

MALAYSIA

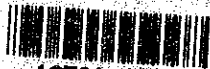
Feasibility Study for  
Beluru-Long Lama-Limbang  
Trunk Road Construction Project  
in Sarawak

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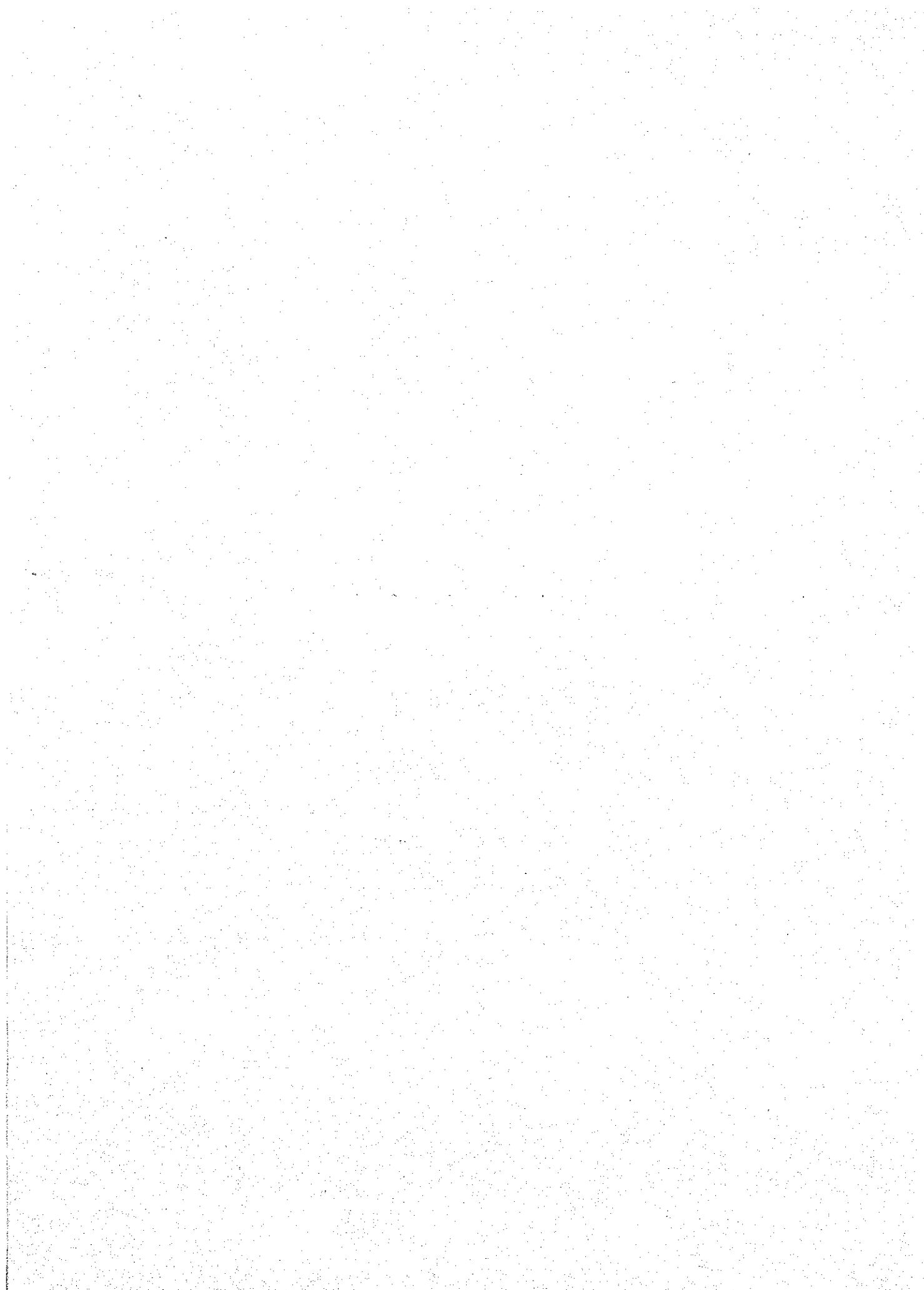
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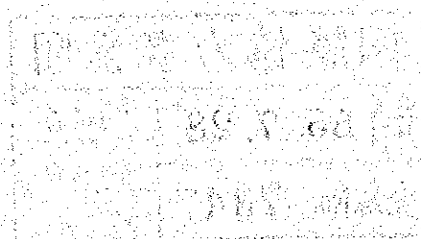


**MALAYSIA**

**Feasibility Study for  
Beluru/Long Lama/Limbang  
Trunk Road Construction Project  
in Sarawak**

**FINAL REPORT  
Vol. III : ADDENDA**

**March 1980**



**JAPAN INTERNATIONAL COOPERATION AGENCY**

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## A d d e n d a

The attached addenda consists of four contents for drawing up the Final Report as follows:

Addenda 1. Memorandum for the Final Report

- " 2. Summary of Construction Cost of the Trunk Road  
(03 standard)
- " 3. Examination of Maintenance Cost
- " 4. Terms of Reference for Consulting Engineering Services  
Part 1.

