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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 29

KABUPATEN MINAHASA

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 Minahasa in Sulawesi Utara 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.

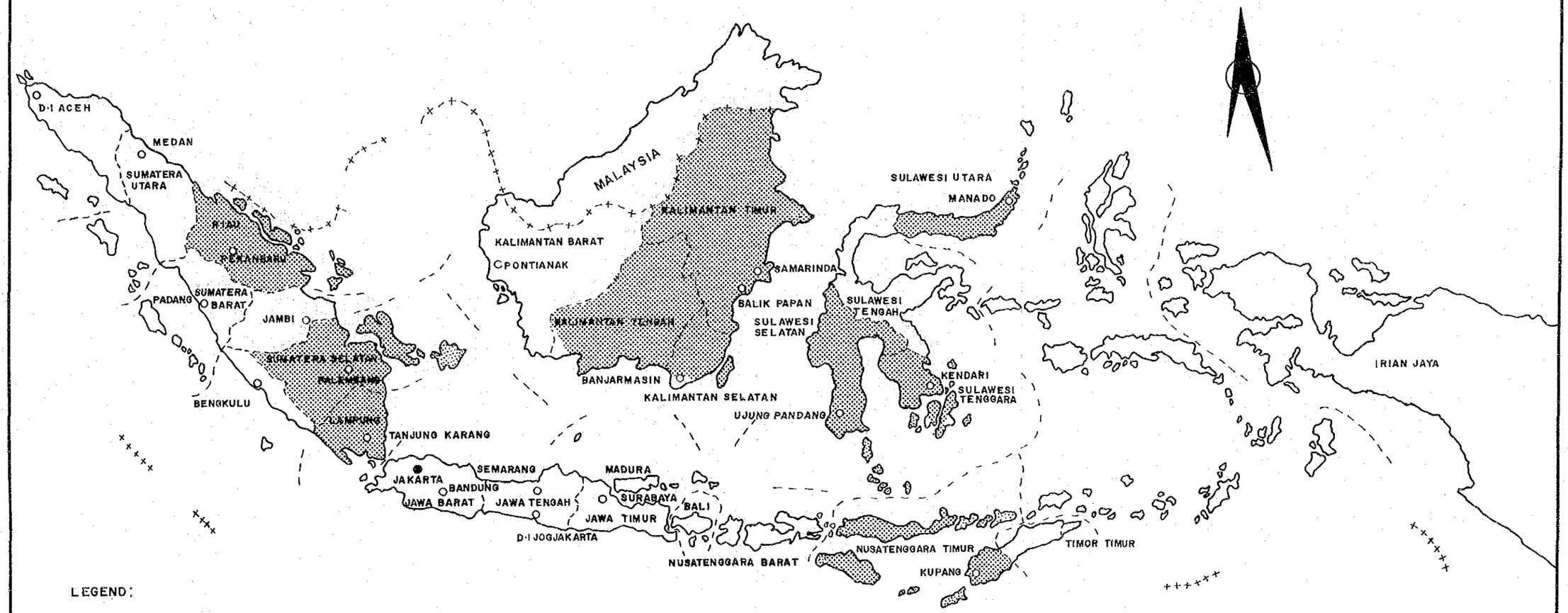
Since the study period was limited, without cooperation of Bina Marga, Bangda and local governments of both province and Kabupaten in collecting the data, the study would not have been completed within the period.

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



LEGEND:

- CAPITAL CITY
- PROVINCIAL CITY
- NATIONAL BOUNDARY
- PPOVINCIAL BOUNDARY
- LOCATION OF THE PROJECT AREA

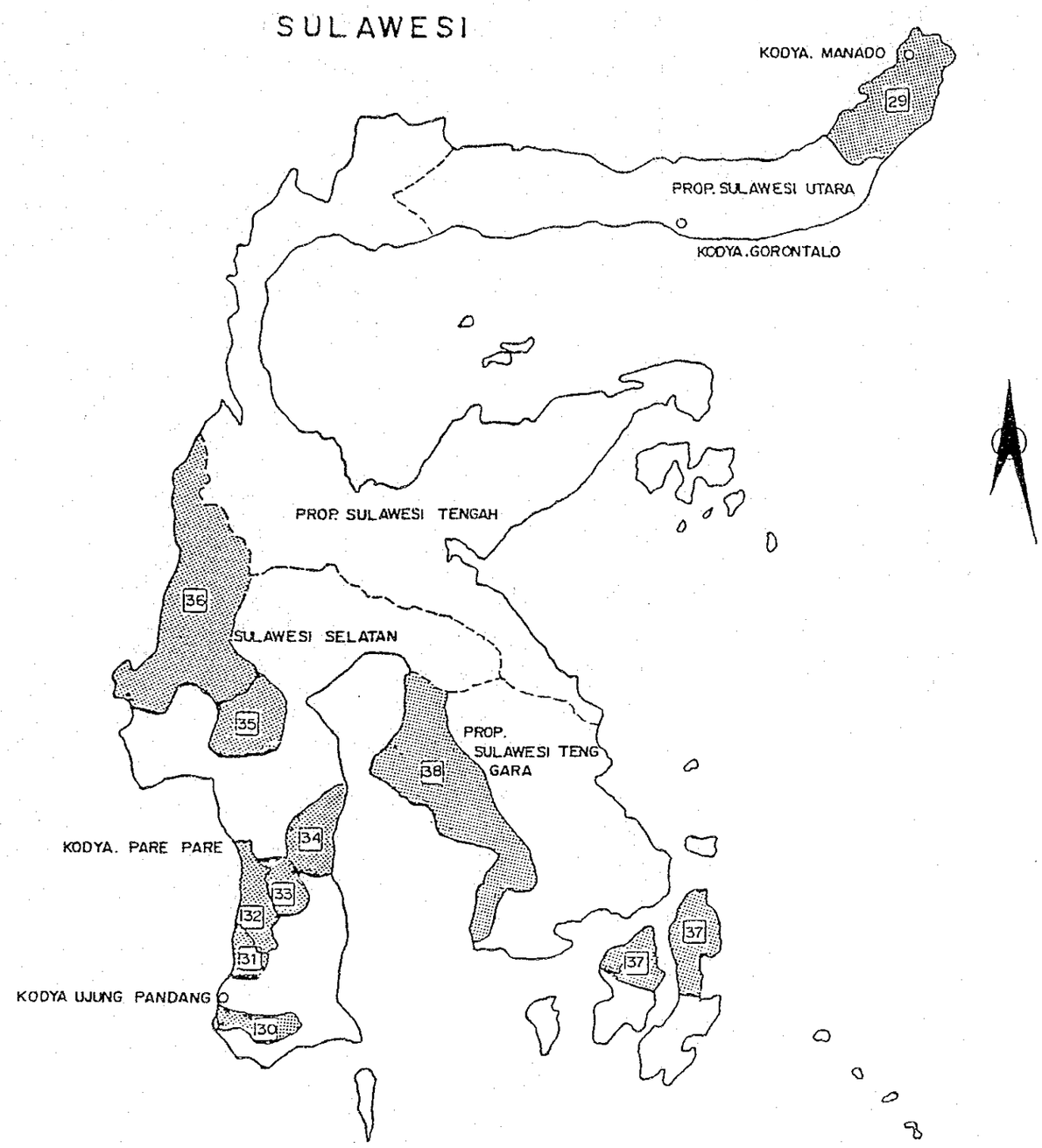
SCALE :

0 130 260 390 650 Km

VIII · PROPINSI SULAWESI UTARA
29 · KAB · MINAHASA

IX · PROPINSI SULAWESI SELATAN
30 · KAB · GOWA
31 · KAB · PANGKAJENE KEPULAUAN
32 · KAB · BARRU
33 · KAB · SOPENG
34 · KAB · WAJO
35 · KAB · TANA TORAJA
36 · KAB · MAMUJU

X · PROPINSI SULAWESI TENGGARA
37 · KAB · MUNA
38 · KAB · KOLAKA



LEGEND :

