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NEW SOUTH WALES

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MINISTERIAL CHANGES

Since the resignation from Cabinet of Mr. Rex Jackson, who was Minister for Roads up to 27 October 1983, the Hon. L.J. Brereton, M.P., the Hon. G. Paciullo, M.P. and the Hon. P.D. Hills, M.P. have successively held the portfolio of Minister for Roads. Mr. Hills was sworn in on 10 February 1984.

Patrick Darcy Hills was born on 31 December 1917 and educated at Marist Brothers College, Darlinghurst. From 1948 until 1956 he served as an Alderman of the Sydney City Council. He was Lord Mayor of Sydney from 1952 to 1956. In addition, Mr. Hills was a member for the Sydney County Council 1949-54. He held the position of Chairman in 1952.

Mr. Hills has been the Member for the electorate of Elizabeth (formerly Phillip) since 1954. He was the Minister Assisting the Premier and Treasurer in 1959; the Minister for Local Government and Highways 1959-65 and concurrently Deputy Premier 1964-65; the Deputy Leader of the Parliamentary Labor Party 1965-68 and Leader 1968-73; the Minister for Mines and Energy 1976; the Minister for Industrial Relations, Mines and Energy 1976-78; the Minister for Industrial Relations, Technology and Energy 1978-80; the Minister for Industrial Relations and Energy 1980-81; the Minister for Industrial Relations and Technology 1981-84; and now, Minister for Industrial Relations and Roads.

We congratulate Mr. Hills on his appointment as Minister for Roads.

$5 BILLION ROAD PROGRAMME

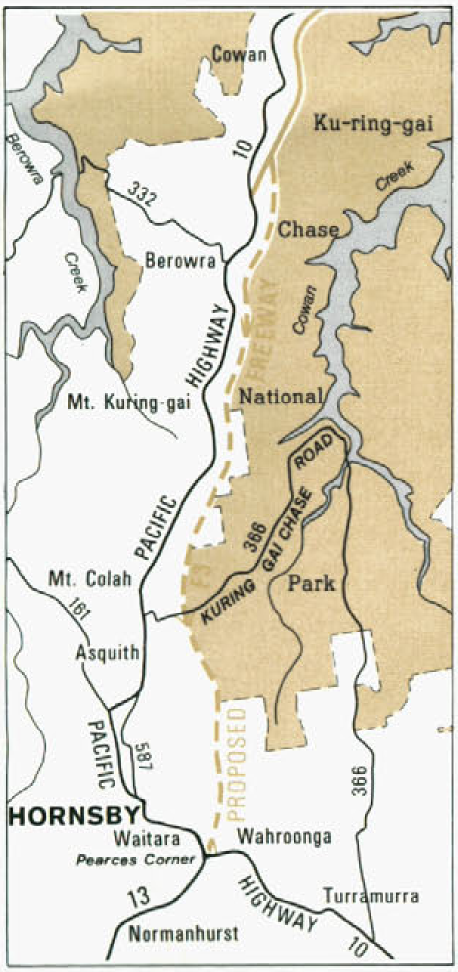
New South Wales' roads received a great boost in September 1983 when the Premier, Mr. Neville Wran, Q.C., announced a $5 billion road programme. The roadworks are being undertaken throughout New South Wales and they will be completed over the next five years.

The prime objective of the programme is the improvement of the State's arterial road system. New construction work will absorb about $3.5 billion, with the balance being directed to maintenance.

The works will double the present 170 kilometre length of freeway standard roads. They will provide a sealed surface to more than 250 kilometres of gravel road and will reconstruct in excess of 1,000 kilometres of pavement.

It has been estimated that the expenditure of these funds will result in annual savings to the community of $800 million

The route of the F3 - Sydney-Newcastle Freeway between Wahroonga and Berowra.



in reduced travel times, lower vehicle costs and reduced accident costs.

Furthermore, an additional 8,000 jobs will be created in the State's road construction industry as well as associated industries supplying equipment and materials.

This article features a number of major works being undertaken within the programme. Future issues will contain more detailed accounts as projects near completion. The year 1988 will see a higher standard road system that will benefit the whole of New South Wales.

SYDNEY REGION

Berowra to Wahroonga Section of F3

In 1979 the Australian Government approved the National Highway system being extended from Berowra to Wahroonga. This was based on the grounds that Pennant Hills Road and the Pacific Highway near Pearces Corner at Wahroonga provide the first acceptable loading and dispersal points for freeway traffic.

The New South Wales' Government has approved the location of this work between Wahroonga and Mt. Colah, and an early decision is to be made on the section north of Mt. Colah to permit completion of the whole length within four years.

The proposed route commences near Pearces Corner, the intersection of the Pacific Highway and Pennant Hills Road, and connects with the existing Freeway at Berowra.

Interchanges are proposed at Mt. Colah (Ku-ring-gai Chase Road), Windy Banks and Berowra. Overpasses will cross the Freeway at Alexandria Parade and Edgeworth David Avenue, Wahroonga; Church Street and Harwood Avenue, Mt. Ku-ring-gai; and Cowan Parade, Berowra.

Dual carriageways will be provided for the full length. From Pennant Hills Road at Wahroonga to Ku-ring-gai Chase Road at Mt. Colah the carriageways, each 11.1 m wide, will have three lanes. From Ku-ring-gai Chase Road to Berowra the carriageways, each 7.4 m wide, will have two lanes.

The overall work will involve nearly four million cubic metres of earthworks and the construction of 14 bridges.

The freeway will be constructed in cutting to the maximum feasible extent to reduce both visual and noise impact on adjacent properties. The use of noise barriers will also be considered.

The natural environment will be protected with special measures to control erosion and preserve natural vegetation. Erosion controls include minimal vegetation clearing, sediment control, rock facing of embankments, lining open drains, mulching and accelerated revegetation.

Natural vegetation will be preserved by minimising disturbance, controlling stream velocities and topsoiling, seeding and mulching after construction. Native flora will be encouraged, especially in landscaped areas.

A contract has been awarded to Pearson Bridge Pty. Ltd. for construction of the Edgeworth David Avenue bridge over the Freeway at Wahroonga.

The overall project is planned for completion during the 1988/89 financial year at an estimated cost of $65 million.

Widening of Pennant Hills Road

Work commenced recently on the widening of Pennant Hills Road over the 6 km length between Beecroft Road, Pennant Hills and Pearces Corner, Wahroonga. The work is expected to take about five years to complete at an estimated cost of $36 million.

Improvement of this length will complement the extension of the F3 — Sydney-Newcastle Freeway south from Berowra to Pearces Corner, by facilitating the loading and dispersal of traffic.

There will be three lanes in each direction, each 3.4 m wide with a 1.5 m median. Right turn bays will be provided at intersections.

Bridgeworks to be undertaken include the widening of the Pennant Hills Railway overbridge to six lanes and the construction of a footbridge at Normanhurst, adjacent to the public school.

The effect of the route on adjacent

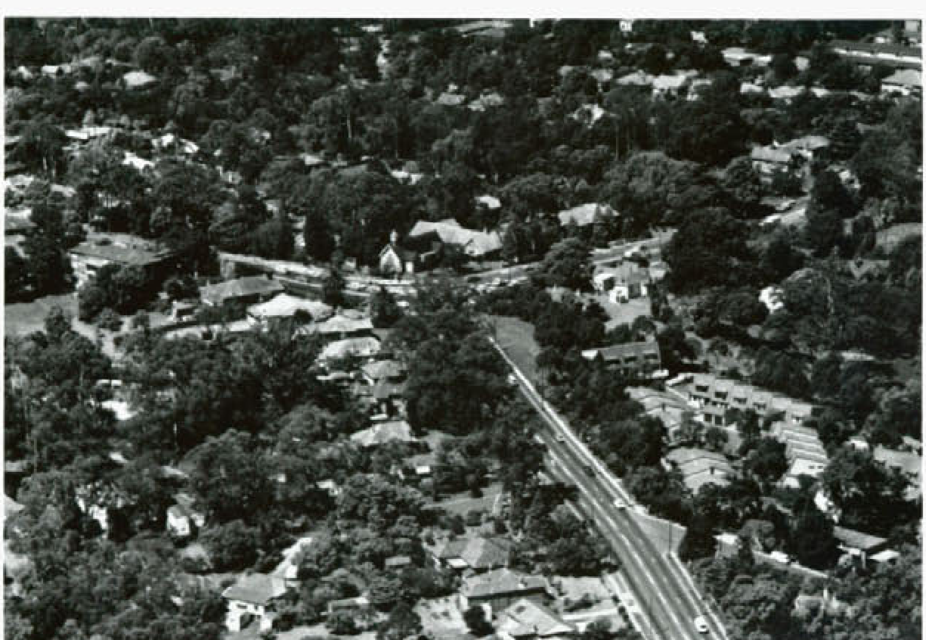
property is substantial but unavoidable. It lies along the ridge between Lane Cove River and Berowra Creek headwaters, and there is no practical alternative to link the western and northern regions of Sydney. When completed the work will considerably reduce traffic on adjacent local streets.

Duplication of the Bridge over Parramatta River at Uhrs Point, Ryde

The existing Ryde Bridge is a 328 m long, three lane steel truss and girder bridge with a footway on the upstream side. The bridge provides for three lanes of traffic under a 2/1 tidal flow arrangement. The direction of travel in the central lane is controlled by movable medians which operate automatically in response to traffic demand. However, delays in peak hour are still common and construction of a duplicate bridge is proposed to alleviate these problems.

The new bridge will carry southbound traffic. It will be located immediately downstream of the existing structure which will be retained to carry northbound traffic

It is proposed to construct a 334 m long bridge, with continuous steel trough girders and a concrete deck. The deck section provides for a three lane carriageway of 11.4 m between kerbs and there will be a 3.6 m wide shared pedestrian walkway and cycleway on the downstream side of the structure.



Pearces Corner at Wahroonga, where the Pacific Highway and Pennant Hills Road intersect.

Existing traffic arrangements at Ryde Bridge over the Parramatta River.

The needs of river traffic in the area have been provided for in the design of the new bridge. River traffic generally passes under the three main span openings of the existing bridge and similar size openings have been provided in the duplication. Approach spans in the new structure are approximately twice the original length of the existing spans, thereby reducing the number of piers. New piers will be aligned where practicable with existing piers, again for the convenience of river traffic.

The duplicate bridge will be completed during 1987.

New Pymble Interchange

Work is about to commence on an interchange at the intersection of the Pacific Highway (State Highway No. 10) with Ryde and Mona Vale Roads (Main Road No. 162) at Pymble.

The need for the interchange is evident because of:

- long delays experienced at the intersection during peak hours;
- a high accident rate at the site;
- the constraints currently imposed on vehicle movements.

Future traffic growth will exacerbate the present situation.

Design

A two level interchange is proposed with Mona Vale/Ryde Road passing under the Pacific Highway. Ramps will connect to the highway level where all turning movements will take place. The design features a special U-turn facility which enables access to and from the adjacent local street system.

The underpass involves excavation of a slot, 70 m long and 24.2 m wide, to carry Mona Vale/Ryde Road. Consultants who are designing the work have proposed the use of bored piles to support the deck. After this is constructed and carrying highway traffic, excavation for Mona Vale/Ryde Road will proceed. The deck will be 34.7 m wide including approach slabs.

Retaining walls up to 7 m high are required on the approaches. These will be either cantilevered retaining walls, or concrete lining walls anchored to rock.

Adjustments are required to watermains, sewers, telephone lines, gas mains and electrical cables.

Associated work by the State Rail Authority has been underway since September 1983. A new two span 50 m long rail bridge is being constructed to the east of the existing 24 m long structure which will be demolished. The new approaches will feature reinforced earth walls. Completion is expected in June 1985 at an estimated cost of $5.5 million.

Construction

It is proposed that the work be executed in five stages, involving four major traffic switches:

Stage 1 — State Rail Authority bridge.

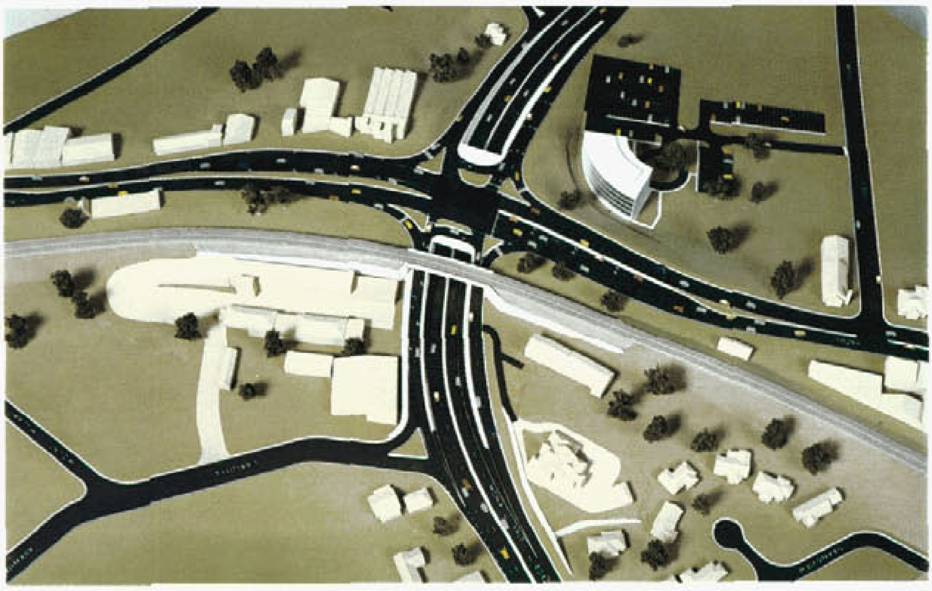
Stage 2 — Work in Ryde Road (concurrent with Stage 1). Ramps and temporary lanes in Mona Vale Road (to commence 12 months prior to first traffic switch).

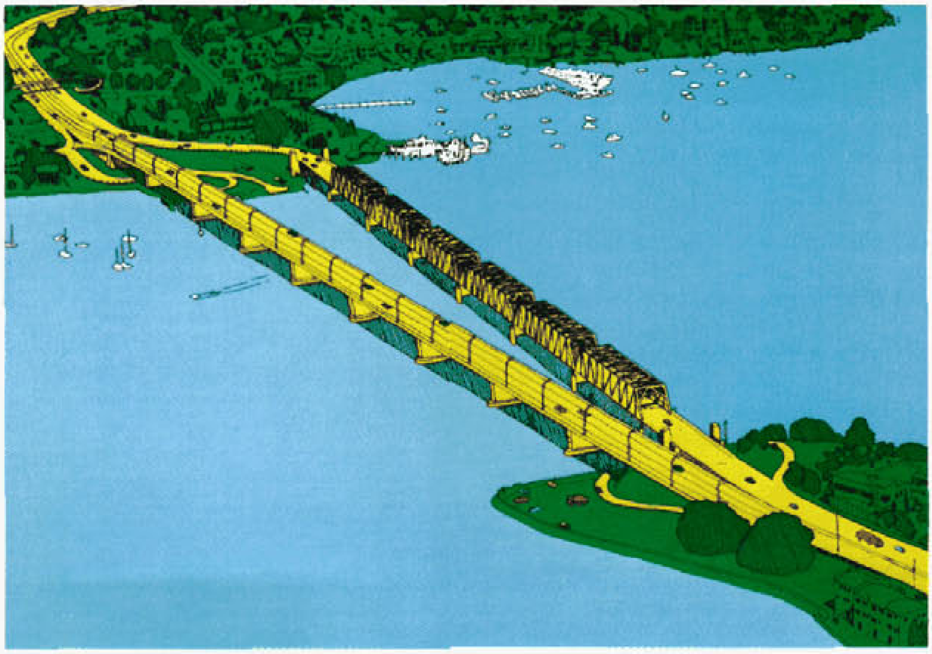
Stage 3 — Traffic switch 1 (for six months). No change to Pacific Highway. Mona Vale/Ryde Road traffic channelled onto ramps and temporary lanes. Construct western 29 m length of cutting and ramp in Mona Vale Road.