These addenda were prepared in compliance with the comments from the government of Malaysia on the Draft Final Report presented before.





Memorandum for the Final Report

(I) Reviews of the Comments of the Government

(1) Meeting notes of 11.12.79 and 18.12.79

Paragraph 6

Comment: The Highway Planning Unit referred the Study Team to Page 30 of the Drawings Report where the Team has recommended 183 meters as against the estimated 1000 meters gradient which would definitely increase costs. Also the scale for feeder roads was considered wrong being based on 1:5. Highway Planning Unit informed that it had no objection to the design geometrics/criteria presented by the Study Team except that the minimum radius was considered too high and if reduced could in the lower costs.

Answer: A comment on the critical length of 183 m and 1000 m is made later in Comment (6). The scale for feeder road will be revised in the Final Drawings. While it was agreed by the Government that the design geometrics/criteria presented by the study team was applicable to this project, the team decided to subdivide the classification of the maximum gradient into two categories (Normal and Absolute) as follows:

		(Unit: %)					
		TRUNK ROAD			FEEDER ROAD		
1	Terrain	F	R	M	F	R	M
9	Max.	Normal			5	6	8
	Gradient	Absolute			6	8	10

F = Flat, R = Rolling, M = Mountainous

The class of design criteria adopted to the minimum radius could not be revised because elaborate work on the map of 1 : 10000 would not result in a substantial difference in the cost estimate. Re-examination before adoption should be further conducted in the course of the detailed design.

Paragraph 7

Comment: Benefit cost ratios at the discount rate of 8% shown in the first table on page S-12 of the summary report are inconsistent with the values of costs and benefits given.

Answer: This is simply due to misprinting since the cost values are entered in the benefit column while benefit values in cost column. The errors will be corrected in the Final Report.

Paragraph 11

Comment: The Study Team was requested to work out estimates based on the alternative as proposed by the Sarawak State Government, who proposed that the road be constructed in stages due mainly to budget constraints and pavement class.

Answer: Review of this comment will be described later in answering Comment (8).

Paragraph 15

Comment: Referring to Pages 8-14 of the main Draft Final Report, it was noted that land compensation was not worked out. Thus, the Study Team was requested to include estimates on crop compensation as well as estimates on inflationary effects. Highway

Planning Unit would assist the Study Team with respect to the latter estimates.

Answer: Crop compensation is duly taken into account in estimating the project cost. As to the estimates of inflationary effects, an escalation factor for the corresponding cost elements was to be provided by the Authorities. The cost estimate was based on the prices of March '79 since the inflation factor was not given from the Authorities. No difficulties are foreseen in adjusting the base of cost estimate, if the annual inflation rates to be applied to the cost estimate in current prices for the road construction work are provided.

Paragraph 2.3.3.

Comment: It was raised that the use of 03 standard for trunk roads could save about 30% of the costs. It followed that if the whole project used 03 standard, then there could be an overall 30-40 % saving. The Chairman requested the Consultants to provide a rough calculation on the possible saving if 03 standard were used.

Answer: Review of this comment will be described later in answering Comment (7).

(2) Social Benefits

Comment: The Consultants are to give more weight to social benefits of the proposed road. Social and other intangible benefits were mentioned in rather general terms in the Draft Final Report.

Answer: Additional analysis and description will be made in the section 10-4-4 of the Final Report.

(3) Terms of Reference

Comment: The Consultants are to draw up Terms of Reference for detailed engineering design and construction supervision of the road as agreed. This does not appear to have been included in the Draft Final Report.

Answer: Draft Terms of Reference for detailed engineering design of the project road construction will be prepared in a separate volume. That for construction supervision should be prepared at the stage of detailed design.

(4) Construction Cost

Comment: There seems to be an unexplained difference in the estimated Construction cost of the trunk road in the Draft Final Report Summary, Page S-14 of M\$162.14 million and the main text, Table 8-9 of \$152.079 million.

Answer: The total project cost in the summary included the cost of bituminous surfacing for 112.3 kilometers of 1, 2, 3 and 8 sections, while that in the table 8-9 excluded the cost.

(5) Design Return Period

Comment: Referring to paragraph 5-3-3 (5), page 5-37 of the Draft Final Report, a design return period of 30 years has been used for the design of high water discharge. The current practice in the PWD is to use a design return period of 50 years. The Consultants should adjust to the standard requirement of the PWD.

Answer: The design return period of 30 years has been determined taking into consideration the regional characteristics of the project area. The factors used in making this decision will be noted in section 5-3-3 of the Final Report.

(6) Critical Length of Gradient

Comment: The discrepancies of the vertical alignment pointed out have to be amended to conform with the recommended design criteria.

Answer: Gradients in the Draft Final Drawings were re-examined in the light of the classification mentioned previously in the Comment of Paragraph 6. In cases of the sheet no. 25, 29 and 30, their gradients are not revised since the gradients are in the normal category of the mountainous terrain. In cases of the sheet no. 22, 26 and other several places in which it is found the modification is necessary, their gradients are revised by applying the absolute category of the rolling terrain.

