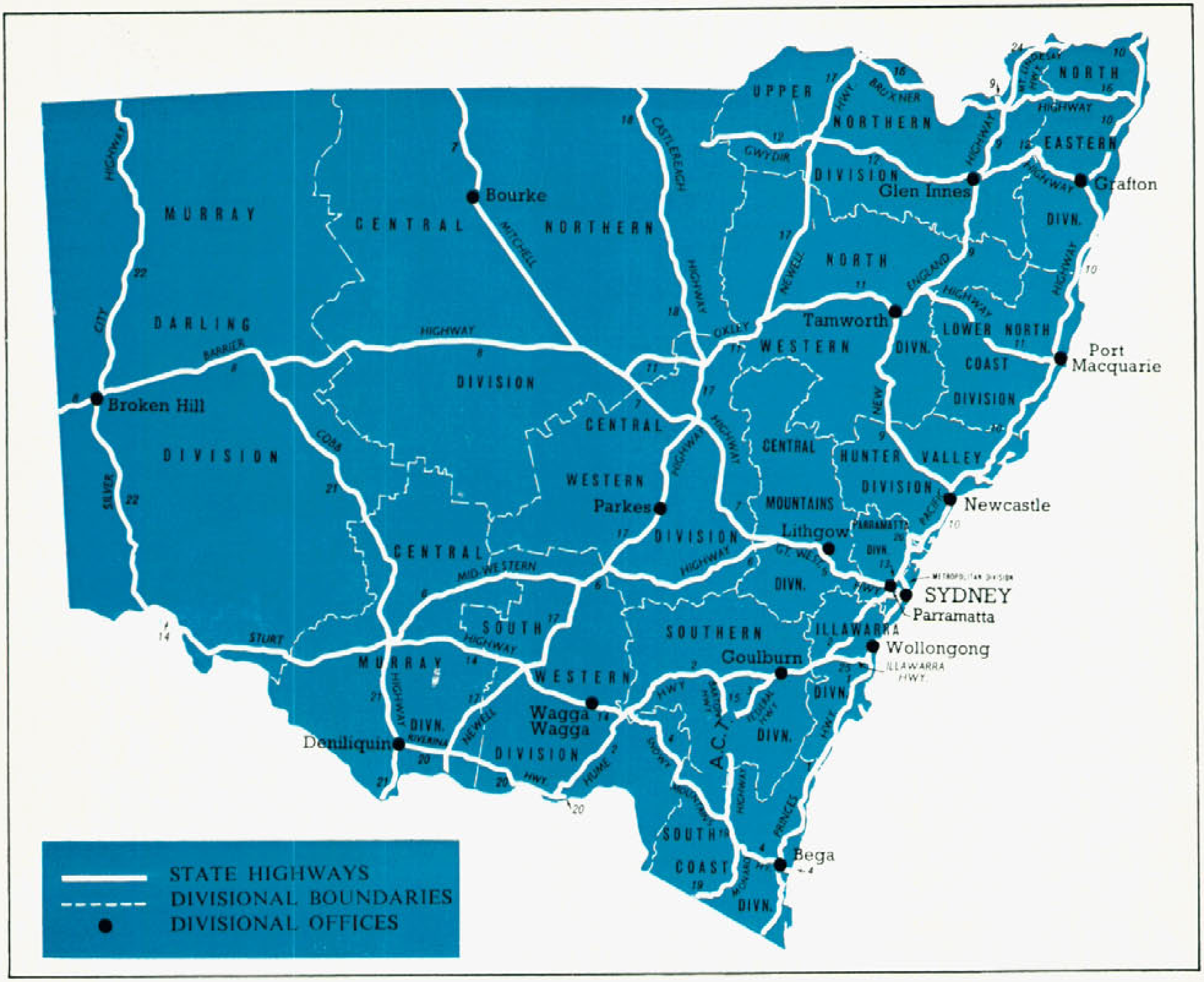
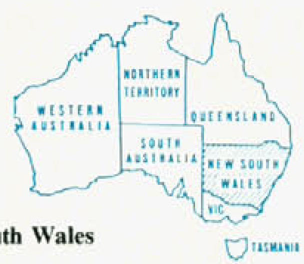
MAIN ROADS

MARCH 1977





New South Wales

Area—801 428 km²

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

Length of Public Roads—208 804 km

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

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

ROAD CLASSIFICATIONS AND LENGTHS IN NEW SOUTH WALES

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

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

MAIN ROADS

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96 TENDERS ACCEPTED BY DEPARTMENT

Front cover: Construction of the North Western Freeway across Darling Harbour (see articles on pages 88 *and* 90).

Back cover: Two views of the new, eye-catching pedestrian overbridge which crosses the future route of the F4 Western Freeway at Melton Street, Auburn (see details in December, 1976 *issue of* "*Main Roads*", *Vol.* 42, *No.* 2, *pages* 39 *and* 41).

WATER WOES

Water is probably the most abundant material on this earth. It is said that about three-quarters of the surface materials on the earth consist of water. Water in rocks, together with water in and under the surface of the earth's crust, accounts for 6.3% of the total amount of water on the earth.

Water can be soft, hard, heavy, sea, salt, fresh, rain, flood and, on rare occasions, even pure. Water can be both a blessing and a curse—it is claimed by some that man himself comes from water!

It is a blessing to the parched earth—to the thirsty traveller—to the farmer tending his crops—to the city dweller for purifying the air. Without water, life would wither. In stark contrast, terror, misery and disaster result from floods created by the curse of an overabundance of water.

Like everyone else, engineers in the Department of Main Roads have problems with water, both on the surface of roads and beneath them.

Water in small streams and big rivers creates problems because there is always the need to build bridges over it. Concentrated water on wide flat pavements can cause vehicles to aquaplane and can lead to a dangerous loss of control by the driver.

While the initial effect of water on roads can be quite different for different types of road surface, the final effect, if water is allowed to flow unchecked, is complete failure of the road—be it natural surface, gravel surfaced or even bitumen surfaced.

For any road pavement to function efficiently, water must be collected and taken away from the carriageway, the road formation and the road reserve. Water which has soaked into the ground must be intercepted and disposed of before it penetrates beneath the road surface. This is particularly so in the case of sealed roads and the article on subsoil drainage on page 66 explains what this involves.

Water of a different kind—in the form of valuable wetlands—comes into road planning considerations for the F3 near Warnervale, in discussions about environmental impact on page 77, while some unusual underwater work is described on pages 90–1.

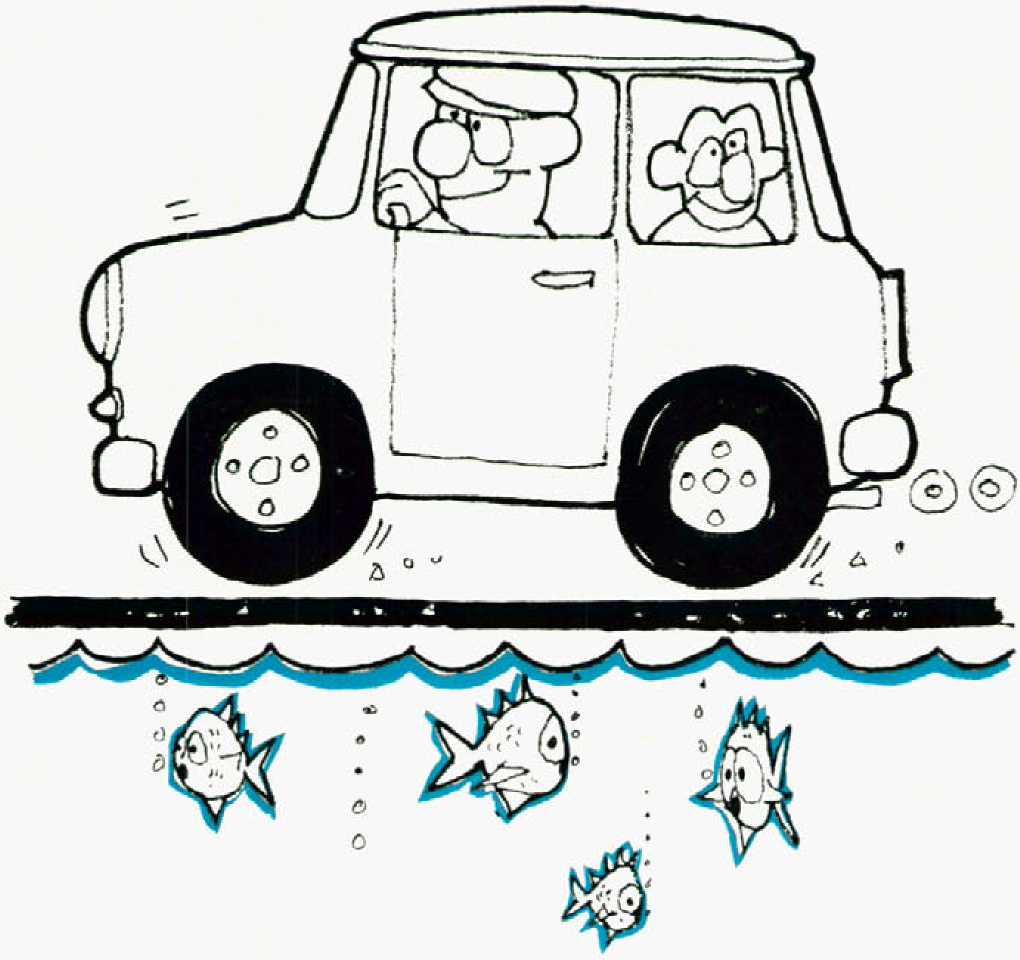
Samuel Taylor Coleridge's Ancient Mariner complained of

"Water, water everywhere
nor any drop to drink"

and, putting it poetically, too much water can often be the albatross around the neck of the modern road engineer. ●

This article has been adapted from a paper "Subsoil Drainage Practice on Rural Freeways and Suggestions for Improvements and Further Research" presented at a Workshop on Subsoil Drainage arranged by the National Association of Australian State Road Authorities on 23rd and 24th November, 1976. The paper was prepared and presented by Mr J. B. Anderson, A.S.T.C., M.I.E.Aust., Divisional Engineer, Outer Freeway Construction Division and Mr A. Tinni, B.E., Supervising Engineer, Outer Freeway Construction Division. Details and diagrams showing suggested design methods and calculations included in the paper are not shown in this article. A record of the workshop (summarising the ten papers presented and subsequent discussions and conclusions) has been prepared and published by NAASRA. Copies of the 32-page record are available from the Department's Plan Room at a cost of $1.50 each.

Water in Pavements



Sub-grade or subsoil drains are laid adjacent to the road pavement for three principal purposes.

1. To lower the level of a water table.
2. To intercept or drain underground water flows.
3. To collect and remove water entering the road structure through the pavement and shoulders.

The definition of the terms sub-grade drain and subsoil drain as given in the Australian Standard AS 1348-1972—Terms Used in Road Engineering—does not adequately describe the functions of this extremely important facet of road construction.

There is an important need to create an awareness among road design and construction personnel of the complexities of sub-grade drainage. This need can be met in part by a general education programme involving the basic theories and calculations associated with sub-grade drainage work. An appreciation of the practicalities and limitations of construction on an economically acceptable basis is also necessary. For example, with modern road design criteria there are often long vertical curves and the attainment of desirable grade requirements in sub-grade drainage systems under these conditions becomes a major problem. Whatever the solution to this particular problem it is expensive and may be avoided if considered as part of the basic road design.

The techniques of sub-grade drainage practice used on rural freeways are based on experiences on wide pavements with thin asphaltic concrete running surfaces flanked by wide grassed median areas.

From time to time rural freeways must traverse areas which have poorer quality materials such as decomposed shales and clays. The need to keep a consistent moisture content in the pavement layers built on these poorer materials is becoming increasingly important and special measures may be necessary to overcome the deficiencies in these materials immediately under the pavement layers.

The behaviour of completed pavements has been critically observed over recent years and assessments made of failure criteria and specific causes. An appraisal of these assessments has led to a number of modifications to the methods adopted for the collection and removal of subsoil water. The departures from standard must be regarded as trials in many cases as their value can only be confirmed when the completed pavements have been under traffic for some time.

CONTROL OF SUBSURFACE WATER

The basic methods used to control, channel and collect subsurface water are:

☆ Subsoil drains,

☆ Sub-grade drains,

☆ Spigot and socket rubber ring jointed stormwater pipes for carriageway drainage,

☆ Spigot and socket jointed cross-drainage culverts, and

☆ Lime stabilisation of the selected sub-base layer.

To ensure that stormwater cannot enter the pavement layers or sub-grade from pipe drainage within the formation, spigot and socket rubber ring jointed pipes are used for all longitudinal and cross-drainage lines which carry the water from the carriageway pavements and shoulders. Rubber ring joints are also used on cross-drainage pipes where the cover under the pavement layers is less than 1 metre.

All other stormwater pipe culverts are spigot and socket jointed. Joints are sealed with hand packed mortar with small gaps left in the top half of the joint to allow subsurface water to escape and so dissipate pore pressure.

Lime stabilisation of the selected sub-base layer not only provides stiffness and strength under the pavement but also forms a near-impervious layer which is not as moisture susceptible as untreated material. Moisture susceptible materials show a marked degradation in structural performance in the presence of excess moisture.

Water that enters the pavement structure through the running surface is collected on this layer and taken away by sub-grade drains provided at the edges of the shoulders. Water that enters from the sides of the formation is also collected by these sub-grade drains.

LOCATION, DEPTH AND WIDTH

Because of the high standard of construction of freeways and the volume and speed of traffic using them, it is important that excess water, both surface and sub-surface, is collected and removed.

In cuttings, surface water is collected in concrete gutters and sub-grade drains are constructed within the road shoulders and adjacent to the lip line of these gutters.

Sub-grade drains are also used on fills and are laid at the outer edge of the shoulder but within the shoulder structure.

The normal depth at which sub-grade drains are laid is about 1 metre below the finished surface level but this depth can be varied to suit particular circumstances and to satisfy minimum grade requirements. A standard trench width of 300 mm has been adopted. This is a convenient backhoe bucket width and can also be achieved with tractor-mounted continuous chain cutter trenchers.

Transverse sub-grade drains are provided on an "as required" basis. At bridge structures they are laid at nominal distances of 4 m and 20 m from the abutments on the uphill side of the structure.

When a water table is present it is possible that the spacing of the longitudinal sub-grade drains at 12.5 metres will not depress the water table sufficiently at the centre of the pavement and there is a likelihood of capillary action introducing unwanted water into the pavement layers. The capillary rise in a particular soil should be calculated when considering these conditions.

Sub-grade drains are generally laid to the freeway grades with 1 per cent desirable minimum and ½ per cent the absolute minimum grade. There are locations, however, where it is extremely difficult, if not impossible, to achieve satisfactory grading because of the vertical geometry of the road design.

DRAINAGE PIPES

For sub-grade drainage of freeway pavements 100 mm diameter corrugated perforated plastic piping is currently used. The wall thickness of the piping is about 0.6 mm.

The depth of the corrugations is between 4 and 6 per cent of the internal diameter of the pipe and the spacing of the corrugations is between 5 and 10 per cent of the internal diameter of the pipe.

The perforations are formed by longitudinal cuts along the crests of the corrugations or by circumferential slots in the bottoms of the corrugations. Each perforation is between 5 mm and 6 mm long and between 0.6 mm and 1 mm wide.

The lines of perforations are placed 120° from each other in the longitudinal format and generally somewhat closer in the circumferential format.

FILTER MATERIAL

In *all* instances filter material is designed to suit the existing sub-grade material and the inlet conditions of the subsoil pipe.

Until recently the design of filter material generally has been based on only two criteria, "piping" and "permeability".

In the most recent construction of freeways in rural areas, however, the design has been based on five parameters:

Top: "A standard trench width of 300 mm has been adopted. This is a convenient backhoe bucket width and can also be achieved with tractor-mounted continuous chain cutter trenches".

Above: "In cuttings, surface water is collected in concrete gutters and subgrade drains are constructed within the road shoulders and adjacent to the lip line of these gutters".

(1) Piping ratio	$\frac{D_{15F}}{D_{85S}} < 4$	Terzaghi, Casagrande, *et al*
(2) Permeability ratio	$\frac{D_{15F}}{D_{15S}} > 5$	
(3) Uniformity ratio	$\frac{D_{50F}}{D_{50S}} < 25$	U.S. Army Corps of Engineers. U.S. Bureau of Reclamation.
(4) Slot width requirement	$\frac{D_{85F}}{\text{slot width}} > 1.2$	U.S. Army Corps of Engineers.
(5) Maximum size filter	10 mm	To avoid puncturing.

F = filter material
S = insitu soil
D_{15} = effective grain size based on the sieve opening that 15% of the material passes

Caution is still required with this approach, as the analysis gives a theoretical design grading for a filter material which does not necessarily satisfy the permeability requirements of the sub-grade drain. In the majority of cases, subsurface water movement occurs along faults, joints, cracks, bedding planes, etc., and not as an even flow through the soil mass—which is what the design provides for.

CONSTRUCTION METHODS

Sub-grade drainage trenches are excavated after the sub-base layer has been compacted and shaped.

The drainage pipe comes in 120 metre rolls and at least one outlet is arranged for that length of subsoil drain.

Pipes are laid in the trench with the perforations in the 12, 4 and 8 o'clock positions. This ensures that they are above the siltation level of the pipe and, in theory, the maximum inlet area is available for water to enter the pipe.

Pipes are joined either by cutting and lapping or using patent joiners and then tied.