Stage 4 — Traffic switch 2 (for four months). Pacific Highway moved to the east, Mona Vale/Ryde Road traffic still channelled onto ramps. Construct centre 21 m length of tunnel.

Stage 5 — Traffic switch 3 (for eight months). Pacific Highway moved to the west. Construct final 20 m length of tunnel. Traffic switch 4 to final arrangement.

Site of the proposed interchange at Pymble, at the intersection of the Pacific Highway with Ryde and Mona Vale Roads.





An artist's impression of the new bridge (on the left) that will carry southbound Princes Highway traffic over the Georges River at Tom Uglys Point.

The complex nature of the staging is necessary to maintain traffic flow during construction. Public utility adjustments will add further constraints in programming.

The project is being financed under the Australian Bicentennial Road Development Program. The total cost, including the rail bridge, is estimated at $14 million.

Duplication of Tom Uglys Bridge

The existing steel truss bridge over the Georges River at Tom Uglys Point, Blakehurst was opened to traffic in 1929. The bridge provides three traffic lanes which operate on a 2/1 tidal flow arrangement. Movable medians change the direction of travel in the central lane to accord with traffic demand.

Because of the high volume of traffic, the bridge has become a serious traffic bottleneck on the Princes Highway. To overcome the problem, a new bridge is being constructed downstream from the existing structure. When completed, the three-lane bridge will carry southbound traffic and the existing crossing will carry northbound traffic only.

The new bridge will consist of a nine span composite steel box girder/reinforced concrete deck structure, 604 m long and 16 m wide. A length of 70 m has been adopted for intermediate spans and 50 m for end spans. The major span length was adopted to match those of the existing bridge so that navigational access will not be restricted. The total length of the new bridge will be slightly greater than the existing bridge as the new structure will also span access roads on both northern and southern foreshores.

A minimum vertical clearance of 6.73 m will be provided above high water level, which is similar to that at the existing bridge. The depth of the superstructure will be kept to a minimum both to maintain the same vertical clearance for navigational purposes and to minimise the differences in carriageway levels in the bridge approaches.

The bridge deck will provide a three-lane carriageway, 12.9 m wide between kerbs, with a 2.1 m wide footway on the downstream (eastern) side. The three composite concrete and steel box girders forming the superstructure cross-section will be continuous over their full length and will be anchored to one abutment so that all movement takes place at the single expansion joint located at the opposite abutment.

The superstructure will be supported on piers comprising single reinforced concrete walls. Each pier will be supported on eight large diameter open-ended steel piles driven through river sands up to 50 m deep to rock.

The new structure is an Australian Bicentennial Road Development project. It will cost approximately $9 M and is expected to be completed in 1986.

Regentville Bridge Duplication

The first 5 km section of the F4 - Western Freeway between Regentville and Emu Plains was opened in October 1971. As part of this section, a two-lane, prestressed concrete bridge was constructed over the Nepean River at Regentville. (See 'Main Roads' Journal, Vol. 37, No. 2, p. 46.)

At the time of its construction, provision was made for the bridge to be duplicated at some future date. Therefore, full width abutments for both bridges were completed initially and the two river piers for the future bridge were constructed to above normal water level to facilitate later work.

The existing structure provides one lane for eastbound traffic and one lane for westbound traffic. It will be used for two westbound lanes of traffic when the new bridge, for eastbound traffic, is completed.

Construction details

The new structure will be 16.4 m wide overall and will have a length of 318.4 m between the faces of the existing abutments, made up of three central spans 71.6 m long and two end spans each 51.8 m long.

The shore piers to be constructed on each river bank will be supported on one metre diameter cast-in-place piles, each having a capacity of 300 tonnes.

The superstructure will comprise a twin cell prestressed concrete box girder with a stiffened reinforced concrete cantilever cast on the northern edge to support the footway.

The box girders will generally consist of precast concrete segments 12.3 m wide overall. Precast diaphragms 760 mm wide are provided at each pier. The maximum weight of the precast units is of the order of 40 tonnes. The end stressing blocks to the superstructure at each abutment are to be cast-in-place.

The bridge is to be constructed on a span by span method of construction proceeding from the eastern abutment with the precast segments being joined by a 90 mm wide cast-in-place concrete joint before being stressed together longitudinally by internal 22/12.7 mm strand tendons.

The northern pedestrian railing and the steel railing of the traffic barrier of the existing bridge will be removed and re-used on the new bridge, together with the fluorescent lighting units for the footway located at the back of the traffic barrier.

The bridge was designed by Consultants. A tender for the construction of the bridge has been let to Transbridge Pty.Ltd. for $2.7 million. Work should be completed by the end of the 1984/85 financial year.

F5 from Casula to Beverly Hills

The F5 — South Western Freeway is planned eventually to extend from Sydney's inner south west to a point south of Berrima. The Department is presently concentrating on the length between Casula and Beverly Hills, and proposes to construct the road south from Aylmerton towards Berrima in the near future.

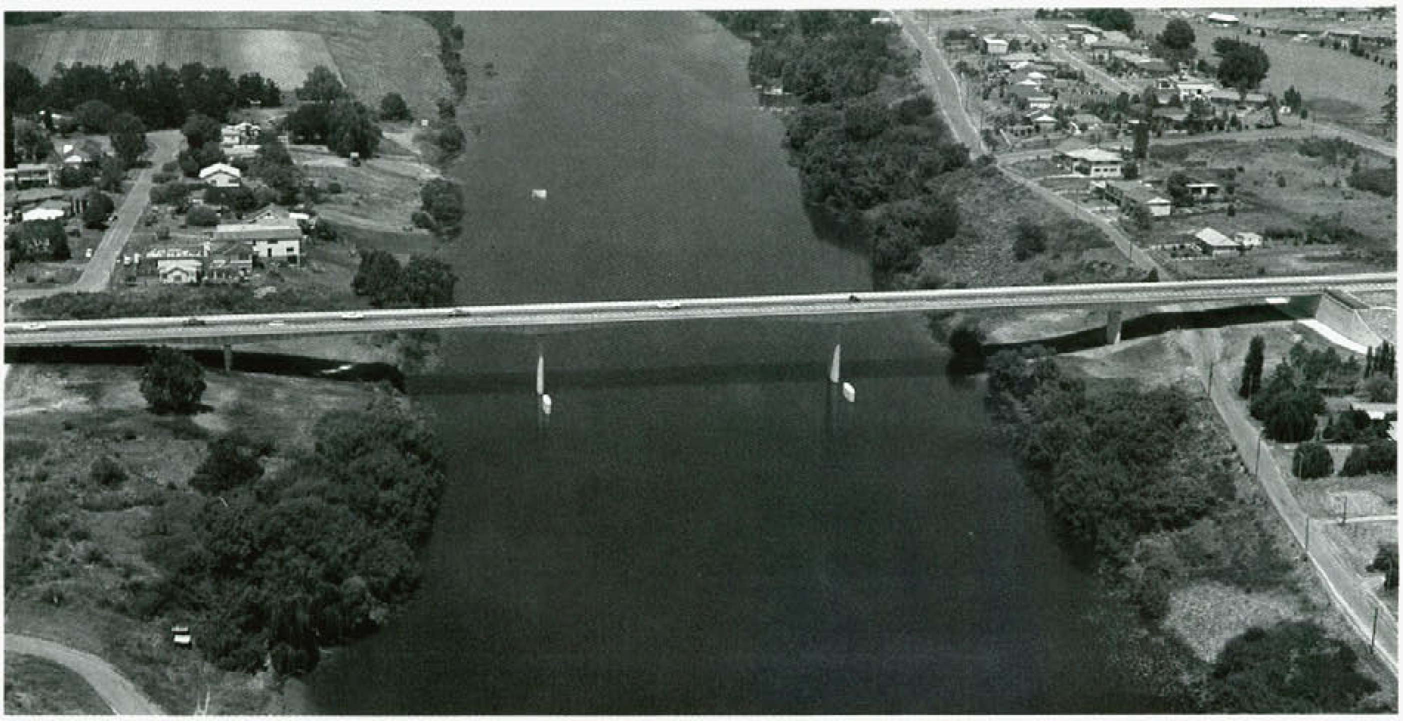
Casula to Moorebank

Construction of the F5 from the Hume Highway, Casula to Heathcote Road, Moorebank is to be completed by mid-1984.

The work is being carried out in three stages:

Stage 1 — the section from just east of the Hume Highway to the western abutment of the new bridge over the Georges River. Earthworks and drainage were carried out by Walker Civil Engineering Pty.Ltd. at a cost of $247,800. The construction of the Hume Highway junction will cost $400,000.

A duplicate of this bridge will be built to provide dual carriageways of the F4 — Western Freeway over the Nepean River at Regentville.



Stage 2 — the section from the eastern abutment of the bridge over the Georges River to Heathcote Road including the junction with Heathcote Road. Earthworks and drainage are being carried out by J. Smit and Sons at a cost of $1,038,373.

Stage 3 — the laying of cement concrete pavement over the entire length. A contract for the amount of $1,198,975 has been let to Citra Constructions Ltd. The pavement will be four lanes from the Hume Highway to Moorebank Avenue and two lanes thereafter.

The new four lane, 290 m long bridge over the Georges River is a seven span structure with a composite steel box girder and reinforced concrete deck. It is 15.1 m wide between kerbs and has an overall width of 18.3 m including a 2 m wide footway. The structure was built by Enpro Constructions Pty. Ltd. for $3 million.

The bridge carries the F5 over the Main Southern Railway Line and Lakewood Crescent. It provides an alternative to the nearby causeway crossing at Cambridge Avenue, Glenfield, which is subject to flooding.

Moorebank to Beverly Hills

Design is well in hand for the whole length of the Freeway between Heathcote Road, Moorebank and King Georges Road, Beverly Hills. It is the State Government's intention to complete a single carriageway along this section as soon as possible to provide an improved through route.

Arterial Route between Liverpool and Wentworthville

It is planned to construct an arterial route from the Hume Highway at Liverpool, via Smithfield, to link with the Parramatta By-pass at Wentworthville.

This will involve the upgrading of Secondary Road No. 2071. It is the only classified road running north/south between Woodville Road and Wallgrove Road. The route traverses industrial areas at Smithfield and Liverpool. The busy commercial centre of Parramatta will be more easily accessible, as well as the industrial areas of Pendle Hill and Chipping Norton.

The three geographic barriers that will be encountered are Prospect Creek, Orphan School Creek and the Sydney Water Supply Canal. These points currently attract traffic delays because of limited alternative crossings as Smithfield Road and Fairfield Road are the only main routes between Merrylands West and Fairfield Heights.

At the northern end of the route, two deviations will have to be constructed to ease traffic congestion on Centenary Road, South Wentworthville. At the southern end, a deviation is required to link Joseph Street to Orange Grove Road at Cabramatta West. This would ease traffic flow on Sackville Street between Canley Heights and Fairfield. Other minor deviations are required at St. Johns Road, Canley Heights and Hamilton Road, Fairfield West.

On a larger scale, the route will provide better access between Campbelltown and Hornsby, drawing traffic from other routes.

Most of the area at the northern end of the route is developed, but development is still occurring to the south-west in the St. Johns Park area. This is certain to increase traffic density in the near future, including cross traffic to the amenities and railway line at Cabramatta, Canley Vale and Fairfield.

The route has been designed initially as a four lane divided carriageway. A wide median is being provided to allow for the addition of two lanes at some later stage.

Work has commenced at Cambridge Street, south of Canley Vale Road; Joseph Street, south of St. Johns Road; and Joseph Street, north of John Street.

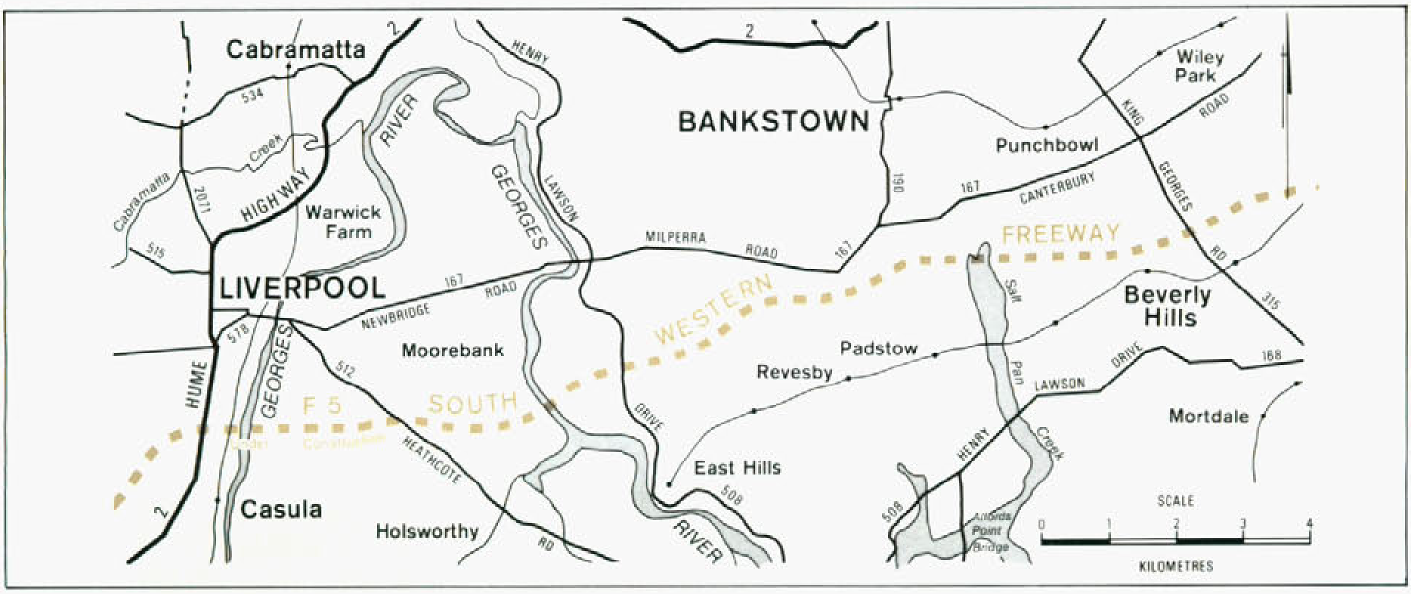
The estimated cost of the upgrading to four lanes is $28 million.

Continuing Western Region Roadworks Programme

In October 1982, the State Government announced an extensive programme of roadworks for Sydney's fast-developing Western Region. Over 40 projects are involved, which will cost an estimated $115 million, and be completed in the 1986/87 financial year.

This programme of road improvements will reduce travelling times as well as transport costs (particularly for industry), reduce road accidents, provide better communications for social, recreational and cultural activities and accelerate the commercial development of the western region.

The route of the F5 — South Western Freeway between Casula and Beverly Hills.



Many of the works are already underway, including these three major projects:

Completion of F4 between Auburn and Harris Park

In December 1982, the Premier, the Hon. Neville Wran, Q.C., officially opened two sections of the F4 Western Freeway, from Young Street, Concord to Melton Street, Auburn (5.7 km) and from Church Street, Harris Park to the Great Western Highway at Frances Street, Mays Hill (3 km).

Work is continuing on the middle section between Auburn and Harris Park.

Melton Street, Auburn to James Ruse Drive, Granville:

When this 2.1 km section is complete, access will be available from James Ruse Drive and Silverwater Road.

The main feature of this section is the bridge over Duck River at Auburn. It is 300.2 m long consisting of nine spans of precast, post-tensioned segmental girders.

