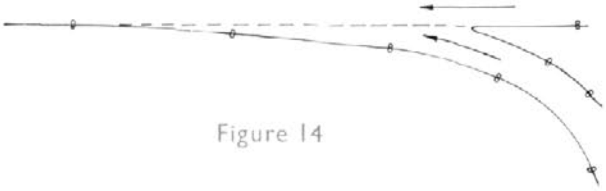


Figure 14

and would indicate that the proposed intersection is grossly under designed.

A value of Y in the range 0·75 to 0·80 is probably the upper limit for comfortable operation of the intersection. For values of Y between 0·75 and 1·0 there will be queues waiting on the approaches throughout the peak hour and these will not normally clear each cycle. An intersection which has a Y value in either peak of 0·75 at present has no reserve capacity for future traffic growth.

A value of Y for present traffic of around 0·4 allows a fair margin of reserve capacity. Providing the phasing arrangements of the signals are not changed and the distribution of traffic between the various approaches remains the same the value of Y will increase each year in direct proportion to the increase in the total entering volume using the intersection. With traffic growing at the rate of 5% compound per annum an intersection with a Y of 0·40 now would have reserve capacity for 14 to 15 years. This is considered a reasonable life to design into a channelised intersection.

It is sometimes possible by providing more extensive roadworks such as a separate left turn lane to reduce the present Y value of a design marginally (say from 0·40 to 0·39). Improvements of this order of magnitude should be treated with caution as in effect they prolong the tolerable life of the design by only a few months.

Left Turns

It is probably desirable to say a little about the use and design of left turn lanes. Consider the intersection of two residential streets 12·8 metres between kerbs with two 3·7 metre footways. In a normal urban street a kerb radius of the order of 6·1 metres (figure 10) would be provided.

The use of a 6·1 metre radius on the kerb allows most commercial vehicles to negotiate the left turn at low to moderate speeds without encroaching either on the footway with the rear wheels or on the opposite side of the road centre lines with the front wheels (figure 11).

A 2·5 by 2·5 metre cut off permits retention of the full footway width around the corner.

The use of smaller curve radii results in difficulties for turning vehicles. The use of larger radii while assisting the turning movements introduces hazard for pedestrians and problems in locating traffic signal pedestals and stop lines (figure 12).

When volumes of left turning traffic are large it is often convenient to introduce separate left turn lanes. These are also sometimes desirable to allow pedestrians to be moved across the road in stages. The corner islands used should have an area of at least 6 square metres to provide for adequate visibility of the island, shelter for pedestrians, ease of maintenance and the possible installation of traffic signal pedestals.

Dimensions, including the combination of three curves of different radii (known as a three centred compound curve) can be calculated to provide for the tracking of the left rear wheel of a semi trailer when the right front wheel is constrained in its path by the kerb of the corner island.

Compound curves are not required when the amount of off tracking is small which occurs for large radius left turns and/or small deflection angles. Compound curves are also generally unnecessary when there is no corner island as the front wheels of the occasional semi trailer can then be steered sufficiently wide to preclude the back wheels mounting the kerb. The additional setting out required to substitute a three centred curve for a single radius is not warranted in these cases.

Separate left turn lanes at traffic signals are often permitted to flow freely at all times under the "Turn left at any time with care" traffic regulation. This increases the capacity of the intersection as the left turning traffic does not need to be included in the total traffic required to share the available green time.

However, unless the entry taper to the left turn lane is sufficiently long to permit unrestricted entry to the left turn lane at all times unimpeded by queues of through vehicles the left turn lane will not run freely at all times and in fact little increase in capacity may be attained (figure 13).

It is also necessary if the left turning traffic is expected to flow at all times for a proper merging area to be provided down stream of the intersection where the left turning traffic joins the through traffic in the cross street (figure 14).

Construction of left turn lanes frequently requires acquisition from corner properties. Sometimes vacant land is available and sometimes it is possible to include the left turn lane on the residue of a corner block which has been acquired for general road widening. However, when it is necessary to acquire property, particularly developed property, specifically to allow a left turn lane to be constructed the proposal should always be carefully examined to ensure that the expected benefits will be obtained and that improvement to traffic flow justifies the expense of acquisition and construction.

Right Turns

Right turn lanes almost invariably give an improvement in road capacity and should be provided at all intersections where this is feasible. On a divided road with a median at least 5 metres wide right turn lanes can normally be provided without difficulty. Desirable dimensions for such lanes are shown in figure 15.

Right turn lanes should normally be at least 32 metres long so as to provide storage for four vehicles. The maximum length is determined from the expected queue length. A length of 8 metres should be provided for each vehicle in the queue.

On high-speed roads the length of the right turn lane should be adequate for turning vehicles to enter it without having to slow appreciably in the through lane. However, right turn lanes which are too long can encourage through drivers to use them as additional through lanes when they are not occupied by right turning vehicles.

Radii for the reverse curve at the entrance to the right turn lane should be carefully chosen. Radii which are too small result in unused pavement at the start of the lane. Radii which are too large can make accidental entry by through vehicles too easy.

On the departure side of an intersection where a right turn lane is provided, it is desirable to flare the end of the median if possible to assist through drivers who have entered the right turn lane by mistake to regain the correct lane.

Where a median is less than the minimum desirable width needed to contain a sheltered right turn lane it is often possible by local widening of the

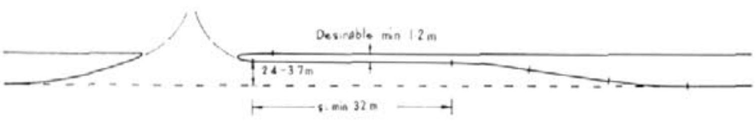


Figure 15

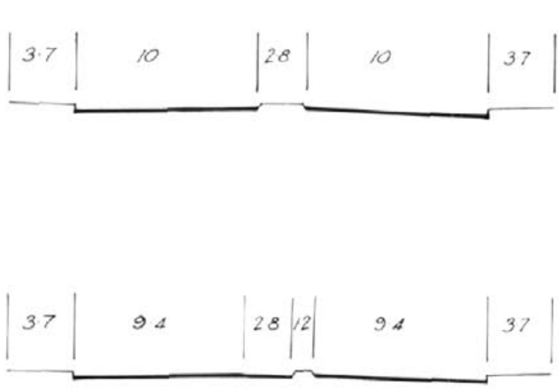


Figure 16

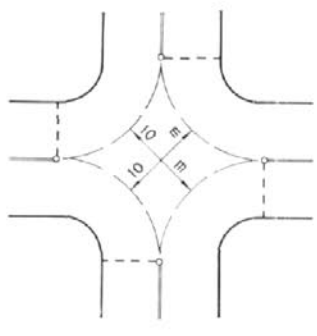


Figure 17

median and reduction of the carriageway and/or footway width to provide one, and consideration should always be given to this. A cross section as shown in figure 16 can be varied in the immediate approach to a major intersection to allow a minimum width right turn lane to be provided.

A reduction in capacity of the through lanes caused by this narrowing is normally more than offset by the increase in capacity due to the extra lane at the intersection.

When two opposing right turns are expected to run simultaneously the turning radii and the tangent points should be chosen so that there is a clear width of at least 10 metres which enables two turning vehicles to pass each other with adequate clearance (figure 17).

Radii for right turns much above 15 metres should be treated with caution as they could encourage high-speed turns and lead to accidents.

One situation in which the provision of a sheltered right turn lane is unnecessary and can, in fact, be undesirable is a junction at which the predominant movement is the right turn (figure 18).

Minor Channelisation

Channelisation is often required at an intersection to permit the more effective display of a Stop sign or a traffic signal pedestal or to control one specific movement which drivers are making incorrectly or too fast. In such cases, care should be taken to install only the minimum number of islands as excessive channelisation can:

(a) introduce unwarranted obstructions into the road pavement;
(b) unnecessarily restrict parking and private access adjacent to the intersection; and
(c) create problems of pavement maintenance and drainage.

A problem which sometimes arises is the location of Stop signs at an intersection of a residential street and a main road in a provincial city or country town. Figure 19 shows the extent of channelisation which is usually adequate in such cases.

It will be noted that islands are provided in only two out of the four arms of the intersection and this gives adequate guidance for all right turning movements as well as suitable sites for the Stop signs. The islands are desirably a minimum of 1·2 metres wide to protect the sign or signal pedestal and approximately 10 metres long. Shorter islands are hard to maintain and inconspicuous. Longer islands can interfere with access to adjacent properties.

The Department does not normally provide raised islands in areas without street lights. Painted islands and medians are usually used instead. In some circumstances, raised islands may be acceptable at unlit "T" junctions provided they are located in the stem of the "T" and not in the through road, are readily seen by approaching traffic and delineated by pavement reflectors (figure 20).

Flares and Offsets

The approach ends of islands are normally flared back behind the theoretical traffic lane edge. This has the two fold purpose of reducing the probability of accidental collision with the island and also of relieving the optical illusion of a constriction in the lane at the start of the island. Median islands in side streets should be set back 0·6 metres

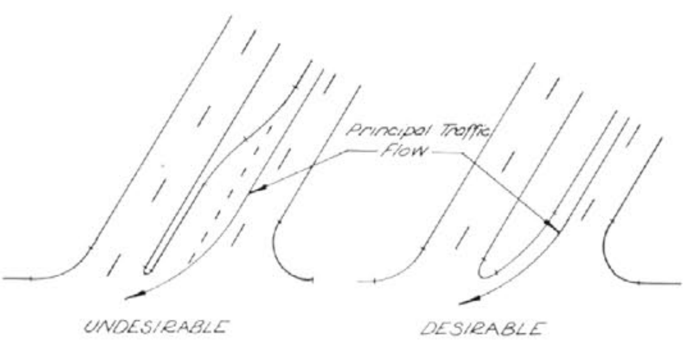


Figure 18

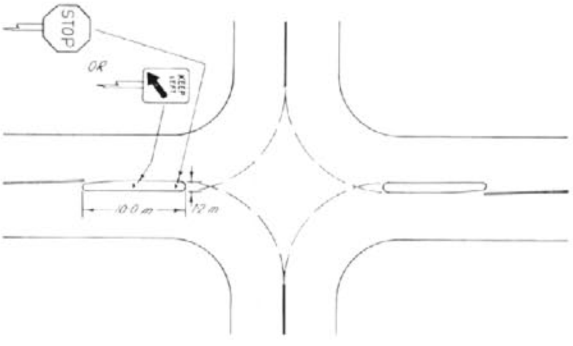
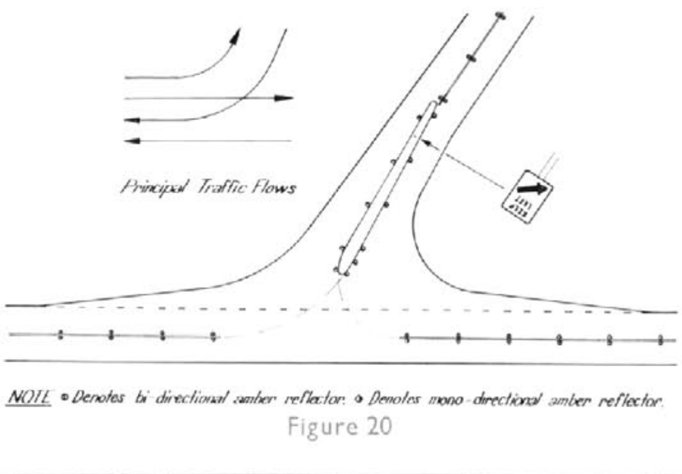


Figure 19



NOTE ● Denotes bi-directional amber reflector. ◐ Denotes mono-directional amber reflector.

Figure 20

behind the prolongation of the kerb line of the through street for the same reasons.

Chevron pavement markings, are normally used to define the true lane edge from which the island kerb is offset.