Where possible, outlets are incorporated into gully pit walls, approximately 150 mm above the invert level. Otherwise, standard precast outlet headwalls are used. In both instances the outlet is covered by galvanised 12.7 mm (½ inch) mesh bird wire to prevent ingress of rodents, rabbits, etc. The wire mesh is attached with screws and is easily replaceable.

Maintenance of the sub-grade drain is provided through "cleanouts" provided at maximum intervals of 60 metres. The cleanout is constructed by joining a connecting pipe to the sub-grade pipe and encasing the joint in concrete. The concrete ensures that filter material cannot enter the sub-grade pipe through inadequacies at the joint and it also provides the strength required to insert and bend cleaning rods. Plastic lid assemblies are incorporated in the concrete gutters or cast-in-situ pads on fills.

Designed filter material is placed in approximately 300 mm layers and thoroughly compacted by vibrating plate compactors and by flooding. For the first layer compaction, a split foot vibrating plate may be necessary to avoid crushing the plastic pipe.

After completion of compaction all pipes are flushed out to remove the fines that entered the system during flooding of the filter material. This operation serves as a check to ensure that pipes have not been damaged by crushing. If filter material is flushed out during this operation it would indicate that joints have been pulled apart.

Outlets and cleanouts are marked with lemon yellow pegs or marks painted on rock faces. A number of alternative systems for marking outlets are being investigated.

QUALITY CONTROL

Quality control is exercised to a high degree throughout every stage of construction. These stages can be summarised as:

(a) Design of filter material,
(b) Testing of sub-grade pipe,
(c) Compaction tests of filter material,
(d) Grading checks on compacted filter for material breakdown and contamination,
(e) Protection from contamination during construction, and
(f) Decontamination of the top of the sub-grade drain.

(a) *Design of Filter Material*

The method of design of filter material has been discussed previously.

(b) *Pipe strength*

Sub-grade piping is tested in regard to its properties, dimensions, perforations and strength.

(c) *Compaction of filter material*

Special emphasis is given to the compaction of the filter material as sub-grade drains are within the pavement structure and latent consolidation cannot be tolerated.

There are no standard tests available for density measurement of coarse granular materials and special techniques have been evolved. Field compaction is compared to laboratory maximum dry rodded weight achieved by Standard Proctor procedure. To measure field densities, however, a specially adapted CBR mould is forced through a base plate into the filter material. The material within the mould is then carefully scooped out, dried and weighed. Field compaction is required to be a minimum of 100 per cent of laboratory compaction. The repeatability of this technique has been found quite satisfactory.

(d) *Grading checks*

Some breakdown of material during compaction will always occur. However, this has to be such that the additional fraction passing 150 μm (B.S. 100) is negligible.

Prior to use, filter material is checked to ensure that this does not occur.

Contamination with fines can drastically reduce the permeability of the filter, e.g.:

% passing 150 μm	Permeability metres per day
0	25 to 90
2	3 to 30
4	0.6 to 15
6	0.15 to 6
7	0.06 to 1

(e) *Protection during construction*

Once the drains have been constructed, it is of the utmost importance that they be protected from contamination, scouring and from acting as a stormwater drain. Measures which can be taken to reduce the likelihood of any of these occurrences are as follows:

☆ As soon as the filter material has been placed, a 50–75 mm "capping" of road base material is rolled into the trench.

☆ If this is not possible and the trench must be left under construction traffic then 50–75 mm of the filter material is removed by hand immediately prior to placement of the base course and again the base course "capping" rolled in.

☆ Introduce a shallow graded drainage ditch on the pavement side of the sub-grade drain to collect and channel run off.

☆ On steep grades this ditch may be supplemented by diagonally placed sand bags to deflect and slow down the run off from the pavement.

(f) *Decontamination*

Decontamination of the top of the drain, immediately prior to placement of the basecourse, is a standard procedure. The top 50 mm (or more if required) of the filter material in the drain is removed and immediately backfilled with the actual basecourse material and compacted. This operation is quickly followed up with the spreading and compaction of the base-course layer.

IMPROVEMENTS

It has become apparent that to provide effective and economical subsoil drainage systems there must be continuing education and research into areas where present practices are inadequate or appear capable of improvement.

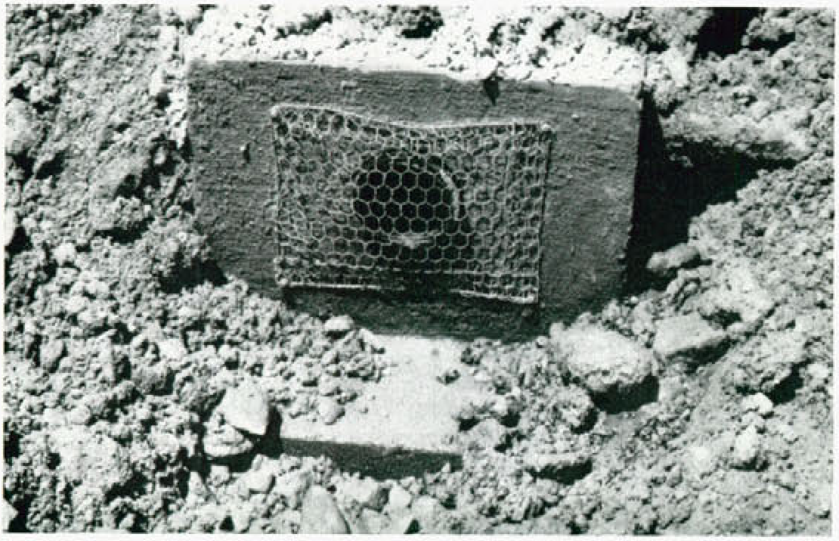
Both designers and constructors should be informed of the basic principles involved in subsurface drainage so that they might better understand how to achieve a desired result.

General guidelines or standards suitable for Australian conditions and covering the manufacture of piping (materials, quality, testing, etc.), installation requirements, construction tolerances and so on would be of considerable assistance in establishing a uniform practice.

The cost of ideal designed filter materials is becoming prohibitive and research undertaken to reduce this cost would be beneficial. Areas in which research could be effective in this regard are the use of filter socks around pipes to enable a relaxation of the grading requirements for filters, a study of the minimum filter layer thickness required between pipe and surrounding material which could result in reduced trench width, determination of the smallest effective diameter of piping which might be able to be used where only small volumes of water are likely to be carried.

While there has been a reasonable amount of fundamental research undertaken in various institutions, there is a need to extend the purely academic approach to cover the feasibility of implementation and assess the cost and benefits likely to result in practice. ●

"Outlets are incorporated into gully pit walls . . . and covered by galvanized 12.7 mm (½ inch) mesh bird wire to prevent ingress of rodents, rabbits, etc.".



"To measure field densities . . . a specially adapted CBR mould is forced through a base plate into the filter material. The material within the mould is then carefully scooped out, dried and weighed".

New Bridge over Yass River at Yass

The present bridge over the Yass River linking Yass and North Yass on the Hume Highway is 85 m long. It has a steel lattice-truss span 55 m long, with two timber beam spans at either end each approximately 7.5 m long. This historic bridge was built in 1871 and is familiar to many road users because of the curved overhead bracing between the two trusses.

The passage of time has taken its toll of the old bridge. Its deteriorating condition, narrow width, and limited overhead clearance has dictated the need for a new bridge to cater adequately for the heavy traffic using the Hume Highway.

This view shows how close the new structure is to the old one which it will soon replace. Comur Street can be seen in the background.

The bridge is located at the end of Comur Street, the main street through the business centre of Yass. The most suitable location for the new bridge would have been where the existing bridge now stands but this would have involved providing a very costly but temporary high-level flood-free crossing of the river—to cater for the heavy and continuous Highway traffic volumes while the old bridge was demolished and the new bridge built.

By shifting the line of the Highway slightly, it was possible to locate the new bridge immediately upstream of the existing bridge but, at the Yass end, it will be partly superimposed over the old bridge. Portions of the new Yass abutment and the downstream footway will not be completed until traffic is using the new bridge and the affected part of the old bridge has been demolished.

The new bridge will provide for a service road to pass beneath the Yass end span. At North Yass a footpath will be built beneath the bridge to provide a connection between the footpaths on either side of the Highway.

General Description

The new bridge will be approximately 100 m long with spans of 30 m, 40 m, and 30 m. Its overall width will be 13 m with a carriageway 8.6 m wide between kerbs. There will be two traffic lanes and two footways.

Traffic barriers comprising low concrete parapets surmounted by steel railings will separate the carriageway from the footways. Steel grille railings will be provided along the outside edges of the footways.

The bridge deck will be on a 3.7 per cent grade rising from the Yass end. At the Yass abutment the vertical clearance above the highest known flood level (1959) will be 0.5 m.

Because of its urban location, the new bridge will carry a considerable number of public utilities. These will be suspended from the concrete deck slab, between the two steel trough girders.

Substructure

The granite rock at the site is covered by overburden varying in depth from 6.5 m at the Yass abutment to 2 m at the North Yass abutment. The foundations for Piers 1 and 2 and for the North Yass abutment are spread footings on rock, while the foundations for the Yass abutment are steel piling beams driven to rock. The top 1.5 m of these steel piles is encased in concrete for protection against corrosion.

The piers are of reinforced concrete and have single tapered hexagonal columns with cantilevered headstocks. The width of the columns varies between 3 m and 5 m and the thickness varies between 0.4 and 1 m. A vertical groove in the centre of each column face will enhance the appearance of the pier columns.

The reinforced concrete abutments are retaining walls tied back to buried anchor-beams. They are flanked by independent concrete retaining walls which are elliptical in plan. All visible surfaces of the abutments and wingwalls will be bush hammered.

The continuous superstructure will be fixed by steel bearings at the North Yass abutment. Expansion bearings of the neoprene pot/P.T.F.E. (low friction) disc type are to be provided at the Yass abutment and both piers. The design temperature movement at the Yass abutment is $\pm$ 35 mm. A flexible rubber deck expansion joint between the superstructure and the rear wall of the abutment will provide for this movement at deck level.

Superstructure

The superstructure will be continuous for the full length of the bridge and will consist of twin steel trough girders acting compositely with a reinforced concrete deck slab.

The cross-section of the bridge is similar to that of the Macarthur Bridge over the Nepean River at Camden (see article in June, 1971 issue of "Main Roads", Vol. 36, No. 4, pp. 98–103) and to the viaduct spans of the newly completed Sheahan Bridge over the Murrumbidgee River at Gundagai (see article in March, 1974 issue of "Main Roads", Vol. 39, No. 3, pp. 66–9). However, the special construction technique used at these two bridges (that is, of prestressing the deck by controlled lowering after the deck concrete had been cast and cured), has not been adopted for the Yass River Bridge because of its relatively short length.

The steel trough girders are 1.43 m high. The webs, which are inclined at 1 in 4 from the vertical, are 16 mm plates and the bottom flanges are 2.05 m wide and vary between 12 and 32 mm in thickness depending on bending moment requirements. The top flanges vary between 475 x 40 mm over the piers to 350 x 20 mm at mid-span. Welded stud shear connectors along the top flanges provide for the composite action of the concrete deck slab.

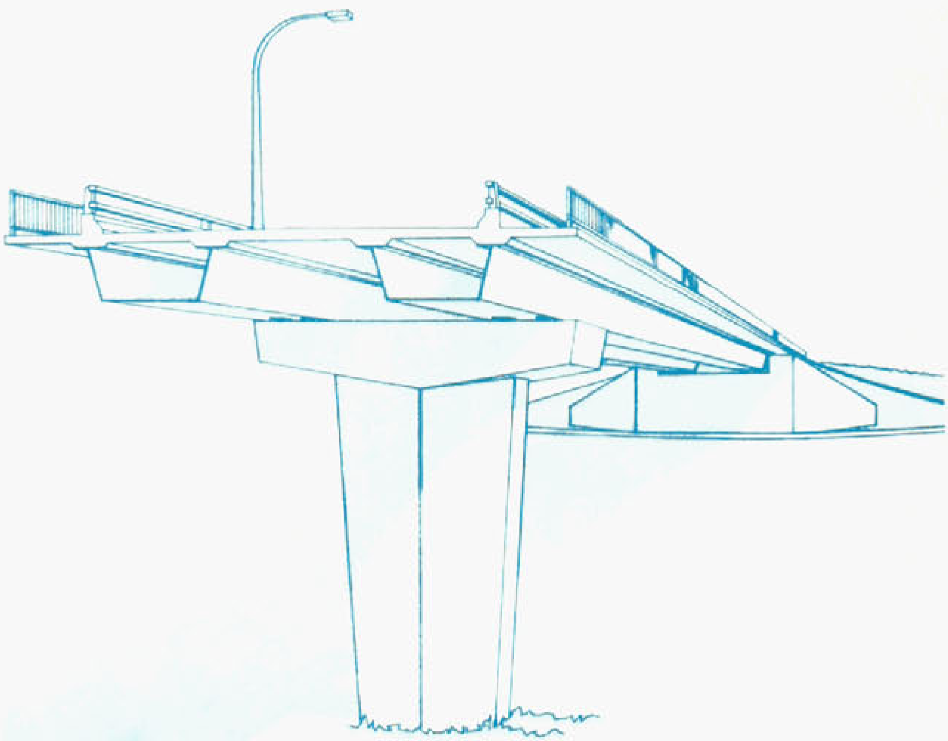
The superstructure has been detailed for fabrication in segments approximately 20 m long and weighing between 14.5 and 18.8 tonnes. The site joints between segments will be full penetration butt welds.

A single longitudinal T-shaped stiffener, made from 12 mm plate, is provided for the bottom flanges of the girders for a length of 9.64 m on each side of the pier centreline.

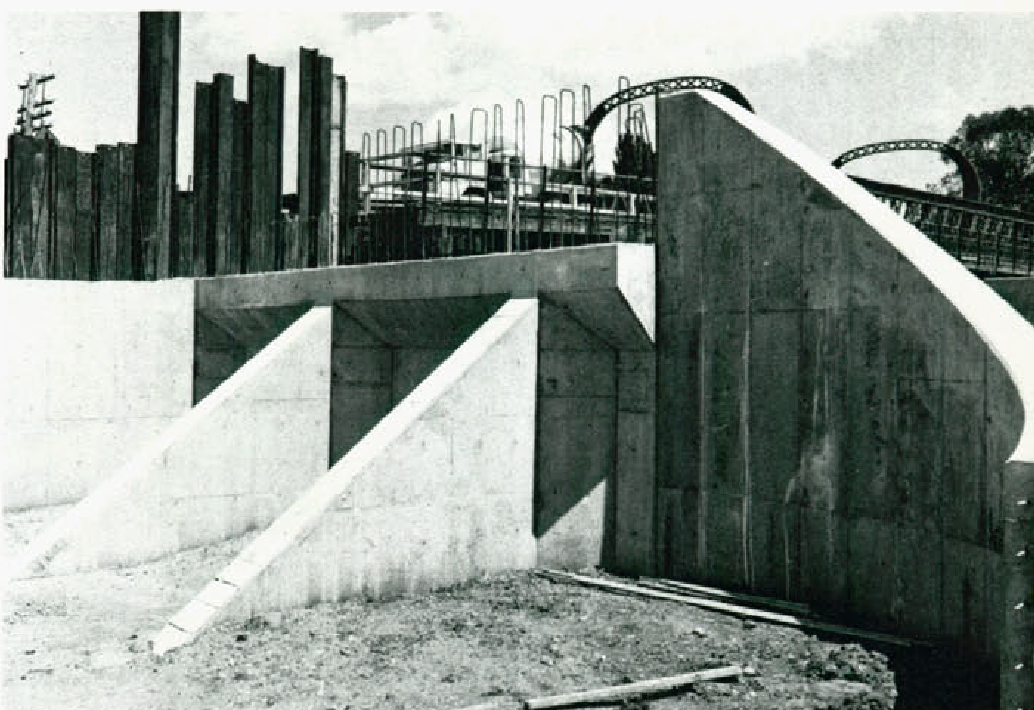
The steel in the top and bottom flanges will be AS 1204 Grade 250 LO, i.e., steel with guaranteed notch ductility. All other steel will be Grade 250.

The trough girders will be provided with internal diaphragms at the piers and abutments only. Because of their thickness, the webs do not need intermediate stiffeners. Cross-girders consisting of rectangular hollow sections are provided at the piers and abutments, between the two girders at the level of the bottom flange. Until the deck concrete has been cast and cured, the top flanges of the girders will be temporarily braced by tie bars at 3 m spacing.

The thickness of the reinforced concrete deck slab varies between 200 and 280 mm. Casting of the deck will be carried out in five main sections with transverse



Here we see the reinforced concrete abutments which are tied back to buried anchor-beams and are flanked by independent curved retaining walls.



