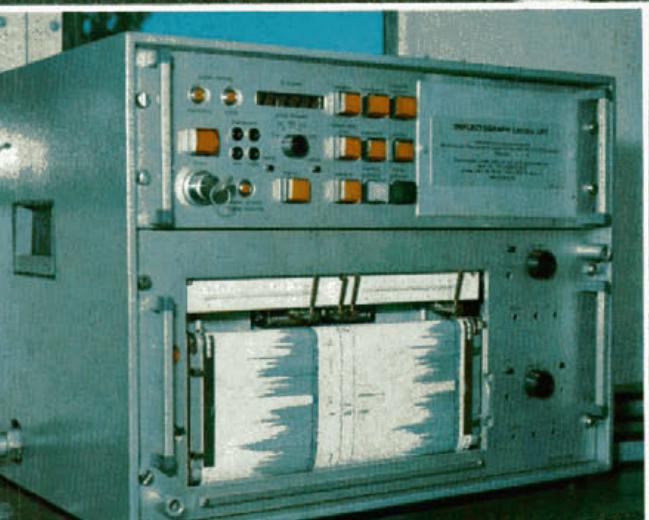
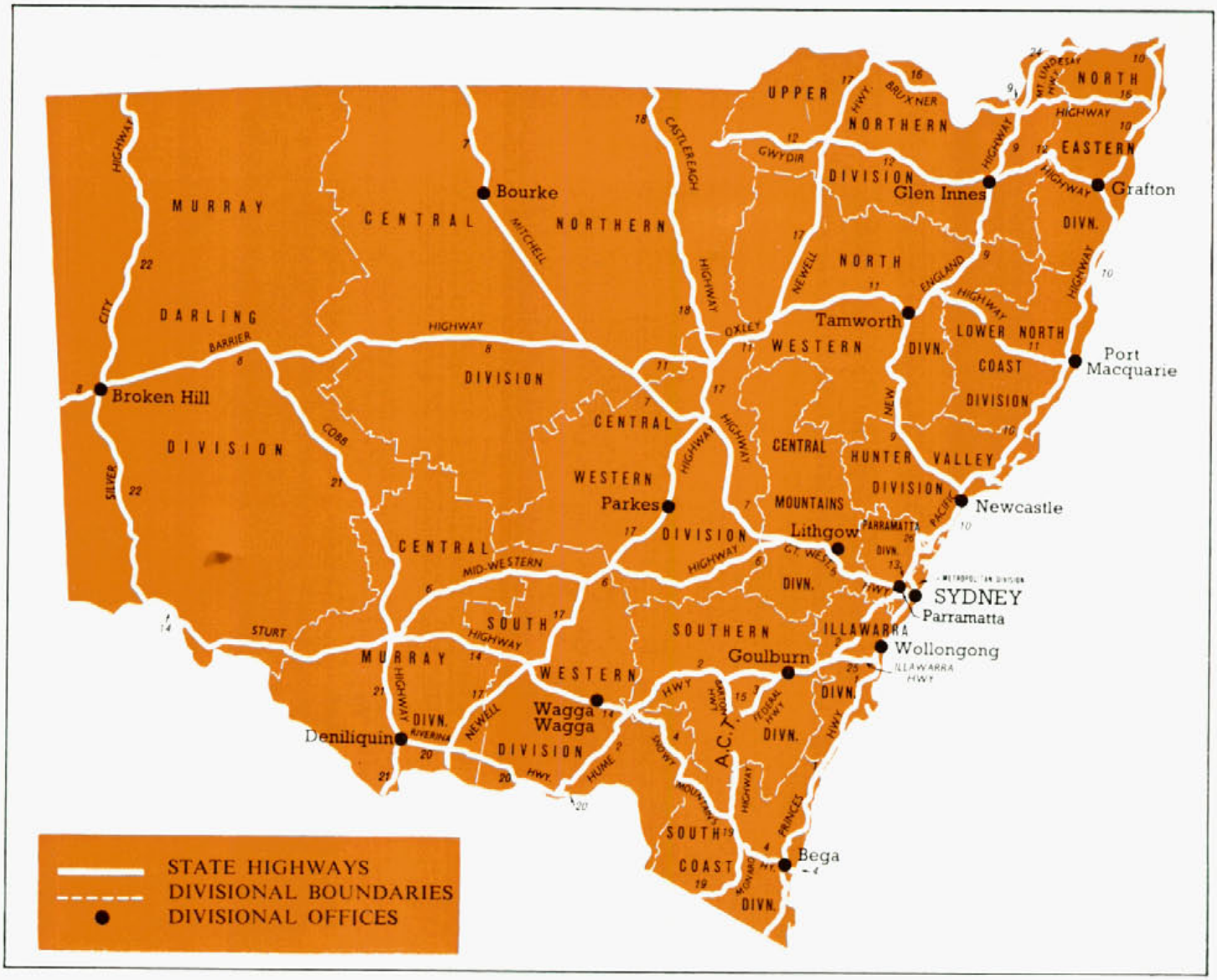
MAIN ROADS

MARCH 1976





New South Wales

Area—801 428 km^2

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

Length of Public Roads—208 804 *km*

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

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

ROAD CLASSIFICATIONS AND LENGTHS IN NEW SOUTH WALES

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

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

MAIN ROADS

JOURNAL OF THE DEPARTMENT OF MAIN ROADS, NEW SOUTH WALES

MARCH, 1976

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PLAY IT AGAIN

They say it is possible to write a song about anything, and thinking back over countless hit parades, musicals and operas, the range of titles and subjects is certainly varied. It is intriguing how constantly composers can juggle combinations of notes and come up with a version that no-one else has thought of before. Our lives are not only enriched by the works of classical composers but also enlivened by such popular numbers as "Zorba the Greek", "Lara's Theme" from Dr Zhivago, and Neil Diamond's "Sweet Caroline".

Be they protest, blues, gospel, country and western or movie themes, most songs seem to be personal statements reflecting inner feelings . . . and so it is hard to find any at all related to roads. "Follow the Yellow Brick Road" from the Wizard of Oz and Roger Miller's "King of the Road" are two of the few that come to mind.

In radio and TV programmes, and movie films, music is used to create appropriate moods. To have to be content with presenting just a visual image in words and pictures—as in "Main Roads"—can therefore sometimes be frustrating. *It would be nice* to be able to call in the Sydney Symphony Orchestra sometime to accentuate an article with a resounding fanfare—or to put some of our more exciting news to music and have it sung by Julie Andrews or Shirley Bassey or Barbra Streisand or Kamahl or Glen *Campbell!*

In the meantime we could suggest a few older songs to play on your tape-deck while reading this issue. As a background for the article on the Department's new Deflectograph how about Doris Day's early number "Every little movement has a meaning all its own"? "Smoke gets in your eyes" would be appropriate for "Roads and Pollution" and Helen Reddy singing "I am woman" could lead into the article on Mrs Macquarie's roadbuilding interests.

As a backing for "Roads in the Future" something on the Moog Synthesiser might go well or, if you prefer to be nostalgic, we could take a clip from the soundtrack of that classic scene in "Casablanca" where Ingrid Bergman begs the pianist to "Play it again, Sam" . . . and (with Bogart arriving too late to stop him) he sings "The fundamental things apply, as time goes by".

If there is any fundamental "message" underlying the choice of songs *that* we would make, if we had the chance, it would be to underscore the point that roads, like music, enrich our lives. Indeed, although Departmental engineers are roadmakers rather than musicmakers, nevertheless their "compositions" bring their own type of "harmony" and added pleasure to life . . . . . and that's worth singing about.●

Assessing the structural condition of roads

THE DEPARTMENT'S DEFLECTOGRAPH

Asphaltic concrete surfacing is being used increasingly on both new and existing main road pavements throughout New South Wales. This has accentuated the need for information on the structural properties of underlying base and sub-grade layers. Until recently such information had been obtained by the use of Benkelman Beam apparatus (see June, 1973 issue of "Main Roads", Vol. 38, No. 4, pp. 107–110). However, the purchase of a Lacroix Deflectograph and its delivery in July, 1975 has provided the Department with an automated pavement monitoring device, which exceeds the capabilities of the Benkelman Beam and supplements the seventeen Benkelman Beams in use by the Department around the State.

Previous Limitations

The Benkelman Beam obtains an indication of the overall structural condition of a length of road pavement more directly than can be derived from field sampling and laboratory testing of materials from the road. However, the rate at which it can test sections of road is limited. Even an experienced team of operators can only progress about 4–5 km per day, stopping at approximately 80 m intervals and measuring in only one wheel track. Its use is therefore generally restricted to investigations for particular projects or along limited lengths of road, rather than for monitoring pavement conditions generally as an aid to planning and programming.

New Needs

A much more comprehensive monitoring of road pavement performances and conditions can be obtained by the new Deflectograph. From the range of devices available for automatic measurement and recording of pavement deflections, the Deflectograph has achieved wide recognition and acceptance. The information which it can provide may be related to results obtained with the Benkelman Beam and is suitable for:

* systematic future programming of maintenance and construction,
* road needs survey inventories,
* overlay design and
* pavement design research.

The Deflectograph was developed at the Laboratoire Central des Ponts et Chaussees in France in the mid-1950's. Since then it has been progressively improved and it is now possible to automatically process the deflection data obtained by the unit.

At present there are approximately forty Deflectographs operating in France, United Kingdom, South Africa and other countries. The Country Roads Board, Victoria, acquired a unit about eighteen months ago.

What is a Deflectograph?

The Deflectograph consists of three principal components.

1. A truck with ballast to provide a rear axle load of 8·2 t.
2. A measurement beam, which is suspended on a moving carriage under the truck, to which are attached two probes similar to Benkelman Beams. These two probes are each located just ahead of and in line with the space between the tyres of the rear dual wheels.
3. A measuring and recording system which converts the displacement of the tip of the probe arms into an electrical signal. This system is housed in the separate cabin at the rear of the driver's cabin.

As the Deflectograph originated in France, the measurement beam and associated equipment were especially designed to suit a particular type of truck manufactured in France. The cost of tailoring the equipment to suit a different vehicle would be considerable, so the Department, in common with other users of the Deflectograph, purchased the machine as a unit including the standard left-hand drive and five cylinder diesel truck for which it was designed.

It has been found, however, that the left-hand drive vehicle has a particular advantage in countries such as Australia, where traffic travels on the left-hand side of the road. This arises from the driver's position being immediately adjacent to the outer edge of the road and enables him to keep the Deflectograph accurately located along the outer wheel path area of the pavement.

How the Deflectograph Operates

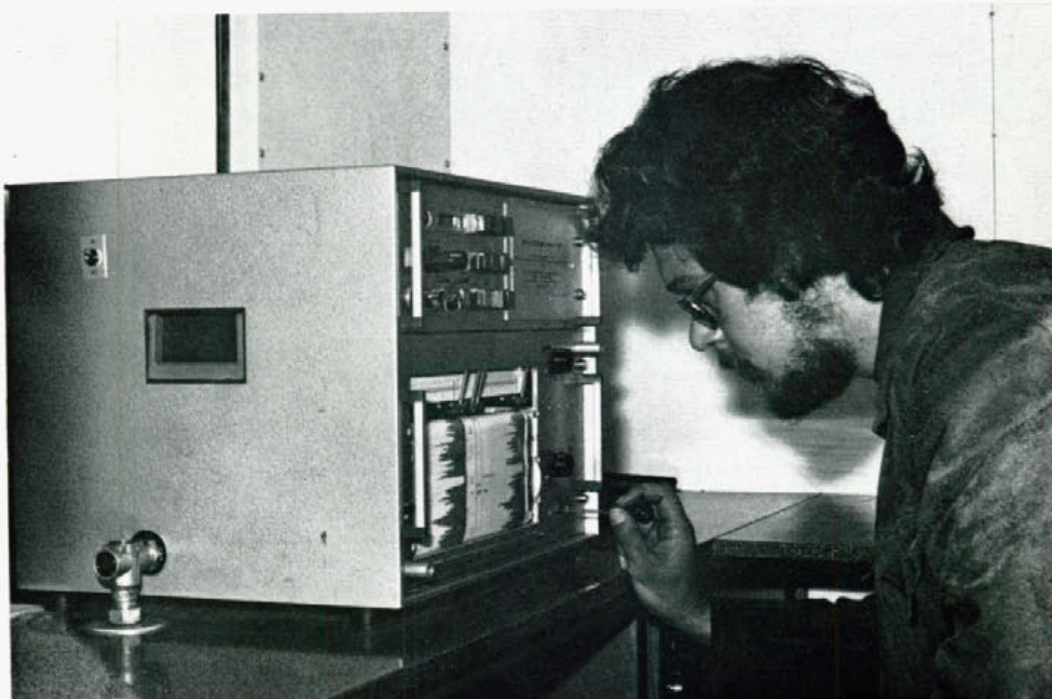
On routine work, the Deflectograph can traverse approximately 8 km per day taking measurements in both wheel

paths simultaneously at intervals of 3·4 m along the road.

In operation, the Deflectograph travels at a speed of approximately 2 km per hour.

At the commencement of a series of tests, the measurement beam is at rest on the pavement with the tips of the probes a set distance ahead of the rear dual wheels of the vehicle. As the truck moves forward the probe arm rotates through a very small angle relative to the reference frame.

The displacements of the probe arms (i.e., the deflection of the pavement surface) reach a maximum when the wheels are near the tips of the arms. The movement of the probe arm relative to the measurement beam is converted by a transducer to an electrical impulse which



Top right: Side view, showing the position of the measuring beam and the left-hand probe at the commencement of a measuring cycle

Centre: Position of the probe between the rear wheels just after the completion of a measuring cycle and immediately prior to being hauled forward to commence the next measuring cycle

Right: Operator at the Deflectograph control console observes the dual graphical print-out of deflections as they are simultaneously recorded for each wheel path

is conveyed to the recording equipment in the special cabin.

When the measurement phase has been completed the beam is automatically pulled forward by the cable and winch system to which it is attached, until its position relative to the truck is the same as at the beginning of the cycle. The beam then comes to rest on the pavement and a new measurement cycle commences. There is no need for the truck to stop at any time during the measurement process—an activity which can continuously produce readings at 3·4 m intervals along the road. An example of the graphical print-out obtained from the recording equipment is shown in Figs. 1 and 2.

In Fig. 1 the scale is reduced so that only maximum deflections are recorded. From this it is possible to quickly observe the condition of the whole length of pavement traversed.

In Fig. 2 the distance scale has been increased to show the shape of the individual deflection bowl at each point.

Research is currently being carried out to establish the relationships of the shape of this deflection bowl to the stiffness of pavement and subgrade layers, as has been done with the Benkelman Beam.

Utilising the Information

As there is a relationship between the results obtained with the Deflectograph and those obtained with the Benkelman Beam, the output from the Deflectograph may be used directly in the design of pavement overlays.

The graphical record produced by the Deflectograph can also be visually displayed through an oscilloscope. Another method for recording the Deflectograph's results is on punched paper tape from which the Department's computer can produce a print-out. Such print-outs will eventually become part of a State-wide, computerised inventory of road conditions.

The Department's Deflectograph is now past the initial commissioning stage and to date has spent most of its time on the Hume Highway. Consideration is now being given to the alternatives of strengthening or reconstructing various sections where deflectograph measurements have indicated the need for one or the other.