---- PROVINCIAL BOUDER

LOCATION OF THE PROPOSED AREA

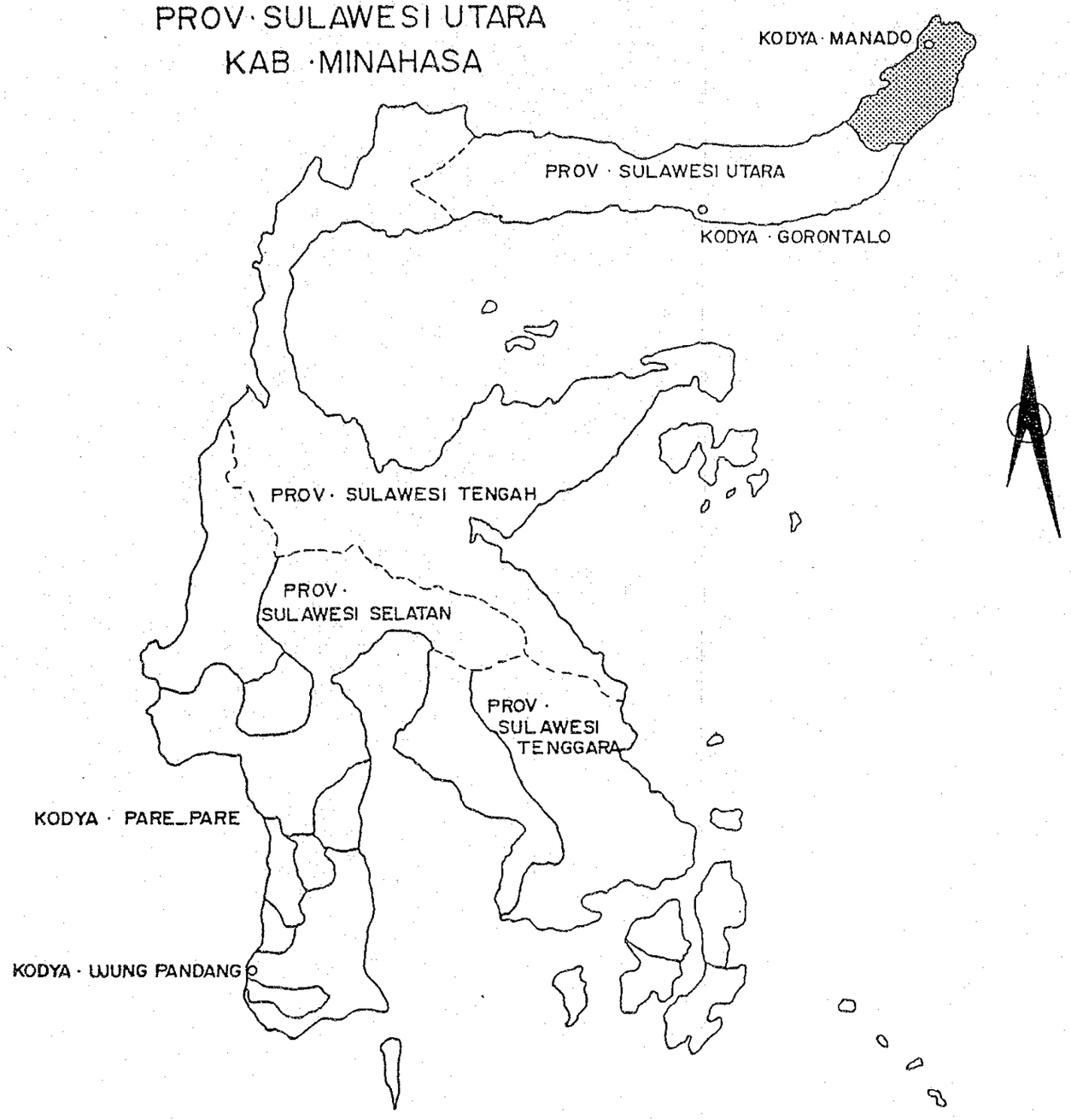
SCALE :

0 92 184 276 460 Km

SULAWESI

PROV · SULAWESI UTARA

KAB · MINAHASA



LEGEND :

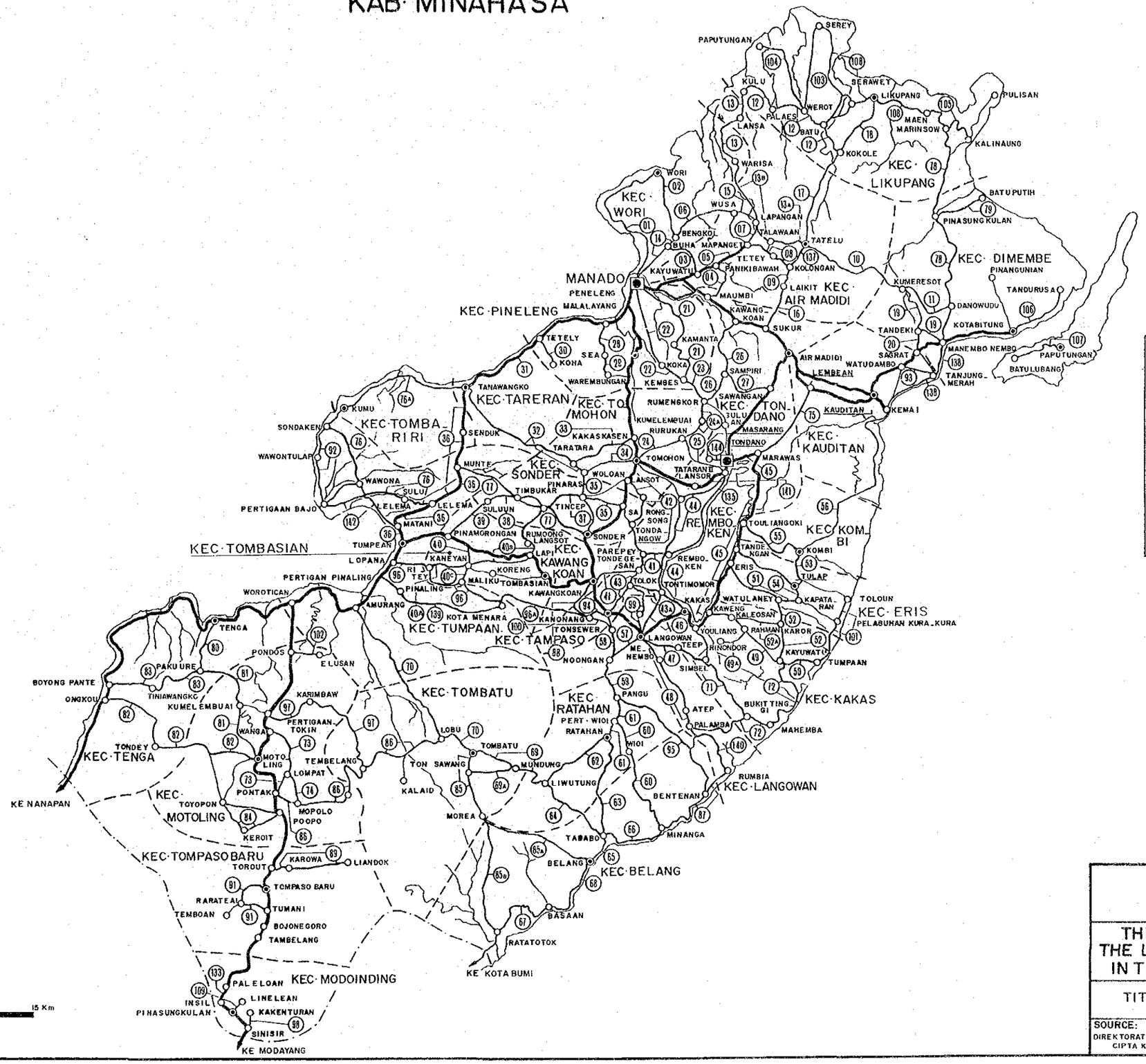
---- PROVINCIAL BOUNDARY

LOCATION OF THE PROJECT AREA

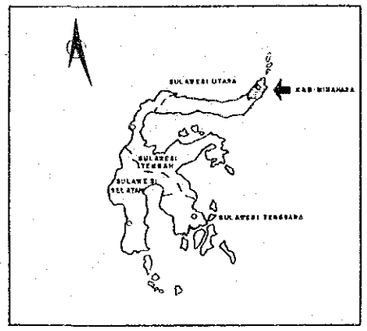
SCALE :