Bridges will carry the freeway over Deniehy and Wentworth Streets, Granville, and an overbridge will carry Stubbs Street, Auburn over the freeway. Opening of this section is tied to the completion of James Ruse Drive, where roadworks and construction of the new bridge over the Carlingford Railway are well in hand. This bridge is programmed for completion in August 1984, though work on medians and guardrails may have to be delayed to facilitate traffic switches while the level crossing in James Ruse Drive is removed. Part of the viaduct over James Ruse Drive between Granville and Harris Park will need to be built before construction of this section can be completed.

Work in progress on Secondary Road No. 2071 at Canley Heights.

Duplication of the bridge over South Creek at St. Marys on the Great Western Highway.

The whole section from Melton Street to James Ruse Drive is expected to be open to traffic in September 1984.

James Ruse Drive, Granville to Church Street, Harris Park:

This 1.8 km section will be in viaduct for its full length. The design of the viaduct includes the crossing of the quadruplicated Western Railway Line at Harris Park.

Foundation piling has been completed between Wentworth Street, Clyde and the Carlingford Railway Line, and is under way between the railway line and Onslow Street, Granville.

Work on the viaduct superstructure is in progress, and the project is programmed for completion by 1985/86 at an estimated cost of $33 million.

Completion of the viaduct will join the whole length of freeway between Concord and Mays Hill, giving an overall 12.4 km of uninterrupted freeway. The total project will have involved the construction of 24 bridge structures, and cost $105 million.

Extension of Parramatta Bypass

In March 1984, tenders will be invited for the construction of a further section of the Parramatta Bypass. This consists of a six lane divided roadway from Old Windsor

Road, Northmead to Wentworth Avenue, Wentworthville.

When completed, the Parramatta Bypass will form a ring road system around the Parramatta Central Business District. It will link Parramatta Road, the F4 Western Freeway, Victoria Road, Kissing Point Road, Pennant Hills Road, Windsor Road, Old Windsor Road, the Great Western Highway and Secondary Road No. 2071 (the arterial route between Wentworthville and Liverpool).

The ring road will not only provide a bypass of Parramatta, but will provide a focus of radial arterial routes onto the Parramatta Central Business District, encouraging its future development and that of surrounding areas.

When this new section is finished, the only outstanding section of the route will be from Wentworth Avenue to the Great

An artist's impression of the F4 — Western Freeway viaduct looking west from Wentworth Street, Granville to Church Street, Parramatta. (Right)
A completed section of the Parramatta Bypass, looking west across the Windsor Road overbridge at Northmead. (Below)

Western Highway, involving a grade separation at the Great Western Highway.

The contract for this part of the bypass will include all clearing, earthworks, drainage, pavement, kerbs and gutters, guardrails and landscaping. It will also include the demolition of the concrete channel at Coopers Creek and the construction of a new reinforced box culvert.

The Department will arrange separately for fencing, property adjustments, signposting, linemarking, traffic signals and all public utility adjustments.

The contract period is 60 weeks, and it is expected that the work will be completed and open to traffic by June 1985. Estimated cost of the project is $2.9 million.

Improvements to Great Western Highway

Widening of the Great Western Highway (State Highway No. 5) to six lanes through Prospect, St. Marys and Kingswood is being carried out at an estimated cost of $32 million. Property and public utility adjustments have commenced preparatory to widening to six lanes between Glossop Street, St. Marys and Gipps Street, Werrington. A new bridge duplicating the existing crossing of South Creek at St. Marys is now being built and will provide for two westbound traffic lanes. The final stage of widening the highway to six lanes between O'Connell Street, Werrington and Parker Street, Kingswood is also underway.

ILLAWARRA REGION

Extension of F6 to Yallah

The F6 Southern Freeway is planned eventually to link Sydney and Wollongong, and then proceed south to Kiama. The route will generally run parallel to the Princes Highway.

Sections of the F6 have been completed progressively since 1963, including a 15.5 km length from Mt. Ousley to Fowlers Road, Dapto and the 23 km Waterfall - Bulli Pass Tollway. Work is presently continuing between Kanahooka and Yallah. Total cost of this section is estimated at $11 million.

Kanahooka to Dapto

At present, the two carriageways of the freeway merge into one just north of Byamee Street, Dapto. A bridge will be built to carry another F6 carriageway over Byamee Street. When completed this year, it will enable the second carriageway to be extended further south.

The Byamee Street bridge and others already built at Harvey Street, Fowlers Road and Emerson Road are essential features of the freeway and will allow access from the Princes Highway to the growing residential areas of Kanahooka, Koonawarra and Lakelands.

Dapto to Yallah

Earthworks and pavement construction are being carried out on the 4.5 km section south of Fowlers Road to the Princes Highway at Yallah. This section is expected to be completed by mid-1985.

Kiama Bypass

Work has commenced on the construction of a $20 million deviation of the Princes Highway to bypass the main shopping and business centre of Kiama.

The 5.3 km long bypass will extend southward from near North Kiama Drive to rejoin the present Highway near Easts Beach. It will have dual carriageways, each with two lanes, separated by a median, with an additional climbing lane on some lengths. The new route will be a motorway with restricted access, giving priority to through traffic. Four bridges will carry the bypass over

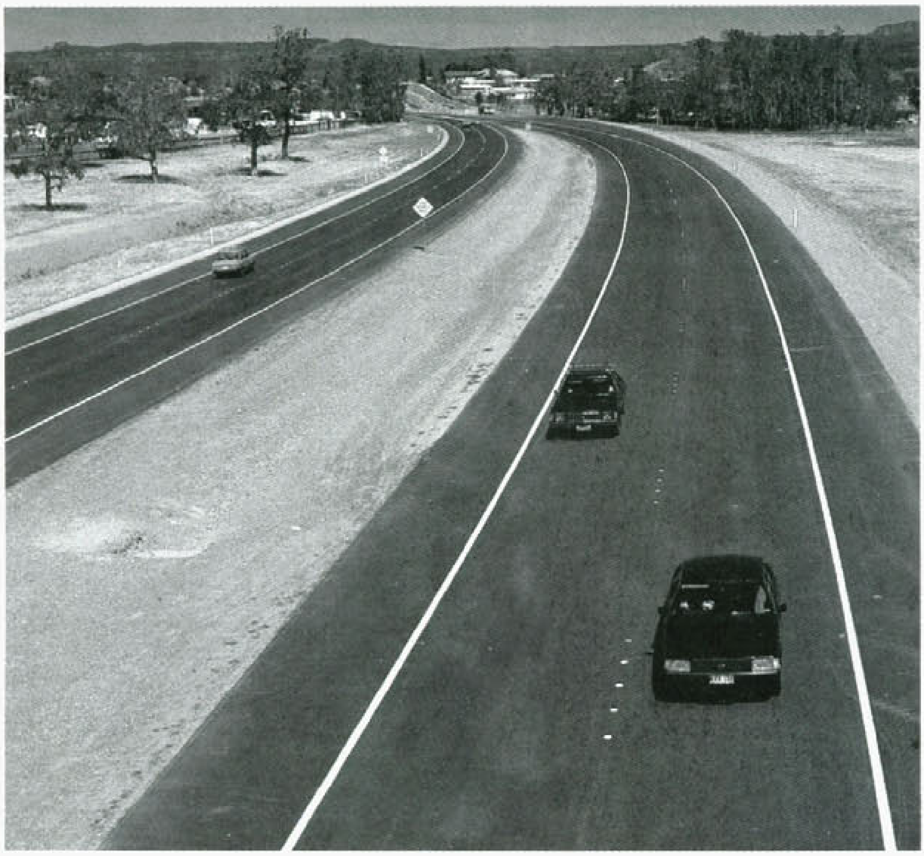
- the railway siding near Panama Street
- Spring Creek
- Terralong Street, and
- Bland Street.

Another bridge will carry Saddleback Mountain Road over the bypass. At this location (i.e. Saddleback Mountain Road) the bypass will be in a cutting about 20 metres deep.

At Terralong Street, a short length of new access road will be built just to the west of the bypass to provide a link between the through route and the local street system. Connections to and from the bypass will also be available at Gipps Street, and at the southern end.

Associated roadworks will include a connection between Hutchinson Street and Panama Street, to the west of the bypass, north of Kiama. Local traffic links will also be maintained by the building of a connection between Farmer Street and Hothersal Street (North), east of the bypass.

The work being carried out in 1983/84 is being financed with $1 million made available by the Federal Government



Looking south along the F6 — Southern Freeway from Kanahooka Road to Fowlers Road, near Wollongong.

under an Assistance Programme for Special Development Projects and Employment Generation Initiatives in the Hunter and Illawarra Steel Regions. A further $3 million will be available for the bypass in 1984/85 and subsequently normal State and Federal road funding will be used.

It is expected that the work will take about three years to complete. When finished, the bypass and associated reconstruction and up-grading of the Princes Highway to both the south and north of Kiama will eliminate the long delays to traffic which often occur in this area during peak holiday periods.

By taking away through traffic, the bypass will make conditions much more pleasant in the other streets of Kiama. It will bring safer conditions to both through and local road users as well as for shoppers, people living on the present route of the Highway and visitors to this popular South Coast tourist Centre.

A short informal ceremony was held near Saddleback Mountain Road on 19 December 1983 to mark the commencement of earthworks on the bypass.

The then State Minister for Roads, the Hon. George Paciullo, M.P. and the Federal Member for Macarthur, Mr. Collin Hollis (representing the Federal Minister for Transport, Hon. Peter Morris, M.P.) each dug out a spadeful of earth to give a symbolic start to the project. Work was then continued by two Departmental bulldozers.

Mr. George Peterson, State Member for Illawarra was present on behalf of the local Member for Kiama, Mr. Bill Knott. Also in attendance were the Mayor of Kiama, Alderman Arthur Campbell and the Commissioner for Main Roads, Mr. Bruce Loder.

Both Mr. Paciullo and Mr. Hollis spoke briefly about the project to a small gathering - and each planted a tree to mark this important occasion in Kiama's history.

An aerial view of the outskirts of Kiama, where the bypass will be built.

HUNTER REGION

New bridge over Hunter River at Singleton

A new bridge over the Hunter River at Singleton is under construction. The new structure will form part of a deviation of the New England Highway.

At present, the highway traverses the Dunolly Bridge, a narrow timber structure built in 1905. This can no longer cope with the large volume of traffic, substantially heavy vehicles, which now uses the highway. When the highway traffic has been diverted, Dunolly Bridge will be redecked and retained to provide access to and from the Putty Road, which links Sydney's Western region, via Windsor, to the northern areas of the State.

The new bridge will be 260 m long with provision for two lanes of traffic. There will be a footway on the downstream side of the bridge and the offloading ramp for southbound traffic will enter into Queen Street, Singleton.

The substructure contract, awarded to Transbridge Pty. Ltd. in September 1983 for a tender price of $365,000, is nearing completion.

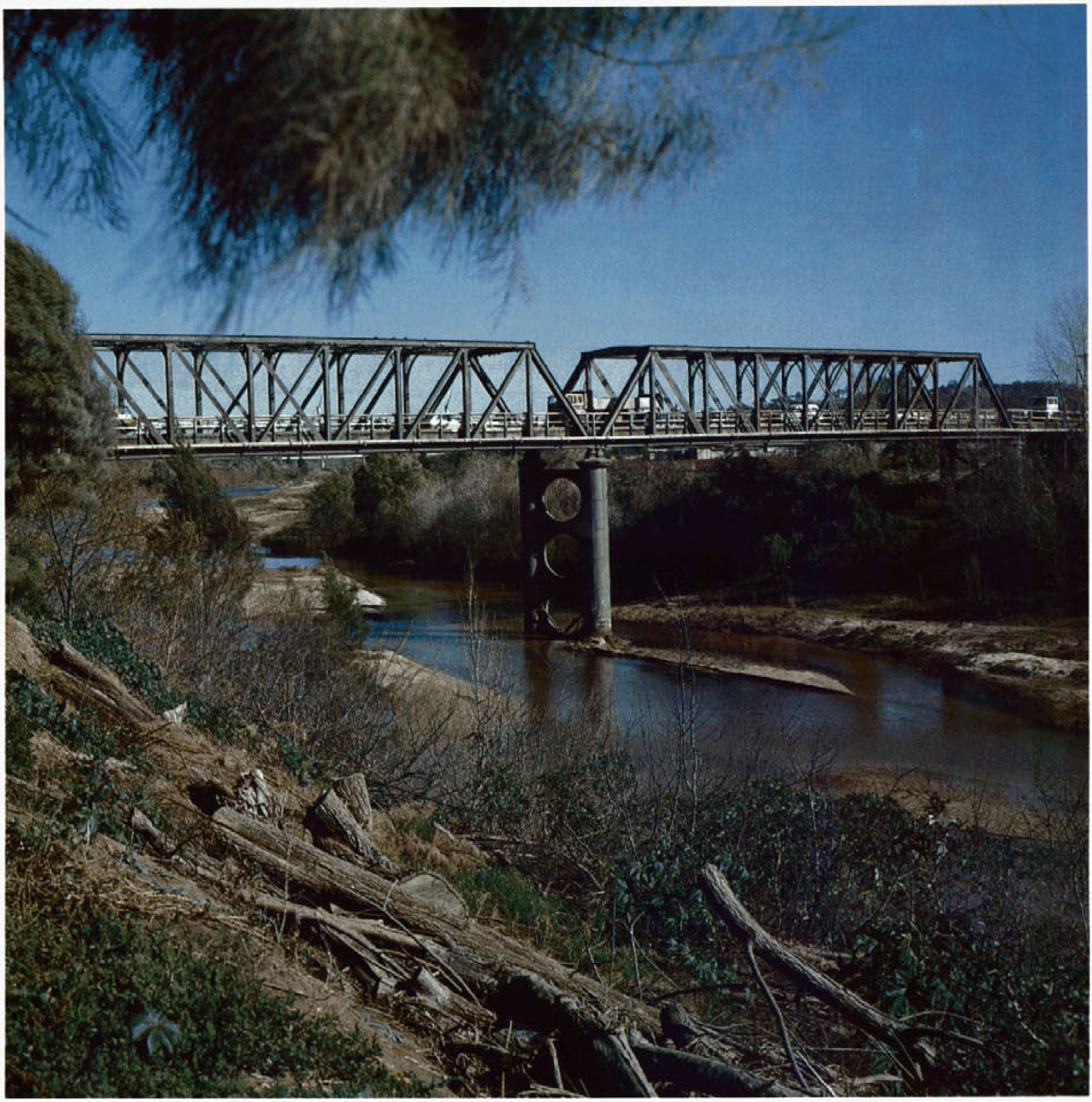
A contract for $1.8 million has recently been awarded to Enpro Constructions Pty. Ltd. of Unanderra for construction of the bridge superstructure.

The whole project is expected to be completed by 1986 at a cost of $6 million. It will be fully funded as part of the Australian Bicentennial Road Development Program.

The Hexham Bridge Duplication Project

Work is well advanced on the construction of a second bridge across the Hunter River at Hexham, just north of Newcastle on the Pacific Highway. The new bridge is expected to be opened to traffic late in 1985 to supplement the existing narrow steel truss structure.

The second bridge will be the central feature of a $14 million project to improve traffic flow at the junction of the Pacific and New England Highways at Hexham. These form the main corridor between Newcastle and surrounding regional centres such as Raymond Terrace, Maitland and Cessnock, carrying heavy commuter and industrial traffic as well as tourist traffic.



The Hunter Valley is being developed as a major industrial growth area. The new bridge is one of a number of large projects underway in the area to build the transport infrastructure required to service this development.

Construction of the new bridge will improve traffic flow in the area, particularly with the commencement of production at the new $650 million aluminium smelter at Tomago, four kilometres from Hexham. When in full operation, the smelter is expected to result in a five per cent increase in traffic volume at Hexham with an annual road haulage of 600,000 tonnes of raw materials to Tomago and of 220,000 tonnes of aluminium to the Port of Newcastle by way of the Hexham bridges, in addition to the traffic of 900 employees commuting daily.