Equipment such as the Deflectograph is typical of the modern aids necessary for the monitoring of conditions on main roads throughout the State. They are of great benefit in assessing priorities in the future planning and programming of maintenance and construction works.●

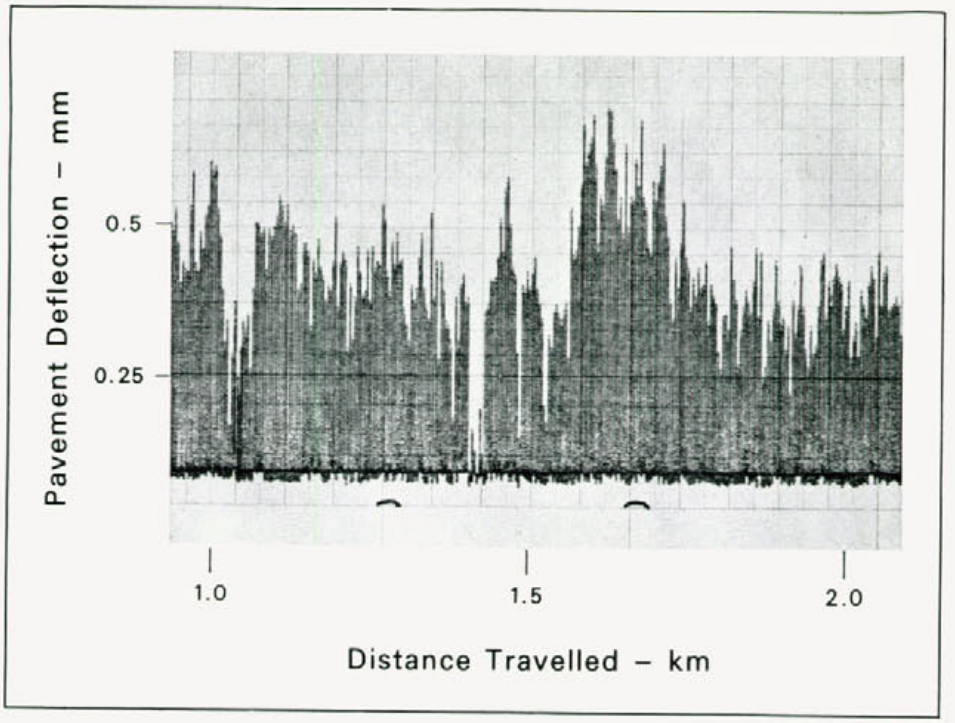
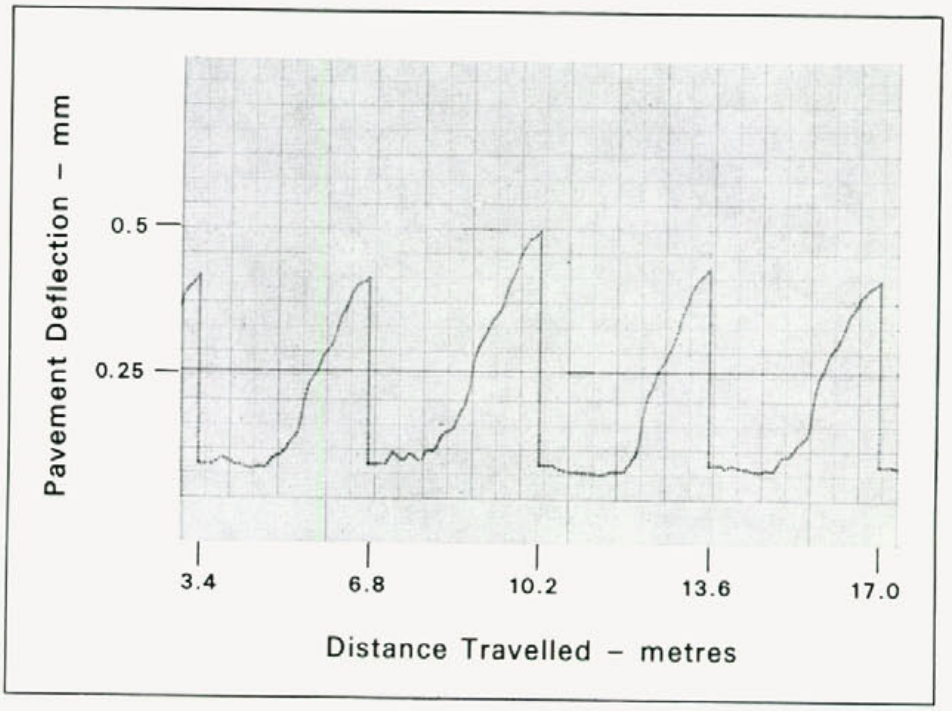


Figure 1: Typical graphical print-out, with distance scale reduced so that only the maximum deflection is recorded. This gives a visual indication of the overall structural condition of the particular length of road

Figure 2: Typical graphical print-out, with distance scale extended so that the shape of each pavement deflection bowl is shown. All readings are obtained at a standard distance of 3·4 m apart, irrespective of adopted print-out scale



International Training Course in Road Engineering

An International Training Course in Road and Bridge Engineering is being conducted by the Department, in collaboration with the National Association of Australian State Road Authorities, for Engineers sponsored under the Colombo Plan, the Special Commonwealth African Assistance Plan, the South Pacific Aid Programme and the Australia Papua New Guinea Education and Training Scheme.

The course, which is of 13 weeks duration, is designed to give the selected students theoretical and practical instruction in Australian methods for the design, construction and maintenance of low cost roads and bridges. This will enable the participants to assess the applicability of these methods to conditions in their own countries.

The 19 students selected for this course are from Bangladesh, Burma, India, Indonesia, Malaysia, Nepal, Nigeria, Pakistan, Sikkim, Sri Lanka and Thailand. They are all qualified Engineers, with a minimum of 5 years and up to 10 years experience in general road engineering practice, who will be able to influence their own country's road building activities on their return. A requirement for entry to the course is the ability to speak English fluently.

Before commencing the technical and practical sessions of the course, a week's induction is provided at which the characteristics of the people and areas among which the students will be moving during the course are explained by officers of this Department and of the Australian Development Assistance Agency. Almost every aspect of Australian life (from its economy to type of food, religion, politics, banking, shopping and education) is outlined and questions invited so that maximum assimilation can be effected in the brief time available. This induction period includes an afternoon tour of Sydney and a four-day orientation tour of Canberra, the Snowy Mountains Area and the South Coast Region of New South Wales in order that the students can gain at first hand a better knowledge of Australian conditions and Australian roads.

At the beginning of the second week the course is officially opened, the students welcomed and the objectives of the course outlined. This is followed by each student presenting a short informative summary of his personal history, the country in which he lives, the organisation for which he works, and the functions for which he is responsible. This early familiarisation is aimed at increasing confidence and participation in course discussion.

During the ensuing weeks the course provides a comprehensive and balanced programme of technical lectures and discussions on aspects of road and bridge planning and design, organisation and administration, job management, construction and maintenance methods including such specialised activities as pavement design, site investigation, sampling and testing of road materials, computer techniques, traffic surveys and intersection design, waterway calculations and the design and manufacture of bridge components in steel and concrete.

The technical sessions, which are all being conducted by officers of the Department, are grouped into three distinct categories, viz. roads, bridges and administration. These three technical sessions are separated by two periods, each of approximately 2 weeks, during which the students are attached to different Departmental Divisions throughout the State, to observe road and bridge construction and maintenance practices at first hand. In the last 2 weeks of the course, provision is made for attachment to specialist sections in the Department's Head Office to give the students the opportunity of working in and observing the activities of those Sections which are of particular interest to the individual. The course terminates with 2 days of discussion and review.

While the students are shown many activities of a highly technical nature, it is always borne in mind that the course objective is to give the greatest appreciation of "*low cost stage construction methods*".

The Australian Development Assistance Agency, the National Association of Australian State Road Authorities and this Department are most appreciative of the ready response shown by the African and Asian Governments to this course and similar courses which were conducted by the Department in 1969, and by the Country Roads Board, Victoria in 1970; the Main Roads Department, Queensland in 1971; the Highways Department, South Australia in 1972; the Main Roads Department, Western Australia in 1973; and the Main Roads Department, Queensland in 1974.

The exchange of knowledge during the formal lectures and the experience gained in the practical sessions could lead to the adoption in Asian and African countries of techniques which have proved to be successful in Australia. Those associated with the conduct of the course appreciate the opportunity of passing on the expertise which they have gained during their own professional careers and are rewarded by the interest and friendship of the participants.●

An article entitled "A Spreading Pattern of Involvement" was published in the December, 1971, issue of "Main Roads" (Vol. 37, No. 2, pp. 36–40) and gives details of earlier courses.

TOLL COLLECTION

on the Waterfall-Bulli Pass Tollwork

2

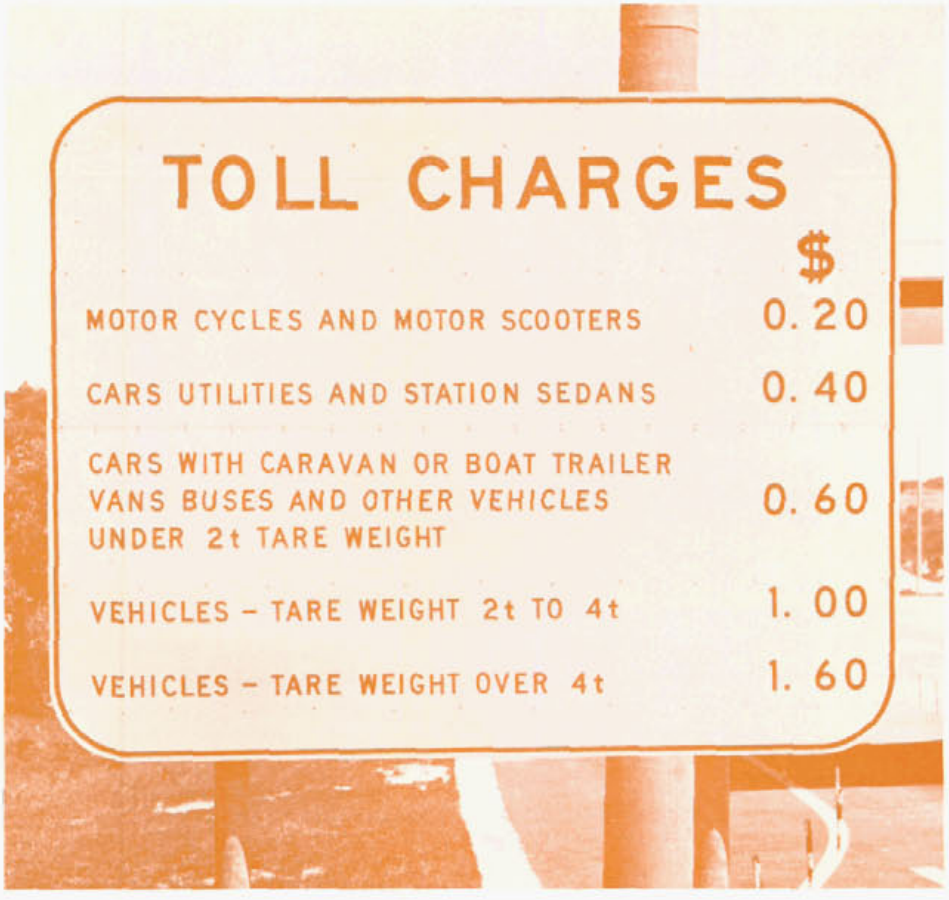

3


4

The Southern Freeway between Waterfall and Bulli Pass was opened to traffic on 24th July, 1975 and operates as a tollwork (see construction details in the September, 1975 issue of "Main Roads", Vol. 41, No. 1, pp. 2–9). Tolls are collected from both southbound and northbound traffic at the Waterfall Toll Plaza using both manual and automatic systems. Electronic equipment installed at the toll barrier registers the collection of tolls by both systems.

Under the manual system, when the payment of the toll is made by the motorist, the Toll Collector presses the appropriate button on the keyboard in his booth. This action activates a *patron indicator light* on a post situated in the prow of the booth, facing the driver, who can clearly see what has been registered. The payment is also indicated by coloured lights on the top facia of the toll barrier above each lane. Combinations of different coloured lights show the amount of toll received by the Collector. The amount received is also recorded by a computer housed in the control centre and shows up on a visual display unit viewed by the Toll Controller on duty in the control centre.

The processing involved with payments made by motorists using lanes with automatic toll collection equipment follows a different pattern due to the need for the electronic checking of the coins placed in the receiving basket. These coins pass into a receiver (which is spinning continuously to separate them) and then slide down a chute under an electronic eye which counts the total and, if it is the correct amount, releases the coins into a vault. In the event of the coins not totalling the correct amount they are retained in a *trap* leading to the vault, making it possible for the Toll Supervisor to inspect the coins and ascertain the short payment. Payment of the outstanding amount will release the trapped money into the vault.



Opposite page:

1: Aerial view looking south over the toll plaza at Waterfall, showing the control centre on the right

2, 3: Large signs warn approaching motorists of "car only" lanes where payments of 40 cents are accepted and registered by automatic toll collection equipment

4: Amounts received by the Toll Collectors are registered immediately on computer tapes for totalling and checking later

Some drivers do not make the best use of the toll collection system and the following appeal is repeated.

Drivers should not enter the lanes marked "*Cars only*" *and* "*Exactly 40c*" unless they have the correct change ready. They should also remember especially during peak periods, that the use of the minimum number of coins (i.e., two 20 cent coins) *ensures* a *faster* passage through the booth. Drivers of vehicles other than cars (including cars towing trailers or caravans) must use the booths where there are Toll Collectors—as their *arrival at the "automatic" booths* will only lead to delays and frustration.

The "automatic" lanes are also equipped with sensors installed in the road pavement (and connected to the computer equipment) to indicate the presence of a vehicle entering the lane. The computer records both the presence of the vehicle and the payment of the correct toll on a visual display unit and in the computer memory.

A vehicle entering an "automatic" lane will be faced with a red (stop) light until the correct toll is paid by the motorist. The computer recording the correct toll payment changes the red light to green indicating that the driver may proceed. Further sensors installed in the road pavement on the exit side are also connected to the computer and these note the movement of the vehicle and change the lights to red as soon as it has passed.

Surveillance of the toll barriers is maintained continuously 24 hours a day, 7 days a week by Toll Controllers working shift-work, under the direction of the Tollway Manager. The barriers can be observed by the Toll Controller from his position at the computer console in the toll office and control centre, which is connected to TV cameras mounted both north and south of the barriers. The TV cameras are operated by the Toll Controller who can focus and zoom them on to any of the traffic lanes. Each Collector can be contacted by and can contact the Tollway Manager or the Toll Controller through an inter-communication system. Malfunctions of

any of the equipment liable to cause delays to traffic can be reported to the Tollway Manager or the Toll Controller from all cabins of the toll barrier, in order that the opening and closing of alternate lanes can then be arranged.

Toll Collectors, Supervisors and Controllers all work to rosters on a rotating shift basis. Each Toll Collector is allocated a number for computer purposes and "*signs on*" to the computer with this number each time he commences a shift. As part of the security and organisational process, if a Collector forgets to "*sign on*" when commencing duty and begins to record the collection of tolls through his lane, the computer sets up a warning signal to the Toll Controller who can then remind the Collector. When the Collector has "*signed on*", this is indicated on the visual display unit of the computer console and acknowledgement by the Controller cancels the warning signal.

Cash collected by Toll Collectors is held until the end of their shift, at which time it is summarised, bagged and chuted into a safe deposit under the observance of the Toll Supervisor or Toll Controller. The safe deposit is later opened in the presence of two officers and the amounts counted in a special counting room by two officers, under the observance of the Tollway Manager. It is ensured that the receipts totalled by the checking officers agree with the pay-in slips, summarised previously by each Toll Collector. As each Toll Collector's takings are confirmed with the pay-in slip, the amounts are summarised and details passed to the Tollway Manager, who checks them against a computer-produced print-out for further agreement.

Coins are bagged in quantities acceptable to the banking authorities and in volumes which (weightwise) are able to be handled with ease. The counting is done mechanically and the machines are set to stop when the required amount has been deposited in each bag. This applies to each denomination of coin, all of which are counted by the one machine.

The toll recording equipment installed on the Waterfall–Bulli Pass Tollwork is considered the most advanced at present available in Australia. The specifications formulated for this equipment were as a result of experience gained over many years at the Sydney Harbour Bridge and in more recent years at the Berowra–Calga Tollwork.●

LET THE RECORDS SPEAK . . .

Toll Collecting in Eighteen Eleven

Leaving aside the collection of tolls at bridges (such as the floating bridge over South Creek near Windsor, where Andrew Thompson was permitted to collect tolls as early as 1802) let us see what the contemporary records said about the introduction of toll roads (or turnpikes as they were then known) 165 years ago. Set down beside the previous article on present-day toll collection procedures at Waterfall, they allow us to make direct and interesting comparisons.

By Public Notice in the Sydney Gazette of 24th March, 1810, the newly-arrived Governor Lachlan Macquarie invited people to indicate the terms on which they might be prepared to collect tolls, nominating "*the extent of road that will be made good, each month until the whole is completed*".

Either no-one wanted to tackle the work or their proposals were not satisfactory for at the end of April, 1810, Macquarie wrote to Lord Castlereagh in London that he had "*resolved on making a Turnpike Road between the Town of Sydney and the Hawkesbury*". Funds were to be advanced out of the Colonial (Police) Fund and were to be "*repaid, with Interest, from the Produce of the Tolls to be established on the Road when finished*". (Historical Records of Australia, Series I, Vol. 7, p. 275, Macquarie to Castlereagh, 30th April, 1810.)

When the road was about to be opened a year later a lengthy proclamation was made, specifying various "do's" and "don'ts" (mainly don'ts) to the people who would soon be using it. It probably has not been printed in full since then—so here it is, in all its linguistic glory.

"*PROCLAMATION*

30th March, 1811

WHEREAS the construction and preservation of safe and commodious highways is a matter of great and general importance, and tends greatly to increase commerce and promote civilization; and whereas large sums of money have been expended in order to render the public highway between the town of Sydney and the town of Parramatta perfectly safe and commodious, and still further sums will be occasionally required in order to keep and preserve such highway in a proper state of repair; and whereas it is highly reasonable and equitable that all costs, charges, and expenses attending the same should be equally borne by those who daily participate in the numerous advantages and benefits resulting from the establishment and preservation of such public highways: It is, therefore, hereby ordered and declared by His Excellency the Governor and Commander-in-Chief, that from and after the tenth day of April, now next ensuing, the high road between the towns of Sydney and Parramatta shall be and the same is hereby declared to be a turnpike road, and all persons riding, leading, or driving any horses, mares, geldings, cattle, sheep, swine mules or asses on the said road, or using any carriage, gig, chaise, cart, or waggon on the said road, or through the turnpike gates now established on the said road, or either of them, shall pay to the gatekeeper thereof, or his assistant, for the same, according to the following rate, viz:—

	£	s.	d.
For each and every head of horned cattle, the sum of ..	0	0	2
For each and every score of sheep or swine	0	0	10
For every single horse ..	0	0	3
For every cart drawn by a single horse or bullock ..	0	0	4
For every cart drawn by two horses or bullocks ..	0	0	6
For every cart drawn by three horses or bullocks ..	0	0	9
For every cart drawn by four horses or bullocks ..	0	0	10
For every waggon drawn by two horses or bullocks ..	0	0	10
For every waggon drawn by three horses or bullocks ..	0	1	0
For every waggon drawn by four horses or bullocks ..	0	1	2
For every single horsed chaise	0	1	0
For every curricle with two horses	0	1	6
For a four-wheeled carriage drawn by two horses ..	0	2	0
For the same drawn by three horses	0	2	6
For the same drawn by four horses	0	3	0

But it is hereby provided, that no person shall be liable to pay toll at any gate on the said road for any horse, beast, or carriage, more than once within the twenty-four hours

Provided also, that no person having paid the toll at any one gate on the said road shall be liable to pay toll at any other gate on the said road on the same day.

And it is hereby further declared, by the authority aforesaid, that no toll shall be paid at any turnpike gate on the said road in respect of carriages solely employed in carrying materials for the repair of the said road, or for going to or returning from such employment.