General Design Rules

In considering the design of an intersection the designer should have a simple check list to ensure that all aspects of the design have been covered by him. A suggested check list is as follows:

1. *Location and sight distance*

Often the location of an intersection which is to be reconstructed has previously been determined and is controlled by long established road boundaries. However, where the designer has freedom in locating the site of the intersection he should be particularly careful to ensure that all approaching motorists have an adequate view, not only of the other motorists, but also of the layout of the road pavement within the intersection. The best location for an intersection is within a sag, the worst just over a crest.

2. *Volume of traffic to be handled*

The intersection must be adequate for the expected volume of traffic but should not be over designed if traffic volumes are low.

3. *Existing and potential vehicle conflicts*

The design should seek to minimise conflicts between streams of vehicles and hence to reduce the accident potential.

4. *The proposed form of traffic control*

The intersection which is to be controlled by traffic signals can be designed differently from one which is uncontrolled.

5. *The special needs of pedestrians, buses, etc.*

6. *The feasibility and desirability of acquisition*

Proposed acquisition should be justified by commensurate benefits to traffic. Small and relatively costly property adjustments can often be avoided by minor changes in the design.

7. *The location and cost of affected public utilities*

The cost of relocating a major P.M.G. pit can often equal the cost of roadworks in a channelisation scheme. Again, minor adjustments to the design can often allow significant savings both in the cost of the job and the time necessary to complete it.

8. *The anticipated life of the project and its compatibility with other projects*

Major reconstruction of an intersection which will extend its useful life by a mere 2 or 3 years is rarely justified. A design which is grossly out of scale with the adjacent intersections on the same route (i.e. either more extensive or more restrictive) needs rethinking.

9. *Construction under traffic and stage construction*

Consideration should be given as to how the work is to be constructed under traffic and whether it can be built in stages.

10. *Local requirements*

It is frequently desirable to retain or tie into existing kerb and gutter. There may be war memorials, fountains or other local features which should not be disturbed or which require special consideration. The location and significance of these in the design should be ascertained at the earliest possible stage.

11. *Signposting, lighting and pavement marking*

Does the design as conceived present any particular problems with signposting, street lighting or pavement marking?

Submission of intersection designs

When an intersection design is prepared either by the Department's staff or by a Council, a report covering the following aspects is required to accompany the layout plan.

1. *An assessment of priority*

If an intersection is in a current programme or a commitment has been made to have it constructed shortly the design should be examined sooner than if it is intended merely to define possible future requirements.

2. *A recent traffic count*

The most recent traffic count including an assessment of commercial vehicles and pedestrians if these are important to the design should be provided. If a significant change in traffic pattern is anticipated this should be indicated together with reasons for the change.

3. *An accurate base plan*

The design should always be superimposed on an accurate base plan to a scale of around 1 : 500. The base plan should show:

- (i) details of property boundaries particularly where these do not coincide with fence lines;
- (ii) location and size of public utilities which are affected or which are close enough to the work to be affected by any suggested amendments to the design;
- (iii) location of improvements on private property which can be affected by the design;
- (iv) location of awnings or balconies projecting over the road reserve;
- (v) the location of any trees, monuments etc. which it is particularly desired should not be disturbed;
- (vi) the location of minor lanes and side streets and private accesses which could affect the design;
- (vii) existing pavement, kerb and gutter, traffic signals and signs;
- (viii) existing pedestrian crossings and bus stops;
- (ix) sufficient details of the roads in approach to the intersection to enable the design to confidently be related to existing or proposed work away from the intersection;
- (x) a long section for each approach.

4. *Property information*

A decision on the location of a new road boundary can often be influenced by such matters as whether a property which could be affected is an owner occupied residence or one of a series in common ownership awaiting redevelopment. There is often an opportunity to acquire property in exchange for adjoining residues and so get a much better design.

5. *Photographs*

A series of photographs taken from each approach looking towards the intersection and from the intersection looking back along each approach plus photographs of any particular features which have influenced the design are invaluable in assisting the examination officer in the examination of designs●

* * * * *

Material for this article has been reprinted from "Some Aspects of Intersection Design", as presented by J. M. McKerral, B.E., M.S.(Cal), Dip.T. & C.P., M.I.E.Aust., Assistant Traffic Service Engineer, Department of Main Roads, to the Local Government Engineers Association of New South Wales Annual Conference, 12th April, 1973.

A previous article on "The Design of Channelised Intersections" appeared in "Main Roads", Vol. 25, No. 3, pp. 67–79, March 1960.

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3. Policy for Geometric Design of Rural Roads, N.A.A.S.R.A., 1970.
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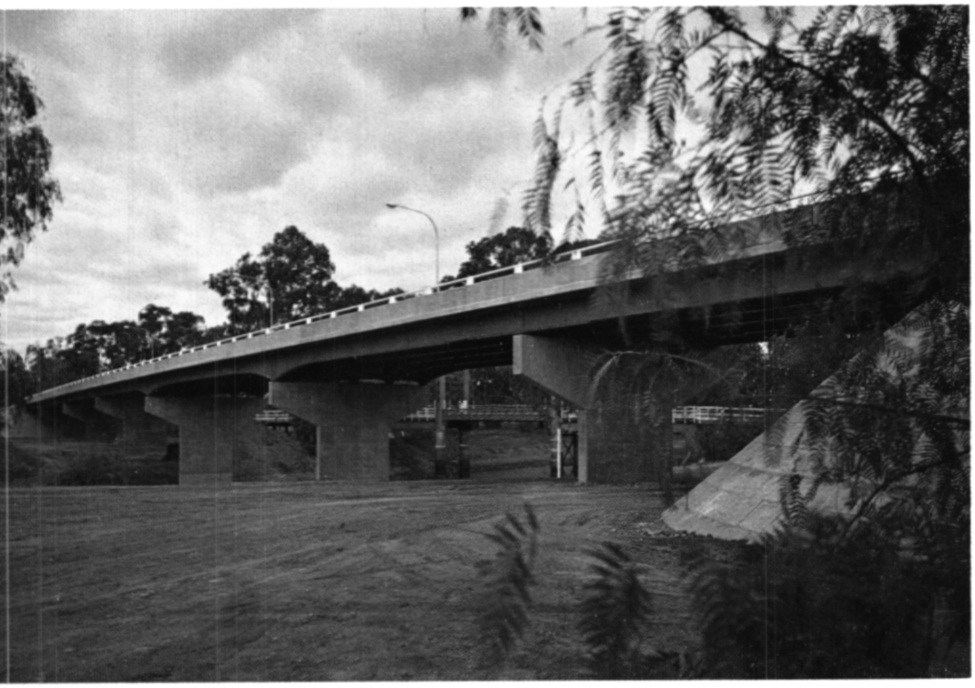
(Left) Near the top of Bulli Pass construction is underway on the southern end of the Southern Freeway. This view shows the Appin Road overbridge in the foreground crossing the freeway and connecting with the Prince's Highway. In the distance is the connection to Mt Ousley Road, (M.R. 513).

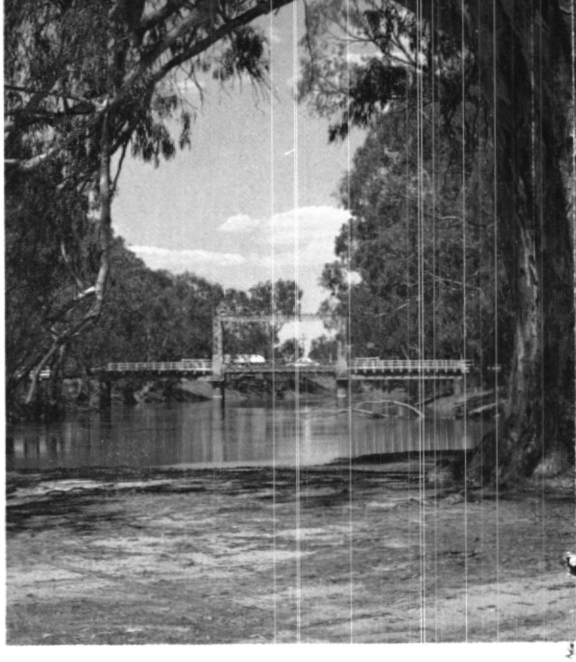
Southern Freeway

(Above and below) Construction of the freeway across Maddens Plains.

(Left) A striking feature of this photograph of construction at the northern end of the freeway, near Waterfall, is the rich brown colour of the stabilized road base.

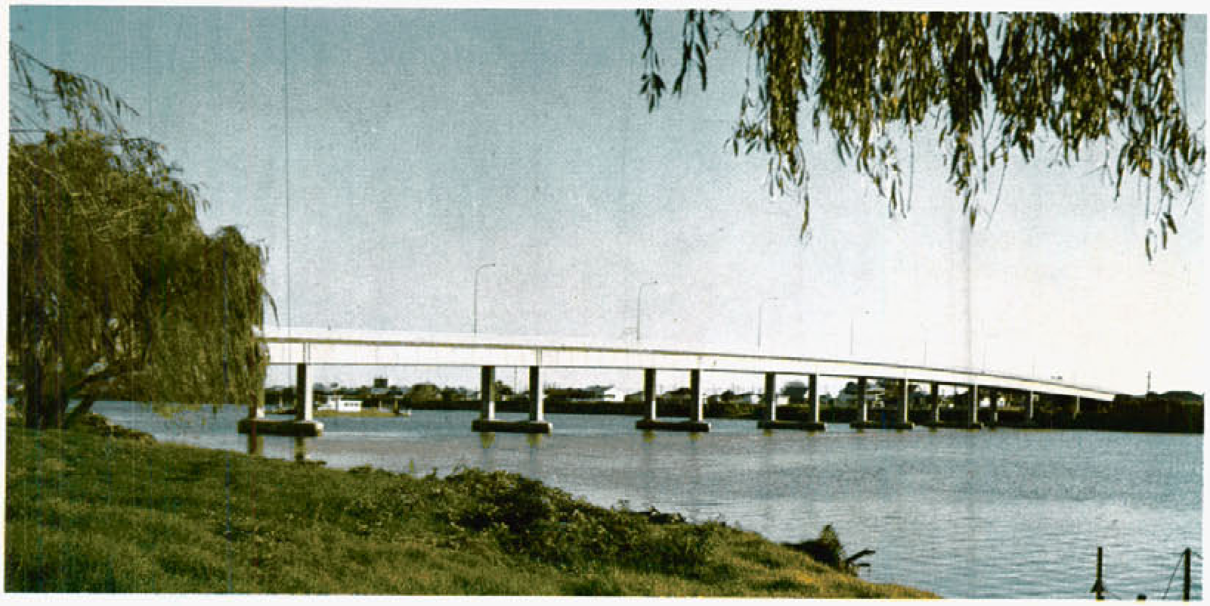
Balranald





A.M. Friday, 8th June, 1973 and the residents of Balranald, on the Sturt Highway, bid farewell to their old bridge (above) and greet this elegant new structure which spans the Murrumbidgee River (left).

P.M. Friday, 8th June, 1973 and a huge crowd of visitors and local residents gather by the banks of the Murrumbidgee River once again, this time further upstream at Hay. Their beautiful new bridge (above) also replaces a very old structure, shown here at right.



A Big Week for New Bridges

Smithtown

A.M. Friday, 15th June, 1973 at Smithtown on Main Road No. 556 and a new 1,125 feet long bridge over the Macleay River (top photograph) is opened to replace a vehicular ferry service (above).

Hay

ON TOUR

ROADS FOR TOURISTS

The extraordinary growth of the tourist industry in this country can best be gauged by the growth in the numbers of tourists visiting Australia. In this sense a tourist is defined as one who is a visitor for a period of less than one year. During the year 1961, the start of a decade, 99,269 tourists visited Australia and by 1970, the end of the decade, this number had increased to 416,128.

Although people have always travelled, the word "tourist" did not enter the English language until the early 19th century when travelling for pleasure or culture became easier through refinements in the means of travel brought about by the industrial revolution.