With the amendment of gradient, construction cost estimation and economic evaluation are also revised in the Final Report.

(7) Alternative Design Standard

Comment: It is recommended for the present that the trunk road cost be estimated on two alternative design standards, namely:

- (a) 03 standard with a reduction of the maximum gradient from 9% to 8% and to reduce the proposed road width from 24 feet to 20 feet except at the Kubong-Limbang Junction.

(b) 05 standard as the normal trunk road standard adopted in Sarawak.

Answer: The cost of the trunk road is estimated under the 03 standard according to the above request. The result of the estimation will be prepared in a separate volume. The estimation under the 05 standard will be deleted in the Final Report since it is very similar to the cost estimated with the recommended standard.

The following is the comparison of the construction cost between 03 standard and recommended standard for the trunk road.

	Gravel	Surfac.Dress.	Bitum.Surfac.
Recommended Standard	154986	165851	180765
03 Standard	135803	144935	157477
03 Standard/ Recomm.Stand.	88 %	87 %	87 %

The savings in cost by the use of 03 Standard will be approximately 13%.

(8) Construction Schedule by the Government

Comment: The Chairman requested the Japanese Team to:

Study the cost-benefit of a two-phase construction plan:

Phase I Sg. Tinjar-Long Lama-G. Mulu Junction.

Phase II G. Mulu Junction-N. Medamit including the upgrading of existing roads.

Answer: The alternative construction plan mentioned is added in the analysis in the Final Report. This alternative plan will be shown under the code numbers of B4, B5 and B6 in the table 10-1 of the Final Report.

(II) Amendment of Unit Price of Surface Dressing

As the result of re-examining the cost estimation and the design method of the Road Note 31 in the Draft Final Report, the unit price of the surface dressing should be revised in the following ways:

Conception of the Surface Dressing

<u>Item</u>	<u>Final</u>	
Number of Layer	2 layers	(5)
Max. size of crushed stone	14 mm	(30)
Dimension of unit price	M\$/m <sup>2</sup>	(M\$/m <sup>3</sup> )
Unit cost (Foreign)	2.01	(137.07)
" (Local)	1.00	(68.85)
" (Tax)	0.55	(37.38)

Figures in the parenthesis shows values of the Draft Final Report

Following the above revision, the construction cost of the trunk road in the Chapter 8 and the economic escalation in the Chapter 10 will be reduced and amended in the Final Report.

It is recommended in the Final Report that the surface dressing method should be applied instead of the gravel surfacing. This recommendation will be incorporated in Chapter 10 of the Final Report.

