REPUBLIC OF INDONESIA
MINISTRY OF PUBLIC WORKS
DIRECTORATE GENERAL OF HIGHWAYS

THE FEASIBILITY STUDY OF THE LOCAL ROAD DEVELOPMENT IN THE REPUBLIC OF INDONESIA

KABUPATEN REPORT 1

KABUPATEN INDRAGIRI HULU

MARCH 1986

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

This is the Kabupaten Report of the Feasibility Study of the Local Road Development in the Republic of Indonesia for Kabupaten Indragiri Hulu in Riau Province. The report has been prepared by the Study Team of the Japan International Cooperation Agency (hereinafter called JICA).

Based upon a request from the Government of Indonesia, the Government of Japan arranged for JICA to conduct the Study and JICA accordingly organized a Study Team. The study was carried out using data which were generally prepared by the Kabupaten, routed through the province, under the instructions of Bina Marga of the Ministry of Public Works and Bangda of the Ministry of Home Affairs.

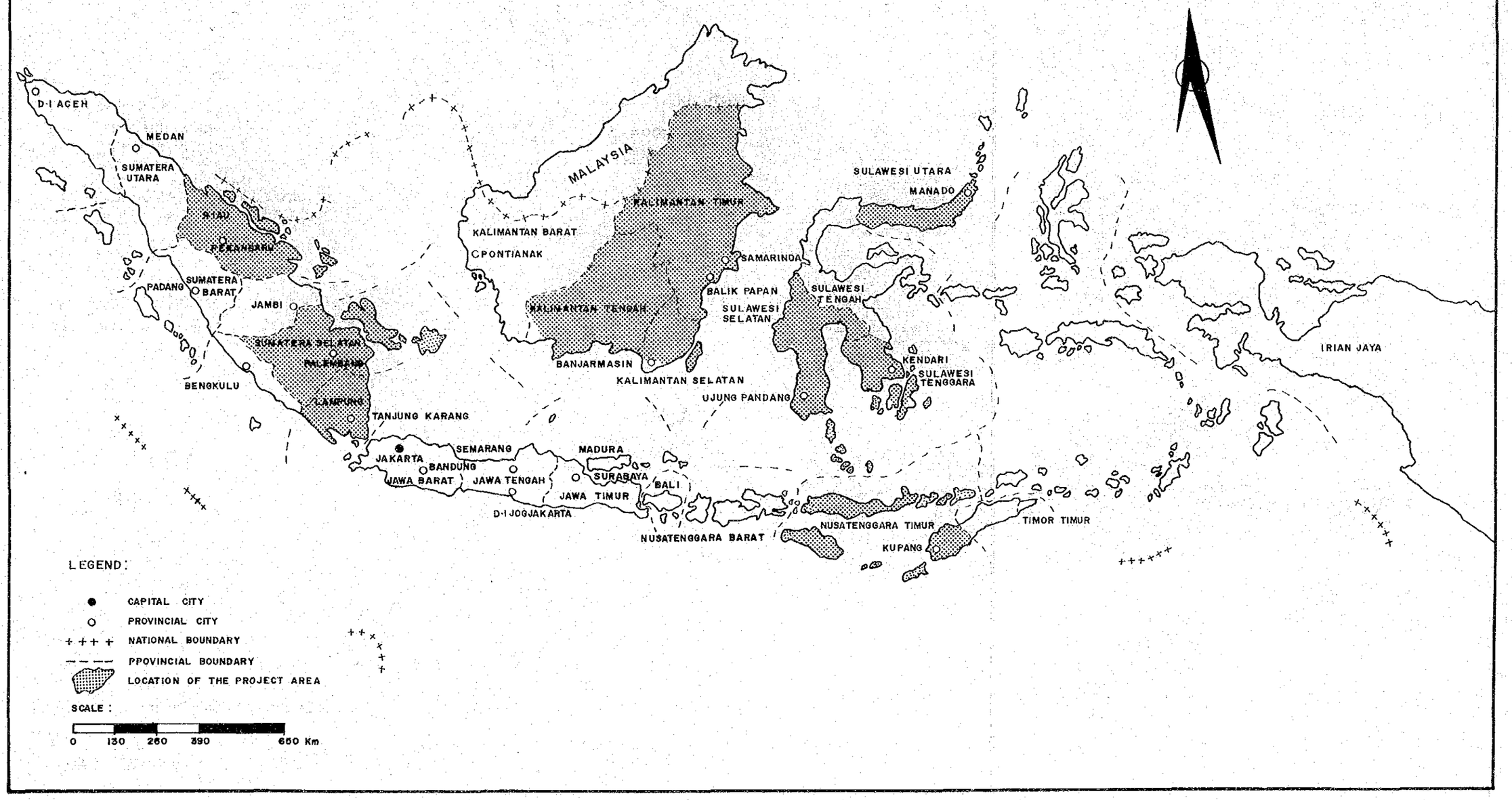
Since the study period was limited, without cooperation of Bina Marga, Bangda and local governments of both province and Kabupaten in collecting the data, the study would not have been completed within the period.

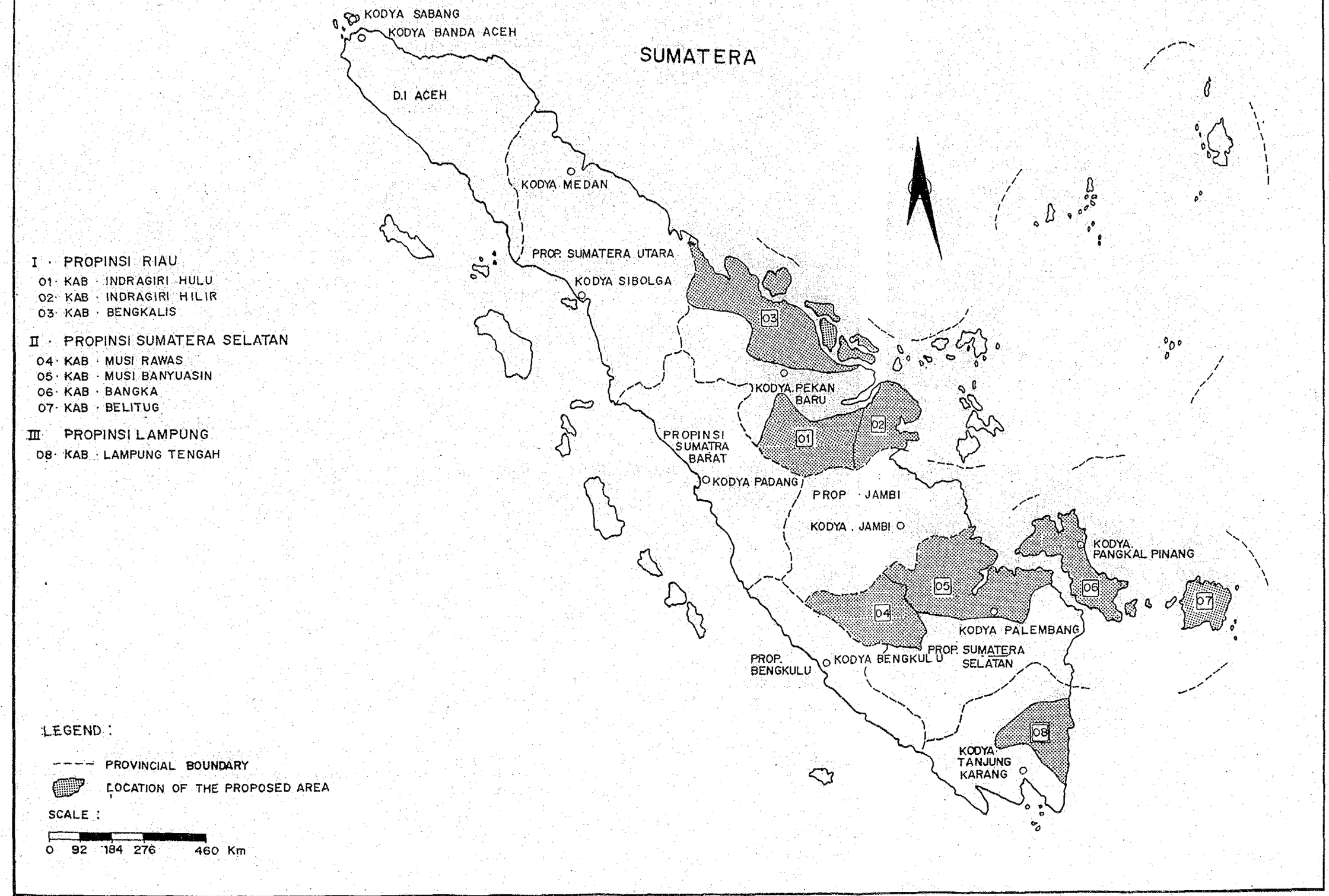
The report consists of the results of the feasibility study and proposed implementation programme of the local road development in the Kabupaten.

The simplified economic feasibility evaluation methodology utilized for the study was established by the Study Team in Phase I Study through a pilot study of seven (7) model Kabupatens, and is described in the Main Report.

The purpose of the study for the Kabupaten is mainly to estimate the total Project Cost for the local road development but only limited data is available for study base. Therefore a detailed survey and design for the improvement of the Kabupaten roads should be carried out before commencing the Project together with a review of this report.

