THE GOVERNMENT OF PAPUA NEW GUINEA

THE DETAILED DESIGN
ON
ROAD CONSTRUCTION PROJECT
IN
BEREINA - MALALAUA

TENDER DOCUMENTS

(Volume III - 2)

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JAPAN INTERNATIONAL COOPERATION AGENCY

PAPUA NEW GUINEA

DEPARTMENT OF WORKS

TRANS-ISLAND HIGHWAY
BEREINA TO MALALAUA ROAD CONSTRUCTION PROJECT
CENTRAL/GULF PROVINCES

TENDER DOCUMENTS

FOR

LOT II : MIARU RIVER TO MALALAUA SECTION
CONTRACT NO. SC 120-33-814/B
CH 33+500 TO CH 80+596

VOLUME III-2

SPECIFICATION

DOCUMENT NO._____

TRANS-ISLAND HIGHWAY

BERINA TO MALALAUA ROAD CONSTRUCITON PROJECT

CENTRAL/GULF PROVINCES

TENDER DOCUMENTS
(LOT I AND LOT II)

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BEREINA TO MALALAUA ROAD CONSTRUCTION PROJECT
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GROUP 1

GENERAL

1.1 Location and Nature of the Works

The Works involve all Permanent and Temporary Works in connection with the construction of the Miaru River to Malalaua section (47.1km, CH 33+500 to CH 80+596) of the Bereina to Malalaua Road Construction Project, Gulf Province.

The Works include, but are not limited to the following:

(i) Provision and maintenance of Engineer's staff office, laboratory and residences;

(ii) Routine maintenance of the existing road and completed works from the date of commencement until the date of completion for the whole of the Works;

(iii) Earthworks excavation and embankment;

(iv) Sand mat filling and geotextile fabric installation on soft ground;

(v) Construction of sandy gravel lower subbase, cement treated upper subbase and cement treated base course;

(vi) Construction of double bituminous surface treatment including prime coat;

(vii) Construction of culverts and other drainage structures;

(viii) Construction of six bridges with a total span of approximately 470m and erosion protection structures;

(ix) Road furniture and pavement markings;

(x) Provision and maintenance of vehicles for use by the Engineer's staff;

(xi) Provision of miscellaneous equipment for use by the Engineer's staff; and

(xii) Maintenance of completed Works for 12 months from the date of completion of the Works.

1.2 Bill of Quantities

The expression of Bill of Quantities, Schedule Rate, Scheduled Rate(s), Schedule of Rate and Estimated Quantities, Schedule of Quantities and Rates, schedule unit prices, tendered unit price(s), prices tendered, schedule unit rate and unit rate shall mean the Bill of Quantities contained in Volume II-2 and includes the Tendered Rates and Prices therein.

1.3 Standard to be Provided

The Contractor shall bear the cost of and provide all Australian Standards and other publications referred to in the Specification. Photocopies of the standards and publications are not acceptable. The Edition of the Australian Standards shall be those editions (including amendments) which are listed in the current Annual List or Yearbook at the date of issue of Tender Documents to tenderers unless otherwise specified. These standards and publications shall become the property of the Employer on completion of the whole of the Works.

The standards and publications required are those listed in Appendix A.

1.4 Drawings

The drawings forming part of the Contract are listed in Appendix B. The Contractor will receive copies of the drawings as provided for by Clause 6 of the Conditions of Contract.

1.5 Possession of Site

The Contractor shall be given possession of the Site as stated in Clause 42.1 of the Conditions of Contract Part II.

1.6 Maintenance of Roads

1.6.1 The existing highway, bridges, drainage structures, associated highway appurtenances, connecting roads and tracks within the Site, shall be maintained by the Contractor during construction and until the issue of the Certificate of Completion. After the issue of the Certificate of Completion the provisions of Clauses 49.2 and 49.3 of the Conditions of Contract shall apply.

1.6.2 The Contractor shall also maintain sections of existing road that are yet to be given into his possession and sections of road connecting to the Site which he has

exposed to the haulage of materials, except where such haulage in the opinion of the Engineer does not constitute any substantial cause for additional maintenance.

1.6.3 The Contractor's obligation under this Clause in respect of each portion of the Site of which he is given possession shall commence on the day following the date upon which he was given possession of that portion.

1.6.4 The Contractor shall maintain the surface of the road, bridges, culverts and other drainage structures, roadside ditches and hard shoulders of the existing road and the completed work as directed and to the standard required by the Engineer.

1.6.5 The Employer shall carry out routine maintenance of each portion of the highway immediately prior to the Contractor being given possession of that portion.

In the event of the routine maintenace done by the Employer is not sufficient for the Contractor's use, the Contractor shall carry out such additional maintenance as necessary to restore the highway to a standard that he requires. This additional maintenance shall be at the Contractor's own expense.

1.6.6 The initial improvement of the existing road from Iokea to Apanaipi section (about 13 km) and from Koaru village to the end point of the Project (about 25 km) for the access to the Site and haulage shall be made by the Contractor and shall be available for the transportation purpose and traffic. The cost of such work and subsequent maintenance of these sections shall be deemed to be included in the contract price. Any damage to the existing road due to haulage and transportation resulting from the Contractor's operation shall be repaired at his own expense.

1.7 Contractor's Site Establishment

The Contractor shall provide and maintain all plant and equipment necessary to carry out the Works, all necessary temporary buildings and accommodation, sheds and stores and remove same from the Site on completion of the Works.

Within a period of 28 days of the acceptance of his tender, the Contractor shall submit a programme to the Engineer giving details of his intended site establishment procedure.

The temporary buildings and accommodation erected by the Contractor for his own use will remain the property of the Contractor.

1.8 Removal of Trees, Utility Services and Other Obstructions

If any trees, utility services or other obstructions are required to be removed, relocated or disconnected during the progress of the Permanent Works and are not otherwise specifically catered for in the Contract, the Contractor shall draw the Engineer's attention to them and the Engineer shall arrange for their removal, relocation or disconnection by the Contractor or otherwise.

1.9 Extraordinary Traffic

Further to the requirements of Clause 30.1 of the Conditions of Contract, the Contractor's attention is drawn to the vehicle weight and axle loading limits and spacing laid down in the current Motor Traffic Regulations particularly in relation to the use of vehicles for the haulage of materials and aggregates. The Contractor shall note any gross load limit which applies to any existing crossing.

1.10 Traffic Arrangement

The Contractor shall comply with the requirements of the Department of Transport and Civil Aviation and/or Police and/or any other relevant authority regarding any special traffic arrangement which may be necessary.

1.11 Traffic Movement

The Contractor shall so arrange and plan his operations so as to ensure the least obstruction and inconvenience to vehicular and pedestrian traffic. The Contractor shall not at any time have under construction a greater length or amount of roadworks than his resources can properly execute having due regard to the convenience of the public.

If in the opinion of the Engineer the Contractor has not complied with this Clause the Engineer may order the Contractor to suspend such part of the Works until such time when the Contractor has complied with the provisions of this Clause.

1.12 Temporary Diversion of Traffic

Where it is necessary for the proper execution of the Works for the Contractor to provide diversions for traffic using the existing highway within the Site, the details of such diversions and any necessary Temporary Works shall be subject to the acceptance of the Engineer. The Contractor shall construct and maintain such diversions and Temporary Works to a standard that will ensure proper passage for traffic in all weather conditions. Upon completion of the work requiring diversion the Contractor shall remove the diversion and Temporary Works and leave the area in a sightly condition and restore drainage to the satisfaction of the Engineer.

1.13 Warning Signs, Guide Markers and Barricades

Further to the requirements of Clause 19.1 of the Conditions of Contract, the Contractor shall erect and maintain temporary traffic warning signs in advance of places on the Site where his operations interfere with traffic using the existing highway, and at all intermediate points where the new work crosses or coincides with an existing road.

Barricades shall be erected and maintained in front of obstructions clearly indicating temporary detours. Where traffic is diverted from its original route, where excavations are alongside the trafficked route, and elsewhere as directed, the edge of the road or detour shall be clearly delineated by guide markers firmly driven into the ground, except where the Engineer permits portable guide markers to be employed. Warning signs, barricades and guide markers shall be constructed, painted and erected in accordance with the details shown on the Drawings or as directed by the Engineer.

The Contractor shall not be relieved of any liability under the Contract by the provisions of this Clause.

1.14 Road Closure

Closure of the existing highway shall not be permitted unless authorized by the Engineer in respect of particular periods of time and particular sections of road.

1.15 Existing Road Furniture

Existing road signs, guide posts, guard rails and such like road furniture which the Contractor requests permission to move for the necessary performance of the Works and which would otherwise remain; such existing road furniture which is required to be relocated on account of the road reconstruction; shall be dismantled with due care to avoid unnecessary damage and shall be reinstalled at the location, as directed by the Engineer. Any existing road furniture, which is removed but is not reinstalled, shall remain the property of the Employer and shall be delivered to the nearest Department of Works depot, as directed by the Engineer.

1.16 Centre-Line Survey

A centre-line survey shall be carried out based on the Drawings furnished by the Engineer. The survey shall use as "original points" the monumented control points from the topographical survey shown on the Drawings. The Contractor shall be responsible for setting of the road centre-line on the ground, erecting all necessary temporary reference pegs for construction purpose, and erecting permanent Kilometre posts which shall remain after completion of the Works.

The Contractor shall agree with the Engineer the proposed methods of executing and recording the centre-line survey, and shall notify the Engineer in writing at least 2 weeks before such survey commences in any particular section of the Site.

The Contractor shall carry out the survey but the Engineer shall have the opportunity to check each survey and recording. The Engineer shall direct extra surveys to resolve any doubts which may arise as to the correctness of any survey or record. Thereafter the Engineer's decision as to what shall be recorded as the correct survey shall be final.

The road centre-line shall be staked by wooden pegs on the ground at 25 m intervals, and at the beginning, intermediate and end points of curves. The Permanent Works in a particular section shall not commence until the centre-line survey has been completed, record drawings submitted and the Engineer indicated that he has no further comment.

The centre-line survey record drawings shall be traced and printed by the Contractor, who shall submit (and resubmit if necessary) three copies of each record survey drawing in draft to the Engineer until the Engineer has indicated that he has no further comments. Once the record survey drawings have been completed in the foregoing manner, each drawing shall be signed by the Contractor and by the Engineer and shall form the basis for the setting out of the Works. The original of each signed survey drawing shall be retained by the Engineer and three copies of each signed record survey drawing shall be supplied to the Engineer by the Contractor.

The Contractor shall be responsible for maintaining the temporary reference pegs and permanent Kilometre posts to a standard acceptable to the Engineer as well as all bench marks, pegs, offset pegs (where centre-line pegs have to be renewed) and other things used in setting out the Works.

The permanent Kilometre posts shall be concrete pegs of 0.10 m square projecting 0.50 m above ground surface.

1.17 Temporary Access Road and Temporary Diversion Bridge

Where access to working areas is not available, the Contractor shall provide temporary access roads to these areas at locations and along routes as are acceptable to the Engineer. In addition, the Contractor shall provide temporary diversion bridges for crossing rivers, streams or other existing waterways, if and where necessary.

The Contractor shall maintain the temporary roads and bridges in a satisfactory condition acceptable to the Engineer for as long as required but not beyond the end of the Period of Maintenance.

1.18 Temporary Works

The Contractor shall provide, maintain and remove on completion temporary structures required for the construction of the Works. Such Temporary Works shall be designed and constructed to carry the imposed loads. Drawings and calculations for Temporary Works thereto shall be forwarded to the Engineer for his information.

Notwithstanding any comments made by the Engineer on the design of the Temporary Works, the Contractor shall remain wholly responsible for their efficiency, security, safety and maintenance.

1.19 Construction Procedure (Bridges)

The Contractor shall ensure that his erection procedures do not overstress the Permanent Works or are in any way detrimental to the Permanent Works. The Contractor's attention is drawn to the requirements of Section 12 of the N.A.A.S.R.A. Bridge Design Specification 1976. The Contractor shall pay particular attention in ensuring the stability of his Temporary Works, the Permanent Works and all components thereof at all times.

The stress as permitted in Article 12.2.4 of the N.A.A.S.R.A. Bridge Design Specification 1976 shall, for the combination of dead load, live load, erection stresses, wind and normal stream flow be limited to the basic allowable stresses. The Contractor is to submit his erection proposal to the Engineer at least 28 days prior to his intended start of construction.

Construction of any bridge shall not commence until the Engineer has indicated that he has no further comment on the Contractor's erection procedure.

The provision of this Clause shall in no way relieve the Contractor of his obligations under the Contract.

The erection procedure for Bridge No.6 (Lakekamu Bridge) and Bridge No.7 (Tauri Bridge) shall be a launching erection procedure as shown on the Drawings. If the Contractor intends to use any alternative erection procedures, he shall submit fully detailed proposal in accordance with this Clause.

1.20 Helicopter Charge for Centre-Line Survey and Prepatory Works

The Contractor may if he wishes hire a helicopter for carrying out the centre-line survey, providing Engineer's office, laboratory and residences, and Contractor's site establishment.

Within a period of 28 days of the acceptance of his tender, the Contractor shall submit a programme to the Engineer giving details of his intended helicopter hire.

1.21 Detailed Survey and Monthly Progress Payment Survey

The areas to be occupied by borrow pits, quarry sites, river deposits, spoil banks, structure sites, and bridge sites, shall be the subject of detailed surveying by the Contractor. Surveying shall include cross sections of the ground line at 25 m centres as directed by the Engineer pursuant to Specification Clause 4.19.

Monthly progress payment surveys of the Works shall be carried out in accordance with Clauses 56.1 and 56.2 of the Conditions of Contract.

1.22 Reports

The Contractor shall prepare and furnish to the Engineer at regular monthly intervals, and in a form to be determined by the Engineer, five (5) copies of monthly reports describing work completed and progress relative to the agreed programme.

In addition, the Contractor shall submit to the Engineer at the end of each week a weekly report on work carried out during the week, and work to be carried out in the following week. Reports on labour and plant utilization shall be submitted daily.

1.23 Progress Photographs

(a) The Contractor shall provide colour progress photographs taken as and when directed by the Engineer and in any case at intervals of not more than one month.

(b) Sufficient photographs shall be taken and one proof copy of each shall be supplied to the Engineer to allow him to select the photographs which in his opinion provide the best record. On each occasion that progress photographs are taken, the Contractor shall provide 2 prints of not less than 250 mm x 200 mm from each selected photograph, the original negative of both selected and unselected photographs, and two acceptable hard covered ring-

file type albums with clear plastic sleeves, each album being of a size that it can accommodate 1 set of prints. The negatives shall be presented in a separate album. Each photograph shall have the title typed below it. Each "monthly" set of photographs is to be accompanied by two A4 size plan(s) of the Site with arrows indicating the locations and directions in which the photographs were taken.

(c) The photographs, negatives and albums shall become the property of the Employer.

(d) The backs of both the sets of the 250 mm x 200 mm photographs are to be titled by the Contractor in accordance with the Engineer's instructions and dated and signed both by the Contractor and the Engineer as agreement of the date on which they were taken and their location. The Contractor shall also affix a typed label giving the approved title and number to the front of the photograph.

(e) The photographs shall be taken by a skilled professional photographer acceptable to the Engineer. Similarly, processing shall be carried out by a competent processing firm acceptable to the Engineer.