0 92 184 276 460 Km

KAB. MINAHASA



LOCATION MAP



LEGEND :

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

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

TITLE :

SOURCE:	SCALE:	PROVINCE : SULAWESI UTARA
DIREKTORAT JENDERAL CIPTA KARYA	AS SHOWN	KABUPATEN : MINAHASA

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 Minahasa is the northeastermost Kabupaten in Sulawesi Island. It is bordered on the southwest by Kabupaten Bolang Mangondow and is surround from the north coast through to the south coast by the Sulawesi Sea and the Maluku Sea. Going further northward on the water Kabupaten Minahasa is adjacent to the archipelagic Kabupaten, Sangihe Talaut.

A mountain range 1500 to 2000 meter high forms a corridor from the southwest to the northeast. Almost in the centre of the corridor lies Tondano Lake, considered to be a crater lake, with the capital of the Kabupaten, Tondano, standing at the north. On the south side of the mountains steep slopes fall to the shore so few flat areas exist. The other side, north of the mountains, shows gentle features compared with the south side. Around the lower reaches of the Manado and Ranoyaba Rivers there are flat areas. The Manado River rises from Tondano Lake and the Ranoyaba River flows northward rising from the boundary with Kabupaten Bolang Mangondow. The provincial capital, Manado, stands at the mouth of the Manado River.

The Kabupaten has an area of 4,322 square kilometers, approximately 23 percent of the total of the province. It consists administratively of 27 Kecamatans.

1.1.2 Meteorological Conditions

The average number of rainy days and the average amount of yearly rainfall in Kabupaten Minahasa are 213 days and 2,478 mm respectively.

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

The number of working days which is necessary for planning the construction schedule in chapter 6, is estimated at 170 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 : Sulawesi Utara
KABUPATEN : Minahasa STATION : Kayuwatu Manado

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	25	416	26	413	24	216	23	187	26	287
February	24	499	25	269	25	364	15	34	28	381
March	17	255	21	365	23	323	11	46	25	288
April	22	397	19	336	24	164	12	210	27	376
May	13	82	27	217	19	192	25	269	28	280
June	17	177	18	199	16	463	24	199	21	175
July	8	15	20	136	-	-	23	155	24	156
August	15	159	5	39	4	20	19	147	11	245
September	5	10	16	65	3	42	16	128	23	310
October	16	122	20	145	5	52	18	181	15	162
November	15	259	22	237	11	98	20	309	16	85
December	27	285	25	422	22	288	25	306	24	516
Total	204	2,676	244	2,843	176	2,222	231	2,171	268	3,261

1.2 Socio-Economic Conditions

1.2.1 Population

The population of Kabupaten Minahasa in 1983 was 704,024 which was approximately 31.1% of the 2,262,400 total population of Sulawesi Utara Province as shown in Table 1-2-1.

The population density was 1.63 persons per ha which was higher than the provincial density of 1.19.

The recent annual average growth rate of population of the Kabupaten is 2.0% which is slightly lower than both the provincial rate of 2.3% and the national rate of 2.2%. This may be caused by outflow of population to other areas.

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:					
MINAHASA	704,024	2.0	432,200	1.63	1983
PROVINCE:					
SULAWESI UTARA	2,215,300		1,902,300		1982
	2,262,400	2.3	1,902,300	1.19	1983
	2,309,400		1,902,300		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 : 1983

PROVINCE : SULAWESI UTARA

KABUPATEN : MINAHASA

KECAMATAN	POPULATION	PROPORTION (%)
MODOINDING	7,829	1.1
TOMPASO BARU	19,902	2.8
BELANG	21,749	3.2
TOMBATU	32,861	4.7
MOTOLING	40,337	5.8
TENGA	28,211	4.0
TOMBASIN	25,219	3.7
RATAHAN	20,906	3.0
LANGOWAN	37,932	5.4
KAKAS	22,287	3.3
TOMPASO	12,682	1.7
REMBOKEN	10,530	1.6
KAWANGKOAN	23,598	3.4
TARERAN	20,659	3.0
TUMPAAN	17,487	2.6
TOMBARIRI	19,234	2.7
SONDER	16,886	2.4
TOMOHON	68,528	9.7
TONDANO	40,268	5.8
ERIS	17,572	2.5
KOMBI	11,911	1.7
KAUDITAN	27,404	3.9
AIR MADIDI	30,517	4.4
PINELENG	25,922	3.7
WORI	23,153	3.4
DIMEMBE	39,220	5.6
LIKUPANG	31,225	4.4
TOTAL	224,630	100

1.2.2 Land Use

In Kabupaten Minahasa, 257,079 ha of the current available land use area, which is approximately 59.5% of the 432,200 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 246,731 ha of agricultural harvest area and 10,348 ha of residential area which are 96.0% and 4.0% of the current available land use area respectively.

The agricultural harvest area consists of 49,021 ha of paddy field, 145,710 ha of plantation and 52,000 ha of other cultivated area which are 19.9%, 59.1% and 21.0% 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 : SULAWESI UTARA

(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
MINAHASA	31,182 (7.2)	17,839 (4.1)	52,000 (12.0)	145,710 (33.7)	10,348 (2.4)	-	9.753 (2.3)	97,369 (22.5)	68,000 (15.8)	432,200 (100)	1982

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 Minahasa in 1984 were 81,237 ha and 268,853 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 30,547 ha and 142,304 ton respectively which are 27.6% and 52.9% of the total food crops. The yield rate of paddy production is 4.70 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 1983 through 1984 were 0.7% and 5.1% respectively. However in the long term both area and production are tending to decrease. It is desirable that productivity of paddy increases and this depends upon the future development of irrigation.

The commodity crops, of which palm oil, clove and coffee are major, are produced in the plantations. The area and production of plantation crops in 1983 were 124,982 ha and 116,243 ton respectively with current growth rates of 0% and 4.5% as shown in Table 1-2-5. Thus the plantation crop which is exported is an important agricultural product. 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 64.2% of the total population as shown in Table 1-2-6. Thus this is an agricultural Kabupaten.

It is suggested that the kabupaten takes steps to produce a highly developed agricultural system by measures such as increase of double crop fields, improvement of irrigation facilities and rearrangement of the cultivated fields.

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

KABUPATEN : MINAHASA

CULTIVATED AREA

(ha)

ITEM	YEAR						AAGR (%)
	1979	1980	1981	1982	1983	1984	
PADDY	43,584	46,707	45,313	43,068	30,371	30,547	
OTHERS	84,596	71,996	72,130	63,822	84,019	50,690	
TOTAL	128,180	118,703	117,443	106,890	114,390	81,237	

PRODUCTION

(ton)

ITEM	YEAR						AAGR (%)
	1979	1980	1981	1982	1983	1984	
PADDY	202,777	195,203	195,872	177,603	135,460	142,304	
OTHERS	142,615	149,110	172,273	170,268	189,451	126,549	
TOTAL	345,392	344,313	368,145	347,871	324,911	268,853	

YIELD RATE

(ton/ha)

ITEM	YEAR						AAGR (%)
	1979	1980	1981	1982	1983	1984	
PADDY	4.2	4.2	4.3	4.1	4.5	4.7	

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 : SULAWESI UTARA

KABUPATEN	AREA (ha)	PRODUCTION (ton)	AAGR (%) AREA	AAGR (%) PRODUCTION
MINAHASA	124,982	116,243	0	4.5

Table 1-2-6 POPULATION OF AGRICULTURAL SECTOR

PROVINCE : SULAWESI UTARA

KABUPATEN	AGRICULTURAL SECTOR	TOTAL POPULATION	PROPORTION (%)	AAGR (%)	SURVEY YEAR
MINAHASA	452,000	704,024	64.2	2.0	1984

Notes :

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

1.2.4 Other Economic Activities

Notable economic activities excluding agriculture in Kabupaten Minahasa are fishery and livestock sectors.