Tourism, like any other trading industry, has several trade areas. It has an export area, an import area and a home consumption area. In these three trade areas it is important that the tourist, the "trade item", be provided with the means of travel either by road, rail, water or air. These means of travel are trade service facilities and it is absolutely essential that these service facilities be to a standard to satisfy the tourist and provoke favourable reaction. A country must be adequately equipped with sufficient means of efficient transport to meet the most exacting travel demands from tourists.

Of the four service facilities the most important is roads. Roads are not only a facility in their own right, they are needed to maintain access to the other facilities.

Roads in Australia, while designed primarily to meet the business and social needs of the population, are also a means for the tourist to move quickly and comfortably from one tourist attraction to another.

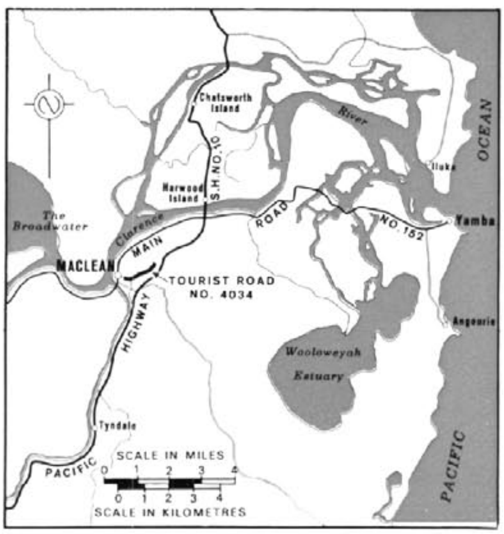
Each State has its own system of important or major roads and into these various systems is woven a network of National Routes which are primary arterial roads passing through or near almost all the principal centres of Australian population. The National Route system includes the most practicable direct route from each State capital to another State capital and to Canberra.

In New South Wales the main roads system provides an adequate network of primary roads for safe and easy travel. As early as 1950 the Department recognised the needs of the tourist industry for access roads to important tourist areas and to isolated natural features of special tourist interest. There was also a need to improve roads which carried mainly tourist traffic or traffic arising from the tourist industry.

Accordingly the Main Roads Act was amended to allow the Department to provide financial assistance to Shire and Municipal Councils for the construction and maintenance of roads which would make accessible areas used or likely to be used by tourists. There was therefore woven into the main roads system a series of tourist roads in New South Wales and this mileage consists of 52 individual roads varying in length from less than one quarter of a mile to 21 miles.

The reasons for declaration of a tourist road vary and details about two are given here.

Opposite: From Sugarloaf Point, near Seal Rocks, an almost untouched length of beach stretches southwards.



TOURIST ROAD 4034 to Maclean Lookout

The Shire of Maclean (estimated population June 1972—7,710) encompasses a very popular tourist region around the estuary of the Clarence River on the North Coast of New South Wales. Principal town in the Shire is Maclean by which the Clarence River flows to empty into the Pacific Ocean about 15 miles further on. The twin towns of Yamba and Iluka stand at

A section of the view from the Maclean Lookout looking across the Clarence River to Harwood and Chatsworth Island

the mouth of the Clarence River and are the most popular tourist resorts of the region.

Almost the entire Shire can be viewed from a spectacular lookout on Tourist Road 4034. The road commences at the junction of Grafton Street and Wharf Street, Maclean, and runs generally north easterly for approximately one mile until it reaches the lookout.

The view of course, has always been there, but for many years was appreciated only by the few who dared negotiate the rough track leading to it. In March 1963, the Council of the Shire of Maclean made application for proclamation of the road as a Tourist Road. At that time there was bitumen to 0·18 miles east of Grafton Street with the remaining 0·82 being earth formation. Subsequently it was proclaimed a Tourist Road on 9th December, 1964 and now has a bitumen surface over its complete length.

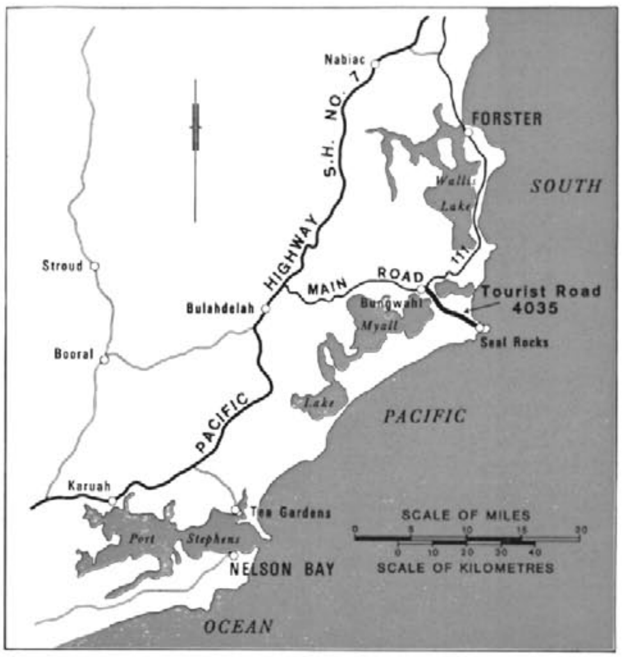
Semi-tropical Maclean is the centre of the sugar-cane growing district along the Clarence River and is an important fish producing area. The beautiful river is popular for water sports and many thousands of visitors holiday in the towns of Yamba and Iluka and enjoy the pleasures of river and ocean every year.

At Iluka, the New South Wales Government is constructing a new deep-sea port. Estimated to cost over $10,000,000 on completion, the port is being developed to enable the lower Clarence area to serve as the coastal outlet for the produce of northern and north-western New South Wales.

TOURIST ROAD 4035
Seal Rocks Road

The fishing village of Seal Rocks, 184 miles north of Sydney, perches right on the shore of Sugarloaf Bay. Flush-decked, broad beamed fishing boats, dragged up on the beach, are separated from the small houses by a road. Lobster traps sprawl on the beach and on a summer day a sunny, almost mediterranean atmosphere hangs over this pleasant little spot.

Tourist Road 4035 leads into Seal Rocks. This road branches from Main Road 111 (known as the Lake's Way) near Bungwahl and has a length of about 7 miles. Although the country it traverses is not of particular note, the attractiveness of the town it leads to and the important lighthouse nearby, were sufficient to make local residents agitate for improvements to the road in 1960. It was proclaimed a Tourist Road on 25th November, 1964.



The name Seal Rocks was derived from an outcrop of basalt type rocks lying a little way out to sea where a small colony of seals has made its home and can usually be seen sunning on the rocks. These seals are the Australian Fur Seal and their colony is the most northerly site at which they are located. A reef formed by the rocks is dangerous to ships using the coastal shipping lanes and a lighthouse was built on Sugarloaf Point in 1875 to warn of the hazard.

Before the lighthouse was established, there were many arguments about the most suitable location—on the Rocks themselves or on the mainland nearby. Although the mainland at Sugarloaf Point was chosen in 1873, the light is called both Seal Rocks and Sugarloaf Point. The original cost of the 49 feet high circular brick and cement tower, its apparatus and surrounding buildings, was almost £10,000.

The light stands 258 feet above high water and in addition to the main white revolving light, there is a subsidiary fixed green light which covers Seal Rocks and nearby navigation hazards. During clear weather, the main light has a geographical range of 23 miles and the green light a range of 12 miles.

In the general areas of Tourist Road 4035 are several famous beauty spots. The magnificent lakes, Wallis Lake, Smith Lake and the Myall Lakes, are within short drives. Many visitors to the area make their headquarters at Forster or Tuncurry, two resorts situated on opposite sides of the entrance to Wallis Lake, and enjoy day trips to the various beauty spots or fish, water ski and swim in the ocean and lakes.

Wallis Lake is a beautiful sheet of water 16 miles long and up to six miles wide, dotted with tiny islands and heavily wooded down to its water's edge. It was named after James Wallis who was Commandant at Newcastle in 1815. About four miles south of the entrance to Wallis Lake is Cape Hawke, another famous spot for tourists. The three Myall Lakes have been the centre of a clash between conservationists and developers in recent years. The developers, in particular rutile miners and local tourist interests, wish to make changes in the Lakes area which fall into direct conflict with the aims of such groups as the Myall Lakes Committee. Formed in 1968, this Committee has recommended that an area of 96,000 acres—69,000 acres of land and 27,000 acres of lake surface—be proclaimed a National Park. By Government Gazette of 28th April, 1972, a total of 38,127 acres (including water surface) were dedicated as a National Park and approximately 700 additional acres have since been added to the Park's area.

Previous articles on particular Tourist Roads have appeared in "Main Roads" as follows:

4011—Sept. 1967	4005—June 1966
4031—Sept. 1967	4014—Dec. 1966
4013—Sept. 1967	4030—Dec. 1966
4003—March 1964	4004—June 1963
4033—June 1966	

In fine weather seals can be seen on the rocks (top left of photograph), near the town of Seal Rocks

Fishing boats dragged onto the beach at Seal Rocks

TOURIST INFORMATION SIGNS

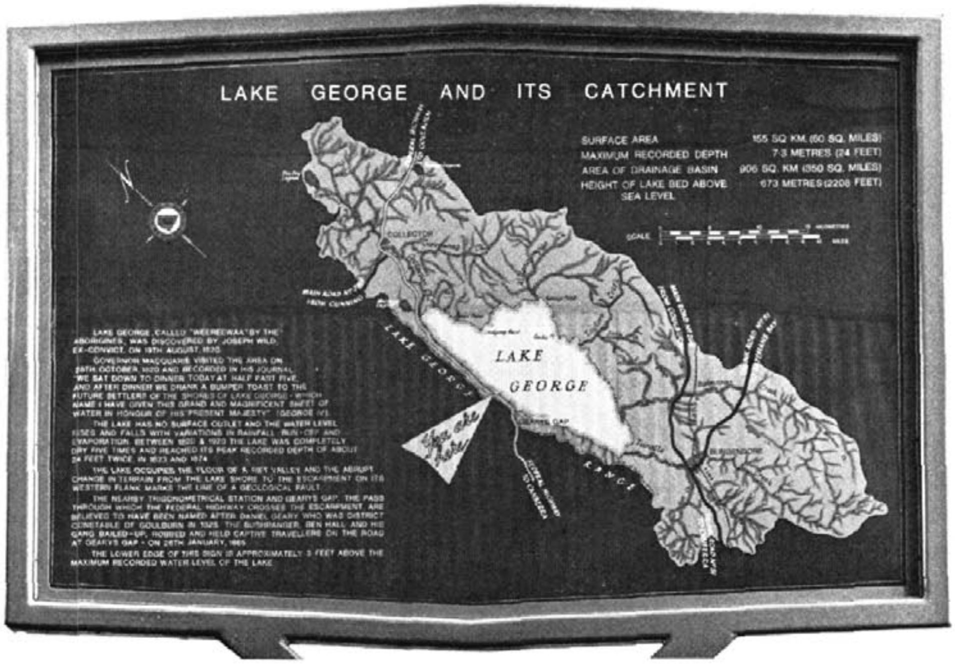
Tourist Information Signs, similar to that illustrated on this page, will be erected by the Department of Main Roads at several roadside locations where there are points of particular geographical, geological or historical interest. Most locations for the signs are expected to be roadside rest areas or established fireplaces.

This sign shown here is the first. It was erected on 10th August, 1973, at Geary's Trig Rest Area beside the western shore of Lake George on the Federal Highway.

Three other locations have been chosen for these signs:

- At Minnamurra Rest Area on the Prince's Highway (S.H. No. 1) at 4 miles north of Kiama. This sign will indicate the geological structure forming the coastal plain and the Dividing Range extending to Moss Vale.
- At the Rest Area on Pacific Highway (S.H. No. 10), 2·8 miles north of Karuah and 35·8 miles north of Newcastle. The geological structure of the Karuah-Bulahdelah area along the line generally following the route of the Pacific Highway will be illustrated on this sign. Creeks and features named on the cross section are also indicated by information signs on the Highway itself.
- At the roadside fireplace on the southern side of Main Road No. 184 at the summit of Mt Tomah east of Lithgow.