(f) Proof copies shall be supplied to the Engineer within 7 days of the photographs being taken and the required number of prints shall be provided within 21 days of the Engineer notifying the Contractor of those photographs which have been selected.

1.24 Test - General

(a) Tests required under the Contract or as directed by the Engineer shall be carried out by the Contractor except the following tests which will be performed in the Engineer's laboratory or the field by the Engineer's Representative with such labour and assistance including transport as may be required by the Engineer, provided by the Contractor:

(i) Sieve analysis;

(ii) Dry density/moisture content relationship test (laboratory compaction test) AS 1289 Test E1.1 or E2.1.

(iii) Atterberg limits;

(iv) Concrete strength tests (including preparation and transportation core.)

(v) CBR tests AS 1219 Test No. F1.1;

(vi) Unconfined compressive strength tests AS 1141.51;

(vii) Aggregate tests

(b) The Contractor is at liberty to be present at all times when the tests listed above are being performed but failure to be present shall not invalidate the test results.

1.25 Site Information

A number of drillholes, boreholes and trial pits have been made on parts of the Site, and in other areas, some of which may constitute possible sources of materials for construction. The results of these investigations are included in the "Local Conditions" Report.

The "Local Conditions" Report is not part of Contract Documents but is made available to assist the Contractor in his own investigations.

Various aerial photographs of the Site are also available and may be inspected by arrangement with the Engineer.

The Contractor's attention is drawn to Clauses 11.1 and 12.1 of the Conditions of Contract wherein his general obligations in respect of Inspection of Site etc. are defined. Every effort has been made to ensure that the geotechnical information contained in the Report gives a reliable description of the conditions likely to be encountered during the construction of the Works, but the Contractor shall be deemed to have considered this information critically during the preparation of his tender and to have carried out such further investigations and tests as he considers necessary. The Contractor shall not be entitled to additional payment on the grounds that any information given in the "Local Conditions" Report is incorrect or misleading.

In particular the geotechnical information in respect of materials sources is no confirmation that the materials from those sources are available in sufficient quantities without selection and processing. The Contractor shall investigate these sources and other material sources to ensure that they are suitable for exploration; and to establish the quantities available.

1.26 Method of Measurement

M.1.1 The item for the Provision of Contractor's Site establishment, unless itemised specifically elsewhere in the Bill of Quantities, shall include for:

(i) The provision and transportation to the Site of plant, equipment, vehicles, stores and materials not to be incorporated in the Works, and all temporary buildings and accommodation for the Contractor's use necessary for the construction of the Works to commence.

(ii) The erection of temporary buildings and accommodation for the Contractor's use.

(iii) The provision and installation of electricity supply, water supply, sewerage and garbage disposal facilities appropriate for the Contractor's use.

(iv) Any other expenses incurred by the Contractor in establishing himself on Site.

This Lump Sum item is payable upon the establishment of the Contractor on Site to the satisfaction of the Engineer.

M.1.2 The item for Maintenance of Contractor's Site establishment shall include for:

(i) The provision and transportation to, and from the Site of plant, equipment, stores and materials not incorporated in the Works necessary for the continued construction of the Works.

(ii) Expenses incurred in maintaining and running the Site services of the Contractor's Site establishment.

(iii) Supervisory and superintendent staff costs including salaries, gratuities, leave pay, insurances, accommodation, travel and on Site vehicles.

(iv) Management and administrative costs both on and off the Site.

(v) Any other expenses incurred by the Contractor in running his Site establishment.

Payment will be made in equal monthly instalments over the period stated in the Appendix to Tender as the time for completion of the whole of the Works. In the event of completion of the whole of the Works in advance of the time for completion stated in the Appendix to Tender, then the balance of the monthly instalments not yet paid to the Contractor will be certified as payable upon the issue of the Certificate of Completion for the whole of the Works. Any extension of time granted under Clause 44.1 of the Conditions of Contract will not entitle to the Contractor to payment under this item unless such payments are specifically assessed by the Engineer.

M.1.3 The item for the removal of Contractor's Site establishment shall include for:

(i) The transportation from the Site of remaining plant, equipment, stores and materials, temporary buildings and accommodation.

(ii) The dismantling of temporary buildings and accommodation.

(iii) The disposal of stores and materials not removed from the Site.

(iv) Any other expenses incurred by the Contractor in disestablishment from the Site.

This Lump Sum item is payable upon removal of the Site establishment to the satisfaction of the Engineer.

M.1.4 The item for centre-line survey shall include for:

(i) Employing a surveyor acceptable to the Engineer for carrying out the survey.

(ii) Providing necessary survey equipment.

(iii) Providing labour for clearing, surveying, transporting, locating existing control points,ect.

(iv) Providing wooden pegs, and permanent concrete markers.

(v) Carrying out the necessary survey.

(vi) Providing a record drawing showing the complete survey (original plus 4 dyeline prints).

(vii) Providing transport necessary for carrying out the survey, except hiring helicopter.

Payment shall be made at the sum entered in the Bill of Quantities for the conducting centre-line survey. This Lump Sum item is payable upon the completion of all sections to the satisfaction of the Engineer.

M.1.5 A lump sum item is included for helicopter hire for the centre-line survey and any other prepatory works. The item for helicopter charge shall include for hire, fuel, insurances and forming land sites. Payment will be made by installments as determined by the Engineer, based on original receipts and actual flight records. If the lump sum is priced and no helicopter is used at all, the lump sum will become payable on the satisfactory completion of the centre-line survey.

M.1.6 The item for conforming to Clause 10.1 of the Conditions of Contract (Performance Security) shall include for complying with that Clause. Payment will be made when the Performance Security has been provided to the satisfaction of the Engineer.

M.1.7 The item for conforming to Clauses 21.1, 22.1, 22.2, 23.1, 23.2, 23.3. 24.1 and 24.2 of the Conditions of Contract (Insurances and Indemnities) shall include for complying with the requirements of the Contract in this respect. Payment will be made by installments as determined by the Engineer when original receipts and original policy documents have been provided to the satisfaction of the Engineer.

M1.8 The item for conforming to Group 1 of the Specification not covered elsewhere shall include for complying with Group 1 of the Specification as appropriate. Payment will be made by monthly installments on the same basis as "Maintenance of Contractor's Site Establishment".

M.1.9 The item for conforming to the requirements of the Conditions of Contract not covered elsewhere shall include for complying with the Conditions of Contract as appropriate. Payment will be made by regular installments as determined by the Engineer.

M.1.10 Any work instructed by the Engineer to be carried out by the Contractor in respect of the removal of trees, utility services, or other obstructions (Specification Clause 1.8) will be measured for payment under Dayworks.

M.1.11 No separate payment will be made for any other expenses or costs incurred in complying with the requirements of Group 1 General or the Conditions of Contract not itemised in Group 1 of the Bill of Quantities, as these be deemed to be included in the items in Group 1 or in the rates and prices entered in other Groups of the Bill of Quantities.

GROUP 2

PRELIMINARIES

Clause No.	Title
2.1	General
2.2	Engineer's Office and Laboratory
2.3	Engineer's Residences
2.4	Location of Site
2.5	Site Works
2.6	Services
2.7	Radio Communication
2.8	Furniture and Equipment
2.9	Maintenance of Office, Laboratory and Residences
2.10	Engineer's Staff Vehicles
2.11	Maintenance of Vehicles
2.12	Ownership of Building, Furniture and Equipment
2.13	Notice Boards
2.14	Provision of Helicopter for the Engineer's Use
2.15	Assistance for Engineer
2.16	Ground Investigation
2.17	Method of Measurement

GROUP 2

PRELIMINARIES

2.1 General

The work covered under this Specification shall be provided up to the end of the latest Period of Maintenance, or such earlier date as may be authorized by the Engineer and shall include the provision, erection, furnishing and maintenance of the Engineer's office, Engineer's laboratory and Engineer's residences, the provision of services thereto, the provision and maintenance of vehicles and equipment for use by the Engineer's staff, all as specified and scheduled hereunder.

2.2 Engineer's Office and Laboratory

2.2.1 Layout

The Engineer's office shall conform to the layout shown on the Drawings. The type and number of offices shall be as follows: 1 no. for Type 1 at Malalaua and 2 nos. of Type 3 at Miaru and Terapo.

Each office shall have an awning adjacent to it as a vehicle park capable of parking 3 cars.

1 no. laboratory shall be provided at Malalaua. The minimum floor area of the laboratory shall be 60 sq.m. and the height from floor level to roof springing shall be 2.5m minimum. The laboratory shall have adjacent to it an awning of minimum plan area 50 sq.m.

2.2.2 Design and Construction

The Contractor shall submit his detailed proposals including documentation showing design and construction drawings of the office and the laboratory within twenty eight (28) days of the date of the Letter of Acceptance. Notwithstanding any other requirements under the Contract, construction of the office and laboratory shall not commence until the Engineer has indicated that he has no further comments on the Contractor's proposal.

2.2.3 Design Criteria

The following criteria are provided for the Contractor's information regarding the design of Engineer's office and laboratory.

(a) Foundation

Galvanized steel or concrete piers shall be used. For the office there shall be a minimum clearance of 500mm between finished ground level and floor bearers. The laboratory including the awning area shall have a concrete floor.

(b) Windows

Windows shall be full height, except for the toilet windows which shall be high set, fitted with adjustable glass louvers. Louvers shall have a locking device. Windows shall be fly wired and fitted with burglar bars.

(c) Linings

External walls shall be marine quality plywood or other weatherproof material. Internal walls and ceilings shall be plywood or similar sheet material. Office floor shall be T and G boarding, sanded and sealed. Toilet floor shall be finished with PVC tile or sheet. Laboratory floor shall be mesh reinforced concrete slab construction, minimum thickness 100mm.

(d) Roofing

Roofing shall be corrugated galvanized iron or similar metal sheet complete with all flashings, cappings, etc. Insulation shall be provided immediately below the decking Sisalation 430 or similar acceptable. A guttering shall be provided.

(e) Lighting

Fluorescent lighting strips shall be provided to a minimum required for standard office accommodation. The Contractor shall supply an electrical layout with his proposals.

(f) Painting

Internal and external surfaces, except the galvanized roofing, shall be painted.

(g) Doors

Doors, except the toilet door, shall be fitted with mortise locks with four keys to each lock. The main office door shall be strengthened to prevent forcible entry and be provided with a deadlock.

(h) Toilet Facilities

Toilet shall be provided with wash hand basin and flushing water closets. A toilet roll holder, disposable paper towel holder and a wall mirror shall be provided and fitted to each toilet. The toilet door shall be fitted with a latch, lockable from the inside only. Urinals shall be provided as shown on the Drawings.

(i) Air Conditioning

Air conditioning units shall be provided and connected to dedicated switched power outlets and fitted as follows:

Offices	10 No.2.0kW Nominal Cooling Capacity
General Office	4 No.3.0kW Nominal Cooling Capacity
Laboratory	2 No.3.0kW Nominal Cooling Capacity

(j) Power Outlets

In addition to the power outlets for air conditioning units, twin socket switched power outlets shall be provided in office rooms (1 no. each), the conference room (3 nos.), the general office area (5 nos.) and the laboratory (5 nos.), and the tea area (1 no.).

(k) Security Lights

Extra security lighting shall be provided and kept illumminated throughout the hours of darkness.

(l) Tea bench shall be provided in sink and cupboards under for each office.

(m) A Built-in bench. (Drawing table height) 2.5m x 1m shall be provided for each office as directed by the Engineer.

(n) Heavy duty workbench with shelving under 1m high, 6 linear metres positioned in laboratory, fitted with stainless steel kitchen type sink shall be provided for the laboratory as directed by the Engineer.

(o) An Electric hot water heater shall be plumbed to sink and hand basin.

2.2.4 Completion of Office and Laboratory

Upon completion the office and laboratory shall be ready for immediate and full occupancy in every respect, including all service connections. The Contractor shall hand over to the Engineer all keys to the building (four complete sets).

2.3 Engineer's Residences

2.3.1 Layout

The works comprises the erection and completion of the following houses for the Engineer's Residences together with associated site works and services, all as per the Drawings and Specification: 4 x H65 Residences at Malalaua, 2 x H65 Residences at Terapo and 2 x H65 Residences at Miaru.

2.3.2 Special Requirement

Unless otherwise specified the Works as shown in the Drawings, the residences shall be constructed in accordance with the following requirement:

(a) Concrete

Unless otherwise specified concrete shall be 20 MPa. A 400x400x70mm concrete splash pad shall be provided under downpipes.

(b) Carpentry and Joinery

(i) Timber Treatment

All weatherboards shall be CCA pressure treated Ex 100 x 25mm. All other timbers shall be in accordance with the requirements of the Forest Industries Council of Papua New Guinea "Guide to Specifying Timber for Structural and Non-Structural Purposes".

(ii) Internal Plywood Linings

Plywood shall be 4mm thick "V" jointed "Prufply" interior grade plywood finished at internal angles with Ex 25 x 25 mouldings. Ceiling lining shall be fixed Ex 50 x 50 ceiling battens at 600 centres and at sheet ends.

(iii) Melamine Decorative Surfaces

Melamine decorative surface hardboard shall be "AQUAPANEL" or similar approved, installed and fixed strictly in accordance with the manufacturer's recommendations.

(iv) Bench Tops

Plastic laminated faced bench tops shall have the opposite face of the bench painted with:

One (1) Coat Wunderprime
One (1) Coat White enamel

(v) Edge Strips

Edge strips to bench tops are to be 10mm thick hardwood with a paint clear finish of:-

Two (2) Coats Polyurethane Gloss Plastic laminate edge strips shall not be used.

(vi) Zincalume Roof and Accessories

Delete the reference to galvanized steel roofing and accessories on the Drawings. Substitute "Zincalume" steel. Roof sheeting shall have a base metal thickness of 0.42mm. Flashings shall have 0.60mm base metal thickness. Zincalume roofing and accessories shall be fixed as recommended by the manufacturer. Zincalume and cappings to rafters shall extend under any fascia purlins which may be rebated into these rafters.

(c) Water Services

(i) Arrange connection of water service to water mains from the rain water tanks as shown on the Drawings. Run new 80mm dia. steel sub main to housing site. Reduce to 50mm dia. PVC pipe within the site. Provide 20mm dia. HDPE water supply to each house.

(ii) Internal water reticulation shall be with 18mm or 15mm dia. copper pipe with 12mm dia. copper branches. Where applicable internal pipings shall be concealed.

(iii) Hot water reticulation shall be in lagged copper tube and reticulated to shower, kitchen sink, hand basin and laundry tub outlets.

(d) Lighting

Internal wiring and electrical fittings shall be provided and installed to each residence. Fluorescent lighting strips shall be provided. The Contractor shall supply an electrical layout.

(e) **Painting**

Paint shall be "DULUX" or similar acceptable and applied in strict accordance with manufacturer's instructions.

Top coat paints with the exception of Clear Polyurethane shall have "Tropical Mould Resistant Additive" and paint thins shall be so marked.

(f) **Miscellaneous**

One (1) standard stove, 4 burner with oven and grill or equivalent and gas supply shall be provided for each residence. A 300 litre solar water heater shall be provided for each residence complete with fixings and fittings.

(g) **Air Conditioning**

Air conditioning units shall be connected to dedicated switched power outlet and fitted as follows: 1 No. 2.0kW and 3 No. 1.0kW Nominal Cooling Capacity for each residence.

2.3.3 Completion of Residences

The Engineer's residences shall be completed at the same time as the completion of the Engineer's office and laboratory.