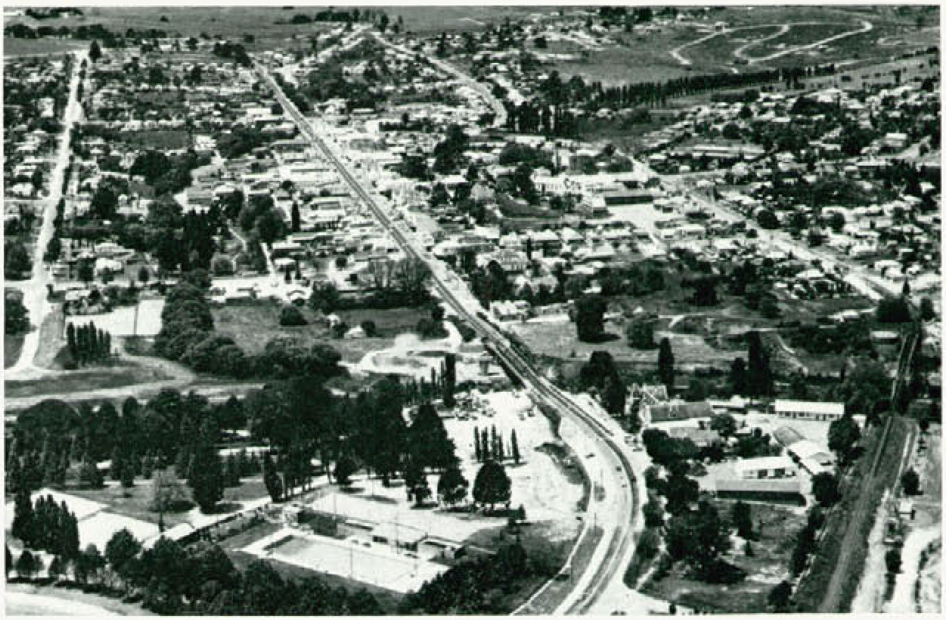
construction joints at 7 m on either side of the pier centrelines. The pier sections will be cast last to minimise cracking of the concrete deck due to the added weight of the concrete.

Construction

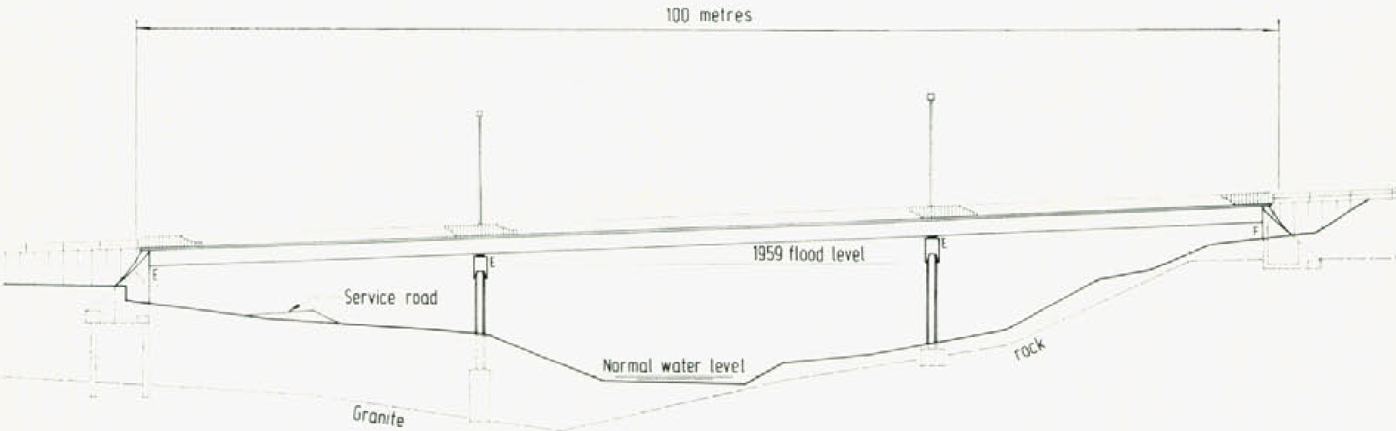
Pearson Bridge (N.S.W.) Pty Ltd is constructing the bridge for the tender price of $573,138. Basic Industries Pty Ltd is fabricating the steel trough girders. It is expected that the bridge will be completed by mid 1977.

The approximate quantities of material which will be used are:

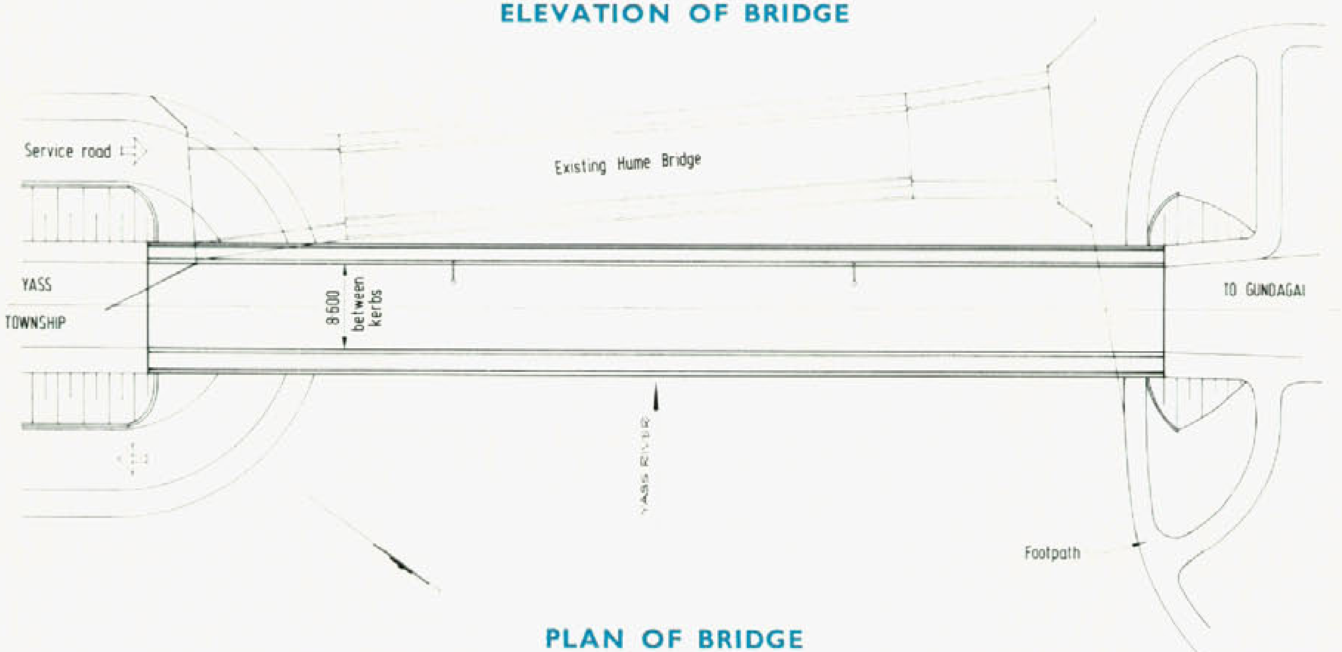
Steel trough girders	166 tonnes
Concrete	730 cubic metres
Reinforcing steel	87 tonnes



This aerial view of Yass, taken in November last year, shows the route of the Hume Highway through the town. The new road bridge construction is in the centre foreground, while on the right the railway bridge can also be seen.



ELEVATION OF BRIDGE



PLAN OF BRIDGE




The PEOPLE INDUSTRY

SOME THOUGHTS ON EMPLOYMENT AND INDUSTRIAL MATTERS


Of all the longstanding "people" relationships in our society, one of the most important today is that between employers and employees—the industrial relationship.

Master and servant relationships have existed for hundreds of years, but it was not until the eighteenth century, with the coming of the Industrial Revolution, that the pattern of industrial relations, as we know it today, began to emerge.

The advent of the factory system brought problems which had not previously existed in western European countries. The steam engine revolutionised industry and with it the whole social structure.

New methods of production and modes of transport evolved and these in turn required the concentration of large numbers of people at the locations where primary resources were available. The owners of material resources grasped the opportunities for massive profits, regardless of the needs of the people.

From all the hardship and exploitation which ensued, and in the absence of any other organisation to take up the cause of the "servant" class, the structure of modern unionism developed. The activities of the early unions highlighted the need for social and industrial reforms and regulation which only governments could provide.

Disagreement between unions and management continues today and diversity of opinions are often still evident. Government, management and the unions have come to terms in many respects, but a lot more agreement is needed in the interests of economic development.

Modern industrial society is being subjected to rapid changes in technology. Unions continue campaigns, including political strikes and demonstrations, which make an impact on many aspects of society. These campaigns are often rejected by sections of the community.

The keynote in industrial relations is one of continuous negotiation. In many European countries, the United States and Japan, negotiations generally take the form of a barter/contract situation between unions and management.

In Australia, legislation in respect of industrial relations was introduced early this century. The Australian Constitution in 1901 provided for legislation relating to industrial disputes extending beyond the boundaries of any one State. The Conciliation and Arbitration Act was passed in 1904 and it lays down conciliation and arbitration procedures where employers, employees and unions cannot agree. All federal awards are made under this Act.

In New South Wales the first industrial legislation was introduced in 1892. Various Acts were subsequently passed and the Industrial Arbitration Act of 1940 established the present pattern of industrial regulation in this State. It provides for the making of awards and agreements which apply throughout the State, and the establishment of a number of tribunals, notably the Industrial Commission and the Conciliation Committees.

The Industrial Commission exercises judicial and conciliatory functions, and consists of up to twelve judges. The Commission hears and determines appeals on questions of jurisdiction, demarcation, deregistration and other industrial matters. The Commission also allocates tasks to seven conciliation commissioners, appointed by the Governor.

The primary function of the commissioners is to chair conciliation committees, to conciliate between parties in dispute, and if possible persuade them to reach amicable agreement on the issue in question. In the absence of agreement, the commissioners are empowered to arbitrate on an issue and their decisions are usually accepted by the disputants.

THE DEPARTMENT AND "ITS PEOPLE"

The Government, through its departments and instrumentalities, is responsible for the most efficient and effective use of public funds. In recent years it has been necessary for the Government of the day to have a greater awareness of the requirements and attitudes of the electorate, and organised labour has tended to exercise more influence on the social and environmental decisions of the Government.

Green bans have been imposed on public works and environmental issues, the conservation of natural flora and fauna, and the preservation of the national heritage, have influenced the planning of many major projects. Not only must the Government be aware of and appreciate the needs of the community, but it must also fulfil those requirements as far as possible.

The Department of Main Roads is a N.S.W. Government statutory authority, and as an instrument of government is a non-profit organisation. Consequently any change or variation in rates of pay, conditions of employment, or custom and practice applicable to State Government employees generally, must also apply to employees of the Department of Main Roads. It is also incumbent on the Department to ensure that its activities in industrial matters do not in any way embarrass other government activity.

The Department is responsible for the maintenance and progressive improvement of roads and bridges on main roads in New South Wales. Together with the necessary plant and equipment, a staff of almost 9 500 persons is employed for this purpose. This labour force is engaged under the terms and conditions of employment applicable to the various crafts, skills and callings of twenty-two employee associations and unions. There are approximately 45 State agreements and awards regulating this employment.

This labour force is located throughout the entire State and so the environment of employees varies from the populous and fertile coastal area to the sparsely populated arid regions in western New South Wales. As a consequence, there is a considerable difference in emphasis on industrial relations between the urban industrialised regions and the rural agricultural areas.

It is the function of the Department's Industrial Officer and his staff to provide specialist industrial expertise to Departmental administration. In its management of labour the Department aims for a balanced development of the State's Main Roads System, consistent with the resources available and having due regard to the need to retain a competent and experienced labour force. The Department's industrial specialists confer regularly with other employers, government and private, as well as with union officials, the more important labour councils and members of the Industrial Commission.

The Department generally has always enjoyed good relations with its staff and employees. This can be attributed in no small degree to the effectiveness of the Department's administration and its implementation by field officers. A close liaison between field officers and the Industrial Officer is maintained.

While the source of labour regulations and working conditions is largely within the legal framework, the application is essentially a human rather than a legal problem. The Department seeks to work towards solving industrial problems in the most amicable and satisfactory manner so that the need to resort to tribunals is reduced to a minimum. However, disputes do occur from time to time, and conciliation or arbitration hearings are sometimes necessary. Union representations occupy a significant amount of the time of management.

In order to maintain good relations between management and employees, and with the efficient use of resources in mind, the Department conducts training programmes. These concern administration of staff and are conducted both at senior and junior levels, with an emphasis on supervision. Medical and safety officers have also been appointed.

It seems from recent developments in Australia that the "golden age" of economic expansion is now at an end. The wages boom of a few years ago has resulted in a state of high inflation and high unemployment. A state of economic reassessment now exists, and the future interaction of unions and management will play a major part in any economic and employment recovery. Technical development will continue and will bring with it new problems.

The early aims of the Australian unions have been achieved to a large degree, e.g., the eight-hour day, five-day week, and substantial improvements in workers' compensation and annual, sick and long service leave. Equal pay for women has been introduced, and flexible working hours are now being introduced in many areas, reportedly to the benefit of both management and the individual worker.

Unions are turning their attention to matters such as the plight of the aged worker, the welfare of the families of deceased workers, safety in industry, better housing for workers and the changing composition of the workforce. To these may be added the problems of environmental control and, especially from the Department's point of view, changing concepts of transport systems—and in particular, the road systems—to accommodate the efficient movement of people and goods.

The industrial relations scene will continue to be dynamic and the importance of social issues will increase. New standards for future negotiation are being set and those affecting wage rates and previously accepted award conditions could assume less importance. New methods of communication are highlighting overseas developments almost as they occur, resulting in the need for new adaptations.

A major development brought about by the present economic situation has been the introduction of a system of indexation of wage increases tied to the Consumer Price Index. In the years between 1967 and 1974 in particular, wages throughout Australia were found to be outstripping productivity and price increases, contributing to a very high rate of inflation. The indexation guidelines of the Conciliation and Arbitration Commission introduced in May, 1975, have inhibited wage rises and stopped the wage spiral.

Despite the apparent success of the guidelines, this method of wage adjustment is under attack from all sides and doubts have been cast on its future retention.

It is expected that industrial relations will continue to be a major force in the Australian social structure. Rapidly changing industrial and social patterns, together with government policies, will have a dramatic effect on the future role of the Department of Main Roads. ●

(*See colour photographs on pages* 80–1.)

FORESEEING FREEWAY EFFECTS

A LOOK AT ROUTE LOCATION AND THE INVESTIGATION OF THE LIKELY ENVIRONMENTAL IMPACT OF THE

Sydney-Newcastle Freeway between Ourimbah and Doyalson

Early last year, the Department published the results of a study on the effects on the surrounding area of the construction of the F3 between Ourimbah and Doyalson.

A summary of the report is presented below. A copy of the original with more details, maps, photographs and aerial mosaics is available for perusal in the Department's Library, Fifth Floor, Head Office.

In considering possible freeway routes in this area, the main natural constraints are the Blackbutt Range and Ourinbah State Forest, the Wyong River flood plain, the Warnervale swamps, and Tuggerah Lake. Geological conditions which suggest land instability, and biologically significant areas, are also factors requiring consideration. Human or man-made constraints which influence route location are the existing road and railway networks, power transmission lines and other public utilities, existing and potential land use, and geological resources.

ALTERNATIVE ROUTES CONSIDERED

Although numerous alternative routes have been investigated in the Ourimbah to Doyalson corridor, only three have been regarded as feasible routes.

The Tuggerah-Kanwal-Doyalson Route

In 1958 this route, passing to the east of Wyong, was investigated and favourably considered on the grounds that it was the best available having regard to the terrain and then existing development. The route utilised a disused former RAAF landing strip at Tuggerah and crossed the wide Tuggerah Lake flood plain near the mouth of the Wyong River. In the mid 1960's a re-examination of the design led to a complete review of the alignment and the modified route appeared on the Wyong Planning Scheme prescribed in 1968.

A combination of factors led to questioning of the route east of Wyong. These included Wyong Shire Council's desire to utilise the landing strip as an aerodrome; the Electricity Commission's proposed future power station in the region; the difficulty of crossing a wide flood plain; and increasing development along the Tuggerah Lake foreshore. By the beginning of 1968 these factors (together with those of stage construction, a possible future arterial route west of Lake Macquarie, service to Wyong and planning considerations) led to a decision to investigate routes passing to the west of Wyong.

The Ourimbah-Warnervale-Doyalson Route

Several alternative routes were investigated in 1968 for a freeway passing to the west of Wyong. The high country and Ourinbah State Forest west of the Ourimbah-Tuggerah area, the Ourimbah Creek and Wyong River flood plains, and the Warnervale wetlands were the main natural constraints. Properties in the Ourimbah - Tuggerah - Wyong corridor west of the Pacific Highway were seen as the main social constraint. Since crossing the Wyong River flood plain was considered to be the major natural obstacle and in order to minimise interference with properties, a route was recommended which cut through a spur of the Blackbutt Range west of Tuggerah and then crossed the Wyong River flood plain at its most narrow section. However, this route encroached upon grounds of the Wyong High School, immediately north of the Wyong River.

In August, 1969, approval to this western route was given and a press release announcing this was made. There was considerable local opposition to the close proximity of the proposed freeway to the Wyong High School, and various bodies suggested alternative routes. These were investigated by the Department but were not found to be as satisfactory as the then preferred route. The Department of Public Health made field tests for possible noise interference to the school and concluded that, provided certain precautions (including noise proofing of class rooms and provision of noise barriers) were taken, the freeway proposal would not cause interference with speech in the classrooms nor interfere unduly with playground conditions. A more westerly route could possibly worsen conditions as shielding would then be more difficult.

A hydraulic model of the Wyong River flood plain confirmed that the approved line gave the shortest length of bridging, the least afflux, and the slowest maximum velocity of flow. However, environmental studies of the route identified slip conditions in the area immediately north of Alison Road and a more detailed geological investigation indicated the presence of an old landslide zone.