# Addenda 2.

## Summary of Construction Cost of the Trunk Road (03 Standard)

		Gravel			Surface Dressing			Bituminous		
		F.C	L.C	Total	F.C	L.C	Total	F.C	L.C	Total
I	General	494	404	898	586	470	1,056	685	589	1,274
	Earth Work	1,237	506	1,743	1,237	506	1,743	1,237	506	1,743
	Drainage	98	346	444	98	346	444	98	346	444
	Pavement	3,544	2,912	6,456	4,468	3,572	8,040	5,451	4,764	10,215
	Bridge	59	172	231	59	172	231	59	172	231
	Miscellaneous	2	100	102	2	100	102	2	100	102
	Sub-Total	5,434	4,440	9,874	6,450	5,166	11,616	7,532	6,477	14,009
	Land Compensation	0	18	18	0	18	18	0	18	18
	Others	1,359	1,110	2,469	1,613	1,292	2,905	1,883	1,619	3,502
	Total Amount	6,793	5,568	12,361	8,063	6,476	14,539	9,415	8,114	17,529
II	General	883	686	1,569	928	718	1,646	975	775	1,750
	Earth Work	2,365	929	3,294	2,365	929	3,294	2,365	929	3,294
	Drainage	279	866	1,145	279	866	1,145	279	866	1,145
	Pavement	1,756	1,443	3,199	2,198	1,759	3,957	2,670	2,330	5,000
	Bridge	4,240	2,463	6,703	4,240	2,463	6,703	4,240	2,463	6,703
	Miscellaneous	194	1,162	1,356	194	1,162	1,356	194	1,162	1,356
	Sub-Total	9,717	7,549	17,266	10,204	7,897	18,101	10,723	8,525	19,248
	Land Compensation	0	3	3	0	3	3	0	3	3
	Others	2,429	1,887	4,316	2,551	1,974	4,525	2,681	2,131	4,812
	Total Amount	12,146	9,439	21,585	12,755	9,874	22,629	13,404	10,659	24,063
III	General	1,540	1,637	3,177	1,636	1,706	3,342	1,738	1,829	3,567
	Earth Work	6,428	2,515	8,943	6,428	2,515	8,943	6,428	2,515	8,943
	Drainage	646	2,010	2,656	646	2,010	2,656	646	2,010	2,656
	Pavement	4,434	3,646	8,080	5,390	4,329	9,719	6,411	5,566	11,977
	Bridge	3,269	4,520	7,789	3,269	4,520	7,789	3,269	4,520	7,789
	Miscellaneous	624	3,682	4,306	624	3,682	4,306	624	3,682	4,306
	Sub-Total	16,941	18,010	34,951	17,993	18,762	36,755	19,116	20,122	39,238
	Land Compensation	0	35	35	0	35	35	0	35	35
	Others	4,235	4,503	8,738	4,498	4,691	9,189	4,779	5,031	9,810
	Total Amount	21,176	22,548	43,724	22,491	23,488	45,979	23,895	25,188	49,083
IV	General	1,676	1,327	3,003	1,774	1,397	3,171	1,879	1,524	3,403
	Earth Work	9,233	3,655	12,888	9,233	3,655	12,888	9,233	3,655	12,888
	Drainage	681	2,122	2,803	681	2,122	2,803	681	2,122	2,803
	Pavement	3,908	3,207	7,115	4,894	3,913	8,807	5,940	5,183	11,123
	Bridge	2,865	3,740	6,605	2,865	3,740	6,605	2,865	3,740	6,605
	Miscellaneous	70	541	611	70	541	611	70	541	611
	Sub-Total	18,433	14,592	33,025	19,517	15,368	34,885	20,668	16,765	37,433
	Land Compensation	0	2	2	0	2	2	0	2	2
	Others	4,608	3,648	8,256	4,879	3,842	8,721	5,167	4,191	9,358
	Total Amount	23,041	18,242	41,283	24,396	19,212	43,608	25,835	20,958	46,793
V	General	593	632	1,225	649	673	1,322	709	746	1,455
	Earth Work	1,682	710	2,392	1,682	710	2,392	1,682	710	2,392
	Drainage	93	347	440	93	347	440	93	347	440
	Pavement	3,191	2,664	5,855	3,755	3,067	6,822	4,356	3,796	8,152
	Bridge	957	2,494	3,451	957	2,494	3,451	957	2,494	3,451
	Miscellaneous	3	109	112	3	109	112	3	109	112
	Sub-Total	6,519	6,956	13,475	7,139	7,400	14,539	7,800	8,202	16,002
	Land Compensation	0	6	6	0	6	6	0	6	6
	Others	1,630	1,739	3,369	1,785	1,830	3,635	1,950	2,051	4,001
	Total Amount	8,149	8,701	16,850	8,924	9,236	18,180	9,750	10,259	20,009
T O T A L	General	5,186	4,686	9,872	5,573	4,964	10,537	5,986	5,463	11,449
	Earth Work	20,945	8,315	29,260	20,945	8,315	29,260	20,945	8,315	29,260
	Drainage	1,797	5,691	7,488	1,797	5,691	7,488	1,797	5,691	7,488
	Pavement	16,833	13,872	30,705	20,705	16,640	37,345	24,828	21,639	46,467
	Bridge	11,390	13,389	24,779	11,390	13,389	24,779	11,390	13,389	24,779
	Miscellaneous	893	5,594	6,487	893	5,594	6,487	893	5,594	6,487
	Sub-Total	57,044	51,547	108,591	61,303	54,593	115,896	65,839	60,091	125,930
	Land Compensation	0	64	64	0	64	64	0	64	64
	Others	14,261	12,887	27,148	15,326	13,649	28,975	16,460	15,023	31,483
	Total Amount	71,305	64,498	135,803	76,629	68,306	144,935	82,299	75,178	157,477



### Addenda 3.

#### EXAMINATION OF MAINTENANCE COST

##### (1) Breakdown of the Recommended Maintenance Costs

In order to examine the difference of maintenance cost between 03 and recommended standard, the process in calculating the cost is shown as follows:

###### (a) Gravel road

###### A. Cost for replenishing of lost materials

$$C_A = 50 \text{ m}^3/\text{km/year} \times 38.99 \text{ M\$/m}^3 = 1950 \text{ M\$/km}$$

\* inclusive of material and operation costs.

###### B. Equipment cost for reclaiming spilled materials

Operation cost on motor grader per kilo-meter is calculated based on the following assumption.

###### Assumptions

rolling times per kilo-meter 6 times

operating speed of motor-grader 3 km/h

operating coefficient of motor-grader 50 %

$$C_B = 94.194 \text{ M\$/h} \times \frac{6 \text{ km}}{0.5 \times 3 \text{ km/h}} = 380 \text{ M\$/km}$$

###### C. Labor cost for reclaiming spilled materials

number of labor per kilo-meter 10 persons

$$C_C = 10 \times 1.56 \text{ M\$/h} \times 4 \text{ hour} = 60$$

Total maintenance cost for gravel road

$$C = C_A + C_B + C_C = 1950 + 380 + 60 = 2400$$

(b) Surface dressing

Area to be maintained (at 10% against total area)

$$1000^m \times 7.32^m \times 0.10 = 732 \text{ m}^2/\text{km}$$

Maintenance cost

$$732 \text{ m}^2/\text{km} \times 3.01 \text{ M\$}/\text{m}^2 = 2200 \text{ M\$}/\text{km}$$