LOCATION MAP OF THE PROJECT AREAS

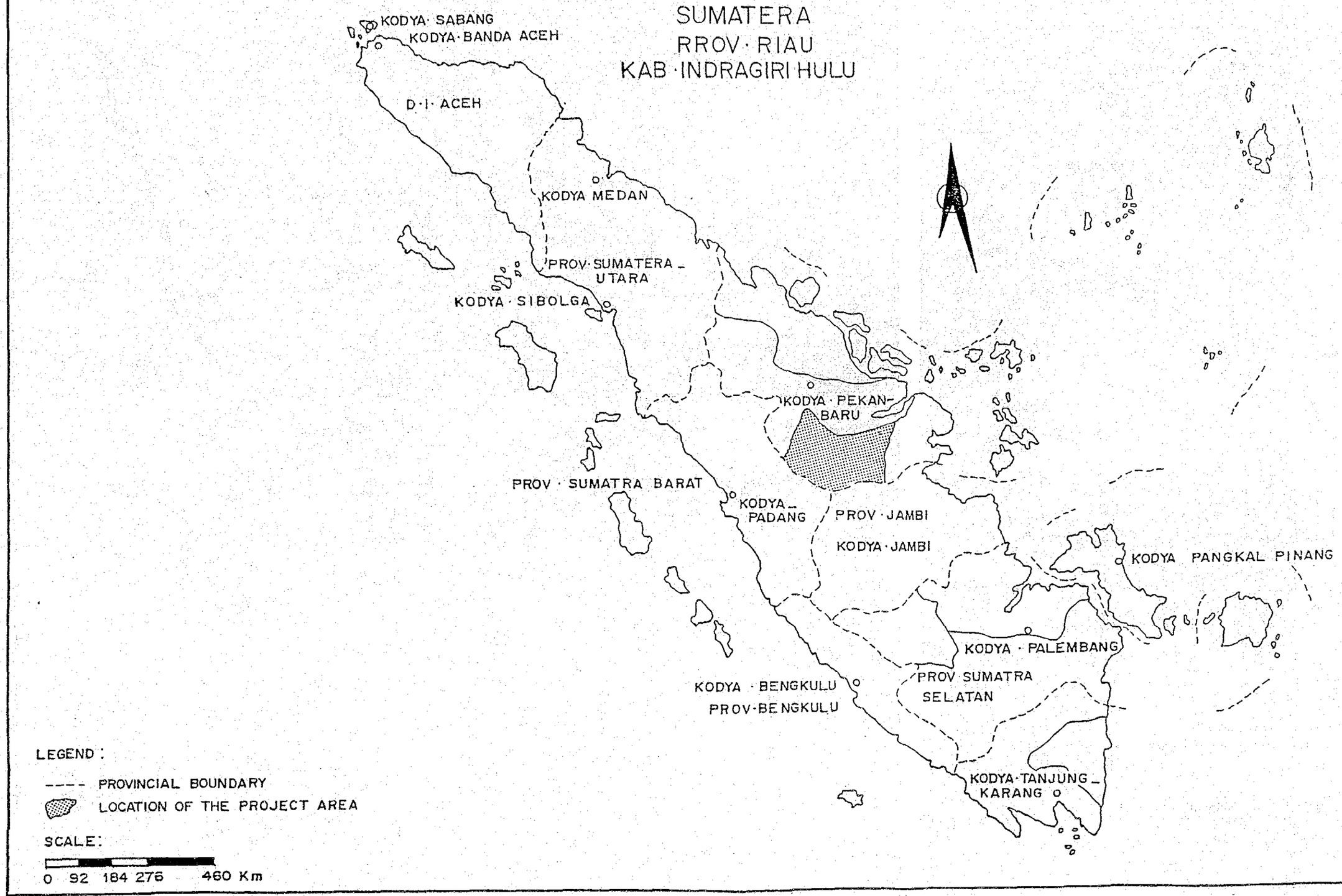



SUMATERA
KODYA SABANG
KODYA BANDA ACEH
D.I ACEH
KODYA MEDAN
PROP SUMATERA UTARA
KODYA SIBOLGA
03
KODYA PEKAN BARU
01
02
PROPINSI SUMATRA BARAT
KODYA PADANG
PROP JAMBI
KODYA . JAMBI
KODYA. PANGKAL PINANG
05
06
07
04
KODYA PALEMBANG
PROP. SUMATERA SELATAN
PROP. BENGKULU
KODYA BENGKULU
08
KODYA TANJUNG KARANG
I · PROPINSI RIAU
01 · KAB · INDRAGIRI HULU
02 · KAB · INDRAGIRI HILIR
03 · KAB · BENGKALIS
II · PROPINSI SUMATERA SELATAN
04 · KAB · MUSI RAWAS
05 · KAB · MUSI BANYUASIN
06 · KAB · BANGKA
07 · KAB · BELITUG
III PROPINSI LAMPUNG
08 · KAB · LAMPUNG TENGAH
LEGEND :
PROVINCIAL BOUNDARY
LOCATION OF THE PROPOSED AREA
SCALE :
0 92 184 276 460 Km

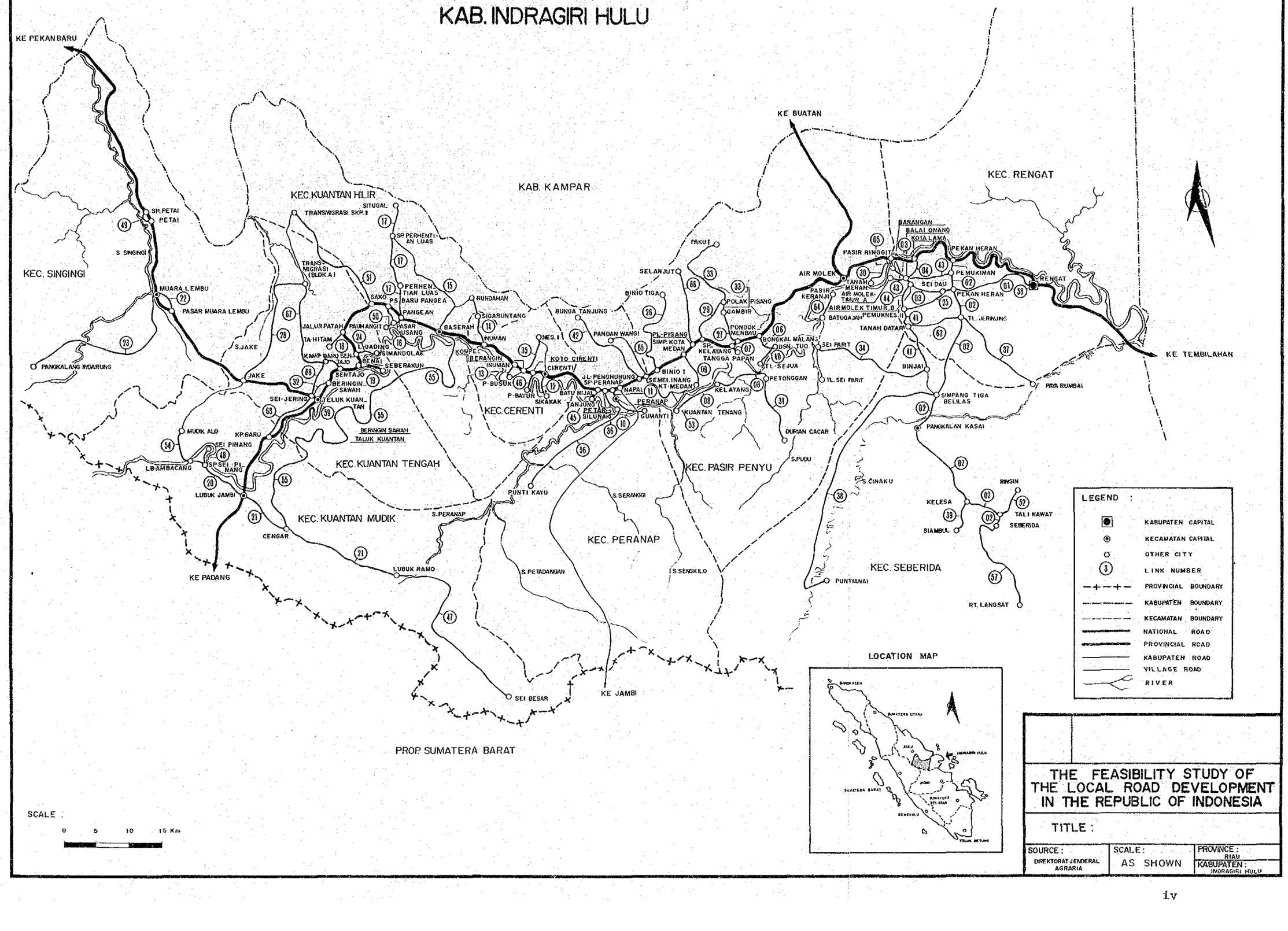
SUMATERA

RROV · RIAU

KAB · INDRAGIRI HULU



KAB. INDRAGIRI HULU



LEGEND :

- KABUPATEN CAPITAL
- KECAMATAN CAPITAL
- OTHER CITY
- (3) LINK NUMBER
- PROVINCIAL BOUNDARY
- KABUPATEN BOUNDARY
- KECAMATAN BOUNDARY
- NATIONAL ROAD
- PROVINCIAL ROAD
- KABUPATEN ROAD
- VILLAGE ROAD
- RIVER

LOCATION MAP

SCALE :

0 5 10 15 Km

THE FEASIBILITY STUDY OF THE LOCAL ROAD DEVELOPMENT IN THE REPUBLIC OF INDONESIA

TITLE :

SOURCE :	SCALE :	PROVINCE :
DIREKTORAT JENDERAL AGRARIA	AS SHOWN	RIAU
		KABUPATEN : INDRAGIRI HULU

C O N T E N T S

Chapter 1 BACKGROUND OF THE KABUPATEN

1.1 Topographic and Meteorological Conditions

1.1.1 Location and Topography

Kabupaten Indragiri Hulu is located in the island area of the southern part of Riau Province, and is bordered on the south by the provinces of Sumatera Barat and Jambi.

The Indragiri River which originates in and flows down from Sumatera Barat Province flows through the Kabupaten from the east to the west. Most of the basin is covered with its tributary streams. South of the main stream of the Indragiri River, excluding the area around Rengat city the capital of the Kabupaten, is mostly hilly although it changes to mountainous close to the boundary. North of the main river is mostly flat compared with south of the river. The north boundary of the Kabupaten is formed by hills. The northern region from the area around Rengat is mostly low and swampy due to flooding by the Indragiri River. This swampy area extends to the boundaries with Kabupaten Indragiri Hilir and Kabupaten Kampar.

The Kabupaten has an area of 15,854 square kilometers, approximately 17 percent of the total of Riau Province. It consists administratively of 9 Kecamatans.

1.1.2 Meteorological Conditions

The average number of rainy days and the average amount of yearly rainfall in Kabupaten Indragiri Hulu are 153 days and 2,139 mm respectively.

One year in the Kabupaten consists of a rainy season and a dry season. The dry season in general is from June through August However this is variable as Table 1-1-1 shows.

The number of working days per year, which is necessary for planning the construction schedule in chapter 6, is estimated at 220 days using the following formula based upon the data shown in the table referred to above.

$$\text{Working Days} = 365 - \text{Holidays} - \text{Rainy Days} + \left(\text{Rainy Days} \times \frac{\text{Holiday}}{365}\right) + (0.10 \times \text{Rainy Days})$$

Where :

- Holidays consist of 52 Sundays and 13 national holidays; and
- 10% of rainy days are assumed to be workable days.

Table 1-1-1

METEOROLOGICAL CONDITIONS

PROVINCE : Riau
KABUPATEN : Indragiri Hulu STATION : Air Molek

MONTH	1980		1981		1982		1983		1984	
	RAINY DAYS	RAINFALL (mm)	RAINY DAYS	RAINFALL (mm)	RAINY DAYS	RAINFALL (mm)	RAINY DAYS	RAINFALL (mm)	RAINY DAYS	RAINFALL (mm)
January	7	97	10	125						
February	12	314	18	204						
March	16	318	17	214						
April	21	300	20	245						
May	14	197	18	192						
June	7	111	8	79						
July	13	178	14	181						
August	10	142	5	78						
September	15	77	21	276						
October	10	220	12	189						
November	16	242	7	19						
December	17	223	18	178						
Total	158	2,419	168	1,980	132	2,017	-	-	-	-

1.2 Socio-Economic Conditions

1.2.1 Population

The population of Kabupaten Indragiri Hulu in 1982 was 259,032 which was approximately 11.2% of the 2,306,000 total population of Riau Province as shown in Table 1-2-1.

The population density was 0.16 persons per ha which was lower than the provincial density of 0.25 and indicates the underpopulation of the Kabupaten.

The recent annual average growth rate of population of the Kabupaten is 5.5% which is much higher than both the provincial rate of 3.1% and the national rate of 2.2%. This may be a result of the on-going transmigration programme.

The population of each Kecamatan and its proportion to the Kabupaten population is shown in Table 1-2-2.

Table 1-2-1 POPULATION BY KABUPATEN

DESCRIPTION	POPULATION	AAGR (%)	AREA (ha)	POPULATION DENSITY (persons/ha)	SURVEY YEAR
KABUPATEN:					
INDRAGIRI HULU	259,032	5.5	1,585,400	0.16	1982
INDRAGIRI HILIR	424,583	2.0	1,232,582	0.34	1984
BENGKALIS	639,607	5.5	3,089,783	0.21	1983
PROVINCE:					
R I A U	2,306,300		9,456,200		1982
	2,373,600	3.1	9,456,200	0.25	1983
	2,442,800		9,456,200		1984
JAWA IS.(Excluding DKI JAKARTA)	91,126,900	1.7	13,159,700	6.92	-
INDONESIA	161,579,500	2.2	191,944,300	0.84	-

Notes :

1. Sources:
   Kabupaten; Kabupaten concerned with the study
   Province ; Jawa and Indonesia:
   Statistical yearbook of Indonesia 1984, published by the Central statistics Bureau.
2. AAGR ; Average Annual Growth Rate.

Table 1-2-2 POPULATION BY KECAMATAN

Year : 1982

PROVINCE : RIAU

KABUPATEN : INDRAGIRI HULU

KECAMATAN	POPULATION	PROPORTION (%)
KUANTAN MUDIK	27,812	10.7
KUANTAN TENGAH	45,256	17.5
SINGINGI	6,539	2.5
KUANTAN HILIR	33,444	12.9
CERENTI	16,966	6.5
PERANAP	12,594	4.9
PASIR PENYU	49,244	19.0
SEBERIDA	22,693	8.8
RENGAT	44,484	17.2
TOTAL	259,032	100

1.2.2 Land Use

In Kabupaten Indragiri Hulu, 149,700 ha of the current available land use area, which is approximately 9.4% of the 1,585,429 ha total area of the Kabupaten, is used for living purposes and for industrial activity of the inhabitants of the Kabupaten. It is the total value of columns (1) through (6) in Table 1-2-3.