Meanwhile, the former State Planning Authority requested that the route of the freeway be relocated further to the west because a new city proposal, centred on Warnervale, was being planned. It was argued that the proposed freeway would have a barrier effect through the new city, that local traffic in addition to through traffic would seek to use the inter-regional freeway, and that valuable, centrally located land would be sterilised. Because of the advanced nature of the freeway design, the added length of more westerly routes, and the urgency of need for a freeway facility, it was initially argued that there was a good case for

FORESEEING FREEWAY EFFECTS

moving the proposed city centre location rather than the freeway location. However, there was no suitable site for the Warnervale City commercial centre other than astride the railway and consequently across the approved route of the freeway. Relocation of the existing railway line was not feasible, and the commercial centre could not be served by a freeway interchange if the freeway passed through it.

A joint submission was made to the Minister for Transport and Highways and the Minister for Planning and Environment. In September, 1974, it was decided to relocate further west the section of freeway between Cobbs Road, Tuggerah and the railway crossing north of Wallarah Creek, even though this would possibly lead to increased construction costs and some delay in completion of the design and acquisition of property.

The Ourimbah-Sparks Road-Doyalson Route

A number of possible locations were examined for a route passing to the west of the Warnervale swamps and Porters Creek flood plain. Crossings of the Wyong River flood plain were investigated using the Department of Public Works' hydraulic model. Consideration was given to a line passing west of the hill immediately north of the Wyong River crossing, to avoid properties fronting Main Road No. 217. However, this appeared undesirable as it would have involved a deep cutting in relatively unstable ground, clearing a swathe through native bush dedicated as a wildlife sanctuary, and relocation of a power transmission line. A route was selected with a view to affecting the least number of properties, given the physical constraints imposed by the terrain, and approval to the new route was given on 10th December, 1975.

Implications of a "No-Construction" Alternative

The study also looked at the adverse environmental impacts likely to affect residents of the settlements along adjacent lengths of the Pacific Highway if the freeway was not provided or if construction was delayed. These effects would take the form of air and noise pollution, vibration, traffic accidents and disruption to shopping, business and other locally-oriented activities. All of these would be expected to increase rapidly in intensity and frequency.

Road-users through the region could expect increasing inconvenience and delay due to congestion, combined with increasing traffic accident and fatality risk. On the 34 km length of the Pacific Highway from Ourimbah to just north of Doyalson there were 4 fatalities, 157 injuries, and 344 accidents reported for the year 1973, and 14 fatalities, 142 injuries, and 382 accidents reported for the year 1974.

A major stimulus to residential and economic development of the Gosford-Wyong region would be lost with failure to construct the freeway. Opportunity to assist in achieving the general objective enunciated in the Sydney Region Outline Plan—of regarding Sydney-Newcastle-Wollongong as a closely related urban complex would also be lost. Continued concentration of growth in the major metropolitan area of Sydney would be encouraged, thereby aggravating Sydney's growth problems.

ENVIRONMENTAL EFFECTS

People and Property

The construction of this section of the F3 will require acquisition of a new road reserve and destruction of some vegetation within it. During construction, it will cause increased dust and noise in a non-urban area and some temporary inconvenience to local traffic. It will require the demolition or relocation of nine houses, part of the Wyong Shire Council works depot, two sheds belonging to the Wyong Co-op Dairy Society and several farm sheds; the destruction of several farm water dams, and severance of several properties. The project design provides for the relocation of affected water storage dams, and restoration of access. All of the properties severed by the freeway, except one, can be connected by stock underpasses, if required.

Bridging of the Wyong River flood plain and Kangy Angy, Buttonderry, Wallarah and Spring Creeks will be necessary. Mardi Road, Mountain Road and one un-named road will be severed, and there will be short-term traffic diversions while bridges are being built at Cobbs, McPherson, Alison, St Johns, Sparks, Roper and Wyee Roads. The main northern railway line will also be overpassed and there will be some short-term effects on public utility services. Some dairy farms, citrus orchards and grazing lands will be affected.

On the credit side, there will be a reduction in noise and air pollution due to the improved alignment and minimal grades on the freeway and to the diversion of through traffic from the residential areas of Tuggerah, Wyong, Kanwal, Charmhaven and Doyalson. Traffic congestion and accident potential on the Pacific Highway between Ourimbah and Doyalson will be reduced. The shopping environment at Wyong will be improved and the economic potential of the Wyong/Warnervale region will be increased by better accessibility.

All school and hospital sites and other noise sensitive areas have been avoided. Appropriate restoration of areas affected by the clearance of vegetation is to be included and trees and shrubs will be planted to supplement the natural vegetation. Scour protection will be provided at culvert outlets and special precautions will be taken to prevent significant erosion during construction. Periodic field inspections will be made to monitor the possible development of any adverse environmental effects after construction.

Agricultural Activities

Agriculture, based mainly on citrus and dairy farming, has been the main rural enterprise in the region. However, as this is a rural/urban fringe area, there is a general air of uncertainty over the future of agriculture, resulting in land speculation and the entry of the part-time or "hobby" farmer. There has been under-utilisation of agricultural land and, in some cases, a change to enterprises which are less demanding on management and capital input, such as beef production or stud farming.

Areas of important agricultural activity where economic viability is now being threatened by advancing urbanisation include the Jilliby Valley, Wyong River, Mardi, and Palm Dale areas. A lot of the properties are too small to provide good returns and their future economic viability is not sound, especially with the present milk quota system. However, there still are viable full-time farms in the area and both the possibility and the actuality of a freeway passing through this rural corridor will increase the pressures for land-use or tenure changes. Much of the land is quite suitable for "hobby farms". These are already evident and they are helping to maintain some of the rural character of the region.

To the east of Ourimbah Creek there is a rapid decline in the economic viability of remaining full-time farms and the future of agricultural activity in this sector is doubtful.

Reserves of Raw Materials

Permian rocks of the Newcastle coal measures underlie the whole area traversed by the proposed freeway route. Existing and proposed major power generation stations in the region are located over areas with substantial coal reserves. Most of the proposed freeway route lies within the boundary of a mine subsidence district. The subject of future subsidence potential will therefore be a matter for further detailed discussion with the Department of Mines, with particular reference to areas in the vicinity of major structures.

Natural road base material and shales and clays for structural products are two other mineral resources in the area. All of the natural road base material sites are quarries in present use, and only the Cobbs Road quarry is affected by the proposed route. The earlier proposed Ourimbah-Warnervale-Doyalson Route would have also affected a large quarry off McPherson Road.

The Department of Mines has identified extensive areas of shale suitable for the manufacture of light burning structural clay products, such as bricks, tiles, and pipes. While these sites have been located, it does not necessarily mean that the reserves will be utilised. The location of several of the sites is such that their value for urban or other uses is possibly higher, especially those within the Wyong-Warnervale area. However, the proposed freeway route does cross a substantial reserve of structural clay in the vicinity of McPherson Road and will sterilise a small portion of this reserve.

Wetlands

There are three wetland areas affected by the proposed freeway route; a small area immediately north of Cobbs Road, an arm of the Warnervale swamps, and a region between Roper Road and Wyee Road. Only the complex of Warnervale swamps is of major biological significance (*see below*).

Since the Warnervale swamps were an important natural constraint on route location, the line adopted avoids these wetlands by passing on higher land to the west, crossing a clay-filled depression which drains from the northwest into the main swamp.

Bushland and Birds

The proposed freeway route does not affect any vegetation of regional significance. Land in the corridor traversed is generally privately-owned and well developed. The route skirts around the edge of the Ourinbah State Forest and does not encroach upon it. The preferred route also avoids a stand of native bush between the Wyong River, Jilliby Road, and Yarramalong Road.

The road reserve of 90 metres will allow ample space for extensive re-vegetation and landscape treatment in harmony with the existing environs.

While scientific officers of the Australian Museum have not studied the area in detail, they regard the Ourinbah and Wyong State Forests as being areas of exceptional biological significance. The lower reaches of Ourimbah Creek could also be significant as resting and breeding sites for water fowl.

The Warnervale swamps are also of important biological significance. During wet periods the swamps flood and provide

FORESEEING FREEWAY EFFECTS

an extensive body of water for water fowl. However, since the water level recedes during dry periods, it is a permanent habitat for frogs and other amphibious, less water-dependent fauna.

A wildlife sanctuary has been established on a property between Jilliby Road and Wyong Creek which is part of a stand of native bush. Bellbirds and other bird species abound in this area.

The proposed freeway route avoids all of these areas of biological significance. High level bridge structures will not interfere with marine species.

Historical Sites

There are no historical sites affected by the proposed freeway route. While there are no known Aboriginal carvings or relics on the route, records of sites are by no means comprehensive. Consequently, the National Parks and Wildlife Service, as the statutory authority legally responsible for the protection and preservation of Aboriginal relics, considers that an on-the-ground survey for relics is required. This will be carried out prior to construction.

Atmosphere

While the freeway will represent a continuous line source of pollutant emissions, these will be significantly less than those occurring under stop-start conditions on the existing Pacific Highway in developed areas.

The movement and dispersion of air pollutants depends principally on topography and meteorology. Winds in the Wyong area are quite varied between January and June, but during the second half of the year a west to northwest stream becomes established. Apart from the plateau residual, or hills, immediately west of the town of Wyong (reaching 100 metres above sea level), the general topography of the region is that of a basin edged in to the north, west and south by hills and opening out to the east onto Tuggerah Lake.

Consequently, air pollutants would readily be dispersed, when westerly winds prevail, predominantly around the north and south of the Wyong township. Further, since the proposed freeway route passes from one to three kilometres to the west of Wyong and Warnervale, the heavier transportation emissions, especially particulate lead, would have the opportunity to fall out before reaching urban areas.

Due to the excellent alignment and flat grades proposed for the freeway, the amount of pollutant emissions will be minimal. Grade separations, controlled access and adequate capacity will eliminate stop/start conditions and will also contribute to a reduction in the amount of vehicle emissions into the atmosphere. Noise levels will also be reduced.

Recreation

No parks or reserves available for public recreation are affected by the proposed freeway route. The Mardi Dam has a small reserve for picnicking but the main recreational attractions of the area are the lakes, lagoons and beaches located three to eight kilometres to the east of the proposed route. The interchanges planned for Cobbs Road, Sparks Road and Main Road No. 509 will increase the regional accessibility of these recreation and tourist attractions.

Scenic views and vistas

The proposed Ourimbah to Doyalson section of the freeway will pass through a rural and natural bushland area. After skirting around the forested and more rugged terrain of Blackbutt Range to the west of Ourimbah, the travellers' view will open out from the confines of a ridge cutting to a panorama of the lush Wyong River Valley. After crossing this valley the view will again be briefly constricted by cuttings before opening out on the right to panoramas of the Warnervale wetland areas. North from St Johns Road the views will be a sequence of confined cuttings with intermittent vistas of natural bush and marshlands.

Regional and Community effects

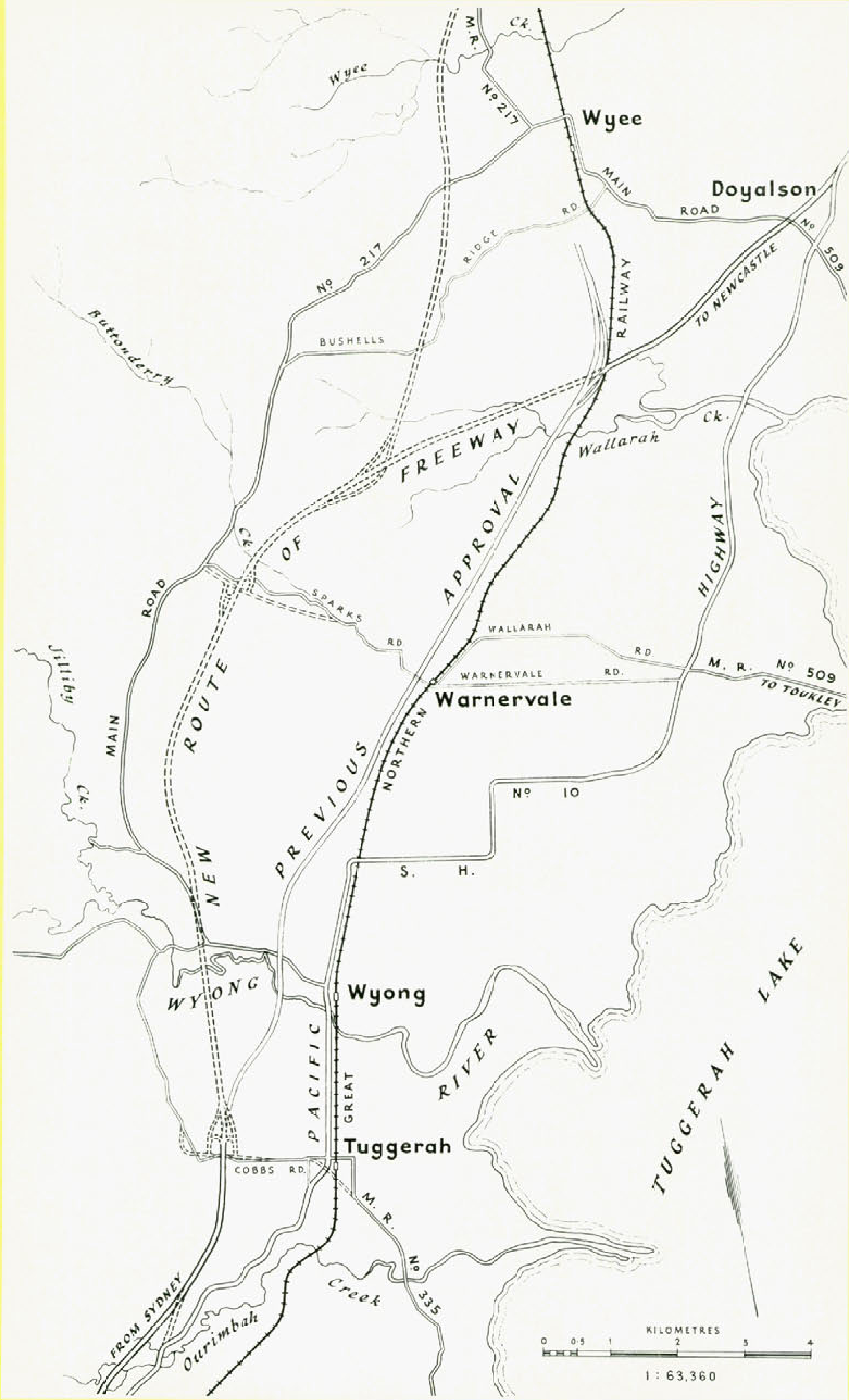
The improved inter-regional accessibility which will result from the provision of this section of the Sydney-Newcastle Freeway will encourage population and economic growth in the area, as well as making the beaches and lakes more accessible. This prospect is likely to be viewed favourably by most residents in the area and also by the business, recreation and tourist-related industries.

During the construction period, a total work force of approximately 250 people will be involved on the project. Because most of this work force will be recruited from those resident within the Gosford to Doyalson region, local employment prospects will be considerably improved for three to four years during the construction phase of the project.

The influx of previously non-resident construction workers, combined with the retention of some workers who currently commute out of the region for employment, will place a slightly higher demand on local services. The commercial centres will be the major beneficiaries of this development. ●

An article entitled "Some Notes on a Study of the Environmental Impact on Freeway F5, from near Campbelltown to Yanderra" appeared in the September, 1976 issue of "Main Roads", Vol. 42, No. 1, pp. 5–7.

This map was included in the Environmental Impact Study outlined in the preceding article and shows proposed routes of the Sydney-Newcastle Freeway from near Ourimbah to near Doyalson.



People: the in all road-building

Over the years, this Journal has featured equipment and techniques used by the Department. For a change, the focus is on people — without which machines wouldn't move and new methods would never be conceived. For, behind every road and bridge project, great and small, are a team of people who planned it, investigated it, designed it, built it and maintained it.

Throughout the State, there are about 14,400 people employed on Departmental road and bridge works, 9,470 of which are employed directly by the Department. A list of all the ways in which they serve would be too long to include here but, there are engineers, road foremen, geologists, gangers, accountants, welders, stenographers, carpenters, architects, computer operators, surveyors, clerks, draftsmen, plant mechanics, valuers, legal officers, testing operators . . . and many, many more.

Some work behind the scenes on vital tasks of which the public is often unaware . . . but they all contribute their varied skills and they all play an important role in improving the Main Roads System of New South Wales.

Some thoughts on employment and industrial matters are presented in an article entitled "The People Industry" on pages 73–4.

ispensable component of

MODERN METHODS in

ROAD DESIGN

Road design has been defined as the art of tailoring the road to meet the needs of the travellers and to fit in with the controls and needs of the environment.

The road designer works by a process of trial and error, studying different alternatives until he finally arrives at what he considers to be the best road design.

Over the last two decades or so, in common with many other road authorities throughout the world, the Department has introduced new techniques for producing contour plans from aerial photographs and also has used computers to carry out many of the tedious road design calculations.

This article gives a brief outline of how these two advances have made the road designer's task much easier. They have enabled him to study more alternatives than he could formerly and with much less effort, so increasing his chances of producing the best road design for each location.

TRADITIONAL ROAD DESIGN PROCEDURES

As indicated in figure 1 (on the right), the horizontal alignment of the proposed road is studied first and then the vertical alignment or "grading".

The main considerations in selecting horizontal alignment are that it should give the shortest practicable route and best standard of line, while avoiding land which is expensive and obstacles and areas which present engineering difficulties.