The current growth of the fishery production can be seen in Table below.

	1980	1984	AAGR (%)
Catch (ton)	19,867	19,423	- 0.6

Notes : 1. AAGR : Average annual growth rate
2. Source : Kabupaten data

The recent catchs show no remarkable increase, however it is presumed that yearly approx. 13,000 tons excluding the consumption of the Kabupaten itself are exported out of the Kabupaten.

The following table shows the current growth rates of the livestock production.

	1980	1984	AAGR (%)
Production (ton)	3,025	4,779	12.1

Notes : 1. AAGR : Average annual growth rate
2. Source : Kabupaten data

As can be seen in the above table, this sector shows a high growth rate and yearly approx. 3,000 tons are presumed to export out of the Kabupaten.
Therefore this sector is expected to become continuously prosperous.

1.3 Present Status of Kabupaten Roads

1.3.1 Outline of Road Networks

In Kabupaten Minahasa a national road called the 'Trans Sulawesi Highway' starts from Manado, the capital of the Province Sulawesi Utara, and runs across the Kabupaten from north to south. It leads to the neighbouring Kabupaten Bolang Mongondaw through Tomohon, Kawangkoan, Tumpean, Amurang, Worotican and Tenga.

In the central area of the Kabupaten the provincial roads form three circular roads connecting with the said national road. The first runs through Manado, Tondano and Tomohon, the second through Tomohon, Tondano and Kawangkoan, and the third through Manado, Tumpean and Kawangkoan.

The other provincial roads are in the northweast and southwest areas of the Kabupaten. These roads lead between Air Madiri and Kotabitung and between Worotican and Sinisir respectively.

The above national and provincial roads act as the regional trunk roads of the Kabupaten and along these regional trunk roads the Kabupaten roads form high density Kabupaten road networks. Exception to this are the north end and the east coastal areas of the Kabupaten because these areas are mostly covered by steep slopes.
In general Kabupaten Minahasa is one of the most developed Kabupatens in terms of Kabupaten road networks.

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 Minahasa are confirmed as 160 links and 1,470 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 3.40 m per ha. This is distinctly higher than the national density of 0.48 m per ha and also higher 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 is progressive in density of Kabupaten roads.

	Total Length (km)	Area (ha)	Density (m/ha)
Kabupaten : Minahasa	1,470	432,200	3.40
Province : Sulawesi Utara	1,470	432,200	3.40
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 sources 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.

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

PROV : SULAWESI UTARA KAB : MINAHASA

(Km)

NO (1)	ASP	L.L	BTB	TNH	KRK	TOTAL
LINK 1	6	12	1	1		19
LINK 2	6	1	3	1		10
LINK 3	1	1	1	5	1	5
LINK 4	5	1	1	1	1	6
LINK 5	5	1	1	1	1	5
LINK 6	1	1	1	5	1	5
LINK 7	1	1	4	1	1	4
LINK 8	11	1	1	1	1	11
LINK 9	2	1	1	1	1	2
LINK 10	1	1	1	1	1	1
LINK 11	8	1	1	1	1	8
LINK 12	6	1	1	3	5	15
LINK 13	1	1	1	12	1	12
LINK 14	3	1	1	1	1	4
LINK 15	2	1	4	1	1	6
LINK 16	6	1	1	1	1	6
LINK 17	12	1	1	1	1	12
LINK 18	8	1	1	1	1	8
LINK 19	11	1	1	1	1	11
LINK 20	4	1	1	1	1	4
LINK 21	17	1	1	1	1	17
LINK 22	13	1	1	1	1	13
LINK 23	5	1	1	1	1	5
LINK 24	10	1	1	1	1	10
LINK 25	6	1	1	1	1	6
LINK 26	3	1	2	9	1	14
LINK 27	1	1	1	1	4	4
LINK 28	2	1	2	1	2	6
LINK 29	6	1	1	1	1	6
LINK 30	3	1	1	1	1	3
LINK 31	10	1	1	1	1	11
LINK 32	25	1	1	1	1	25
LINK 33	4	1	1	1	2	6
LINK 34	5	1	1	1	1	5
LINK 35	5	1	1	3	1	9
LINK 36	1	1	1	1	1	1
LINK 37	5	1	1	4	1	9
LINK 38	11	1	1	1	1	11
LINK 39	9	1	1	1	1	9
LINK 40	1	1	3	1	1	3
LINK 41	12	1	1	1	1	12
LINK 42	12	1	1	1	1	12
LINK 43	4	1	1	1	1	4
LINK 44	24	1	1	1	1	24
LINK 45	26	1	1	1	1	26
LINK 46	5	1	1	1	1	6
LINK 47	1	1	1	7	1	7
LINK 48	16	1	1	1	1	16
LINK 49	10	1	2	1	1	12
LINK 50	1	1	1	5	1	5
LINK 51	8	1	2	5	1	15
LINK 52	1	1	1	9	1	9
LINK 53	6	1	1	1	1	6
LINK 54	12	1	2	1	1	14
LINK 55	8	1	1	1	1	8
LINK 56	34	1	1	1	1	34
LINK 57	6	1	1	1	1	6
LINK 58	3	1	1	9	1	12
LINK 59	5	1	1	1	1	5
LINK 60	14	1	1	1	1	14
LINK 61	9	1	1	1	1	10
LINK 62	16	1	1	1	1	16
LINK 63	10	1	1	1	1	11
LINK 64	1	9	1	1	1	10
LINK 65	3	1	1	1	1	3
LINK 66	4	6	1	1	1	10
LINK 67	2	1	1	6	1	8
LINK 68	7	1	1	1	1	7
LINK 69	5	1	2	2	1	9
LINK 70	18	1	6	1	1	24
LINK 71	2	1	1	23	1	25
LINK 72	1	1	1	18	1	18
LINK 73	11	1	1	1	1	11
LINK 74	1	1	1	7	1	7
LINK 75	1	1	1	13	1	13
LINK 76	1	1	1	9	7	16
LINK 77	1	1	1	1	1	1
LINK 78	1	1	1	1	1	1
LINK 79	1	1	1	10	1	10
LINK 80	1	1	1	1	1	1
LINK 81	9	1	5	9	1	22
LINK 82	7	1	9	11	1	27
LINK 83	3	1	1	7	1	10
LINK 84	1	1	1	11	1	11
LINK 85	6	1	1	1	1	6
LINK 86	1	1	1	15	22	39
LINK 87	4	7	1	1	1	11
LINK 88	4	1	1	1	1	4
LINK 89	1	1	1	9	2	12
LINK 90	8	1	1	1	1	8
LINK 91	19	1	1	1	1	19
LINK 92	1	10	1	3	1	13
LINK 93	1	1	1	1	5	5
LINK 94	3	1	1	1	1	3
LINK 95	1	11	1	6	2	19
LINK 96	10	1	1	2	1	12
LINK 97	4	1	1	11	1	15
LINK 98	2	1	1	1	1	2
LINK 99	1	5	1	1	1	5
LINK 100	2	1	1	1	1	3
LINK 101	15	1	1	1	1	15
LINK 102	3	1	1	1	1	3
LINK 103	1	1	1	8	1	8
LINK 104	1	1	1	8	1	8
LINK 105	1	1	1	15	1	15
LINK 106	3	1	1	1	1	3
LINK 107	2	1	1	25	1	27
LINK 108	2	1	1	25	1	27

Table 1-3-1 (2) EXISTING ROAD LENGTH BY SURFACE TYPE

PROV : SULAWESI UTARA KAB : MINAHASA

(Km)