Existing bridge

The existing Hexham Bridge was opened to traffic in December 1952, replacing a steam driven ferry service. The design had been completed in 1940 but construction was held over because of the war.

Construction of the bridge commenced in 1946 but was slowed by a number of factors including the post war steel shortage and flooding of the river. Because of difficulties experienced by the principal Contractor, the Department assumed responsibility for completion of the project in October 1950.

The Dunolly Bridge at Singleton will be retained for access to the Putty Road.

The 382.8 m long bridge comprises three 12.2 m long steel girder spans on the southern river bank, six steel truss spans over the river and ten 12.2 m long steel girder spans on the northern bank where the swampy ground was too weak to support a road embankment. The 37.8 m long lift span provides 30 m clearance for navigation when fully raised. The five other conventional steel truss spans are 36.9 m long.

While the bridge is still structurally sound, its efficiency is restricted by the narrow 6.7 m clear width between kerbs and the congested intersection in the southern approaches.

Duplication of the existing structure over the Hunter River at Hexham is well under way.

Steel through-truss bridges constructed in years gone by are often too narrow for modern traffic demands and bridges of this type cannot readily be widened.

By the late 1970s it became apparent that it would soon be necessary to build a second bridge at Hexham, and in February 1981 the Premier, the Hon. Neville Wran, Q.C., announced plans to go ahead with the project.

New structure

A new three-lane bridge now under construction on the upstream side of the existing bridge was designed by the Department. It will carry northbound Pacific Highway traffic across the Hunter River, while the existing two-lane bridge will be converted to carry two lanes of southbound traffic, as well as all pedestrian traffic.

A grade separated interchange at the junction of the two highways and a loading ramp for vehicles travelling from the direction of Maitland will be incorporated into the bridgeworks to provide free-flowing access onto the new bridge.

The 576 m long main structure and 186 m long Maitland ramp will consist of a continuous cast-in-place post-tensioned concrete box girder superstructure supported on reinforced concrete abutments and piers with reinforced concrete bored piles founded on bedrock.

The curved arms of the southern end of the structure forming the New England Highway overbridge and the Maitland ramp will consist of single cell box girders, joining in the middle of the bridge to form a twin cell box girder through to the northern abutment.

Spans adjacent to the three abutments will be 30.5 m long with 13 intermediate 39.0 m long spans on the main structure and four intermediate 39.0 m long spans on the Maitland ramp.

Instead of providing a lift-span in the new structure, there will be a permanent navigation clearance 10 m high and 30 m wide in Span 9 over the river navigation channel in line with the lift-span of the existing bridge. While there is still a coal loader in use on the Hunter River adjacent to the downstream side of the existing bridge, few large vessels now navigate upstream beyond the bridge since the closure of the old coal loading facility.

Distinct from the main bridge structure, there will be an auxiliary 15 m long viaduct leading onto the Maitland ramp arm of the new bridge. This structure will be built along the river bank between the highway and the river in conditions too precarious for road construction. The 17 span viaduct will be in three sections of continuous reinforced concrete deck slab supported by driven reinforced concrete piles founded in dense sand.

The bridgeworks are being constructed under two separate contracts - the first for the construction of the reinforced concrete bored piles and pier pile caps of the main structure, and the second for the completion of the main structure and all works in the viaduct.

The letting of separate contracts enabled an early start to be made on the substructure while work was still progressing on the design for the superstructure and viaduct.

The site of the works is crossed by many public utilities and services are being relocated clear of the proposed works. In order to expedite the commencement of the project, bridge construction will commence on the northern side of the river and progress southwards in stages to allow the relocation of services by the various authorities. The total cost of relocating services for the project will exceed $0.5 million.

The contract for the construction of the 102 bored piles and 19 pier pile caps was awarded in March 1983 to Leighton Candac, a joint venture of Leighton Contractors Pty Ltd and Candac Ltd. The $3.2 million contract is expected to be completed by June 1984.

At Hexham, alluvial sand and clay deposits of the Hunter River from 25 to 30 m thick overlie bedrock of layered sandstone, siltstone, shale and tuff.

While the existing bridge has pile caps on the river bed or at ground level founded on driven reinforced concrete piles and secured in dense sands, the pile caps of the new bridge are at water or ground level supported on bored piles taken to rock.

The 1.0 m diameter reinforced concrete bored piles are constructed inside 12 mm thick permanent steel casings driven to bedrock by a Kobe 45 diesel hammer. After the completion of driving, the alluvium is excavated from inside the casings and excavation is carried at least 1.0 m into sound rock to provide a socket for the pile concrete.

Approaches

On the southern approaches, new pavement construction under the project will include strengthening and widening of 1.6 km of the existing highway. The new northbound carriageway construction of the northern approach will be 1.4 km long and will form the first stage of the planned future construction of 8.75 km of dual carriageway on the Pacific Highway from Hexham to Raymond Terrace.

The pavement of the bridge approaches is proposed to be of 200 mm thick unreinforced concrete construction. This will avoid disturbance due to settlement of the soft and weak subgrade, and will also ensure continuous serviceability of the heavily trafficked approaches despite periodic flooding.

The approach embankments are being built on soft saturated clays and construction was started early so that most of the large anticipated settlement as the clay consolidates will occur before construction of the final pavement.

The Department is undertaking instrumentation of the Newcastle and Raymond Terrace approach embankments to monitor the rate of settlement and dissipation of pore pressures so that the amount and duration of surcharging to be carried out on these approaches can be determined.

The $276,000 contract for the construction of the Newcastle approach embankment was awarded to Robson Excavations Pty Ltd of Gosford in April 1983. The design of the bank called for the insertion of approximately 1,000 vertical plastic wicks to drain the 13 m to 18 m thick layer of very soft clay underlying the surface, thereby accelerating consolidation.

A slag layer 1.2 m thick was provided on the natural surface as a free draining platform for construction of the bank to follow. A geotextile material was placed over swampy ground to prevent the underlying clay from being squeezed into the slag under the weight of the embankment thus negating the free drainage provided by the slag.

The wick drains, together with a temporary surcharge of about 1 m depth of fill above final pavement level, should shorten the main consolidation period from many years to less than two.

The Raymond Terrace approach is being constructed by the Department with its own forces. On this side of the river, the surface clay is more permeable and the height of bank to be placed is lower. The finished levels of the new carriageway will follow the levels of the existing highway.

On this approach, approximately 1 km of carriageway is being built on a geotextile material but the use of wick drains was not considered necessary as a temporary surcharge of 1.5 m of slag should be sufficient to produce the necessary accelerated settlement.

The surcharge is being placed in a sawtooth pattern over 50 m lengths of carriageway with 50 m gaps to allow the passage of water should flooding occur in the surcharging period. After sufficient settlement has occurred, the surcharges will be moved to the adjacent areas.

Funding

The total estimated cost of bridgeworks is $9 million, approach works is $4.7 million and relocating services is $0.5 million.

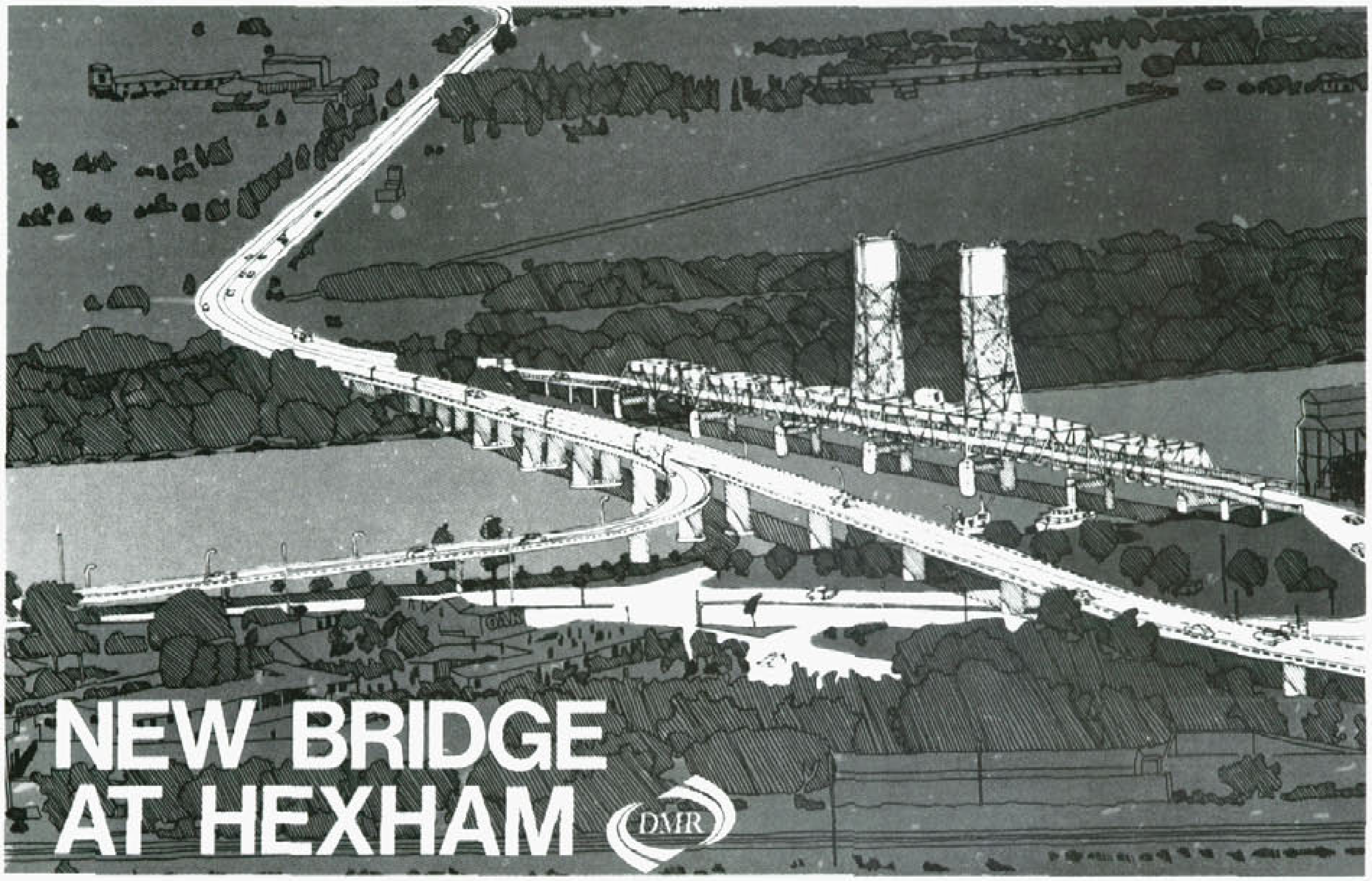
The new bridge is an Australian Bicentennial Road Development project.

The approach works are being funded jointly from National Highway funds (for work on the New England Highway) and State Highway funds (for work on the Pacific Highway).

F3 from Wyee to Wallsend

An Environmental Impact Statement was prepared for this 46 km section of

An artist's impression of the new bridge on the Pacific Highway at Hexham.



Freeway on the western side of Lake Macquarie.

The route proposed in the Statement goes from Wallarah Creek south of Wyee, west of Hue Hue Road to near Morisset. It crosses Dora Creek near its junction with Sandy Creek and travels north to cross Palmers Road east of Freemans Waterholes. The Freeway links up with the Newcastle road network at Wallsend.

The proposed route has interchanges at Morisset, Freemans Waterholes and Barnsley.

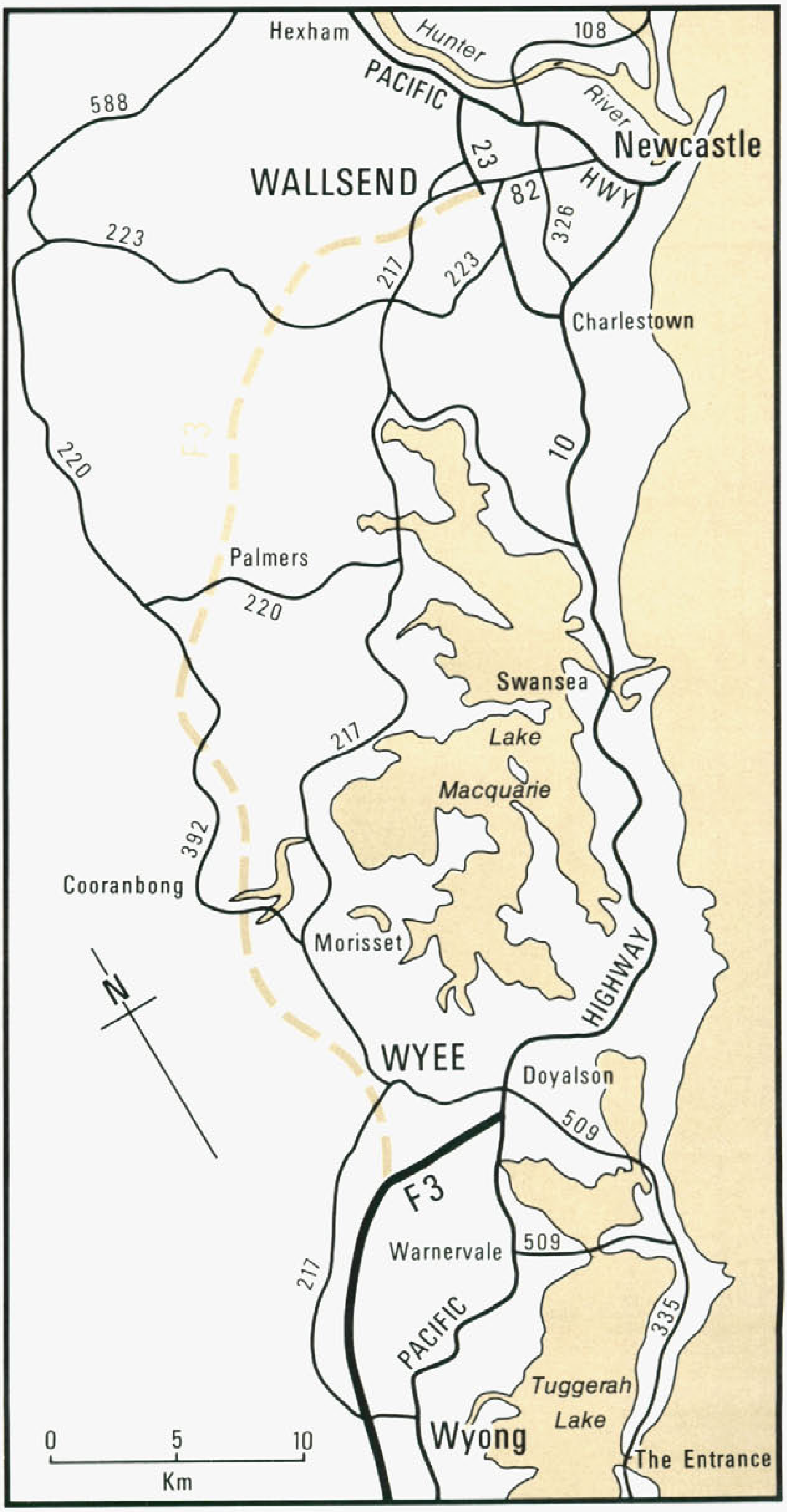
The countryside is generally flat or undulating and poses few engineering problems. Approximately 6.4 million cubic metres of material will need to be excavated, and 25 bridges will be built. The bridges are generally not major constructions, with the exception of the twin 190 m long structures over Dora Creek.

The highly erodible soils along the route make it essential to take appropriate measures to prevent erosion and siltation. These measures will be included in the Freeway construction.

Special consideration has been given to the effect of coalmining under the Freeway route. Where possible the Freeway passes through areas where mining has been completed or follows natural ridges in the topography.