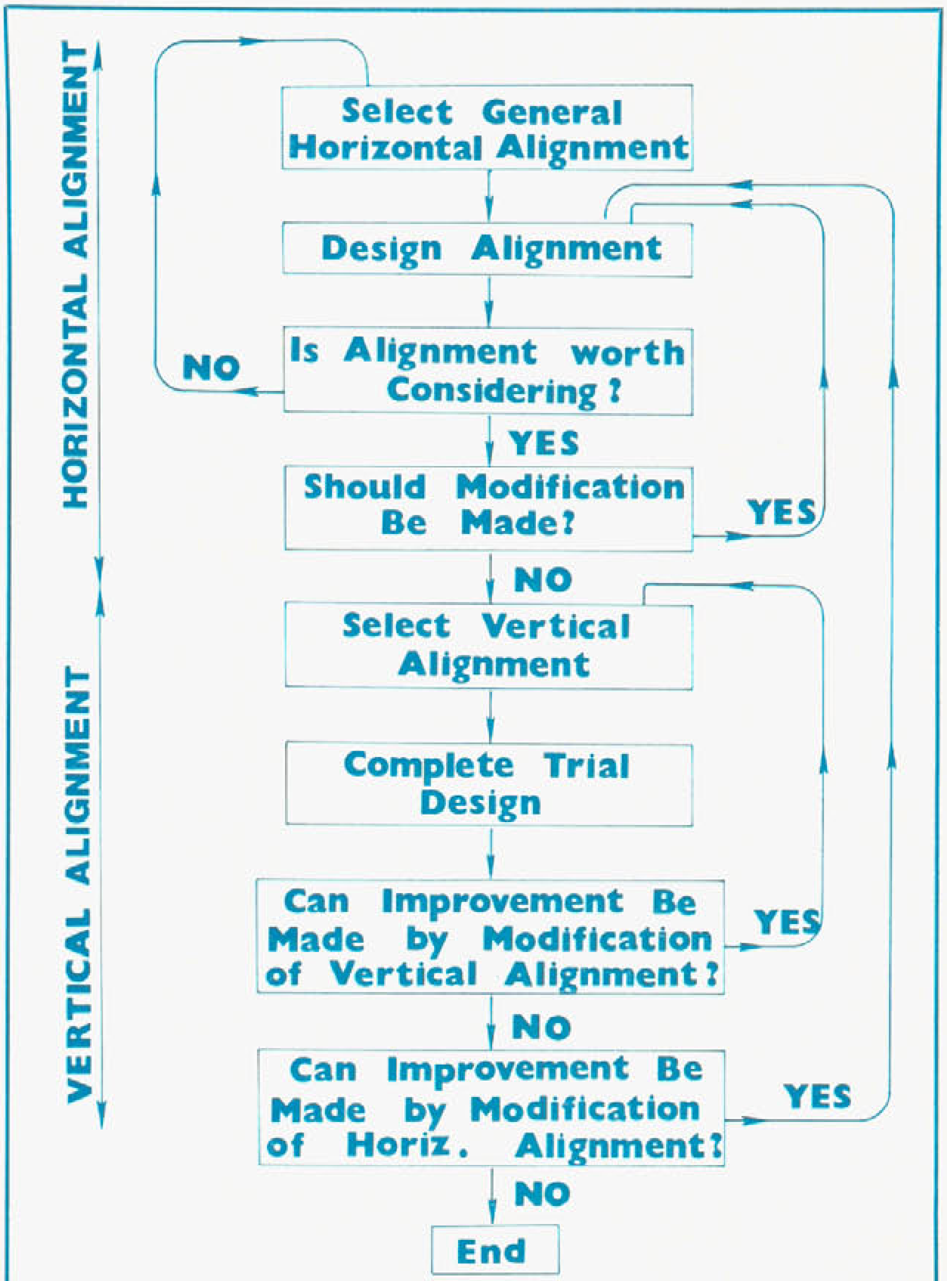
When a trial horizontal alignment is selected, it is pegged at intervals on the ground. The alignment will consist of straights and circular curves, generally joined by transition curves. Levels are next measured on the natural surface at each peg and also at right angles to the alignment on either side of each peg to cover a strip of country along the alignment.

The horizontal alignment and levels are plotted (as shown in figure 2 on page 84) to give the designer, in effect, a three-dimensional picture of the *band of interest* along the trial horizontal alignment.

Next, the vertical alignment or grade line is designed along the trial horizontal alignment.

The grade line is selected to fit the ground as closely as possible and so minimise earthworks. At the same time, the desired standards for steepness of grade, sight distance and riding comfort, are introduced. The selected grade line is shown on the longitudinal sections and the outline of the road is shown on the cross-sections.

At any stage during the progress of the trial design it may become apparent that the design which is emerging should be



THE TRIAL AND ERROR PROCESS OF ROAD DESIGN

FIGURE I

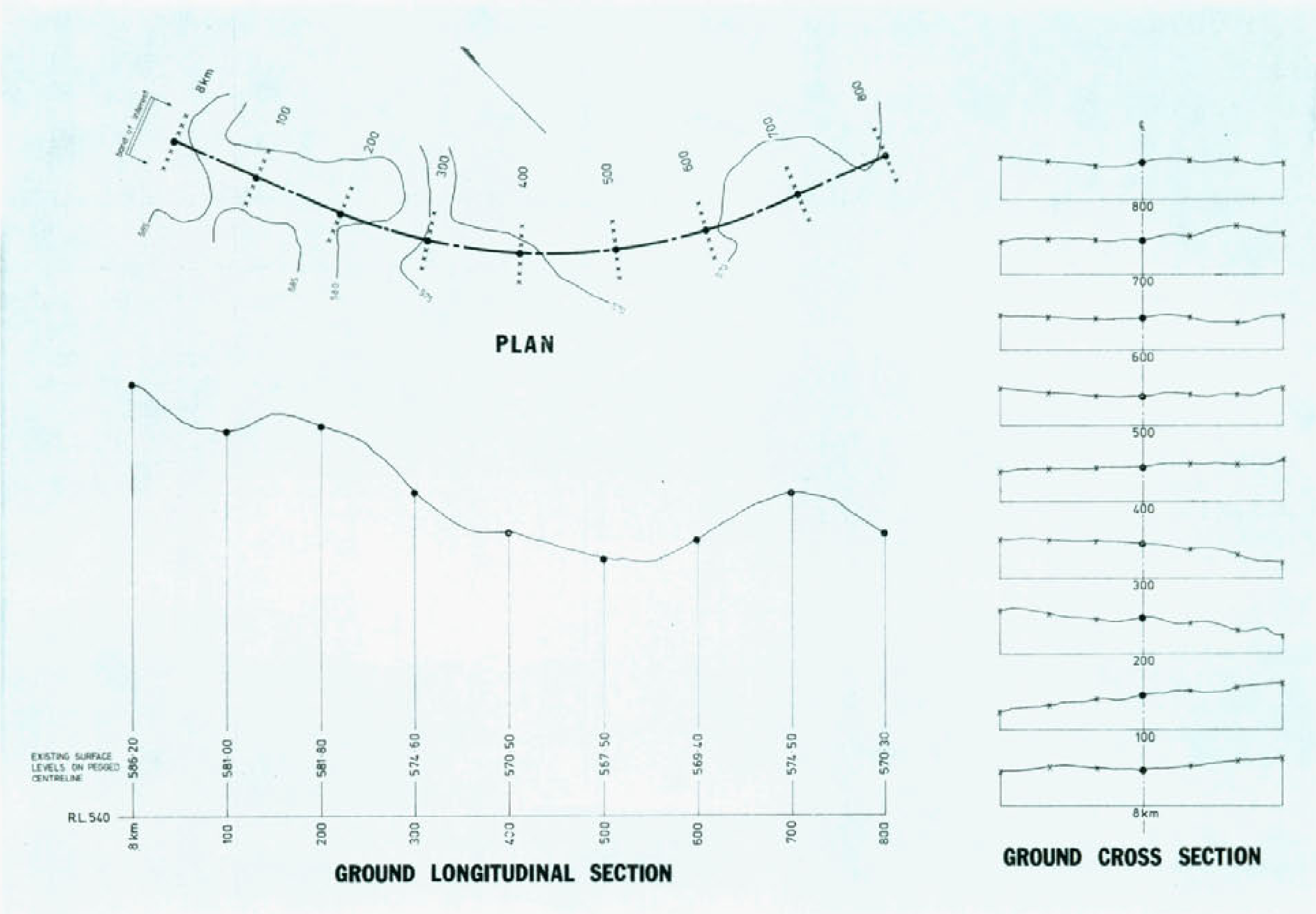


FIGURE 2

modified or even abandoned and a fresh start made.

Finally, when the design is complete, the end result (figure 3 on page 85) shows three views of the proposed road:

☆ Plan.
☆ Longitudinal section (along the centre line).
☆ Cross-sections (at intervals along the road).

These views correspond with the three views in a conventional engineering drawing, i.e., plan, elevation and end elevation.

When details such as drainage, fencing, survey control information, etc., are included, the three views give all the basic information needed to set the road out in the field and to construct it.

SOME DISADVANTAGES

The quality and economy of a road design depends largely on the manner in which the trial horizontal alignment is selected.

Using the traditional method, the designer often has little more than his own judgment to help him in selecting the alignment. If he does not select the best alignment, there may be little opportunity to detect this, as the field survey data usually covers only the narrow band of country along the selected line.

Furthermore, if it is desired to compare two or more lines, as is usually the case, then the whole laborious survey and design process has to be repeated for each line.

These disadvantages can be overcome by making a model of the terrain through which the new road is expected to pass. The field measurements are then replaced by measurements made on the model and a whole series of comparative trial designs can be prepared with moderate effort and without the designer leaving his office.

CONTOUR PLANS

Contour plans are the normal form of ground models used in road design. They are plotted from aerial photographs using a stereo plotter (figure 4 on page 86) or, if photographs are not available or ground cover is dense, the contours may be obtained by ordinary field survey.

The advantage of using aerial photographs as opposed to ground survey methods is that the photographs include a large amount of qualitative and quantitative information that is readily available for use. Furthermore, the accuracy of the work undertaken can be varied to meet the needs of the different design stages. Thus it is possible to prepare a plan of large areas with limited accuracy for locating the general route and then a detailed plan over a narrow band with high accuracy for final design.

USE OF COMPUTERS

Hand in glove with the use of ground models in road design goes the use of computers.

Computers were first used in the 1950's to speed up and relieve the boredom associated with repetitive calculations for road alignments and earthworks.

Nowadays, as well, computers are used extensively in surveying and, when linked with automatic plotters, can be used to draw road plans and even perspective views of the road from selected viewpoints.

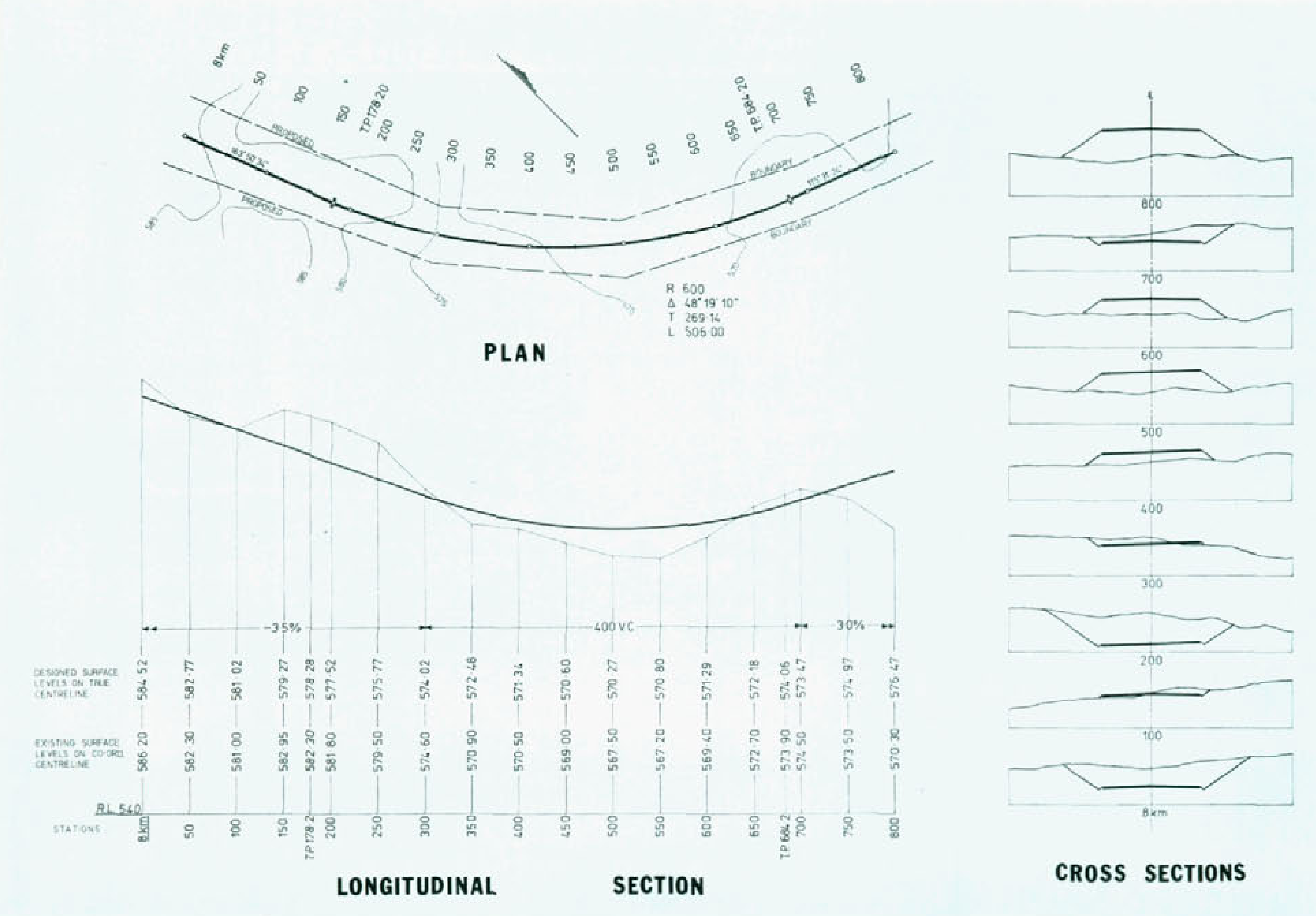


FIGURE 3

THE CO-ORDINATE SYSTEM

The use of the *co-ordinate system* for locating points is almost universal in road design when a computer is being used for the design calculations.

The position of any point may be defined by its X and Y co-ordinates (or its easting and northing) and by its Z co-ordinate (or level).

DIGITAL GROUND MODELS

The *co-ordinate system* enables the ground form to be conveniently specified in numbers, which is necessary before it can be entered in the memory of a computer. There are a number of ways of doing this.

One method is to interpolate from the contour plan the levels at the points on a square grid. Each point is then defined by its co-ordinates and the whole batch of numbers thus produced is known as a digital ground model (figure 5 on page 86).

By connecting the computer to the stereo plotter, such a digital ground model can be produced while the contour plan is being plotted. The contour plan and digital ground model are thus produced simultaneously.

As with the contour plan, the main advantage of the digital ground model in road design is the improved possibility which follows of investigating different alternative horizontal and vertical alignments by computer without having to collect additional survey data.

However, to enter all the data involved, most of which may never be used, large computer storage is required. Another problem is the difficulty in taking into account terrain breaklines, such as streams, existing roads and so on.

Although some research is in progress, the Department does not, at this stage, use a digital ground model but prefers to enter the ground data for each alternative alignment as it comes under consideration, rather than to enter in the computer all the data on the contour plan.

COMPUTER-AIDED ROAD DESIGN METHOD

The first step in a computer-aided road design programme is the same as the first step in a design by the old traditional method, i.e., to select a trial horizontal alignment for the proposed road. Instead of pegging the line out in the field, however, it is merely drawn on the contour plan.

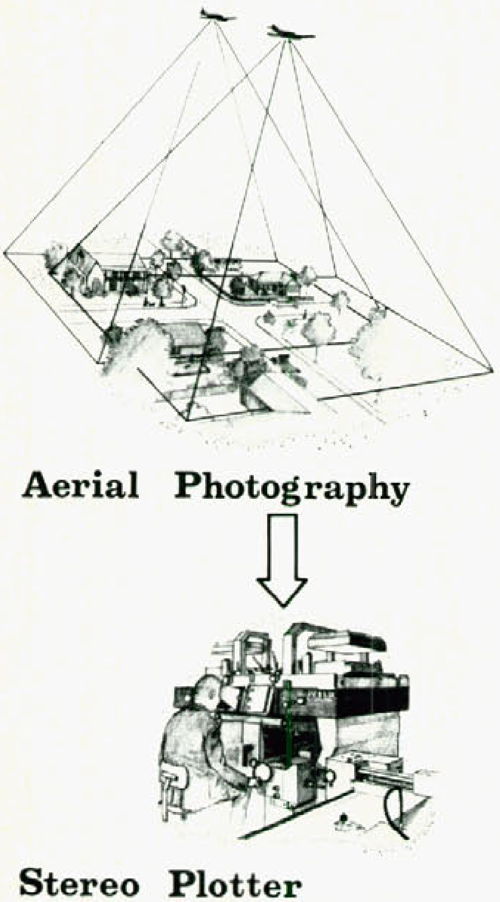
Key information about the alignment is scaled off the plan and entered in the computer. The appropriate alignment programme is then run. The computer does all the necessary calculations and produces a complete list of co-ordinates at intervals along the centre line, allowing it to be completely defined and later—when the time comes—set out in the field.

The next step in the design is to decide upon the vertical alignment or grading. The designer needs a *ground long section* to work on, and, although the computer and plotter could readily be programmed to produce this from a digital ground model, it is far easier and faster to plot the *ground long section* by hand direct from the contour plan.

The vertical alignment or grade line is then designed manually as in a normal design.