2.4 Location of Site

The Engineer's staff office and residences shall be constructed in a fenced area as directed by the Engineer. The orientation and position of the office, laboratory and residences shall be acceptance to the Engineer.

2.5 Site Works

Site works shall include clearing and grubbing, gravel surfaced access from the nearest roadway to the office and residences, including formation of surface drains and installation of concrete pipe culverts at the roadway frontage of the Site. Clearing and grubbing as specified in Group 3, shall be carried out for a distance of 3 metres from the face of external walls of the office building and residence housing.

2.6 Services

The Contractor shall provide utility services to Engineer's office, laboratory and residences as specified

hereunder. The Contractor in providing utility services shall liaise with the appropriate authorities to ensure that they conform to all acts, regulations and ordinances and by-laws governing the installation, operation and maintenance of such services.

2.6.1 Water Supply

The Contractor shall provide and install rainwater tanks for the Engineer's office, laboratory and residences as shown on the Drawings complete with all necessary connections.

In addition to the rainwater tanks, the Contractor shall provide and install water pump, water tank, delivery pipe and necessary fittings necessary to provide an adequate water supply during whole year.

2.6.2 Electric Power Supply

The Contractor shall provide an independent power supply from generators including cabling, poles and necessary accessories and fittings. The 24 hour supply shall be adequate in every respect to meet the demand of the Engineer's office, laboratory and residences.

2.6.3 Sewage Disposal

The Contractor shall provide and install a septic tank complete with absorption trench to service the Engineer's office in accordance with Local Authority requirements and as shown on the Drawings. The required sewage disposal facilities shall be 20 persons at Malalaua, 10 persons at Terapo and 10 persons at Miaru.

In addition septic tanks shall be provided for the Engineer's residences.

2.6.4 Garbage Disposal

The Contractor shall arrange for collection and disposal of all garbage daily from the Engineer's office, laboratory and residences.

2.6.5 Telephone

The Contractor is to arrange for the provision of a three line switchboard and three extension telephones two in the Engineer's office and one in the laboratory and shall pay all installation, rental and telephone charges. The lines shall be completely separate from and independent of the Contractor's telephone system.

2.7 Radio Communication

The Contractor shall provide, maintain and install in the Engineer's office a master VHF single side band transmitter/receiver set with a transmission range of not less than 180km. Such transmission range may require the provision of a relay aerial on high ground. The crystal frequency shall be the same as the transceiver set fitted to each of the Engineer's vehicles and two site offices at Terapo and at Miaru.

Should the Contractor wish to adopt radio transmission communication for his own operations, the equipment shall be on a different frequency to that of the Engineer's staff.

2.8 Furniture and Equipment

The Contractor shall furnish and equip the Engineer's office, laboratory and residences with the items enumerated hereunder:

(i) **Engineer's Office**

3 No.	Electric Powered Refrigerator 0.14 cubic metre capacity (5 cu.ft.)
4 No.	Double pedestal desks (0.85m x 1.9m approx).
14 No.	Single pedestal desks (0.85m x 1.5m approx).
4 No.	Sub Executive style office chairs.
22 No.	General purpose chairs.
4 No.	Typist desk and side table unit.
4 No.	Typist swivel chairs with wheels.
3 No.	Draftsman stool.
5 No.	4 Drawer A1-size horizontal plan chest
6 No.	Lockable steel filing cabinets (4 drawers).
3 No.	Steel lockable cupboard (1m width approx with adjustable shelving).
6 No.	Bookcases (3 shelves, 2 m width approx).
7 No.	Pinboards (1.5m x 0.8m) fixed as directed by Engineer.

12	No.	Waste paper baskets.
4	No.	Plastic garbage bins (large).
3	No.	Tea set (12 piece) including spoons, jugs etc.
3	No.	Hot water urn (5 litre capacity).
20	No.	Fire extinguishers (1.4kg BCF).
10	No.	Stapling machines (standard).
3	No.	Stapling machines (large).
10	No.	Filing punches.
3	No.	Plain paper photocopying machine (Canon NP 3225 or equivalent).
3	No.	Typewriter (Remstar 2000 or equivalent) with type style balls Courier 12, Orator, Prestige Elite and Pica 12.
1	No.	Conference table (10-12 persons).
2	No.	Conference table (5-6 persons).
3	No.	Drafting stand with double elephant size drawing board.
15	L.M.	Shelving 300mm deep as directed by the Engineer.
3	No.	Wild T2 theodolite with tripod.
3	No.	Wild T16 theodolite with tripod.
3	No.	Aga 210 EDM complete with batteries (2), charger, power lead, T2 and T16 adaptors, single prisms, triple prism and range pole.
6	No.	Tribrac and adaptor for EDM prisms.
6	No.	Wild NA1 Automatic level with tripod.
6	No.	Target complete with tripod.
6	No.	Staff (5 m with metric divisions) complete with cover.
6	No.	100m chain.
6	No.	Staff bubble.

24 No. Ranging rods.

6 No. 50m cloth tape.

6 No. 50m steel tape.

6 No. 25m steel tape.

6 Set Walkie-talkie set.

(ii) **Laboratory**

- Soil Subbase and Base Course

1 Set Hand auger set

1 Set Cone penetrometer

AS Sieve set 2/75 mm, 2/37.5 mm, 3/19 mm, 2/13.2 mm, 2/9.5 mm, 2/6/7 mm, 2/4.75 mm, 2/2.36 mm, 3/1.18 mm, 3/600 micron, 425 micron, 2/300 micron, 2/150 micron, 2/75 micron.

1 Set Apparatus for determination of compactor described in E1.1 of AS 1289.

1 Set Apparatus for determination of compactor described in E2.1 of AS 1289.

2 No. Cylindrical metal mould as described at Clause E.1.1.2 (i) of AS 1289 E.1.1

1 No. Steel rammer as described at Clause E2.1.2. (ii) of AS 1289 E1.1.

1 No. Sand cone pouring apparatus complete with conical funnel and tap as described in Fig E3.1.1 of AS 1289.

1 No. Metal tray not less than 300 mm square and with 200 mm or 150 mm diameter hole in the center.

1 Set Apparatus for determination of CBR described in F1.1.2 of AS 1289 complete, excluding items (iv), (x), (xi), (xii) (laboratory test) Plus 5 No. extra cylindrical metal moulds F1.1.2 (ii) AS 1289, complete with base plate and collars

1 Set Apparatus for determination of CBR described at F1.3.2 of AS 1289 complete excluding (viii), (ix) and (x) (Field test).

1 Set	Unconfined compression testing machine complying with AS 1141.51.
1 No.	Drying oven complying with Clause A.1.3.2. of AS 1289. A1.
1 No.	Balance of at least 500g capacity and accuracy of 0.01g.
1 No.	Balance of at least 5kg capacity and accuracy of 1g.
1 No.	Balance of at least 15g capacity and accuracy of 5g.
50 No.	Airtight heat resistant and corrosion resistant container 50 mm dia., 25 mm high.
50 No.	Airtight heat resistant and corrosion resistant container 200 ml capacity.
12 No.	Airtight heat resistant and corrosion resistant container of about 1.5 kg capacity.
2 No.	Scoop approx 100 mm long 60 mm wide.
2 No.	Scoop approx 200 mm long 120 mm wide.
2 No.	Flat glass plate approximately 450 mm square and 10 mm thick.
4 No.	Palette knife with blade 200 mm long, 30 mm wide.
1 No.	Liquid limit apparatus similar in essential details to the device illustrated in AS 1289 Fig C1.1.1.
2 No.	Grooving tool and gauge similar in essential details to that illustrated as AS 1289 Fig C1.1.2 or C1.1.3
4 No.	Wash bottle 500 ml capacity.
6 No.	Enamel, glass or plastic bowl 150 mm dia.
4 No.	Stainless steel or brass shrinkage mould in the form of semi-cylindrical troughs of 250 mm internal length and 25 mm internal dia. with ends brazed on normal to the longitudinal axis of the mould and flush with the top of the mould.

4 No.	124 mm stainless steel or brass shrinkage mould 125 mm internal lengths and 12.5 mm internal dia.
1 No.	Desicator (200-250 mm dia.) containing anhydrous silica gel.
2 No.	Steel straight edge, 500 mm long, 25 mm wide with one bevelled edge.
3 No.	200 ml graduated measuring cylinder
20 No.	5 litre plastic sand container suitable for use with sand cone pouring apparatus.
1 No.	Metal calibrating cylinder of the type illustrated in Fig E3.1.2 AS 1289, and of similar internal diameter to the field density metal tray hole dia.
12 No.	Air drying and sorting tray, 500 mm square by 50 mm deep.
1 No.	Vernier caliper capable of measuring the range 0 to 150 mm.
1000 No.	Polythene sample bags, approx 300 mm wide, 600 mm deep.
1 No.	Mallet or hammer for field density excavations.
2 No.	Handgloves for handling oven trays.
2 No.	Lump hammer (1kg).
2 No.	Cold chisel (3/4").
3 No.	Reinforced washing sieve (75 micron).
3 No.	Sieve brush.
4 No.	Large metal dustbins.
2 No.	Trowel.
1 No.	Pick axe.
1 No.	Sledge hammer (5 kg).
3 No.	Bitumen thermometer capable of measuring from 100°C to 200°C to an accuracy ±1°C.
3 No.	Paint brush (4").

3 No. Paint brush (1").

3 No. Paint brush (1/2").

- Concrete

1 Set Slump test set

1 Set Portable concrete mixer 85 litres capacity

30 No. Cylinder mould (150 mm x 300 mm)

1 Set Capping set with cylinder carrier and sulfer melting pot

1 Set Washington type air metre set 7 litres

1 No. Portable compression testing machine, 100 ton capacity

1 Set Los Angels testing machine

1 Set Coarse aggregate specific gravity test set

1 No. Sample divider (Riffle box) suitable for 40 mm and 28 mm aggregate size as described in Fig 2.4.6 of AS 1141 Sect.2.

1 No. Sample divider (Riffle box) suitable for 20 mm and 14 mm aggregate size as described in Fig 2.4.6 of AS 1141 Sect.2.

(iii) Engineer's Residences

24 No. Beds with mattresses and for each bed 4 bed sheets, 2 blankets, 2 pillows

24 No. Mosquito nets.

24 No. Bedside tables with lamps.

24 No. Chairs.

24 No. Desks (0.85 m x 1.2 m).

8 No. Bookshelf.

8 No. Dining room suite consisting of one table and six chairs.

8 No. Cupboard.

8 No. Sofa

16 No. Armchairs

16 No. Side table

8 No. Washing Machine

8 No. Refrigerator, min. 180 litres.

8 No. Shower curtain

All windows shall be fitted with curtains.

(iv) Miscellaneous

Miscellaneous items shall include materials laboratory consumables, shovels, pick axes, hammers, bush knives, pegs, poles, nails, paints, brushes, typing papers, writing pads, field books, level books, pencils, ball pens, erasers, carbon papers, consumable for photocopying, toilet papers, box files, correspondence files, strings, selotapes, scales (metric), envelopes, staples, clips and the like disposable item of the number and quantity as required by the Engineer's Representative from time to time.

2.9 Maintenance of Office, Laboratory and Residences

Upon completion of the office, the laboratory and the residences, and provision of furnitures and equipment, the Contractor shall provide a routine maintenance service to the end of the latest Period of Maintenance or such earlier date as may be authorized by the Engineer. The maintenance service shall include general building repair, general furniture and equipment repair or replacement, and maintenance of site works including grass cutting.

2.10 Engineer's Staff Vehicles

The Contractor shall provide new vehicles for use of the Engineer's staff of the number and type set out in the Bill of Quantities and detailed below.

(i) Medium Sedan

This vehicle shall be a hard topped, four-wheel drive vehicle of engine size 1700cc to 2000cc, and be capable of comfortably seating four persons including the driver.

(ii) Large 4 Wheel Drive Utility

These vehicles shall be of engine size not less than 4000cc, 4x4 and capable of seating eight persons including the driver.

(iii) Medium Double Cabin 4 Wheel Drive Utilities

These vehicles shall be of engine size not less than 2000cc and capable of seating five persons including driver in a double cab configuration.

(iv) Medium Single Cabin 4 Wheel Drive Utilities

These vehicles shall be of engine size not less than 2000cc. The vehicles shall have a seating capacity in the driving cab for three persons and be a column gear change type.

Vehicles shall be registered and comprehensively insured for any driver, be provided with spare tyre, tool kit, lifting jack and wheel brace, be provided with laminated windscreens and an auto-theft alarm.

The Contractor shall supply, maintain and fit each vehicle with a VHF single side band transmitter/receiver set, in accordance with Clause 2.7 of this Specification.

The vehicles shall revert to the Contractor at the end of the latest Period of Maintenance or such earlier date as may be authorized by the Engineer.

2.11 Maintenance of Vehicles

The Contractor shall maintain the vehicles provided for the use of the Engineer's staff for the duration of the Contract. Maintenance of vehicles shall include registration, comprehensive insurance, repairs including spare parts, replacement of spares, cleaning, servicing, fuel, oil and grease and provision of replacement vehicles should any or all of the vehicles provided originally become unserviceable or unroadworthy.

In the event that a vehicle becomes unserviceable or unroadworthy, or stolen, the Contractor shall provide immediately a replacement vehicle of the same type. The replacement vehicle shall not be more than one year old. The Contractor shall supply, maintain and fit to each such replacement vehicle a VHF single side band transmitter/receiver set on the Engineer's staff frequency.

2.12 Ownership of Building, Furniture and Equipment

The office, the laboratory and the residences shall revert and become the property of the Contractor at the end of

the latest Period of Maintenance or such earlier date as may be authorized by the Engineer. These buildings shall be removed by the Contractor and the Site area made good to the satisfaction of the Engineer.

The furniture and equipment provided under Specification Clause 28 shall revert and become the property of the Employer at the end of the latest Period of Maintenance or such earlier date as may be authorized by the Engineer.

2.13 Notice Boards

The Contractor shall provide for the supply, erection, maintenance and removal of project notice boards, prepared in accordance with the Drawings and erected at locations as directed by the Engineer.

The wording of the Notice Boards shall be as follows and shall include the name of the Consulting Engineers and Contractor.

"Construction and sealing of the Miaru River to Malalaua Section of Trans-Island Highway (47.1 km).

Wok long wokim rot na putim kolta long Wara Miaru igo inap long Malalaua insait long Trans-Ailan Haiwe, longpala bilong em i olsem 47.1 km.

Dala karaia gaukara, mai pisi atoa gaukara danu, Trans-Island Highway dekenai be Miaru Sinavai amo ia lao Malalaua, ena daudau 47.1 km."

2.14 Provision of Helicopter for the Engineer's Use

The Contractor shall arrange for a helicopter to be hired for the Engineer's use for the inspection of the Site etc, as and when directed by the Engineer.

2.15 Assistance for Engineer

(a) The Contractor shall provide labour, staging, ladders, wire ropes, lighting and other equipment, information and assistance required by the Engineer and his staff for inspecting, measuring and for the supervision of the Works.

(b) When directed by the Engineer the Contractor shall provide for the exclusive use of the Engineer's Representative at any time up to the end of the latest Period of Maintenance, the following assistance for the execution of the Engineer's Representative's duties.

Attendants		No.
(i)	field attendants	up to 6
(ii)	office attendant	3
(iii)	laboratory attendants	2
(iv)	night watchman	2

The night watchman shall be provided with suitable accommodation.