(c) Bituminous surfacing

Case I : before exceeding 0.5 million

Volume to be maintained (at 2.5% against total volume)

$$1000^m \times 7.32^m \times 0.05^m \times 0.025 = 9.15 \text{ m}^3/\text{km}$$

Maintenance cost

$$9.15 \text{ m}^3/\text{km} \times 165.28 \text{ M\$}/\text{m}^3 = 1600 \text{ M\$}/\text{km}$$

Case II : after exceeding 0.5 million

$$1600 \text{ M\$}/\text{km} \times 2 = 3200 \text{ M\$}/\text{km}$$

(2) Maintenance Cost for 03 Standard

The primary difference between 03 and recommended standard exists in the difference of lane widths between the two: i.e. 24 in (7.32 m) against 20 in (6.10 m). The difference in maintenance cost between the two cases therefore is mainly a quantitative one.

Maintenance costs for 03 standard calculated in the same method as that for recommended standard are as follows:

Comparison of areas of maintenance involved:

$$\frac{\text{03 Standard}}{\text{Recommended}} = \frac{20 \text{ in}}{24 \text{ in}} \times 100 = 83 \%$$

(a) Gravel road

$$C_A = 50 \times 0.83 \times 38.99 = 1620$$

$$C_B = 380$$

$$C_C = 60$$

Maintenance cost

$$C = 1620 + 380 + 60 = 2100 \text{ M\$/km}$$

(b) Surface dressing

$$2200 \times 0.83 = 1800 \text{ M\$/km}$$

(c) Bituminous surfacing

Before exceeding 0.5 million

$$1600 \times 0.83 = 1300 \text{ M\$/km}$$

After exceeding 0.5 million

$$1300 \times 2 = 2600 \text{ M\$/km}$$

(3) Comparison of Unit Maintenance Cost between 02 and Recommended Standard

(M\\$/km)

	03 Standard	Recommended Standard
Gravel Road	2100	2400
Surface Dressing	1800	2200
Bituminous		
<500,000	1300	1600
>500,000	2600	3200

TERMS OF REFERENCE  
FOR  
CONSULTING ENGINEERING SERVICES PART 1  
FOR  
BELURU/LONG LAMA/LIMBANG TRUNK ROAD

## 1. INTRODUCTION

- 1.1 The Government of Malaysia (hereinafter called "The Government") intends to engage the services of a Consulting Engineering firm (hereinafter called "The Consultant") to carry out detailed engineering services (Part 1) for about 82.9 kms (51.5 miles) of trunk road and five feeder roads which total 49.8 kms or 30.9 miles in length in Sarawak as detailed in Appendix 1 of this Terms of Reference (hereinafter called "The Project").
- 1.2 With the financial assistance of the Government of Japan through its execution agency of overseas technical cooperation, the Japan International Cooperation Agency (JICA), the services of a consulting engineer have already been used for completing a feasibility study and preparing a program for road construction and road improvement of about 237.3 kms (147.4 miles) total of roads in the corridor between Miri/Binturu Road junction - Limbang. Based on the Consultant's recommendations and subsequent reviews, the extent of the project Part 1 was finalized.
- 1.3 The Government has obtained a loan from ( \_\_\_\_\_ ) for financing the foreign exchange element of the cost in carrying out Detailed Engineering Design Part 1 of the Project covered under this Terms of Reference.

## 2. OBJECTIVES

2.1 In broad terms, the objective of the services is to review JICA's Feasibility Study Report, undertake all necessary detailed engineering design for the project, complete with cost estimate and tender documents, and assist the Public Works Department in Sarawak in all matters prior to the award of a construction contract, as are described in Para. 3 SCOPE OF WORK hereof.

2.2 The basic objective of this program is to reach the optimum level of investment and timing for construction of the project. It is noted that in setting up the timing for project implementation, the "stage development" as suggested in the JICA report should be considered as are described in Para. 3 - SCOPE OF WORK hereunder.

### 3. SCOPE OF WORK

#### 3.1 General

- (i) The Consultant will provide professional engineering services required for the preparation of Detailed Engineering Design and Tender Documents for a new 2-lane trunk road, 82.9 kms length starting from Sg. Tinjar (right bank of Sq. Tinjar) running to Sq. Tutoh (proposed junction with feeder road to National Park Base Camp).
- (ii) Detailed engineering for feeder roads shall be included.
- (iii) Review of the Feasibility Study Report of Beluru/Long Lama / Limbang Trunk Road Construction Project and other existing economic data and analysis in order to confirm and measure project's economic feasibility.
- (iv) It should be mentioned that the Detailed Engineering and related bidding documents shall be prepared in accordance with the recommendation for staged construction.
- (v) Design Standard

In accordance with Feasibility Study recommendations, it is planned that:

- a. The new trunk road and all feeder roads will have surface dressing with adequate base and subbase course.
- b. Bridges and other major structures will be constructed of steel or pre-stressed concrete throughout the project, box culverts, and similar structures will be

be performed according to the AASHTO and ASTM standards, to the extent required for the solution of all the engineering problems.