From now on, having designed the horizontal and vertical alignments, the remainder of the geometrical design work can, in effect, be handed over to the computer.

Details of the horizontal and vertical alignments, the cross-section proposed for the road and the ground information are entered in the computer. If the appropriate programmes are then run, the computer will print out just about anything the designer needs to know about the design related to setting out information and earthworks quantities.



COMPUTER PROGRAMMES

The three principal programmes that the Department uses in detailed road design are known as:

☆ "GCORD" (This title has been adapted from "Geometry Co-ordination"),

☆ "DERTH" (This title has been adapted from "Decimal Earthworks"),

☆ "FPEGL" (This title has been adapted from "Formation Peg Level").

"GCORD" is an alignment programme in which the horizontal alignment is entered by specifying the co-ordinates of tangent intersection points, radii of circular curves and transition spiral lengths.

The programme then gives co-ordinates at specified intervals for a given alignment and also for two given offsets to the alignment (such as the two fence lines on each side of the road).

"DERTH" computes cross-section profiles and earthwork volumes. To enable it to do this, a digital model of the natural surface and trial design information need to be fed into the computer. So, the input data required are the levels of the natural surface and offsets at each cross-section, a typical designed cross-section and the grade line.

The output comes in three reports. The first gives earthwork volumes for use in the prelimenary design. The second report gives the levels and offsets at each station or interval on the alignment for the significant points of the designed cross-section. The final report calculates other minor earthwork volumes, such as volume of topsoil in cut, that are needed in final design. By breaking up the output into three reports, computer time is conserved on trial runs.

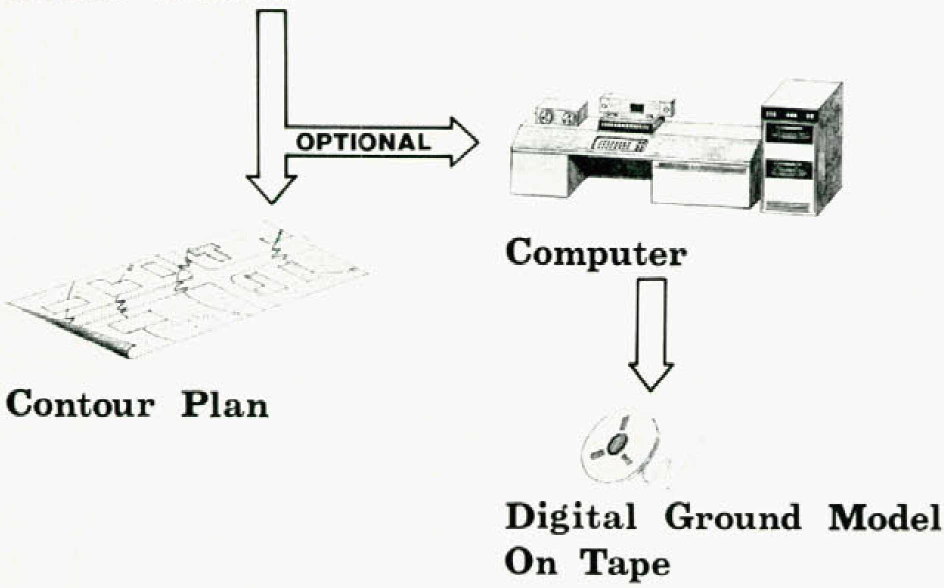


FIGURE 4

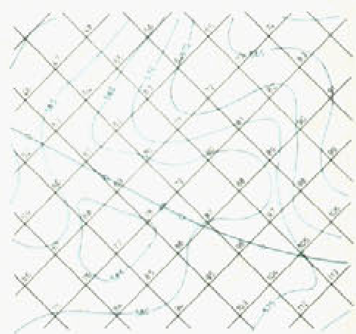
In some recent designs, the drawing of cross-sections has been supplemented in the plans by design data sheets (figure 6 on the right). These are combinations of the output of "DERTH" and "GCORD". The columns headed "STATION" come from "GCORD", the columns headed "DESIGN DATA" come from "DERTH" and the columns "CO-ORDINATES" come from "GCORD", using the cross-sectional data held by "DERTH".

The third programme "FPEGL" is a final pavement setting-out programme. Here, reduced levels on two stakes at given offsets are found (figure 7 on the right). Each pavement surface is defined by a line between a pair of levels, one on each stake. The chainage interval between the stakes is variable but it is usually five metres. The only data required are the cross-sections at changes in the cross-section templates and the grading.

IN CONCLUSION

So it is that, in road design as in many other fields in our changing world, old methods give way to new. Freed from very laborious and time-consuming calculations, the road designer can now more quickly consider more alternatives. Using more efficient techniques in this way, the Department can provide the community with improved road facilities, which add both a satisfying dimension to our motoring experiences and a pleasing feature to our environment. ●

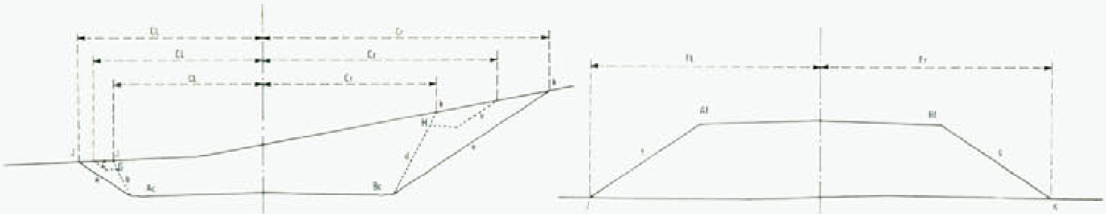
CONTOUR PLAN WITH GRID



DIGITAL GROUND MODEL

POINT	EASTING	NORTHING	LEVEL
46	2000 0	2050 0	588
47	2050 0	2050 0	587
48	2100 0	2050 0	587
49	2150 0	2050 0	585
68			[illegible]
69	2000 0	1900 0	584
70	2050 0	1900 0	581
71	2100 0	1900 0	578
72	2150 0	1900 0	569
73	2200 0	1900 0	567
74	2250 0	1850 0	564
75	1850 0	1850 0	
76	[illegible]		571
[illegible]	2000 0	1650 0	573
112	2050 0	1650 0	573
113	2100 0	1650 0	574
114	2150 0	1650 0	570

FIGURE 5



CROSS SECTION IN CUT CROSS SECTION IN FILL

DESIGN, SETTING OUT AND CROSS SECTION DATA

	DESIGN										DATA												CO-ORDINATES					
STATIONS	NATURAL SURFACE LEVELS			ASSUMED ROCK LEVELS		DESIGN LEVELS (SHOULDER EDGE)			BATTER TERMINAL OFFSETS		BATTER SLOPES HOR to 1 VERT							EARTHWORK QUANTITIES				REMARKS	¢		BATTER TERMINALS LEFT (J)		RIGHT (K)	
	¢	J	K	G	H	¢	Ac or Af	Bc or Bf	LEFT Cl or Fl	RIGHT Cr or Fr	a	b	c	d	e	f	g	CUT	FILL	TOTAL CUT	TOTAL FILL		E	N	E	N	E	N
8km00	586 20	583 70	584·02	0·0	0·0	584 52	584·42	584·42	5·2c	4·7c	1½				1½			25	0	0	0		1 949 013	2 114·959	1 907·672	1 950 721	1 928 726	1 960 723
50	582 30	582 20	582·10	0·0	0·0	582 77	582·67	582 67	1·2f	0·8f						1½	1½	0	-8	25	0		1 965·403	2 067·722	1 930 725	1 967·723	1 950 651	2 007 754
100	582·30	581·80	582·40	0·0	0·0	582 77	582 67	582·67	0·6f	1·4f						1½	1½	0	-6	0	-14		1 960 645	2 020 168	1 990 826	2 047 651	1 989 678	2 049 671
150	582 95	581 97	582·80	0·0	0·0	579 27	579 17	582·17	4·2c	3·6c	1½				1½			18	0	18	0		1 988 720	1 967 546	1 98			
750	573 50	573·40	573 80	0·0	0·0	574 97	574·87	574·87	2·7f	1·9f						1½	1½	0	-14	0	-14		2 318·352	1 490 297	2 460 725	1511·126	2 474 625	1 502 345
800	570·30	571 56	574 20	0·0	0·0	576·47	576·37	576 37	5·1f	4·9f						1½	1½	0	-26	0	0		2 363 123	1 458 070	2 850 825	1 570 112	2 856 781	1 510 654

DERTH G·CORD

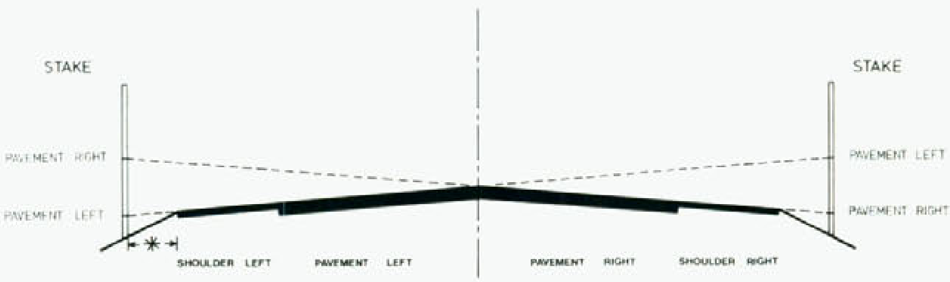
FIGURE 6

This article was prepared by the Department's Assistant Road Design Engineer, Mr P. B. Sheil, B.E., and Mr D. B. Morgan, B.E. The artwork was prepared by Mr W. Willott and Mr R. Muir.

The following articles associated with road location and design have appeared in recent issues of "Main Roads":

- —"*Cadastral Surveys by Photogrammetry*", *March 1975, Vol. 40, No. 3, pp. 90–3;*
- —"*Aerial Cameras for Highway Work*", *March 1974, Vol. 39, No. 3, pp. 76–9;*
- —"*The Changing Approach to Road Design*", *September 1972, Vol. 38, No. 1, pp. 9–14;*
- —"*Specifications for Control Work in Aerial Photography and Photogrammetry*", *June 1972, Vol. 37, No. 4, pp. 116–9;*
- —"*Modern Aids to Road Location*", *March 1972, Vol. 37, No. 3, pp. 70–5, 81;*
- —"*Photogrammetry for Road Engineering Purposes*", *December 1971, Vol. 37, No. 2, pp. 42–6; and*
- —"*Aerial Photography for Road Location and Design*", *September 1971, Vol. 37, No. 1, pp. 23–7.*

FINAL ROAD SURFACE SHAPE



✳ OFFSET OF STAKES NOMINATED TO SUIT JOB AND FINISHING PLANT

USUAL INTERVAL OF CROSS SECTION PROFILES – 5 metres

" FPEGL "

FIGURE 7

GOVERNMENT DECISION ON
INNER-URBAN FREEWAYS

On 23rd February, 1977 the State Government announced its decision to abandon major portions of planned inner-urban freeways in Sydney. On that day, the Minister for Transport and Highways, Mr Peter Cox, M.L.A., issued a statement which is reproduced in full below. The statement began by announcing that . . .

Cabinet had adopted recommendations from its special sub-committee on freeways to abandon large sections of proposed work on the Western, Warringah, Gore Hill, Eastern and Southern Freeways.

Mr Cox said the decision was directly in line with the Government's pre-election promise and subsequent policy that freeways should not be constructed in inner-city areas.

"While the Government recognises the importance of adequate roads in a balanced transport system, it is against inner-urban freeway proposals which would devastate the areas they pass through," he said.

Mr Cox said he and his colleagues, the Minister for Local Government, Mr Jensen, and the Minister for Planning and Environment, Mr Landa, would work with local councils in rehabilitation and development of areas affected.

"We are not anti-freeway and, in fact, there is provision in current planning for major roadworks to fit in with our balanced transport concept."

Mr Cox said virtually all road construction works in the city area were met from Federal funds. "We are not getting enough money from the Federal Government. We really only have enough money to improve what we have and, in conformity with this policy, additional money has been made available to the Traffic Authority this year for traffic engineering works," he added

"Much of the major construction works proposed for inner-urban freeways is now quite beyond financial feasibility. One of the significant factors is that currently available funds and the level of funds likely to be available in the foreseeable future will only provide for limited development and improvement of the existing road system."

Mr Cox said the freeway proposals now abandoned would have cost approximately $491 million on current prices and that sort of money was simply not available.

He said properties held by the Government in the path of planned freeways would be sold or made available for some other public amenity. These are conservatively estimated to be worth $20 million.

"There are necessary procedures under current legislation to be followed in rezoning land for disposal. Nevertheless, even with urgent action on disposal, the flow of funds from sales will be limited in the early stages," Mr Cox said.

He said proceeds from the sale of any properties would be needed for major metropolitan roadworks in view of the insufficient funds now available for roads. The money would be devoted to high-priority metropolitan roadworks.

"The Urban Transport Advisory Council is reviewing transport corridors to provide a better perspective on the need for corridors and the priority of their development," Mr Cox said.

"U.R.T.A.C. is looking at least 20 years ahead and from this, the Government will be in a better position to gauge the need for these funds. Recommendations are expected shortly."

As a result of the elimination of the freeway proposals, other corridor reservations for the county roads would assume greater importance, Mr Cox said.

Mr Cox stressed that the fine details of the proposals had not yet been determined and some minor variations may be necessary due to engineering considerations.

He said the sub-committee met with U.R.T.A.C., the Commissioner for Main Roads, representatives of the NRMA and others to examine all aspects of determining the future of freeways in the Sydney area.

Mr Cox said the position regarding the North Western Freeway and the section of the Eastern Distributor in the Woolloomooloo-Darlinghurst area was still under consideration by the Cabinet sub-committee. It is hoped firm recommendations will be reached in the very near future on these freeways.

Summary of Proposals

F4—Western Freeway

The present corridor reservation will be retained to a point east of Concord Road in the vicinity of Loftus Street, Concord, where connections to the existing road system can be developed. The present and planned construction west of this point would be developed progressively.

The corridor reservation for the inner section of the freeway from the City to that point will be eliminated.

The estimated cost of the roadworks proposed in the abandoned section would have been $287 million.

F1—Warringah Freeway

The corridor reservation beyond Willoughby Road will be eliminated. The current work will be connected to Willoughby Road and abandoned at that point.

The estimated cost of proposed works through to Balgowlah would have been $66 million.

F2—Gore Hill Freeway

The corridor reservation for the proposed Gore Hill extension between Willoughby Road and the Pacific Highway will be retained, but construction will have a low priority.

The Gore Hill Freeway would link the Warringah Freeway at Willoughby Road to the Pacific Highway at Longueville Road, and in turn, with Epping Road to provide an arterial route to the northwest.

A planned subsidiary link to the Pacific Highway along White Street to Palmer Street, Artarmon, is to be abandoned. This would have cost $4 million.

F6—Southern Freeway

The corridor reservation from the city to Huntley Street, Alexandria will be eliminated but the corridor from that point to Tempe is to be retained.

Roadworks associated with this section of the Southern Freeway would have cost $96 million.

F7—Eastern Freeway

The corridor reservation from Taylor Square to Old South Head Road at Bellevue Hill will be eliminated with the exception of requirements for the Bondi Junction bypass road and for a suitable grade-separated interchange at Taylor Square and road improvement works in the Taylor Square-Dowling Street area.

The estimated cost of roadworks now abandoned on this freeway would have been $38 million. ●

Engineer-in-Chief

Retirement

On 17th February, 1977, Mr T. (Tom) S. Hope, A.S.T.C., F.I.E.Aust., F.C.I.T., retired from the Department after holding the position of Engineer-in-Chief since 19th June, 1975.

Mr Hope had been with the Department since 6th December, 1937, except for three years service with the AIF during World War II. A detailed outline of Mr Hope's service with the Department was given in the September, 1975 issue of "Main Roads" (Vol. 41, No. 1, p. 11), while the administrative structure and functions of the Engineer-in-Chief's Branch was given in the June, 1976 (Vol. 41, No. 4) and September, 1976 (Vol. 42, No. 1) issues. When appointed to the position of Engineer-in-Chief, he headed a new team of Chief Engineers, in that none of them had been in their respective positions for more than twelve months. However, this was more than offset by their ability and willingness to work together as a team and this spirit of co-operation has been a feature of Mr Hope's time as Engineer-in-Chief.

While Engineer-in-Chief, Mr Hope gave great impetus to the movement towards establishing a standard set of general conditions for contracting by State Government Departments. These standard conditions were completed during his term as Chairman of the Association of Chief Engineers of Government Departments and Instrumentalities.

As the Department's representative on the Principal Technical Committee of NAASRA, Mr Hope was recently appointed as convenor of the Steering Committee for the Association's Study of Road Maintenance Standards, Costing and Management throughout Australia. During the last twelve months, he has led the Committee through the difficult but vital task of setting the guidelines for the Study, deciding on its extent and specifying how it will be undertaken.

Appointment of Successor

The Department's new Engineer-in-Chief, Mr D. (Doug) C. Jacob, B.E., M.I.E.Aust., M.A.I.T.T., took up his appointment on 18th February, 1977.

Mr Jacob joined the Department in December, 1942, after completing the three-year war-time degree of Bachelor of Science in Engineering at the University of Western Australia in Perth. He worked on the Stuart Highway in the Northern Territory until January, 1944. He then joined the RAAF and served in the Pacific Islands with No. 2 Airfield Construction Squadron. In 1946, he again attended the University of Western Australia to convert his degree to the full Bachelor of Engineering degree.