The current available land use area consists of 124,700 ha of agricultural harvest area and 25,000 ha of residential area which are 83.3% and 16.7% of the current available land use area respectively.

The agricultural harvest area consists of 19,242 ha of paddy field, 81,054 ha of plantation and 24,363 ha of other cultivated area which are 15.5%, 65.0% and 19.5% of the agricultural harvest area respectively.

It can be realized from the land use that the main industry in the Kabupaten is plantation.

Table 1-2-3

LAND USE

PROVINCE : RIAU

(ha)

KABUPATEN	WET PADDY FIELD	UPLAND PADDY FIELD	OTHER CULTIVATED AREA	PLANTATION AREA	RESIDENTIAL AREA	USABLE OPEN SPACE	RIVER & LAKE	FORESTRY AREA	OTHERS	TOTAL AREA	SURVEY YEAR
INDRAGIRI HULU	19,242 (1.2)		24,363 (1.5)	81,054 (5.1)	25,000 (1.6)	-	-	1,237,490 (78.1)	198,279 (12.5)	1,585,429 (100)	1982
INDRAGIRI HILIR	41,985 (3.4)	1,976 (0.2)	225,002 (18.3)	92,864 (7.5)	11,733 (1.0)	-	15,897 (1.3)	839,230 (68.0)	3,895 (0.3)	1,232,582 (100)	1983
BENGKALIS	23,707 (0.8)	11,730 (0.4)	193,841 (6.3)	111,578 (3.6)	-	226,095 (8.6)	-	2,056,307 (66.5)	426,517 (13.8)	3,089,783 (100)	1983

Notes :

1. The value in ( ) denotes the proportion
2. Source : Kabupaten concerned with the study

1.2.3 Agriculture

The cultivated area and food crop production in Kabupaten Indragiri Hulu in 1982 was 21,369 ha and 34,364 ton respectively as shown in Table 1-2-4. Of food crops, the area and production of paddy which consists of wet paddy and upland paddy was 19,242 ha and 11,357 ton respectively which are 90.1% and 33.0% of the total food crops. The yield rate of paddy production is 0.59 ton per ha. Thus, paddy is the most predominant agricultural crop of the Kabupaten.

As the table shows, average annual growth rates of area and production of paddy in 1979 through 1982 were 3.0% and -26.9% respectively which indicates the poor state of paddy production.

The commodity crops, of which rubber is major, are produced by the plantations. The area and production of plantation crops in 1983 were 81,054 ha and 21,696 ton respectively with current growth rates being 7.8% and 2.7% respectively. Thus the plantation crop, which is an export product, is important agriculturally. Some changes are expected considering the international balance of supply and demand.

The population of the agricultural sector which is assumed from the employment in the Kabupaten is 26.0% of the total population as shown in Table 1-2-6. Thus the Kabupaten is an agricultural Kabupaten.

It seems that in Kabupaten Indragiri Hulu it is necessary to promote the redevelopment of agricultural crops as a part of the future transmigration programme.

Table 1-2-4 AREA AND PRODUCTION OF FOOD CROPS

KABUPATEN : INDRAGIRI HULU

CULTIVATED AREA

(ha)

ITEM	YEAR						AAGR
	1979	1980	1981	1982	1983	1984	(%)
PADDY	17,567	15,618	30,732	19,242	-	-	3.0
OTHERS	2,087	2,232	3,236	2,127	-	-	0.6
TOTAL	19,654	17,850	33,968	21,369	-	-	2.8

PRODUCTION

(ton)

ITEM	YEAR						AAGR
	1979	1980	1981	1982	1983	1984	(%)
PADDY	29,037	30,779	20,665	11,357	-	-	26.9
OTHERS	28,710	32,529	22,913	23,007	-	-	7.1
TOTAL	57,747	63,308	43,578	34,364	-	-	15.9

YIELD RATE

(ton/ha)

ITEM	YEAR						AAGR
	1979	1980	1981	1982	1983	1984	(%)
PADDY	1.65	1.97	0.64	0.59	-	-	29.0

Notes :

1. AAGR : Average annual growth rate
2. Source : Kabupaten concerned with the study

Table 1-2-5 AREA AND PRODUCTION OF PLANTATION CROPS
Year : 1983

PROVINCE : RIAU

KABUPATEN	AREA (ha)	PRODUCTION (ton)	AAGR (%) AREA	AAGR (%) PRODUCTION
INDRAGIRI HULU	81,054	21,696	7.8	2.7
INDRAGIRI HILIR	163,429	78,175	7.1	3.6
BENGKALIS	111,578	32,980	8.4	7.1

Table 1-2-6 POPULATION OF AGRICULTURAL SECTOR

PROVINCE : RIAU

KABUPATEN	AGRICULTURAL SECTOR	TOTAL POPULATION	PROPORTION (%)	AAGR (%)	SURVEY YEAR
INDRAGIRI HULU	223,000	259,032	86.0	5.0	1982
INDRAGIRI HILIR	314,000	424,583	74.0	1.5	1984
BENGKALIS	553,000	639,607	86.4	5.5	1983

Notes :

1. AAGR : Average annual growth rate
2. Source : Kabupaten concerned with the Study

1.2.4 Other Economic Activities

According to the ratio of employees by industry in Kabupaten Indragiri Hulu, the primary industry consists mainly of agricultural and forest sectors and employs 90.38% of the workforce. The other industries are mining and manufacturing sectors employing 3.43% and belonging to the secondary industry and commercial and service employing 6.19% and belonging to the tertiary industry.

Rubber is the typical agricultural product in Kabupaten Indragiri Hulu, and there is a rubber processing manufactory with 236 employees in Rengat, capital of the Kabupaten. However, the prosperity of the rubber business depends to a large extent upon trend of the International market.

There are about one hundred and eight factories operating in the processing industries using the materials of timber and various kinds of food. However they are all small-scale domestic/cottage industries with each factory managed by an average of 6 employees.

1.3 Present Status of Kabupaten Roads

1.3.1 Outline of Road Networks

Road networks in Kabupaten Indragiri Hulu are characterized by one provincial road which runs across the Kabupaten from west to east and takes an important role as a regional trunk line.

Starting from Pekanbaru, the provincial capital of Riau, it enters the northwest of the Kabupaten. After that it runs towards east of the Kabupaten at Taluk Kuantan along the left side of the Indragiri River and then crosses over the river at Pasar Ringgit. Further eastward, it runs along the right side of the river and to the neighbouring Kabupaten Indragiri Hilir via Rengat, the Kabupaten capital. In addition there are three provincial roads in the Kabupaten which also take the role of a regional trunk line to the neighbouring provinces and Kabupaten Sumatera Barat and Jambi, and Kampar.

In this Kabupaten the Kabupaten roads are developed based upon the above mentioned provincial road which runs parallel with the Indragiri River. However these Kabupaten roads form their own different networks depending upon the regional development potential. For instance, among the Kabupaten road links the route composed of link Nos 1 and 3, which are now used as a by-pass for the provincial road, are scheduled to be improved as a provincial road in the future. Therefore, a separate programme for bridge construction at 3 kilometres above the ferry terminal is now being planned. When the improvement is finished, the route will be upgraded to provincial road. Thus, the development programme of the Kabupaten roads in Kecamatan Rengat is expected to accelerate within the framework of the provincial road development.

However there is no Kabupaten road north of Rengat because the area is mostly covered by swamp.

In the central area of the Kabupaten, between Taluk Kuantan and Air Molek, most of the villages are distributed along the provincial road on the north side of the Indragiri River, so that most of the Kabupaten roads in the area are used for access to the Indragiri River and/or to the provincial road. This indicates the conversion process of developing land transportation from river transportation.

1.3.2 Road Inventory

From the road inventory data prepared by the Kabupaten, the number and total length of Kabupaten roads to be studied in Kabupaten Indragiri Hulu are confirmed as 68 links and 929 Km respectively. These figures exclude Kabupaten roads with no data.

According to the data the present status of the Kabupaten roads is as follows:

(1) Density of Kabupaten Roads

The density of the Kabupaten roads is 0.59 m per ha. This is higher than the national density of 0.48 m per ha but far lower than 2.11 m per ha which is the density in Jawa Island, excluding DKI Jakarta, as shown in the following table. Thus, the Kabupaten lags extremely behind in density of Kabupaten roads.

	Total Length (km)	Area (ha)	Density (m/ha)
Kabupaten : Indragiri Hulu	929	1,585,400	0.59
Province : Riau	1,882	5,909,756	0.32
Jawa Is.(Excluding DKI Jakarta)	27,715	13,159,700	2.11
Indonesia	92,038	191,944,300	0.48

Notes : 1. The value for the province is the total value for the Kabupatens included in the study.

2. The source of data are as follows:
Kabupaten and Province : Bina Marga Inventory
Jawa and Indonesia : Statistical Yearbook of Indonesia 1984, published by the Central Statistics Bureau

(2) Kabupaten Road Surface Type

The type of surface on the Kabupaten roads in the Kabupaten is shown in Table 1-3-1.

The legend used in the table is as follows:

ASP : Asphalt

Table 1-3-1 EXISTING ROAD LENGTH BY SURFACE TYPE

PROV : RIAU KAB : INDRAGIRI HULU

(Km)

NO		L.L	ASP	BTB	KRK	TNH	TOTAL
LINK	1	11	1		1		12
LINK	2		6	51	1		57
LINK	3	6					6
LINK	4	1			6		6
LINK	5	1			3		3
LINK	6	1			4		4
LINK	7						
LINK	8					20	20
LINK	9				7		7
LINK	10					5	5
LINK	11		1		1		2
LINK	12				4		4
LINK	13				4		4
LINK	14	1			4		4
LINK	15	1			18		19
LINK	16				4		4
LINK	17				19		19
LINK	18	1				3	3
LINK	19	1		1		2	4
LINK	20				10		10
LINK	21				5	23	28
LINK	22		4				4
LINK	23	1			1	29	30
LINK	24				1	2	3
LINK	25				12		12
LINK	26				11	1	12
LINK	27	1			4		5
LINK	28	1			25		25
LINK	29	1			14		14
LINK	30	2				8	10
LINK	31	9			1		10
LINK	32	1			3		3
LINK	33	1		1	14		15
LINK	34	1				34	35
LINK	35	1			10	1	10
LINK	36	1				4	4
LINK	37	1			6	9	15
LINK	38	1		33	1	2	35
LINK	39	1			1	1	1
LINK	40	1			4	1	4
LINK	41	1			1	19	20
LINK	42	1			35	1	35
LINK	43	1			30	1	30
LINK	44	1			20	1	20
LINK	45	1			1	1	2
LINK	46	1			3	1	3
LINK	47	10			1	23	33
LINK	48	1			4	1	4
LINK	49	1			1	1	1
LINK	50	1			3	1	3
LINK	51	1			3	14	18
LINK	52	3			1	1	4
LINK	53	1			1	13	13
LINK	54	1			1	5	6
LINK	55	1			1	67	67
LINK	56	1			1	18	18
LINK	57	1			1	14	14
LINK	58	1	23		2	2	27
LINK	59	1	4		5	1	9
LINK	60	1	1		3	19	22
LINK	61	2	1		1	10	12
LINK	62	23	1		1	1	23
LINK	63	1	1		1	3	4
LINK	64	1	1		1	4	4
LINK	65	1	1		1	15	15
LINK	66	1	1		1	25	26
LINK	67	12	1		1	1	12
LINK	68	1	1		1	18	18
TOTAL		87	39	86	304	413	929
RATIO		9	4	9	33	44	(%)

KRK : Gravel/Stone/Telford/Water Bound Macadam

TNH : Earth

LL : Others

Comparison of the proportion of surface types in the Kabupaten with other regions is as follows:

	ASP	KRK	TNH/LL
Kabupaten : Indragiri Hulu	4.2	42.0	53.8
Province : Riau	3.0	23.3	73.7
Jawa Is.(Excluding DKI Jakarta)	56.2	25.0	18.8
Indonesia	26.0	26.6	47.4

Thus, there are no asphalt paved roads. The proportion of low grade roads such as earth roads and others is distinctly high. This means that the road classification in the Kabupaten is low.