Here the sign will show the geological structure extending from the Cumberland Plain at Richmond to the Lithgow area. The information will be based on a line which generally follows the route of Main Road No. 184 from Richmond to Lithgow and illustrates and describes geological features that the traveller on the road can see. Further development of this fireplace area and the facilities provided may be made after erection of the sign.



By displaying interesting local facts to travellers, it is expected that these signs will further improve the already popular roadside rest areas which first came into existence on State Highways in 1965.

In conjunction with the Departments of Local Government and Lands, as well as Shire and Municipal Councils, the Department of Main Roads has set up 45 rest areas in all and another 14 are either under construction or planned.

Full responsibility for the cost of erection and maintenance of the Tourist Information Signs has been assumed by the Department. The subject matter of the sign, be it geographical, geological, or historical, will be under the final control of the Department regardless of where the proposal for establishment of a sign originates.

The actual positioning of the sign on the site will be arranged so that motorists passing on the Main Road will not be able to read the sign unless they pull into the site and therefore will not create a traffic hazard. Similarly, on the site, the sign and those reading it will interfere as little as possible with the other activities of motorists in the rest areas or fireplaces●

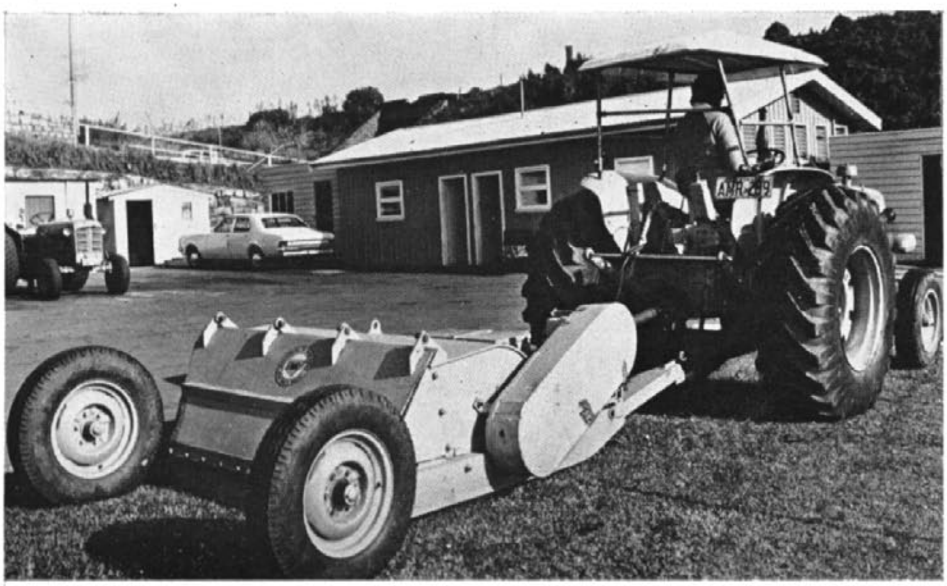
GRASS GROWS,

Whining motor mowers and the accompanying smell of freshly cut grass are familiar weekend sensations for most dwellers in Australia's suburbia. To home owners, it is an inescapable fact that wherever cultivated grass grows, someone must cut it!

The Department of Main Roads has its lawn mowing problems too. This often hated domestic chore becomes an essential task when related to the general landscaping and maintenance of main roads.

The Department's "lawns" vary considerably in size and shape, from open, reasonably level expanses, to steep embankments of grass which deter erosion. As landscaping activities along main roads increase, so do the maintenance duties involved in their upkeep. Australians would hardly tolerate the solution to this extra work which has been attempted in Los Angeles. In that city, on at least one major road, a new artificial landscape of plastic foliage, complete with pipe-stem trunks on the trees, has been installed to reduce maintenance costs. No such scheme is being considered for New South Wales, where we prefer to rely on the less predictable but far more satisfying products of nature for our landscaping effect.

To maintain its roadside grass, the Department utilizes over nineteen different varieties of mowers, each with a specific application. Some of the mowers and their applications are illustrated here.



A. The Department has a large number of heavy duty flail mowers such as the one illustrated here, drawn by a 50 h.p. wheeled tractor. They are used for rough mowing in new areas and will break up coarse grass, vines, obstacles and do limited ground levelling.

B. An 18 inch rotary mower of the "float-on-air" variety is useful for small areas and steep slopes inaccessible to a larger type of mower.

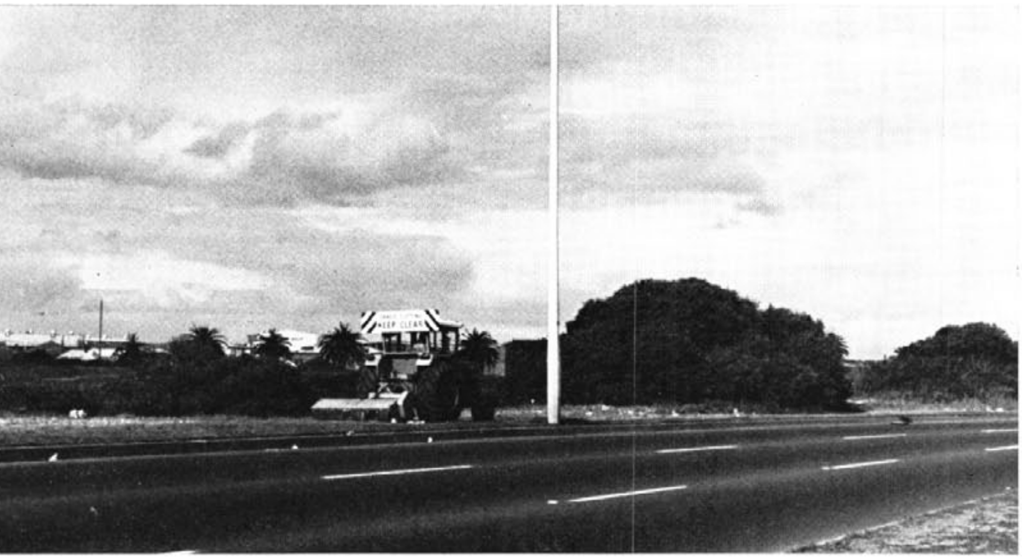
C. Rear mounted flail mower, with grass catcher attached and mounted on a 50 h.p. wheeled tractor. This is a very versatile unit for large flat or almost flat areas of grass.

D. The Department's mowers are now being fitted with the warning sign shown here—"Grass Cutting Keep Clear". The sign is visible to motorists and pedestrians over a long distance as can be seen in this photograph taken on General Holmes Drive (Main Road No. 194).

E. This long reach slope mower mounted on a tractor is extremely useful for difficult slopes and batters and can

GRASS "GOES"

Because the mowers are frequently used on locations where motorists or pedestrians might clash with the mowing process, every precaution is taken to ensure safety. All large roadside mowers, particularly those towed by 50 h.p.



tractors, are now being fitted with warning signs, "Grass Cutting, Keep Clear", each sign being approximately 7 ft long x 1 ft 6 inches high. The sign is designed for mounting at the rear of the tractor or mower and aligned with the right-hand edge of the tractor-mower combination. If a cab or canopy is fitted to the mower the sign is attached to it in a way which does not obstruct the operator's rear vision.

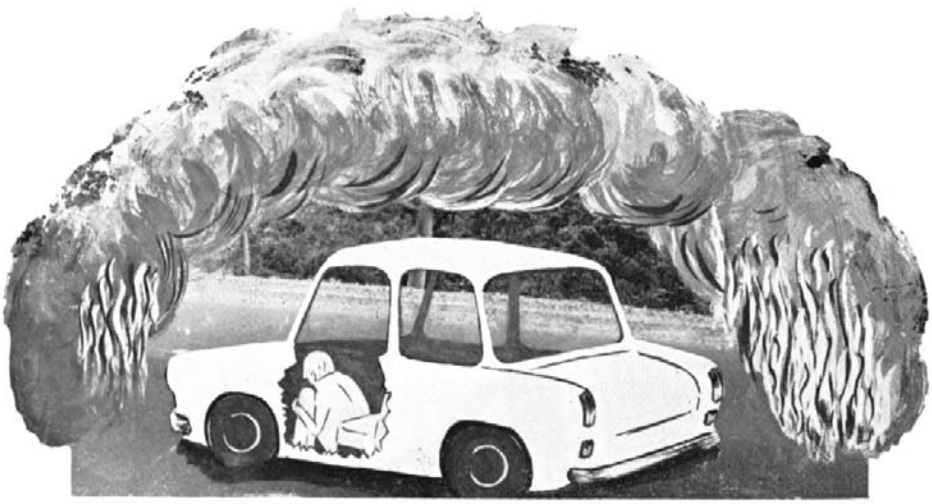
Other signs, warning the public of a motor mower in operation ahead, are used beside busy roads.

The roadside areas where mowers are often in operation, are also the resting places for such objects as old bottles, cans and other odd pieces of litter, deposited there by an untidy public. Such objects could become lethal or cause considerable harm if flung out onto a road during mowing operations. Stones, too, can be thrown up by the action of a mower.

To avoid these dangers, the Department uses as many flail-type mowers as possible. The flail-type mower works on the principle of a horizontal spindle with flail cutters and is much safer to operate in public places because it does not fling "foreign" objects outwards as does a mower with the usual rotary movement●

also be used over guard railing and fences to reach otherwise inaccessible areas of grass. This one is working on the Western Freeway. Another version of this mower incorporates a mowing unit with a shorter reach.

F. *An unusual mower is this front-mounted flail type driven by a 14 h.p. tractor. Although it looks small, it is useful for well-grassed areas of moderate to large size, such as along the Warringah Freeway, shown here.*



BUSHFIRE DANGER

Low–Moderate–High–Very High–EXTREME

Australia's summer—warm days, smoke haze and BUSHFIRE. And it *is* possible for almost any motorist, at some time during his driving experience, to be caught in a bushfire.

The intensity and seriousness of the fire will vary and it may not interfere with normal passage along the road at all. There is always the possibility, however, of a small fire suddenly flaring into a raging front of flames and heat, moving so fast that the occupants of a vehicle are unexpectedly faced with an emergency situation of extreme danger.

What should they do? Stop the vehicle, jump out, and run away from the flames? Keep driving through blinding smoke as the menace rapidly approaches?

Actions such as these, and many others which race through a mind rapidly filling with panic, could frequently result in death. The only reliable way to survive a wall of fire sweeping across the road is to *stay in the vehicle*, if it has a hard top and windows, and most important of all, *control panic*! If the vehicle is of the type which cannot be fully closed, alternative methods of survival are discussed later in this article.

The Chemistry of a Bushfire

A bushfire with flames raging up to 35 feet high, will produce air temperatures, close to the ground and a few feet from the flames, of less than a bearable 45° Celcius. As it roars along, the fire will not deplete the oxygen concentration in the air of its actual combustion zone. Although it will produce large quantities of carbon dioxide this will not reach a serious level. (These facts are not true of fires in buildings.)

The most dangerous product of the bush fire is its radiant heat, which can cause death by extreme heat stroke. Radiant heat, like light, travels in a straight line, does not penetrate solid substances, and is easily reflected. Therefore, if the body can be shielded from radiant heat during the three to four minutes of the intense flaming period, the chances of surviving a bushfire are very good.

A Burning Car

Experiments conducted by the Forestry and Timber Bureau have been carried out on test cars, burning in conditions which are far more severe than the worst forest fire. Findings show that the closed car windows cut radiant heat inside the car by about 50%, and that it takes 30 minutes under these abnormally severe conditions for the cars to catch fire throughout, commencing with the tyres, engine compartment, then the interior and finally the petrol tank.