NO (7)	ASP	L.L	GTB	TNH	KRK	TOTAL
LINK 109	2					2
LINK 110	20					20
LINK 111	6					6
LINK 112	11					11
LINK 113	15			1		16
LINK 114	20					20
LINK 115	8					8
LINK 116	4					4
LINK 117	2		2			4
LINK 118					3	3
LINK 119	4					4
LINK 120	4			4		8
LINK 121	4					4
LINK 122	4					4
LINK 123	2					2
LINK 124	4				1	4
LINK 125	4					4
LINK 126	1					1
LINK 127			1	3		4
LINK 128			1		1	2
LINK 129	8					8
LINK 130	2	1				3
LINK 131	6		1	2		8
LINK 132	4					4
LINK 133	2					2
LINK 134	3		1			4
LINK 135	7					7
LINK 136	4					4
LINK 137	3					3
LINK 138	1					1
LINK 139	4			16		20
LINK 140	1			10		10
LINK 141	1	3		5		8
LINK 142	1			4		5
LINK 143	1					1
LINK 144	4					4
LINK 145	4					4
LINK 146	3			1		4
LINK 147	2					2
LINK 148	5			5		10
LINK 149	12		1	1		14
LINK 150	1			4		4
LINK 151	1			15		15
LINK 152	1			3		3
LINK 153	1			4		4
LINK 154	5			1		5
LINK 155	6			3		9
LINK 156	1			5		5
LINK 157	1			15		15
LINK 158	1			6		6
LINK 159	1			5		6
LINK 160	12					12
TOTAL	345	66	61	443	55	1470
RATIO	57	4	4	30	4	(2)

The legend used in the table is as follows:

ASP : Asphalt

KRK : Gravel/Stone/Telford/Water Bound Macadam

TNH : Earth

LL : Others

Comparison of the proportions of surface type in the Kabupaten with other regions is as follows:

	ASP	KRK	TNH/LL
Kabupaten : Minahasa	57.5	7.8	34.6
Province : Sulawesi Utara	57.5	7.8	34.6
Jawa Is.(Excluding DKI Jakarta)	56.2	25.0	18.8
Indonesia	26.0	26.6	47.4

Thus, in the Kabupaten the proportion of Kabupaten roads with asphalt, surface is much higher than that of Indonesia and even is higher than that of Jawa Island. However the proportion of low grade roads such as earth roads and others remains comparatively. This means that although the road classification in the Kabupaten is rather high, further improvement is desirable.

(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 : Minahasa	36.0	19.6	28.2	16.0
Province : Sulawesi Utara	36.0	19.6	28.2	16.0
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 (1) EXISTING ROAD CONDITION BY SURFACE TYPE

PROVINCE : SULAWESI UTARA

KABUPATEN : MINAHASA

(1)

NO		ASP				LAP				BTN				KRK							
NO		BA	SD	RU	RB	BA	SD	RU	RB	BA	SD	RU	RB	BA	SD	RU	RB	BA	SD	RU	RB
1		10	35	3	11	17	17	28	1												
2		10		49	3	80		12		95		15									
3																	99				
4		20	10	1						60	20	20									
5		50	30	19																	
6														60	20	20					
7										40	29	23									
8		55	30	15																	
9		60	20	20																	
10																					
11		83	12	5																	
12		33	8	33	31					50		50		23	30	43		20		20	
13															33	67					
14		92	5	3						95	3	2									
15		70	23							89	11										
16		76	19	5																	
17		25	10	35																	
18		3	33	54	9																
19		85	15																		
20		20		23																	
21		93	6	1																	
22		83	17																		
23		29	20	51																	
24		65		35																	
25		25	35	12																	
26		66		33						10	18	23					99				
27																		83		30	57
28		55	13	33						15		8	56					15	8		21
29		35	35	30																	
30		17	73	10																	
31		50	31	19						10	60	30									
32		55	22	10																	
33			60	20	13														40	60	
34		93	1	6																	
35		70	23	7				10	70								17	83			
36																					
37		30	70											25	75						
38		76	16	8																	
39		63	50	37																	
40										37	57	7									
41		75	25																		
42		10	55	27																	
43		79	8	13																	
44		71	29																		
45		82		17																	
46		81		18						25		75									
47														26	7	3	71				
48		19	57	17	17																
49		20	24	23	31					93	10	9									
50																5	95				

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

PROVINCE : SULAWESI UTARA

KABUPATEN : MINAHASA

NO	NAME	ASP																					
		BA	SD	RU	RB	BA	SD	RU	RB	BA	SD	RU	RB	BA	SD	RU	RB	BA	SD	RU	RB		
51		21	23	19	37					25	20	30	25			5	95						
52																5	95						
53		5	39	56																			
54		35	61	4						38	63												
55		73	28																				
56		13	63	24																			
57		99	1																				
58		43	33	17	57											14	81						
59		65	40	25																			
60		86	48	38	9																		
61		23	29							75		25											
62		91	7	33	9																		
63		22	13	48	19									20		60	20						
64						4	7	56	33				99										
65		32	48	20																			
66		15	66	17			1	17	83														
67		25	35	35	5									5		80	15						
68		20	45	35																			
69		54	28	14	4					70	25	5				1	99						
70		61		39						96		34											
71		68		33												5	95						
72																5	95						
73		79		13	8																		
74															60	38	42						
75														29		71							

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

PROVINCE : SULAWESI UTARA

KABUPATEN : MINAHASA

NO	ASP				L.L				DIP				TAN				KRK			
NO	BA	SB	RU	RB	BA	SB	RU	RB	BA	SB	RU	RB	BA	SB	RU	RB	BA	SB	RU	RB
LINK 76															42	58	22	8	51	19
LINK 77																				
LINK 78																				
LINK 79													85	39	46					
LINK 80																				
LINK 81	71		29						81		19		4	19	76					
LINK 82	26	9	39	26					18	34	48	11			22	78				
LINK 83	80	20											86	33	51					
LINK 84													8	78	22					
LINK 85	53	8	39																	
LINK 86	90		10						56	59			97		80	3	64		31	
LINK 87	70	23	8				28	78												
LINK 88	25		75																	
LINK 89									60	10					13	88	30	30		10
LINK 90	60	35	21																	
LINK 91	8	36	46	10																
LINK 92					51	5	41							6	99					
LINK 93																	60	26	14	
LINK 94	83		17																	
LINK 95					6	8	93	33							58	12			80	20
LINK 96	30	13	27	30											80	20				
LINK 97	66	34													14	86				
LINK 98	28	20	52																	
LINK 99								99												
LINK 100	28	33											50	50						
LINK 101	39	25	36																	
LINK 102	93		7																	
LINK 103													19	5	76					
LINK 104													35	33	23	10				
LINK 105														33	67					
LINK 106	90		10																	
LINK 107	25		75											36	61	2				
LINK 108	25		75										6	42	44	8				
LINK 109	55	45																		
LINK 110	73		27																	
LINK 111	62	8	30																	
LINK 112	59		41																	
LINK 113	58	20	16	7											60	40				
LINK 114	69	2	29																	
LINK 115	40	39	38	4																
LINK 116	25		25																	
LINK 117	55	18	28						36	13	13	38								
LINK 118																			50	50
LINK 119	85	15																		
LINK 120	80		10	10									30	58						
LINK 121	40		40																	
LINK 122	65		35																	
LINK 123		15	60	25																
LINK 124	65	15	20																	
LINK 125	38	30	33																	
LINK 126	50	50																		
LINK 127										80	20			77	23					
LINK 128									10	50	40							30	20	
LINK 129	59	41																		
LINK 130	60		40			70		30												
LINK 131	65	35	7											25	15	6				
LINK 132	43	25	33																	
LINK 133		35	65																	
LINK 134	37	33	10						30	20										
LINK 135	84	15	1																	
LINK 136	85	15																		
LINK 137	80	4	17																	
LINK 138																				
LINK 139	58		43										89		67	19				
LINK 140														80		20				
LINK 141					67	33	33						30	39	23	8				
LINK 142	50	50													30	70				
LINK 143																				
LINK 144	78	5	18																	
LINK 145	55	13	25	8																
LINK 146	68	3	13	15									80		20					
LINK 147	10	20	25	15																
LINK 148	60	40												50	50					
LINK 149	50	6	16	27					75	25				5	95					
LINK 150														33	68					