(3) Surface Condition of Kabupaten Roads

The surface condition of the Kabupaten roads classified as good, fair, poor and bad which are shown as BA, SD, RU and RB respectively, are summarized in Table 1-3-2.

Comparison of the proportions of the various surface conditions of the Kabupaten roads in the Kabupaten with other regions is as follows:

	Good	Fair	Poor	Bad
Kabupaten : Indragiri Hulu	61.8	24.4	12.1	1.7
Province : Riau	40.2	30.2	25.9	3.7
Jawa Is.(Excluding DKI Jakarta)	45.6	29.8	19.6	5.0
Indonesia	43.5	21.8	21.1	13.6

Table 1-3-2 EXISTING ROAD CONDITION BY SURFACE TYPE

PROVINCE : RIAU

KABUPATEN : INDRAGIRI HULU

(1)

NO	L.L				ASP				BTB				KRK				TNH			
NO	BA	SD	RU	RB	BA	SD	RU	RB	BA	SD	RU	RB	BA	SD	RU	RB	BA	SD	RU	RB
LINK 1	99		1		99		1													
LINK 2					91	9			92	8										
LINK 3	94	6																		
LINK 4													83	15	2					
LINK 5													57	15	28					
LINK 6													90	10						
LINK 7																				
LINK 8																	39	19	2	
LINK 9														71	29					
LINK 10																		42	58	
LINK 11					95		5						90	10						
LINK 12													13	60	28					
LINK 13													63	28	10					
LINK 14													79	4	18					
LINK 15	95	5											89	9	2					
LINK 16													88	13						
LINK 17													76	18	6					
LINK 18																	87	10		3
LINK 19		75	25							75	25						30	40	30	
LINK 20													6	71	24					
LINK 21													79	10	11		99		1	
LINK 22					99	1														
LINK 23													99	1	1		99	1	1	
LINK 24													10	80	10			52	48	
LINK 25													56	34	10					
LINK 26													82	17	1			20	80	
LINK 27	20	70	10										15	78	8					
LINK 28													85	13	2					
LINK 29													79	15	6					
LINK 30	80	20															74	19	7	
LINK 31		20	68	12										20	80					
LINK 32													68	23	9					
LINK 33									80	20			88	12						
LINK 34	80	20															85	15		
LINK 35													79	11	11					
LINK 36																	98		2	
LINK 37													90	7	3		81	6	13	
LINK 38									88	12							88	13		
LINK 39																				
LINK 40														45	50	5				
LINK 41	30	30	30	10													39	33	21	7
LINK 42													62	21	11	5				
LINK 43													55	26	13	6				
LINK 44													52	28	15	5				
LINK 45													90		10		95		5	
LINK 46													92	5	3					
LINK 47	42	31	24	4													11	16	39	34
LINK 48													97		1					
LINK 49																				
LINK 50													99		1					
LINK 51	80	10	10										94		6		75	10	12	3
LINK 52	37	27	30	7													40	30	20	10
LINK 53																	33	29	23	15
LINK 54		80	20														11	73	16	
LINK 55																	33	28	28	11
LINK 56																	82	17	1	
LINK 57																	28	65	7	
LINK 58					47	53							15	85			13	88		
LINK 59					71	29							32	68						
LINK 60													60	13	27		69	17	14	
LINK 61	88	13															88	13		
LINK 62	69	17	10	4																
LINK 63	95	5															85	15		
LINK 64																	70	13	13	5
LINK 65																	87	13		
LINK 66	75	25															87	13		
LINK 67	75	17	7	2																
LINK 68																	61	21	12	7
AVERAGE	59	26	13	2	84	15	1	0	65	29	6	0	63	25	12	1	59	24	15	3
LENGTH		87 Km				39 Km				86 Km				306 Km				413 Km		
(Km)	51	23	11	2	33	6	0	0	56	25	5	0	192	76	36	3	244	99	62	12

The surface condition levels of the Kabupaten roads in the Kabupaten are comparatively higher than both those of Indonesia and Jawa Island. The proportion in good condition is relatively high.

(4) Terrain Conditions of Kabupaten Roads

The difficulty of road improvement is mainly dependent upon the terrain conditions.

The terrain conditions of the Kabupaten roads, classified as flat, hilly, mountainous and swampy which are shown as DT, BK, GN and RW, are summarized in Table 1-3-3.

The proportions of terrain conditions in the Kabupaten are 62.0% flat, 34.0% hilly, 1.0% mountainous and 3.0% swampy.

1.3.3 Bridge Inventory

A bridge inventory showing the existing condition of bridges on the Kabupaten roads in Kabupaten Indragiri Hulu was prepared by the Kabupaten.

The bridges types are classfied as timber, concrete, steel and others which are shown in the inventory as KY, BT, BJ and LL respectively.

The inventory shown in Table 1-3-5 indicates a total of 136 bridges with a total length of 1,688 m of which 106 or 77.9% are timber, 1 or 0.7% are concrete and 26 or 19.1% are others. Steel bridges account for 3 or 1.5% of the total. Three bridges with a total length of 41 m are required to be newly constructed.

Table 1-3-3 EXISTING ROAD LENGTH BY TERRAIN CONDITION

PROV : RIAU KAB : INDRAGIRI HULU

(Km)

NO (3)	DT	RW	BK	GN	TOTAL
LINK 1	12				12
LINK 2	16	24	17		57
LINK 3	6				6
LINK 4	3		3		6
LINK 5	3				3
LINK 6	3		1		4
LINK 7					
LINK 8	19		1		20
LINK 9	2		5		7
LINK 10	5				5
LINK 11	2				2
LINK 12	4				4
LINK 13	2		2		4
LINK 14	4				4
LINK 15	5		14		19
LINK 16	4				4
LINK 17	18		1		19
LINK 18	3				3
LINK 19	4				4
LINK 20	10				10
LINK 21	16		12		28
LINK 22	4				4
LINK 23	8		22		30
LINK 24	3				3
LINK 25	3		9		12
LINK 26	5		7		12
LINK 27	5				5
LINK 28	19		6		25
LINK 29	5		9		14
LINK 30	10				10
LINK 31	2		8		10
LINK 32	1		2		3
LINK 33	12		3		15
LINK 34	33		2		35
LINK 35	8		2		10
LINK 36	4				4
LINK 37	13		2		15
LINK 38	29		6		35
LINK 39					
LINK 40	4				4
LINK 41	2		14	4	20
LINK 42	9		25	1	35
LINK 43	7		23		30
LINK 44	12		8		20
LINK 45	2				2
LINK 46	3				3
LINK 47	10	3	20		33
LINK 48	4				4
LINK 49					
LINK 50	3				3
LINK 51	18				18
LINK 52	1		3		4
LINK 53	13				13
LINK 54	2		4		6
LINK 55	37		30		67
LINK 56	14		4		18
LINK 57	14				14
LINK 58	27				27
LINK 59	9				9
LINK 60	17		5		22
LINK 61	3		9		12
LINK 62	9		13	1	23
LINK 63	4				4
LINK 64	3		1		4
LINK 65	15				15
LINK 66	12		13	1	26
LINK 67	10	1	1		12
LINK 68	5		13		18
TOTAL	574	28	320	7	929
RATIO	62	3	34	1	(%)

Table 1-3-4 NUMBER AND LENGTH OF BRIDGES

PROV : RIAU KAB : INDRAGIRI HULU

<<<< BRIDGE >>>> (UNIT: m)

	EXISTING		NOT EXIST		TOTAL	
LINK NO	NO.	LENGTH	NO.	LENGTH	NO.	LENGTH
1	2	24.00			2	24.00
2	22	322.65			22	322.65
3	3	50.00			3	50.00
4	1	25.00			1	25.00
5	1	4.70			1	4.70
8	4	65.70			4	65.70
9	5	50.00			5	50.00
15	3	47.70			3	47.70
17	3	25.00			3	25.00
20	3	43.20			3	43.20
21	15	271.30			15	271.30
23			1	4.00	1	4.00
24	2	37.50			2	37.50
25	3	23.00			3	23.00
26	2	14.40			2	14.40
28	5	64.40			5	64.40
30	4	40.00			4	40.00
31	5	44.50			5	44.50
32	1	9.70			1	9.70
33	3	20.30			3	20.30
37	4	32.50			4	32.50
38	7	44.70			7	44.70
40	1	5.90			1	5.90
41			1	15.00	1	15.00
42	3	22.35			3	22.35
43	1	10.40			1	10.40
44	3	32.60			3	32.60
45	1	15.00			1	15.00
47			1	22.00	1	22.00
48	2	36.00			2	36.00
51	1	20.00			1	20.00
54	3	30.00			3	30.00
58	1	15.00			1	15.00
59	4	45.40			4	45.40
60	3	24.40			3	24.40
61	3	35.90			3	35.90
62	1	11.60			1	11.60
63	1	5.70			1	5.70
64	1	23.00			1	23.00
65	2	26.00			2	26.00
67	7	68.70			7	68.70
TOTAL	136	1688.20	3	41.00	139	1729.20

Table 1-3-5 NUMBER OF EXISTING BRIDGES BY BRIDGE TYPE

PROV : RIAU KAB : INDRAGIRI HULU

	<<< BRIDGE >>>				(No)
103 (18)	KY	LL	BJ	BT	TOTAL
LINK 1	1				2
LINK 2	18	2	2		22
LINK 3	1	2			3
LINK 4		1			1
LINK 5	1				1
LINK 8	4				4
LINK 9		5			5
LINK 15	2	1			3
LINK 17	2	1			3
LINK 20		3			3
LINK 21	12	2		1	15
LINK 23					
LINK 24	1	1			2
LINK 25	3				3
LINK 26	2				2
LINK 28	5				5
LINK 30	4				4
LINK 31	4	1			5
LINK 32	1				1
LINK 33	3				3
LINK 37	4				4
LINK 38	7				7
LINK 40	1				1
LINK 41					
LINK 42	3				3
LINK 43	1				1
LINK 44	3				3
LINK 45	1				1
LINK 47					
LINK 48	2				2
LINK 51	1				1
LINK 54	2	1			3
LINK 58	1				1
LINK 59	3		1		4
LINK 60	2	1			3
LINK 61		3			3
LINK 62	1				1
LINK 63	1				1
LINK 64		1			1
LINK 65	2				2
LINK 67	7				7
TOTAL	106	26	3	1	136
RATIO	78	19	2	1	(%)

The number of existing bridges by span length is as follows:

Bridges Type	Span Length (m)										
	<3	<5	<8	<10	<12	<14	<16	<18	<20	<99	Total
Timber	13	28	24	15	10	4	5	2	1	4	106
Concrete	-	1	-	-	-	-	-	-	-	-	1
Steel	-	2	-	-	-	-	-	-	-	2	3
Others	1	7	5	-	6	4	1	-	-	2	26
Total	14	37	29	15	16	4	6	2	1	8	136

Thus, most of the existing bridges on the Kabupaten roads are timber and the majority of spanlengths is within the range of 3 m to 8 m.

1.3.4 Traffic

Inventories of the average daily traffic (ADT) on the Kabupaten roads in Kabupaten Indragiri Hulu were prepared by the Kabupaten and are shown in Chapter 2.

From the inventories, total value of average daily trips by vehicle type and their proportions in the Kabupaten in 1984 are summarized as follows:

	SEDAN	BUS	TRUCK	MOTOR-CYCLE	TOTAL
Total Trips	393	430	1,287	4,226	4,223
Proportion (%)	6.20	6.79	20.31	66.70	100.00

Source : Bina Marga Inventory

The proportions of registered vehicles by vehicle type are as follows:

	SEDAN	BUS	TRUCK	MOTOR-CYCLE	TOTAL
Proportion (%)	7.20	3.15	15.91	73.74	100.00

Source : Kabupaten.

Thus, the proportion of motorcyles in the Kabupaten is by far the highest.

From the above tables the following can be observed:

- Number of total trips might be underestimated
- Proportions are probably reasonable.

Essentially, for estimation of future traffic volumes past and present traffic data together with the trend in the number of registered vehicles are important basic data. However the data obtained for the study was traffic count data for each road link in 1985 and of low reliability.

Therefore the future traffic volumes are estimated by the calculation process recommended in chapter 3 of the Main Report.