Tests on vehicle petrol tanks have produced results which directly oppose the common belief that a bushfire will explode a vehicle by igniting its petrol.

What to Do

The various tests and experiments already made in bushfire conditions and the examination of experiences in actual fires have led to conclusions which recommend the following action in a bushfire emergency:

When driving into an area where bushfires have been reported, it is always advisable to check maps or make a mental note of the locations of roadside rest areas and crossroads along the route.

Do not continue to drive a vehicle through blinding smoke. Switch on headlights and park on the most sparsely vegetated area available.

Wind up all windows and take shelter low down in the vehicle, under the dashboard if possible, and put some type of cover over your body.

If you must leave your vehicle, or if it is not possible to seal the vehicle in the first place and you are on foot in the fire, move to burnt bare ground, run as little as possible (or you will become more prone to heat stroke) and never dash through flames unless you can see clearly beyond them.

Throughout this, remember that your main objective is to find an escape from heat radiation and to do this you can take shelter in wheel ruts, earth depressions, close by logs or large rocks, cover yourself with dirt or sand or take refuge in ponds, running streams or culverts. Do not go into elevated water tanks where the water will heat up rapidly.

If you are able to remain in your vehicle throughout the period of radiant heat, and this is extremely likely, when exiting from the vehicle afterwards take care not to touch metal parts such as door handles and to inspect any likely damage to the tyres, engine, boot and beneath the vehicle. Watch for falling leaves and branches which may still be alight and remember that fresh air will be near ground level and burnt areas will not be dangerous again. In most cases, you should be able to drive the vehicle afterwards, at least to a place where further inspection and any necessary repairs can be carried out.

Perhaps the hardest task in bushfire survival is the control of emotions. Panic is the biggest danger of all and if this can be conquered, and the advice given here closely followed, then survival is possible●

Sources of reference for preparation of this article were:

"Don't Panic", by N. P. Cheney, Forestry & Timber Bureau which appeared in "Nat/Dev", the National Development quarterly magazine, September 1972.

"Bush Fire Bulletin", Winter 1970; *The "Open Road", November* 1972.

"Don't Panic" from "Autosafe", December 1972; *"Surviving in a Bushfire" from "Amicus" (A.M.P. Society) Vol.* 11, *No.* 6, 1972.

NEW ASPHALT MIXING PLANT

A contract has recently been let for the design, manufacture and installation of a new asphalt mixing plant of 400 tonne per hour capacity at Central Asphalt Depot, Granville. This will replace two existing plants of 140 tonne per hour combined capacity which were installed in 1955. Those plants had replaced two plants of 20 tonne per hour combined capacity installed in 1933. Descriptions of the earlier plants were given in the September 1956 and May 1933 issues of "Main Roads".

The growth in plant size has been necessary to match the growth in asphalt usage by the Department in the Sydney area. This has increased at a fairly uniform rate from 50,000 tonnes per year in 1954–55 to 320,000 tonnes per year in 1972–73. As well as the increase in annual usage there has been an even more significant increase in peak demands over short periods. This has been due to the use of deeper asphalt pavements and to improvements in asphalt paving techniques. For example, when the Department's C.M.I. Autograde machine as well as the other four paving teams in the Sydney area are spreading asphalt simultaneously, peak hourly demand could be as high as 600 tonnes which is well beyond the capacity of both the Department's plant and all other available sources of supply.

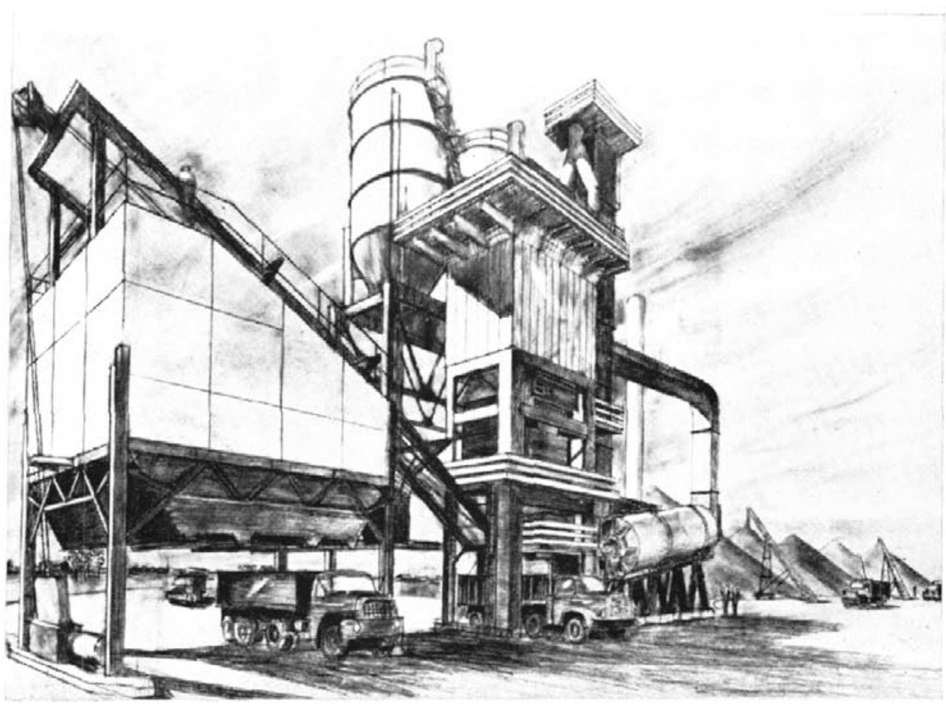
The existing plants were the largest in Australia and were more than four times larger than needed at the time of their installation. The foresight of the Engineers responsible for their installation was fully justified as the Department's needs exceeded the capacity of the plants in 1965 after only ten years operation. Since then it has been necessary for supplementary supplies of asphalt to be drawn from other sources. The plants have served well, at greater than rated outputs in recent years, but their mechanical condition has naturally deteriorated. They are also outmoded in many respects and inadequate in capacity. It was therefore necessary to consider their replacement in order to provide for present and future needs and to gain advantage from improvements in asphalt plant design.

After considering all reasonable alternatives it was decided to install, at the existing site, a single, modern plant, sufficiently large to produce the bulk of the Department's annual requirements for the next ten to fifteen years but to rely upon supplementary sources of supply during periods of peak demand. By doing this, the Department is saving public money in retaining a production organisation which has always been an efficient and economical one, is maintaining the ability to do urgent and specialized work as and when required to meet traffic needs, is providing the means of training technical staff, as well as the ability to do experimental work, is keeping abreast of developments in the asphalt industry and is maintaining its place as one of the leaders in that field.

Preliminary quotations for a new plant were invited in 1971 by public advertisement both in Australia and overseas. From the offers received, six firms were selected and invited in 1972 to submit firm tenders for the work. The successful tenderer was Barber Greene Australia Pty Ltd who will manufacture the plant in Australia at a cost of $984,820.

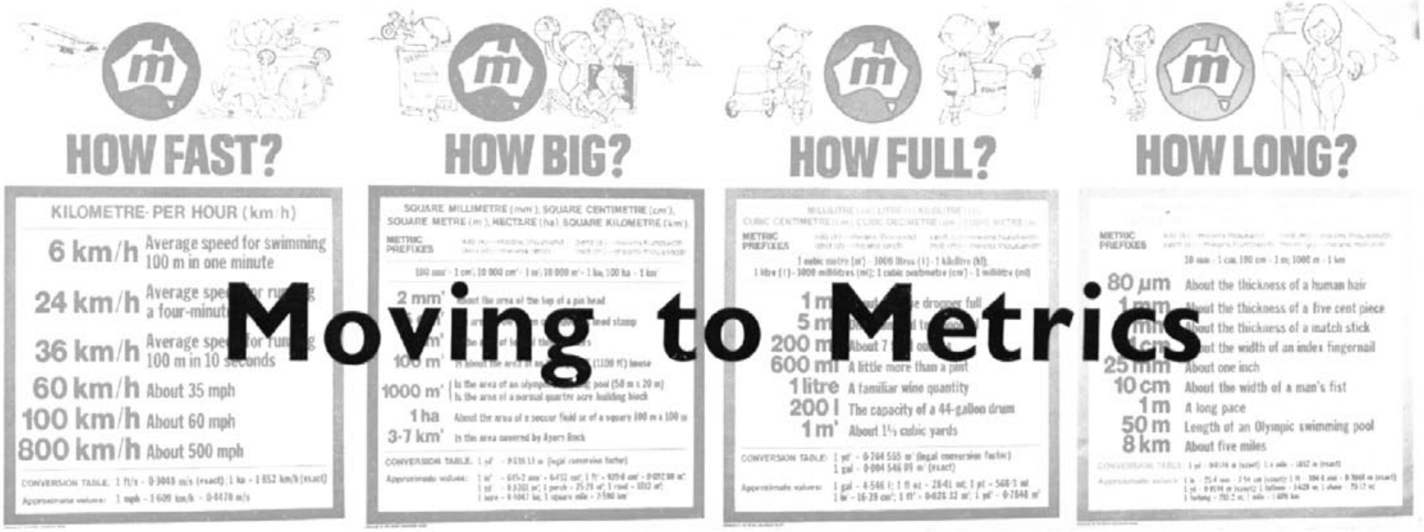
The plant will be of the batch type with a pugmill of 6,800 kg capacity housed in a Model BH mixing tower. It will include an aggregate receiving and stacking system of the radial type with an underground reclaiming system. A bag type secondary dust collector will ensure that the exhaust from the plant is as clean as possible and well within the requirements of the air pollution control authority as the Department intends to set an example in this respect. A hot asphalt surge storage system capable of holding up to 400 tonnes of asphalt of four different types in separate bins will be provided. This will allow continuity of production independent of irregularities in truck movements. The plant will be fully automated for greater efficiency and savings in labour costs.

It is expected that the plant will be installed and ready for operation early in 1974●



Artist's impression of the New Asphalt Mixing Plant at Granville

Moving to Metrics



Throughout Australia, preparations for the nation's conversion to the metric system of measurement are progressing. Large organisations such as the Department of Main Roads face a tremendous task. This article has been prepared to give a detailed background of the metric system itself, the logic behind its choice for Australia and its particular impact on the work of the Department.

Where Did it All Come From?

What is this "new" system of measurements which seems so vastly complicated at first glance, and yet is so important that it will supplant all other forms of measurement throughout the world by the year 2000?

The first proposal for a decimal system of measurement was made about the middle of the 16th Century at which time man had already perceived that a definable and stable system of weights and measures might be developed to simplify the many different systems then in use. It was not until 1791, however, that any practical steps were taken to implement such a system.

In that year, the Paris Academic des Sciences recommended abolition of the old measures in favour of a unified system based on a natural unit of length (later named the metre). In 1875, the delegates of 17 nations signed a treaty known as the Metre Convention. The treaty bound its signatories to the establishment of a permanent institution, the Internation Bureau of Weights and Measures as guardian of all matters concerned with the system. In addition a General Conference of Weights and Measures was established to deal with all international matters pertaining to the new system.

From these foundations our modern metric system evolved. Adoption of the system internationally was given impetus by the scientific and industrial revolutions of the eighteenth and nineteenth centuries.

It became obvious as technology advanced and communications between the countries of the world increased that the metric system had many advantages particularly its established acceptance by international agreement and its basic simplicity and coherence which is readily adaptable to most types of measurement.

As it was originally devised, the metric system was based on the metre, gram and second, but the centimetre replaced the metre as a base unit in 1873. Known as the CGS system, it has been used in many countries and, until recently, was the system taught in our schools. Another metric system, the MKS (later the MKSA) system, with base units of the metre, kilogram and second (adding later the ampere), has also been developed and used.

In 1948, the General Conference of Weights and Measures decided to establish a more practical system better suited to the needs of all signatory countries to the Metre Convention and from this the SI or International System of Units was adapted in 1960.

Although the SI system is still being refined, it has become the internationally recognised system and its advantages have been sufficient to encourage some countries already using CGS and other metric systems to change to SI.