And it is hereby further ordered and declared, by the authority aforesaid, that no person shall be liable to pay toll at any turnpike gate on the said road for or in respect of any horses, mares, geldings, horned-cattle, sheep, swine, or other beasts going to or returning from water or pasture, provided they shall not pass upon such road more than for the space of three miles in going to or in returning from water or pasture.

And it is hereby further ordered and declared, by the authority aforesaid, that if the owner, or driver, or rider of any horse, cart, or carriage liable to pay toll, shall turn out of the said road in order to avoid the payment of such toll, and shall afterwards return and proceed upon the said road, he shall, upon conviction before one justice, by the oath of one witness, forfeit (if he be the owner) a sum not exceeding five pounds, nor less than twenty shillings; and if he be the driver or rider, and not the owner, he shall forfeit any sum not exceeding fifty shillings, nor less than ten shillings.

And it is further ordered and declared, by the authority aforesaid, that if any person shall take off any horse, or other beast of draught, from any cart, waggon, or other carriage, with intention to avoid the payment of toll for the same, he shall, upon conviction in such form as is above-mentioned, forfeit the sum of five pounds.

And it is hereby further ordered and declared, by the authority aforesaid, that if any person shall fraudulently or knowingly take, or attempt to take, the benefit of any exemptions from toll herein mentioned, not being legally entitled so to do, he shall, upon due conviction in the manner and form aforesaid, forfeit a sum not exceeding five pounds, nor less than forty shillings.

And it is hereby further ordered and declared, by the authority aforesaid, that if any person shall resist or make forcible opposition against any person employed in the due execution of this proclamation, or shall assault any collector of the tolls in the execution of his office, or shall pass through any gate, rail, chain, or fence without paying toll, or shall rescue any cattle, carriages, or other goods detained or distrained for the non-payment of toll, he shall forfeit a sum not exceeding ten pounds nor less than forty shillings, upon being convicted in such manner and form as is above-mentioned.

And it is hereby further ordered and declared, by the authority aforesaid, that if any person liable to pay toll on the said road in respect of any horses, cattle, or carriages passing thereon, shall neglect or refuse to pay toll for the same to the collector or gatekeeper duly demanding the same, such collector or gatekeeper may hereby lawfully detain or distrain such horses, cattle, or carriages, or such of the goods contained upon or therein the same as he may deem adequate to the payment of such toll, until the same shall have been paid.

And it is hereby further ordered and declared, by the authority aforesaid, that if any person shall either by day or night wilfully or maliciously pull down, pluck up, throw down, level, or otherwise destroy any turnpike-gate, post, rail, wall-chain, bar, or other fence set up to prevent persons passing without paying toll, or any house erected for the use of such turnpike-gate, or shall maim or otherwise violently beat or bruise any person there employed in the collecting of the toll, or shall rescue, or attempt to rescue, any person lawfully in custody for any of the said offences, he shall, upon conviction thereof before two or more magistrates, be publicly whipped, and sentenced to imprisonment and hard labour for the space of three years.

And it is hereby further ordered and declared, by the authority aforesaid, that all penalties and forfeitures imposed by this proclamation shall be levied by distress and sale of the goods of the offender by warrant of the justice convicting the offender, and that the same shall be paid half to the informer and half to the trustees and commissioners of the road for the use of the said road, and in case such distress cannot be found, and such penalties and forfeitures shall not be forthwith paid, such justice shall commit the offender to the common gaol for the space of six months, unless the said penalty or forfeiture shall be sooner paid: Provided, nevertheless, that no warrant of distress shall be issued for levying any penalty or forfeiture incurred by this proclamation until six days after the offender shall have been convicted, and an order made and served upon him, or left at his dwelling house or last place of abode, for the payment thereof: Provided also that every forfeiture recovered on the information of any tolltaker, or other person employed therein, and receiving reward or salary for his or their services, shall be wholly applied to the use of the said road.

And it is hereby further ordered, by the authority aforesaid, that all prosecutions commenced for any offence against this proclamation shall be commenced within three kalender months after the offence committed.

And it is hereby further ordered and declared, by the authority aforesaid, that no toll or duty shall be taken by virtue of this proclamation for any horses belonging to officers or soldiers upon their march or upon duty, or for any horses, cattle or carriages actually and solely employed in the service of Government, or in carrying any sick or wounded soldiers."

(From Historical Records of New South Wales, Vol. 7, pp. 514-7; also published in the Sydney Gazette of 6th April, 1811.)

The toll house at the Sydney end was a simple building, hardly comparable to Francis Greenway's later elaborate edifice or to today's functional but complex control centres at Waterfall and Berowra.

"22*d December* 1810
Estimashun: I Will Under take to Build the tole Bar Hous At the Botom of the Brickfield Hill ten feet High, Nine feet from flour to the Celing, one feet in the Ground, Dige foundation twenty four feet in the Clear Bey Sixteen feet and find the Bricks Lime and Sand Laths and Nails and Workmanship and Plastor the same and Wight Wash fitt to Innabat and the Harth Stone for the fire Place in Workman Lick Manner In and for the Consideration of Eighty Nine (pounds) four Shillings. £89 4 0

Thos Legge, Builder
Approved of & Conditions agreed to,
L. Macquarie."

(Colonial Secretary's In-Letters, 1810, p. 248. N.S.W. Archives Ref. 4/1725.)

When reporting to Lord Liverpool later in 1811, Macquarie proudly claimed (probably with a touch of exhuberant exaggeration). . .

"The Rate of Toll established on the Parramatta Road has been on so moderate a Scale that no Murmur or Complaint has ever been raised against it, the people feeling much pleased and happy with the Accommodation thus afforded them, and the Facility with which they can now travel on foot or on horseback, in Carts or Carriages, from one part of the Country to another."

Explaining the economic advantages of the turnpike system he went on . . .

"The Expence attending the Construction of these public Roads, which has been very considerable, has been paid out of the Colonial Police Fund; and this Fund arises principally from the Duty of three Shillings per Gallon which I have laid on all Spirits Imported into this Country. This Advance from the Police Fund may be properly Considered as a Loan from it, for it is to be repaid by the Amount of Tolls levied at the Turnpike Gates, after deducting the Salaries paid to the Gate Keepers, &c., which is regularly paid into the Hands of the Treasurer of the Police Fund, and is so considerable as not only to pay the Interest of the Money so advanced, but also to leave a considerable Surplus for the Reduction of the Principal itself."

(HRA, I, Vol. 7, p. 387, Macquarie to Liverpool 18th October, 1811.)

Macquarie was dismayed to hear that Lord Liverpool did not "entirely approve" of his "good Turnpike Road" and defended his actions with the following argument.

"Altho' there are many opulent Settlers in this Colony, still the great Bulk of the People are poor, and as Yet totally unable to bear any heavy Taxes or Burthens of any Description; Consequently permanent Roads through this Wide Extended Colony Cannot be Constructed at the Entire Expence of the Inhabitants for many Years to Come, and they imagine (and I must Confess, I think, with Justice) they have a Right to Expect that at least a part of the Colonial Revenue, particularly that part of it Collected on the Very Spirits which they drink such Quantities of, ought to be laid out and Appropriated to the Construction of permanent Roads and Bridges, and Streets and Wharfs, Wherever they are essentially Necessary for the Improvement of the Country or Towns, and the Comfort and great Accomodation of the Public."

(HRA, I, Vol. 7, p. 604, Macquarie to Liverpool 17th November, 1812.)

. . . and so say all of us!●

There is much still to tell about tolls and turnpikes in the early years of the colony and so further articles will appear from time to time in future issues of "Main Roads".

An article entitled "Turnpikes in Early New South Wales" was published in the June, 1951 issue of "Main Roads" (Vol. 16, No. 4, pp. 107-111) and is now available in reprint form, together with an article on "Miles and Milestones". The reprints can be obtained by writing to, telephoning or calling at the Public Relations Section, Third Floor, Head Office.

What will it be like to travel on rural highways in New South Wales in twenty-four years' time, at the beginning of the 21st Century? How many vehicles will be using them and what will be the major trends in roadbuilding?

FORWARD PLANNING TO 2000 A.D.

During 1970, a study project was undertaken in the Rural Investigations Section of the Department on "Rural Highway Development to A.D. 2000". The purpose of this study was to prepare a plan for the development of State Highways in rural areas. It had long been recognised that the needs of the rural State Highways have exceeded the capacity of immediately available financial and other resources, but there has also been a need for a more systematic approach to priorities on a Statewide basis of traffic needs, to ensure that the best use is made of resources.

The study has involved the estimation of traffic volumes on all rural highways to the year 2000, an analytical section by section assessment of the present adequacy of the highways, and an estimation of the date and extent of desirable improvements.

The completed plan serves as a guide to the allocation of priorities for investigation and programming. For example, it has been calculated that dual carriageways will be needed on approximately 1700 km of rural State Highways by the year 2000, while other lengths will need widening or reconstruction to higher standards of alignment.

The year 2000 has been chosen as the upper limit for advance planning because beyond this period there is too much uncertainty over population changes and modes of travel. Even within this period there are many uncertainties.

Factors such as the availability of funds, the existing condition of bridges and sections of pavement, varying traffic growth in different areas, and community pressures will all affect the order in which work is undertaken. They will not, however, detract from the value of the plan, which will be reviewed periodically in the light of changing conditions.

Forecasting Traffic Trends

Any assessment of rural highway development primarily involves projected traffic growth. This, in turn, is based on likely population growth and vehicle ownership and usage trends. The resulting calculated growth rate is applied to the latest available traffic volumes to forecast likely figures for tomorrow.

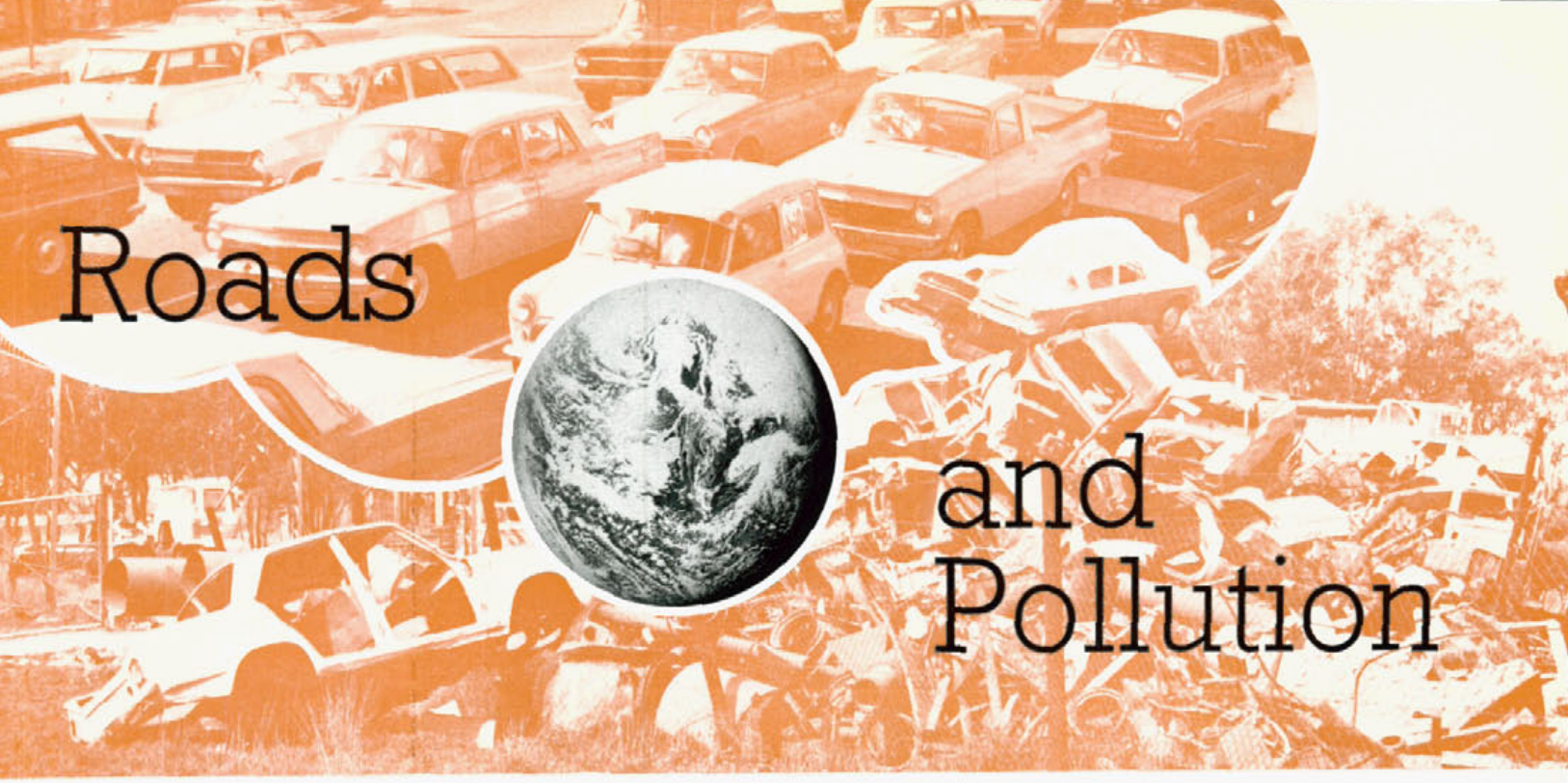
Past records show that traffic does not increase uniformly on all roads but that there is a very wide range of traffic variation. Traffic volumes are more likely to increase at an *average* rate on heavily trafficked roads, whereas there may be faster growth rates on some sections of lightly trafficked roads. Those roads which are more heavily trafficked will require the earliest attention. The more erratic growth pattern of lightly trafficked roads will not affect advance planning in the immediate stages.

Keeping Ahead

As traffic volume increases on any road, the level of service experienced is gradually reduced. The trend in future roadbuilding will therefore be towards improvements which will result in higher levels of service. These include pavement widening, road shoulder widening, increasing sight distance, increasing lane numbers (e.g., adding climbing lanes), replacing narrow bridges and by-passing congested streets.

Implementing one or more of these improvements at a particular location will result in an immediate betterment to traffic flow at that point. If improvements can keep ahead of the rate of increasing traffic flow, better travelling conditions will prevail. Therefore, planning is always closely linked to the latest traffic trends as they become evident and this permits determinations to be made with regard to construction needs, and priorities in time and money.

The year 2000 sounds undeniably exciting in terms of possible technical advances, conjuring up visions of futuristic highways (see article on "Roads in the Future" on pages 90–3 of this issue), but in all probability, although many innovations will be introduced, the roads of rural New South Wales will, in general, appear much the same as those of today. Sections of highway will be wider, better aligned and of stronger construction for longer survival beneath the wheels of heavier transports. There will certainly be an increase in lengths of dual carriageways and there will be climbing lanes at many more locations. But any really striking changes in the highway scene will probably be changes in the vehicles travelling along them. The standard of the roads themselves cannot be advanced beyond the capabilities of the drivers using them. As suggested in the article "Roads in the Future", if the method of controlling a road vehicle could be removed from human responsibility, many imaginative speculations might then be made about changes in the design of roads. But while ever vehicles on rural roads remain under manual control, it is unlikely that any dramatically new approach will flow from the planners' drawing boards—and rural roads will remain essentially the same in concept as they are at present.●



Roads and Pollution

The text of this article and most of the illustrations are reprinted from the brochure "Roads and Pollution" which was recently published by the National Association of Australian State Road Authorities. The brochure is one of a series outlining some of the social, economic and environmental issues associated with present-day road construction programmes. Copies of this brochure and others in the series are available free of charge, from the Department's Public Relations Section, Third Floor, Head Office or from any of the State Road Authorities listed at the end of the article.

The brochure "Roads and National Development" was reprinted in the March, 1975 issue of "Main Roads", Vol. 40, No. 3, pp. 70–5.

Up to the eighteenth century, it was usual for roads in towns to be used as the rubbish dump for adjoining houses. Our sewers and garbage collection services and the virtual disappearance of the horse as a means of transport have largely overcome the problem of filth in the streets, and the threat of epidemics from that sort of pollution now seems remote. Today, we are more conscious of a wider scale of events which can affect our quality of life. We are learning to think of planet earth as a type of *space-ship* which must provide all the resources for the teeming millions who travel aboard it. There is increasing concern that our way of life is resulting in more and more waste and in more and more pollution on our *space-ship*, and is leading to the exhaustion of precious resources.

The State Road Authorities throughout Australia are aware that there are pollutants associated with road travel, and this brochure deals with two major aspects of this problem —solid wastes and vehicle exhaust emissions. A separate brochure dealing with a related environmental issue — traffic noise — has already been published.

It is easy to demand that no effort be spared to preserve our environment but the world is full of worthy causes and they cannot all receive top priority. The State Road Authorities hope that this brochure will assist us all to identify important issues (particularly those problems involved in the extensive use of motor vehicles) and, where possible, solve or reduce them, using the most efficient means available to us. There is scope for action by governments, and there is scope for action by each one of us, as individuals.

AN UGLY PROBLEM

We can certainly all do something to *break the dirty habit* which we, as a community, have of dumping waste products on the roadside. To say the least, such littering is aesthetically offensive. Papers and packages, plastic containers, glass bottles, metal cans and food leftovers create an eyesore. But litter on roads is not only unsightly, it can be dangerous, too, as broken glass and other sharp objects can rip tyres and cause blow-outs. In providing places for pests and vermin to breed, litter can also be unhealthy.

The volume of litter dumped on the roadside tends to be highest on the more heavily trafficked highways. This litter has to be removed and it is a costly business for which we all pay in the long run. Australia's nine hundred Municipal and Shire Councils spend a rather staggering $30 *million* annually on the removal of litter. The combined cost of sweeping the streets, cleaning drains and collecting the litter within the Brisbane city area alone exceeds $1·3 million each year. On top of these amounts, the State Road Authorities also have to allocate considerable funds to allow maintenance gangs to clean up the mess so often made by motorists. The removal of roadside litter wastes both money and manpower which could otherwise be devoted to the provision of landscaping or improved road facilities.