Chapter 2 ESTIMATIONS OF FUTURE TRAFFIC VOLUME AND BENEFIT

2.1 Future Traffic Volume

2.1.1 Traffic Growth Rate

The traffic growth rate used for estimation of the future traffic volume on the Kabupaten roads was estimated by the following calculation process.

Growth of Production Basis "A":

$$\sqrt{\text{Annual Population Growth of the Kabupaten} \times \text{Growth of the Total Cultivated Area}}$$

Growth of Productivity "B" :

$$\sqrt{\text{Growth of the Total Paddy Field Area} \times \text{Growth of the Paddy Production per ha}}$$

Traffic Growth Rate: Initial estimated figure:

$$\overline{GR'} = \sqrt{A \times B}$$

Traffic Growth Rate GR =Final adjusted figure:

$$\sqrt{GR' \times \text{Trend of GDP/Capita of the Province Concerned}}$$

Results of the estimation are shown in Table 2-1-1.

Table 2-1-1 TRAFFIC GROWTH RATE ESTIMATION

PROV : RIAU KAB : INDRAGIRI HULU

A)	Growth Rate of Population	: 5.50 (%)
B)	Growth Rate of Cultivated Area	: 6.50 (%)
C)	Growth Rate of Rice field	: 3.00 (%)
D)	Growth Rate of Rice yield rate	: -7.90 (%)
E)	Growth Rate of GDP / capita	: 6.80 (%)
a)	Geometrical Mean (A x B)	: 6.00 (%)
b)	Geometrical Mean (C x D)	: -2.60 (%)
c)	Geometrical Mean (a x b)	: 1.61 (%)
d)	Geometrical Mean (c x E)	: 4.17 (%)
	TRAFFIC GROWTH RATE	: 4.17 (%)

2.1.2 Present and Future Traffic Volume

The future traffic volumes on the Kabupaten roads in 1998 for the Project life time of ten years were estimated by the following formula :

$$Tn = Te\ (1 + r)^n$$

Where :

Tn : Future traffic volume n years later
Te : Traffic volume in 1984
r : Traffic growth rate

The results are shown in Table 2-1-2 together with the traffic volume in 1984.

Table 2-1-2 EXISTING AND FUTURE TRAFFIC VOLUME

PROV : RIAU KAB : INDRAGIRI HULU

(SPD : 1/2)

	INVENTORY (1984)					RATE	AFTER 14 YEARS (1998)					CLASS
LINK NO	MBL	BUS	TRUK	SPD	TOTAL		MBL	BUS	TRUK	SPD	TOTAL	
1	60	40	120	150	295	4.2%	106	71	213	266	523	IIIA
2	40	50	120	300	360	4.2%	71	89	213	532	638	IIIA
3	20	15	42	100	127	4.2%	35	27	74	177	225	IIIB-1
4	8	10	30	40	68	4.2%	14	18	53	71	120	IIIB-2
5	12	15	30	100	107	4.2%	21	27	53	177	190	IIIB-2
6	0	0	6	4	8	4.2%	0	0	11	7	14	IIIC
7	0	0	0	0	0	4.2%	0	0	0	0	0	IIIC
8	12	0	0	100	62	4.2%	21	0	0	177	110	IIIB-2
9	9	5	12	70	61	4.2%	16	9	21	124	108	IIIB-2
10	0	0	0	0	0	4.2%	0	0	0	0	0	IIIC
11	15	30	30	80	115	4.2%	27	53	53	142	204	IIIB-1
12	0	0	6	20	16	4.2%	0	0	11	35	28	IIIC
13	0	0	4	20	14	4.2%	0	0	7	35	25	IIIC
14	12	15	10	100	87	4.2%	21	27	18	177	154	IIIB-2
15	10	9	23	60	72	4.2%	18	16	41	106	128	IIIB-2
16	1	2	3	20	16	4.2%	2	4	5	35	28	IIIC
17	4	6	8	40	38	4.2%	7	11	14	71	67	IIIB-2
18	2	1	5	8	12	4.2%	4	2	9	14	21	IIIC
19	0	0	0	8	4	4.2%	0	0	0	14	7	IIIC
20	1	2	3	16	14	4.2%	2	4	5	28	25	IIIC
21	0	0	5	40	25	4.2%	0	0	9	71	44	IIIC
22	4	2	5	8	15	4.2%	7	4	9	14	27	IIIC
23	1	2	0	8	7	4.2%	2	4	0	14	12	IIIC
24	0	0	0	12	6	4.2%	0	0	0	21	11	IIIC
25	9	12	10	70	66	4.2%	16	21	18	124	117	IIIB-2
26	0	0	6	20	16	4.2%	0	0	11	35	28	IIIC
27	0	0	6	50	31	4.2%	0	0	11	89	55	IIIB-2
28	0	0	5	4	7	4.2%	0	0	9	7	12	IIIC
29	0	0	8	30	23	4.2%	0	0	14	53	41	IIIC
30	9	14	14	50	62	4.2%	16	25	25	89	110	IIIB-2
31	0	0	0	60	30	4.2%	0	0	0	106	53	IIIB-2
32	0	0	4	10	9	4.2%	0	0	7	18	16	IIIC
33	0	0	30	200	130	4.2%	0	0	53	354	230	IIIB-1
34	0	0	4	50	29	4.2%	0	0	7	89	51	IIIB-2
35	12	15	12	100	89	4.2%	21	27	21	177	158	IIIB-2
36	6	8	8	90	67	4.2%	11	14	14	159	119	IIIB-2
37	8	11	30	100	99	4.2%	14	19	53	177	175	IIIB-2
38	40	50	39	200	229	4.2%	71	89	69	354	406	IIIB-1
39	0	0	0	0	0	4.2%	0	0	0	0	0	IIIC
40	0	0	0	0	0	4.2%	0	0	0	0	0	IIIC
41	0	0	300	150	375	4.2%	0	0	532	266	664	IIIA
42	0	0	30	70	65	4.2%	0	0	53	124	115	IIIB-2
43	0	0	24	60	54	4.2%	0	0	43	106	96	IIIB-2
44	0	0	18	50	43	4.2%	0	0	32	89	76	IIIB-2
45	0	0	4	50	29	4.2%	0	0	7	89	51	IIIB-2
46	0	0	0	0	0	4.2%	0	0	0	0	0	IIIC
47	3	6	5	40	34	4.2%	5	11	9	71	60	IIIB-2
48	0	0	0	0	0	4.2%	0	0	0	0	0	IIIC
49	0	0	0	0	0	4.2%	0	0	0	0	0	IIIC
50	0	0	3	40	23	4.2%	0	0	5	71	41	IIIC

Table 2-1-2 EXISTING AND FUTURE TRAFFIC VOLUME

PROV : RIAU KAB : INDRAGIRI HULU

(SPD : 1/2)

	INVENTORY (1984)					RATE	AFTER 14 YEARS (1998)					CLASS
LINK NO	MBL	BUS	TRUK	SPD	TOTAL		MBL	BUS	TRUK	SPD	TOTAL	
51	0	0	0	8	4	4.2%	0	0	0	14	7	IIIC
52	0	0	0	0	0	4.2%	0	0	0	0	0	IIIC
53	0	0	0	8	4	4.2%	0	0	0	14	7	IIIC
54	0	0	0	0	0	4.2%	0	0	0	0	0	IIIC
55	0	0	0	30	15	4.2%	0	0	0	53	27	IIIC
56	0	0	20	50	45	4.2%	0	0	35	89	80	IIIB-2
57	0	0	0	0	0	4.2%	0	0	0	0	0	IIIC
58	40	25	48	500	363	4.2%	71	44	85	886	643	IIIA
59	15	31	20	208	170	4.2%	27	55	35	369	301	IIIB-1
60	32	40	120	400	392	4.2%	57	71	213	709	695	IIIA
61	0	9	11	12	26	4.2%	0	16	19	21	46	IIIC
62	3	0	15	60	48	4.2%	5	0	27	106	85	IIIB-2
63	0	0	6	24	18	4.2%	0	0	11	43	32	IIIC
64	0	0	5	20	15	4.2%	0	0	9	35	27	IIIC
65	0	0	8	32	24	4.2%	0	0	14	57	43	IIIC
66	0	0	6	24	18	4.2%	0	0	11	43	32	IIIC
67	5	5	6	32	32	4.2%	9	9	11	57	57	IIIB-2
68	0	0	0	20	10	4.2%	0	0	0	35	18	IIIC
PERCENT	6.20	6.79	20.31	66.70			6.20	6.79	20.31	66.70		

2.2 Benefit

2.2.1 Benefit Estimation Method

Generally, estimation of the benefit on each Kabupaten road due to the Project was made by analyzing the direct benefit i.e. the VOC reduction benefit, which was estimated by comparing "with project" and "without project" based upon the future traffic volume on the road. However for the following road links it was decided to estimate the indirect benefit through the producer's surplus benefit.

a) Road links with present traffic volume (ADT) less than 60 equivalent 4-wheel vehicles.

b) Road links with no 4-wheel vehicle operation at present.

The indirect benefit was changed into the future traffic volume and the VOC reduction benefit was estimated.

The VOC adopted for the estimation is shown in Table 2-2-1.

Table 2-2-1 VEHICLE OPERATION COST ON KABUPATEN ROADS

(KM)

SURFACE	CONDITION	SEDAN	BUS	TRUCK	MOTORCYCLE
ASPHALT	GOOD	104.7	86.2	85.4	15.9
	Fair	125.5	101.0	98.0	18.2
	Poor	164.1	135.2	138.5	22.8
	Bad	222.1	202.0	205.0	29.1
GRAVEL	Good	125.7	101.4	102.5	18.5
	Fair	145.0	124.6	127.1	21.1
	Poor	198.6	172.6	178.4	27.1
	Bad	242.7	228.9	231.2	31.8
EARTH	Fair	201.8	180.0	185.1	28.0
	Poor	240.7	218.2	225.8	31.8
	Bad	264.9	278.0	281.7	35.5

Source : Bina Marga

Table 2-2-2 FUTURE TRAFFIC VOLUME ESTIMATED BY THE PRODUCER'S SURPLUS

PROV : RIAU KAB : INDRAGIRI HULU

(1998)

LINK NO	CLASS	SURFACE	MOBIL	BUS	TRUCK	SEPEDA	TOTAL
6	IIIC	KRK	1	1	2	6	7
10	IIIC	KRK	2	2	6	19	20
12	IIIC	KRK	3	3	10	32	32
13	IIIC	KRK	3	3	9	28	29
16	IIIC	KRK	4	4	12	40	40
17	IIIB-2	KRK	18	19	58	191	191
18	IIIB-2	KRK	7	7	22	72	72
19	IIIB-2	KRK	8	9	26	84	85
20	IIIB-1	ASP	29	31	94	308	308
21	IIIA	ASP	73	80	238	783	783
23	IIIB-1	ASP	25	27	80	264	264
26	IIIC	KRK	2	2	6	19	20
27	IIIC	KRK	1	1	2	7	8
28	IIIA	ASP	56	61	182	600	599
29	IIIC	KRK	2	2	7	22	22
31	IIIC	KRK	1	2	5	15	16
34	IIIB-2	KRK	13	15	43	143	143
40	IIIC	KRK	1	1	2	6	7
43	IIIB-2	KRK	12	13	38	125	126
44	IIIB-2	KRK	6	6	19	63	63
45	IIIC	KRK	1	1	2	6	7
46	IIIC	KRK	2	2	7	24	23
47	IIIA	ASP	86	94	281	923	923
48	IIIB-2	KRK	9	10	30	98	98
50	IIIC	KRK	3	3	9	30	30
51	IIIB-1	ASP	23	26	76	250	250
52	IIIC	KRK	3	4	11	36	36
53	IIIC	KRK	3	3	8	27	28
54	IIIB-2	KRK	16	17	51	168	168
55	IIIA	ASP	133	146	436	1432	1431
56	IIIB-2	KRK	6	7	21	69	69
57	IIIB-2	KRK	12	13	39	127	128
63	IIIC	KRK	4	4	13	44	43
65	IIIB-2	KRK	5	6	17	57	57
66	IIIC	KRK	4	4	13	42	42
67	IIIB-1	ASP	27	29	88	288	288
68	IIIB-1	ASP	41	45	135	444	443

2.2.2 Benefit

The benefit estimation was carried out for each Kabupaten road. Table 2-2-3 shows a sample of the result of benefit estimation. In the table "surplus" and "VOC" show the estimation method utilized and III A, III B-1, III B-2 and III C show the road classification.