(c) The field, office and laboratory attendants shall be available on Site during the Contractor's site working hours (including any work carried out on Sunday and Public Holidays). Nevertheless the attendants may be required to work outside these hours when required by the Engineer's Representative.

2.16 Ground Investigation

The Contractor shall at any time up to the time for completion of the whole of the Works when ordered by the Engineer, undertake any of the following:-

(i) additional ground investigation including drill holes, borehoes and trial pits;

(ii) the installation of standpipes and piezometers;

(iii) the monitoring of standpipes and piezometers;

(iv) the installation of measuring devices to observe vertical and horizontal movements;

(v) the monitoring of such measuring devices;

(vi) the testing of soil samples to determine moisture content, density, grading etc.

The Contractor shall allow for any reduction of the efficiency of his operations and for delays or stoppage caused by any of the above items. The Contractor shall also take all necessary precautions to ensure that existing or new instrumentation is not disturbed or damaged.

The Contractor shall employ an acceptable sub-contractor with a properly trained and experienced English-speaking engineer, who shall be responsible for any ground investigation, instrumentation and soil testing.

On receipt of an instruction from the Engineer under this Clause, the Contractor shall prepare a programme and present to the Engineer his proposals for carrying out the investigation, including proposals for obtaining access etc. The Contractor shall not proceed with the field work until the Engineer has indicated he has no further comments on the Contractor's proposals.

The field work for each such instruction shall be programmed to finish within the time directed by the Engineer. For each such instruction, the Contractor shall provide the number of rigs and crews or other equipment, subject to the Engineer's Representative's prior agreement, required to complete the investigation within the time directed.

Notwithstanding the requirements above, the Contractor shall commence the field work for such instructions within one month of its issue, or as directed by the Engineer.

2.17 Method of Measurement

M.2.1 The item for Provision of the Engineer's office and laboratory including utility services shall include for:-

(a) clearing and grubbing, site formation and preparation;

(b) foundations, flooring, structures, fencing, rainwater tanks, guttering, surface water drainage, sewage disposal, services including telephone electricity and water supply, fixtures, toilet facilities, air conditioners, security lighting, surfaced access;

(c) painting.

Attention is drawn to the fact that, if the Engineer does not subsequently instruct the Contractor to remove the office and laboratory, no additional payment will be made in respect of anything described in this Clause. This item will be measured for payment when the facilities have been provided to the satisfaction of the Engineer.

M.2.2 The item for Provision of the Engineer's residences including utility and services shall include for:

(a) clearing and grubbing, site formation and preparation;

(b) foundations, flooring, hardstanding, structures, fencing, rainwater tanks, guttering surface water drainage, sewage disposal, services including electricity and water supply, fixtures, solar water heater, toilet and bathroom facilities, fitted kitchen facilities including gas cooker and gas

supply, air conditioner, security lighting, surfaced accesses, washing line;

(c) painting.

Attention is drawn to the fact that, if the Engineer does not subsequently instruct the Contractor to remove the residences, no additonal payment will be made in respect of anything described in this Clause. This item will be measured for payment when the facilities have been provided to the satisfaction of the Engineer.

M.2.3 The item for Maintenance of Engineer's office and laboratory shall be made on a monthly basis and shall include for:

(a) cleaning and removal of waste;

(b) general building maintenance and renovations;

(c) electricity provided by generator;

(d) water supply;

(e) watching and guarding;

(f) making good any losses or damage;

(g) maintenance of services;

(h) maintenance of facilities,furnitures and equipment;

The quantity measured under this item shall be the number of months from the date when, in the opinion of the Engineer, office and laboratory is ready for occupation until the date when the Engineer instructs its removal, or instructs that it is not to be removed and that maintenance is no longer required.

M.2.4 The item for Maintenance of Engineer's residences shall be made or a monthly basis and shall include for:

(a) clearing of compound, grass cutting and removal of waste;

(b) general building maintenance and renovations;

(c) electricity provided by generator;

(d) water supply;

(e) watching and guarding;

(f) making good any losses or damage;

(g) maintenance of services;

(h) maintenance of facilities,furnitures and equipment;

The quantity measured under this item shall be the number of months from the date when, in the opinion of the Engineer, office and laboratory is ready for occupation until the date when the Engineer instructs its removal, or instructs that it is not to be removed and that maintenance is no longer required.

M.2.5 The item for dismantling the Engineer's office and laboratory shall include for:

(a) demolishing or dismantling as necessary and removing from the Site the office and laboratory, the awnings, hardstanding, fencing, rainwater tanks, services, fixtures, toilet facilities, air conditioners, security lighting;

(b) disconnecting all services and sealing off disused services;

(c) reinstating any damaged or unfinished areas;

(d) the credit value of reusable and salvagable items;

M.2.6 The item for dismantling the Engineer's residences shall include for :

(a) demolishing and dismantling as necessary and removing from the Site the residences, fencing, rainwater tanks, services, fixtures, gas cooker, air conditioners, security lighting;

(b) disconnecting all services and sealing off disused services;

(c) reinstating any damaged or unfinished areas;

(d) the credit value of reusable and salvageable items;

M.2.7 A Provisional Sum is included in the Bill of Quantities for the payment of public utility charges and local authority charges for the Engineer's office and laboratory. This item shall include for:

(a) the costs of telephone calls from the Engineer's office and laboratory;

(b) any local authority charges for the Engineer's office and laboratory;

(c) any other utility charges which the Engineer nominates for payment under this item;

Attention is drawn to the fact that costs of installation of utilities ie. telephone etc. are not measured for payment under this item. Payment under this item shall be made or production of the necessary accounts from the utility companies or local authorities.

M.2.8 An item is provided for in the Bill of Quantities for the Contractor to enter a percentage charge to cover his costs and profits in respect of the previous item.

M.2.9 The item for master VHF radio transmitter/receiver equipment to the Engineer's office shall include for:

(a) equipment in office including masts and repeater station;

(b) testing and commissioning of system;

(c) operation, maintenance and running costs of equipment;

(d) removal when instructed by the Engineer;

This item will be measured for payment when the facilities and the vehicles have been provided and are operational to the satisfaction of the Engineer.

M.2.10 The item for the Provision of vehicles including VHF transceivers for Engineer's staff shall include for:

(a) supplying and delivering to the Site, the vehicle in proper working order, including VHF transceivers;

(b) taxing the vehicle for use on public roads;

(c) removing the vehicle off Site when instructed by the Engineer;

This item will be measured for payment on a number basis under each type of vehicle entered in the Bill of Quantities. This item will be measured for payment from the time when each vehicle is provided in proper working order to the satisfaction of the Engineer.

M.2.11 The item for maintenance of and fuel for Engineer's staff vehicles shall include for:

(a) meeting the vehicle running costs including fuel, oil, lubricants, tyres, puncture repairs, licences, taxes, road tests, servicing and spare parts;

(b) insuring the vehicle comprehensively to cover any qualified driver authorised by the Engineer together with authorised-passenger liability cover;

(c) maintaining the vehicle in a roadworthy condition and in conformity with the vehicle manufacturer's recommendations;

(d) cleaning the vehicle daily inside and outside;

(e) providing a satisfactory replacement vehicle when the regular vehicle is unavailable or unserviceable.

M.2.12 An item is included in the Bill of Quantities for maintenance on a vehicle - month basis for distances travelled up to 2,500 kilometres per month on average or a-month period of the Contract.

A separate item is also included in the Bill of Quantities for maintenance of and fuel for Engineer's staff vehicles for distance travelled in excess of 15,000 km per 6-month period. This item shall include for additional fuel, maintenance and spares occasioned by the excess distance. The rate shall be applied to each vehicle at the kilometre reading at the end of each 6-month period less the previous 6-month period's reading, in excess of 15,000 km in the 6 monthly period. The first 6-month period shall commence on the day of delivery of each vehicle to the Engineer.

M.2.13 The item for Provision of furniture and equipment for the Engineer shall include for providing the furniture and equipment listed in Specification Clauses 2.8 (i) (ii) and (iii). This item will be measured for payment when the specified items have been provided to the satisfaction of the Engineer.

M.2.14 A Provisional Sum is included in the bill of Quantities for the Provision of miscellaneous and equipment and supplies for the Engineer's office and laboratory. This item shall include for the provision of miscellaneous equipment and supplies in accordance with Specification Clause 2.8 (iv).

M.2.15 An item is provided in the Bill of Quantities for the Contractor to enter a percentage charge to cover his costs and profits, in respect of the previous item.

M.2.16 A Provisional Sum is indicated in the Bill of Quantities for helicopter hire.

M.2.17 An item is provided in the Bill of Quantities for the Contractor to enter a percentage charge to cover his costs and profits, in respect of the previous item.

M.2.18 The item for Project Notice Boards shall include for:

(a) providing, fabricating, erecting, painting and fixing;

(b) maintaining and repainting if required;

(c) dismantling when directed;

M.2.19 Provisional Sum for Ground Investigation, etc.

M.2.20 An item is provided in the Bill of Quantities for the Contractor to enter a percentage charge to cover his costs and profits, in respect of the previous item.

M.2.21 The item for assistance for the Engineer shall include for providing the field, office, laboratory attendants and watchman in accordance with Specification Clause 2.15.

GROUP 3

GROUP 3

CLEARING AND GRUBBING

3.1 General

Clearing and grubbing shall include those works necessary for the roadway and bridge sections, fill borrow pits, quarry sites, river deposit sites and access roads. The clearing and grubbing shall be classified into the following catagories: dry land area, common swamp area, Alika Swamp, fill borrow pits, and other areas.

At least one month prior to commencement of the clearing and grubbing works, the Contractor shall submit his detailed proposals for the common swamp area and the Alika Swamp to the Engineer. The Contractor shall not proceed with clearing and grubbing in these areas until the Engineer has indicated that he has no further comment on the Contractor's proposals.

3.2 Clearing

Except for trees and shrubs to be preserved as indicated on the Drawings or as designated by the Engineer, "Clearing" shall mean the felling of trees and scrub by cutting or breaking off, not higher than seven hundred and fifty (750) millimetres above ground level, and shall include the removal of fallen trees, stumps, logs, upturned roots, rotten wood and other vegetable growth and accumulations of rubbish of whatever nature, including vehicle chassis and parts, and any other objectionable material from the area to be cleared as ordered by the Engineer.

"Clearing" shall also include the removal of existing cribwork, guard rails, buildings and fences within the limits of the Works, but shall not include the removal of concrete headwalls, wingwalls, concrete floodways or concrete box culverts.

Concrete headwalls, wingwalls and floodways shall be classified as material Type C and shall be paid for as such in accordance with measurements established by the Engineer, and at the scheduled rate for Earthworks Type C in the Bill of Quantities.

"Clearing in the common swamp area" shall mean the felling of trees and scrub by cutting, or breaking off at the water level, and shall include the removal of fallen trees, stumps, logs, upturned roots, rotten wood and other vegetable growth and accumulations of rubbish of whatever nature and any other objectionable material from the area

to be cleared as indicated on the Drawings or as directed by the Engineer.

"Clearing in the Alika Swamp" shall mean the cutting of all vegetable growth at the bottom of the water, and removal of vegetable growth and other objectionable material from the area to be cleared as indicated on the Drawings or as directed by the Engineer.

The area to be cleared shall be that described below or as shown on the Drawings or as directed by the Engineer:

(i) the area within the highway right-of-way including the bridge sections, the area within the visibility site lines, borrow pits, quarry sites, river deposit sites and access roads;

(ii) the area required for turnouts or other drainage ditches and channels for stream diversions;

(iii) the area required for foundations for structures;

(iv) in case earthworks extend outside the limits of the right-of-way, the area required is to be between the limits of right-of-way plus five (5) metres wide on both sides.

All such areas shall be called "the Area".

3.3 Disposal of Material

Material, slash and debris resulting from clearing operations shall be disposed of by burning unless otherwise directed by the Engineer. Unmerchantable timber, stumps, etc. shall not be disposed of by pushing outside of the right-of-way. Trees within "the Area" shall be felled but, in the event of any tree falling outside "the Area", such trees shall be cut up and together with all debris and slash therefrom, brought back to "the Area" and burned there. The Engineer may designate certain trees or shrubbery to be left standing, in which case the Contractor shall avoid damage or injury to such trees or shrubbery in felling adjacent timber, burning or any other clearing operations. Such trees or shrubbery are to be limbed or thinned to such height and extent as may be ordered by the Engineer.

Except as provided elsewhere slash and debris shall be piled and burned at points located centrally in "the Area". The number of fires to be started at any one time shall be limited to the capacity of the Contractor's equipment and organization to provide adequate protection against the spreading of the fires to adjacent timber or property.

Materials and debris which cannot be burned may be buried within the right-of-way, outside of embankment and structural backfill areas, or disposed of outside the right-of-way and limits of view from the Project. The Contractor shall make all necessary arrangements with property owners and meet all costs for obtaining and using suitable disposal areas.

Clearing must be carried out and completed at least 3000m ahead of any earthwork operations.

3.4 Grubbing

Grubbing means the entire removal and disposal as described in Clause 3.3 of stumps, roots, embedded logs, to a depth of at least 150mm below the ground level and at least 300mm below the bottom of the lowest subbase course.

Grubbing for the common swamp area and the Alika Swamp means entire removal and disposal as in Clause 3.3 of stumps, roots and embedded logs in the water. These grubbing works shall be carried out to the satisfaction of the Engineer bearing in mind the subsequent works to be carried out.

The area to be grubbed shall be the area described below or as shown on the Drawings or as directed by the Engineer in writing:

(i) the area for roadway excavation and embankment is to be occupied by the limits of the required earthwork slopes plus two (2) metres wide on both sides;

(ii) the area whereto road is on embankment site in common swamp areas and in the Alika Swamp is defined as the area between the limits of geotextile fabric installation work plus two (2) metres wide on both sides;

(iii) the area occupied by the completed earthworks for borrow pits, quarry sites, river deposit sites and access roads.

Stump holes and other holes from which obstructions are removed shall be backfilled with selected material and thoroughly compacted. Grubbing shall be completed at least 200-300 m in advance of any earthworks operations.

3.5 Clearing of Bridge Site

Clearing shall be carried out in accordance with Clause 3.2 of this Specification. Stumps and roots which would

be within five (5) metres of the outer lines of the structure shall be grubbed to a depth of at least three hundred (300) millimetres below the level of the natural surface or the finished surface, whichever is the lower.

3.6 Measurement and Payment

The area measured for payment for "clearing and grubbing" shall be the plan area of clearing for:

(a) land areas
(b) common swamp areas
(c) Alika Swamp areas
(d) fill borrow pit areas

Payment for limbing and thinning of trees and shrubbery shall be made under Group 19, Dayworks, for work instructed by the Engineer.

Attention is drawn to the fact that clearing and grubbing for:

(a) subbase/base course borrow pits areas
(b) quarry sites areas
(c) river deposit sites areas
(d) access roads areas

is not measured for payment under clearing and grubbing, but under items in Groups 4,5 and 6.

The item for clearing and grubbing shall include for the clearing and grubbing required and for everything furnished and done regardless of the nature of condition of "the Area" and including backfilling of stump holes and other holes from which obstructions are removed, with suitable material.