Coal seams under the Freeway are at depths between 600 m and 1000 m. Each seam is approximately 2 m thick and surface settlement of up to 1 m can be expected. Designs have allowed for this. Bridges, for instance, have been designed in most cases using simply supported girders. This design will allow long-term settlement to take place without placing excessive stress on the structures.

The Environmental Impact Statement was put on public display in March 1983, and matters raised by the public are still under consideration. It is expected that a final determination will be made shortly.



The route of the F3 — Sydney-Newcastle Freeway between Wyee and Wallsend.

Improvements on Hume Highway

Extension of dual carriageways continues on the Hume Highway (State Highway No. 2), which is the main intercapital route between Sydney and Melbourne. The route incorporates the 64 km long F5 South Western Freeway which, together with the highway south to Albury, is a declared National Route.

The following sections are currently under construction:

- A 3.7 km section from Black Bobs Creek (27 km south of Mittagong) south to Cherry Tree Hill. This is a Bicentennial road project funded by the Federal Government and is planned for completion later this year at a total cost of $5.2 million. A four span, 94 m long concrete girder bridge has been built over Black Bobs Creek to carry the two northbound highway lanes.
- A 6.8 km section of dual carriageway, from 13.5 km south of Goulburn. This $6 million project is also due for completion late this year.
- A 4 km section from 16.2 km south-west of Yass is continuing under Bicentennial Road Development funds.
- A 3.5 km section from 5.8 km south of Gundagai. This will eliminate the last remaining flood-affected section of the Hume Highway south of Gundagai. It will join the recently completed 11.5 km Tumblong Deviation, which is also being extended further south by 6.3 km at a cost of $9 million.
- Dual carriageway over Kyeamba Gap, 76 km to 83 km south of Gundagai. This is due for completion in 1985 at an estimated cost of $9 million.

Construction is about to start on three sections of dual carriageway, at 47 km to 57 km, 71 km to 78 km and 90 km to 99 km south of Yass. The total cost of these works has been estimated at $29 million.

A six lane configuration has been used on the Somersby to Ourimbah section of the F3 — Sydney-Newcastle Freeway because of high traffic volumes and rugged terrain.

Dual carriageway under construction on the Hume Highway between Black Bobs Creek and Cherry Tree Hill.

Further improvements on the Hume Highway include the construction of several bypasses around town centres to improve driving conditions as well as conditions for residents. Work on the Marulan Bypass will commence shortly. Bypasses of Goulburn and Jugiong are currently at design stage. A bypass of Coolac, together with a 31 km deviation over the Cullerin Range to bypass Gunning, is also planned for completion before the 1988 Bicentenary.

The old bridge over the Tweed River at Barneys Point.

F3 from Calga to Ourimbah

This 21 km length of the Freeway will represent a great saving in time and distance for the motorist. The section will be 14 km shorter than the existing route.

The design of the Freeway is generally for four lanes (two in each direction). However, the sections from Calga to Kariong and from Somersby to Ourimbah will be six lanes. This is due to the expected high traffic volumes and the rugged terrain in the area. Rather than provide conventional climbing lanes it is more economical to build the Freeway to a full six-lane width.

In both these sections, it has been necessary to exceed the desirable gradient. The approaches on both sides of the major Mooney Mooney Creek bridge will have a grade of 7 per cent. The grade north from Kariong will be 6.5 per cent and between Somersby and Ourimbah will be 6.3 per cent.

As sections of the Freeway pass through large areas of natural bushland, including part of Brisbane Water National Park, special measures were developed to keep disturbance to a minimum.

Clearing will be limited only to the area to be occupied by completed works. Shrubs and undergrowth vegetation will be replanted after construction. Topsoil will be stored for re-use in the area from which it was taken, and foliage from felled trees will be used for mulching regeneration areas.

A model of the new bridge over Terranora Creek at Boyds Bay.

These measures should ensure rapid revegetation of completed works areas. Inspection of regeneration areas will prevent unwanted species establishing themselves in the area and encourage native flora similar to that existing in each area before construction.

Keeping the destruction of native vegetation to a minimum will also minimise the effect on fauna in the area. A steel arch underpass is being provided to allow wildlife free movement across the Freeway route. A 1.5 m wallaby-proof fence will deter them from crossing the actual road.

The numerous Aboriginal rock carvings in the area have been located and the Freeway designed so that all significant sites are avoided. Sites near the Freeway construction will be clearly marked and personnel instructed to avoid them.

The Freeway follows the route of the existing Highway for one section approaching Kariong. To allow construction without obstructing traffic, it was necessary to build a 4 km deviation of the Highway. The deviation was opened in October 1983, and as well as taking traffic around construction areas provides motorists with improved conditions.

The northern section of this work between Somersby and Ourimbah was opened in December 1983. This section joined an existing high standard divided carriageway section of the Highway,

An artist's impression of the completed structure at Mildura.

which in turn joins the Freeway north of Ourimbah.

The section between Calga and Somersby, which includes the new Mooney Mooney Creek bridge, is expected to be open during 1986/87.

Two new bridges for Tweed Heads area

More roadworks are planned along the Pacific Highway to alleviate heavy local and tourist traffic in the Tweed Heads area.

Boyds Bay

The existing two lane bridge at Boyds Bay over Terranora Creek, built nearly 50 years ago, has become a regular bottleneck for holiday traffic.

The proposed new bridge will be a five lane prestressed concrete structure situated immediately east of the existing bridge. Two lanes will be for southbound traffic, two lanes for vehicles heading north to the centre of Tweed Heads and the left-hand northerly lane for traffic proceeding into Kennedy Drive. A 2.4 m wide pedestrian footway will be provided on the eastern side of the new structure.

This bridge and associated roadworks are expected to be completed by the end of 1985.

These improvements will complement the forthcoming construction of the 6 km long Tweed Heads Bypass from Sextons Hill to the Queensland border. Preliminary work on this project started last year.

Barneys Point

It is also planned to replace a steel and concrete bridge over the Tweed River on the Pacific Highway at Barneys Point. Built in 1936, the structure is just 6 m wide between kerbs and has a single bascule span which is opened regularly to allow the passage of river vessels.

The new bridge will provide four lanes and a footway for pedestrians. It will be a high level structure, with a minimum vertical clearance of 15 m above mean high water level and a minimum horizontal clearance of 20 m. This will eliminate the need for an opening bridge. It will be located approximately 80 m downstream from the existing bridge.

The cost of both bridges and associated approach works will be approximately $18 million.

Three bridges over the Murray River

Mildura

A $10 million project is underway to replace six narrow timber bridges which provide a crossing of the Murray River at Mildura.

The main structure to be replaced is the steel truss lift span bridge on the Sturt Highway. Built in 1927 as part of the main Sydney-Adelaide route, it will be demolished when the replacement bridge is completed.

The new bridge comprises a nine span prestressed concrete single cell box girder type structure. It has an overall length of 331 m and an overall width of 12.33 m. A span length of 37 m has been adopted for all spans except the end spans, which are 30.8 m long. The new structure is located on a deviation of the Sturt Highway. Upstream of the existing bridge, it provides a vertical clearance in excess of 8.5 m above the highest recorded flood level in the navigation channel, thereby eliminating the need for a lift span.

An artist's impression of the new bridge over the Murray River at Tocumwal, with the existing bridge downstream.

The bridge deck will provide a carriageway 9.8 m wide between kerbs with a 1.5 m wide footway on the downstream side. The continuous box girder, which is to be constructed by the precast segmental erection method, is supported on single column rectangular tapered reinforced concrete piers with shaped ends. The piers are founded on a group of driven open-ended steel tubular piles with full length reinforced concrete infill. Expansion joints are provided at the abutments only.

The bridge is currently expected to be completed in the first half of 1985. The $3.6 million cost of this border bridge will be shared equally between New South Wales and Victoria.

In addition to the new border bridge, the deviation in New South Wales requires the construction of three smaller concrete structures to replace four old timber beam bridges. The full cost of $1.1 million is being met by the Department, whereas the Road Construction Authority will meet the cost of the one remaining approach bridge on the Victorian side of the border.

Tocumwal

Separate rail and road bridges are planned for the crossing of the Murray River at Tocumwal to replace the existing road/rail steel truss bridge. The old structure, 4.27 m wide between kerbs, is prone to lengthy traffic delays because of the need to stop motor vehicles to allow trains to pass.

The Department is responsible for the design and construction of the new road bridge, which is 9.2 m wide between kerbs and provides a 1.5 m wide footway on the upstream side.

The design of the superstructure will be similar to that of the Mildura Bridge, which is presently under construction. It will consist of six continuous spans (two 32 m long and four 37 m long) of precast post-tensioned concrete segmental single box girders supported on reinforced concrete piers and spill-through abutments. Each pier and abutment will be supported on six tubular steel piles with concrete infill.

The southern abutment will be located some 60 m behind the southern bank, to provide a waterway for the flood channel that cuts across the bend in the river upstream and hence minimise the effects of scour.

Design and construction of the new rail bridge are being undertaken by the State Transport Authority of Victoria. The cost of this project will be in excess of $2 million and will be shared between the Department and the Road Construction Authority of Victoria.

Moama

A similar project to that at Tocumwal is planned to replace another road/rail bridge over the Murray River, between Moama and Echuca on the Cobb Highway. The existing bridge, built in 1878, causes similar delays to traffic as the Tocumwal bridge.

The design and construction of this structure will be carried out by the Road Construction Authority of Victoria. However, the Department will share the cost of the replacement bridge and will fund the approaches on the New South Wales side of the border. Total cost of the project will be almost $3 million.

CONSTRUCTION AND MAINTENANCE OF PAVEMENTS

XVII WORLD ROAD CONGRESS – SYDNEY 1983

At the XVII World Road Congress held in Sydney in October last year, five questions on various aspects of roadbuilding were discussed. Question II, 'Construction and Maintenance of Pavements', was the principal topic at the Congress.

The following is a reprint of the Australian Report on Question II, National Reporter Mr. A. Leask, (B.E.), Materials and Research Engineer, Department of Main Roads, New South Wales.

SUMMARY

A. GENERAL QUESTIONS

Recent trends, innovations and developments in Australia are described, in respect of pavement evaluation techniques involving visual assessment systems in conjunction with objective measurements of deflection, roughness and friction by means of automated equipment. Also the utilisation of blast furnace slag is discussed, as well as examples of the influence of susceptibility to flooding and mine subsidence on pavement design and construction techniques.

B. FLEXIBLE PAVEMENTS

Strategies for pavement construction are discussed with particular reference to permeability and moisture control. A trend is noted in some areas towards the use of graded macadam materials in combination with a stabilised underlying layer. In other areas different trends are apparent in the use of stabilisation or an alternative technique involving very high levels of compaction. Reference is also made to the use of performance monitoring, a national data bank, reclaimed rubber in bitumen, hydrated lime as an antioxidant in bitumen, a waste ash as a pavement material, cement stabilisation for recycling pavement bases, and an improved process of asphaltic concrete production.

Note: Because of space limitations, Section C — Concrete Pavements has been omitted from this reprinting. (An article on the Department's use of concrete in road pavements appears in the June 1982 issue of the 'Main Roads' Journal, Vol. 47, No. 2, p. 38.)

A. GENERAL QUESTIONS

1. DEVELOPMENT OF THE TECHNIQUES USED IN EACH COUNTRY SINCE THE CONGRESS IN VIENNA UNDER PRESENT ECONOMIC, SOCIAL AND ENERGY CONSTRAINTS — REASONS WHICH HAVE LED TO THAT DEVELOPMENT

Road construction and maintenance in Australia are being significantly influenced by economic constraints, with the real value of funds available for roadworks declining. Moreover, while adapting to this confinement there is a need also to progressively increase maintenance expenditure in order to incorporate new as well as existing assets. Consequently construction activity is being constricted and curtailed.

The situation is being aggravated by the social pressures to provide better roads, not only in terms of road user costs, safety and comfort, but also in terms of conservation of the environment and natural resources, particularly fossil fuel.

It has been estimated that, in Australia, transport costs represent on average about a quarter of the cost of goods and services. Although there are many components within the transport costs themselves, there is little doubt that these are influenced substantially by the condition of the road network and the level of service it provides for transport operators.

There is a clear need to further improve and develop the road communication network in Australia. This need, together with the combined effects of monetary constraints and inflation, has intensified the incentive to develop techniques and exploit materials which will result in improved efficiency.

3. PROGRESS IN THE OPERATIONAL ASSESSMENT OF PAVEMENT QUALITY

3.1 Contributory criteria: deflection, cracking, rutting, skidding resistance properties, evenness, rumbling noise, rolling resistance

There has been a significant adjustment of attitudes to pavement evaluation in Australia in recent years, involving the application of new techniques, including visual assessment as well as objective data from monitoring equipment such as the La Croix Deflectograph, SCRIM and the NAASRA Roughness Meter.

The data being generated are used for the design of maintenance or rehabilitation strategies for discrete sections of pavement and, in the longer term, to establish data banks to facilitate the development of comprehensive pavement management systems.

3.2 Overall criteria such as the present serviceability index

From field studies, actual variabilities in dimensions of roadworks have been determined as a first step towards establishing a statistically based specification - acceptance system. The dimensions investigated include pavement level, thickness, crossfall, grade, width and alignment (1).

Random measurements of surface level departures from design were taken from a large number of pavement construction jobs. The components of variance due to sampling and testing, construction and survey variabilities were separated. The components of variance were then used to calculate specification target standard deviations for four different options of construction standards, which reflect different quality requirements, viz. freeway, highway, urban arterial and rural local road standards.

3.3 Establishing limit values leading to necessary repairs

From a correlation exercise carried out guideline criteria for terminal roughness have been established for design purposes. The limits are used, also as a guide at this stage, for maintenance requirements. More comprehensive guidelines for pavement rehabilitation have now been issued in New South Wales (N.S.W.) (2).

5. WASTE PRODUCTS, BY-PRODUCTS, FRINGE MATERIALS

By-products of iron and steel making have been used in increasing quantities in recent years, mainly in N.S.W. where 85 per cent of the 4.9 million tonnes per annum of slag is produced (3).

Blast furnace slag comprises 70 per cent of the slag produced and is the type most commonly used for roadworks. It is used for road pavements both in the raw condition and crushed to meet various specifications for size and grading. To achieve maximum density grading, fines are added; about 4 per cent by mass. Currently shale and fine quarry dust are added, and previously fly ash and iron ore dust have been used. Approximately 0.75 million tonnes per annum of densely graded fine crushed slag roadbase are now used within 100 km of the Port Kembla Steelworks south of Sydney. There is a trend towards greater use of slag roadbase without added fines, as a free draining graded macadam type of material.

Slag roadbase undergoes a slow pozzolanic type reaction without added lime, and compressive strengths between 15 and 20 MPa after about 4 years have been measured in cored samples.

The Deflectograph machine carries a beam 'T' frame under the chassis. Inset shows the Deflectograph recorder, housed inside the cabin.

Age of Seal	Mean Coefficient of Wet Friction*	Standard Deviation
Initial	0.71	0.05
7 weeks	0.60	0.03
7 months	0.59	0.04
1 year	0.57	0.04
1 year 7 months	0.73	0.03
2 years 9 months	0.53	0.04

Table 1: Foamed Slag Friction Values

** Measured by portable pendulum apparatus*

Autogenous healing of cracks has also been observed.

Blast furnace slag is also used as aggregate for asphaltic or cement concrete, and for surface treatments. It is also produced in a granulated form called 'slag sand', and with a vesicular structure called 'foamed slag'. The latter has been tried as a surface treatment having good skid resistance, and is discussed in more detail in Section A6.

6. USE OF ARTIFICIAL AGGREGATES

As mentioned in Section A5 an aerated vesicular form of blast furnace slag, called foamed slag, has been used in field trials in N.S.W. as a skid resistant aggregate. The particular material produced for the trials is relatively weak and under severe stress conditions it tends to break down into smaller particles which may also be incorporated in the binder. The coefficient of friction measured repeatedly at a site with heavy traffic is reported in Table 1. The fluctuation evident in these values at 19 months has been attributed to the breakdown of the aggregate (4).