Table 2-2-3

RESULTS OF BENEFIT ESTIMATION

KABUPATEN : INDRAGIRI HULU

(1000Rupiah)

	LINK 1	LINK 2	LINK 3	LINK 4	LINK 5	LINK 6	LINK 8	LINK 9	LINK 10	LINK 12
	12 Km	57 Km	6 Km	6 Km	3 Km	4 Km	20 Km	7 Km	5 Km	4 Km
	IIIA	IIIA	IIIB-1	IIIB-2	IIIB-2	IIIC	IIIB-2	IIIB-2	IIIC	IIIC
YEAR	VOC	VOC	VOC	VOC	VOC	Surplus	VOC	VOC	Surplus	Surplus
1988	0	0	0	0	0	0	0	0	0	0
1989	22169	111774	4764	671	2255	0	17016	4031	279	75
1990	23077	116498	4962	695	2323	0	17366	4154	279	182
1991	24058	121630	5160	728	2446	0	18277	4394	678	239
1992	24966	126140	5364	762	2571	4	19257	4540	901	303
1993	26109	131747	5603	785	2640	4	19607	4674	922	314
1994	27172	137340	5807	820	2766	5	20587	5005	1138	383
1995	28314	143052	6058	864	2894	5	21638	5161	1180	553
1996	29475	149069	6316	888	2994	5	22619	5397	1417	675
1997	30701	155189	6562	933	3122	12	23108	5549	1859	804
1998	32009	162089	6814	968	3251	16	24159	5794	2297	989
SUM	268050	1354528	57410	8114	27262	51	203634	48698	10950	4517
COST	113312	586416	11078	-7301	10159	-8062	80840	14829	-4343	-5749
/Km	9443	10288	1846	-1217	3386	-2016	4042	2118	-869	-1437

Chapter 3 ENGINEERING

3.1 Design Criteria and Specification

3.1.1 Geometric Design Criteria

Currently a technical standard for improvement of Kabupaten roads i.e. PETUNJUK TEKNIS INPRES PENUNJANGAN JALAN KABUPATEN, TAHUN 1984-1985 is established by Bina Marga.

The geometric design criteria in the above standard are recommended to be adopted in general for the Project. Following discussions with Bina Marga, exceptions to this are allowed for Pavement width and pavement type to minimize the construction cost of the Kabupaten road improvement, if necessary. The geometric design criteria adopted for the Project are shown in Table 3-1-1. The typical cross sections of Kabupaten roads are shown in Fig. 3-1-1.

3.1.2 Loading Specification

The LOADING SPECIFICATIONS FOR HIGHWAY BRIDGES BY DIRECTORATE GENERAL BINA MARGA is used in principle as the basic specification of loading and the TECHNICAL STANDARD FOR KABUPATEN ROADS compiled by Bina Marga shows that the design live load for bridges on Kabupaten roads is 70% of the Bina Marga live road. However, after discussions with Bina Marga the following loads were decided as the design live loads for the standard bridges of Kabupaten roads:

a. 50% of Bina Marga live load (hereinafter BM 50) is applied for concrete and timber bridges on roads of III A classification.

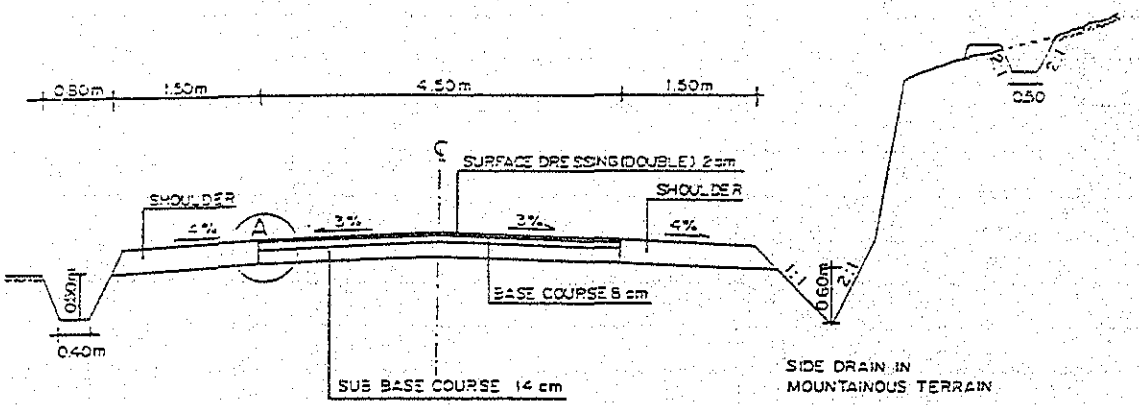
b. 10-ton truck load is applied for timber bridges on roads of III B-1, III B-2 and III C classification.

Table 3-1-1 DESIGN CRITERIA FOR KABUPATEN ROADS

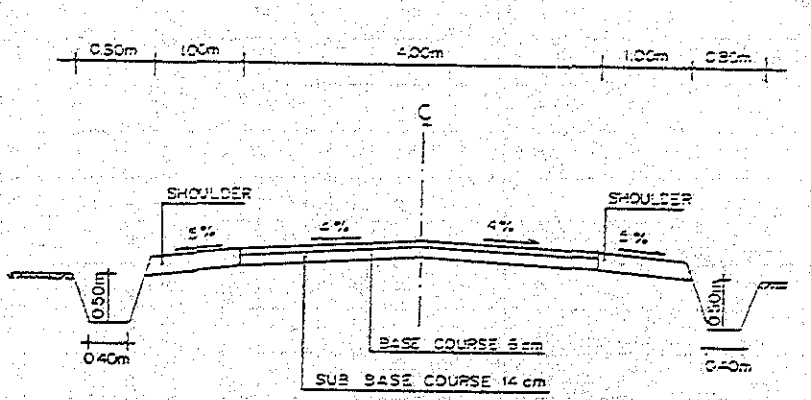
ROAD CLASSIFICATION		CLASS III A			CLASS III B-1			CLASS III B-2			CLASS III C		
SURFACE TYPE		ASPHALT SEAL (DOUBLE)			ASPHALT SEAL (SINGLE)			GRAVEL			GRAVEL		
TRAFFIC VOLUME : ADT (Forecast 10 th year average per day)		3000 - 500			500 - 200			200 - 50			50		
TERRAIN		FLAT TO ROLLING	HILLY	MOUNT-AINOUS	FLAT TO ROLLING	HILLY	MOUNT-AINOUS	FLAT TO ROLLING	HILLY	MOUNT-AINOUS	FLAT TO ROLLING	HILLY	MOUNT-AINOUS
TRAFFIC LANES		1+	1+	1+	1+	1+	1+	1+	1+	1+	1	1	1
DESIGN SPEED (Km/hr)	DESIRABLE	70	60	40	70	40	30	60	40	30	50	30	AS PRACTI-CABLE
	MINIMUM	30	30	30	30	30	AS PRACTI-CABLE	30	30	AS PRACTI-CABLE	30	AS PRACTICABLE	
GRADIENT (LIMITING) (%)	DESIRABLE	4	5	8	4	6	8	4	7	8	5	8	12
	MAXIMUM	7	7	10	7	8	10	7	9	12	7	12	16
PAVEMENT WIDTH (M)	DESIRABLE	6.0	6.0	6.0	4.5	4.5	4.5	4.5	4.5	4.5	3.5	3.5	3.5
	MINIMUM	4.5	4.5	4.5	3.5	3.5	3.5	3.5	3.5	3.5	3.0	3.0	3.0
SHOULDER WIDTH (M)	DESIRABLE	2.0	1.5	1.5	1.5	1.5	1.0	1.5	1.0	1.0	1.0	1.0	0.75
	MINIMUM	1.5	1.0	0.75	1.0	1.0	0.75	1.0	0.75	0.5	0.75	0.5	0.5
ROAD BED WIDTH (M)	DESIRABLE	10.0	9.0	9.0	8.0	7.5	6.5	7.5	6.5	6.5	5.5	5.5	5.0
	MINIMUM	6.0	6.0	6.0	5.5	5.5	5.0	5.5	5.0	4.5	4.5	4.0	4.0
RIGHT OF WAY (M)	DESIRABLE	16			12			12			12		
	MINIMUM	12			10			10			8		
ROAD CAMBER (%)	PAVEMENT	3			3			4			4		
	SHOULDER	4			4			5			5		

Fig. 3-1-1 STANDARD ROAD CROSS SECTIONS

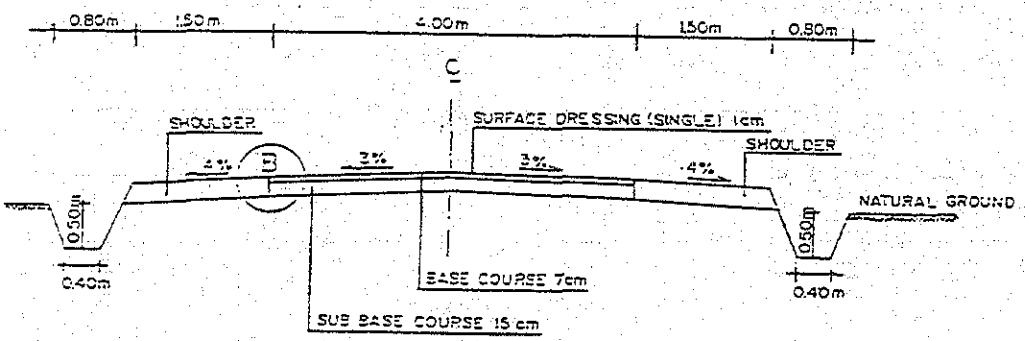
CLASS III A



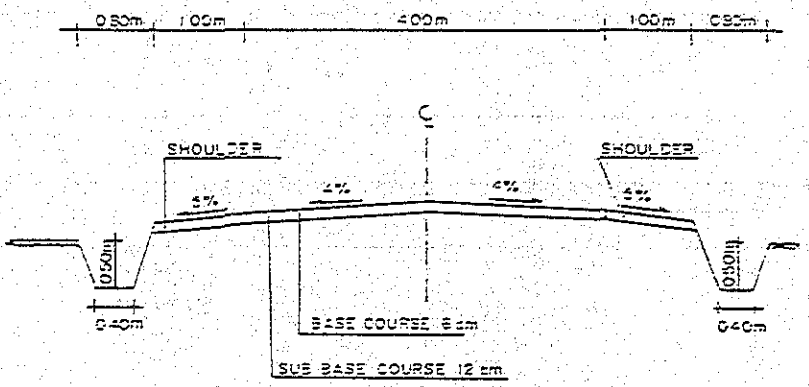
CLASS III B-2



CLASS III B-1



CLASS III C



3.2 Pavement Design

3.2.1 Design Conditions

From the engineering data prepared by the Kabupaten it is noted that the pavement structure of the Kabupaten roads seems to have been determined without adequate designs, therefore the Kabupaten roads generally have insufficient capacity. The standards generally used for highway pavement design such as Road Note 29, Road Note 31 and AASHTO are not suitable for Kabupaten roads with small traffic volumes and loads.

Therefore formulae suitable for the pavement design of Kabupaten roads are recommended as described in Chapter 5 of the Main Report.

The following are important factors for the design of pavement thickness.