CLEARING AND GRUBBING

CLEARING

STANDARD LIMIT 20 m.BOTH SIDE FROM THE CENTERLINE AS FIG.1

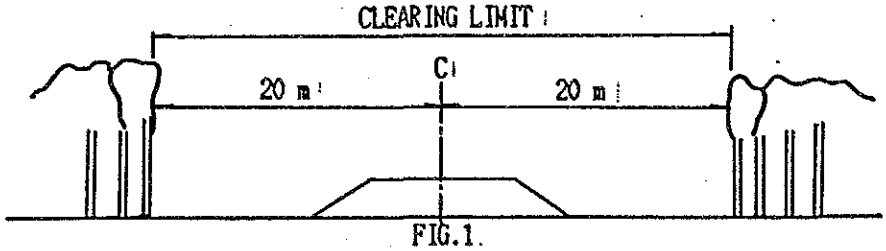


FIG.1.

INCASE MORE THAN 20 m.FROM THE CENTER LINE TO TOP OF CUTTING SLOPE, EXCEEDING 5 m.OUT SIDE FROME THE TOP OF CUTTING SLOPE AS FIG.2

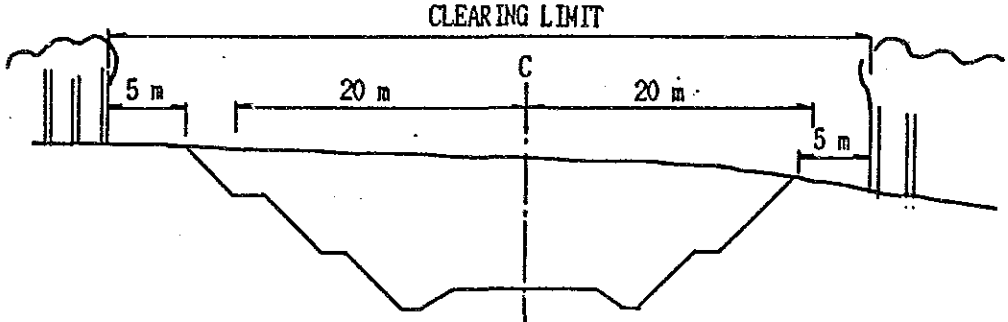


FIG.2

GRUBBING

STANDARD LIMIT 2 m.OUT SIDE FROM THE TOE OR TOP OF SLOPE AS FIG.3

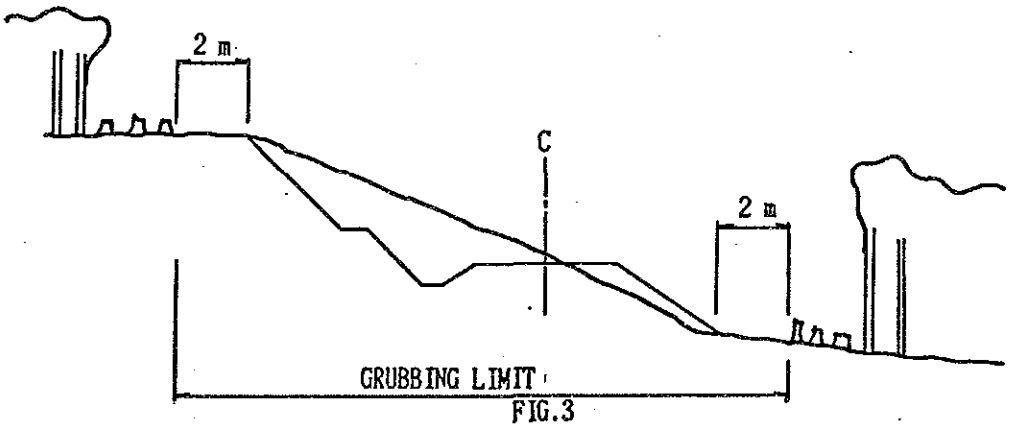


FIG.3

INCASE SETTING GEOTEXTILE SECTION
2 m.OUT SIDE FROM THE EDGE OF SETTING GEOTEXTILE AS FIG.4

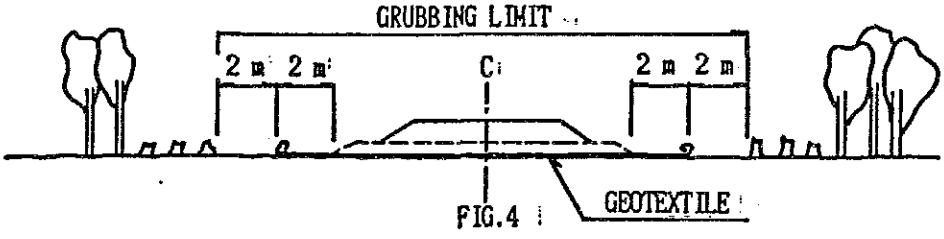


FIG.4

GROUP 4

EARTHWORKS

GROUP 4

EARTHWORKS

4.1 Description

Earthworks shall include excavation, construction of embankments and the removal of topsoil and unsuitable material required for the formation of the roadbed; excavation for roadway structures, drainage ditches, take-off ditches or channels for stream diversions; removal of surcharge material, organic waste material and unsuitable overburden from roadway site and from any borrow pit and its disposal; excavation of materials below grade; excavation of borrow pits; the earthworks necessary for the connection of intersecting roads, public or private, within the limits of the Works; the hauling and disposal of excavated material; and the trimming of shaping of excavations and embankments; the improvement works for soft ground including the installation of geotextile fabric, sand mat filling, sand bags, settlement measuring apparatus, field observations, bearing units and subsoil drains.

4.2 Extent of Work

The dimensions of the excavations and embankments shall be generally in accordance with the typical cross sections, plan and longitudinal profile, and detailed cross sections shown on the Drawings. The Engineer may vary details such as width of the roadbed or the slopes and batters as conditions and circumstances relating to pavement thickness, material stability or other reasons, may dictate. The dimensions of other earthworks operations not shown or specified on the Drawings shall be in accordance with the directions and requirements of the Engineer.

The subgrade level may be varied to suit changes in thickness of pavement in those sections where the final surface level cannot be varied because of the requirements for structures, or for any other reason.

The slopes of excavations and embankments shall be trimmed neatly and evenly to the line and slope shown on the Drawings or as instructed by the Engineer. Undercutting of slopes in excavation shall be made good as directed by the Engineer and costs thereof shall be borne by the Contractor.

Existing pavement shall not be excavated where it is to be incorporated in the new construction unless otherwise instructed by the Engineer. The limit of excavation adjacent to existing pavement which is to remain as subbase will be determined on site by the Engineer and this limit will be marked on the cross sections. Where the depth of this excavation exceeds 200 millimetres below top of subbase level a step or steps with vertical face of 150 millimetres and horizontal face of 300 millimetres shall be formed and the quantity included in the volume to be excavated.

The embankment on soft ground shall be constructed in accordance with the typical cross sections shown on the Drawings. The dimensions of the sand mat filling, geotextile fabrics, reno mattresses and sand bags shall be as indicated in the detailed cross sections shown on the Drawings. The subgrade level prior to starting the pavement work may be changed in accordance with the field observation results as directed by the Engineer.

Field observation shall be conducted by the Contractor using settlement plates and displacement pegs located at points as shown on the Drawings.

4.3 Tolerance in Level and Alignment

The surface of the finished subgrade shall not be more than 30 mm higher or more than 50 mm lower than the required levels and shall contain no depressions which may prevent the free run off of surface water.

The alignment of the finished earthworks shall be such that the dimension measured at right angles from the designated centreline to the top of the embankment slope, or to the toe of the batter in cuttings, is nowhere less than the dimension shown on or inferred from the Drawings. The Contractor shall not be paid for earthworks placed outside the limits designated on the Drawings or directed by the Engineer unless such additional material has been ordered to be placed by the Engineer.

The surface of the finished subgrade on soft ground shall be in accordance with Specification Clause 4.25.

4.4 Subgrade

The finished subgrade level specified in the Contract will be subject to changes if in the opinion of the Engineer such a change is necessary or desirable. If the changes result in higher levels then the extra fill material shall comply with Clause 4.15 of this Specification and payment shall be as per Clause 4.21 of this Specification.

4.5 Description of Material Types

Excavation shall be classified under the following material types:-

(a) Type A
(b) Type B
(c) Type C
(d) Type D

The material encountered in any highway excavation shall be classified as one of the types listed above. In no case will a material be classified using percentages of two or more types.

Where material changes from one type to another in an excavation the Contractor shall immediately notify the Engineer in order that sufficient field measurements can be taken to establish the boundary between the two types of materials for quantity determination. Should the Contractor fail to so notify the Engineer then the classification of the material type for measurement and evaluation shall be entirely at the discretion of the Engineer.

(1) Type A - Solid Rock

Type A material shall include all forms of "solid rock in place" occurring in masses, ledges, seams or layers of sufficient hardness which in the judgement of the Engineer it is not practicable to excavate without drilling and blasting.

It shall not include detached masses of rock or boulders containing a volume of less than 1.0 cubic metre and shall not include material which in the judgement of the Engineer can be loosened by a single tyne hydraulic ripper drawn by a tractor unit with a minimum total weight of 22 tonnes and flywheel horsepower rating of 180 HP or metric equivalent.

(2) Type B - Materials Requiring Ripping

Type B material shall mean those materials of such density or so firmly cemented that they cannot be removed by push blade action only of a tractor unit of minimum weight of 16 tonnes and flywheel horsepower rating of 180 HP or metric equivalent; that is, they cannot be removed without first loosening them by means of ripping equipment, or some means other than continuous drilling or blasting.

(3) Type C - Concrete and Masonry

Type C material shall include bridge piers, bridge abutments, culvert headwalls, wingwalls, footings, retaining walls and spillways.

(4) Type D - Common

Type D material shall include all other materials of a nature not included in the foregoing definition of Type A, B or C materials.

4.6 Unsuitable Material

4.6.1 Roadway Cut

Where material is found in cut which in the opinion of the Engineer is not suitable for the construction of embankments it shall be removed and disposed of to the designated areas as shown in the Drawings or other areas acceptable to the Engineer. Material such as organic soils, peat, material containing large amounts of roots or other vegetable matter or compressive soils shall be classed as unsuitable. Topsoil shall also be classified as unsuitable and disposed of as described unless the Contract provides elsewhere for it to be stockpiled for re-use.

Material that cannot be compacted to the required standard merely because it is too wet or too dry is not to be classified as unsuitable unless the results of drying and compaction trials, stipulated in Clause 4.15, in the opinion of the Engineer demonstrate that it is not practicable to use such materials in the Works.

4.6.2 Subgrade

Where the Engineer is of the opinion that material below natural ground level under embankments or below the designated subgrade level in cuttings will be detrimental to proper construction, it shall be removed to such depth and over such areas as are shown on the Drawings or as directed by the Engineer. Excavation carried out under this Clause that is not covered by Clause 4.22 shall be paid for as unsuitable material.

Material removed below subgrade as a result of an instruction by the Engineer in accordance with Clause 4.4 hereof shall be paid as Excavation Type D provided that the instruction was given prior to the Contractor completing excavation.

4.6.3 Dredging Excavation

Where material is found in soft ground under water which in the opinion of the Engineer is not suitable for construction of embankments it shall be removed and disposed of as dredging. The excavated material shall be disposed of at the designated areas shown in the Drawings or other areas acceptable to the Engineer.

Dredging excavation of replacement works for the Alika Swamp shall be carried out by acceptable construction equipment to the lines and levels shown on the Drawings or to such lines and levels as the Engineer may direct.

4.6.4 Spoil Bank

Unsuitable material shall be hauled to and placed at the designated spoil banks or other areas acceptable to the Engineer. The Contractor shall carry out clearing and grubbing prior to the disposal and in such a manner as to provide a stable, well drained and neat appearance and shall not obstruct drainage nor cause injury to highway works or private property.

No separate payment shall be made for the spoil bank and this cost shall be included in the scheduled rate stated in the Bill of Quantities for the various items of earthworks.

4.6.5 Measurement and Payment

The Work is measured by volume in cubic metres in accordance with Clause 4.19.

The measurement of dredging excavation shall be made by cross-sectioning the area excavated and calculating the volume in cubic metres. Provided that no payment will be made for over-excavation.

The payment for unsuitable material shall be made at the scheduled rate per cubic metre in the Bill of Quantities, such items as (a) Roadway; and (b) Alika Swamp (Dredging). These rates shall include full compensation for excavating, loading, haulage, spreading and satisfactory disposal and for furnishing labour, materials, equipment and incidentals necessary to complete the work.

4.7 Rock Cut

Excavation in rock shall be undertaken generally according to the Drawings or as directed by the Engineer.

Rock cuts shall be excavated to 300mm below subgrade level

to a firm and reasonably smooth and uniform surface. No pinnacles of rock shall be left protruding from the surface of the cut and broken rock of greater diameter than 150mm shall be removed. Payment will be made for the actual quantities taken out as provided in Clause 4.19. Rock cuts shall be brought up to subgrade level by backfilling with material acceptable to the Engineer, and the surface made uniform as to line and grade in preparation for the pavement courses.

Payment for such backfilling will be made at the scheduled rate for Embankment.

When ordered by the Engineer the same procedure for backfill will apply to cuts in material other than solid rock. The work shall be so conducted, whether by blasting or otherwise, so that the sides of the cut shall be left in as regular and as reasonably safe condition as practicable. Excavated rock of suitable quality required for stone pitching, gabions, etc. shall be reserved and deposited in dumps if so ordered by the Engineer.

A berm of at least 600mm shall be left between the top of slope of rock cuttings and the toe of slope of overlying materials. In solid rock cuts, where pockets which will not drain are formed below the subgrade level by blasting, the Contractor shall, at his own expense, provide drainage by ditching to a free outlet as ordered and shall backfill both.

4.8 Dangerous, Loose and Overhanging Rock

The Contractor will be required to remove dangerous, loose and overhanging rock within or outside the limits of the highway right-of-way when and where ordered by the Engineer. This work will be measured and paid for as Earthworks.

4.9 Overbreak in Solid Rock

Overbreak resulting from fault or negligence of the Contractor shall be removed or disposed of as directed by the Engineer at no cost to the Employer.

Definition of negligence will be deemed to mean lack of cut-off drill holes on the back slopes, excessive spacing of drill holes and their overloading.

4.10 Surplus Material

Suitable excavated material in roadway cut shall be used, so far as is practicable, in constructing embankment. Required roadway excavation in excess of that needed for construction shall be removed and disposed of at

designated areas in such a manner as to provide a stable, well drained and neat appearance and shall not obstruct drainage nor cause injury to highway works or private property. Designated areas shall be shown on the Drawings or shall be other areas acceptable to the Engineer.

No separate payment shall be made for disposal of surplus material and this cost shall be included in the excavation in accordance with Specification Clause 4.19.

4.11 Enlargement of Cuttings

In cases where the quantity of material taken from a regular cutting will not be sufficient to form the requisite embankment, the deficiency may be supplied by taking material from cuttings within or outside the right-of-way at such places as are acceptable to the Engineer, or from enlargement of the regular cuttings, made uniformly on one or both sides of them, and the sides of the excavation in all cases shall be dressed to such slopes as the Engineer may require. The material excavated in this manner will be considered as Borrow and Specification Clause 4.18 will apply.

4.12 Use of Explosives

Except as specified hereinafter, rock may be carefully excavated with the use of explosives. The surroundings of any permanent or temporary structure and equipment of every kind should be protected against damage and flying debris.