7. IMPACT OF EARTHQUAKES AND FLOODS ON THE DESIGN CONCEPT OF PAVEMENTS AND AERODROME RUNWAYS. WHAT CAN BE LEARNED FROM EXAMINATION OF AREAS AFFECTED

The design of certain pavements has been influenced significantly by the prevalence of flooding in one case, and by potential mine subsidence in another.

In the north coast region of N.S.W., the raising of road levels would have increased the severity of flooding and adversely affected the use of fertile farm land. Therefore reconstruction of the highway was effected without raising levels by the use of a concrete pavement including mass concrete subbase. This was the only feasible type of construction on the very weak subgrade with a high water table. A continuously reinforced concrete pavement was adopted (5).

Mining subsidence to the extent of 1.5 m has occurred on a freeway south of Sydney in sandstone strata. Damage to the pavement was minimal although some concrete surface drains and drainage structures were broken. The pavement included a self-cementing slag base with unconfined compressive strength up to 20 MPa after 4 years. Subsequently, a concrete pavement has been adopted in an area of potential mine subsidence on a freeway north of Sydney. This pavement is of plain (unreinforced) concrete base without dowels, and mass concrete subbase. Concrete was selected because of the weak subgrade, but choice of the short slab configuration is at least partly attributable to the subsidence possibility.

B. FLEXIBLE PAVEMENTS

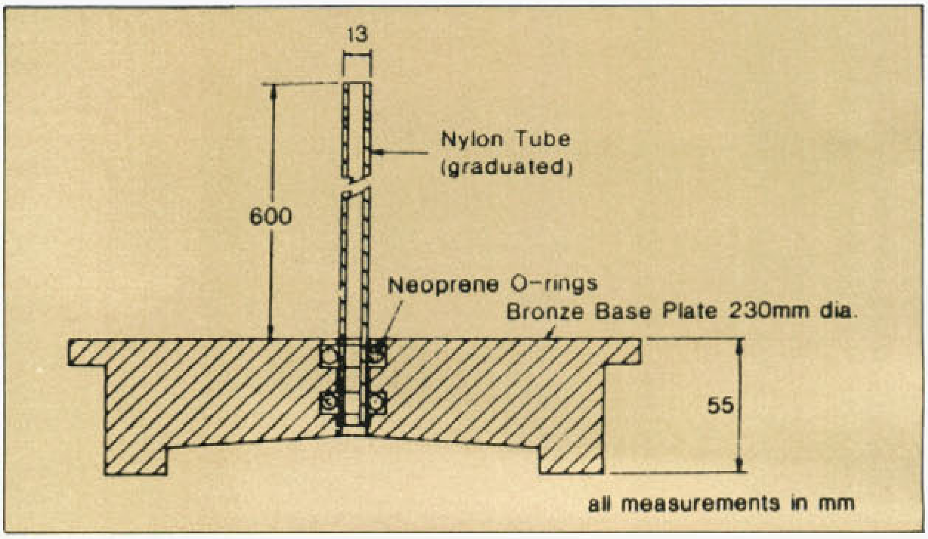
1. STRATEGIES FOR PAVEMENT CONSTRUCTION AND MAINTENANCE

1.1 Interaction between maintenance policy and pavement design. Social, technical and economic advantages of the various strategies

Strategies for pavement construction vary from State to State, although the recently published NAASRA Interim Guide to Pavement Thickness design (6) has introduced a substantial degree of uniformity. For instance, the assessment of subgrade strength, moisture conditions and traffic loading would now be fairly uniform.

In recent years general emphasis has been given to the relative permeability of pavement layers and the need for pavement drainage. A project of the Australian Road Research Board (ARRB) involved the development of criteria for filter materials and other aspects of subsurface drainage. An important contribution of this project is the development of a falling head permeameter (7) as shown in Figure 1, which can be used in construction and maintenance to determine the relative permeability of materials as placed. Wearing surfaces can be checked, including cold joints, cracks, etc. The test can also detect a significant reduction in permeability at a rolled surface where a slurry has been produced. This occurrence may be severe enough to constitute a permeability reversal, with the attendant risk of a perched water table developing. In this case saturation of the adjacent material will occur. This phenomenon is con-

Fig. 1: Falling head permeameter



sidered to be of major importance for both construction and maintenance practice.

Consistent with these principles of permeability and drainage, a trend is developing in some areas towards the use of macadam, or graded macadam, type materials. For example, in recent freeway construction near Sydney, macadams and pavement drains were adopted as shown in Figure 2. An essential feature of this pavement is the provision of a stabilised (or non water susceptible) layer beneath the macadam material.

This feature is consistent with a trend in N.S.W. towards stabilisation of subbase or subgrade, giving an 'upside-down pavement' configuration. Lime stabilisation is most commonly used, but on very weak subgrades, subbase consisting of cement/fly ash treated material or lean-mix mass concrete is now increasingly used.

In Queensland (Qld.) cement treated materials are used both as subbase and base. Applications of these types of pavement structure are discussed in Section B8.

The construction process itself also involves various strategies. For instance, in Victoria (Vic.), a high level of compaction is sought, and statistically based control procedures for compaction have been implemented in recent years. A high level of compaction is regarded as a viable alternative to increasing pavement stiffness by stabilisation. Laboratory testing has shown that for many materials the CBR value is more than doubled if compaction is increased from 95 to 100 per cent of the maximum dry density achieved with Modified Compaction (8). Some examples are given in Table 2.

Table 2: Effect of Compaction on Material Strength

Material	CBR (4 day soaked) compacted at lab. OMC (Modified Comp) at 95% Max. dry density	CBR (4 day soaked) compacted at lab. OMC (Modified Comp) at 100% Max. dry density
Crushed Hornfels	90	130
'Salamander'	35	65
River Gravel/Sand		
Mix 1	100	260
Mix 2	90	220
Sandstone No.1	120	180
Sandstone No.2	50	110
Siltstone	45	90
River Gravel	30	140
Limestone	80	130

In some States the level of compaction is now assessed by density measurement with nuclear meters. Some States use the backscatter mode of measurement, while others use the sub-surface probe for wet density measurement. In N.S.W. a meter has been developed with a 20mm diameter probe containing two radioactive sources, for both density and moisture measurement from below the surface.

In some areas of N.S.W. the uniformity of compaction is being checked during construction by deflection measurement with the Benkelman beam. This method is also used to ensure that further material is not placed over layers which exhibit excessive deflection because of moisture.

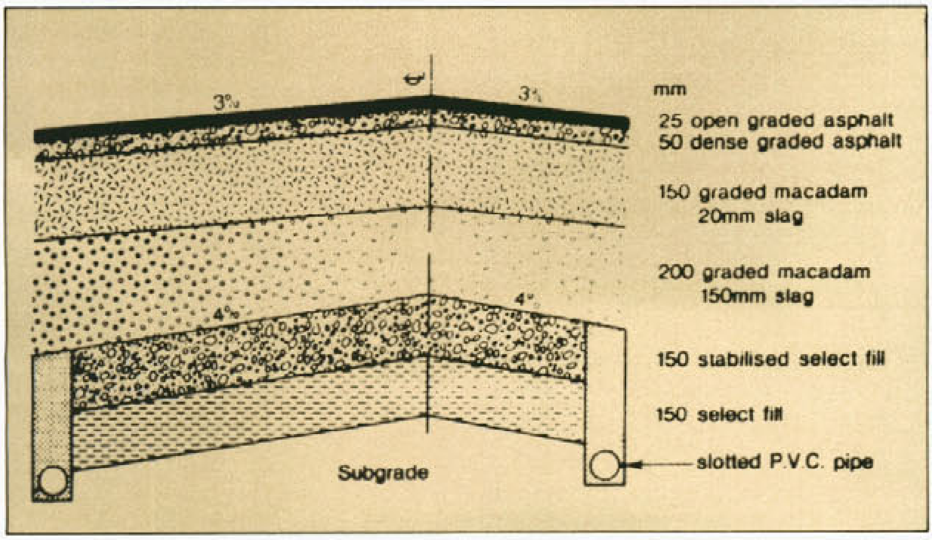
1.2 Data Bank

The National Association of Australian State Road Authorities (NAASRA), in 1981, commenced a study of rural arterial roads using a computer model called the NAASRA Improved Model for Project Assessment and Costing (NIMPAC) which operates on a data bank. The model, by comparison of data bank inventory with assessment standards, generates improvement projects to specific design standards, and rehabilitation projects under various strategy rules. The various categories of project are costed together with road maintenance and vehicle operating costs. Assessment and design standards, strategy rules and cost parameters are user variable. The effect of varying maintenance effort, on road condition and on road, vehicle and maintenance costs, can be modelled. This work is continuing until 1985.

The NAASRA data bank is stored in continuous format and contains the following general classes of information:

- identifiers — particularly permanent reference points and road function classification
- geometry — continuous length, widths, horizontal and vertical alignment
- description — shoulders, kerbs, median
- pavement and surface characteristics — type, roughness, PSI, year of last construction/reconstruction/reseal
- operational characteristics — particularly traffic volume composition and growth
- structure details — function, geometry, load capacity

Fig. 2: Freeway No. 5 pavement



2. ASSESSMENT OF LONG-TERM BEHAVIOUR OF TRADITIONAL TECHNIQUES FOR WEARING COURSES, BASE COURSES AND SUBBASES

2.1 Statistics of use of these techniques, results from the point of view of long-term behaviour

Pavement performance monitoring has commenced in recent years at specific sites to assist in maintenance planning and for the refinement of design and construction procedures.

In Victoria, the monitoring programme includes over twenty sections of rural freeway pavement constructed since 1980. The data collected comprise deflections and roughness values, measured by the La Croix Deflectograph and BPR Roughometer respectively, as well as records of all surface defects and maintenance activities. Testing is generally on a two yearly cycle, but new pavements are tested at the time of commissioning and again after one year. A good correlation has been obtained between the measured performance and that predicted by elastic analysis, particularly with respect to fatigue in asphalt surfacing (8).

In N.S.W., about thirty monitor sites have been established for assessing pavement performance based on testing with the La Croix Deflectograph and NAASRA Roughness Meter, and on visual assessment. Monitor sites have also been established in many areas for evaluating seasonal variations in pavement deflection and skid resistance, and for evaluating the field performance of various aggregates for skid resistance.

4. MODIFIED BINDERS AND VARIOUS ADDITIVES

4.1 Effective importance of the use of bituminous binders modified by polymers, bitumen-sulphur binder, adhesion agents, etc.

4.1.1 Rubber bitumen:

Although for 30 years rubber in bitumen has been used in field trials, it is only in recent years that rubber bitumen seals and strain alleviating membrane interlayers (SAMI) have come into general use. They are now in use in five States: Victoria, New South Wales, Queensland, Western Australia and South Australia. Both scrap and liquid rubber additives are used and the practice in Vic. and N.S.W. is summarised below. Reference is made in Section 4.2 to laboratory work conducted by the Australian Road Research Board.

4.1.2 Practice in Victoria (9):

The use of bitumen scrap rubber seals in Victoria has in recent years involved approximately 100 km of two lane carriageway and 280 tonnes of scrap rubber annually. Techniques have been developed which permit the use of conventional sprayers.

The scrap rubber buffings are added to the bitumen through an 'in-line' mixing box as the binder is pumped into the sprayer. This assists in dispersing the rubber uniformly in the bitumen.

Three broad concentration levels of rubber are used, with average values of 5, 15 and 20 per cent by mass of the blend. These apply respectively to the following situations:

(a) Where there is a need for a binder with better initial aggregate retention than normal bitumen.

(b) As for (a) but with more severe road geometry and traffic loading. Also where flexural cracking has occurred but is not severe (fine cracks only).

(c) Where flexural cracking is moderate to severe, but the pavement shape is acceptable. Major cracks are pretreated and the pavement is patched as necessary in advance.

4.1.3 Practice in N.S.W.:

In the year 1980/81 in N.S.W. nearly one million litres of rubber bitumen was sprayed in maintenance treatments (equivalent to 70 km of two lane carriageway), and the figure has increased since then. As well as scrap rubber, a concentrate of liquid rubber in bitumen is used. This concentrate is available in liquid and solid form, the latter in bag type packs. Scrap rubber is used at an average concentration of 20 per cent by mass.

The principal applications for rubber bitumen have been:

(a) Strain alleviating membranes (SAM) as surface treatments where cracking (usually flexural type) is substantial but pavement shape is acceptable.

(b) Strain alleviating membrane interlayers (SAMI) to inhibit reflection cracking where relatively thin asphalt overlays are to be used on cracked pavements. The overlay thickness used has generally been in the range 30 to 60 mm.

(c) Sealing of bridge decks, either new bridges before asphalt surfacing or old bridges as maintenance. This is a special application of SAMI or SAM.

Another special application of category (b), is an overlay or surfacing system consisting of a SAMI under 30 mm of open graded asphalt. This system has been used for rehabilitation after applying an asphalt correction course to restore pavement shape. The SAMI plus open graded asphalt is a relatively flexible surfacing with good riding qualities, good skid resistance and reduced spray hazard. In one case a new asphalt pavement has been treated with this surfacing because early cracking was anticipated.

4.1.4 Hydrated lime as an antioxidant:

A laboratory investigation (10) has indicated that hydrated lime dispersed in bitumen at concentrations of up to 12 per cent by mass of the blend should produce a significant reduction in the rate of hardening of seal bitumens in service, as shown in Figure 3. The test used is for assessing the durability of bitumen and is described in Section 4.2 below. Field trials of hydrated lime as an antioxidant additive have been established.

4.2 Tests and requirements

4.2.1 Rubber bitumen:

In laboratory experiments carried out at the Australian Road Research Board it has been found that digestions of vulcanised natural scrap rubber buffings from the retreading of tyres, are less stable thermally than those made from vulcanised synthetic rubber but are marginally more effective at the same concentration (11). The effectiveness of the latter material is very dependent on the morphology of the particles which, in turn, is decided by the comminution method used to produce them. Particles produced by a cryogenic impact process are much less effective than those produced by a grinding process in which the particles are torn from the bulk rubber. The temperature and time of digestion are of the order of 200°C and one hour respectively.

The elasticity and consistency of dispersions of comminuted scrap rubber and synthetic polymers in bitumen are assessed by shearing a 10 mm thick sample between parallel plates under a constant stress. When a strain of unity is reached the load is removed and the elastic recovery measured. The sample is maintained at a temperature of 60°C.

4.2.2 Hydrated lime as an antioxidant:

The intrinsic resistance of a bitumen to hardening in a thin bituminous surfacing is assessed by exposing a thin film at 100oC to the action of the oxygen in air in the absence of light (12). Exposure is continued until the bitumen reaches an (apparent) viscosity level at 45°C (called the critical viscosity) which has been related to distress in thin surfacings in service in the southern regions of Australia. Several State Road Authorities are specifying a minimum period of exposure to reach the critical viscosity of 9 or 10 days for bitumens complying with the requirements of the national specification (13) for Class 170 bitumens (viscosity at 60oC from 140 to 200 Pa.s).