To try to remedy this situation, the State Road Authorities have provided litter bins at roadside rest areas, at wayside stops, at scenic viewpoints and at parking bays. By means of educational campaigns and the distribution of brochures, motorists are urged to use these facilities and to protect the roads and the environment from ugly, unsafe and unhealthy litter. As a deterrent, anyone found depositing litter on road reserves is liable to be fined.

Looking at the subject in a wider context, it would assist if it were more economical to recycle the large number of cans and bottles used in the packaging of all types of liquid commodities. In Australia, about 4 000 million steel cans go on the home market each year, but a mere fraction of these—only 1 per cent—is recovered. Three hundred million aluminium cans are manufactured every year and the recovery rate is less than 25 per cent. Tens of millions of glass bottles and jars are manufactured annually and fortunately a considerable quantity of re-cycling is carried out both by re-using some bottles, and by conveying *non-returnable* bottles to plants for crushing and subsequent processing into new glass containers.

It is a pity that the economic advantage of recycling cans, bottles and jars has not yet reached the stage where the motorist is prepared to claim salvage value and so reduce the litter problem. This possible solution has, in fact, become more remote with the growing use of *no-deposit* containers.

Above and Below: George Street, Sydney (looking south from Bathurst Street) carried a constant stream of horse-drawn traffic in 1892 *(photograph by courtesy of N.S.W. Government Printer). Today, the vehicles are different and so are the forms of pollution*

"The first serious attempts to deal with mobile source air pollution in the United States occurred around the turn of the century. The problem was the horse. The average horse produces approximately 22 *lb of solid waste and* 1 *gallon of urine a day. Writers in popular and scientific periodicals were demanding 'the banishment of horses from American cities'. One authority wrote in* 1908 *that the* 120,000 *horses in New York City 'were an economic burden and an affront to cleanliness and a terrible tax on human life'. The solution to the problem of the horse, agreed the critics of that time, was the adoption of the 'horseless carriage'. In a city like Milwaukee in* 1907, *for instance, with a human population of* 350,000 *and a horse population of* 12,500, *the horse meant* 133 *tons of manure a day. Or, as a health official in Rochester calculated in* 1900, *'*15,000 *horses in that city produced enough manure in a year to make a pile covering an acre of ground* 175 *feet high and breeding* 16 *billion flies'. In addition, there was a serious abandoned dead horse problem not unlike abandoned auto problems. Owners of horses tended to leave the dead animals where they fell. They were even more difficult to trace than today's registered abandoned automobiles."*

From: "Mobile Source Air Pollution—Who Won the War?" by S. William Gouse Jr, published in the November, 1972 issue (Vol. 4, No. 1) of the International Journal of Environmental Studies.

DISCARDED VEHICLES AND TYRES

Another problem lies in the disposal of motor vehicles which have reached the end of their economic life, usually after 10 to 12 years but often less in the case of accident-damaged vehicles. As the number of vehicles increases, so this problem increases. In Sydney each year, over 20 000 cars are collected by local suburban Councils and disposed of at costs of up to $55 per car. The lack of convenient "*burial grounds*" for so many old cars and trucks is fast becoming a major problem to local government authorities in urban areas.

It is widely recognised that the earth's resources of metals and other elements have a finite limit and that the deferment of an ultimate shortage can be achieved by a "recycling" process, both for ferrous and non-ferrous metals. In Australia, two mobile compactors have been built to flatten dumped vehicle bodies so that they can be easily transported to a *fragmentiser* which converts them into shredded metal. This method is considered to be the most successful way of disposing of old vehicle bodies.

A modern *fragmentiser*, processing about 156 000 car bodies a year, has the capacity to produce 92 000 tonnes of clean shredded steel, as well as large quantities of non-ferrous metals, mainly aluminium, zinc, copper and brass. Through recycling processes developed by modern technology, more than 85 per cent of the total weight of vehicles can be utilised. The value of this recycling is apparent from recent estimates which indicate that motor vehicles are manufactured in Australia at a rate in excess of 500 000 annually and require a total quantity of about 480 000 tonnes of steel. Unfortunately, it is not always an economic proposition to transfer a vehicle to a *fragmentiser*. Consequently, many vehicles are illegally abandoned and left as unsightly objects beside roads, in reserves and on private land.

Motor vehicle tyres also can present a problem for disposal, because if burnt they give off an offensive amount of smoke. Quite a number of alternatives are under consideration in various parts of the world and these include burying the tyres or disposing of them at sea. Another possibility under investigation is the idea of freezing them in liquid nitrogen to a point where they can be smashed into small pieces of rubber crumb, fibre fluff and metal beading. These three products can then be recycled for various uses.

VEHICLE EMISSIONS

Air pollution by motor vehicles is increasing and State Road Authorities have a responsibility, although an indirect one, to help combat this insidious problem.

Australia is largely a city dwelling nation and more than 60 per cent of the population lives in only five cities. As an example, the population of the Sydney, Newcastle and Wollongong region is 2·8 million compared with a total population in New South Wales of 4·7 million. Furthermore, the annual population growth of this area has recently been almost 95 per cent of the State total. It is clear that the purity of city air influences the environment of the major proportion of the population.

The general levels of air pollution are therefore being measured in our cities in order to determine the concentration of contaminants (such as sulphur dioxide, smoke, suspended and deposited dust, iron, copper, lead, ozone, carbon monoxide, hydrocarbons, oxides of nitrogen and fluorides).

Over the years, the nature of the pollutants in the air has changed considerably. To the long familiar common smoke and ash

Wizard of Id cartoon: Reproduced by courtesy of Alan Foley Pty Ltd

particles have been added a significant amount of ozone, carbon monoxide, oxides of nitrogen and hydrocarbons. Nitrogen oxide and hydrocarbons are the main raw materials which, when exposed to the ultraviolet light in sunlight, combine in photochemical reactions to produce smog.

Research by *Haegen-Smit* in Los Angeles and by others elsewhere, indicates that photochemical smog is largely due to automobile emissions. In Australia, estimates have been made of the amount of pollutant substances emitted, working on statistical information from various local sources and using the emission factors recommended by the United States Environmental Protection Agency. From these estimates, it appears that Australian road transport discharges into the air about 4 million tonnes of carbon monoxide each year. Similarly, road transport contributes about 800 000 tonnes of hydrocarbons (which is about 55 per cent of the total emission of hydrocarbons) and about 400 000 tonnes of oxide of nitrogen (which is about 45 per cent of the total emission of these oxides in Australia).

These figures tend to support the view that photochemical smog is primarily the result of vehicle emissions. The number of motor vehicles on Australian roads in 1973 was 5·2 million and this is expected almost to double by 1990. As the number of vehicles increases, so air pollution will worsen—unless emissions are reduced.

The degree of pollution from carbon monoxide and hydrocarbons is noticeably less from diesel-engined vehicles than from petrol-engined vehicles, despite the visually objectionable nature of emissions from diesel engines. However, this advantage is partly offset by higher emissions of oxides of nitrogen, oxides of sulphur and solid particles from diesel engines. A comparison of average emission factors in grams per litre of fuel is shown in the table below.

It is clear that when vehicles are in a *stop-go* situation, or travelling slowly, the concentration of air pollution from vehicle emissions is significantly greater than it is when they have free movement. Studies were carried out in 1966 in ten major American cities to determine the average traveller's exposure to carbon monoxide in 20–30 minute runs. As a result of the tests, it was shown that pollution on arterial roads was 21 per cent greater than on freeways.

The graph below indicates a typical relationship between carbon monoxide emissions and average vehicle speeds. At 15 km/hr, the amount of carbon monoxide emitted is 100 grams/km. At 45 km/hr, the amount of carbon monoxide emitted decreases to about 40 grams/km. As the speed of the vehicle increases, the carbon monoxide emitted decreases but at a lessening rate.

In an attempt to tackle this problem of vehicle pollution, legislation has been introduced. For example, in New South Wales, the Clean Air Act became operative in 1969, and related primarily to industrial emissions. However, in 1972 motor vehicle legislation was introduced as an amendment giving the Act control over emissions of exhaust fumes from motor vehicles.

At the national level, the Australian Transport Advisory Council (which is composed of Ministers of all State Governments and the Australian Government) has issued Australian Design Rules, to lay down emission standards for all new vehicles. These rules include standards for carbon monoxide and hydrocarbon emissions during idling and at prescribed engine speeds.

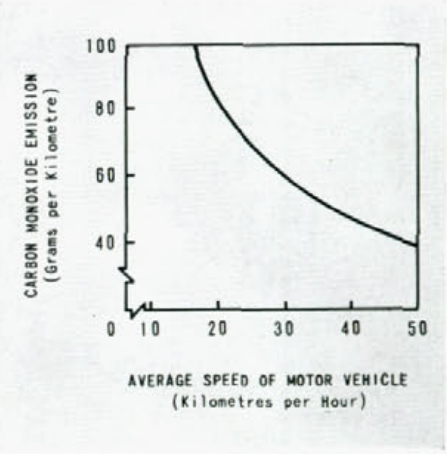
One further method of curtailing atmospheric pollution from vehicle emissions could be the development of new forms of engine power, but this possibility faces many difficult problems which must be solved before general implementation can occur.

DUST PROBLEMS

Back in 1908, the authors of Coane's "Australasian Roads" wrote that "were it desired to construct a dust-raising machine, it would be found that a high-speed modern motor car possessed most of the necessary qualifications". Unsealed roads still present a dust problem, which is more acute in some States than in others. Naturally, the solution is to provide bituminous sealed road pavements and the State Road Authorities and

Substances emitted	Petrol engines (grams per litre)	Diesel engines (grams per litre)
Aldehydes	0·53	1·34
Benzo-pyrene	0·00007	0·00011
Carbon monoxide	276·0	7·14
Hydrocarbons	24·3	16·4
Oxides of nitrogen	13·5	26·7
Oxides of sulphur	1·06	4·76
Organic acids (acetic)	0·53	3·70
Solid particles	1·34	13·4

Source: "Handbook of Environmental Control", by R. G. Bond and C. P. Straub, Vol. 1, pages 328 and 340.



The current address, post office box numbers and telephone numbers of the State Road Authorities are listed below.

Department of Main Roads,
309 Castlereagh Street,
Sydney, New South Wales 2000

Box 198, P.O.,
Haymarket, New South Wales 2000

Tel. 2 0933

Country Roads Board,
60 Denmark Street,
Kew, Victoria 3101

Tel. 86 5321

Main Roads Department,
Boundary Street,
Spring Hill, Queensland 4000

Box 1412T, G.P.O.,
Brisbane, Queensland 4001

Tel. 24 2011

Highways Department,
33–37 Warwick Street,
Walkerville, South Australia 5081

Box 19, P.O.,
Walkerville, South Australia 5081

Tel. 269 8911

Main Roads Department,
Waterloo Crescent,
East Perth, Western Australia 6000

Box X2255, G.P.O.,
Perth, Western Australia 6001

Tel. 25 0221

Department of Public Works,
10 Murray Street,
Hobart, Tasmania 7000

Box 936J, G.P.O.,
Hobart, Tasmania 7001

Tel. 30 9011

Department of Construction,
17 Yarra Street,
Hawthorn, Victoria 3122

Box 2807AA, G.P.O.,
Melbourne, Victoria 3001

Tel. 81 0271

local Councils are doing this just as fast as funds will permit.

Not everyone realises that dust pollution can cause economic loss as well as personal discomfort. For a number of reasons, the value of pasture land can be reduced if it adjoins dusty roads. In the wool industry, dusty wool is sold at a substantially lower rate than clean wool. Crops can also be similarly affected. In one instance, the frequent passing of vehicles along an unsealed road resulted in the grain on crops to a depth of 100 metres into an adjacent property being spoilt. Dusty roads can even cause stock losses. A United Graziers Association of Queensland report has recently stated that while a total of 500 beasts were being transported by truck on a 14-hour, 160 km journey through severe "bulldust" conditions, 64 suffocated.

In addition to these problems, the cost of vehicle operation is higher on dusty roads than on bitumen-surfaced roads. One Queensland bus company reported that a normal vehicle life of 480 000 km was reduced to 240 000 km under dusty conditions. Due to dust, brake linings, which averaged 160 000 km on the 660 km bitumen-surfaced Brisbane to Rockhampton run, were reduced to a life of 40 000 km on the 1 860 km Brisbane to Mount Isa run which is unsealed for 325 km. In addition, due to excessive wear, brake drum replacement was necessary on all vehicles used in the latter service. Other cost disadvantages of roads which are dusty or do not have a bitumen surface include increased liability to windscreen damage, clogged air-conditioning, greater tyre wear, and shorter life of electrical equipment.

Even when the through lanes of a road are bitumen surfaced, there can be a problem from dust if the shoulders are only gravelled, especially in or near a township. Where the State Road Authority or local Council cannot economically justify bitumen surfacing the shoulders, it may be able to give relief by providing wider traffic lanes, generally about 3·7 metres for each lane. Such widening offers a substantial economy in shoulder maintenance, and largely overcomes the tendency for traffic to drive along the unsealed shoulders.

Although road construction activities themselves may be regarded as only short-term pollution problems, they can be of significant concern to residents living adjacent to the roadworks. State Road Authorities help to alleviate the nuisance and annoyance caused during their work by watering and spraying with emulsion to keep dust down and by general job cleanliness.

ROADSIDE REGROWTH

Most roadworks disturb the local landform and vegetation to some degree and can sometimes cause siltation and erosion before natural regrowth takes over. To reduce the period of time and the degree of exposure of the raw earth surface, special *batter* protection techniques and flatter slopes can be used to stabilise the sides of cuttings and embankments. Where necessary, a topsoil layer is added prior to completion of the work and turfed or seeded by various methods. One effective process is *hydro-mulching* whereby a mixture of suitable grasses and ground cover plants (either as seeds or chopped runners) is applied in the form of a spray, complete with a fertilizer and a holding agent.

CONCLUSION

Everyone would surely agree that the cumulative effects of roadside litter and discarded motor vehicles detract from the type of community standards we like to see around us. The problem would not be as great if there were easier and more economic ways of recycling glass bottles and metal cans, as well as worn-out motor vehicles and tyres. Clean roads and surrounding areas can add immensely to the enjoyment—and safety—of motoring. On the other hand, littering by irresponsible or thoughtless persons can lead to the destruction of the natural beauty of our countryside and coastline, and can quickly take the pleasure out of touring.

Positive moves are being taken to control emissions from motor vehicle engines but traffic congestion will probably continue to contribute substantially to urban atmospheric pollution. However, the smoother traffic flow which can be provided by a well-planned system of roads (including freeways) offers a considerable improvement in air quality, because of the reduced quantities of fumes emitted by each vehicle.

The dust pollution problem is being gradually overcome as State Road Authorities and Councils complete new lengths of sealed roads, but vast distances still remain to be completed before farmers and graziers can cease to count the cost of dust damage to their crops and stock. The advantages of dust-free roads to the individual, to the State and to the national economy as a whole, and the adverse effects of dust pollution on all aspects of the human environment, should not be underestimated.

The growing pollution of our *space-ship* earth is a many-sided problem and the solution is equally varied, involving Government authorities, private organisations and individuals in a wide range of responsibilities. Let us all resolve today to play an effective part in protecting our natural heritage and in keeping Australia clean and beautiful.●

Opposite page:

1. *Roadside litter is unsightly, unhealthy and costly to clean up*
2. *Air pollution from vehicle emissions is significantly greater in stop-go situations than where movement is unhindered*
3. *Dust is not only a nuisance, it can also spoil wool and crops being grown near the road*
4. *The frightening amount of pollutant substances emitted by motor vehicles can be reduced by legislation, smoother traffic flow, new forms of engine power, and increased concern and action by all vehicle owners and drivers*
5. *Litter bins at roadside rest areas encourage travellers to be tidy*
6. *Street sweepers are one of the many machines used to keep roads and adjacent road reserves clean and attractive*
7. *Roadside junk yards are no answer to the problem of obsolete vehicles. One solution is to flatten the vehicles and transport them to a fragmentiser which can convert them into shredded metal*
8. *Hydro-mulching reduces the scarring effects of roadworks by speeding up roadside regrowth*

1

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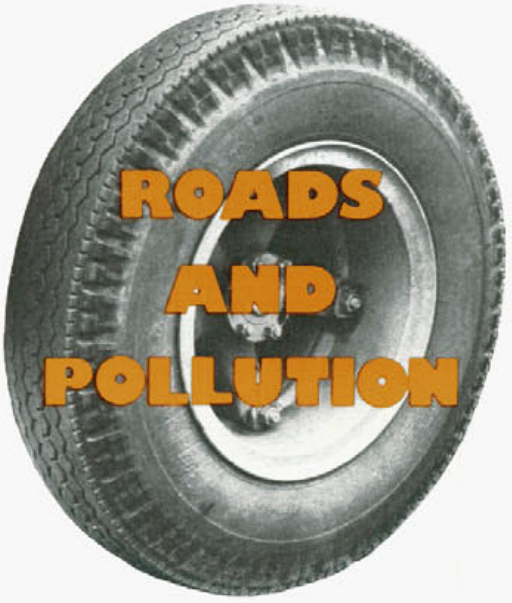
LITTER



ROADS AND POLLUTION

DUST

FUMES

DISCARDED VEHICLES

5

6

7

8

Left: Mrs Macquarie's Chair as it looks today.

Below: More than ever before the pleasant tree-shade
chair offers a quiet retreat from the hectic bustle of t
city.