In the handling, storage and use of explosives, the Contractor shall comply with all applicable legislation, regulations and by-laws, and with AS 2187 - SAA "Explosives Code Part 1 - Storage and Land Transport of Explosives and Part 2 - Use of Explosives".

When blasting in the vicinity of buildings and structures, ground vibrations shall not exceed the maximum values specified in AS 2187. The Contractor shall supply and operate a vibrograph or similar instrument so that the Engineer can measure the ground vibrations at any point. Should the values specified in AS 2187 be exceeded, the Contractor shall reduce the amount of charge used. The Contractor may be required to carry out trial blasting so that the maximum charge to be used can be determined.

The Contractor shall give the Engineer at least ten (10) days notice of any intention to excavate by blasting and shall furnish full details of the location thereof and the methods he proposes to adopt. Blasting shall not be undertaken without the Engineer's consent and only at times acceptable to the Engineer.

The Contractor shall provide screens, barriers, mats and the like to limit the effects of blasting, but notwithstanding the effects of the provision of such screens, barriers, mats and the like, the Contractor shall be responsible for any loss, damage or injury sustained by the public or by workmen (whether employees of the Contractor, Engineer, Employer or other authority) and for damage to property of any description whatsoever caused directly or indirectly by such blasting.

Secure storage places shall be provided for explosives and such places shall be clearly marked with warning signs. Only persons trained and experienced in the handling of explosives shall be allowed to use them, and no shot shall be fired until a warning has been sounded and all persons within radius of danger removed. The warning device shall give an audible warning clearly different from any other sound normally heard on the Site.

In case the vicinity of the work is accessible to the general public, the Contractor shall, before any shots are fired, post men about the Works in various directions to warn all persons of the danger existing and to prevent them approaching closer than safety permits.

When blasting is likely to endanger life or property, the Engineer shall have the power to prohibit the use of explosives or prescribe and enforce such rules and regulations as he may deem necessary; but the prescribing or failure to prescribe such rules and regulations shall not relieve the Contractor from any responsibility under the Contract.

4.13 Excavation for Structural Foundations

4.13.1 General

This clause shall apply to excavations for structural foundations including bridgeworks, drainage work and relevant roadway structures, other than those which require cofferdams. For cofferdams see Group 10 of this Specification.

4.13.2 Material Types

Foundation excavation shall be classified under one of the following material types:-

(a) Type A
(b) Type B
(c) Type C
(d) Type D

as defined in Clause 4.5 of this Specification.

4.13.3 Execution of Works

The Contractor shall be responsible for safely maintaining the excavation and for the observance of all existing and relevant laws and regulations regarding safety on construction sites. The Contractor shall take all necessary precautions and shall make good all settlements or damage to buildings, footpaths, roads and services caused by his excavation or other construction activities. The Contractor shall so plan and execute his works that, as soon as practicable after the Engineer's approval of the founding surface of the excavation has been given, the blinding concrete shall be poured.

In the event that water, or any other cause, has in the opinion of the Engineer caused the deterioration of the surface before the blinding concrete is poured the Engineer may order the Contractor, at the Contractor's expense to excavate until the deteriorated material is removed and fill to the originally approved level with blinding concrete. In materials other than rock the Engineer may approve the use of approved backfill in place of blinding concrete.

In the event that the approved founding level is below the foundation as shown on the Drawings the Engineer may order the level to be built up to the level shown on the Drawings as follows:-

Excavations in rock, the fill shall be blinding concrete. Excavation in other materials, the fill shall be sub-base material as defined in Clause 5.1 of this Specification. The fill shall be compacted to 95% relative compaction in accordance with AS 1289 Test No. E1.1.

The fill shall extend beyond the base size as shown on the Drawings in all plan directions by a distance equal to the depth of the fill used.

Where the necessity for building up of the base of the excavation is due to over excavation by the Contractor the work shall be carried out at the Contractor's expense.

4.13.4 Measurement of Excavation for Structural Foundations

The quantities of excavation given in the Bill of Quantities are calculated from the projected area of the footings, or parts thereof, onto a horizontal plane (i.e. the plan area of the footings shown on the Drawings) multiplied by the average vertical depth of the excavation from cleared surface level as given in Group 3.

The Contractor will be deemed to have included in his rate for shoring or battering of the excavation.

In the event of alterations of the foundation levels, quantities shall be calculated by the same method, but the vertical dimensions shall be measured from the Contract levels. In addition, if the plan dimensions of footings are changed by the Engineer, quantities shall be calculated by multiplying the variation of the plan area by the average vertical depth from the natural surface to the approval foundation level.

4.14 Fill to Structural Foundations

4.14.1 General

This Clause shall apply to fill to structural foundations including bridgeworks, drainage works and relevant roadway structures. Construction of fill to structural foundations shall not commence until the Engineer has satisfied himself concerning pertinent foundation conditions that may affect the future stability of the bridge, other structures or embankments. Unless the procedure for construction is stated on the Drawings the Contractor must submit his proposed method to the Engineer for review. Work shall not commence until the Engineer has given his consent in writing to the Contractor's proposals.

4.14.2 Scope

Works covered by this Clause are as follows:-

(a) Backfill to excavations for structural foundations after construction of permanent foundations.

(b) Backfill to bridge abutments.

(c) Roadway embankment within "Bridge Section".

4.14.3 Backfill to Excavation for Structural Foundations

After installation of permanent foundations and removal of all temporary work, the remainder of the space excavated shall be carefully backfilled and consolidated with selected gravel, gritty loam, or if approved, the excavated material. Material removed during the excavation, if suitable and not required for specific re-use may be used in approach embankments or disposed of as directed by the Engineer.

Placing and compaction of the fill shall be carried out in even layers not exceeding 300mm depth, with compaction to 90% relative dry density in accordance with AS 1289 Test E1.1.

4.14.4 Backfill to Bridge Abutments

(1) Material

Material used behind bridge abutments shall conform to the requirements for subbase as defined in Clause 5.1 of the Specification. In addition, a drainage layer 500mm wide shall be placed behind wall type abutments and shall extend down to a soil drain. The drainage layer shall be of free draining gravel, crushed rock or other material all of which will pass 75mm sieve. The percentage passing a 4.75mm sieve shall not be greater than 25. The materials for the drainage layer shall be free of vegetable matter and balls of clay. Where indicated on the Drawings, drainage pipe shall be supplied and laid, to a 1% minimum fall, behind the abutment. Installation is to be concurrent with construction of the drainage layer.

(2) Extent of Backfill

Unless otherwise indicated on the Drawings, the fill to bridge abutments extend above a surface extending back from the line where the piles or the excavation as defined in Clause 4.12 cut the cleared ground surface, as defined in Group 3, or such lower level as the Engineer shall direct the Contractor to remove unsuitable material.

Where the Contractor chooses to batter excavations rather than support the vertical face as in Clause 4.12, the battered volume shall be included in the above fill but no payment shall be made for the additional fill required.

4.14.5 Roadway Embankments

The approaches shall be constructed as the rest of the roadworks except that a construction method for the approaches shall be proposed and construction shall commence on the written approval by the Engineer. The embankments shall be carried out in accordance with Clause 4.15 of this Specification.

4.14.6 Measurement and Payment

(a) The Measurement shall be made by volume in cubic metres. The quantity is calculated from the pay lines shown on the Drawings. Roadway embankments shall be measured in accordance with Clause 4.21 of this Specification.

(b) Payment for backfill shall be made at the scheduled rate per cubic metre. The rate shall include all necessary costs incurred in carrying out and

completing the work as specified. Payment for roadway embankments shall be made at the scheduled rate per cubic metres in accordance with Clause 4.21 of this Specification.

4.15 Embankments

4.15.1 Earth Embankments

This section applies to embankments constructed from materials containing less than 15% by volume of rock larger than 150mm.

Embankments shall be constructed from materials obtained from cuts along the road or from the borrow pits designated in accordance with Clause 4.11 and 4.18, or approved by the Engineer.

The areas where embankments are to be constructed shall be cleared in accordance with Specification Group 3 of vegetation, in addition any soft, loose or organic material shall be removed to a depth determined by the Engineer. Where an embankment is to be constructed on a side slope steeper than 1V:4H the natural surface shall be scarified and benched as shown on the Drawings or as directed by the Engineer.

Earth embankments shall be constructed in successive horizontal layers not exceeding 250 mm in loose thickness. Each layer shall be compacted to not less than 95% of the laboratory dry density as determined by AS 1289 Test No. E1.1. The in-situ dry density of embankments shall be determined by AS 1289 Test No. E3.1 or E3.3 as appropriate at locations chosen by the Engineer.

Materials which cannot be compacted to the required density because of a high moisture content shall not be used without prior aeration and drying. The Contractor shall allow in his rates for drying out of materials and keeping them at or near optimum moisture content prior to the placing of the next successive layer.

Where compaction trials show that a materials cannot be sufficiently dried out to a moisture content within such a range as will make possible its compaction to the required density and, in the opinion of the Engineer, alternative materials are not readily available, such materials shall be compacted to a dry density equal to at least the maximum dry density at field moisture content as determined by AS 1289 Test No. E1.1. The field moisture content shall be determined from a representative sample taken at a depth of at least 300 mm from the surface of the material. The Contractor shall so plan his operations so that such materials are placed in the lower layers of embankment. They shall not be placed within 600mm of the underside of subbase.

The 300 mm layer below the sub-base or such other thickness as may be directed by the Engineer, shall be constructed using materials which shall have a minimum 4 day soaked CBR of 4% when compacted to 95% of the maximum dry density determined by AS 1289 Test E1.1.

At least 7 days prior to the intended completion of an embankment, the Contractor shall notify the Engineer and submit for his acceptance samples of the material to be used in the layer described above. If such material is to be of a different quality or from a different source than that of the previous embankment layer, then the Contractor shall prepare the embankment to the appropriate level and notify the Engineer of his intention to proceed with the placing of the material in sufficient time to allow the Engineer to carry out such inspections and tests as he may deem necessary.

Earth embankments carried out on soft ground in the swamp area shall be specified in this Clause. The special provisions stated in Clause 4.25 shall be applied to the embankment work on soft ground.

4.15.2 Rock Embankments

This section applies to embankments constructed from materials containing more than 15% by volume of rock larger than 150mm. Embankments shall be constructed in layers equal in thickness to the largest average size of the materials but not exceeding 600mm. Greater lift thickness will be permitted by the Engineer under special conditions provided the Contractor can spread the larger material satisfactorily. The materials shall be deposited and spread so that the large rocks are well distributed and the intervening spaces filled with smaller sizes and fines as may be available to form a stable embankment.

Each layer shall be compacted by a vibrating roller with a static load per 100mm width of roll of at least 2.1 kN. Compaction shall be continued until movement of the surface under the action of the rollers is negligible and is to the satisfaction of the Engineer.

Where permitted by the Engineer, side hill fills where the width is too narrow to accommodate equipment may be placed by end dumping until sufficient width of the embankment had been formed to carry equipment, after which the remainder shall be placed in layers and compacted as specified.

The 300mm layer, below the subbase, or such other thickness as may be directed by the Engineer, shall be formed of material smaller than 75mm nominal size and shall have a minimum 4 day soaked CBR of 8%, when compacted to 95% of maximum dry density determined in accordance with AS 1289 Test No. E1.1. Such materials

shall be compacted, in layers not exceeding 200mm loose thickness.

At least 7 days prior to the intended completion of an embankment, the Contractor shall notify the Engineer and submit for his acceptance samples of the materials to be used in the layer described above.

If such materials are to be of a different quality or from a different source than that of the previous embankment layer, then the Contractor shall prepare the embankment to the appropriate level and notify the Engineer of his intention to proceed with the placing of the material in sufficient time to allow the Engineer to carry out such inspections and tests as he may deem necessary.

4.16 Slips

For slips in existence prior to the commencement of work on the Site or where a slip occurs in the roadway from an excavation (or out of an embankment) already trimmed to the slope as specified by the Engineer before the final acceptance of the Works, such slip material shall be removed by the Contractor from the roadway (or replaced by the Contractor in the embankment).

The classification of material in slips shall be in accordance with its conditions at the time of removal regardless of its prior condition.

Materials to replace embankment slips shall be obtained from sources acceptable to the Engineer.

If a slip is caused by the failure of the Contractor to execute the work in the proper manner as determined by the Engineer, or if the Contractor leaves slopes undercut so that a slip may subsequently occur, the Contractor shall undertake remedial work to the extent ordered by the Engineer at the Contractor's expense.

Where a slip cannot be attributed to any failure on the part of the Contractor, remedial work directed by the Engineer shall be measured and paid for as Dayworks.

4.17 Ditches

Ditches of whatever nature which may be considered necessary for the proper drainage of the work shall be constructed at such points and to such cross sections, alignments and grades as shown on the Drawings or as the Engineer may direct. This shall include inlets and outlets to culverts and ditching of all kinds. Ditching quantities shall be considered as ordinary excavation quantities and shall be measured, classified and paid for as such.

4.18 Borrow

Borrow shall consist of suitable and satisfactory material, obtained from Borrow Pits nominated on the Drawings or from sites acceptable to the Engineer actually required for the construction of embankments.

The Contractor shall give due consideration to the requirements of Specification Clauses 4.10 and 4.11 and shall so plan his earthworks operations in order to maximise the use of suitable materials obtained from excavations and to minimise the requirement for the use of Borrow.

Borrow Pits nominated on the Drawings or accepted by the Engineer shall be excavated so that they will drain to the nearest natural outlet or to such outlets as are designated by the Engineer. Side slopes of Borrow Pits shall be trimmed and dressed to such slopes as are acceptable to the Engineer. Borrow Pits shall be staked out and cross-sectioned by the Contractor in the presence of a representative of the Engineer's staff before the Contractor begins work therein and no excavation, other than the excavation of test pits for material testing, shall be allowed of any material from the Borrow Pits prior to this being done to the satisfaction of the Engineer.

The nominated Borrow Pits and Embankment Sections to which the borrow materials shall be hauled are as follows:-

Borrow Pits	Embankment Sections
No. 1	CH 33+904 - CH 34+150
No. 2-1	CH 48+000 - CH 51+200
No. 2-2	CH 48+000 - CH 51+200
No. 3-1	CH 51+200 - CH 54+000
No. 3-2	CH 54+000 - CH 59+919
No. 4	CH 59+988 - CH 64+000 and
	CH 65+950 - CH 68+677
No. 5	CH 68+799 - CH 80+596
Stockpile No. 1	CH 33+550 - CH 33+810

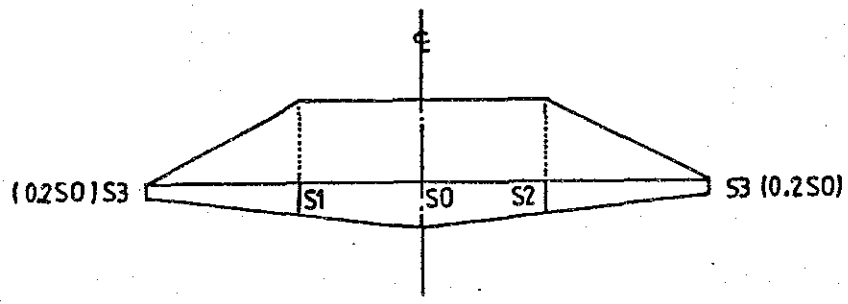
Stockpile No. 1 designated on the Drawings shall be classified as a Borrow Pit under this Clause. The stockpile material shall be utilized for the roadway embankments of Lot II work. The stockpile material will be formed by this and will be surplus material from the roadway excavation of the Lot I Contract.