Around the World

Although the initiative to develop the metric system was taken by France, that country did not adopt the system until 1840, by which date it was already being used by Belgium, Holland and Luxemburg (1820). A number of other countries who were signatories to the Metre Convention did not actually make a decision about converting to the system until many years later, for example the United Kingdom, which signed in 1884, officially announced its intention to convert industry in 1965. The United States, a party to the original treaty, has still not announced definite arrangements for metric changeover, although it has passed legislation to establish a metric conversion board.

Many nations have now been using the metric system for years (at present about 136 countries are using the metric system or are in the process of changing to it) and Australia's decision to convert to metrics is well timed for her particular needs. Canada, Hong Kong, New Zealand, Papua and New Guinea, Singapore, South Africa and the U.S.A. —all the countries with which we have essential international ties, have converted, or are in the process of doing so.

Metrics will become a major "common denominator" for mankind, a "language" which an educated person of any nationality will comprehend, and a step in the right direction if we are ever to see the countries of the world working together in a state of international harmony.

Should the cost of conversion for each country be totalled together, it would surely be the largest "bill" of all time. But on the credit side there is the certain knowledge that the initial expense will be heavily outweighed by the universal benefits of the system.

In Australia

An extensive inquiry by a Select Committee of the Senate during 1967–68, proved that there was tremendous support for metric change in Australia. Resulting from this inquiry, the Metric Conversion Bill was passed and received assent on 12th June, 1970. In the same year, as laid down in the Act, the Metric Conversion Board was established.

Although metric conversion in Australia is primarily a voluntary operation, the Board must consult with those who will be involved in making the change. Under the fourteen-member board, over 100 committees have been appointed to advise on the best methods of change in the various sectors of the community.

There are numerous reasons for Australia's change to metrics. The system is basically very simple although it appears complicated at first glance, and this simplicity will eventually reward us with increased efficiency and economic savings. It will reduce the teaching time in schools previously devoted to the Imperial system of weights and measures and also give a better grounding of basic physical principles. With the technical exception of the U.S.A., all major countries have made the decision to convert to metrics or have already converted and in this country, where approximately 75% of our exports go to the metric countries or countries which are changing, the economics of our trade relations surely demand such a change. Australia is also in a position where its large migrant population means that more than 10% of people over the age of 16 years have been familiar with metric measurement before arriving here.

To quote the Metric Conversion Board's 1973 publication, "Metric Practice"—

"*The change will provide a unique opportunity to rationalise and modernise industrial practices, to avoid unnecessary diversity in manufacturing products and to bring Australia's technical standard specifications into accord with those adopted internationally, which are nowadays almost entirely in metric terms.*"

To date, the metric system has been successfully adopted in Australia by the pharmaceutical industry (1965) and many electronics and chemical industries have been working in metrics for some years. In October, 1971, wool sales went metric and horse racing (August 1972) and temperature (September 1972) have also made the change. This year primary schools have been teaching metrics and secondary students will be similarly instructed from 1974.

From 1st July, 1973, several other major changes took effect—road, rail, sea and air freight services converted, paper manufacturers, printing and advertising, fertilizers, leather, cement and ready mixed concrete, sand and aggregate, and a number of small industries, all made the change to metrics.

We are in the period of greatest changeover activity from now until the end of 1974 and it is expected that by 1976 70% of metric conversion will be completed throughout Australia.

The SI System

The SI System is the metric system adopted by Australia. It uses 7 base units, 2 supplementary units and a number of derived units. The 7 base or primary units are:

metre (m) —Measure of length
kilogram (kg)—Measure of mass
second (s) —Measure of time (unchanged)
ampere (A) —Measure of electrical current (unchanged)
kelvin (K) —Measure of thermodynamic temperature
candela (cd) —Measure of luminous intensity
mole (mol) —Measure of substance

A great advantage of the SI system over the older metric system is that there is only one SI unit for each physical quantity and there are no odd multiplying factors to be remembered. Larger and smaller units are obtained by combining set prefixes with the SI units. Thus "milli" means a thousandth as in "millimetre", and "kilo" means a thousand times as in "kilometre", "kilogram" and "kilowatt".

The Department of Main Roads will use the term "Metric System" in place of SI system in all Departmental correspondence and the same principle has been adopted for the text of this article.

Scope of Change on Main Roads

The Metric Conversion Board urges the public to "think metric" during the changeover period, rather than convert each new measurement into its old equivalent.

Metric conversion on Main Roads is well advanced even though motorists can see little evidence of it yet.

The Department has adopted a Metric Conversion timetable which closely follows that devised by the National Association of Australian State Road Authorities (NAASRA). The public will be most concerned with the metric conversion of road signs, encompassing mile-posts and direction signs of all types, advisory speed, flood depth, overhead bridge clearance, maximum load and speed limit signs.

The Department of Main Roads is co-operating with the Department of Motor Transport to bring about this conversion of road signs on Main Roads during a one month period—July, 1974. Prior to this time, a general review of speed zoning on State Highways will be made by the Department of Motor Transport and the Police Traffic Branch before new speeds are gazetted. The change in speed limit signs will be made the occasion to adopt the international design of signs throughout Australia.

The new speed limit will be 40, 60, 80 and 100 km/h. In special instances 120 km/h will be used on freeways. Existing speed limits will generally convert as follows:

20 mph — 40 km/h
35 mph — 60 km/h
45 and 50 mph— 80 km/h
55 and 60 mph—100 km/h
65 and 70 mph—120 km/h

However in some instances, a 45 mph zone may be reduced to 60 km/h and 55 mph to 80 km/h.

Therefore, from July next year, the motorists will "think metric", and providing that the speedometer and odometer of his vehicle have been metrically converted, there will be no need for mental conversion of metrics to imperial units.

Metric Conversion in the Department

In addition to the conversion of road signs and other visible motoring aids, the Department will gradually go metric to the extent that every employee will, in some manner, be affected by metric conversion during his daily work routine. The following major changes will be necessary:

- Measurements of all kinds, e.g. length, area, volume, mass, force, pressure and stress, temperature etc. will be stated in new units and symbols. Fractions will no longer be used.
- Scales of drawings will be altered, e.g. the scale of 1 : 100 will replace $\frac{1}{8}$ in = 1 ft 0 in, 1 : 2 000 will replace 200 ft = 1 in etc.
- Computer programmes will need to be amended to take into account new units of measurement.
- Construction equipment, weighing and measuring equipment will need to be recalibrated in metric terms.
- Estimating, costing, work study, purchasing, and all data will have to be restated in metric terms.
- Specifications and standard drawings, and all other essential reference documents, will have to be revised and expressed in metric terms, and many council activities will be similarly affected.

In broad outline, the Department will adopt the timetable for introduction of the Metric System which was prepared by NAASRA, and from time to time, more specific dates of conversion will be notified.

As is the case with most metric conversion plans, although it is possible to set dates for the introduction of the system, it will not be practicable to fix definite dates for cessation of the use of imperial units, and in many cases both types of measurement will be used for some time after the introduction of the metric units. It is anticipated that Councils, in respect of works on Main Roads under Council's control, will also adhere to this timetable. (See diagram.)

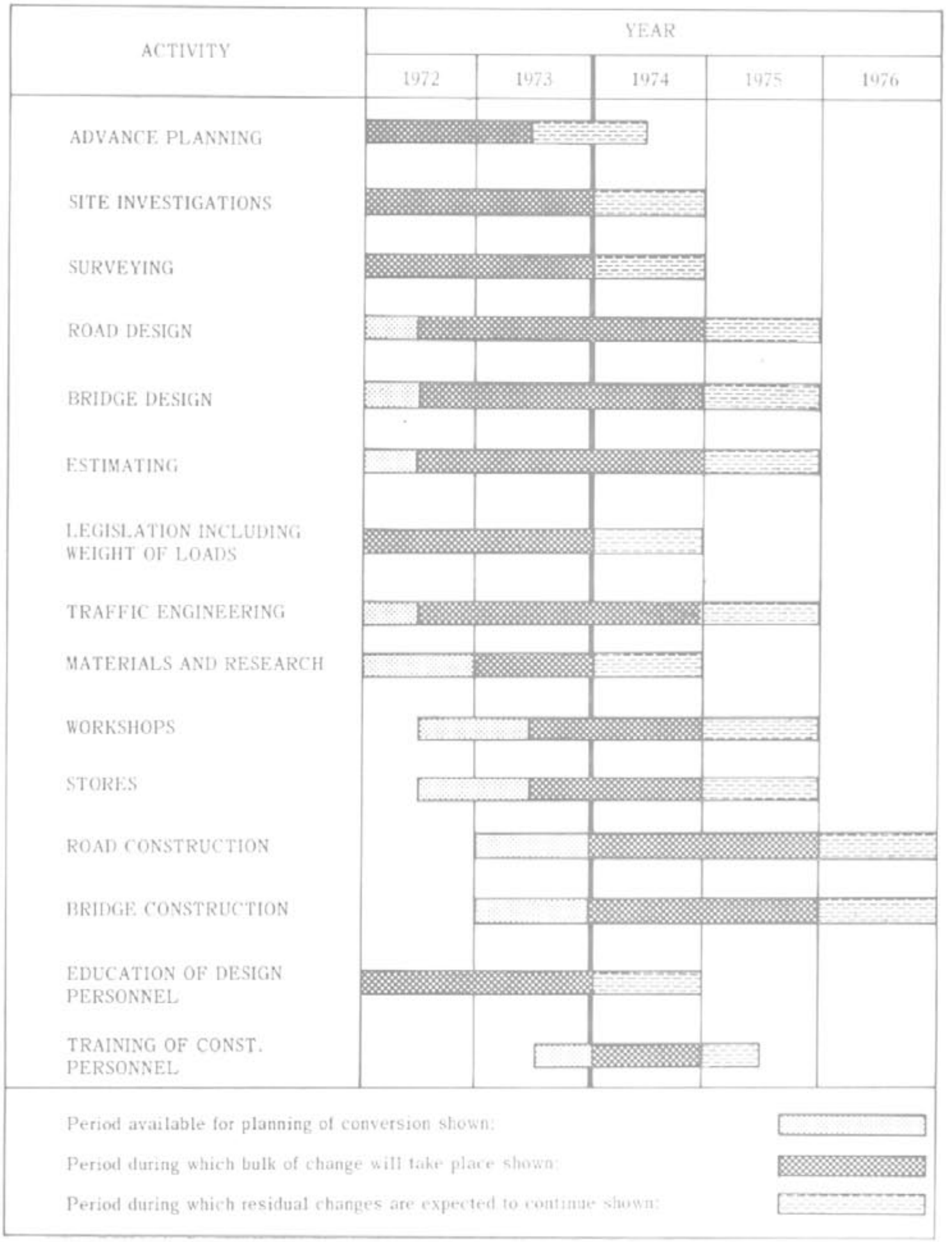
Replacement of Road Signs

The magnitude of the task facing the Department can be gauged by the fact that about 140,000 road signs will need replacement or conversion and 7,000 mile posts will need immediate replacement during the one month conversion period.

Much of the responsibility for this conversion lies with the Divisional Engineer and his staff in each of the Department's 16 Divisions. On him is the responsibility for the organisation, co-ordination and control conversion of all signs on main roads within his particular Division. He must also make

DEPARTMENT OF MAIN ROADS, N.S.W.

TIMETABLE FOR METRIC CONVERSION



"Timetable for Metric Conversion, Department of Main Roads, N.S.W."

"Metric posters and cartoon characters reproduced by courtesy of the Metric Conversion Board"

arrangements with local representatives of the Department of Motor Transport that speed limit signs and advisory speed signs on a particular length of road are converted concurrently. This policy is expected to minimise inconvenience to the motorist.

Each Divisional Office will face its own particular problems on sign conversion in its area. Extensive field surveys are being undertaken in all Divisions to identify the number and location of signs to be converted or replaced and to obtain details of the conversion plate or replacement sign. At the same time, the positions for kilometre posts are being marked on the ground and the legends recorded.