Left: The unknown artist who painted this "Picnic at Mrs Macquarie's Chair" in 1855 certainly put plenty of colourful costumes on his canvas. However, he has given almost mountainous proportions to the rock into which the chair was carved.

The original of this painting is displayed at Old Government House, Parramatta – on loan from the Dixson Galleries, Sydney.

Right: Mrs Elizabeth Macquarie, from a miniature by an unknown artist.

Painting and miniature reproduced by courtesy of the *State Library of New South Wales.*

Mrs Macquarie's Road

One hundred and sixty years after it was first constructed, the part of Mrs Macquarie's Road leading to her favourite vantage point and to her "Chair" still retains its natural appeal.

More about this fascinating part of our heritage is included on pages 94–95.

Sightseers came in hundreds to Mrs Macquarie's Point to see the official opening of Sydney Opera House on 20th October, 1973. This aerial view shows much of the area traversed by Mrs Macquarie's Road in 1816.

TOURIST ROAD NO. 4020

WATTAMOLLA ROAD

Situated on the coastline of the Royal National Park, 13 kilometres from Audley, picturesque Wattamolla is one of the many popular and scenic beaches south of Sydney. Access to the beach is along Tourist Road No. 4020 which branches from Sir Bertram Stevens Drive (Main Road No. 393) and continues through bushland for a distance of 3·3 kilometres.

Wattamolla was discovered by the explorers Midshipman Matthew Flinders and Surgeon George Bass on one of their many exploratory voyages along the New South Wales coast. On this particular journey the 22-year old Flinders and the 25-year old Bass set out in March, 1796 with Bass's servant, William Martin, to explore the river which was reputed to exist just below Botany Bay but they were driven much further south by adverse weather.

Struggling to return up the coast in their tiny boat, the second "Tom Thumb", they encountered more bad weather and found shelter in the still waters of the small inlet which they called "Providential Cove" and which they later learnt was known to the Aborigines as "Watta-Mowlee".

Flinders gave a vivid description of their experiences in his book "A Voyage to Terra Australis", published in London in July, 1814 (just one day before he died).

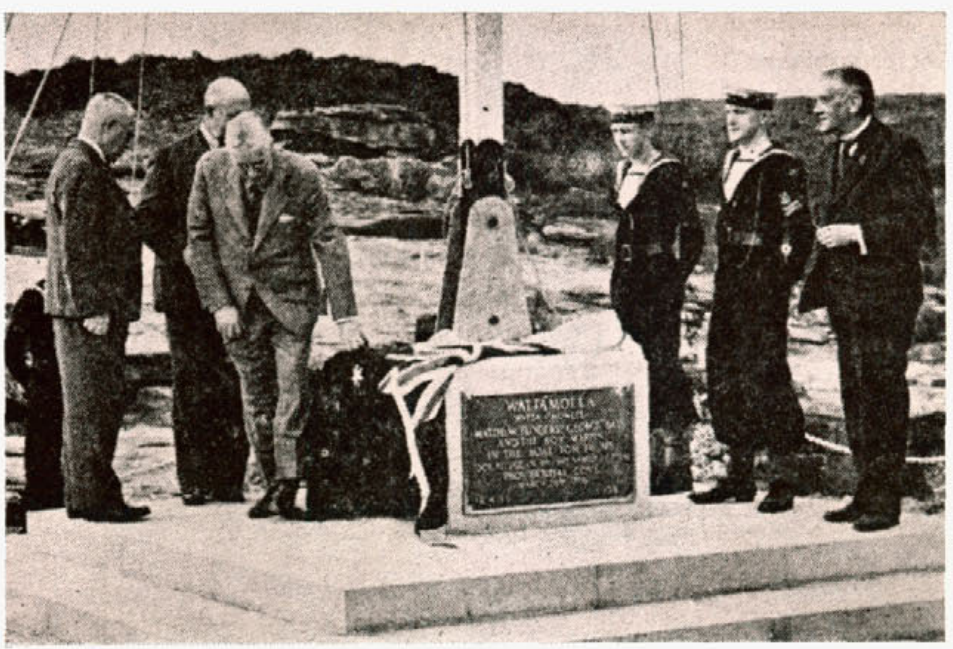
"*March 29. By rowing hard we got four leagues nearer home; and at night dropped our stone under another range of cliffs, more regular but less high than those near Hat Hill. At ten o'clock, the wind, which had been unsettled and driving electric clouds in all directions, burst out in a gale at south, and obliged us to get up the anchor immediately, and run before it. In a few minutes the waves began to break; and the extreme danger to which this exposed our little bark, was increased by the darkness of the night, and the uncertainty of finding any place of shelter. The shade of the cliffs over our heads, and the noise of the surfs breaking at their feet, were the directions by which our course was steered parallel to the coast.*

Mr Bass kept the sheet of the sail in his hand, drawing in a few inches occasionally, when he saw a particularly heavy sea following. I was steering with an oar, and it required the utmost exertion and care to prevent broaching to; a single wrong movement, or a moment's inattention, would have sent us to the bottom. The task of the boy was to bale out the water which, in spite of every care, the sea threw in upon us.

After running near an hour in this critical manner, some high breakers were distinguished ahead; and behind them there appeared no shade of cliffs. It was necessary to determine, on the instant, what was to be done, for our bark could not live ten minutes longer. On coming to what appeared to be the extremity of the breakers, the boat's head was brought to the wind in a favourable moment, the mast and sail taken down, and the oars got out. Pulling then towards the reef during the intervals of the heaviest seas, we found it to terminate in a point; and in three minutes were in smooth water under its lee. A white appearance, further back, kept us a short time in suspense; but a nearer approach showed it to be the beach of a well sheltered cove, in which we anchored for the rest of the night. So sudden a change, from extreme danger to comparatively perfect safety, excited reflections which kept us some time awake: we thought Providential Cove a well-adapted name for this place; but by the natives, as we afterwards learned, it is called Watta-Mowlee.

On landing next morning, March 30, water was found at the back of the beach. The country round the cove is, in general, sandy and barren. No natives were seen, but their traces were recent.

The extremity of the reef, which afforded us such signal shelter, bore S.E. by E. from the centre of the beach, the north head of the cove E.N.E.; and except at the intermediate five points of the compass, Watta-Mowlee affords shelter for large boats, with anchorage on a fine sandy bottom.



Left: These illustrations show some of the scenic and aquatic attractions of Wattamolla

Right: The unveiling of the Bass and Flinders Memorial at Wattamolla, on 22nd October, 1938 by Mr K. R. Cramp, President of the Royal Australian Historical Society

(Reproduced by courtesy of *Sydney Morning Herald*)

Between three and four miles to the northward of this cove, we found the river, or rather port, which was the original place of our destination; and it having been a pilot named Hacking, from whom the first information of it had been received, it was named after him: by the natives it is called Deeban."

The northern headland of Wattamolla is still named "Providential Head" while the southern tip is appropriately called "Boy Martin Point". A plaque commemorating the landing of Bass, Flinders and Martin was unveiled at Wattamolla by members of the Royal Australian Historical Society on 22nd October, 1938, by arrangement with the National Park Trust.

A year after Bass and Flinders' first visit, Wattamolla became associated with a more tragic episode in our early history. While sailing from Calcutta to Port Jackson, the cargo ship "Sydney Cove" developed leaks and was eventually beached on a small island in the Furneaux Group (north of Tasmania) in February, 1797. Seventeen of the crew (that is five Europeans, including William Clarke and twelve Lascar seamen) attempted to sail to Sydney in a longboat, but it was wrecked near Cape Everard (Victoria), not far south of the present New South Wales border. They then set out overland on 15th March, but, experiencing incredible hardships as they struggled up the coast, most died along the way. On 15th May, (62 days and over 500 kilometres later) Clarke, with one European and one Lascar seaman, reached Wattamolla in the last stages of exhaustion. They managed to attract the attention of some fishermen who rescued them and took them to Sydney. This ended one of the most remarkable overland journeys in the colony's early history.

In September 1797, Bass revisited Wattamolla on a journey overland from the Cowpastures (Camden) to the coast, during which he crossed the headwaters of the Hacking River. Three months later, he again used the cove for a night's anchorage at the beginning of his memorable 1 930 kilometres voyage to Bass Strait and back, exploring the coast and searching for other survivors from the "Sydney Cove". This 12-week trip was undertaken in an 8·7 metre long whaleboat manned by six naval oarsmen.

For many years after these visits the district around Wattamolla remained unexplored and unattractive to settlers. On 6th November, 1845, the Surveyor-General Sir Thomas Mitchell, issued instructions to Assistant Surveyor Darke to survey a "*village reserve at Wattamolla and lay out allotments*", but apparently little further action followed.

Panoramic view of Wattamolla showing (from left to right) the ocean beach, the lagoon, the picnic reserve, the refreshments centre and parking area

On 26th April, 1879 Australia became the second country in the world (the United States of America was the first) to dedicate land as a national park. At this time, a vast and magnificent area of 7 284 hectares south of Port Hacking was first dedicated as a public reserve. In the following year (1880), the first rangers were appointed and in 1886 it was proclaimed as a public park, being about this time approximately doubled in area. Subsequent additions have brought the total area now under the administration of the National Parks and Wildlife Service (which was established on 1st October, 1967) to just on 14 912 hectares.

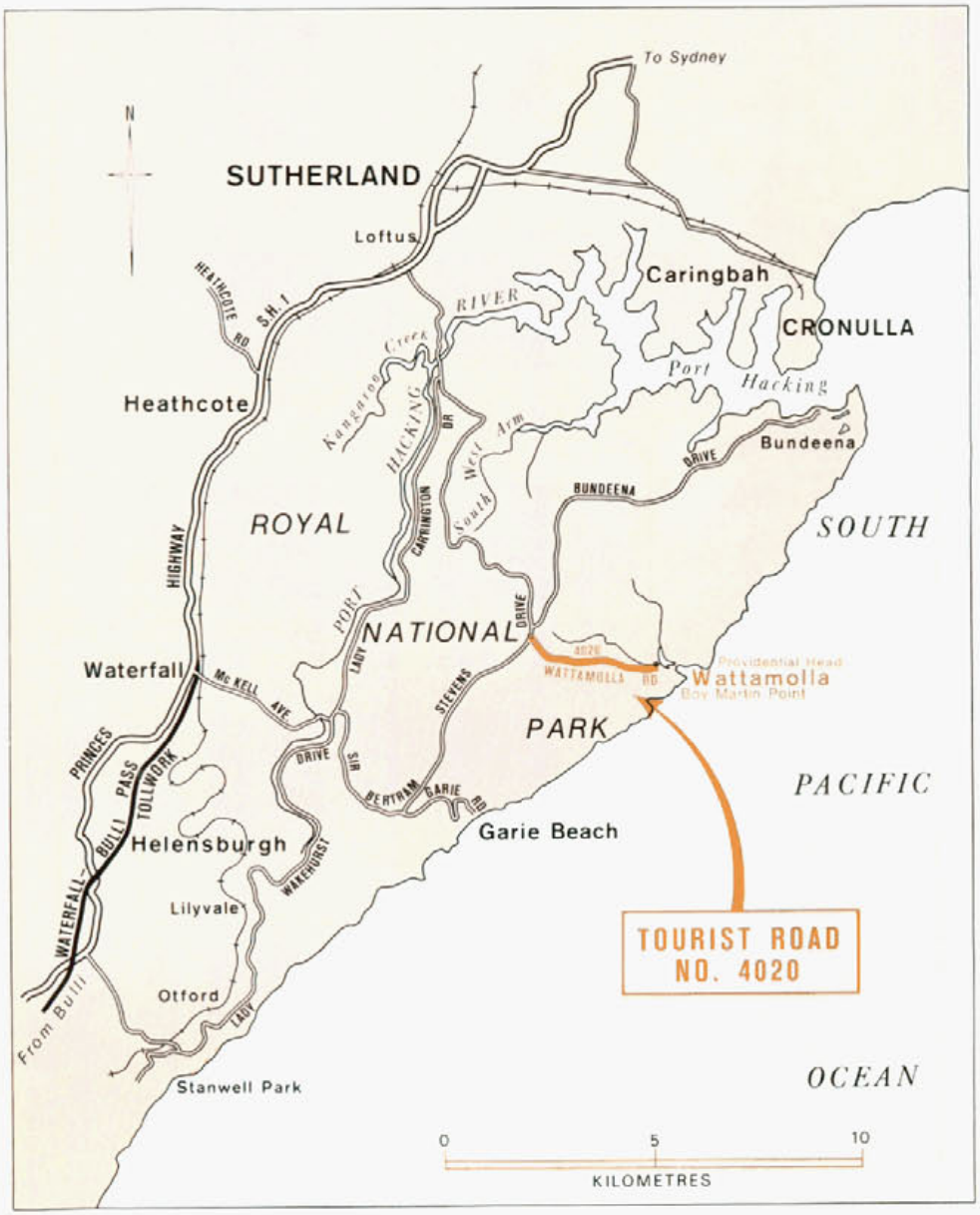
A plaque on a sandstone monument (the same one to which the Bass and Flinders plaque is attached), situated near the kiosk at Wattamolla, notes that "*This tablet was erected by the National Park Trust in recognition of the generous act of Mr E. J. Coote of Bellevue Hill Sydney, who presented to the Trust forty acres of this land overlooking Wattamolla entrance, 9th December*, 1933".

Wattamolla has long been a regular camping place for hikers and for fishermen who originally gained access along a track before construction of the road (from Sir Bertram Stevens Drive—Main Road No. 393) in 1935. In that year the National Park Trust announced that Wattamolla would be opened to tourist traffic by the construction of a road, as part of a general policy to make all major beauty spots in the park accessible to motorists.

In 1939, the road from the Princes Highway near Loftus through the Park to Waterfall was proclaimed Main Road No. 393 and it was maintained by the National Park Trust until 1955. In that year, the Trust, which had adopted the prefix "Royal" following a visit by her Majesty Queen Elizabeth II in 1954, requested that consideration be given to the sealing of the roads to Wattamolla and Garie.

In 1956, the Department of Main Roads agreed to undertake the reconstruction and bitumen surfacing of Wattamolla Road in the light of the Trust's difficulty in maintaining the road. This work was completed in 1961 and coincided with an amendment in the Main Roads Act providing for proclamation of certain roads as *tourist roads*. Consequently, in December 1962, Wattamolla Road was proclaimed Tourist Road No. 4020. Because the whole length of Wattamolla Road is within the Royal National Park, the Department has paid the full cost of any construction and maintenance works.

From Sir Bertram Stevens Drive (Main Road No. 393), Wattamolla Road passes through small valleys of thick low vegetation. An attractive ocean opens out and the road leads down to well-kept picnic grounds with plentiful car parking. A short stroll through parklands leads to a pretty lagoon stretching out beneath a waterfall. Wattamolla Falls are fed



from Coote Creek (named after the benefactor mentioned above) from the west, while Wattamolla Creek flows into the lagoon from the north. This salt-water lagoon forms a natural swimming pool fringed by yellow sand, grassy, tree-shaded shores and steep cliffs. Close to the eastern side of the lagoon, a deeply-curving ocean beach provides a spectacular swimming alternative for surf lovers and an excellent location for fisherman.

In the nearby bushland and along the coastal walking tracks (and the Curra Moors walking track to the southwest) a variety of wildlife can be seen by the observant visitor as this area is the haunt of wallabies, native rats and marsupial mice. Some of the varied species of birds (over 200 types live within the Park) that may be seen inland in the vicinity of Wattamolla are honeyeaters, wattle birds, wonga pigeons, fantail cuckoos, quails and wrens, while near the seafront there are silver gulls, terns, shearwaters, swallows, swifts, kestrels and an occasional albatross and sea eagle.

Vegetation in the coastal scrub and heath country is characterised by shrubs, mallees and grasses. The displays of natural flowers on these heaths are one of the Park's major attractions from August to November each year. Rock engravings, kitchen (shell) middens and axe grinding grooves made by the aboriginal people who lived here in the past can also be viewed, but because such irreplaceable relics of past traditions are susceptible to vandalism their positions are not widely advertised.

Situated within a national park, Wattamolla has the special appeal of being a well-developed recreation spot which retains its natural unspoilt charm and the great beauty of its original environment. The thousands of visitors to the area each year have justified the proclamation of Wattamolla Road as Tourist Road No. 4020.●

It is suggested that motorists intending to visit Wattamolla should call at the Park Headquarters and Visitors' Centre at Audley (open 8.30 a.m. to 4.30 p.m.) where information and literature are available.

The quotation from Matthew Flinders' book, "A Voyage to Terra Australis" is reproduced by courtesy of the Mitchell Library, Sydney.

Additional information about Bass and Flinders can be found in Volumes 1 and 4 of the Australian Encyclopedia (published by the Grolier Society) and in Volume 1 of the Australian Dictionary of Biography (edited by D. Pike).

Bass and Flinders' journeys, as well as more details about the wreck of the "Sydney Cove" and subsequent exploration are described in Volume 3 of the Australian Encyclopedia under "Exploration by Sea".

An article on the unveiling of the Bass and Flinders Memorial at Wattamolla by Mr K. R. Cramp appeared in the Journal of the Royal Australian Historical Society, Vol. 24, Pt 6, 1938, pp. 481–8.

Recent Publications

Several new maps, brochures and reprints now supplement the extensive list of informative publications which are issued free to the public by the Department. The latest publications are detailed below and all are available on written request or by calling at the Public Relations Section, Third Floor, Head Office.

Four Maps of New South Wales

It has been the Department's practice to annually revise the "Four Maps of New South Wales" at 30th June, to include additional bituminous surfacing and revisions to distances and travelling times. The new maps are generally printed during August-September each year and the 1975 edition is now available.

The four maps are printed back to back on one folded sheet. Each map measures approximately 41 cm wide x 31·5 cm high and has been drawn at a scale of approximately 32 km to 1 cm. The titles of the maps are:

- Classification of Main Roads—with Local Government Area boundaries,
- Types of Surface on Main Roads,
- * Distances by Main Roads, and
- * Travelling Times by Main Roads.