The material of each nominated Borrow Pit shall be only utilized for the limited roadway chainage as stated above. The Contractor shall take care not to arise the payment claim.

If the Contractor uses the borrow material for the other purpose, except for the above Embankment Section, the Engineer will have the right to deduct that volume calculated by the Engineer.

The quantity of Borrow used for the calculation of payment for Borrow shall be the net volume required for the construction of embankments to the specified dimensions, resulting from the shortfall, if any, in the net quantity of suitable material obtained from the specified site excavation and the net quantity of material required to construct the embankments to their specified dimensions. No allowance shall be made in the calculation of such quantity for either bulking or wastage.

In addition, the quantity of Borrow used for soft ground shall be the net volume required for the construction of embankments to the specified dimensions plus settlement volume. Embankment volume shall be calculated based on settlement survey results in accordance with Clause 4.31 of this specification. Net embankment volume will be calculated from the final cross-sections. Original ground level shall be surveyed on the sand mat surface just after spreading and compacting the sand mat material. The settlement volume shall be calculated by the following figures and actual settlement at the end of the period of suspended duration in accordance with Specification Clause 4.25 or starting time of subbase work as approved by the Engineer.



The actual settlement shall be measured at S0,S1, and S2 in accordance with Specification Clause 4.30. Settlement at both embankment toes will be calculated at 0.2 x S0.

The payment shall be made at the scheduled rate per cubic metre for Borrow and the rate shall include the removal of overburden and its disposal, the maintenance and tidying up on completion of the Borrow Pits and the construction and maintenance of access roads thereto. This scheduled rate for Borrow shall also include the winning,

stockpiling, loading and haulage of the material to the designated chainage, and for furnishing labour, materials, tools, equipment and incidentals necessary to complete the Borrow to this Specification and as directed by the Engineer. An interim payment may be made in accordance with Clause 4.21 of this Specification.

Should the Contractor wish to use Borrow except for the nominated Borrow Pits, in lieu of excavated material deemed suitable for use in embankments by the Engineer, he may request the written approval of the Engineer to do so and such approval shall not be unreasonably withheld. In such cases, Borrow shall be obtained at the Contractor's own expense and the surplus suitable material resulting from such operation shall be stockpiled neatly to the satisfaction of and in locations nominated by the Engineer.

4.19 Measurement and Payment for Excavation

(1) Finally accepted road excavation shall be measured in its original position from the ground line as it exists after clearing and grubbing operations have been completed and the volume determined in cubic metres from original and final cross-sections of required work by the formula:-

$$\tfrac{1}{2} (A + B) L$$

where A and B are end areas separated by a length L measured horizontally along the road centreline. The frequency of cross-sections shall be as shown on the Drawings or as provided in the Construction Tables or as specified by the Engineer. The area of the cross-section to be measured as roadway excavation shall be that area bounded by the ground line as it exists after clearing and grubbing operations, the required cut slopes and the underside of required subbase or such lower levels specified or instructed to be excavated. Where excavation in rock is to be paid for separately the area of the cross-section shall be divided along the surface of the rock. Excavation of unsuitable material, and isolated volumes of other required excavation which it is impractical to measure by the cross-section method shall be measured by taking appropriate measurements on Site.

(2) The quantities of excavation measured in (1) shall be paid for at the scheduled rates per cubic metre for the various types of materials excavated. These rates shall include full compensation for loosening, blasting, breaking up, removal, loading,

haulage for 5.0km and satisfactory disposal of excavated materials and for draining, drying out as necessary and keeping earthworks free from water and for shaping, and for finishing subgrade surfaces and for furnishing all labour, materials, tools, equipment and incidentals necessary to complete the work in this Specification and as directed by the Engineer.

(3) An interim payment may be made on the measured volumes of required excavation actually excavated but before final shaping at a rate of 70% of the scheduled rate provided the Contractor's intention to complete is clear.

4.20 Measurement and Payment for Overhaul

Subject to the following provision, when excavated materials are hauled a distance greater than 5.0km, the Contractor may claim additional compensation for overhaul. Overhaul is defined as the haulage only of material from roadway cut or borrow areas except for the nominated Borrow Pits, measured as the net volume required for the construction of embankments to their specified dimensions for a distance in excess of that stated in the contract to be the maximum length of haul over which the scheduled rates for excavation shall be applied.

Payment for overhaul will be made on the basis of the quantities measured as described in Clause 4.19. No allowance will be made for shrinkage or swell.

If the Contractor intends to claim for overhaul of material beyond the maximum length of one way haulage specified he shall notify the Engineer of his intention to make such a claim and shall advise the proposed nature of his operations which will necessitate such overhaul being required. The Engineer shall then advise the extent of excavated material to be overhauled and limits of the overhaul. Thereafter the Contractor shall make such measurements as are necessary to determine the number of units of overhaul to be claimed and shall afford the Engineer the opportunity of checking such measurements before commencing haulage.

If prior agreement from the Engineer is not obtained to haul material in excess of the specified distance, it shall be deemed that the material has not been hauled in excess of this distance. Should the Contractor desire to haul material in excess of the specified distance without receiving additional payment, he shall be so permitted subject to any other requirement of the Specification. The scheduled rate shall apply for each kilometre and part thereof measured to the nearest tenth of a kilometre, beyond the free haul limit of 5.0 km.

4.21 Measurement and Payment for Embankments

(1) Finally accepted embankment shall be measured in cubic metres from cross-sections taken at the frequency as shown on the Drawings, as provided in the Construction Tables or as specified by the Engineer, the volume to be measured shall be the net volume of required embankment completed in accordance with the Specification and the alignments, levels, grade and dimensions shown on the Drawings or as directed by the Engineer. The volume shall be determined by the formula:-

$$\tfrac{1}{2} (A + B) L$$

where A and B are areas separated by a length L measured horizontally along the centreline of the road. The cross-sectional area to be used shall be that area bounded by the required finished subgrade, the required side slopes and the ground line as it exists after clearing and grubbing operations have been completed.

The finished subgrade is defined as the nominal level shown in the Drawings or directed by the Engineer above which pavement materials as defined by Group 5 of the Specification may be placed. In cases where the Contractor is required to replace unsuitable material excavated in accordance with Clause 4.6.2 the volume shall be measured on site by an appropriate method. No account shall be taken of benching, terraces or steps formed in accordance with Clause 4.15 or for the compaction of material loosened pursuant to Clause 4.12 of this Specification. Deductions from the measured volume shall be made for culverts, bridges and for all volumes separately measured and paid for where they lie within the measured volume.

In addition the embankment volume on soft ground shall be measured by the above net volume plus settlement volume. The settlement volume shall be calculated in accordance with Specification Clause 4.18.

(2) The quantities of embankment measured in (1) shall be paid for at the scheduled rate per cubic metre regardless of the source of the material and regardless of whether the excavation of the material has been paid for under another item or not. The rate shall be full compensation for performing all work required including preparation of foundations, benching, spreading, carrying out drying trials, carrying out compaction trials, processing, drying, watering, compacting, trimming and furnishing labour, materials, tools, equipment

and incidentals necessary to complete the embankments to this specification and as directed by the Engineer.

(3) Trimming of embankment shall include the neat finishing of the subgrade surface and of all batters to the lines shown on the Drawings, clearing of any waterways of debris arising from the embankment operation, and the removal of any other loose rock, boulders, or excess material resulting from the trimming operations. The Contractor shall trim the embankments to the tolerances required by Clause 4.3 of this Specification prior to the placing of any subbase material.

(4) An interim payment may be made on the measured volumes of required embankment actually constructed before final shaping at a rate of 80% of the scheduled rate provided that the Contractor's intention to complete is clear in the opinion of the Engineer.

4.22 Excavation and Filling of Soft Spots

Where, in the opinion of the Engineer, unsuitable material occurs in isolated soft spots below subgrade level in cuttings or at original ground level after clearing and grubbing under embankments, in quantities of less than 25 cubic metres, this shall be excavated and filled with suitable material. Such measurement shall be made separately from the main excavation. The item shall include for excavation and haulage of the unsuitable material to spoil areas designated by the Engineer. This quantity shall be paid for at the scheduled rate per cubic metre and shall include the work necessary to spread and compact the replacement material in layers not exceeding 200 mm loose thickness to a minimum density of 95% of the laboratory dry density as determined by AS 1289 Test No. E1.1.

4.23 Compaction of In-Situ Subgrade in Excavation

The finished subgrade in excavation shall be compacted such that the material up to 150 mm below subgrade level has a dry density nowhere less than 95% of the maximum dry density as determined by AS 1289 Test No. E1.1.

No separate payment will be made for complying with this Clause as it will be deemed to be included in the item for excavation in Group 4 of the Bill of Quantities.

4.24 Replacement of Material in Excavation

Where the Engineer directs that changes be made to the subgrade level pursuant to Clause 4.4 or where the Engineer orders excavation in the subgrade pursuant to Clause 4.6.2, the excavated material shall be replaced with materials complying with the requirements of Clause 4.15. Materials replacing any excavated materials in accordance with this Clause shall be measured and paid for in accordance with Clause 4.21.

4.25 Embankment on Soft Ground

This Clause applies to embankments constructed on soft ground across the common swamp area and the Alika Swamp area. Embankment materials, embankment method, specification, measurement and payment shall be in accordance with the relevant Clauses of Specification Group 4.

The Contractor shall submit his proposals explaining his detailed construction methods and field observation plan to the Engineer, and shall not commence work until the Engineer has indicated that he has no further comments on his proposals.

Embankment filling shall be controlled so that the rate of filling does not exceed 50 mm per day averaged over the construction period. After initial completion of embankment to the subgrade levels shown on the Drawings, the following suspended duration period shall be kept to complete and minimise the consolidated and residual settlements of the soft ground before starting the subbase work:-

Description	Chainage	Length (m)	Suspended Duration Period (Days)
Miaru	33+550 - 34+150	506	700
Alika	37+750 - 38+200	450	700
Kapuri	57+100 - 59+800	2,700	550
	59+800 - 60+100	231	550
	60+100 - 62+400	2,300	700
	62+400 - 64+000	1,600	700
Lakekamu	67+100 - 67+500	278	700
	67+500 - 68+200	700	700
Tauri	68+200 - 68+550	350	400
	68+850 - 69+000	150	400
	68+550 - 68+850	178	400
Makara	73+000 - 76+300	3,256	550
Sappaharo	76+300 - 77+700	1,357	950

The Engineer may change the filling speed and the suspended duration period as a result of field observation in accordance with Specification Clause 4.32.

In case unexpected settlement and displacement develop during embankment work, filling shall cease immediately. Embankment work shall not recommence unless the Engineer gives his consent.

The Contractor shall provide experienced technical staff for the works across soft ground during the construction of embankments, and for field observation.

The Engineer may direct that embankments are raised above subgrade level during embankment work. This additional embankment material shall be measured and paid for in accordance with Clauses 4.18 and 4.21.

4.26 **Sand Mat Filling on Soft Ground**

Sand mat material shall be placed at thickness of 500 mm or 1,000 mm compacted in place as shown on the Drawings or as directed by the Engineer. Sand mat material shall be obtained from nominated Sand Borrow Pits No. 1, No. 2 and No. 3 and processed in order to achieve the specified requirement.

Sand mat material shall be well graded sand and shall conform to the following requirements: the fraction passing the 75 micron sieve shall not be greater than 3%; 85% diameter of particle shall be 1 to 5 mm; 15% diameter of particle shall be 0.1 to 0.75 mm. The sand obtained from the Sand Borrow Pit No. 2 (Ilabala Hill) shall be processed to be between 3% and 10% for the fraction passing the 75 micron. Where the fraction passing 75 micron is more than 3%, subsoil drain shall be provided in the sand mat as shown in the Drawings and as directed by the Engineer.

Sand mat material shall be placed on the geotextile fabric installed on the soft ground and the 1st layer shall be carefully spread by small low pressure bulldozer acceptable to the Engineer and by manpower. The thickness of each layer shall be not more than three hundred (300) mm before compaction. Each layer except the 1st and 2nd layers shall be compacted to not less than 95% of the laboratory dry density as determined by AS 1289 Test No. E1.1. The compaction of the 1st and 2nd layers shall be to the satisfaction of the Engineer. The preceding and adjacent roller tracks shall be lapped by more than 300mm and when compacted density shall be essentially uniform throughout the layer.

Moisture contents shall be controlled during construction to the satisfaction of Engineer. If the moisture content is high, drying shall be carried out at the stockpile.

Volume of sand mat material compacted in place shall be measured by the planned cross-section area based on the thickness as shown on the Drawings or as directed by the Engineer, and the lengths measured horizontally along the road centreline.

Payment for sand mat filling shall be made at the scheduled rate in cubic metres of compacted volume in the Bill of Quantities. The rate shall be full compensation for labour, materials and equipment, necessary to perform the work to include preparation of borrow pits, construction and maintenance of access road, stockpiling the material if any, hauling, placing, spreading, drying/wetting or scarifying as necessary, compaction, and testing including test fills.

4.27 Sand Filling in Alika Swamp, including Replacement Sand

Sand material shall be obtained from Sand Borrow Pit No. 1 nominated and processed in order to achieve the specified requirements. Sand material shall be well graded sand and shall conform to the following requirement: the fraction passing the 75 micron sieve shall not be greater than 3%; 85% diameter of particle shall be 1 to 5 mm; 15% diameter of particle shall be 0.1 to 0.75 mm.

Sand filling work shall be made in the water as shown on the Drawings. The sand material shall be placed in the replacement excavation and on the geotextile fabric. The sand material in replacement excavation shall be placed by acceptable construction equipment and shaped to the designated level shown on the Drawings in consideration with the following geotextile fabric installation.

The thickness of each layer of sand material which is placed on geotextile fabric shall be not more than 500mm and the density shall be essentially uniform throughout the layer.

Volume of sand filling material shall be measured by the planned cross-section area based on the thickness as shown on the Drawings or as directed by the Engineer, and the lengths measured horizontally along the road centreline.

Payment for sand filling shall be made at the scheduled rate in cubic metres of net volume in the Bill of Quantities. The rate shall be full compensation for labour, materials, and equipment, necessary to perform the work to include preparation of borrow pit construction and maintenance of access road, stockpiling the material if any, hauling, placing, spreading and compaction.

4.28 Sand Bags

Sand bags shall be placed and shaped in the water of the Alika Swamp and part of common swamp as shown on the Drawings. The bag shall be synthetic fibre bag with sufficient permeability or equivalent for approval of the Engineer. Filling material in bag shall be soil cement material which is 93 percent of sand borrow pit material and 7 percent of Portland cement. Cement content and gradation of sand borrow pit material shall be tested on Site to the satisfaction of the Engineer. The soil cement material shall be placed in the bag and fully tamped in the bag; the open end of the bag shall be sewn up.

The Work shall be measured by volume in cubic metres shown on the Drawings. This volume shall be calculated by stacked bags on the ground. Payment shall be made at the scheduled rate in the Bill of Quantities and shall include full compensation for supply of bag, filling material, haulage, placing and for labour, materials, equipment, tools and incidentals necessary to complete the work.