1) Design Traffic Volume

As the pavement thickness is designed for each road classification the design traffic volume of which the target year is 1998, is adopted for each classification as follows:

Road Classification	Design Traffic Volume (vpd)
III A	1,000
III B-1	500
III B-2	200
III C	50

2) Strength of Roadbed

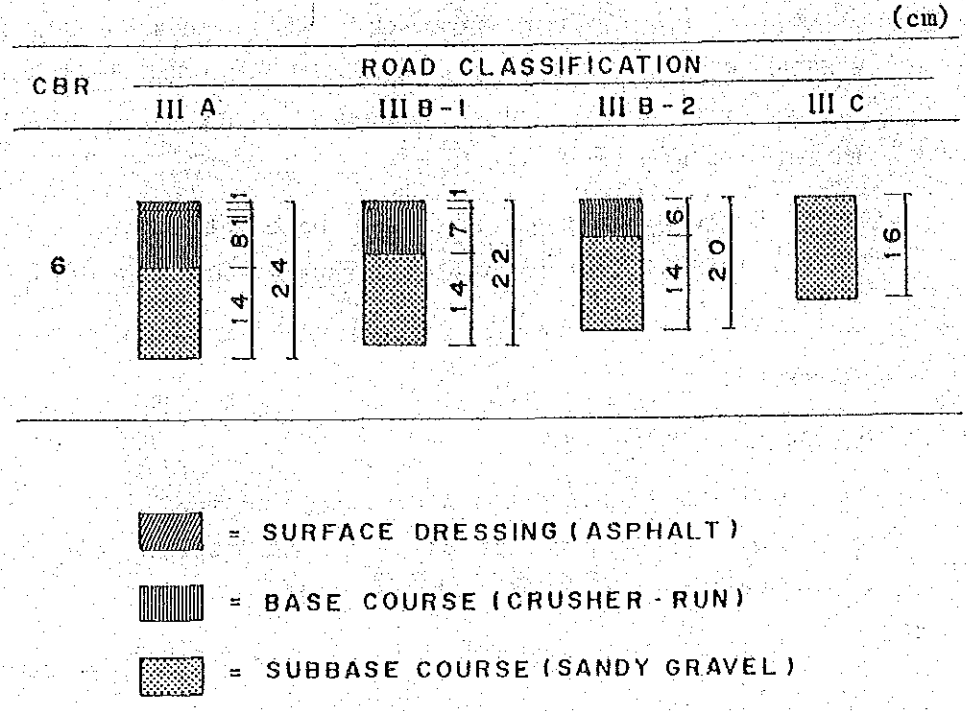
The CBR value of the existing roadbed is a very important factor for the pavement design but no results are available from CBR tests on the Kabupaten roads.

CBR of the laterite is generally in the range of CBR 4 to 10. However site CBR tests should be conducted before construction to finally decide the pavement thickness.

3.2.2 Pavement Structure

Fig. 3-2-1 shows the standard pavement structure adopted for the Kabupaten roads.

Fig. 3-2-1 PAVEMENT STRUCTURE



3.3 Design of Bridges and Other Structures

3.3.1 Standard Bridge

There are so many bridges to be improved or to be constructed on the Kabupaten roads in the Project Area that it is very difficult to prepare an individual design for each bridge. Therefore, standardization is recommended as being necessary for the bridge design with conclusions as described below.

(1) Bridge Type

1) Superstructure

The following two types have been finally selected with the agreement of Bina Marga after studying the actual rural conditions of bridge construction. Fig. 3-3-1 shows the cross sections of standard types.

a. Timber beam bridge (hereinafter timber bridge) for roads class III B-1, III B-2 and III C.

b. Reinforced concrete T-girder bridge (hereinafter RC-bridge) for roads class III A.

2) Substructure

Taking account of the actual combinations of super and substructure types noted from the field survey, the following two types are recommended as standard because of ease of construction and economy.

a) Timber pile bents for timber bridge

b) Rubble in mortar masonry for RC bridge

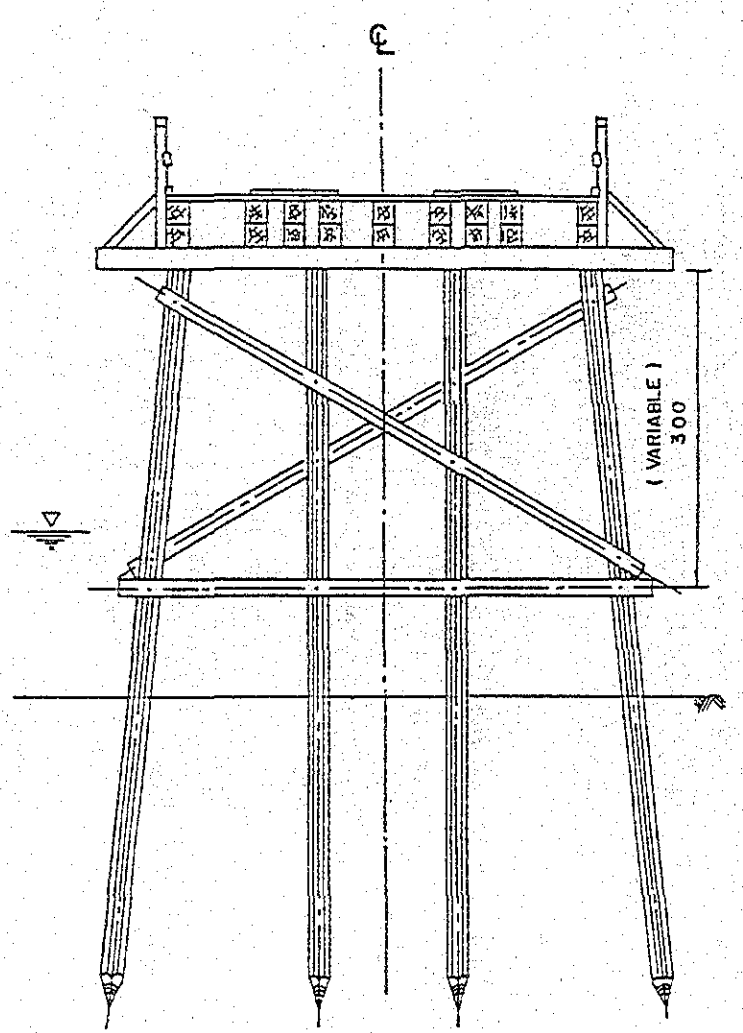
3) Foundation

There is no information of subsoil conditions in the inventory data. However, timber piles of 20 cm diameter are generally recommended as piles of this type are in common use.

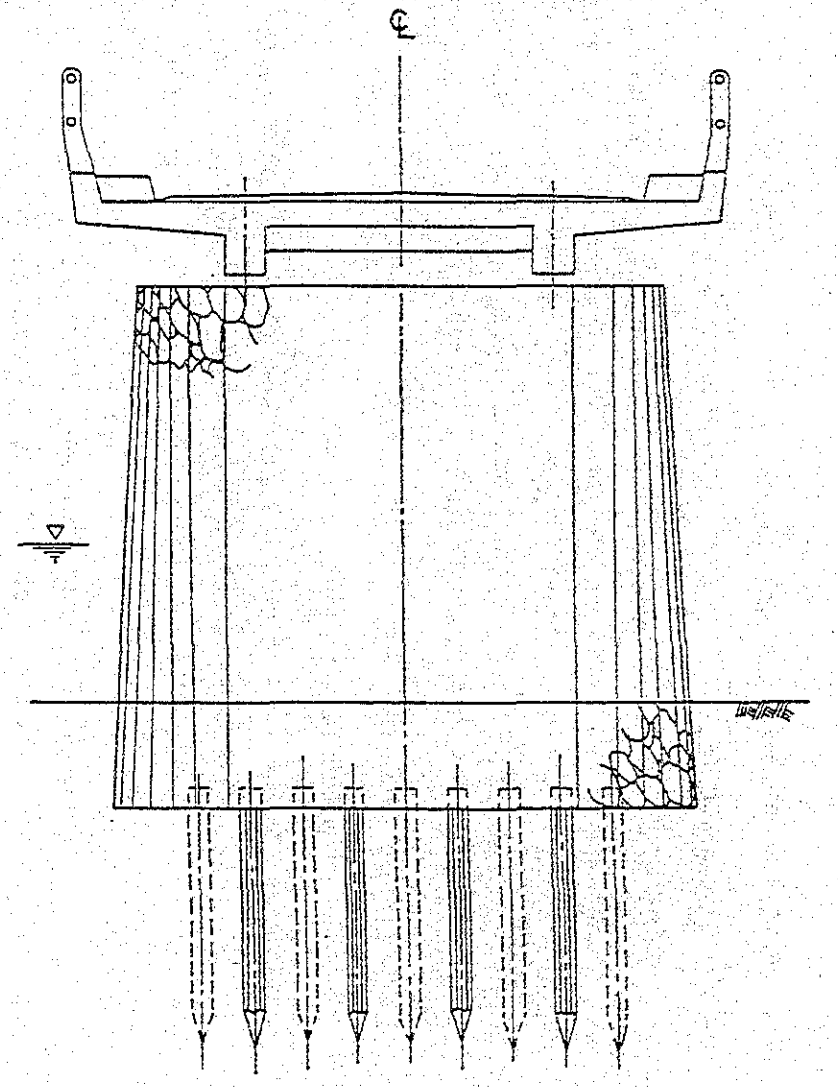
The pile length is suggested to be a minimum of 3 meters under the bottom of the foundation. The length and number of piles should be decided in order to be adequate for the condition of the foundation materials.

Fig. 3-3-1 CROSS SECTIONS OF STANDARD BRIDGES

TIMBER BRIDGE



REINFORCED CONCRETE BRIDGE



(2) Bridge Width

The effective bridge widths for the standard bridges have been decided as follows through discussions with Bina Marga considering the actual width of Kabupaten roads:

a) Timber bridge: 4.0 m in general
b) RC bridge : 4.5 m in general

(3) Span Length

The range of span lengths are determined as:

a) Timber bridge: 3.0, 5.0 and 8.0 m
b) RC bridge : 3.0, 5.0, 10.0 and 15.0 m

3.3.2 Other Structure

Culverts and retaining walls shown in Fig. 3-3-2 and Fig. 3-3-3 are recommended as standard structures.

(1) Culvert

The following two culvert types have been adopted for the transverse drainage.

a) Reinforced concrete pipe culvert ϕ 80 cm
b) Rubble in mortar box culvert with RC slab 80 cm X 80 cm

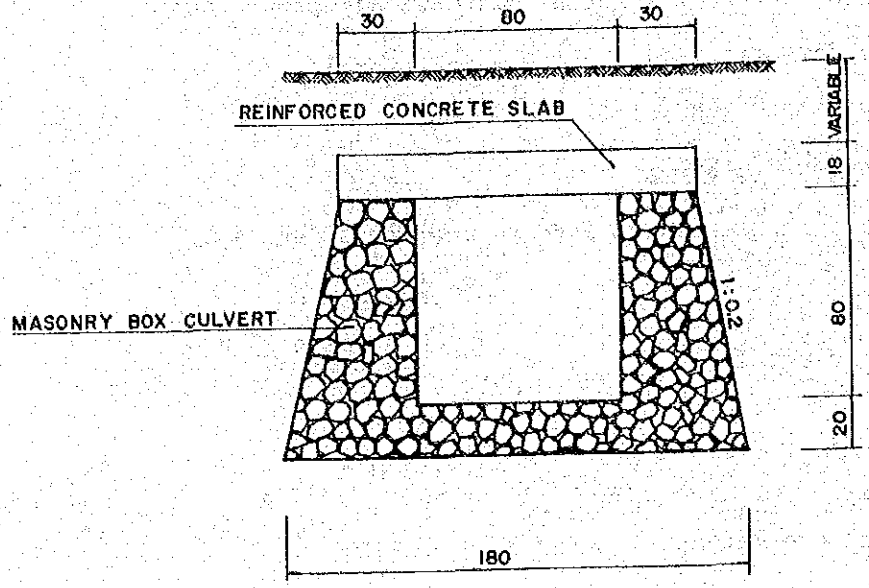
(2) Retaining Wall

The following two types of retaining walls have been adopted because of ease of construction, economy and familiarity in Indonesia.