Table 1-3-2 (4) EXISTING ROAD CONDITION BY SURFACE TYPE

PROVINCE : SULAWESI UTARA

KABUPATEN : MINAHASA (%)

102	ASP				L.L				BTB				TAH				KRK			
102	BA	SD	RU	RB	BA	SD	RU	RB	BA	SD	RU	RB	BA	SD	RU	RB	BA	SD	RU	RB
LINK 151													5	51	44					
LINK 152														63	37					
LINK 153															5	95				
LINK 154			80	20																
LINK 155	52	4	12	33											1	99				
LINK 156															1	99				
LINK 157														79	21					
LINK 158															1	99				
LINK 159			99	1											99	1				
LINK 160	21	34	45																	
AVERAGE	51	21	24	4	31	5	27	39	37	26	28	9	9	19	35	36	27	13	36	24
LENGTH	845 Km				86 Km				61 Km				443 Km				55 Km			
(Km)	431	177	203	34	20	3	18	25	23	16	17	5	40	84	155	159	15	7	20	13

The surface condition level of the Kabupaten roads in the Kabupaten is lower than both that of Indonesia and of Jawa Island. The proportion in good condition is relatively low. Accordingly there is yet scope for improvement of maintenance in the Kabupaten.

(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 51.0% flat, 41.0% hilly and 8.0% mountainous.
There is no swampy area in the Kabupaten.

1.3.3 Bridge Inventory

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

The bridge 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 1-3-4 and Table 1-3-5 indicates a total of 48 bridges with a total length of 397 m of which 9 or 18.6% are timber and 30 or 62.5% are concrete. Steel bridges account for only 9 or 18.6% of the total. On the other hand, 10 bridges with a total length of 2,212 m are required to be newly constructed.

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

PROV : SULAWESI UTARA KAB : MINAHASA

(Km)

102 (3)	DT	BK	GN	RW	TOTAL
LINK 1	12	4	2		18
LINK 2		10			10
LINK 3	5				5
LINK 4	6				6
LINK 5	4	1			5
LINK 6	5				5
LINK 7	4				4
LINK 8	11				11
LINK 9	2				2
LINK 10					
LINK 11		8			8
LINK 12	6	9			15
LINK 13	12				12
LINK 14	4				4
LINK 15	5	1			6
LINK 16	6				6
LINK 17	12				12
LINK 18	5	3			8
LINK 19	11				11
LINK 20		4			4
LINK 21	2	13	1	1	17
LINK 22	5	8			13
LINK 23		5			5
LINK 24	2	8			10
LINK 25	2	3	1		6
LINK 26	7	7			14
LINK 27	2	2			4
LINK 28	4	2			6
LINK 29	1	5			6
LINK 30		3			3
LINK 31	3	8			11
LINK 32	13	12			25
LINK 33	3	3			6
LINK 34	3	2			5
LINK 35	9				9
LINK 36					
LINK 37		9			9
LINK 38		11			11
LINK 39		9			9
LINK 40		3			3
LINK 41	11	1			12
LINK 42	1		11		12
LINK 43	2	2			4
LINK 44	9		15		24
LINK 45	16	7	3		26
LINK 46	3	3			6
LINK 47	7				7
LINK 48	2	14			16
LINK 49	4	5	3		12
LINK 50		5			5
LINK 51	10	4	1		15
LINK 52	1	8			9
LINK 53	2	4			6
LINK 54		2	12		14
LINK 55	1	7			8
LINK 56	27	7			34
LINK 57	5	1			6
LINK 58	12				12
LINK 59			5		5
LINK 60	14				14
LINK 61	4	4	2		10
LINK 62	11	5			16
LINK 63	8	3			11
LINK 64	5	5			10
LINK 65	3				3
LINK 66	8	2			10
LINK 67	5	3			8
LINK 68	7				7
LINK 69	6	3			9
LINK 70	10	14			24
LINK 71	24	1			25
LINK 72	3	15			18
LINK 73	11				11
LINK 74	1		6		7
LINK 75		13			13
LINK 76	13	3			16
LINK 77					
LINK 78					
LINK 79	10				10
LINK 80					
LINK 81	1	21			22
LINK 82	7	20			27
LINK 83	3	7			10
LINK 84	11				11
LINK 85		6			6
LINK 86	14	18	7		39
LINK 87	4	7			11
LINK 88		4			4
LINK 89	3		9		12
LINK 90	4		4		8

Table 1-3-3 (2) EXISTING ROAD LENGTH BY TERRAIN CONDITION

PROV : SULAWESI UTARA KAB : MINAHASA

(Km)

I02 (3)	DT	BK	SN	RW	TOTAL
LINK 91	3		16		19
LINK 92	11	2			13
LINK 93	5				5
LINK 94		3			3
LINK 95		19			19
LINK 96	3	8	1		12
LINK 97	7		8		15
LINK 98	2				2
LINK 99	5				5
LINK 100	3				3
LINK 101		15			15
LINK 102	1	2			3
LINK 103	2	6			8
LINK 104	8				8
LINK 105	1	14			15
LINK 106	3				3
LINK 107	7	20			27
LINK 108	5	22			27
LINK 109	2				2
LINK 110	20				20
LINK 111	6				6
LINK 112		11			11
LINK 113	16				16
LINK 114	12	8			20
LINK 115	8				8
LINK 116	4				4
LINK 117	2	1		1	4
LINK 118	3				3
LINK 119	4				4
LINK 120	8				8
LINK 121	4				4
LINK 122	4				4
LINK 123	2				2
LINK 124	4				4
LINK 125		4			4
LINK 126	1				1
LINK 127		4			4
LINK 128	1		1		2
LINK 129	4	4			8
LINK 130	3				3

(Km)

I02 (3)	DT	BK	GR	RW	TOTAL
LINK 131	8				8
LINK 132	2		2		4
LINK 133	2				2
LINK 134	3		1		4
LINK 135	1	6			7
LINK 136	4				4
LINK 137	3				3
LINK 138					
LINK 139	1	19			20
LINK 140	10				10
LINK 141		8			8
LINK 142	1	4			5
LINK 143					
LINK 144	1	3			4
LINK 145	4				4
LINK 146		4			4
LINK 147	2				2
LINK 148	10				10
LINK 149	2	12			14
LINK 150		4			4
LINK 151		15			15
LINK 152		3			3
LINK 153	4				4
LINK 154	1	4			5
LINK 155	9				9
LINK 156	5				5
LINK 157	15				15
LINK 158		5	1		6
LINK 159	6				6
LINK 160	12				12
TOTAL	749	607	112	2	1470
RATIO	51	41	8	0	(%)

Table 1-3-4 NUMBER AND LENGTH OF BRIDGES

PROV : SULAWESI UTARA KAB : MINAHASA

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

	EXISTING		NOT EXIST		TOTAL	
LINK NO	NO.	LENGTH	NO.	LENGTH	NO.	LENGTH
2	2	12.50			2	12.50
4	2	16.80			2	16.80
6			3	2100.00	3	2100.00
7	1	6.00			1	6.00
14	1	23.00			1	23.00
21	1	16.00			1	16.00
31	4	24.00			4	24.00
37	2	7.00			2	7.00
39	3	36.00			3	36.00
40	1	5.00			1	5.00
44	1	2.80			1	2.80
49			1	15.00	1	15.00
70	2	35.00			2	35.00
81	3	14.00	1	5.00	4	19.00
83	1	4.00	1	5.00	2	9.00
89			1	50.00	1	50.00
91	2	12.00			2	12.00
92	1	6.00	1	15.00	2	21.00
108	1	8.00			1	8.00
110	13	124.00			13	124.00
117	1	14.00			1	14.00
123	1	7.00			1	7.00
126	1	5.00			1	5.00
129	1	4.00			1	4.00
133	1	7.00			1	7.00
151	2	7.50	2	22.00	4	29.50
TOTAL	48	396.60	10	2212.00	58	2608.60