Table 3: Physical Properties of Bottom Ash

Property	Value Unstabilised	Value Stabilised (6% lime)
Maximum Dry Density	1.06 t/m3 @ 35% moisture	1.165 t/m3 @ 20% moisture
Unconfined Compressive Strength	0-0.3 MPa after 28 days	4.6 MPa after 11,000 degree (C) hours
CBR	70% + 13.5	> 100%
Modified Texas Triaxial	Class 2.9 @ 25.2% moisture 3.0 @ 23.2% moisture 3.3 @ 28.2% moisture	Class 0
Lower Liquid Limit	40-52	
Lower Plastic Limit	Non plastic	
Linear Shrinkage	Nil	
Coefficient of Saturated Permeability (constant head permeameter	0.3 m/day @ hydraulic gradient 2	0.03m/day @ hydraulic gradient 1.3 after 24 hours curing 0.006 m/day after 72 hours testing (leaching of lime evident)

6. NEW TYPES OF MATERIALS FOR WEARING COURSES AND BASE COURSES

6.2 Tests and requirements

6.2.1 Bottom ash:

In N.S.W. a waste material from a thermal power station has been used as pavement material, both subbase and base. The material is known as 'bottom ash' as it collects in the bottom of the furnace. This ash is then sluiced away and pumped to settling ponds from which it is stockpiled by swamp dozer.

Physically the ash is a granular material with grains predominantly in the sand sizes, but ranging from 10 mm to dust. The ash has a low compacted density, the unit weight being approximately half that of normal pavement materials. A summary of some of the physical properties is given in Table 3 and Figure 4.

Chemically the bottom ash is similar to fly ash which is often used to replace part of the portland cement in concrete mixes. A comprehensive testing programme (14)

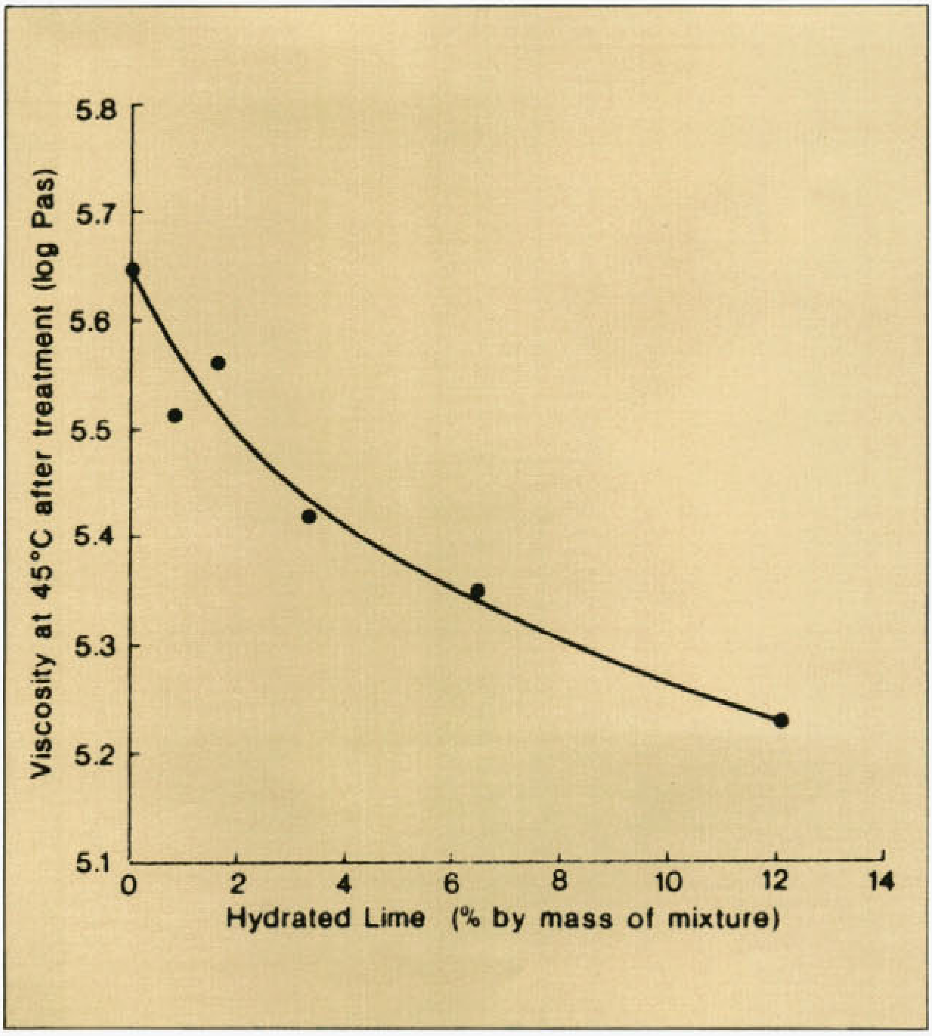
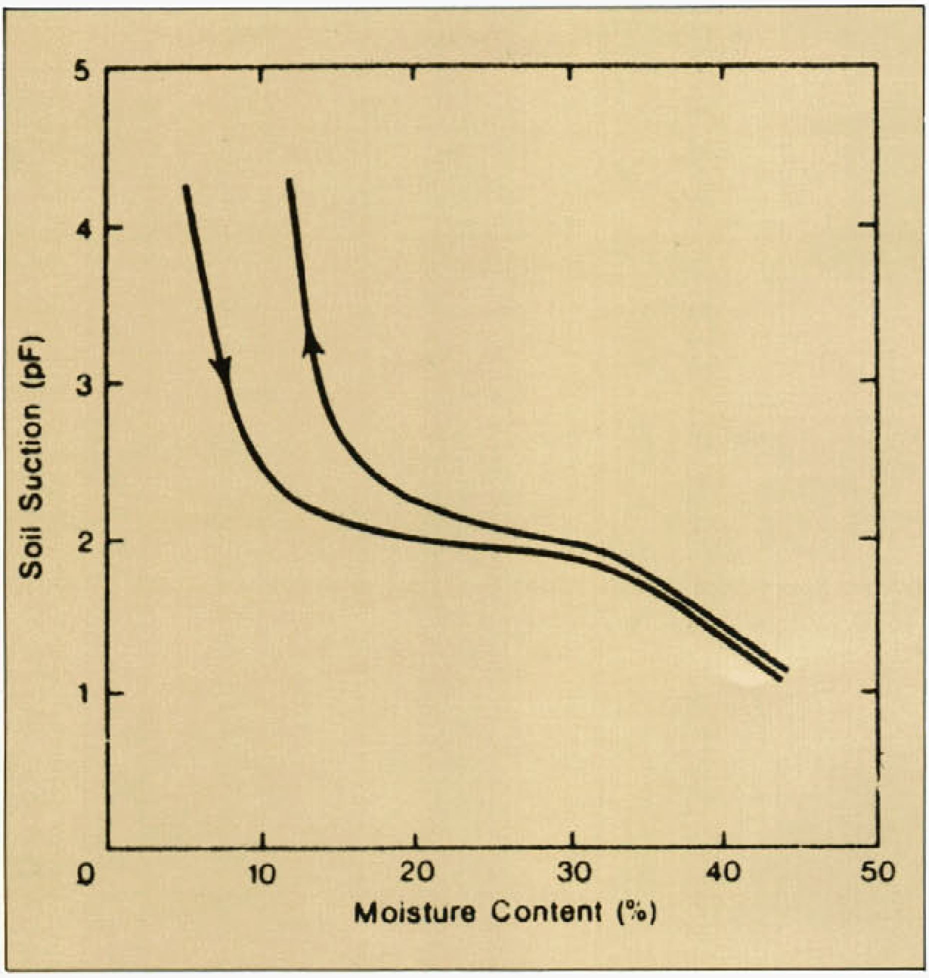


Fig. 3: Effect of hydrated lime concentration on the rate of hardening of a bitumen. (Exposure for 10 days under conditions of a durability test.)



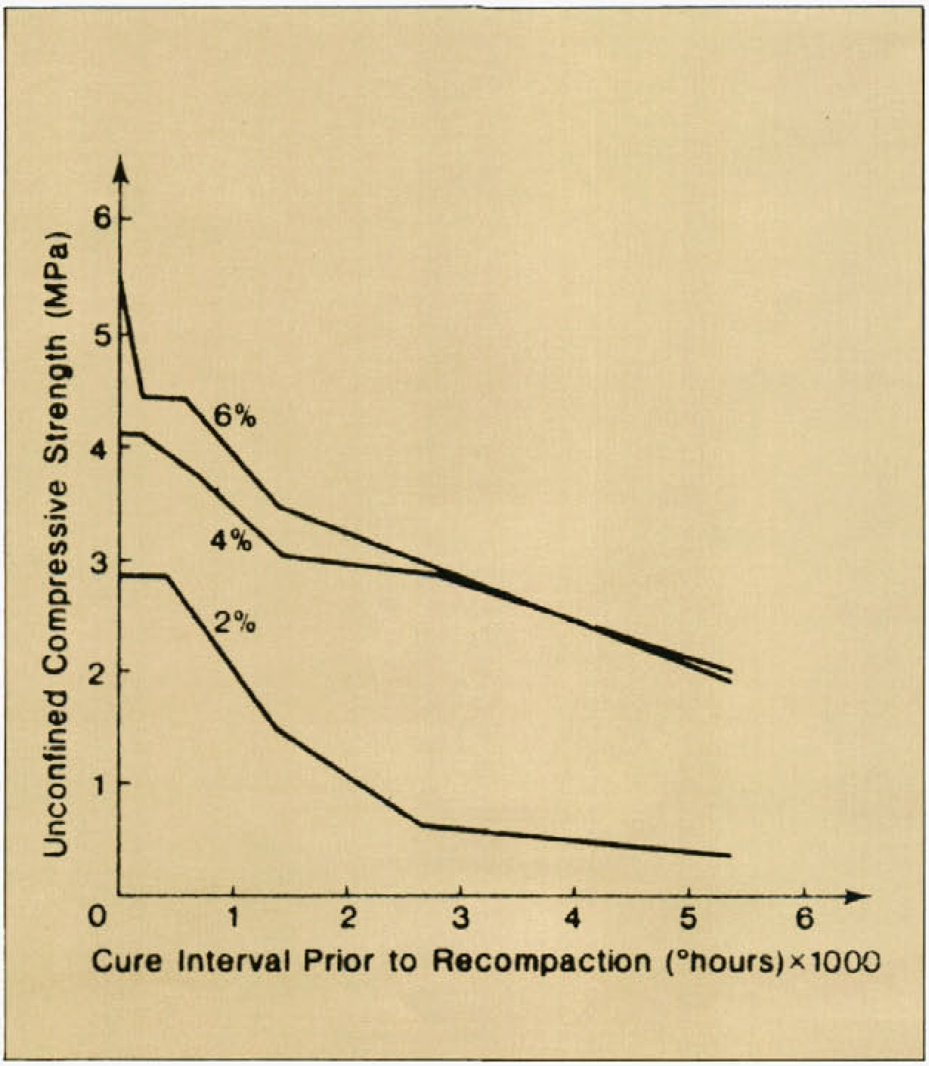


Fig. 4: Suction-Moisture content for bottom ash (Left)

Fig. 5: Effect of recompaction on the strength of lime-ash mixtures (Below)

was carried out using bottom ash stabilised with various amounts of lime (calcium hydroxide).

The unconfined compressive strength increased uniformly with increasing lime content up to 6 per cent by mass, the maximum value tested. The corresponding strength was 4.6 MPa after moist curing for 11,000 degree (C) hours. The strength also varied uniformly with curing time up to this value. The effect of recompaction on strength is given in Figure 5. An elastic characterisation of the bottom ash with 6 per cent lime, is given in Figure 6.

In addition to material characterisation in the laboratory, the bottom ash was tested on a small scale test track at Sydney University, and in two field trials (experimental pavements) with various pavement structures of lime stabilised and unstabilised bottom ash. The performance of the ash in the test track was comparable with the control material, a fine crushed rock.

The behaviour of the field trial pavements was compared with the predictions of elastic analysis, in terms of surface deflection and, in the instrumented trial, horizontal strain at the bottom of the pavement.

The field trials highlighted some potential construction problems with the bottom ash, related to its permeability, absorptive properties, fineness for base material, high reactivity with lime, and low relative density. These potential construction problems are, respectively:

(a) Permeation of moisture to subgrade
(b) Absorption of bitumen, or its lighter fractions
(c) Separation of seal from base
(d) Time sensitivity for recompaction and final trimming
(e) Wear and erosion of unprotected surfaces under traffic, or of edge batters.

The bottom ash stabilised with 6 per cent lime, is being used for regular construction as subbase material, at present. This application is consuming all the bottom ash available from one power station.

8. RECYCLING AND RESTORATION OF FLEXIBLE PAVEMENT MATERIALS

8.1 Experience acquired in these techniques (pavement quality, behaviour and service life, influence on investment and maintenance costs); introducing restored materials within the system of traditional requirements

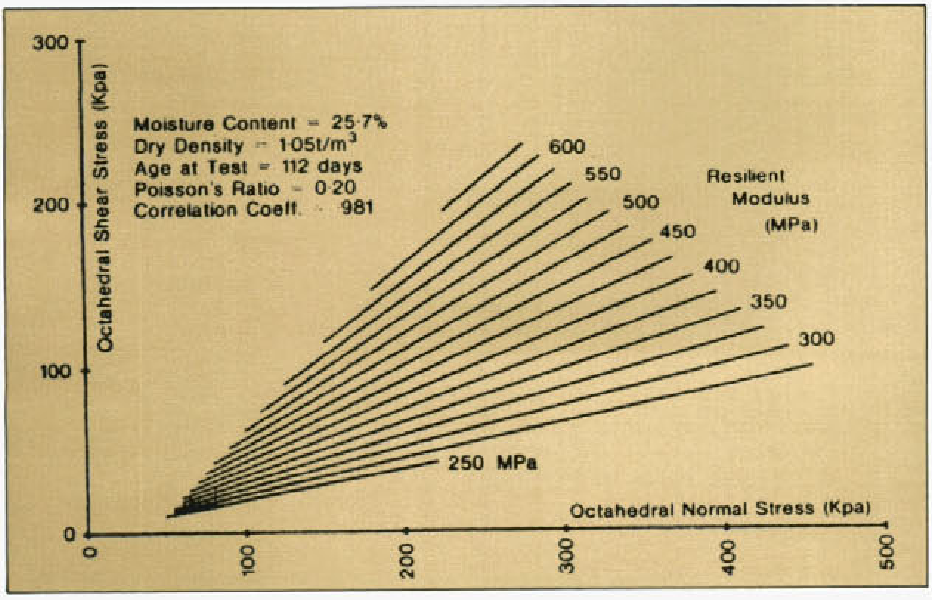
8.1.1 Practice in Queensland:

In Queensland the Main Roads Department is using recycling techniques in the restoration of granular flexible pavements with thin sprayed seals which have reached a stage of deterioration at which they can no longer be held in a traffickable condition by patching (15).

One rehabilitation technique used is to stabilise the existing unbound granular pavement with cement in one pass to a depth up to 300 mm. The thickness of treatment required is determined for a 20 year design life using mechanistic pavement design procedures.

This means that previously lightly constructed pavements can be strengthened to provide a further 20 years design life without the addition of significant amounts of imported material. The process enables relatively short sections of pavement to be treated as a maintenance operation without significant problems in conforming to the level of adjoining sections of road or without having to widen formations to accommodate thick granular overlays. The rehabilitated cement treated base is given a thin sprayed seal. The cost of this rehabilitation treatment is considerably less than an asphaltic concrete overlay.

Fig. 6: Elastic characterisation of bottom ash with 6% lime using a repeated load triaxial/octohedral stress model



The process also has the advantage of eliminating the rutting failures which are prevalent in the humid tropical environment of North Queensland in unbound granular pavements due to the pavement material becoming saturated.

The treatment is carried out over a width of one third of the two lane pavement while the traffic is using the other two thirds and shoulders. This facilitates traffic control.

There are two disadvantages of the process. The surface finish obtained, although acceptable, is sometimes not quite as good as achieved in new construction. Heavy vibrating compactors are required to compact the thick layers of cement treated material and even with this equipment, the degree of compaction achieved in the lower part of the layer is less than that achieved in the upper part of the layer. If the existing gravel is fine it may not always be possible to meet specified requirements for compaction in the lower part of the layer.