The Metropolitan Division, which is responsible for main roads in a large section of the Sydney area, has a multitude of different direction signs to convert. It has overcome the problem of so much variety in sizes and messages by implementing a fairly unique system of photography for all signs under its control.

To do this, a special tape giving particularly clear measurement, was developed. The tape was hooked on to each sign and a photograph taken of the full sign. Where necessary, a zoom lense was used for a closer picture of the section of sign containing imperial units. In this way, carefully controlled photography could be carried out from a vehicle on the road. The zoom lense also enabled photographs to be taken of other signs on the opposite side of wide roads. Approximately 1,500 signs were photographed during the survey. Field sheet records were constantly kept on the location of all signs and details inserted in a master register.

Not every sign photographed in this survey will require conversion but the information gained has established a valuable record for the Divisional Office. Decisions made on the signs to be converted and the method to be used indicate that about 540 new signs will be erected in the Metropolitan Division and 100 metric overlay plates also used.

Details of the mechanics surrounding the conversion of each different type of road sign show the breadth of detailed planning which must accompany such a change if it is to be carried out successfully:

Speed Limit and End Speed Limit Signs. As mentioned before, these signs are basically the responsibility of the Department of Motor Transport. They will be given the highest priority during the changeover period and will be replaced completely by signs with an entirely new format.

Advisory Speed Signs. Again a complete replacement of signs will be necessary, but the new sign will be similar in format to the old style.

Kilometre Posts. Eventually, most main roads will have kilometre posts at 2 km intervals, but during the month of changeover, they will be placed 10 km apart on both sides of the road and the positioning and erection of intermediate posts will be determined later.

Reassurance Signs and Finger Boards. In general, these signs will be converted by removing an overlay revealing the metric measurements beneath and attaching a "km" conversion patch above the metric distance. Where there is no overlay plate, a plate showing the entire block of distances in kilometres will be attached over the distances in miles with a stick-on conversion patch "km" attached above the new plate. Approximately 12 months later the "km" patch will be removed.

Signs showing approximate distances in yards. Such signs as supplementary distance plates used with warning signs and service signs such as Rest Areas, Fire Places and Truck Parking Areas often show fairly approximate distances, e.g. 400 YDS, and only the units will need conversion, e.g. an overlay M covering YDS should be sufficient.

Warning Signs. To maintain a well presented message, where necessary the full "Next X M" will be replaced.

Flood Depth Indicators. New Depth Indicators showing height in metres are to be erected on galvanised pipe supports and the old indicators removed immediately or soon after, at which time a plate reading "IN METRES" added to each advance warning sign—"ROAD SUBJECT TO FLOODING, INDICATORS SHOW DEPTH"—"IN METRES".

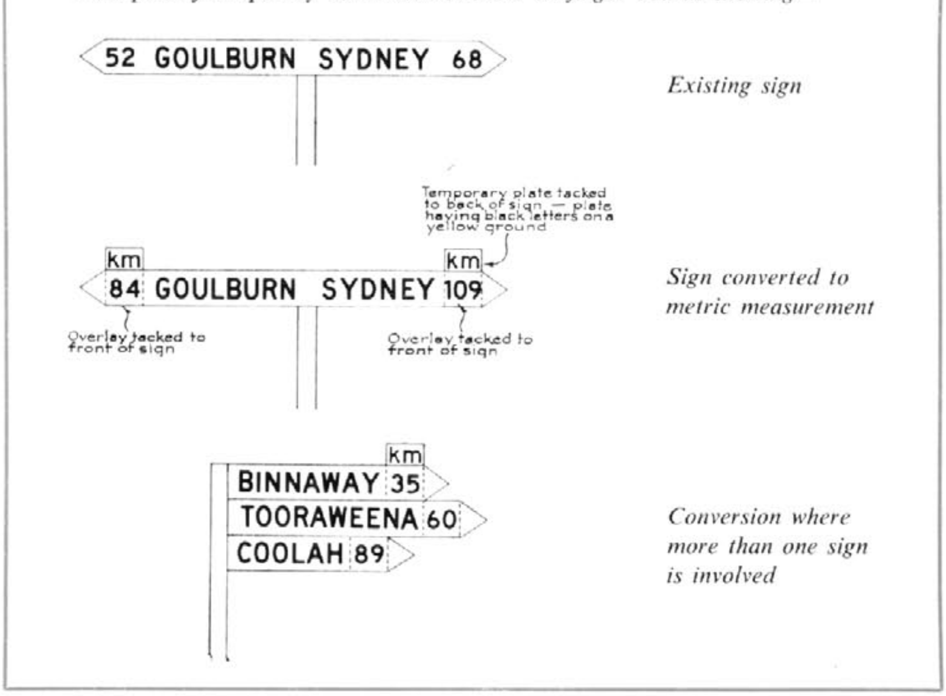
Clearance Signs. An overlay plate will go over the old units during July 1974 and concurrently the imperial units will be displayed under the new sign for a period of about 12 months.

Speed Limit on Bridge Signs. These will be replaced completely to the nearest 10 km/h.

Load Limit Signs. The word "TON" or letter "T" should be overlaid with a plate showing the word "tonne" or letter "t" respectively.

Temporary Warning Signs. A stick-on overlay patch will be affixed during July 1974.

Antiquity needs consideration too in the Department's conversion to metric mileposting. The old "blocky" sandstone mileposts on the Great Western Highway from Sydney to Penrith and on the Hume Highway and Campbelltown Road from Ashfield to Campbelltown are to be retained in their existing locations. They will be moved back when road widening occurs. The "blocky" milepost illustrated here is located near Crossroads on the Hume Highway (*S.H.* 2)



Examples of temporary conversion stickers on finger boards showing—

Existing sign

Sign converted to metric measurement

Conversion where more than one sign is involved

Legislation, Including Weight of Loads.

Ordinance No. 30c of the Local Government Act is to be amended to metric units and action concerned with this change is underway. Loadometers (portable weighing machines) are being converted and weighbridges will be converted progressively as they are due for certification.

Materials and Research

Test procedures and test report forms for laboratory use are now being converted and materials specifications are being progressively revised to metric units. New metric test sieves are being purchased and new gauges and dials are being obtained for major items of testing equipment.

Workshops and Stores

The purchase and use of metric size materials is being introduced progressively as the various items become available from suppliers.

Road Design

Metric standards for design of two lane rural roads were issued in April, 1973, and since that date designs have been in metric or imperial units, corresponding to the units used in the survey.

Approximately 50% of the designs for freeway and other major works in the inner area are now being prepared in metric units.

Bridge Design

From 1st August, 1973, bridge designs will be entirely in metric units and Consulting Engineers, who have been briefed for preparation of designs, have been instructed to prepare all designs in metric.

It is not proposed to conduct formal training courses for design personnel in the various sections of the Department, as it is expected they will adapt quickly to metric units. Training construction personnel in metric usage will be commenced later as it is considered that no advantage would be gained from training too far in advance of actual usage. On-job instruction will be carried out as metric plans are made available.

Construction of Roads and Bridges

Construction work based on metrics is scheduled to commence in metric units in January, 1974. The extent to which this will be possible will depend on the availability of plans and materials.

Advance Planning

The road surface type inventory for 1972–73 has been prepared in imperial units. This is being converted to metric units and will be used as a base for the next inventory which will be completely in metric units.

Site Investigation

Since late 1971, all ground control surveys have been made in metric units. Tellurometers used for measuring long distances read directly in metric units. In the past the readings have been converted to imperial units and with the introduction of the metric system, this is no longer necessary. The plotters used in photogrammetry were originally designed for metric units and were converted to imperial units to suit the Department's requirements at the time of purchase. They have since been reconverted to metric.

Surveying

Property surveys have been metric since July, 1972, and all survey plans prepared since that date for submission to the Registrar General's Department have been metric.

Engineering Surveys have been metric since April, 1973.

Estimating

Metric units will be used for estimates for those jobs designed in metric units●

TENDERS ACCEPTED BY COUNCILS

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

Council	Road No.	Work or Service	Name of Successful Tenderer	Amount
				$
City of Newcastle	S.H. 10 & 23	Supply and delivery of up to 2,300 tons of plant mix for resheeting works at various locations within the City boundary.	Boral Road Services Pty Ltd	27,000.00
City of Newcastle	T.R. 82	Construction of a 3-span prestressed and reinforced concrete bridge, 105 feet long over the stormwater channel at Richardson Park, Hamilton South.	J. V. Harris	164,413.00

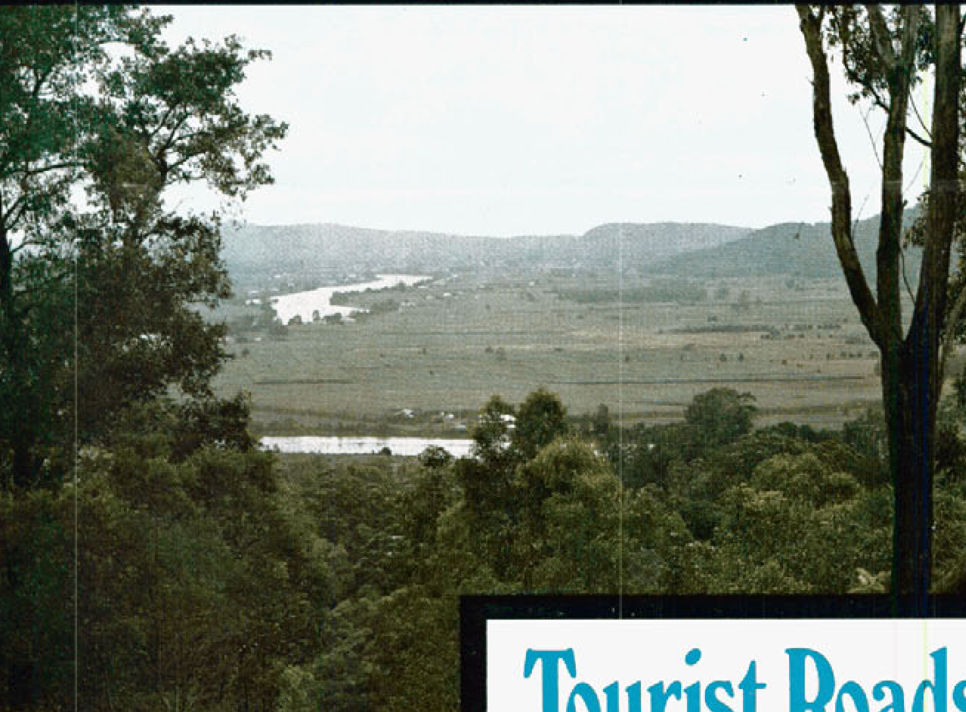
City of Wagga Wagga	S.H. 14	Sturt Highway. Laying of asphaltic concrete on deviation of highway between Edward Street and Ashmont Avenue, Wagga Wagga.	Pioneer Asphalts Pty Ltd	17,670.00
Ashford	D.W. 3099	Construction of 4-cell, 10 ft x 6 ft 6 in, reinforced concrete box culvert, 3·7 miles from Main Road No. 137.	N. Del Gatto	11,418.00
Bibbenluke	S.H. 19	Monaro Highway. Construction of two reinforced concrete box culverts; a 3-cell, 12 ft x 10 ft culvert over Ryans Creek and a 2-cell, 10 ft x 10 ft culvert over Station Gully, at 17·7 and 18·3 miles south of Bombala respectively.	K. E. Bottom	56,943.00
Bibbenluke	T.R. 91	Construction of earthworks, drainage and minor ancillary works between 10·5 and 12·3 miles east of Bombala.	Monaro Road Construction Pty Ltd	30,525.00
Bowral	M.R. 260	Construction of a concrete crib block retaining wall at Southdown Hill, from 4·1 to 4·4 miles south of State Highway No. 2, Hume Highway.	Fred Berridge Constructions	11,400.51
Byron	T.R. 65	Construction of a 4-span prestressed and reinforced concrete bridge, 140 feet long over Belongil Creek, 1·5 miles from Byron Bay.	Kennedy Bros	51,401.00
Carrathool	T.R. 80	Construction of a 10-span prestressed and reinforced concrete bridge, 200 feet long over Middle Billabong Creek, 24 miles west of Hillston.	Danckert Constructions	58,307.90
Gilgandra	M.R. 205	Construction of a 4-span prestressed and reinforced concrete bridge, 148 feet long over Tooraweenah Creek at Tooraweenah.	A. Cipolla and Co. Pty Ltd	39,799.00
Gosford	M.R. 349	Supply of timber for redecking of the bridge over Woy Woy Bay.	R. Lowe	10,740.19
Gosford	M.R. 349, M.R. 505, M.R. 580	Supply of asphaltic concrete for resurfacing at various locations.	Bituminous Pavements Pty Ltd	17,000.00
Holroyd	S.R. 2071	Construction of deviation of Warren Road near Long Street and northern approach to bridge over Prospect Creek.	R. and M. Eastick (Contracting) Pty Ltd	123,720.73
Kyogle	M.R. 361	Construction of a 3-span prestressed and reinforced concrete bridge, 105 feet long over Bottle Creek, 36·5 miles south of Woodenbong.	M. O. and P. J. Kautto	33,203.00
Lachlan	T.R. 61	Bituminous surfacing between 10 and 11·7 miles west of Condobolin.	Allen Bros Pty Ltd	17,108.40
Wingecarribee	M.R. 260	Construction of a 7-span prestressed and reinforced concrete bridge, 245 feet long over Wingecarribee River at Bong Bong.	E. Saunders and Son	105,702.89
Yallaroi	S.H. 16	Bruxner Highway. Construction of a 12-cell reinforced concrete box culvert over Newlands Creek, 15·9 miles west of Yetman. Comprising 10 cells, 5 ft x 5 ft and 2 cells, 7 ft x 7 ft.	N. Del Gatto	19,088.15