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

PROV : SULAWESI UTARA KAB : MINAHASA

(No)

IO3 (IB)	BT	BJ	KY	TOTAL
LINK 2	2		1	2
LINK 4		2		2
LINK 6				
LINK 7	1			1
LINK 14			1	1
LINK 21	1			1
LINK 31	4			4
LINK 37	2			2
LINK 39			3	3
LINK 40	1			1
LINK 44			1	1
LINK 49				
LINK 70	2			2
LINK 81	3			3
LINK 83	1			1
LINK 89				
LINK 91	1		1	2
LINK 92	1			1
LINK 108	1			1
LINK 110	5	7	1	13
LINK 117	1			1
LINK 123			1	1
LINK 126	1			1
LINK 129	1			1
LINK 133	1			1
LINK 151	1		1	2
TOTAL	30	9	9	48
RATIO	63	19	19	(%)

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

Bridge Type	Span Length (m)										
	〈3	〈5	〈8	〈10	〈12	〈14	〈16	〈18	〈20	〈99	Total
Timber	2	3	2	-	1	-	-	-	-	1	9
Concrete	3	9	14	1	-	-	1	-	1	1	30
Steel	1	2	1	3	1	-	-	-	1	-	9
Others	-	-	-	-	-	-	-	-	-	-	-
Total	6	14	17	4	2	-	1	-	2	2	48

Thus, most of the existing bridges on the Kabupaten roads are concrete, and the majority of spanlengths is within the range of 5 m to 8 m.

1.3.4 Traffic

Inventories of the average daily traffic (ADT) on the Kabupaten roads in Kabupaten Minahasa 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 1985 are summarized as follows:

	SEDAN	BUS	TRUCK	MOTOR-CYCLE	TOTAL
Total Trips	3,270	1,406	1,395	3,514	9,585
Proportion (%)	34.12	14.67	14.55	36.66	100.00

Source : Bina Marga Inventory

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

	SEDAN	BUS	TRUCK	MOTOR-CYCLE	TOTAL
Proportion (%)	2.35	18.01	8.86	70.78	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 : SULAWESI UTARA KAB : MINAHASA

A)	Growth Rate of Population	:	2.00 (%)
B)	Growth Rate of Cultivated Area	:	0.50 (%)
C)	Growth Rate of Rice field	:	0.70 (%)
D)	Growth Rate of Rice yield rate	:	5.00 (%)
E)	Growth Rate of GDP / capita	:	5.30 (%)
a)	Geometrical Mean (A x B)	:	1.25 (%)
b)	Geometrical Mean (C x D)	:	2.83 (%)
c)	Geometrical Mean (a x b)	:	2.03 (%)
d)	Geometrical Mean (c x E)	:	3.65 (%)
	TRAFFIC GROWTH RATE	:	3.65 (%)

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 1985
r : Traffic growth rate

The results are shown in Table 2-1-2 together with the traffic volume in 1985.

Table 2-1-2 (1) EXISTING AND FUTURE TRAFFIC VOLUME

PROV : SULAWESI UTARA KAB : MINAHASA

(SPD : 1/2)

	INVENTORY (1985)					RATE	AFTER 13 YEARS (1998)					CLASS
LINK NO	MBL	BUS	TRUK	SPD	TOTAL		MBL	BUS	TRUK	SPD	TOTAL	
1	30	10	5	25	58	3.7%	48	16	8	40	92	IIIB-2
2	6	14	6	10	31	3.7%	10	22	10	16	49	IIIC
3	0	0	0	0	0	3.7%	0	0	0	0	0	IIIC
4	25	0	10	30	50	3.7%	40	0	16	48	80	IIIB-2
5	75	10	15	30	115	3.7%	120	16	24	48	183	IIIB-2
6	20	0	10	30	45	3.7%	32	0	16	48	72	IIIB-2
7	10	0	5	15	23	3.7%	16	0	8	24	37	IIIC
8	20	10	10	20	50	3.7%	32	16	16	32	80	IIIB-2
9	25	15	10	10	55	3.7%	40	24	16	16	88	IIIB-2
10	0	0	0	0	0	3.7%	0	0	0	0	0	IIIC
11	7	3	5	17	24	3.7%	11	5	8	27	38	IIIC
12	20	8	12	30	55	3.7%	32	13	19	48	88	IIIB-2
13	0	0	0	0	0	3.7%	0	0	0	0	0	IIIC
14	20	0	15	30	50	3.7%	32	0	24	48	80	IIIB-2
15	10	0	5	20	25	3.7%	16	0	8	32	40	IIIC
16	10	5	5	10	25	3.7%	16	8	8	16	40	IIIC
17	25	15	10	10	55	3.7%	40	24	16	16	88	IIIB-2
18	25	15	10	10	55	3.7%	40	24	16	16	88	IIIB-2
19	30	40	30	50	125	3.7%	48	64	48	80	199	IIIB-2
20	5	5	5	10	20	3.7%	8	8	8	16	32	IIIC
21	0	0	0	0	0	3.7%	0	0	0	0	0	IIIC
22	10	25	5	15	48	3.7%	16	40	8	24	76	IIIB-2
23	7	6	4	10	22	3.7%	11	10	6	16	35	IIIC
24	10	8	7	4	27	3.7%	16	13	11	6	43	IIIC
25	20	10	25	10	60	3.7%	32	16	40	16	96	IIIB-2
26	10	10	10	15	38	3.7%	16	16	16	24	61	IIIB-2
27	0	0	2	5	5	3.7%	0	0	3	8	8	IIIC
28	40	30	10	45	103	3.7%	64	48	16	72	164	IIIB-2
29	3	2	5	6	13	3.7%	5	3	8	10	21	IIIC
30	10	5	10	15	33	3.7%	16	8	16	24	53	IIIB-2
31	20	20	20	50	85	3.7%	32	32	32	80	135	IIIB-2
32	60	0	10	50	95	3.7%	96	0	16	80	151	IIIB-2
33	0	0	5	10	10	3.7%	0	0	8	16	16	IIIC
34	40	0	20	70	95	3.7%	64	0	32	112	151	IIIB-2
35	2	1	0	2	4	3.7%	3	2	0	3	6	IIIC
36	0	0	0	0	0	3.7%	0	0	0	0	0	IIIC
37	4	1	0	12	11	3.7%	6	2	0	19	18	IIIC
38	40	15	5	15	68	3.7%	64	24	8	24	108	IIIB-2
39	28	8	4	30	55	3.7%	45	13	6	48	88	IIIB-2
40	7	3	1	8	15	3.7%	11	5	2	13	24	IIIC
41	10	0	4	20	24	3.7%	16	0	6	32	38	IIIC
42	5	3	2	15	18	3.7%	8	5	3	24	29	IIIC
43	5	5	5	10	20	3.7%	8	8	8	16	32	IIIC
44	75	0	25	80	140	3.7%	120	0	40	127	223	IIIB-1
45	82	0	22	34	121	3.7%	131	0	35	54	193	IIIB-2
46	6	2	6	15	22	3.7%	10	3	10	24	35	IIIC
47	6	0	5	1	12	3.7%	10	0	8	2	19	IIIC
48	2	0	5	20	17	3.7%	3	0	8	32	27	IIIC
49	80	30	50	50	185	3.7%	127	48	80	80	295	IIIB-1
50	0	0	0	10	5	3.7%	0	0	0	16	8	IIIC

Table 2-1-2 (2) EXISTING AND FUTURE TRAFFIC VOLUME

PROV : SULAWESI UTARA KAB : MINAHASA

(SPD : 1/2)