- d. In particular, the sample soils will be tested for:
  - 1) Classification according to the AASHTO method,
  - 2) Dry density, moisture content relationship, and determination of bearing capacity by the CBR Test on representative samples of the different soil types,
  - 3) Strength or consolidation testing related to foundation type for bridge or other major structures.
- e. The construction material samples will be tested according to the AASHTO and ASTM standard.

(iii) Drainage and Bridge Investigation

- a. The Consultant shall pay particular attention both to the collection and critical examination of all available data and to the integration of such data with the information collected directly on site (trend of water course, study of deposited alluvia, stream velocity and maximum flood levels, type and degree of erosion, zones inundated or likely to be inundated, etc.)
- b. The extension and nature of the catchment basins of the different water courses will be determined by examining topographical and geological maps as well as by means of the direct investigations mentioned above.



constructed of reinforced concrete throughout the Project.

3.2 The services required shall be divided into Phase I and Phase II according to the scope of work and time schedule. In general, services will consist of:

(i) Phase I: Review of all economic evaluation and engineering recommendations in the F.S. Report prior to entering into the detailed engineering stage.

(ii) Phase II: Following the approval by Public Works Department of Phase I services, in total or any part, engineering works will be performed as required for detailed engineering design, preparation of detailed construction drawings, estimates of construction cost, tender and contract documents, and other special report, all as described in Para. 7.

#### 4. EXECUTION OF CONSULTING SERVICES

4.1 The Consultant shall perform all technical studies, field investigation and related works, herein described as required to attain the objectives described in Para. 4 hereof.

In the conduct of this work the Consultant shall cooperate fully with the Public Works Department which will provide data, services and facilities outlined in Para. 4 hereof. The Consultant shall be solely responsible, however, for analysis and interpretation of all data received and for all findings conclusions and recommendations.

##### 4.2 Phase I of the Services

###### - Review of the Feasibility Study Report

The Consultant shall review all engineering recommendations and the economic evaluation presented in the Feasibility Study Report of Beluru/Long Lama/Limbang Trunk Road Construction Project as part of the engineering decision and design criteria evaluation prior to entering into the final engineering design of this project. More specifically, the Consultant shall fulfill the following requirements:

###### (1) Review Traffic Studies

Make review traffic studies and analysis which will include, but not necessarily be limited to the following:

- a. Review and evaluation of existing/available traffic studies and analysis.

- b. Make additional surveys at selected points.
- c. Study the present and planned development of the influence area of this trunk road project, particularly the transport demand.

(ii) Design Standards

Review the recommended design standards in the Feasibility Study Report with regard to application to the Detailed Engineering Design.

(iii) Location Survey

Perform location survey; including a careful review of the entire alignment as proposed in the Feasibility Study Report. Reconnaissance survey in the field will be coordinated with 1 : 40,000 scale aerial photographs and 1 : 10,000 topographical map in order to satisfy the survey requirements for Phase I of the study; and a base control traverse will be established in the proximity of proposed alignment.

(iv) Soil and Material Surveys

Make soil and material surveys in sufficient detail to:

- a. Establish minimum subgrade elevations, or positions in the profile, all along the route locations.
- b. Establish pit locations for prospecting local construction materials.
- c. Determine the foundation requirements for all structures with additional borings and/or other appropriate investigations.

(v) Hydrological Surveys

Evaluate all available data related to hydrological survey and make such additional surveys as may be necessary for the design of this road.

(vi) Right-of-Way

Develop right-of-way plans throughout the project; these shall be based upon the selected centerline, and the construction limits shall be determined as accurately as possible from preliminary data. The Consultant shall not be responsible for the determination of the property lines for each owner; but all existing building, fences, hedges, ditches, walls and other apparent delineation between plots shall be shown on special right-of-way maps to permit the Government to prepare right-of-way acquisition at the earliest possible date.

4.3 Phase II of the Services

A. Field Surveys

(i) Topographical Survey

The Consultant shall carry out such topographical surveys as are necessary for the accurate design and location of the road alignment and for the production of right-of-way plans which can be used for any land acquisition which may be necessary. The Consultant shall establish permanent survey marks and bench marks to be used in setting out the works. At each bridge site, the conformation of the rivers shall be determined at an appropriate distance on each

side of the centerline corresponding to the requirements of Para. 4.2 (iii) C; indications of high water levels on the stream banks shall be determined and noted. All survey information and data will be recorded and preserved in approved standard survey note books; upon completion of the work all survey notes become the property of the Public Works Department.