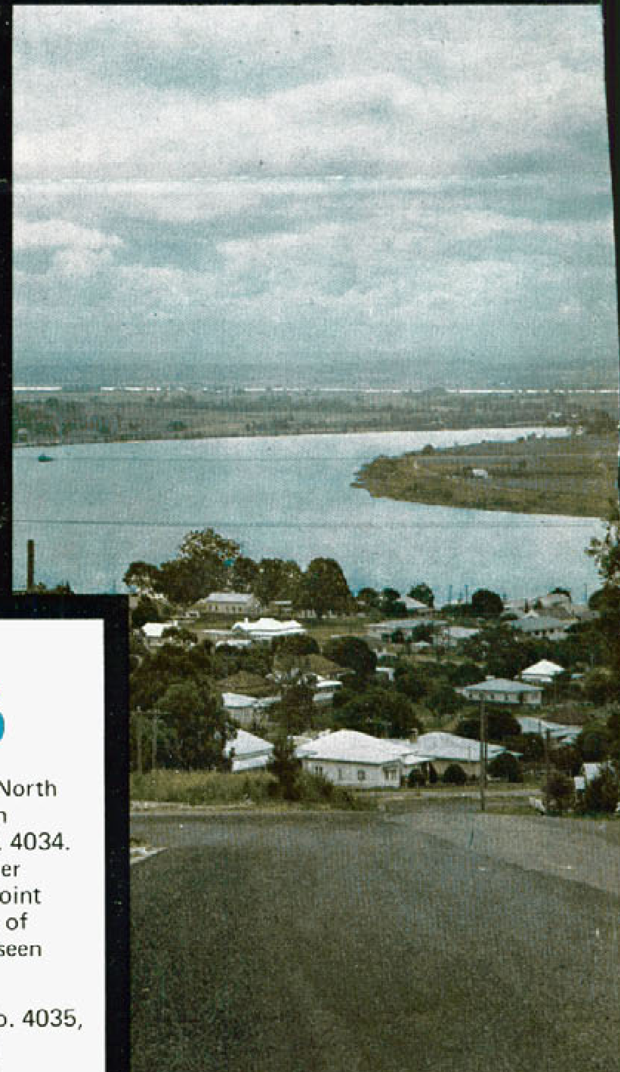
TENDERS ACCEPTED BY THE DEPARTMENT OF MAIN ROADS

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

Road No.	Work or Service	Name of Successful Tenderer	Amount
			$
Southern Freeway	City of Wollongong. Construction of a cast-in-situ reinforced concrete box culvert at Waterfall, 27·5 miles south of Sydney to house toll collection facilities.	Concast Pty Ltd	28,943.00
State Highway No. 2	Shire of Gundagai. Test loading of four case-in-situ piles for new bridge over the Murrumbidgee River at Gundagai.	Ground Test Pty Ltd	16,200.00
State Highway No. 5	Great Western Highway. City of Blue Mountains. Correction of shape (using asphaltic concrete) of climbing lanes between 5·8 and 16·1 miles west of Katoomba.	Bituminous Pavements Pty Ltd	10,143.48
State Highway No. 5	Great Western Highway. Municipality of Blacktown. Supply and delivery of up to 9,500 tons of ⅜ in gauge asphaltic concrete for resurfacing between Prospect and St Marys.	Bituminous Pavements Pty Ltd	147,725.00
State Highway No. 6	Mid-Western Highway. Shire of Lyndhurst. Construction of single span slab portal frame bridge 60 feet long over Mount Macquarie Road at Carcoar.	A. Cipolla and Co. Pty Ltd	129,775.00
State Highway No. 7	Mitchell Highway. Supply and delivery of surface and basecourse gravel to reconstruction between 3·9 and 5·7 miles north of Molong.	L. J. Osborn	22,240.00

State Highway No. 8	Barrier Highway. Shire of Central Darling. Construction of a 23-span prestressed and reinforced concrete bridge, 460 feet long over Grassmere Creek at 26·6 miles west of Wilcannia.	Kev. Rohrlach Constructions Pty Ltd	132,523.00
State Highway No. 9	New England Highway. Supply and delivery of up to 2,000 tons of ⅜ in gauge Plant Mix with Koppers Tar Binder to reconstruction work between Long Bridge, Maitland and Tally Ho Park, Rutherford.	Bituminous Pavements Pty Ltd	24,780.00
State Highway No. 9	New England Highway. Supply and delivery of up to 1,100 tons of ⅜ in and ¾ in gauge asphaltic concrete for resheeting and strengthening of pavement between 16·8 and 17·5 miles west of Maitland.	Bituminous Pavements Pty Ltd	16,043.00
State Highway No. 9	New England Highway. Supply and delivery of up to 780 tons of ⅜ in and ¾ in gauge asphaltic concrete for resheeting and strengthening of pavement between 18·45 and 19·05 miles west of Maitland.	Bituminous Pavements Pty Ltd	15,382.00
State Highway No. 9	New England Highway. Supply and delivery of up to 1,040 tons of ¾ in gauge asphaltic concrete for resheeting and strengthening of pavement between 22 and 22·8 miles west of Maitland.	Bituminous Pavements Pty Ltd	11,440.00
State Highway No. 9	New England Highway. Supply and delivery of up to 1,100 tons of ⅜ in and ¾ in gauge asphaltic concrete for resheeting and strengthening of pavement between 5·4 and 6·1 miles north of Muswellbrook.	Bituminous Pavements Pty Ltd	19,276.00
State Highway No. 9	New England Highway. Supply and delivery of up to 720 tons of ⅜ in gauge asphaltic concrete for resheeting and strengthening of pavement between 18·45 and 19·05 miles west of Maitland.	Bituminous Pavements Pty Ltd	10,828.00
State Highway No. 10	Pacific Highway. Haulage of up to 7,000 tons of Slag Products from B.H.P. stockpile to construction between Naru Street and Robert Street, South Belmont.	Brambles Industrial Services	10,080.00
State Highway No. 10	Pacific Highway. Supply and delivery of up to 1,000 tons of ⅜ in open graded Bituminous Plant Mix with R90 Binder to reconstruction work between Southern Catherine Hill Bay Turnoff and Lake Macquarie Shire Boundary.	Bituminous Pavements Pty Ltd	14,410.00
State Highway No. 10	Pacific Highway. Supply and delivery of up to 1,000 tons of ⅜ in gauge asphaltic concrete for resheeting and strengthening of pavement between 11·7 and 12·75 miles north of Newcastle.	Bituminous Pavements Pty Ltd	12,900.00
State Highway No. 10	Pacific Highway. Shire of Hastings. Construction of 3-span, prestressed concrete plank overpass, 120 feet long in the northern approach to the bridge over the Wilson River at Telegraph Point.	Transbridge Pty Ltd	88,551.00
State Highway No. 12	Gwydir Highway. Supply, heat, haul and spray bitumen at various locations.	Boral Road Services Pty Ltd	11,531.60
State Highway No. 16	Shire of Tenterfield. Construction of two reinforced concrete box culverts; a 9-cell, 6 ft x 6 ft culvert over Sandy Creek and a 13-cell 10 ft x 9 ft culvert over Gulf Creek at 20·67 and 20·77 miles east of Bonshaw respectively.	N. Del Gatto	56,885.70
Trunk Road No. 51	City of Queanbeyan. Construction of a 6-span steel girder and reinforced concrete deck bridge, 463 feet long over the Queanbeyan River at Queanbeyan. The contract price includes the demolition of the existing bridge and abutments.	Central Constructions Pty Ltd	291,174.00
Main Road No. 173	City of Sydney. Construction of Kings Cross Road Tunnel. The work includes site excavation, pavement construction and associated drainage, concrete footings and columns for future air space development, the erection of walls and roofing and the provision of all mechanical and electrical services.	Pearson Bridge (N.S.W.) Pty Ltd	1,974,873.00
Main Road No. 178	City of Campbelltown. Construction of a 3-span prestressed and reinforced concrete girder bridge, 240 feet long to carry Camden Road over the South Western Freeway at 33·6 miles south of Sydney.	John Holland (Constructions) Pty Ltd	183,671.00
Main Road No. 373	Epping Road. Municipality of Ryde. Supply and delivery of up to 4,000 tons of ⅜ in gauge asphaltic concrete for reconstruction between Shrimpton's Creek and Terry's Creek.	Pioneer Asphalts (N.S.W.) Pty Ltd	62,400.00
Main Road No. 556	Shire of Macleay. Supply and laying of asphaltic concrete on the deck of the new bridge over the Macleay River at Smithtown.	Bituminous Pavements Pty Ltd	10,464.30
Various	South Grafton Works Office. Supply and delivery hot mixed, cold laid bituminous plant mix to various stockpile sites.	Bituminous Pavements Pty Ltd	20,562.00
Unclassified	Municipality of Rockdale. Construction of a 2-span prestressed and reinforced concrete bridge, 80 feet long over the Western Suburbs Outfall Sewer near Marsh Street, Arncliffe.	Pearson Bridge (N.S.W.) Pty Ltd	139,909.00
Unclassified	Municipality of Bankstown. Supply and delivery of up to 1,500 tons of ¾ in gauge asphaltic concrete for surfacing of northern approach to new bridge over the George's River at Alford's Point.	Bituminous Pavements Pty Ltd	23,625.00





Tourist Roads

One of the most beautiful views on the North Coast of New South Wales can be seen from the lookout at the end of Tourist Road No. 4034. A section of the view over the Clarence River is illustrated at top left and also from the point where the Tourist Road leaves the junction of Grafton Street and Wharf Street, Maclean, seen top right.

Seal Rocks, reached on Tourist Road No. 4035, offers travellers breathtaking vistas of wild coastline broken by wide peaceful beaches. Below left is Sugarloaf Point and at bottom right, the Seal Rocks lighthouse, almost 100 years old, stands solid and dutiful against a misty sky.