Returning to the Department's service in January, 1947, Mr Jacob worked in the Bridge Design Section in Head Office for two years before being transferred to Parkes Divisional Office in January, 1949. This was followed by appointments at Bega Divisional Office in February, 1953 and at Newcastle Divisional Office in April, 1956. In 1959, he completed the Traffic Control Course at the University of New South Wales.

Mr Jacob was appointed as Divisional Engineer at Tamworth in December, 1961 and in March, 1965 he was transferred to Parramatta as Divisional Engineer. After three years in this position, he was transferred to Head Office in September, 1968 as Assistant Highways Engineer and later appointed as Deputy Highways Engineer.

In 1971 he undertook the course for executives at the School of Administration, University of New South Wales, and the following year he attended the advanced course at the Australian Administrative Staff College at Mount Eliza in Victoria.

In 1972, with the Department's present Traffic Engineer, Mr K. W. Dobinson, he visited the United Kingdom and Europe for four weeks to investigate the types of fog warning systems which had been developed in other countries. This visit led to the decision to instal the present driver aid system on the Waterfall-Bulli Pass Tollwork.

Mr D. (Doug) C. Jacob

After attending a refresher course at the Administrative Staff College at Mount Eliza, Mr Jacob was appointed to the position of Engineer for Programmes and Budgets in August, 1974. This was followed by his appointment in June, 1975 as Deputy Engineer-in-Chief. ●

CLEAN UP DOWN UNDER

unusual underwater assignment

During recent months, passers-by might have been surprised to see a "frogman" emerging from holes in the ground at the North Western Freeway construction site at Darling Harbour. Here's the explanation.

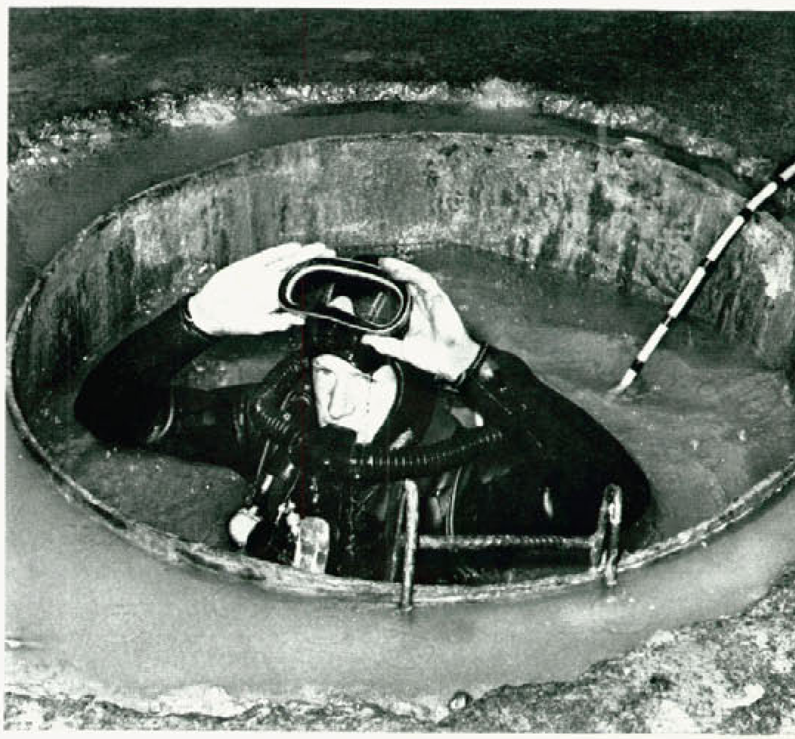
WHERE

A section of the North Western Freeway (F3) has, for some time, been under construction across the railway goods yards at Darling Harbour. When completed it will replace Pyrmont Bridge, which will then be demolished to allow redevelopment of the southern end of Darling Harbour by the Maritime Services Board.

This section of the Freeway will include connections to several city streets, namely Bathurst, Druitt and King Streets—as well as the Western Distributor—for inwards traffic. Connections for outwards traffic will be from Day, Druitt and Market Streets.

The design of this section has been undertaken by consulting engineers, De Leuw, Cather of Aust. Pty Ltd and construction so far has been largely by the Department's own forces with some contract work.

The present construction is mainly of viaduct structures up to 25 metres high. The design provides for segmental pre-stressed concrete columns and steel girders within the railway marshalling yards, while outside this area, the columns are reinforced concrete and the superstructure is reinforced or prestressed concrete, for the most part cast-in-place.



at freeway construction site

WHY

The viaduct structures are generally founded on 1.2 metre diameter cast-in-place piles, bored to bedrock which is up to 25 metres below ground level. There are over 400 of these piles in this section. A few foundations are spread footings, located beyond the original harbour shoreline where rock is close to the surface.

However, most of the area involved has been reclaimed from Darling Harbour during the last one hundred years or so. The railway yards in particular were filled in the 1920's using material excavated during construction of the city underground railway tunnels. In some locations, the buried remains of old wharves and other old structures have been encountered. Because of the nature of the fill material, permanent steel casing (10 mm thick) has been used for the protection and strengthening of the piles.

These casings have been sunk to rock using the Department's French Benoto boring machine which also excavates within the casing with a hammer grab. An article on the Benoto machine appeared in the September, 1974 issue of "Main Roads", Vol. 40, No. 1, pp 19–21.

Below the pile casing, drilling is continued to form a rock socket as a foundation for the pile. A Calweld rotary drilling rig with a bucket-type bit on a telescopic stem is generally used. The depth of the rock sockets vary from 1 to 5 metres. Rock cores are obtained to assess the quality of the sandstone encountered.

As the water table is only about 2 metres down, the pile holes are practically full of water. Therefore, the sockets are cleaned initially with an airlift and then by a diver. The airlift operation involves lowering a pipe to the bottom of the excavation and drawing up the sediment using a stream of compressed air.

Following further cleaning and any necessary "touching up" of the excavated area by a diver, steel reinforcing cages are installed and concrete is poured underwater by tremie. The cleaning is necessary in order to allow the concrete to get a firm grip on the rock walls and base of the socket hole.

HOW

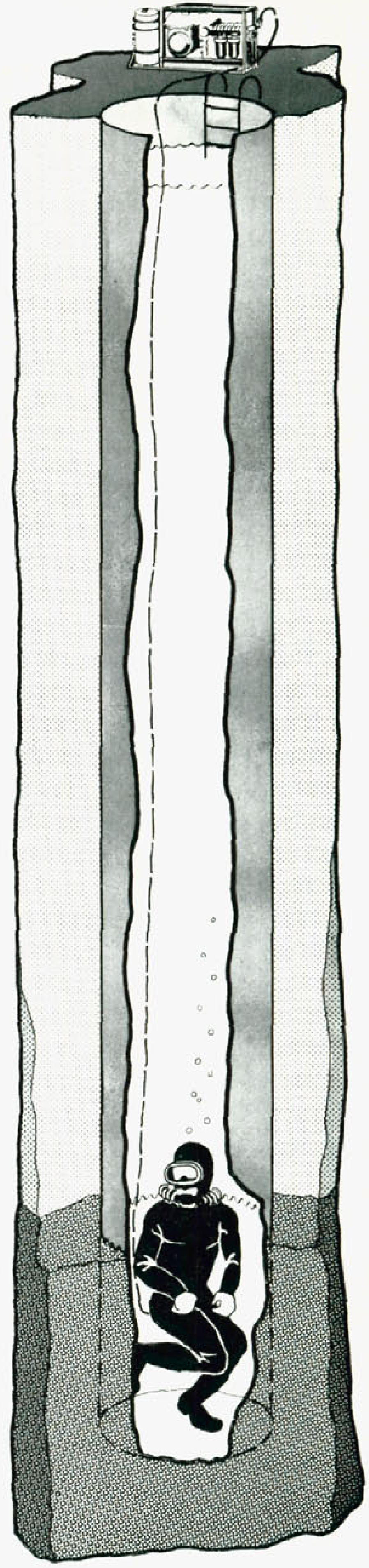
The diver's prime task is to inspect, clean and seal the sides and bottoms of the socket holes. He carries out the cleaning work using a high pressure water jet to "wash" down the walls. He also directs the bottom of the airlift by hand during the final stages of the clean-up.

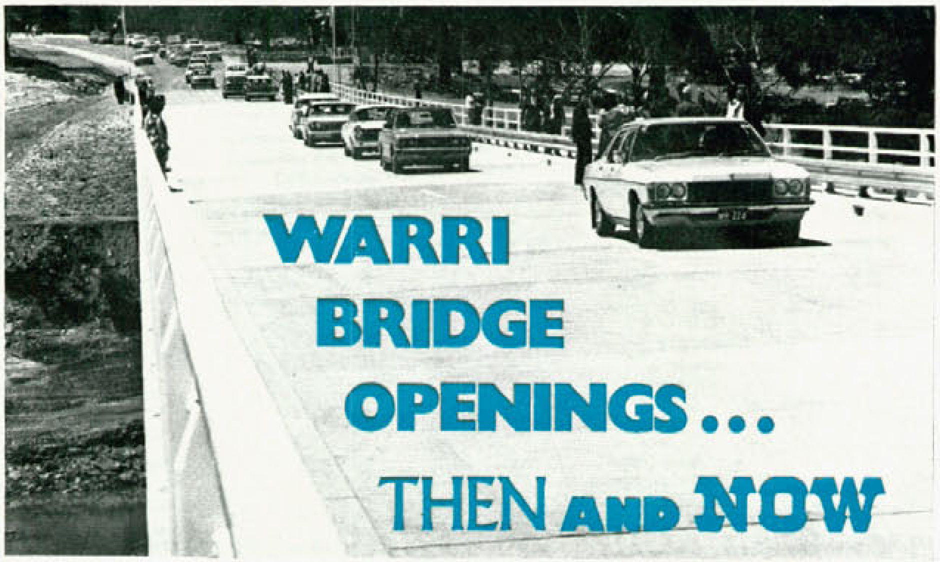
During his work, the diver presents a report to the Department's engineer on the condition and depth of the pile excavation to the bottom of the casing and within the socket hole. Any soft clay zones or mud leaks found by the diver in the rock socket have to be sealed by him. To do this, a fast-setting (5 minute) underwater sealing cement compound is lowered down to the diver and he has to press it into the voids by hand.

The divers are employed by the Diving Company Pty Ltd of Harbord, which is undertaking the work for the Department on a twelve-months contract. The diver has an airline attached to an above-ground air compressor and, in addition, he carries a three-minute supply on his back for emergency use. He carries sufficient lead weights to maintain "neutral buoyancy".

The diver's job is an example of man's remarkable ingenuity and his skill in adjusting to an unnatural environment—for he works alone in darkness, feeling his way around the narrow confines of the cylindrical holes and undergoing considerable water pressure in the deeper piles, as well as turbulence during the high pressure jetting and the airlift. ●

An article entitled "Construction of Substructure of Darling Harbour Viaduct of the North Western Freeway" appeared in the June, 1973 issue of "Main Roads", Vol. 38, No. 4, pp. 101–6.





Official vehicles lead the motorcade of first cars to cross the new structure on 19th November, 1976.

The views from down on the Shoalhaven River are well worth the time to stop and see.

As described in the December, 1976 issue of "Main Roads" (Vol. 42, No. 2, pp 44–7), a new bridge over the Shoalhaven River at Warri, near Braidwood on Trunk Road No. 51, was opened on 19th November, 1976. It replaced a timber structure built in 1892 which in turn had replaced one built in 1874. Space precluded the inclusion in that issue of the description of happenings 102 years earlier on 28th September, 1874, when the original bridge was officially opened.

We have therefore included below—in full—the 1874 report from the *Sydney Morning Herald* correspondent. For the record, we have also reprinted an edited report from the *Goulburn Evening Post* (leaving out statistical data, already included in our last issue) of the opening of the new bridge at a ceremony organised by Tallaganda Shire Council.

Research so far has failed to reveal what happened to the 1874 bridge to require a new structure by 1892. So, if any readers know the answer, please let us know too.

THEN

Extract from "Sydney Morning Herald", 28th September, 1874.

THE OPENING OF WARRI BRIDGE

(from our correspondent).

On Wednesday, the 23rd instant, the bridge spanning the Shoalhaven river at Warri was formally opened for public traffic by Mr E. Greville, M.L.A., for whose exertions his constituents, at a public meeting, desired that he should open and name the bridge, in recognition of his services in obtaining so great a boon. All the places of business in the town of Braidwood were closed, and, at an early hour, vehicles of every description, well loaded, and equestrians from all parts of the district were making their way to Warri, about nine miles from Braidwood, to participate in the demonstration. At 11 o'clock there were at least 800 persons present, and as far as the eye could reach the road there was well lined, all coming towards the bridge; and at 12 o'clock the number increased 300 more, at which hour the committee of management formed the concourse into procession, which was headed by Mr and Mrs Greville, supported on the right by Mr Wallace, J.P., and on the left by Mr Gillham. The clergy then followed, being represented by the Rev. C. J. Byng (Anglican) and the Rev. W. Robson (Wesleyan), then the committee; the band appeared next in order, followed by members of the various Oddfellows' Lodges in the district, the school children, and then the public. In this order they marched over the bridge from the Goulburn side—a mistake I think. When upon the bridge the Oddfellows opened out, allowing the children and public to pass through the line. Upon returning, the procession halted when Mr and Mrs Greville reached the centre of the bridge. Mr Greville then addressed the concourse in a very suitable speech, and named the structure as the "Warri Bridge" by breaking a bottle of champagne upon the middle arch. The procession being headed by the band, proceeded to the marquee to luncheon, when, after satisfying the inner man, the loyal toasts "The Member for Braidwood", "The Committee", "The Chairman" (Mr R. Maddrell, J.P.), &c., were given, and duly responded to—the children being provided with abundance of sandwiches, cakes, tea, oranges, which it needs hardly worth mentioning, were done justice to, if the quantity eaten is any **guarantee.** *There were all kinds of games indulged in, the elderly seeming to enjoy themselves as much as the young—Mr Bennett, with his "round-about", being well patronised by all classes.*

The following is a description of this bridge:—The bridge is constructed of timber and comprised of six openings, built on the queen-truss principle—namely four 90 feet, one 60 feet, and one 30 feet; total 460 feet in length, with a clear width of roadway of 20 feet. The piers, which are composed of 21 logs, each 14 inches square, rise to a height of 33 feet above the ordinary level of the stream, and 5 feet clear of the highest flood marks. The upright piles are diagonally braced and spurred up and down stream, chased and keyed into the solid granite rock to the depth of 4 feet, and stopped with Portland cement—the whole strapped and bolted together in the strongest conceivable manner to resist the greatest strain that can be possibly brought against them. The abutment piers are planked up level with the decking to receive the embankments of *road approaches. The chords or stringers resting on corbels on top of piers, on which the trusses are erected, being built of three thicknesses of sawn planks, each 35 feet long, 14 inches deep, and 6 inches thick, making a solid girder 15 x 14 inches square, with butts properly shifted, forming one continuous girder throughout the entire length of the bridge, with half-inch boiler-plates on both sides of stringer, well apped over each joint, and most securely fastened with through screw bolts. The stringers are cambered, 7 inches to the length of each span, to increase their strength. The main straining beams and rafters of trusses—which are 14 x 15 inches square, planed and fitted together in heavy castings at the angles, and cast iron shoes at heels of rafters fitting into butting cills—are strongly braced and bolted together with 1½ inch iron suspension rods screwed top and bottom on thick wrought-iron plates, and are strutted and kneed from main beams to ends of cross beams projecting 5 feet outside of stringers. The decking, which is of 4 inch planking, close laid diagonally at the angle of 90°, to ensure the greatest strength, are spiked and bolted to joists and beams resting on the stringers, and fastened at ends on each side of roadway with kerb logs; also, posts and hand rails running the entire length of the bridge.*

The whole structure is of the best description of hardwood timber, carefully selected and well-seasoned before being erected in the work. The design reflects the highest credit on Mr Bennett, the head of the Department of Roads, and on Mr Sorrie, the contractor, who has so successfully carried the work out to completion, which will prove a lasting improvement to the line of road, and a benefit much wanted to the Braidwood district and adjacent country. I must not forget to mention Mr Moir, the foreman of Works, whose skill and ability in carrying out instructions from his chief are equally worthy of commendation.

The large concourse who had assembled to witness the opening of this bridge, after the ceremony, enjoyed themselves heartily in various amusements till about 4 p.m., when the greater majority returned to their respective homes, highly delighted with the happy day they had spent at Warri.

Portion of the crowd at the recent opening ceremony, gathered in front of the dais and marquee set up at the Braidwood end of the Bridge.

The Commissioner for Main Roads, Mr A. F. Schmidt, having just unveiled the plaque.

NOW

Edited Extract from "Goulburn Evening Post", 22nd November, 1976.

"The N.S.W. Department of Main Roads was recognising the growing importance of the road from Canberra to Batemans Bay through Braidwood, and had spent $1.5 million on it this financial year, including the new Warri Bridge."

This comment was made at the official opening of the bridge on Friday by the N.S.W. Commissioner for Main Roads, Mr A. F. Schmidt.

He said the new bridge was an important one, and it was being opened on an important day, the birthday of Ferdinand de Lesseps, who engineered the Suez Canal.

Amongst the official guests were Mr Murray Sainsbury, M.H.R., and Mr Ron Brewer, M.L.A. Chairman was Tallaganda Shire President, Cr A. Mackay. Mulwaree and Yarrowlumla Shires were also represented.

Cr Mackay said the old Warri Bridge had been fast wearing out. It was most important as it provided Braidwood with a direct link to Canberra. "We now look forward to an improved road to match the bridge" he said.