The first two maps are printed on one side of the sheet and the last two maps are on the other side. The maps are folded to approximately 14 cm wide x 33·5 cm high. The back panel lists the addresses and telephone numbers of all the Department's Divisional Offices.

These maps continue to be the Department's most popular publication and are an invaluable help in the preparation of holiday and business itineraries.

Flat, unfolded versions of the first two maps have been printed separately with an overlay showing the Department's divisional boundaries and headquarters.

Maps of Sydney and Suburbs, and Sydney and Surrounding Districts

The revised edition (1975) of the maps of "Sydney and Suburbs" and "Sydney and Surrounding Districts" has also just been published. These maps are printed back-to-back on a single sheet measuring 99 cm x 70 cm and are folded, for convenience, to the smaller size of 25 cm x 18 cm.

The area included in the "Sydney and Suburbs" map extends from Broken Bay in the north to Port Hacking in the south and to Blacktown and Liverpool in the west. The scale on this map is one kilometre to 1·5 cm. The extent of the map of "Sydney and Surrounding Districts" has been altered for this edition and now covers the area bounded by Gosford in the north, Camden and Campbelltown in the south and Penrith in the west. It has a scale of one kilometre to one centimetre. The new boundaries have been chosen so that when forthcoming maps of "Newcastle and Surrounding Districts" and "Wollongong and Surrounding Districts" are published, the three may be placed together to provide information on a continuous corridor extending from Maitland in the north to Nowra in the south.

As well as showing the routes of proposed Freeways and those sections already constructed or under construction, both maps feature different classifications of roads in the Main Roads System, that is, State Highways, Trunk Roads, Main Roads, Secondary Roads, and Tourist Roads. For the benefit of both Council and Departmental officers who may regularly use the maps for reference purposes and for the information of other authorities and interested persons, the classified numbers of State Highways, Trunk Roads, Main Roads, etc., are shown adjacent to the appropriate routes.

Limited quantities of each map have been printed on one side only and supplied flat for mounting on board or on linen, or for installing on rollers in wall-mounted map units. These unfolded maps have also been overprinted to show the Department's divisional boundaries.

Similar maps showing the Main Roads System in "Newcastle and Suburbs" and "Newcastle and Surrounding Districts" have recently been produced by the Department.

NAASRA Publications

Three new brochures have recently been produced by the National Association of Australian State Road Authorities to encourage public interest in the work being undertaken by its Member Authorities. The first is entitled "Public Transport on Roads" and highlights the value of roads in the overall planning of public transport services. The second new publication is "Roads and Traffic Safety", and as the title implies, this examines aspects of the relationship between roads and traffic accidents. The third is "Roads and Pollution", which is reprinted in full on pages 70–3 of this issue. The publications contain numerous colour

photographs, graphs and statistics and have been written in easy-to-read non-technical terms.

These three brochures are part of a series being produced by NAASRA to outline some of the social, economic and environmental issues associated with present-day road construction programmes. *Copies of the* following earlier brochures are still available—"Roads and National Development" (reprinted in "Main Roads" Vol. 40, No. 3, March, 1973, pp. 70–5), "Roads and Traffic Noise" and "Town Bypasses".

Waterfall–Bulli Pass Tollwork Brochures

Two publications relating to the new Waterfall–Bulli Pass Tollwork were produced at the time of completion of the project in July, 1975.

One brochure, "Waterfall–Bulli Pass Tollwork", is a well-illustrated 12-page publication *which details the design,* construction and landscaping of this section of the Southern Freeway and also includes some history about early routes south to the Illawarra Coast. *Two pages are also devoted to the* electronic driver aid system which has been installed along the route to warn motorists of driving dangers ahead by displaying advisory speed *signs during fog and when other* hazardous conditions prevail.

The second publication is a leaflet entitled "An Introduction to the Driver Aid System installed on the Waterfall–Bulli Pass Tollwork". This explains in more detail how this system operates and what the motorist should do if involved in an accident or breakdown on this section of the F6. This brochure was reprinted in the September, 1975 issue of "Main Roads". Motorists using the Tollwork are urged to obtain a copy to familiarise themselves with the signs beforehand and to keep in the *glove-box* of their vehicle as a handy helpful reference.

Bridge Building in New South Wales 1788–1938

This publication is a 24-page reprint of *three historical articles* which originally appeared in "Main Roads" back in the 1950's. The articles were "Bridge Building in New South Wales"—Part 1—"The Early Stone Bridges"; Part 2—"Early Timber and Iron Bridges"; and "Bridges and Vehicular Ferries Across Sydney Harbour—The Story of their Development".

An interesting quotation introducing the first article is well worth repeating here, as it illustrates the main reason why these reprints are made available to answer enquiries from those people who want to know something about the bridge building styles of yesteryear. "*History—social, economic, and military—clusters more thickly about bridges than about towns and citadels.*"—John Buchan (Lord Tweedsmuir) in "Introduction to British Bridges", 1933.

NEW MINISTER FOR HIGHWAYS

The Hon. J. C. Bruxner

The succession of Sir Eric Willis, K.B.E., C.M.G., M.L.A., as Premier of New South Wales on 23rd January, 1976 in place of Hon. T. L. Lewis, M.L.A. resulted in a change of Minister responsible for the administration of the Main Roads Act.

The new Minister for Transport and Minister for Highways is the Hon. James Caird ("Tim") Bruxner, M.L.A., who was previously both Minister for Decentralisation and Development, and Minister for Tourism. Mr Bruxner took up his new appointment on 23rd January, 1976, replacing the Hon. M. S. Ruddock, M.Ec., M.L.A. who had been Minister for Transport and Highways since 10th October, 1975 (see September, 1975 issue of "Main Roads", Vol. 41, No. 1, p. 10) and has now been appointed Minister for Revenue and Assistant Treasurer.

Mr Bruxner was born at Tenterfield, in the New England region, in 1923 and was educated at Cranbrook School, Sydney, where he was school captain in 1940. He went on to study Law at the University of Sydney, but his studies were interrupted by World War II in which he served as a member of the First Armoured Brigade, 2nd AIF, and later as a Pilot Officer in the Operations Training Wing of the RAAF.

After the war, Mr Bruxner returned to Roseneath, the family property at Tenterfield, until it was sold in 1950. He now runs the property, Old Auburn Vale, one of the oldest holdings in the Inverell district, where he is engaged in the breeding of Aberdeen Angus cattle.

In 1962, Mr Bruxner was elected to the New South Wales Parliament as Member for Tenterfield, following the retirement of his father Lieut.-Col. Sir Michael Bruxner, K.B.E., D.S.O., M.L.A. (see March 1968 issue of "Main Roads", Vol. 33, No. 3, p. 59 and June 1975 issue, Vol. 40, No. 4, p. 107).

From January, 1973, he became Minister for Housing and Co-Operative Societies until 20th November of the same year when he was sworn in as Minister for Decentralisation and Development. In the latter position, he guided legislation through Parliament to provide for the State's involvement in the Albury-Wodonga and Bathurst-Orange Growth Centres.

Mr Bruxner's thirteen year career in State politics led to his election on 9th December, 1975 as Deputy Leader of the Australian Country Party (N.S.W.). While still holding the portfolio of Minister for Decentralisation and Development, Mr Bruxner was sworn in as Minister for Tourism on 17th December, 1975 thus giving him a dual Ministerial role in the Liberal-Country Party coalition Government.

During his Parliamentary career, Mr Bruxner has played an active role in water conservation, served on a Select Committee on the timber industry and led the States in renegotiating the Commonwealth-States Housing Agreement. He has also been a strong supporter of the Industrial Design Council of Australia, which is involved in activities to assist country manufacturers.

Mr Bruxner is married with one son who is engaged in law practice in Sydney.

PROPERTY ENQUIRIES

The purchase of a home, a factory or business premises is the largest single capital investment that most people make during their lives. Before making the investment it is important that they should know whether the property is affected or is likely to be affected by current or future road proposals. It is the Department's policy to provide a free enquiry service, whereby, information regarding the effect of future road proposals upon properties, is readily available to the public.

Two Hundred Thousand Letters Per Year

General details of future through traffic routes can be seen on town planning scheme maps and are also exhibited from time to time in brochures and scale models. However, these sources do not supply enough information to show the precise effect of roads upon individual properties and the Department must carry out a certain amount of preliminary design work to enable this to be done.

A staff of technical and clerical officers is maintained in Head Office and in Divisional Offices to deal with the thousands of written enquiries that are received annually from solicitors, members of the public, companies, real estate agents, local councils and statutory authorities. The total number of enquiries received per annum has been in excess of 200 000.

Some Planning Controls on Property

Modern town planning legislation was introduced in New South Wales about 30 years ago. The regional and local planning schemes which have since been developed include Arterial or County Roads (which are based upon the Department's road network). Land required for future widening or deviations is protected, by the provisions of the planning scheme ordinances, against development that is likely to substantially increase the ultimate cost of constructing these routes.

Planning authorities are required to obtain the Department's concurrence or consent to changes in the use of affected properties pending future road construction and there are provisions in the legislation for some properties to be acquired from owners when planning consent has been refused. Scheme ordinances also incorporate controls to eliminate traffic hazards and congestion along or in the vicinity of major through traffic arteries.

It is important that owners be aware of these limitations when buying or selling properties and it now is customary for developers to seek the Department's views before any land dealings are completed. This has resulted in a tenfold increase in the volume of enquiries received in the past 15 years.

Printed Forms Speed Replies

It has been found that enquiries made in person or by phone, delay the flow of answers, while verbal information is sometimes misinterpreted. Accordingly, the Department supplies printed forms upon which applicants can place all of the details that are needed to identify properties and subdivisions. These forms are available in duplicate, upon request, from the Department's offices and avoid the delays that occur when enquirers give incomplete or unnecessary information in written or typed letters.

Upon receipt, each request for property information is registered and passed to the appropriate officer for attention. About three quarters of all enquiries received, concern property that is well clear of any Main Roads proposal and the original of the application form is stamped accordingly and returned to the sender within a few days of its receipt.

What the Owner Wants to Know

Property enquiries in the vicinity of future road proposals need to be examined in more detail so that individual replies can be prepared. Dimensions are given when part of a property is required for road purposes and a plan is prepared if the affected area is an irregular shape and there could be confusion arising from a written description. Where applicable, enquirers are advised to consult councils regarding the effect of local planning schemes and the Department sends a copy of all these replies to the planning authorities concerned, to assist in their consideration of development applications.

There are a number of questions that concern owners of property affected by road proposals. When will their land be acquired? What amount will they receive in compensation? Can improvements be made to the property in the meantime?

Existing Buildings to Remain in Use

The Department's funds are insufficient to enable all built-up properties to be acquired in advance of road construction and in general the Department does not commence negotiations until about 3 years before the expected construction date. Accordingly, existing buildings on the route of future roads can remain in use until roadworks are about to commence. The Department also does not object to minor improvements or amenity additions being made to dwellings to keep them habitable.

Reasonable alterations or additions to industrial or commercial premises affected by road proposals, may be approved conditional upon the owners agreeing to limit their future claims for compensation to the development as now existing. These agreements are known as Deeds of Release and are registered as Caveats upon the land title. Their purpose is to allow firms to continue to operate and expand upon their present sites, without involving the community in heavy additional acquisition costs in the future.

When Will the Department Buy My Home?

Subject to availability of funds the Department provides estimates to owners of the likely date when affected properties will be acquired. This service enables home owners and companies to plan their future movements and to decide upon new sites.

When acquisitions are finally undertaken they are negotiated upon the basis of the current market value of equivalent properties unaffected by road proposals. The Department has the power of compulsory resumption of property but does not exercise this power in other than exceptional circumstances. Practically the whole of the land required for road purposes is purchased by negotiation and mutual agreement with the owner.

No objections are raised to affected properties being sold privately in the interim period, and it has been found in these cases that assurances on the possible date and the basis of future acquisition, usually are sufficient to ensure that the owner's equity is preserved. However, the Department is prepared to consider the early acquisition of some properties in cases of genuine proven hardship.

All current owners are notified by letter when the Department is ready to commence negotiations to acquire land for a new project.

Land Available on Short Term Lease

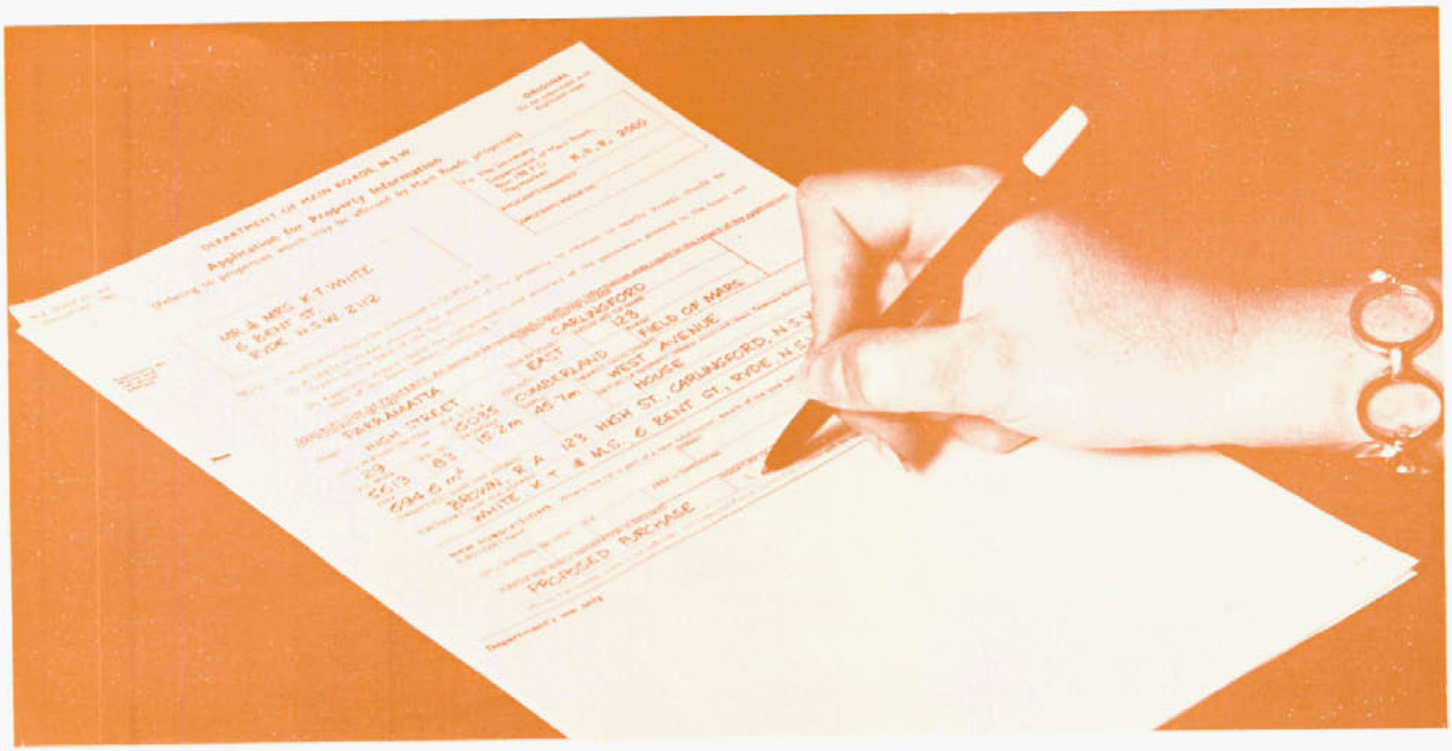
The Department now holds a considerable amount of vacant and built-up land on the routes of future roads in the Sydney, Newcastle and Wollongong areas. The N.S.W. Planning and Environment Commission also has purchased many vacant lots in Sydney which will be transferred to the road authority in due course.