4.29 Geotextile Fabric on Soft Ground

Geotextile fabric shall be installed on the soft ground as shown on the Drawings or as directed by the Engineer. Geotextile fabric shall comply with the following requirements:-

Type A : Tensile strength shall be not less than 30kg f/3cm
Permeability (k) shall be not less than 1×10^{-2} cm/sec

Type B : Tensile strength shall be not less than 120kg f/3cm
Permeability (k) shall be not less than 1×10^{-2} cm/sec

Type A geotextile fabric shall be lapped at joints by 500mm or sewn where ordered by the Engineer.

Type B geotextile fabric shall be jointed by sewing up of appropriate ligatures and the strength of the joint part shall be more than 70 percent of the specified tensile strength above.

Measurement shall be in square metres based on the surface area of the fabric installed inplace and accepted by the Engineer.

Payment shall be made at the scheduled rate in the Bill of Quantities and shall be full compensation for supply, transport, placement and fixing and shall include for all laps at joints, sewing, labour, equipment, materials, tools and incidentals necessary to complete the work.

4.30 Settlement Measuring Apparatus

Settlement plates shall consist of 600mm square steel plate, 20mm dia. steel rod and 100mm dia. PVC pipe. Steel rod and steel plate shall be jointed as shown on the Drawings. Steel rod and PVC pipes shall be jointed by screws and couplings. Displacement pegs shall consist of timber pile of 10cm square and 2.0m long.

Timber pegs shall be made from sound, fully seasoned and approved Papua New Guinea hardwood of straight grain and free from shakes, knots and other defects and have a strength not less than Department of Forestry designation strength Group 3.

Installation points for the measuring apparatus shall be indicated on the Drawings or as directed by the Engineer.

Settlement plates shall be installed at 250 m interval and three points per cross-section as shown on the Drawings. If the Contractor wishes extra settlement plates, for more accurate calculations of Borrow and embankment volumes he shall install those at his own cost.

Settlement plate shall be installed in the sand mat material which is 50 to 100mm over the geotextile fabric or as directed by the Engineer. Steel rod and PVC pipe shall be kept vertically during embankment work. Displacement pegs shall be driven as shown on the Drawings. The base pegs shall be fixed in locations which are not affected by displacement due to the road embankment.

Measurement for settlement plate shall be made on the basis of the actual number of the said survey points according to the Drawings and the Specification. Payment shall be based on the number of settlement plates remaining in a function, as determined by the Engineer at the end of the period of suspended duration in accordance with Specification Clause 4.25 and at the scheduled rate in the Bill of Quantities. The rate shall include the cost of labour, tools, equipment and materials, excavating, backfilling, surveying, maintaining and incidentals necessary to the work.

Measurement for displacement pegs shall be made on the basis of number which comprises seven pegs and one base peg at survey point according to the Drawings and the Specification. Payment shall be based on the number of settlement plates remaining in a function, as determined by the Engineer at the end of the period of suspended duration in accordance with Specification Clause 4.25 and at the scheduled rate in the Bill of Quantities. The rate shall include the cost of labour, tools, equipment and materials, driving, temporary access, surveying, maintaining and incidentals necessary to the work.

4.31 Field Observation

Frequency and duration for the field observation shall be as follows unless otherwise directed by the Engineer:-

(1) Settlement Plate

- During embankment work	1 observation every 5 days (survey shall be made at the first layer placement).
- 0-3 months after the completion of embankment (subgrade surface)	1 observation every 5 days
- Remaining construction period	1 observation every month

(2) Displacement pegs

Frequency and duration shall be same as settlement plate observation.

The Contractor shall provide a field survey group to the satisfaction of the Engineer. The field survey group shall include a specialist for the improvement work on soft ground. Field observation shall be recorded daily and reported to the satisfaction of the Engineer.

The Contractor shall protect settlement plates and displacement pegs during above field observation period.

Where the settlement and displacement are not affected by the embankment and seem to be constant, and the Engineer determines discontinuance of the field observation, the field observation may be stopped. In case that unexpected behaviour of soft ground occurs during the field observation, the survey shall be carried out frequently or as directed by the Engineer.

If the results of the settlement plates appear unusual in the opinion of the Engineer, he may order boreholes or drillings.

No separate payment shall be made for field observation. The cost incurred for surveying, reporting, analysing, maintaining, labour, equipment, tools and materials and incidentals necessary to the work, shall be included in the Contract Price.

4.32 Bearing Units

Bearing units shall consist of timber piles and cross timber, which are 150 mm in diameter, and installed behind

bridge abutments as shown on the Drawings. The timber piles and cross timber materials shall be in accordance with Clause 10.2 of this Specification.

Timber piles shall be driven in accordance with Group 10 of this Specification. Measurement and payment for timber piles shall be made by Clause 10.9.1 of this Specification.

Cross timber shall be connected rigidly with the timber piles, by bolts and steel wire approved by the Engineer. Measurement shall be made in linear metre in accordance with the Drawings or as directed by the Engineer. Payment for cross timber shall be made at the scheduled rate of the Bill of Quantities, which is full compensation for furnishing all materials, labour, equipment, tools and other incidentals necessary to complete the work.

4.33 Subsoil Drains

In accordance with Clause 7.10 of this Specification.

GROUP 5

BASE AND SUBBASE

GROUP 5

BASE AND SUBBASE

5.1 General

This work shall consist of furnishing, placing and compacting base and subbase material and shaping and preparing a formation for base course on the subbase and the existing road pavement all in accordance with this Specification and alignments, levels, grades, dimensions and cross-sections shown on the Drawings and as required by the Engineer.

The subbase and base course covered by this Specification shall be lower subbase (sandy gravel), upper subbase (cement treated sandy gravel) and base course (cement treated sandy gravel) as shown on the Drawings.

5.2 Subbase

5.2.1 Materials for Subbase

Materials for subbase shall be selected from an acceptable source as shown on the Drawings or otherwise acceptable to the Engineer and shall be free of vegetable matter and balls of clay. The material source is to be Subbase Borrow Pit No. 3. The Contractor's proposal for selection and processing shall be submitted to the Engineer. Full scale production shall not commence until the Engineer has instructed that he has no further comment on the Contractor's proposals. Overburden materials which are unsuitable for subbase materials shall be removed and disposed of to the designated spoil bank in accordance with Clause 4.6 of this Specification. The materials shall comply with the following requirements:-

(a) The lower subbase material (untreated subbase) shall have a laboratory CBR value after 4 days soaking of not less than 8 when compacted to at least 95% maximum dry density as determined by AS 1289 Test No. E1.1.

(b) The upper subbase material (cement treated subbase) shall have a laboratory CBR value after 4 days soaking of not less than 25 when compacted to at least 95% maximum dry density as determined by AS 1289 Test No. E1.1.

The fraction of cement treated material passing 425 micron sieve shall have a plasticity index not greater than 10 when tested in accordance with AS 1289 Test No.C1.1 and C2.1 and calculated by method C3.1.

(c) The material for both the lower and upper subbases shall be well graded and shall conform to the requirements given in the following table:-

Sieve Size		Percentage by Weight Passing
75	mm	100
37.5	mm	80 - 100
19	mm	65 - 90
9.5	mm	50 - 80
4.75	mm	40 - 65
2.36	mm	30 - 55
425	micron	10 - 25
75	micron	3 - 15

(d) The fraction passing the 75 micron sieve shall not be greater than two thirds of the fraction passing the 425 micron sieve.

(e) The fraction retained on a 2.36mm sieve shall consist of particles or fragments of stone, gravel or sand and shall not include any material that breaks up when alternately wetted and dried.

(f) The fraction passing the 425 micron sieve shall have a liquid limit not greater than 30 when tested in accordance with AS 1289 Test No. C1.1 and C2.1 and calculated by method C3.1.

5.2.2 Subgrade

The subgrade and all drainage works shall be completed in accordance with this Specification for at least 100 metres ahead of the placing of the subbase material. Notwithstanding any earlier acceptance, any damage to or deterioration of subgrade shall be made good before subbase is placed.

5.2.3 Preparation of Subbase

Where subbase is to be placed on an existing pavement, the existing pavement shall be scarified to a depth not less than 150mm shaped as necessary and recompacted with the addition of subbase material. Scarified and added material shall be compacted in a layer not exceeding 250mm uncompacted thickness. Each layer shall be compacted to at least 95% of the maximum dry density as determined by AS 1289 Test No. E1.1. The density of compacted material shall be determined by AS 1289 Test No. E3.1. The tests shall be made at locations chosen by the Engineer.

5.2.4 Subbase Spreading and Compaction

Subbase shall be evenly spread at the appropriate moisture content in a layer or layers not exceeding 250 mm

uncompacted thickness. The layers shall be as nearly equal in thickness as possible. Areas of segregated material shall be removed and replaced with well graded material.

Each layer shall be compacted to at least 95% of the maximum dry density as determined by AS 1289 Test No. E1.1. The density of compacted material shall be determined by AS 1289 Test No. E3.1 at locations chosen by the Engineer.

Cement treated material shall be spread and compacted in accordance with Clause 5.4 of this Specification.

5.2.5 Crossfall

On sections of normal crossfall, rolling shall be carried out parallel to the road centreline beginning at the outer edge and progressing toward the crown. On superelevated sections, rolling shall begin on the low side and proceed towards the high side except in construction for widening where rolling shall always progress from the outer edge towards the existing pavement.

5.2.6 Finished Subbase Surface

The subbase shall be finished to give a hard dense surface throughout and free from irregularities of any kind. The finished surface shall vary not more than 10 millimetres above or 20 millimetres below the planned levels at any point. The deviation from a straight edge 3 metres long laid on the surface parallel to the centreline or at right angles to the centreline on a crossfall shall not exceed 15 millimetres. Subbase which does not conform to the above requirements shall be reworked, watered and thoroughly recompacted to conform.

5.2.7 Existing Pavement

In cases where the existing pavement has been excavated to the underside of the base course in accordance with Group 4, the surface of the existing pavement remaining shall be scarified and processed as necessary and compacted to a minimum depth of 150 millimetres to achieve not less than 95% of the maximum dry density as determined by AS1289 Test No. E1.1 to provide a formation for the base course. The finished surface and tolerances shall be the same as is specified for the finished surface of the subbase.

5.2.8 Volume Measurement

The volume of subbase material compacted in place and accepted by the Engineer shall be measured as the product of the average end area based on the nominal thickness and the length measured horizontally along the road centreline excluding the existing pavement remaining in place.

5.2.9 Payment for Measured Work

The work measured as provided above shall be paid for at the scheduled rate for the items listed above. The payment shall be full compensation for opening up borrow pits, procuring materials, processing, hauling, scarifying, placing, watering, compacting, finishing and shaping, and for labour, equipment, tools and other incidentals necessary to complete the work specified in Clause 5.2. In addition, the rate for subbase shall include the removal of overburden and its disposal, the maintenance of the borrow pit and the construction of access roads where required at the borrow pit.

Interim payment may be made on the loose volume in cubic metres of subbase material satisfactorily stockpiled on site at the rate of 30% of the scheduled rate for subbase providing that the Contractor's intention to use this material in the Works is clear.

Payment for cement treated subbase shall be made in accordance with Clause 5.4 of this Specification.

5.3 Base Course

5.3.1 Material for Base Course

Base course material shall be selected from an acceptable source as shown on the Drawings or otherwise acceptable to the Engineer, and processed to conform with the specified requirements. The material source for base course is to be Base Borrow Pit No. 1. Borrow Pits from which the sand and gravel are obtained shall be stripped of earth and vegetable matter before any material is removed therefrom. Processing shall include where necessary crushing, screening, separation, blending and any other operation necessary to produce a material conforming to the requirements of this Specification. The method of selection and processing shall be reviewed by the Engineer. Full scale production shall not commence until the Engineer has given his consent in writing to the Contractor's proposals.

Overburden materials which are unsuitable for base course materials shall be removed and disposed of to the designated spoil banks in accordance with Clause 4.6 of this Specification.

The required material shall be free of vegetable matter and balls of clay and shall conform to the following requirements:-

(a) The material shall be well graded and shall conform to the requirements given in the following table:-

Sieve Size		Weight Passing Percentage by
37.5	mm	100
19	mm	60 - 100
9.5	mm	40 - 80
4.75	mm	30 - 60
2.36	mm	20 - 45
425	micron	10 - 25
75	micron	3 - 15

(b) The fraction passing the 75 micron sieve shall not be greater than two thirds of the fraction passing the 425 micron sieve.

(c) The fraction retained on the 2.36mm sieve shall consist of hard durable particles or fragments of stone, gravel or sand and shall not include any material that breaks up when alternately wetted and dried. The coarse aggregate shall have a percentage of wear as determined by AS 1141 - 1974 (Los Angeles machine) of not more than 35.

(d) The fraction of cement treated material passing the 425 micron sieve shall have a plasticity index of not greater than 6.

(e) The cement treated material shall have an unconfined compressive strength of 18kg/cm^2 after 7 days curing when compacted to at least 95% maximum dry density as determined by AS 1289 Test No. E2.1 and tested by AS 1141.51 unconfined compressive strength of compacted bound materials.

5.3.2 Preparation of Subbase

Where base course is required to be laid on a prepared formation of either the subbase or the existing pavement in accordance with Clause 5.2, this formation shall be completed for at least 100m ahead of the placing of base course material. Notwithstanding any earlier acceptable of prepared formation any damage to or deterioration in this formation shall be made good before base course is placed.

5.3.3 Base Course Spreading

Base shall be evenly spread over the full width of the road bed in layers with uncompacted thickness not exceeding 250 millimetres subject to the approval of the Engineer. The layers, if more than one, shall be as nearly equal in thickness as possible. The material may be spread and shaped by any method which shall not cause the segregation of the coarse and fine particles. Any areas of segregated coarse or fine material shall be

corrected or removed and replaced with well graded material.

5.3.4 Existing Pavement

Where base course material is required to be added to an existing pavement and construction of formation for base in accordance with Clause 5.2 is not required, the surface of the existing pavement shall be scarified and shaped as necessary and recompacted with the addition of the base material. The total depth of scarified and added material shall not exceed the permissible depth of loose layer.

5.3.5 Base Course Spreading and Compaction

Rolling shall be carried out parallel to the road centreline beginning at the outer edge and progressing towards the crown on sections of normal crossfall and beginning on the low side and progressing towards the high side on superelevated sections. Each layer shall be compacted to at least the density determined as providing an unconfined compressive strength of 18 kg/cm^2 pursuant to Clause 5.3.1 (e). The density of the compacted material shall be determined by AS 1289 Test No. E3.1. The tests shall be carried out by the Engineer to the full depth of the layer at locations chosen by him.

Cement treated material shall be spread and compacted in accordance with Clause 5.4 of this Specification.

5.3.6 Finished Base Course Surface

The base course shall be finished to give a hard, tight, dense, stone mosaic surface free of segregated material, cakes of excessive fines, roller marks and other surface irregularities and shall conform to the following tolerances:-

(a) the minimum thickness shall nowhere differ by more than 10 millimetres from the required thickness;

(b) the alignment of the pavement shall be such that the dimension from the designated centreline to either edge of the layer measured at right angles to the centreline is nowhere less than the dimension shown on the Drawings;

(c) the finished surface shall vary not more than 15 millimetres above or below the required levels at any point. The deviation from a straight edge 3 metres long laid parallel to the centreline or at right angles to the centreline on a cross fall shall not exceed 10 millimetres. Base course which does not conform to these requirements shall be reworked, watered as necessary and recompacted to conform.