Cr Mackay presented a painting of Charleyong, done by Winifred Beamish, to Mr Schmidt. This would remind him of the occasion.

Mr Ron Brewer said this was the beginning of a link, and it was proper that the Commissioner should open it, rather than a politician. He reminded the gathering that Mr Schmidt was divisional engineer in Goulburn twenty years ago.

Mr Brewer commented that this development saw the start of the road as a major trunk road.

Mr Sainsbury said he had been in politics only one-tenth of the time Mr Brewer had, but he had seen two fine bridges opened by the D.M.R. The other, earlier this year, was at Goulburn. The crowd at Braidwood was even larger and this showed great community interest. ●

TRAFFIC AUTHORITY of New South Wales

The establishment of the Traffic Authority of New South Wales on 1st June, 1976 brought about substantial changes to the administration of traffic control throughout the State.

This article is intended to inform interested people and authorities of new procedures now in operation, and to indicate to them the means by which their complaints and, hopefully, their constructive criticisms can be brought under notice.

The article is based on a leaflet which has been produced by the Traffic Authority and copies are available, free of charge, on request from the Secretary of the Traffic Authority (see address at end of this article) or from the Head Office and Divisional Offices of the Department of Main Roads.

WHY A TRAFFIC AUTHORITY

Prior to the establishment of the Traffic Authority, five Departments as well as local councils were independently involved in road traffic matters with overlapping of interests, duplication of activities and a lack of co-ordination as regards policy. Various committees existed to deal with or co-ordinate some functions but member Departments were not bound by committee decisions. The Traffic Advisory Committee, which represented Departments now on the Traffic Authority, was one such committee which functioned without statutory powers and its effectiveness was severely limited on this account.

There was obviously a need to establish a single decision-making traffic authority so as to offer a unified approach to growing traffic problems.

State Parliament passed legislation in April, 1976. This took effect from 1st June, from which date the Traffic Authority assumed full responsibility for road traffic control throughout New South Wales.

WHAT IT IS

The Traffic Authority is not a Department. It is a committee established under the Traffic Authority Act, 1976 as a statutory corporation responsible to the Minister for Transport and Highways.

Membership of the Traffic Authority comprises—the Commissioner for Motor Transport (Chairman), the Commissioner for Main Roads, the Commissioner of Police, a Commissioner of the New South Wales Planning and Environment Commission, a member (or officer) of the Council of the City of Sydney, and a person nominated jointly by the Local Government Association of New South Wales and the Shires Association of New South Wales.

The Authority is aided by the Chief Commissioner, Public Transport Commission of New South Wales and a representative of the Transport Workers Union of Australia (New South Wales Branch).

A Secretariat, which functions as a Branch within the Department of Motor Transport, provides administrative support and access to the Departments and organisations represented on the Traffic Authority.

ITS AIMS

The Authority's objects are—

- ☆ to promote safety and efficiency in the use of the State's road system, having regard to both traffic and environmental interests; and
- ☆ to provide an administrative system for the management of road traffic responsive to community needs, and to changes in social attitudes and values, as well as innovations in technology.

WHAT IT DOES

Through the whole area of traffic management, control, operations and safety, the Traffic Authority—

- ☆ develops policy guidelines and establishes general standards, principles and priorities for the implementation of improvement measures;
- ☆ provides a focus of responsibility for decisions by the various instrumentalities involved; and
- ☆ co-ordinates the activities of Departments and other public authorities concerned with the carrying out of the Authority's plans and proposals.

HOW IT FUNCTIONS

The Minister for Transport and Highways

The Authority is subject to the control and direction of the Minister (now the Minister for Transport and Highways) of State Parliament appointed to administer the Traffic Authority Act. The Minister appoints Members of the Authority other than the four official members and may remove any such appointed member.

The Minister has control over the funds expended by, or for, the Authority and it is required to submit to him an annual report of its work and activities.

The Traffic Authority

Throughout the State, many decisions affecting traffic operations have to be made every day. The Traffic Authority has delegated much of this responsibility to local representatives who are far more familiar with local problems than are Authority members.

It does, however, retain the role of determining:

- ☆ Policies
- ☆ Priorities
- ☆ Programmes

and meets regularly to discuss these matters.

The Traffic Authority has available to it the facilities and officers of its member Departments and other public authorities where necessary. In consequence, it has no need to directly employ a large number of technical experts to deal with day to day problems.

The Secretariat

Its Secretariat is provided by the Chairman as a branch of the Department of Motor Transport and comprises administrative and technical officers with wide experience in traffic planning and administration. Its role is to assist the Traffic Authority in planning and development of policy and in the co-ordination of inter-departmental activities.

The Department of Main Roads

Traffic engineering activities previously undertaken by the Department of Motor Transport (traffic signals, signs, road-markings, etc.) have been transferred to the Department of Main Roads, which is now the Authority's principal construction agency.

Because of the technical expertise and experience available in that Department, the Authority has also delegated to it powers to approve the provision and installation of traffic facilities on all public roads within New South Wales subject to the policies, priorities and programmes set down by the Traffic Authority.

These powers are exercised by the Department's Divisional Engineers located at Divisional Offices throughout the State.

The Police Department

Necessarily, all decisions on traffic control must have regard to both the need for and the practicality of law enforcement. In this regard the Commissioner of Police retains his responsibility for the enforcement of traffic laws and regulations relating to decisions taken by the Authority or its delegates.

Local Government Authorities

Delegation and decentralisation of decision-making to a local level for the provision of traffic control facilities required to solve or avoid a local problem is an essential component of the Traffic Authority's overall strategy. It has agreed, therefore, to allow councils to decide what minor traffic facilities are necessary on council-controlled streets.

To ensure consistency of standards and treatment throughout the State, guidelines as to good and proper practice are being issued to councils to assist them in the exercise of these powers. Additionally, prior to implementing any approval, they are required to obtain the agreement of regional representatives of the Police Department so far as safety and enforcement aspects of a proposal are concerned, and of the Department of Main Roads in respect of both safety and traffic operations.

Councils have generally found it convenient to set up special joint "Traffic Committees" with representatives of the two Departments to expedite decision-making in this area.

The Department of Main Roads retains powers to erect traffic facilities on local roads also, but will exercise these only in exceptional circumstances.

Finance

The Traffic Facilities Fund has been established to provide for the expenditure necessary in providing and maintaining traffic control facilities throughout the State.

The Department of Main Roads administers that part of this fund which is required to meet such expenditures on council roads.

LOCAL DECISION-MAKING—WHO TO SEE

Major Facilities—e.g., priority road schemes, transit lanes, clearways, speed zoning and speed limits, pedestrian overbridges, subways and traffic signals.

Enquiries should be directed to the Divisional Engineer of the Department of Main Roads at the nearest Divisional Office—see map inside the front cover of this journal. For a full list of addresses, contact the Public Relations Section, Head Office.

Minor facilities—e.g., local parking or standing restrictions, stop and give way signs, no right turn, no entry, no U-turn, keep left, marked footcrossings, centre lines and lane lines.

Enquiries should be directed:

☆ if on a council road—to the relevant city, municipal or shire council;

☆ if on a highway, main road or secondary road—to the Divisional Engineer, Department of Main Roads in the area concerned.

Public Vehicle Facilities—e.g., taxi-cab stand, bus stand and bus stop etc.

Enquiries should be directed:

(a) for privately operated services—
  - ☆ in the Metropolitan, Newcastle and Wollongong Transport Districts—to the Regional Superintendent, Department of Motor Transport in the area concerned; or
  - ☆ in other areas—to the city, municipal or shire council for the area concerned; and

(b) for Government bus services—
  - ☆ to the Area Manager, Public Transport Commission in the area concerned.

General questions and matters of policy

Enquiries should be directed to:

The Secretary,
Traffic Authority of New South Wales,
52 Rothschild Avenue,
(Box 110, Post Office)
Rosebery. N.S.W. 2018.
Telephone 663 0725 ●

TENDERS ACCEPTED BY COUNCILS

The following tenders (in excess of $20,000) for road and bridge works were accepted by Councils for the three months ended 31st December, 1976.

Council	Road No.	Work or Service	Name of Successful Tenderer	Amount
				$
Abercrombie	Various classified and unclassified roads.	Sealing and resealing of various roads with bitumen	Emoleum (Australia) Ltd	27,996.83
Ashford	M.R. 137	Construction of new bridge over Waterhole Creek, 19.3 km north of Ashford.	L. G. Rixon	46,555.29
Ashford	M.R. 137	Construction of new bridge over Myall Creek, 18.5 km north of Ashford.	L. G. Rixon	77,215.30
Ashford	Various roads	Bitumen re-sealing	Emoleum (Australia) Ltd	31,592.32
Bellingen	Various roads	Supply, heat, haul, and spray of up to 123 880 litres of R90 bitumen and incorporate cutter oil and precoat and load up to 1 040 cubic metres of 14 mm aggregate.	Shorncliffe Pty Ltd	23,864.05
Camden	M.R. 154 and M.R. 178.	Reconstruction on improved alignment, including approaches to new bridge over Narellan Creek 0.0 km to 3.4 km from M.R. 178 at Narellan.	Blue Metal and Gravel Pty Ltd	54,318.60
Goulburn	S.H. 2	Laying asphaltic concrete in Cowper Street, Goulburn	Allen Bros (Asphaltic Contractors) Pty Ltd.	55,210.00
Parry	S.H.11	Supply of sealing aggregate	Pioneer Concrete (N.S.W.) Pty Ltd.	27,062.27
Parry	S.H. 11	Supply of bitumen	Boral Road Services	61,705.08
Tweed	M.R. 399	Supply and delivery of deck units to Chillingham Bridge, 15 km north of Murwillumbah.	R. K. C. Williams Pty Ltd	41,664.00

TENDERS ACCEPTED BY COUNCILS—continued

Council	Road No.	Work or Service	Name of Successful Tenderer	Amount
				$
Tweed	Rural Local Road and Piggabeen Road.	Supply and delivery of deck units and driving of piles at Cobaki Bridge at Cobaki.	R. K. C. Williams Pty Ltd	49,215.60
Warren	M.R. 202 and M.R. 333.	Bitumen reseal on various lengths	Shorncliffe Pty Ltd	32,003.12
Wollondilly	Various roads	1976/77 County of Cumberland and Country Trunk, Main and Tourist Roads Maintenance and Improvement Programme.	Alan Wright Bitumen Sealing Pty Ltd.	38,289.69
Wyong	M.R. 335	Supply and delivery of concrete pipes and box culverts for reconstruction through Killarney Vale Shopping Centre from Killarney Street to Norton Avenue.	Monier Pipes Pty Ltd	44,860.56
Wyong	M.R. 335	Laying of pipe drainage system in connection with reconstruction through Killarney Vale Shopping Centre from Killarney Street to Norton Avenue.	Keith Arndell	51,361.91

TENDERS ACCEPTED BY THE DEPARTMENT OF MAIN ROADS

The following tenders (in excess of $20,000) for road and bridge works were accepted by the Department for the three months ended 31st December, 1976.

Road No.	Work or Service	Name of Successful Tenderer	Amount
			$
North Western Freeway	City of Sydney. Darling Harbour Section. Supply, fabrication, delivery and unloading on the site of structural steelwork for decks EH1 and EH2.	State Dockyard, Newcastle	190,512.00
State Highway No. 9	New England Highway. City of Maitland. Construction of 4 860 lineal feet of A type concrete table drains including supply of concrete at construction of dual carriageways between 25.9 to 28.5 km west of Newcastle.	R. A. Gilford Pty Ltd	34,263.00
State Highway No. 9	New England Highway. City of Maitland. Supply and delivery of up to 1 800 tonnes of 20 mm dense graded tar asphaltic concrete into Department's spreader between 25.9 and 28.5 km west of Newcastle.	Bitupave Ltd	37,674.00
State Highway No. 9	New England Highway. City of Tamworth. Surfacing with asphaltic concrete on 6-lane divided carriageway between Kent and Gipps Streets, Tamworth.	Pioneer Asphalt Pty Ltd	75,080.00
State Highway No. 9	New England Highway. Shires of Manning and Parry. Construction of concrete integrated kerb and gutter in cuttings 41 km south and 36 km north of Tamworth.	S. C. Marton, Muswellbrook	25,102.60
State Highway No. 10	Pacific Highway. Supply and spray of up to 123 900 litres of R90 bitumen and spreading 10 mm precoated aggregate supplied by Department in stockpile sites.	Boral Road Services	32,460.00
State Highway No. 10	Pacific Highway. Shire of Lake Macquarie. Supply and delivery of up to 900 tonnes of 20 mm dense graded tar plant mix for construction of dual carriageways between Oakdale Road and Oxford Street, Gateshead.	Bitupave Ltd	26,577.00
State Highway No. 10	Pacific Highway. Municipality of Taree and Shire of Manning. Surface preparation and protective coating of steelwork at bridge over Dawson River at Cundletown and bridge over Lansdowne River at Coopernook.	K.G.B. Painting Contractors (K. & G. Bradica) Pty Ltd	43,739.00
State Highway No. 10	Pacific Highway. Shire of Byron. Supply and laying asphaltic concrete to deck and road approaches to new railway overbridge at Bangalow, 27 km north of Ballina.	Bitupave Ltd	35,876.80
State Highways Nos 10 and 16	Pacific and Bruxner Highways. Supply, heat, haul and spray R90 bitumen to various lengths of the Highways under control of Ballina Works Office.	Boral Resources (Qld) Pty Ltd	95,311.98
State Highways Nos 10 and 12	Pacific and Gwydir Highways. Supply, heat, haul and spray R90 bitumen to various lengths of the Highways under control of South Grafton Works Office.	Boral Resources (Qld) Pty Ltd	32,715.00
State Highways Nos 10 and 12	Pacific and Gwydir Highways. Supply, heat, haul and spray R90 bitumen to various lengths of the Highways under control of South Grafton Works Office.	Shorncliffe Pty Ltd	91,080.00
State Highway No. 11	Oxley Highway. Shire of Hastings. Supply, heat and spray R90 bitumen, at various locations.	Shorncliffe Pty Ltd	60,861.15
Main Road No. 278	Shire of Goodradigbee. Surface preparation and painting steelwork of superstructure of Taemas Bridge over Murrumbidgee River, 24.1 km south of Yass.	Kada Painting Contractors Pty Ltd	56,980.00
Main Road No. 286	Kosciusko National Park. Loading, hauling and tipping material.	Petamin Explorations N/L	42,392.00
Main Road No. 286 and Alpine Way	Kosciusko National Park. Supply, deliver and lay up to 2 400 tonnes of 10 mm asphaltic concrete.	Allen Bros (Asphaltic Contractors) Pty Ltd	118,365.00
Main Road No. 373	Municipality of Ryde. Construction of new bridge over Lane Cove Road at North Ryde.	G. Abignano Pty Ltd	1,025,744.00

MAIN ROADS STANDARD SPECIFICATIONS

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

ROAD SURVEY AND DESIGN

	Form No.
Design of two-lane rural roads (Instruction—1964)	355
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Plan and longsection—Two lane rural roads	SD 6215
Standard cross sections for bitumen surfaced two-lane rural roads (1973)	SD 6056

URBAN DRAINAGE

Concrete converter	A 1418
Concrete work other than bridges	738 (Metric)
Design of subsoil and subgrade drainage (Instruction—1973)	513 (Metric)
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With kerb inlet only	A 1043
With grating and extended kerb inlet	A 1352
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With grating for mountable kerb	A 4832
Kerb and gutter shapes (1975)	SD 6246
Perambulator ramp	A 3491
Vehicle gutter crossings (1974)	SD 6247
Waterway calculations for urban drainage (Instruction—1963)	371B

CULVERTS

(a) Cast in place reinforced concrete box culverts—

Box culverts with wearing surface	SD 6270
Single cell box culvert under fill from 1 m	SD 6271
Single cell box culvert under fill from 0·3 to 1 m	SD 6272
Multiple cell box culvert under fill from 1 m	SD 6273
Multiple cell box culvert under fill from 0·3 to 1 m	SD 6274

(b) Precast reinforced concrete box culverts—

Erection of precast concrete box culverts (1975)	138B (Metric)
Supply of precast concrete box culverts (1975)	138A (Metric)

(c) Pipe culverts—

Construction of concrete pipe culverts (1974)	25 (Metric)
Design of concrete pipe culverts (1974)	25A (Metric)
Headwalls for pipe culverts—	
Single row—	
600, 750, 900 mm dia.	SD 139
375, 450, 525 mm dia.	SD 143
1 050 mm dia.	SD 172
1 200 mm dia.	SD 173
1 350 mm dia.	SD 174
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Supply and laying of asbestos cement drainage pipes (1972)	861

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Waterway diagram (0 to 200 acres)	A 26

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Bituminous surfacing job summary (1974)	1011 (Metric)
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Supply and delivery of aggregate for use in bituminous plant mix (1975)	952 (Metric)
Supply and delivery of asphaltic concrete (1975)	953 (Metric)
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Supply and laying of dense graded tar plant mix (1975)	954 (Metric)
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Corrugated steel guard rail—anchor plates (1976)	SD 6264
Corrugated steel guard rail—steel posts (1976)	SD 6277
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Drawings: Sheep fence (1974)	SD 494
Rabbit-proof fence (1974)	SD 498
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Floodgate (1974)	SD 316
"Manproof" pipe and chainwire boundary fence (1975)	611 (Metric) SD 6278
Post and wire fencing (1974)	141 (Metric)
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MANUALS *

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

D.M.R. BOOKLETS

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

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

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

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

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