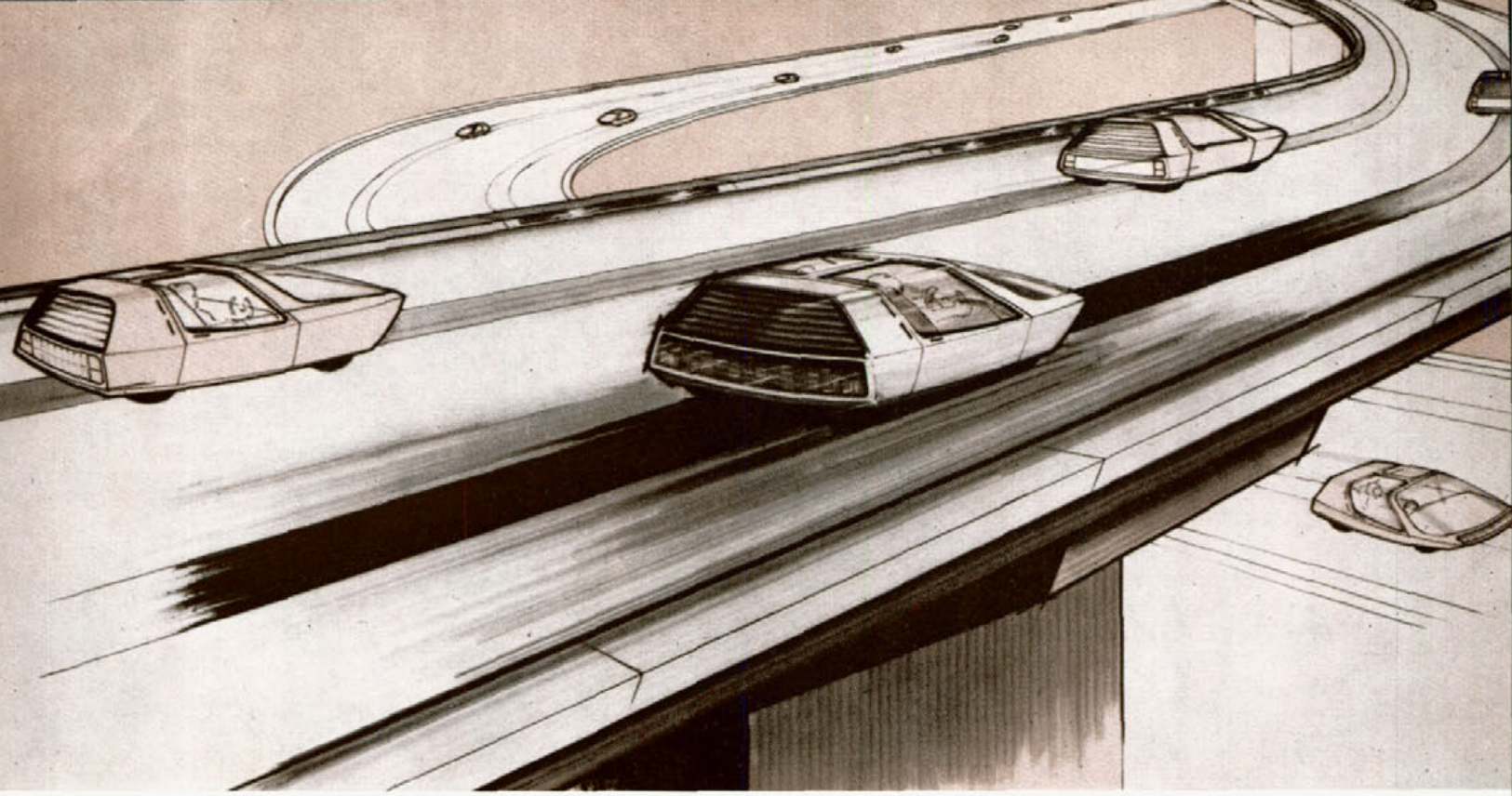
Pending road construction, these properties are available on lease for purposes compatible to the surrounding area. The usual period of leasing is 2 to 5 years on terms related to current market values. The use and any development of the properties is subject to the Department's agreement and local council requirements.

It is possible, of course, for private owners to arrange to lease out their properties under similar conditions before the Department takes acquisition action.

Information Kept Up To Date

It is the Department's policy to supply the public with information that is correct at the time of an enquiry. However, some variations in the boundaries and sometimes the location of future road proposals are inevitable as more detailed investigations reveal site or design problems. It is advisable, therefore, to check with the Department each time that a property changes hands.●





ROADS IN THE FUTURE

After an anniversary year during which we frequently looked back to past years, it is now appropriate that we look forward to see what changes and challenges the future might bring for road designers.

This article has been adapted from an address given by the Department's Road Design Engineer, Mr V. P. O'Grady, B.E., M.T.C.P., M.I.E.(Aust.). It is intended as a "thought-provoker" on what may lie ahead, but should not be taken to indicate any firm Departmental planning policy.

Making Ways For Wheels

The wheel is some seven thousand years old and the combustion engine some two hundred years old. The marriage of these two, performed by George Stephenson with the opening of the Stockton–Darlington railway, has lasted 151 years and, judging by the results of this union, would indeed appear to be one of those marriages "*made in heaven*".

For the 6 800 years before James Watt took out his first patent for the combustion engine in 1769, wheeled vehicles were limited to designs which incorporated various combinations of wheels and axles, with a platform or box on top, and a shaft or two attached for towing by animal power.

The tyres on these early carts, drays, chariots, chaises, gigs, cabriolets, waggons, stagecoaches—call them what you will—were generally rigid, made of wood and later of iron. But they did not perform very well in fine grained *non-plastic* materials (such as dry sand) nor in highly *plastic* materials (such as wet clay). This deficiency led to the development of road pavements, which usually took the form of mechanically interlocked stones.

Of all the early road-builders, the Romans were the most efficient, their 80 000 kilometre road network being more than adequate for their needs. The Roman road, which consisted of hand-placed stone blocks held in position by finer rock chips and cemented together, was designed to sustain heavy loading from rigid tyres.

The fall of the Roman Empire was followed by a period of stagnation in road construction and maintenance during the Dark Ages. The next *milestone* in road construction only appeared in quite recent times, about 170 years ago, when James McAdam and Thomas Telford developed ideas for utilising some of the Roman road-building techniques of interlocked stone pavements. This breakthrough, along with the advent of the internal combustion engine, really got things moving. Transport was no longer dependent on animal power nor the forces of nature (wind, tides, water) to supply energy.

The combustion engine was modified from external to internal operation and the air-cushioned rubber tyre brought in smoother riding, with a bounce instead of a bone-shaking shudder. The demise of the rigid tyre (at least in Western countries) allowed the

construction of what are now termed flexible pavements, which are considerably cheaper per square metre than the hand-packed stones of the Ancient Romans or Thomas Telford.

Compared to the first 6 900 or so *dormant* years of the wheel's life, the past 70 or so years have been positively frantic. During this period, the motor vehicle has undergone several metamorphoses from the early hand-cranked "T-model" type to the highly powered vehicles of today. While the motor car has increased in power, reliability, speed and comfort it has still remained under man's direct and individual control.

Paralleling the development of the motor vehicle have been the demands for more suitable road pavements of continually improving standards of horizontal and vertical geometry. The attempt to specify how the road might match vehicle capabilities and driver expectations is called *road design*, the standards and construction costs of which have been continually moving upwards. Pavements nowadays have to be constructed *truer*, that is, more exactly to the design specifications. Horizontal curves need to be larger in radius and the vertical curves smoother.

Over the last fifteen years (less than one quarter of one per cent of the wheel's life span to date), road designers have been designing high-speed roads to the limitations of the driver rather than the vehicle. The pavement may be *true* enough for speeds in the vicinity of 150 km/h, the grades may be flat enough for the vehicle to sustain that speed, the curves may be large enough in radius for a vehicle to be stable on them at that speed, but what of the driver?

Most drivers do not drive at these speeds because they realise that their reaction time would probably be too slow to avert trouble in times of emergency. Similarly, they are aware that (except in flat, open country) their range of vision is usually not sufficient to allow them to manoeuvre safely and avoid sudden hazards. They are understandably uncomfortable at the thought of hurtling along at high speed while there are so many possibilities for sudden interruption to their movement.

Nowadays, on high speed roads, sight distance in the cuttings, rather than centrifugal force, determines the minimum radius of the curves. The latter is no longer a problem as curves are appropriately banked. Sharp crests are also avoided because of the restrictions they impose on the forward view of drivers. The sight distance over crests, rather than the reduction in effective gravity forces, determines the parabola length used in the design of the road through the change in grade. Similarly, on high speed roads, the parabola length used in their design at sags (*i.e., dips*) is based on the distance illuminated at night by vehicle headlights, rather than on the increase in effective gravity forces.

Possibilities for Tomorrow

Now we have come close to identifying one of the several factors which may well cause drastic changes in road design standards within the next thirty years or less.

If automatic devices, probably electronic, could be satisfactorily developed to effectively take over from man the functions of seeing and reacting, there would be a marked increase in road safety and road capacity, while faster speeds would be feasible. Traffic lights at intersections represent the beginning of these electronic controls. They observe the vehicle approaching by means of a magnetic loop in the pavement and react by changing the traffic lights to green as soon as it is convenient to do so, having regard to other traffic. By observing, remembering and acting, the traffic light system takes over part of these functions from the driver and/or traffic policeman.

On some United States freeways, electronic devices measure and identify acceptable time gaps in lane flow and, by means of lights and signs, beckon forward vehicles waiting at the on-ramp —with constant messages urging them to travel at certain speeds in order to flow into those gaps in safety. In the United States and Europe, research is active to develop an electronic system of controls which will ensure that a vehicle can not only travel up to an acceptable maximum speed without colliding with the vehicle in front, but can also overtake with safety, and come to a halt when faced with obstructions, such as stationary vehicles.

Research seems to be dividing into two schools of thought—the *car-following theory* and the *slot theory*. In the *car-following theory*, the electronically operated vehicle regulates its distance behind the vehicle in front by observing relative velocities, acceleration and distances by means of radar, infra-red or supersonic sensors. It remains in one lane, or opts to change lanes, as guided by a set of coils within it which react to the field of magnetic flux set up by one, or a pair, of charged wires set longitudinally in the road pavement. When the vehicle leaves the highway on which it is electronically controlled, it reverts to manual driving. In a project in Ohio, sponsored by the United States Bureau of Public Roads this system has been operated safely at speeds of up to 100 km/h.

In the *slot theory*, the road pavement contains a continuous bank of electronic wire loops, and the following vehicle is restricted by braking or encouraged by accelerating, having regard to the time since the vehicle ahead passed over the particular loops.

Without doubt there is an enormous amount of research yet to be carried out before either of these systems could become safe and economical. Nevertheless, electronics offer us the elimination of dependence on human reaction time and this means that vehicles can drive more closely together, thereby raising road capacity. Sight distance becomes irrelevant and thus curves can be built to sharper radii, limited only by the friction value of the tyres and lateral stability. For the same reason, both over and under vertical curves can be shortened,

ROADS IN THE FUTURE

continued

limited only by the acceptable rate of change of gravity.

Because of a significant reduction in driver fatigue, sustained speeds can be higher, and with electronic controls, this will require *truer*, smoother road pavements. At the same time, electronic control could ensure that intersections or interchanges are negotiated at low speeds (say not more than 20 km/h), so that radii could be sharp. The land area required would be far less than for a conventional intersection or interchange.

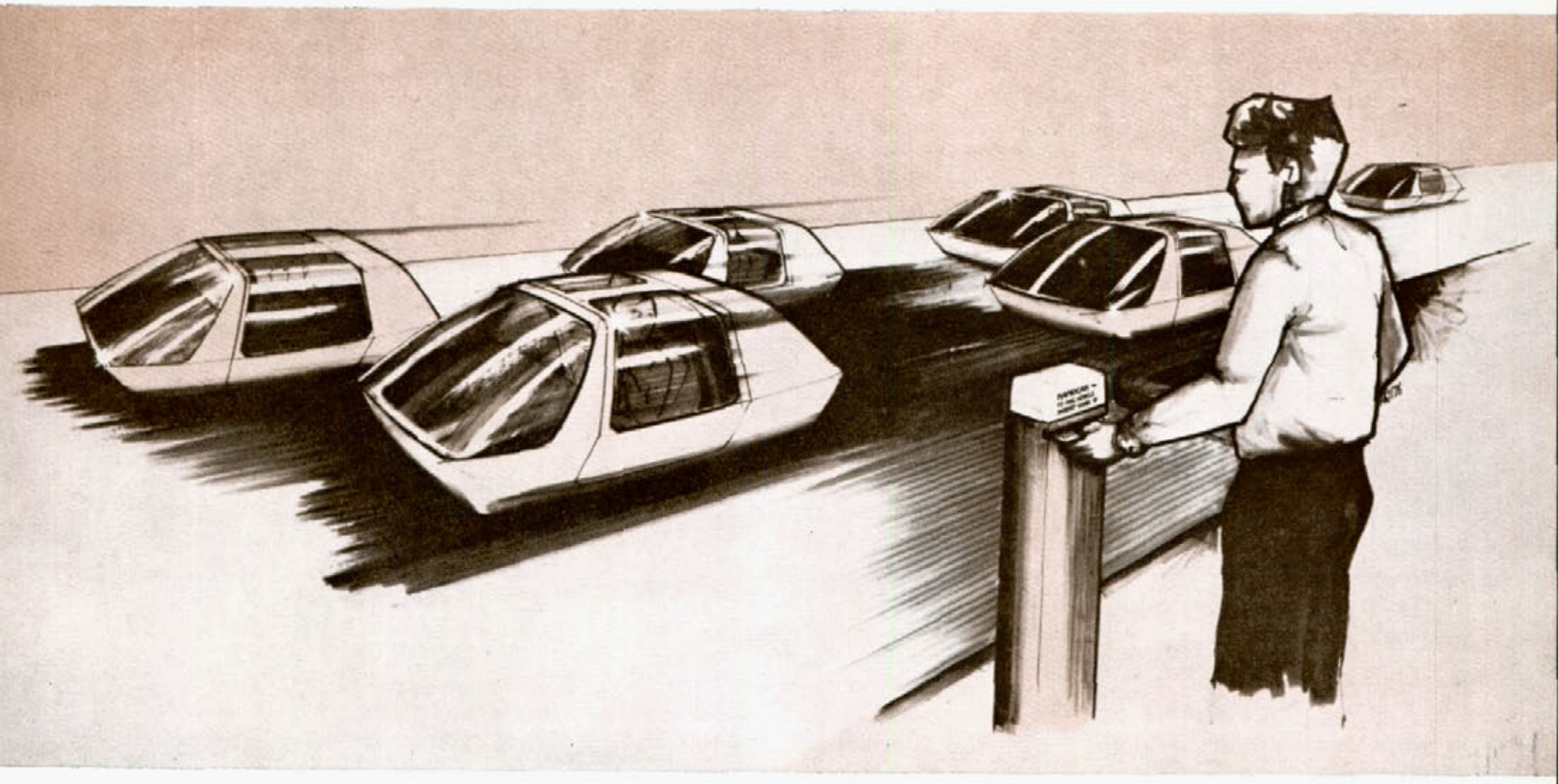
If we look at the amount of electronic guidance now used in the more modern railway systems, or in the fully instrumented approach of an airliner to its runway, it must be reasonable to assume that some of the benefits of these forms of guidance could become available to road vehicles.

More Automation

There is another possibility in highway development—that is, the complete departure from the existing highway as we know it. Mr J. L. Loder, in a paper on "New Systems for Urban Transportation" presented to The Institution of Engineers, Australia, in 1970, states that "*in the foreseeable future automated transport will require a separate right-of-way on which to operate*". This proposal would allow for the use of ordinary vehicles, with extra fittings, but would not permit the use of ordinary vehicles under human, "unautomated", control in the same traffic stream. Mr Loder foresees that "*the degree of control should be sufficient to enable the system to operate initially at* 60 *mph* (97 km/h) *with* 10 *feet* (3 metres) *spaces between vehicles*", i.e., a possible capacity of 12 000 vehicles per lane hour. Compare this with the maximum of only about 2 000 vehicles per lane hour under driver control.

In an article entitled "Electronic Flight" published in the October, 1973

Artists impressions by P. Eldridge, Public Relations Section



issue of the "Scientific American", Messrs Henry H. Kolm and Richard D. Thornton envisage vehicles suspended by magnetic fields—"*magnetic levitation*"—as distinct from wheels or air cushions, and driven by linear induction motors at speeds up to 500 km/h.

The Energy Crisis

Apart from the political question of which nations have most access to the world's oil reserves, the *energy crisis* refers to the possibility that the world might soon be running out of petroleum products, or other fossil fuel products, or both.

Estimates of the energy life of fossil fuels vary. It is possible that if the fossil fuels continue to supply the bulk of the world's energy requirements, only about a century remains before most of the ultimate resources of the members of the petroleum family—crude oil, natural gas and natural gas liquids, tar, and oil shales—are exhausted. Similarly, about 300 to 400 years remain before exhaustion of most of the world's coal resources. However, if coal were used as the main energy source, its supply would only last about another 100 to 200 years.

Whatever number of years remain, the end of these resources must be inevitable while they continue to be used, particulary at the present high rate. In anticipation, some overseas countries have experimented with petrol rationing and have shown greater interest in substitute fuels (even though they might not develop as much power in the engine as petrol does).

There were some interesting benefits resulting from the energy crisis. After the fuel crisis in the United States, in November/December, 1973, the National Road Safety Council reported that 1 000 fewer people were killed on the roads in 1973 than in 1972.

In connection with chemical smog and the adverse contribution by motor vehicles, the New York Department of Air Research recorded falls of between 10 and 20 per cent in carbon monoxide readings in Manhattan during the fuel shortage. In the long run, this pollution problem can be met either by reducing the number of vehicles on the road—even by banning them from certain areas—or by exercising control over exhaust gases, even though this probably leads to some loss of power.

A prolonged energy crisis could result in less motor vehicle traffic, a higher proportion of vehicles with a lower power-weight ratio, and slower travel on significant upgrades. All of this suggests narrower roads (fewer lanes) and a wish for lower grades, which could be achieved, but at the expense of increased horizontal curvature.

The last-mentioned possibility could also pose a real problem in the design of road drainage. Already sight distance requirements produce crests in cuttings which are very difficult to drain because of their long lengths of nearly flat grade, without any opportunity to dispose of water off the pavement, except into parallel table drains or underground drainage. If the vertical curves have to be longer and grades have to be flatter, to suit lower power-weight ratios, it may be necessary to build roads generally *in fill* so that the flat grades are not a drainage problem.

Environmental Issues

It is a simple but true observation that roads can be built in harmony with the environment provided sufficient funds are available. Emphasis on environmental issues will probably have a considerable modifying influence on future road design. It could involve the road designer in providing for flatter batters, giving more attention to vegetation restoration, seeking locations where cuttings would be shallower and less obvious and accepting more restrictions on choices of road locations.

All the abovementioned factors for change—electronic controls, the energy crisis and environment issues—give rise to some new patterns for future road design. All three would appear to support the need for better riding pavements and reduced pavement widths (i.e., fewer lanes), either through increased carriageway capacity (because of electronic controls) or reduced traffic volumes (brought about by the energy crisis or by pollution issues). An energy crisis would call for flatter grades, while electronic controls would permit sharper horizontal curves and sharper *over and under* vertical curves.

Exciting but Frustrating Unknowns

If we study road life histories as an actuary might study human life histories, we discover that the average road life for a major traffic artery is some 35 years or more. Certainly most of the influencing factors which are described in this article will have caused some changes in road design by then and newer influencing factors will have emerged.