(ii) Soil Survey and Laboratory Investigations

- a. The Consultant will first make a general geomorphological study of the road, alignment checking all the relative information obtained from available sources, i.e. Feasibility Study and Preliminary Engineering data, existing literature, etc.
- b. The Consultant will then make a detailed investigation along the road alignment for:
  - 1) Identification of the different types of soil affecting the construction of the road,
  - 2) At the location of bridges and other major structures, identification of the nature and stratigraphy of subsurface soils.
  - 3) Location of sources of construction materials for pavement and structures, including the sampling of different types of materials.
- c. Analyses and testing of disturbed and undisturbed soil samples, as well as construction material samples, shall

B. Draft Detailed Design

The draft detailed design will include the elaboration of field survey data concerning all parts of the project and the preparation of, all contract documents as specified below:

(i) Planimetric Trend of the Road

- a. The Planimetric trend of the road will be based on topographic mapping during this phase, slight variances may be made based on the centerline as staked on the ground only if necessary and these variances will be clearly shown on the plans.
- b. In any case, the centerline traverse will be checked and the data concerning the longitudinal and traverse points will be processed by computer analysis. Longitudinal profiles and cross sections shall be drawn to a suitable scale.

(ii) Road Structure and Pavement Design

- a. On the basis of the results of the soil survey and laboratory investigation, the Consultant will provide recommendations for technical solutions to the problems concerning:
  - 1) Embankment and cut slope gradients;
  - 2) Field compaction requirements,
  - 3) Potential slide areas,
  - 4) Foundations,
  - 5) Ground water drainage,
  - 6) Use and treatment of construction materials for the pavement and structures.

- b. The pavement will be designed according to one of the standard methods based on CBR and AASHTO Test Results.
- c. Three main design elements; will be taken into consideration, namely bearing capacity of the sub-grade soils, traffic volume and growth factor, composition and maximum load of forecast traffic.

(iii) Drainage and Bridge Design

- a. The Consultant will evaluate the data collected from the existing sources and the information obtained directly in the field, and will proceed to choose the methodology most suitable for the local situation for the quantification of the parameters necessary to design the surface drainage works (major and minor structures, guard-ditches, side ditches), as well as protection and defense works.
- b. For major structures, on the basis of the site investigation, the detailed topographical and soil surveys, the hydrological study, the information on the availability of construction materials and skilled labor; the Consultant will prepare the final design for each structure.
- c. The Consultant will take special care in choosing the design for major structures to favor, as much as possible, standardization in order to obtain a reduction in construction cost.
- d. The design of both major and minor structure will comply with the Public Works Department's standards in Sarawak

for bridges and drainage or other standards indicated by the Public Works Department in Sarawak.

(iv) Draft Detailed Design Report

The Consultant will prepare detailed reports containing his findings and recommendations on all parts of the design as described above; in particular, the following subjects will be discussed separately:

- a. Justification of the selected alignment
- b. Characteristics of natural soils and construction materials, including field survey and test report.
- c. Hydrological study
- d. Results of drilling and seismic survey
- e. Design of major structures including the study of the foundation and statistical calculation
- f. Design of the road structure (embankment and cuts, minor longitudinal drainage, compaction requirements, special construction measures for sliding and unstable areas),
- g. Complete pavement design
- h. Defense and protection work design,
- i. Recommendations for ancillary works (parapets, road signs, etc.)
- j. Bidding methods and variations.



(v) Plans and Drawings

The Consultant will prepare drawings for all proposed works as listed below:

- a. Topography
- b. Plans to scale 1 : 100 with plan index,
- c. Longitudinal profile
- d. Cross sections
- e. Typical cross sections
- f. Soil profile
- g. Minor standard drainage structures
- h. Major structures
- i. Protection and defence works
- j. Ancillary works

(vi) Quantity Calculations

- a. The calculation of the quantities for the different types of work to be carried out will be based on the plans and drawings described in the previous paragraphs.
- b. In particular, the quantities for each work item will be calculated and then summarized under the following main work sections:
  1. Clearing and grubbing
  2. Earthwork
  3. Bank protection
  4. Standard structure
  5. Bridges
  6. Pavement

7. Ancillary works

8. Land acquisition

(vii) Cost Estimates

- a. In order to make a fair and reasonable estimate, the Consultant will draw up a unit price analysis for each work item.
- b. The prices resulting from the analysis will be compared with those of previous projects or similar work executed in the country. Should any discrepancies be found, their causes will be identified and studied to arrive at realistic market prices for the work.
- c. The estimate of right-of-way acquisition shall be made on the basis of the unit prices to be furnished by the Government for each type of land utilization.
- d. The Consultant shall make an assessment of the availability and the capacity of domestic and expatriate contractors who would be in a position to contract the proposed works.
- e. The following documents will be presented to the Public Works Department:
  1. Cost analysis,
  2. Bill of quantities for each item subdivided by different sections,
  3. Cost estimate, showing foreign exchange and local currency components.