Another process used which overcomes this problem involves treating 150 to 200 mm of existing pavement in the above manner and then adding a further course of imported stabilised material to make up the full depth of base required.

Although up to 6 per cent by mass of cement has been used in the stabilisation process, no significant shrinkage cracking problems have occurred. It is pointed out, however, that the work has been carried out mainly in a humid sub-tropical or tropical environment where temperature variations throughout the year are minimal.

8.1.2 Practice in N.S.W.:

In N.S.W., the Blacktown City Council is using similar recycling techniques to those described above for Queensland. However, the pavement materials to be cement treated may include asphalt surfacing up to 50 mm thick. The process is regarded as very suitable for urban areas as it is quick, it minimises interference to underground services and surface levels, it produces no waste, it needs no long hauls of granular materials, and streets can be re-opened to traffic at the end of each day's work. The usual range of thickness for recycling is 150 to 200 mm. The total area of pavement recycled over a period of years is some 500,000 square metres (16).

Before recycling of a pavement is undertaken, a condition survey is performed involving visual inspection, deflection measurement, and laboratory testing. At least half of the material is required to be crushed rock or similar granular material. Cement contents of 3 to 6 per cent by volume have been used giving unconfined compressive strengths at seven days in the range 1.0 to 1.5 MPa. The allowable deflections for the completed pavement, as measured by the Benkelman beam, range from 0.6 to 2.3 mm for traffic loadings of 4.4 million to 9 thousand E.S.A. The design life is ten years.

9. EQUIPMENT FOR MANUFACTURE AND IMPLEMENTATION

9.1 Experience acquired in the use of mixing plants of the drum-mixer type

9.1.4 Comparison with traditional types of mixing plants:

An improved process of asphalt production has been developed in Australia which has three principal advantages over present systems. Namely:

(a) there is no requirement for any emission collection equipment;

(b) there is a minimum of energy required for heating and drying of the asphalt mix; and

(c) it has the ability to produce asphalt mixes using recyclable asphalt without any changes or additional equipment.

In this process the cold, damp input materials are mixed with bitumen in a specially designed continuous pugmill. This operation is carried out prior to the resultant partially mixed material entering the heating and mixing drum. The flame is contained in a separate compartment before the drum.

The premixing and a reduced hot gas velocity through the drum considerably reduce exhaust emissions. A reduction in fuel usage is achieved by the use of mechanically atomising burners, having the fuel burnt completely within the specifically designed combustion chamber and by a very finely controlled gas flow into and through the drum (17).

9.2 Laying equipment

9.2.1 Influence of the type of equipment used on the quality of the layer obtained and the uniformity of its depth:

Because of dissatisfaction with the standard of finish obtained when laying crushed rock through conventional asphalt pavers, the Queensland Main Roads Department undertook an investigation to discover the cause.

Levels and nuclear density meter readings were taken while the operation of the machine was observed. It was found that while laying a 150 mm (compacted thickness) course in one layer that there were variations in the density of the material being laid and variations in surface level of the finished compacted course which could be related to the operation of the auger feeding material to the screed. While the auger was not rotating less compaction was achieved in the material being spread and the screed moved downwards. If the auger box was flooded with material there was increased resistance to forward motion of the paver which slowed it, and the screed rose.

The overall result of these variations in the operation of the paver was to produce corrugations in the surface of the base with an amplitude of up to 5 mm. The problem was considerably reduced when the compacted thickness of the layer was reduced to 100 mm.

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The SCRIM machine (Sideways Force Coefficient Routine Investigation Machine) in action on the F1 — Warringah Freeway. Inset shows a close-up of the device under the chassis.


ROAD TEST
WET SURFACE
PASS WITH CARE

Tenders Accepted by Councils

The following tenders (in excess of $20,000) for road and bridge works were accepted for the three months ended 31 December 1983.

Council	Road No.	Work or Service	Name of Successful Tenderer	Amount
				$
Blayney	Various	Bitumen sealing and resealing	Emoleum (Aust.) Ltd.	71,704.66
Blayney	Various	Supply and delivery of cover aggregate.	Readymix Farley Group (N.S.W.)	27,512.00
Bourke	Trunk Road No. 68	Construction of bridge over Winbar Creek, 129.4 km south of Bourke.	L.F.C. Contracting Pty. Ltd.	178,748.00
Cowra	Various	Bitumen sealing and resealing.	Allen Bros. Asphalt Ltd.	92,398.66
Forbes	Various	Bitumen sealing and resealing.	Allen Bros. Asphalt Ltd.	118,649.04
Gilgandra	Various	Bitumen sealing.	Spraypave Pty. Ltd.	78,164.02
Gilgandra	Various	Bitumen sealing.	Blue Metal and Gravel (Country) Pty. Ltd.	31,056.10
Hastings	Rural Local Road	Construction of bridge over Limeburners Creek at 7.2 km north west of Port Macquarie.	Enpro Constructions Pty. Ltd.	1,196,462.00
Hume	Various	Bitumen sealing of roads in Council area.	Allen Bros. Asphalt Ltd.	148,209.86
Lachlan	Various	Bitumen sealing and resealing.	Allen Bros. Asphalt Ltd.	346,870.91
Moree Plains	Various	Supply and delivery of bitumen sealing aggregate.	Johnstone Gravel Co.	63,418.55
Moree Plains	Various	Supply, heat, haul and spray C170 bitumen.	Spraypave Pty. Ltd.	224,437.77
Murrumbidgee	Various	Bitumen spraying of various roads in Council area.	Emoleum (Aust.) Ltd.	160,901.55
Murrumbidgee	Various	Bitumen spraying of various roads in Council area.	Redymix Farley Group	48,256.00
Newcastle	Main Road No. 316	Construction of prestressed concrete bridge over Throsby Creek at Hannel Street, Wickham.	Wood Hall Ltd. (Trading as the Hornibrook Group)	746,022.00
Taree	Trunk Road 90	Construction of bridge over Burrell Creek No. 1 at 21.4 km west of Pacific Highway at Purfleet.	A.R. Dickinson Construction Pty. Ltd.	267,093.00
Temora	Various	Bitumen sealing of various roads in Council area.	Canberra Asphalts Ltd.	154,622.12
Tumbarumba	Various	Bitumen sealing tenders.	Allen Bros. Asphalt Ltd.	84,244.30
Weddin	Various	Bitumen sealing and resealing of various roads in Council area.	Allen Bros. Asphalt Ltd.	170,039.11
Wellington	Various	Bitumen sealing and resealing of roads in Council area.	Emoleum (Aust.) Ltd.	126,369.72
Windouran	Main Road No. 319	Bitumen spraying.	Emoleum (Aust.) Ltd.	66,790.49
Yallaroi	Various	Supply and delivery of bitumen cover aggregate.	Johnstone Gravel Co.	28,074.50
Yallaroi	Various	Supply, heat, haul and spray C170 bitumen.	Emoleum (Aust.) Ltd.	121,648.02

Tenders Accepted by the Department

The following tenders (in excess of $20,000) for road and bridge works were accepted for the three months ended 31 December 1983.

Road No.	Work or Service	Name of Successful Tenderer	Amount
			$
Freeway No. 3	Sydney-Newcastle Freeway. Shire of Wyong and Muncipality of Lake Macquarie. Construction of dual carriageways including structures from Wallarah Creek interchange, Warnervale to Watkins Road, Wyee, 97.9 km to 104 km north of Sydney.	Jennings Construction Ltd.	Schedule of Rates ($7,478,745.00)
Freeway No. 4	Western Freeway. City of Parramatta and Municipality of Holroyd. Construction of reinforced concrete cast-in-place piles between Carlingford Railway Line and Onslow Street, Granville for the new viaduct between Wentworth Street, Granville and Church Street, Parramatta.	Frankipile Australia Pty. Ltd.	$223,431.00
Freeway No. 4	Western Freeway. City of Parramatta and Muncipality of Holroyd. Construction of bridges on the eastern ramps of the James Ruse Drive interchange at Granville.	Enpro Constructions Pty. Ltd.	$1,174,692.00
Freeway No. 5	South Western Freeway. City of Liverpool. Construction of a cement concrete pavement between the Hume Highway and Heathcote Road.	N.S.W. Civil Division Citra Constructions	Schedule of Rates ($1,300,000.00)
Freeway No. 5	South Western Freeway. City of Liverpool. Construction of earthworks and drainage from the bridge over Georges River at Casula to Heathcote Road and reconstruction of a section of Heathcote Road and construction of box culverts.	J. Smit & Sons	Schedule of Rates ($1,200,000.00)
Freeway No. 8	Wollongong Freeway. City of Wollongong. Manufacture, supply, delivery to site, unloading and stacking of precast, pre-tensioned bridge planks for the bridge over Cabbage Tree Creek, 2.2 km north of Gwynneville Interchange, North Wollongong.	E.P.M. Concrete Pty. Ltd.	$118,104.00
State Highway No. 1	Princes Highway. Shire of Bega Valley. Supply and lay asphaltic concrete in Merimbula.	Canberra Asphalters	$29,500.00
State Highway No. 2	Hume Highway. Shire of Mulwaree. Construction of bridge of Wollongong Creek, 18.0 km west of Goulburn.	Gordon Ryan & Sons Pty. Ltd.	$366,000.00
State Highways Nos. 2 & 4	Hume and Snowy Mountains Highways. Shire of Tumut. Win and or crush, load, haul natural gravel from two Departmental pits to stockpile or formation at various locations on both highways.	Olding Excavations	$116,550.00
State Highway No. 3	Federal Highway. Shire of Gunning. Manufacture, delivery and unloading of precast pre-tensioned bridge planks for twin bridge No. 1 and No. 2 over Collector Creek and flood plain at 35.0 km to 37.0 km south of Goulburn.	Humes Ltd.	$631,680.00

Tenders Accepted by the Department (contd.)

The following tenders (in excess of $20,000) for road and bridge works were accepted for the three months ended 31 December 1983.

Road No.	Work or Service	Name of Successful Tenderer	Amount
			$
State Highway No. 5	Great Western Highway. City of Blacktown. Reconstruction and widening between Old Western Road and Reservoir Road, Prospect.	Pioneer Asphalts Pty. Ltd.	$38,086.62
State Highway No. 9	New England Highway. City of Maitland. Supply and lay up to 1200 t. of 5 mm asphaltic concrete and up to 1800 t. of 10 mm asphaltic concrete on rehabilitation between Verge Street and Harvey Road, Rutherford.	Bitupave Ltd.	$210,300.00
State Highway No. 9	New England Highway. Shire of Singleton. Supply and lay up to 4000 t. of 10 mm asphaltic concrete and up to 5000 t. of 20 mm asphaltic concrete to Jump Up Creek and to Three Sisters.	Bitupave Ltd.	$595,280.00
State Highways Nos. 9 & 10	New England and Pacific Highways. Supply and spray up to 150 000 l. of C170 bitumen to various construction and maintenance sites north of Newcastle on both highways.	Bitupave Ltd.	$72,650.00
State Highway No. 9 & Main Road No. 503	New England Highway and Putty Road. Supply and lay up to 200 000 l. of C170 bitumen to reseals on various locations on New England Highway and Putty Road.	Bitupave Ltd.	$121,000.00
State Highway No. 9 and Main Road No. 503	New England Highway and Putty Road. Supply and lay up to 3500 t. of 10 mm asphaltic concrete for maintenance works.	Hawkins Asphalt	$2,607,500.00
State Highway No. 10	Pacific Highway. Shire of Wyong. Installation of sub-soil drains between 123.0 km and 126.0 km north of Sydney — rehabilitation between Gwandalan turnoff and Chain Valley Bay Road.	Tuncuff Pty. Ltd.	$29,900.00
State Highway No. 10	Pacific Highway. Municipality of Lake Macquarie. Supply and lay up to 1100 t. of 20 mm asphaltic concrete and up to 850 t. of 10 mm asphaltic concrete to Roper Road, Doyalson.	Central Asphalt Depot.	$136,907.00
State Highway No. 10	Pacific Highway. Shire of Wyong. Supply and lay up to 2300 t. of 10 mm asphaltic concrete and up to 200 t. of 20 mm asphaltic concrete to construction work at Munmorah, 123.6 km to 125.9 km north of Sydney.	Bitupave Ltd.	$177,175.00
State Highway No. 10	Pacific Highway. Shire of Maclean. Manufacture, shop protective treatment, supply, delivery and stacking of steel bridge barrier and anchor bolts to bridge over Tabbimoble Creek 67.1 km north of Grafton.	Integrated Engineering Pty. Ltd.	$20,194.00
State Highway No. 10	Pacific Highway. Shire of Wyong. Construction of new pedestrian structure at Lake Munmorah Primary School.	W.G.E. Pty. Ltd.	$197,289.30
State Highway No. 10	Pacific Highway. Muncipality of Lake Macquarie. Supply and lay up to 7500 t. of 20 mm asphaltic concrete to reconstruction between 128.0 km and 132.5 km north of Sydney.	Boral Road Surfaces	$525,000.00
State Highway No. 10	Pacific Highway. Muncipality of Lake Macquarie and Shire of Wyong. Supply and spray up to 150 000 l. of C170 bitumen to construction and maintenance sites south of Newcastle.	Boral Road Surfaces	$69,150.00
State Highway No. 10 & Main Road No. 335	Pacific Highway and The Entrance Road. Supply and lay up to 1300 t. of 20 mm asphaltic concrete and up to 900 t. of 10 mm asphaltic concrete for construction of roundabout at intersection of Highway at Tuggerah.	Bitupave Ltd.	$164,466.00
State Highway No. 12	Gwydir Highway. Shire of Moree Plains. Construction of bridges over Burrandoon Watercourse Nos. 1 & 2 at 81.7 km and 82.8 km west of Moree, respectively.	L.F.C. Contracting Pty. Ltd.	$146,905.00
State Highway No. 14	Sturt Highway. City of Wagga Wagga. Manufacture, delivery to site, unloading and stacking of bridge planks for bridge over Tarcutta Creek flood plain at 39.0 km east of Wagga Wagga.	Humes Ltd.	$98,779.20
State Highway No. 16	Bruxner Highway. Shire of Tenterfield. Construction of bridges over unnamed creek and Snake Creek at 105.3 km and 105.7 km west of Casino, respectively.	W.G.E. Pty. Ltd.	$373,249.00
Trunk Road No. 68	Shire of Bourke. Reconstruction and bitumen surfacing between 7.4 km and 13.0 km east of Bourke.	Dallas Green & Co. Pty. Ltd.	Schedule of Rates ($670,000.00)
Main Road No. 198	Shire of Kempsey. Construction of bridge over Belmore River at Gladstone.	Pearson Bridge Pty. Ltd.	$639,000.00
Main Road No. 209	Shire of Muswellbrook. Construction of Lower Wybong bridge over Wybong Creek at Hollydeen, 6.4 km from Sandy Hollow.	Pearson Bridge Pty. Ltd.	$579,000.00
Main Road No. 253	Shire of Oberon. Construction of bridge over Eight Mile Swamp Creek at O'Connell, 24.1 km north of Oberon.	Gervay Constructions Pty. Ltd.	$163,500.00
Main Road No. 279	Shire of Gundagai. Construction of bridge over Morleys Creek in Homer Street, Gundagai.	N.J. McIntosh	$200,000.00
Main Road No. 404	Shire of Bourke. Redecking of bridges over Warrego River at 67.3 km and 66.0 km west of Bourke.	L.F.C. Contracting	$123,860.00
Main Road No. 508	City of Bankstown and Municipality of Hurstville. Widening of bridge over Salt Pan Creek in Henry Lawson Drive, Padstow.	Thiess Contractors Pty. Ltd.	$1,192,734.00
Kosciusko National Park — Road No. 1	Shire of Snowy River. Supply and lay kerb and gutter section of road from 25.3 km to 28.2 km west of Jindabyne.	Seovic Holdings	$60,880.00