a) Rubble in mortar retaining wall
b) Timber retaining wall

Fig. 3-3-2 STANDARD CULVERTS

80 x 80 RUBBLE IN MORTAR BOX CULVERTS



Ø 80 RENFORCED CONCRETE PIPE CULVERT

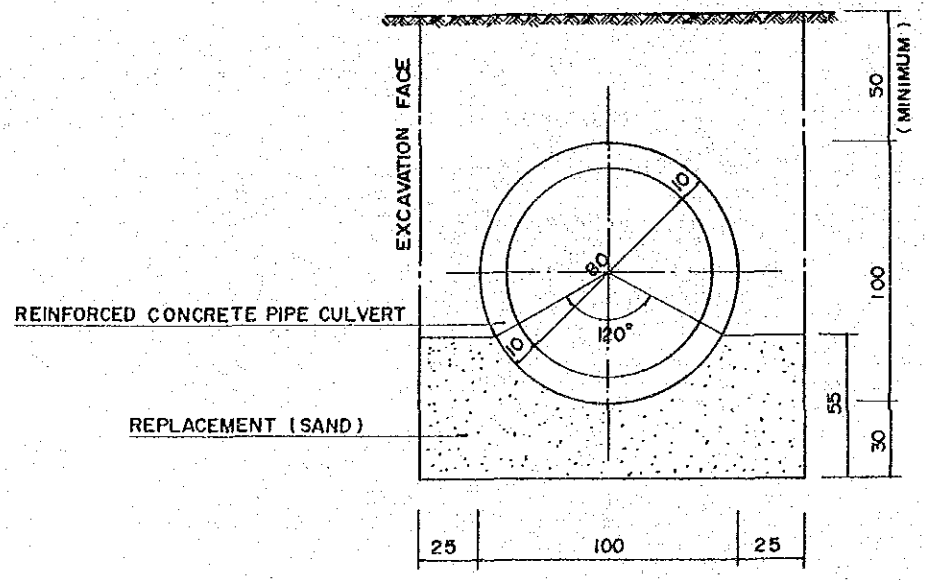
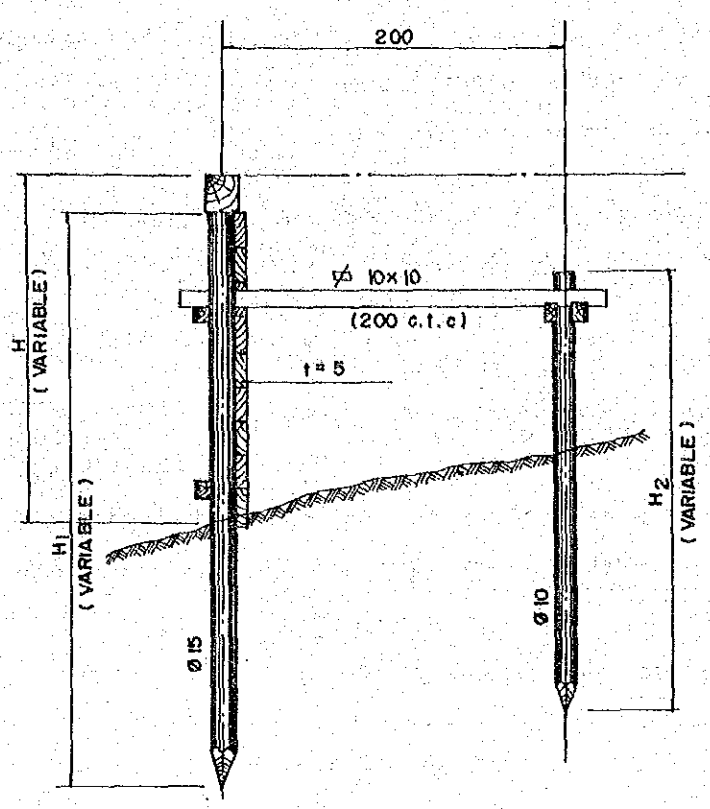
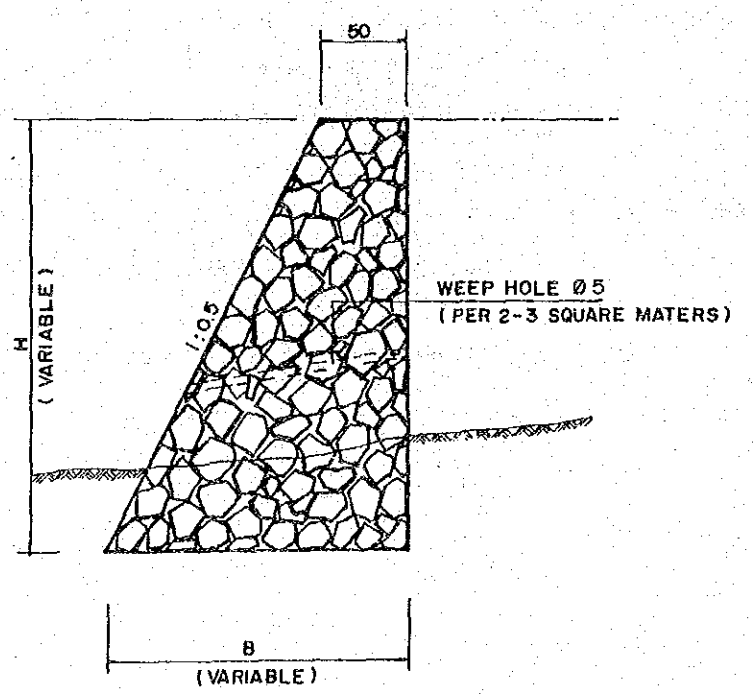


Fig. 3-3-3 STANDARD RETAINING WALLS

TIMBER RETAINING WALL



RUBBLE IN MORTAR WALL



3.4 Selection of Equipment Types

From the results of comparison of two types of Kabupaten road construction methods, i.e. equipment intensive method and labour intensive method construction methods for major works were basically decided as shown in Table 3-4-1.

Table 3-4-1 CONSTRUCTION METHODS FOR MAJOR WORKS

METHOD	WORK TYPE
Equipment Intensive	Earthwork, Base Course and Subbase Course
Labour Intensive	Surface Dressing, Drainage, Bridge and Other Structures.

3.4.1 Points to be Considered for the Selection

Full consideration was given to the following points in studying the selection of equipment type.

a. Most of the construction in the Project is pavement works for road improvement.

b. The pavement width adopted is equal to or less than 4.5 m and therefore large sized equipment is omitted from the selection process.

c. Equipment should be capable of with standing the heavy rainfall and poor soil quality. Equipment for construction in swampy areas is considered if necessary.

d. Uniformity of equipment types with existing equipment is considered to facilitate repair of the equipment in the provincial work shop.

e. Since the scale of the construction is small and transportation of equipment will frequently be necessary, wheel type equipment has been selected as much as possible as this can move by itself or by being towed.

f. The road like to be improved are scattered all over the Kabupatens and therefore a low bed truck or equivalent is necessary for transportation of crawler type equipment. It is desirable to protect the existing pavement from damage caused by the movement of crawler type equipment on the existing roads.

g. The capacity of the equipment has been decided taking into consideration the construction volume and the combination of equipment in the main work.

3.4.2 Combinations of Equipment for Major Works and Maintenance

The combinations of equipment for major works and maintenance are listed in Table 3-4-2 and 3-4-3 respectively.

Table 3-4-2 EQUIPMENT OF ONE WORK GANG FOR MAJOR TYPES OF WORK

TYPE OF WORK	EQUIPMENT REQUIRED	
1. Site Clearing in Light Bush	1- Bulldozer 90 HP 2- Dump Truck 3.0 Ton	1- Wheel Loader 1.2 m^3
2. Excavation & Embankment		
i) Normal Fill	1- Bulldozer 90 HP 1- Vibratory Roller 4.0 Ton (D&T)	1- Water Tank Truck 4,000 Ltr
ii) Fill by Borrow Material	1- Bulldozer 90 HP 3- Dump Truck 3.0 Ton	1- Wheel Loader 1.2 m^3
iii) Fill in Swamp	1- Swamp Bulldozer 90 HP 1- Water Tank Truck 4,000 Ltr	1- Vibratory Roller 4.0 Ton (D&T)
iv) Excavation to Spoil	1- Bulldozer 90 HP 1- Wheel Loader 1.2 m^3	4- Dump Truck 3.0 Ton
3. Subgrade Preparation	1- Motor Grader 75 HP 1- Vibratory Roller 4.0 Ton (D&T)	1- Water Tank Truck 4,000 Ltr
4. Subbase Course	1- Motor Grader 75 HP 1- Vibratory Roller 4.0 Ton (D&T)	1- Water Tank Truck 4,000 Ltr
5. Base Course	1- Motor Grader 75 HP 1- Vibratory Roller 4.0 Ton 1- Portable Crusher/Screens 30-40 Ton/H	1- Water Tank Truck 4,000 Ltr
6. Cement Stabilizing	1- Motor Grader 70 HP 1- Bulldozer 90 HP 1- Wheel Loader 1.2 m^3 1- Flat Bed Truck 3.0 Ton	1- Vibratory Roller 4.0 Ton (D&T) 1- Road Stabilizer 1- Water Tank Truck 4,000 Ltr
7. Surface Course	1- Asphalt Sprayer 850 Ltr 1- Tyre Roller 8-15 Ton 1- Portable Crusher/Screens 30-40 Ton/H	1- Flat Bed Truck 3.0 Ton
8. Concrete	1- Concrete Mixer 0.5 m^3 1- Water Pump 200 Ltr/Min 1- Concrete Vibrator 3.3 HP	1- Flat Bed Truck 3.0 Ton 1- Hand-Guided Vibratory Roller 1000 Kg

Table 3-4-3 EQUIPMENT OF ONE WORK GANG FOR MAINTENANCE

TYPE OF WORK	EQUIPMENT REQUIRED
Road	1- Motor Grader
	1- Tyre Roller 8-15 Ton
	1- Hand-Guided Vibratory Roller 1000 Kg
	1- Flat Bed Truck 3.0 Ton
	1- Dump Truck 3.0 Ton
Bridge and Other Structure	1- Flat Bed Truck With Crane 3.0 Ton

3.5 Workshop and Laboratory

3.5.1 Policy of the Kabupaten Workshop

A workshop will be provided for each Kabupaten. The function of the workshop is to cope with requests from the construction site. The main service will be routine maintenance while the secondary service will be light repairs which can be carried out by changing parts. Dismantling and assembling of units which need setting or adjustment using special equipment or facilities will not be carried out in the Kabupaten workshop. Such repairs are planned to be carried out by the provincial workshop or the regional workshop of Bina Marga.

Accordingly the main tasks of the Kabupaten workshop are as follows:

1) Administration for and storage of equipment
2) Routine maintenance and light repair of equipment
3) Storage and supply of spare parts
4) Operation of equipment including crushing plant.

3.5.2 Workshop Equipment and Tools

Equipment and tools for the workshop are recommended as shown in Table 3-5-1.

Table 3-5-1 WORKSHOP EQUIPMENT AND TOOLS

DESCRIPTION	QUANTITY
Upright Drilling Machine	1 Set
Electric Hand Drill	1
Electric Portable Grinder	1
Disc Grinder	1
Bench Electric Grinder	1
Engineer's Vice	1
DC Electric Welder with Engine	1 Set
Portable Hydraulic Jack, Screw Head	1
Hydraulic Jack	1
Grease Gun	2
Suction Pump for Oil Recovery	2
High Pressure Grease Pump	1

continued

DESCRIPTION	QUANTITY
Drum Opening Spanner	1
Silicon Normal Charger	1
Tyre Changer Air Operated	1
Tyre Service Tool Set	1
Tyre Pressure Gauge	1
Automatic Tyre Inflator	1
Plug Cleaner and Tester	1
Mechanics Tool Set, Heavy Equipment	1
Mechanics Tool Set, Large Vehicle	1
Portable Air Compressor	1
Electric Cord Reel, 15 A, 50 m	1
Oil Measure, Polyethylene	1
Funnel 200 mm, Steel	3
Hand Truck (Cart), 4-Wheel	1
Nylon Sling, 10 ton	2
Chain Block, 1 ton	2
Wire Rope (for sling), 1.8 ton	2
Wire Rope (for sling) 3.2 ton	2
Generator	1

3.5.3 Laboratory

For quality control of construction in the Project it is recommended that a laboratory is provided for each Kabupaten. For each laboratory, provision of laboratory test equipment for the following tests is recommended:

- Physical characteristic, compaction and strength tests for the road bed and pavement materials.
- Slump and strength tests for the bridge concrete.

In the laboratory a fixed water tank should be provided for CBR tests and curing of concrete specimens.