(viii) Preparation of Bidding and Contracting Documents

The Consultant shall prepare the following bidding and contract documents:

a. Bidding Documents

1. Invitation to Bid
2. Declaration of Intention to Bid
3. Instructions to Bidders
4. Form of Bid Guarantee, Bid Bond  
Performance Bond
5. Form of Contract
6. Form of Bid Price Schedule and Schedule of Rates  
and Prices

b. Contract Documents

1. Contract
2. General Conditions of Contract
3. General Specifications
4. Special Specifications
5. Bid Price Schedule & Schedule of Rates and Prices
6. Plans and Drawings
7. Addenda and Supplement
8. Detailed Work Schedule, Plant and Contractor  
Personnel List

c. Final Detailed Design

- (i) Any variations in the project agreed upon with Public Works Department will be made during the revision of the draft detailed design and included in the final design.

(ii) The final detailed design will be delivered to the Public Works Department in 25 copies with respect to those documents reserved for the confidential use of the Public Works Department consisting of:

- a. final reports;
- b. final quantity calculations and cost estimates, and in 50 copies - those documents of the project to be used for bidding and contracting;
- c. drawings, photo-reduced and printed;
- d. bidding and contracting documents.

5. DATA MATERIALS AND FACILITIES TO BE PROVIDED BY THE GOVERNMENT

- 5.1 The Government will provide the Consultant with all information that may be reasonably required for the services, including copies of the Feasibility Study Report on the Beluru/Long Lama/Limbang Trunk Road Construction Project, drawings and collected data from that study, relevant topographic maps and aerial photographs in the possession of the Government, recently prepared contract documents for road projects, construction cost rates of recent tenders for road works of similar nature.
- 5.2 In connection with works by the Consultant that require the cooperation of other Government agencies, the Public Works Department will provide a liaison office.
- 5.3 In order to expedite the progress of the services and to simplify the procedures relative thereto, the Government will designate a project officer duly empowered and authorized to make and implement decisions on organizational, logistical, administrative and other matters brought to his attention by the Consultant, to assure completion of the services according to the required schedule.

6. FACILITIES TO BE PROVIDED BY THE CONSULTANTS

6.1 The Consultant shall provide all such further technical and office equipment as may be required to undertake the services.

6.2 The Consultant shall provide all necessary office and housing and other field accommodation as required in Miri or at the project site.

## 7. REPORTS

7.1 The Consultant shall submit reports to the Government as follows:

- (i) Phase I Report, containing the Consultant's findings and recommendations on the works carried out in Phase I of the services;
- (ii) Draft Phase II Report, summarizing all work carried out under the services, including the Consultant's findings and recommendations in separate volumes;
  - a. Proposed bidding documents with cost estimates showing foreign currency and local currency components separately;
  - b. Complete pavement design calculations with supporting information, earthwork calculations and outline of calculations made for drainage and structural design all design information shall be suitably indexed;
  - c. Soils and materials report, including qualification and location of all available materials, test results etc.
  - d. Detailed Contract Drawings
- (iii) Final Phase II Report, Comprising the Draft Phase II Report incorporating all revisions thereto proposed by the Government and deemed appropriate by the Consultant; and
- (iv) Brief monthly progress reports - only submitted during months when no reports under (i),(ii),(iii), are not submitted, summarizing

progress made during the month, total progress since commencement of the work and identifying causes of significant delays in the Consultant's services and the corrective action taken or recommended.

7.2 The Reports mentioned in (i) (ii) (iii) of the preceeding paragraph shall contain a concise initial chapter summarizing all cost estimates, major findings and recommendations. Estimates of cost and all analysis (including economic evaluations) which support the Consultant's conclusions shall be presented in sufficient detail to permit checking of calculations without resort to supplementary data.

7.3 The Consultant shall submit copies of the reports required under Para. 7.1 to the Government as follows:

Phase I Report	25 copies
Draft Phase II Report	15 copies
Final Phase II Report	25 copies
Final Bidding Documents	50 copies
Progress Report	5 copies



## 8. TIME SCHEDULE

The Consultant shall commence work in Sarawak within thirty days of the effective date of the contract for services.

Reports required under Para. 7.1 (i), (ii), and (iii) shall be submitted to Government as follows:

- Phase I Report: within three calendar months after the effective date of the Contract.
- Draft Phase II Report: within ten calendar months after the effective date of Contract, excluding the period required by Government for review of the Phase I Report.
- Final Phase II Report: within two calendar months of receipt of the Government's comments, on the Draft Phase II Report.

# APPENDIX I

## ROAD SECTIONS INCLUDE IN THE PROJECT

### (Trunk Road)

Sg. Tinjar - Batang Baram	26.2 kms (16.3 miles)
Batang Baram - Sg. Apoh	24.5 kms (15.8 miles)
Sg. Apoh - Sg. Tutoh - G. Mulu feeder road junction	31.3 kms (19.4 miles)
Total:	82.9 kms (51.5 miles)

### (Feeder Road)

Batang Baram - Long Laput	5.7 kms (3.5 miles)
Trunk Road - Long Bedian	23.4 kms (14.5 miles)
Trunk Road - Long Panai	11.4 kms (7.1 miles)
Trunk Road - Long Terawan	4.7 kms (2.9 miles)
Trmle Road - N.P. Base Camp	4.6 kms (2.9 miles)
Total:	49.8 kms (30.9 miles)