In an atmosphere of constant change there is a tendency to be pessimistic about road design. Perhaps it will never be possible to design and construct a road which will not go out of date within its economic lifetime. Automobile manufacturers cannot predict long-range future vehicle developments with any accuracy. Even when they are reasonably sure of changes coming up, they may not divulge the information for fear of their industrial competitors using the knowledge. So road engineers are obliged to locate and design roads to suit vehicles generally as we know them today, and inevitably the roads built today are not fully suited to the vehicles which may use them tomorrow.

Awareness of the changes which are happening at an ever-increasing rate is of little comfort to those conscientiously involved in road planning. The feeling that even the most advanced design will perhaps be out of date by the time its construction has been completed is a nagging dissatisfaction which creeps into any designer's dreams for the future.

What road designers can do is to remain aware that changes are coming at an ever faster rate, and to be sensitive to them . . . and not to expect too many bouquets from future generations for our vision and foresight.●

"A Plan of the Government Demesne Land, surveyed in the year 1816" by C. Cartwright. Reproduced by courtesy of Mitchell Library, Sydney

Mrs Macquarie's Road

Australia's First Tourist Route

This year marks the 160th anniversary of the completion of a road which could well be regarded as Australia's first tourist road. We are so attuned to thinking of Governor Lachlan Macquarie as the sole guiding hand behind early roadbuilding programmes that it may come as a surprise to some to realise that Mrs Macquarie was involved in them, too. But, she was interested more in paths of recreation than in arteries of commerce.

Overlooking Farm Cove, Fort Denison and Woolloomooloo Bay and jutting out between Bennelong Point and Garden Island, Mrs Macquarie's Point is at the northeastern extremity of the Domain. The point was so named because, with its pleasant views of the harbour, it was a favourite vantage spot used by Mrs Macquarie.

Access to the point is still along the drive or road which Mrs Macquarie suggested be made. An extension to the road at the point led to a seat cut out of a large rock and known as Mrs Macquarie's Chair. On its high back is the following inscription.

"BE IT THUS RECORDED THAT THE ROAD
Round the inside of the Government Domain Called
MRS MACQUARIES ROAD
So named by the Governor on account of her having Originally
Planned it Measuring 3 Miles and 377 Yards
Was finally Completed on the 13th Day of June 1816".

In his diary, Governor Macquarie noted . . .

"This day (i.e., Thursday 13th June, 1816) at 1 p.m., Nicholas Delaney the Overseer of the working Gang employed for some time past in the Government Domain reported to me that Mrs Macquarie's New Road (measuring 3 miles and 377 yards) round the inside of the Government (Domain)—together with all the necessary Bridges on the same—were completely finished agreeably to the Plan laid down originally for constructing it by Mrs Macquarie.

As a reward for their exertions in having completed 'Mrs Macquarie's Road', on this particular and auspicious Day, I have given Delaney and his Gang of Ten Men, Five Gallons of Spirits amongst them—as Donation from Government from the King's Store."

Macquarie thoughtfully and proudly referred to the day as *auspicious* simply because it was his wife's birthday!—her 38th in fact. So its completion was in one sense a birthday present—and a very meaningful one too. No doubt on this day, when her special project was at last completed, her thoughts went back to Scotland where years before she had planned a similar waterfront walk. It is intriguing to find that in 1804 (just before he met her for the first time), Lachlan Macquarie admired a path proposed by her for a headland which sounds like it had a remarkable resemblance to the Sydney setting. Macquarie's Journal of 26th June 1804 records these comments . . .

"I walked about with the ladies, and spent a very pleasant day at Airds—I went to look at a very pretty new gravel walk planned by and executed under the direction of Miss Elizabeth Campbell (Mrs Macquarie's maiden name) *of Airds, when she lived here lately . . .; it is a very pleasant walk, round a Point of land jutting into the sea, and called the 'Black Rock'; and shows the good taste of this young lady for ornamented improvements of this kind."*

The route of the Mrs Macquarie's Road is clearly indicated on "A Plan of the Government Demesne Land. Surveyed in the year 1816" by C. Cartwright (reproduced above on the left). It can be seen that the road extended from near the present State Library, skirted the present Domain,

led out to Mrs Macquarie's Point, around Farm Cove and Bennelong Point and back to the old Government House. It was possibly measured from there, as nearby Macquarie Place did not then contain the obelisk, which was erected in 1818. The only obvious bridge needed would have been over the creek at the head of Farm Cove. On Cartwright's plan, one portion of the road along the west side of Farm Cove is inscribed "Mrs Macquarie's Road", while that along the west side of "Woolloomoolla Cove" is titled "Mrs Macquarie's New Road". No doubt a portion of the road consisted of the improvement of existing tracks or paths (e.g., Surgeon Harris states that some existed in 1807), while the "New Road" was presumably entirely original.

In an article on the "History of Sydney Botanic Gardens" (published in the Journal of the Royal Australian Historical Society, Vol. 14, Part 1, 1928, pp. 12, 38–41) Mr J. H. Maiden stated that work on the road was commenced in 1813. Certainly, Overseer Delaney and his gang were reported as being employed there on "*different labouring Works*" in 1813 (HRA, I, Vol. 7 pp. 748–9). Among Mr J. T. Bigge's papers gathered for his "Inquiry into the State of the Colony . . . in 1822" was a list of buildings and works undertaken since 1810, and it included the following two entries.

Date of Completion	*Buildings and works by Government Labour*
1813 ..	*Clearing Government Domain at Sydney of rocks and stumps of trees and converting 3 acres to Garden.*
1818 (*sic*) ..	*Making one mile and ¾ of Road in front of Government House and round the Domain called Mrs Macquarie's Road.*

Another reference is in the long list of works undertaken during Macquarie's governorship, where one accomplishment is "A Road round the inside of the Government Domain always open for the recreation of the Inhabitants on foot". (HRA, I, Vol. 10, p. 47).

In the article mentioned above (written almost fifty years ago), Mr J. H. Maiden claimed that "*The inscription 'Mrs Macquarie's Road, 1816' may still be seen on a rock on the left hand side of the road up the slope after leaving the Corporation Baths*" (now the Andrew 'Boy' Charlton Pool). Elsewhere he described it as being on a cliff, "*alongside the bulge of the road overlooking Garden Island*". A recent search has failed to locate this inscription and any information about it from our readers would be appreciated.

For those with a botanical interest, Maiden mentions in his article the types and origin of many of the trees along Mrs Macquarie's Road.

Mrs Macquarie was not the first to enjoy the view from her favourite headland. The aboriginal name for the area was "Yurong" and after the first settlement at Sydney Cove it was called "Anson's Point". John Anson was a free settler who in 1799 received from Governor Hunter a grant of 100 acres of land at Toongabbie. He also had a farm on the point which he sold in 1808 to go to Hobart, where he died in 1819. What a beautiful piece of real estate was offered in his advertisement in the Sydney Gazette of 29th May, 1808. "*To be let or sold by Private Contract a truly valuable Leasehold Farm, beautifully situated at the Eastern Point of Farm Cove, the property, and formerly in the occupation of John Anson; the whole containing 11 acres and upwards, with excellent pasturage and every accommodation for a Stock Farm; abundantly stocked with various choice fruit trees, and in all respects worthy of attention. For particulars apply to J. Anson, Carpenter, Back Row East.*" (i.e., Kent Street).

Today, residents and tourists alike can drive almost to the tip of Mrs Macquarie's Point and wander along the path to her Chair. From the grassy slopes nearby, they can experience the view that has moved countless visitors to admire the beauties of nature in general and of Sydney Harbour in particular. ●

Above: "Mrs Macquarie's seat, Government Domain" as depicted by Augustus Earle in the late 1820's (From "Views in New South Wales and Van Diemen's Land", London, 1830. Reproduced by courtesy of Mitchell Library, Sydney)

Below: Inscription on rock face behind Mrs Macquarie's Chair

Colour illustrations showing Mrs Macquarie's Chair in 1855 and today are included on pages 80 and 81 of this issue.

More details about Mrs Macquarie can be found in the Australian Encyclopaedia (published by the Grolier Society) and in the Australian Dictionary of Biography, Vol. 2, (edited by D. Pike).

The extracts from Governor Macquarie's diary are reproduced by courtesy of the Mitchell Library, Sydney.

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, 1975.

Road No.	Works or Service	Name of Successful Tenderer	Amount
			$
State Highway No. 1	Princes Highway. Shire of Imlay. Supply and stockpiling of up to 11 900 cubic metres of cover aggregate in the Bega-Eden area.	Blue Metal & Gravel Ltd	101,150.00
State Highway No. 2	Hume Highway. Shire of Goodradigbee. Construction of new bridge over Connor's Creek, 4·5 km west of Bookham.	Siebels Concrete Constructions Pty Ltd	136,432.28
State Highway No. 2	Hume Highway. Shire of Kyeamba. Construction of new bridge over Comatawa Creek at 4·2 km south of Tarcutta.	W. A. Winnett & Son	69,138.10
State Highway No. 10	Pacific Highway. Shire of Byron. Construction of new bridge over railway line at Bangalow.	Hanna & Edmed (Constructions) Pty Ltd	116,076.80
State Highway No. 10	Pacific Highway. Shire of Lake Macquarie. Installation of lateral drains for restoration of slip area opposite George Street, Highfields.	Stewart Bros	23,868.00
State Highway No. 10	Pacific Highway. Shires of Lake Macquarie and Wyong. Supply and delivery of 10 mm of asphaltic concrete for reseals and resheeting of various sections.	Albion Reid (N.S.W.) Pty Ltd	123,789.00
State Highway No. 10	Pacific Highway. Shire of Kempsey. Supply and delivery of fine crushed rock for construction of shoulders at Clybucca Flat, 14·0 km to 19·5 km north of Kempsey.	Fortescue Motors Pty Ltd	120,000.00
State Highway No. 11	Oxley Highway. Shires of Coonabarabran and Liverpool Plains. Construction of new bridge over Cox's Creek at Mullaley, 39·1 km west of Gunnedah.	Dayal Singh Constructions (Tamworth) Pty Ltd	238,528.40
State Highway No. 25	Illawarra Highway. Shire of Wingecarribee. Construction of 4-cell 3 m x 2·2 m reinforced concrete box culvert at unnamed-creek, 13·2 km west of Moss Vale.	G. Ryan	42,442.00
Various	Pacific, Gwydir and Bruxner Highways. Supply, heat, haul and spray R90 bitumen.	Shorncliffe Pty Ltd	26,925.00
Various	Pacific, Gwydir and Bruxner Highways. Supply, heat, haul and spray R90 bitumen.	Q.A.R. Road Services Pty Ltd	69,069.50
Various	Pacific, Gwydir and Bruxner Highways. Supply, heat, haul and spray R90 bitumen.	Spraypave Pty Ltd	33,415.00
Various	Pacific, Gwydir and Bruxner Highways. Supply, heat, haul and spray R90 bitumen.	Q.A.R. Road Services Pty Ltd	29,075.00
Ulmarra Ferry Service	Caretaking and operation.	F. W. Thompson	21,840.00

TENDERS ACCEPTED BY COUNCILS

The following tenders (in excess of $20,000) for road and bridge works were accepted by Councils for the three months ended 31st December, 1975.

Council	Road No.	Works or Services	Name of Successful Tenderer	Amount
				$
Bibbenluke	S.H. 19	Reconstruction 20·26 km to 25·9 km south of Bombala.	Monaro Road Construction Pty Ltd	149,074.60
Carrathool	Various Roads	Supply of Aggregate.	Farley & Lewers Pty Ltd	32,658.57
Carrathool	Various Roads	Bitumen spraying.	Canberra Asphalters Pty Ltd	79,760.46
Gosford	Rural Local Road —Showground Road	Construction of bridge over Narara Creek—No. 2 Bridge.	J. M. Parkinson	113,200.00
Great Lakes	Rural Local Road —Bunyah Road	Construction of reinforced concrete bridge over Horse Creek at Bunyah, 12·5 km from Coolongolook.	N. F. & M. E. Goddard	100,511.00
Lane Cove	S.R. 2092	Reconstruction of Centennial Avenue from Epping Road to Mowbray Road.	Riverstone Plant Hire	218,916.00
Lane Cove	S.R. 2070	Reconstruction of intersection with Northwood Road and Longueville Road at Blaxlands Corner.	John Cassidy Contractors Pty Ltd	69,717.95
Maclean	M.R. 152	Operation of ferry over Clarence River at Bluff Point until end of 1978.	H. Hay	108,000.00

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
Data for design of two-lane rural roads (1973)	892 (Metric)
Flat country cross sections—bitumen sealed pavement (Instruction—1972)	A 6132
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)
Gully grating (1969)	A 190
Gully pit with grating	A 1042
With kerb inlet only	A 1043
With grating and extended kerb inlet	A 1352
With extended kerb inlet only	A 1353
With grating for mountable kerb	A 4832
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	138B (Metric)
Supply of precast concrete box culverts	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
1 500 mm dia.	SD 175
1 800 mm dia.	SD 176
Supply and laying of asbestos cement drainage pipes (1972)	861

BRIDGES

	Form No.
Concrete work for bridges (1974)	350 (Metric)
Data for bridge design (1973)	18 (Metric)
Erection of precast, prestressed concrete bridge units and planks (1975)	557 (Metric)
Erection of precast, prestressed concrete piles (1966)	558
Erection of precast, prestressed concrete bridge girders	561 (Metric)
Excavation for bridges (1974)	563 (Metric)
Extermination of termites in bridges (Instruction—1958)*	326
Erection of structural steelwork	262 (Metric)
Manufacture of precast or cast-in-situ, prestressed concrete bridge members (1970)	556
Manufacture of elastomeric bearings for bridge units and girders (1967)	562
Preparation and pretreatment of metal surfaces prior to protective coating or painting—Method Selection Guide	1032 (Metric)
Protection angles for bridges or culverts with concrete wearing surfaces (1960)	A 1272
Prestressed concrete bridge drawings—	
(a) Prestressed concrete piles—	
12 in x 12 in—35 tons	A 4764
14 in octagonal—45 tons	A 4943
16 in octagonal—50 tons	A 4944
(b) Test load diagrams for prestressed concrete piles—	
12 in x 12 in	A 5601
14 in and 16 in octagonal piles	A 5828
Reinforced concrete piles 35 and 45 tons (1963)	A 1207-8
Reinforced concrete piles (precast) for bridge foundations	564
Superstructure for bridges	568
Supply of high strength steel bolts (1968)	261
Supply of ready mixed concrete, for bridgeworks (1975)	895 (Metric)
Timber for bridges	140
Waterway diagram (0 to 200 acres)	A 26

BITUMINOUS SURFACES

Bituminous emulsions (cationic) (1973)	304 (Metric)
Bituminous emulsion (anionic) (1973)	305 (Metric)
Bituminous surfacing daily record (1974)	400 (Metric)
Bituminous surfacing job summary (1974)	1011 (Metric)
Cutback chart for bitumen seal coats (1973)	466 (Metric)
Performance requirements for mechanical sprayers	272 (Metric)
Sprayed bitumen surfacing (1974)	93 (Metric)
Sprayer loading slip (1974)	401 (Metric)
Supply and delivery of bitumen (1974)	337 (Metric)
Supply and spraying of bitumen (1973)	898 (Metric)
Supply and delivery of aggregate for use in bituminous plant mix (1975)	952 (Metric)
Supply and delivery of asphaltic concrete (1975)	953 (Metric)
Supply and laying of asphaltic concrete (1975)	612 (Metric)
Supply and laying of dense graded tar plant mix (1975)	954 (Metric)
Supply and delivery of dense graded tar plant mix (1975)	955 (Metric)
Supply and laying of open graded bituminous plant mix (1975)	956 (Metric)
Supply and delivery of open graded bituminous plant mix (1975)	957 (Metric)
Supply of prepared cutback bitumen for sealing purposes (1966)	740
Supply and delivery of cover aggregate for sealing and resealing with bitumen (1975)	351 (Metric)
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FENCING

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Chain wire—supply—(1974)	132 (Metric)
Corrugated steel guard rail—supply—(1975)	SD 5595
Corrugated steel guard rail—erection (1975)	680 (Metric) SD 5829
Drawings: Sheep fence (1974)	SD 494
Rabbit-proof fence (1974)	SD 498
Cattle fence (1974)	SD 1705
Floodgate (1974)	SD 316
"Manproof" pipe and chainwire boundary fence	611 (Metric) SD 6278
Ordnance fencing	143, A 7
Post and wire fencing (1974)	141 (Metric)
Removal and re-erection of fencing (1974)	224 (Metric)
Warrants for use of guard fences (Instruction—1973)	246 (Metric)

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	Form No.
Corrugated PVC subsoil drainage pipe (1972)	907 (Metric)
Earthworks and formation including surface drainage (1974)	70 (Metric)
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Shoulders and table drains (1973)	827 (Metric)
Standard rubble retaining wall (1941)	A 114
Standard mass concrete retaining wall (1959)	A 4934
Standard cantilever retaining wall (1959)	A 4935
Subsoil drains (1973)	528 (Metric)
Waterway calculations for bridges and culverts (1964)*	371 A

PAVEMENTS

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

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Roadside fireplace (1974)	SD 4671
Roadside litter bin (1975)	SD 5841

TRAFFIC PROVISIONS AND PROTECTION

Control of traffic at Roads and Bridgeworks (1975)	121 (Metric)
Guide posts—supply (1973)	252 (Metric)
Guide posts—erection (1973)	253 (Metric)
Manufacture of warning signs (1971)	682
Motor grids—24 ft (1964)	A 5770
Plastic guide posts (1972)	880
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Bulk sum contract form, Council contract (1975)	38
Cover sheet for specifications, Council contract	342
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General conditions of contract, Council contract (1966)	24B
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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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