	INVENTORY (1985)					RATE	AFTER 13 YEARS (1998)					CLASS
LINK NO	MBL	BUS	TRUK	SPD	TOTAL		MBL	BUS	TRUK	SPD	TOTAL	
51	25	15	10	25	63	3.7%	40	24	16	40	100	IIIB-2
52	0	0	1	5	4	3.7%	0	0	2	8	6	IIIC
53	9	2	4	20	25	3.7%	14	3	6	32	40	IIIC
54	50	25	10	25	98	3.7%	80	40	16	40	156	IIIB-2
55	21	10	12	40	63	3.7%	33	16	19	64	100	IIIB-2
56	12	3	5	15	28	3.7%	19	5	8	24	45	IIIC
57	20	25	15	5	63	3.7%	32	40	24	8	100	IIIB-2
58	3	2	5	15	18	3.7%	5	3	8	24	29	IIIC
59	15	5	5	10	30	3.7%	24	8	8	16	48	IIIC
60	10	2	8	14	27	3.7%	16	3	13	22	43	IIIC
61	25	20	15	25	73	3.7%	40	32	24	40	116	IIIB-2
62	10	5	5	20	30	3.7%	16	8	8	32	48	IIIC
63	15	20	10	20	55	3.7%	24	32	16	32	88	IIIB-2
64	0	0	0	5	3	3.7%	0	0	0	8	5	IIIC
65	10	15	25	25	63	3.7%	16	24	40	40	100	IIIB-2
66	5	10	20	15	43	3.7%	8	16	32	24	69	IIIB-2
67	20	15	15	25	63	3.7%	32	24	24	40	100	IIIB-2
68	12	18	7	30	52	3.7%	19	29	11	48	83	IIIB-2
69	10	10	10	15	38	3.7%	16	16	16	24	61	IIIB-2
70	0	0	0	0	0	3.7%	0	0	0	0	0	IIIC
71	0	0	0	0	0	3.7%	0	0	0	0	0	IIIC
72	0	0	0	0	0	3.7%	0	0	0	0	0	IIIC
73	25	15	10	15	58	3.7%	40	24	16	24	92	IIIB-2
74	0	0	0	0	0	3.7%	0	0	0	0	0	IIIC
75	0	0	0	0	0	3.7%	0	0	0	0	0	IIIC
76	0	0	3	10	8	3.7%	0	0	5	16	13	IIIC
77	0	0	0	0	0	3.7%	0	0	0	0	0	IIIC
78	0	0	0	0	0	3.7%	0	0	0	0	0	IIIC
79	25	15	10	10	55	3.7%	40	24	16	16	88	IIIB-2
80	0	0	0	0	0	3.7%	0	0	0	0	0	IIIC
81	15	0	4	30	34	3.7%	24	0	6	48	54	IIIB-2
82	25	15	10	25	63	3.7%	40	24	16	40	100	IIIB-2
83	6	0	4	10	15	3.7%	10	0	6	16	24	IIIC
84	5	5	5	5	18	3.7%	8	8	8	8	29	IIIC
85	25	20	20	35	83	3.7%	40	32	32	56	132	IIIB-2
86	0	0	0	8	4	3.7%	0	0	0	13	6	IIIC
87	5	2	2	7	13	3.7%	8	3	3	11	21	IIIC
88	10	10	10	15	38	3.7%	16	16	16	24	61	IIIB-2
89	0	0	0	0	0	3.7%	0	0	0	0	0	IIIC
90	10	5	4	20	29	3.7%	16	8	6	32	46	IIIC
91	15	4	2	4	23	3.7%	24	6	3	6	37	IIIC
92	0	0	4	2	5	3.7%	0	0	6	3	8	IIIC
93	24	0	2	10	31	3.7%	38	0	3	16	49	IIIC
94	20	10	10	15	48	3.7%	32	16	16	24	76	IIIB-2
95	35	41	39	30	130	3.7%	56	65	62	48	207	IIIB-1
96	10	15	5	12	36	3.7%	16	24	8	19	57	IIIB-2
97	4	2	0	3	8	3.7%	6	3	0	5	13	IIIC
98	6	4	0	2	11	3.7%	10	6	0	3	18	IIIC
99	8	0	4	6	15	3.7%	13	0	6	10	24	IIIC
100	2	2	1	5	8	3.7%	3	3	2	8	13	IIIC

Table 2-1-2 (3) EXISTING AND FUTURE TRAFFIC VOLUME

PROV : SULAWESI UTARA KAB : MINAHASA

(SPD : 1/2)

	INVENTORY (1985)					RATE	AFTER 13 YEARS (1998)					CLASS
LINK NO	MBL	BUS	TRUK	SPD	TOTAL		MBL	BUS	TRUK	SPD	TOTAL	
101	25	15	10	20	60	3.7%	40	24	16	32	96	IIIB-2
102	4	0	6	20	20	3.7%	6	0	10	32	32	IIIC
103	5	5	5	10	20	3.7%	8	8	8	16	32	IIIC
104	4	3	7	10	19	3.7%	6	5	11	16	30	IIIC
105	5	5	5	10	20	3.7%	8	8	8	16	32	IIIC
106	40	0	10	30	65	3.7%	64	0	16	48	104	IIIB-2
107	6	2	2	10	15	3.7%	10	3	3	16	24	IIIC
108	15	15	15	20	55	3.7%	24	24	24	32	88	IIIB-2
109	4	2	0	2	7	3.7%	6	3	0	3	11	IIIC
110	700	300	200	800	1600	3.7%	1116	478	319	1275	2550	IIIA
111	15	3	2	10	25	3.7%	24	5	3	16	40	IIIC
112	50	25	25	40	120	3.7%	80	40	40	64	191	IIIB-2
113	20	20	15	25	68	3.7%	32	32	24	40	108	IIIB-2
114	15	11	9	30	50	3.7%	24	18	14	48	80	IIIB-2
115	6	6	5	15	25	3.7%	10	10	8	24	40	IIIC
116	20	30	10	15	68	3.7%	32	48	16	24	108	IIIB-2
117	20	10	10	15	48	3.7%	32	16	16	24	76	IIIB-2
118	5	3	1	15	17	3.7%	8	5	2	24	27	IIIC
119	10	15	5	15	38	3.7%	16	24	8	24	61	IIIB-2
120	4	0	10	70	49	3.7%	6	0	16	112	78	IIIB-2
121	28	0	5	63	65	3.7%	45	0	8	100	104	IIIB-2
122	35	25	30	50	115	3.7%	56	40	48	80	183	IIIB-2
123	8	7	1	3	18	3.7%	13	11	2	5	29	IIIC
124	50	15	10	25	88	3.7%	80	24	16	40	140	IIIB-2
125	75	25	25	40	145	3.7%	120	40	40	64	231	IIIB-1
126	10	10	10	15	38	3.7%	16	16	16	24	61	IIIB-2
127	90	15	20	25	138	3.7%	143	24	32	40	220	IIIB-1
128	7	2	0	10	14	3.7%	11	3	0	16	22	IIIC
129	140	6	10	60	186	3.7%	223	10	16	96	296	IIIB-1
130	50	20	5	25	88	3.7%	80	32	8	40	140	IIIB-2
131	25	15	10	25	63	3.7%	40	24	16	40	100	IIIB-2
132	18	0	5	20	33	3.7%	29	0	8	32	53	IIIB-2
133	15	5	0	6	23	3.7%	24	8	0	10	37	IIIC
134	21	0	8	30	44	3.7%	33	0	13	48	70	IIIB-2
135	42	0	23	32	81	3.7%	67	0	37	51	129	IIIB-2
136	40	25	65	105	183	3.7%	64	40	104	167	292	IIIB-1
137	12	10	6	30	43	3.7%	19	16	10	48	69	IIIB-2
138	0	0	0	0	0	3.7%	0	0	0	0	0	IIIC
139	20	10	5	25	48	3.7%	32	16	8	40	76	IIIB-2
140	0	0	0	5	3	3.7%	0	0	0	8	5	IIIC
141	0	0	0	5	3	3.7%	0	0	0	8	5	IIIC
142	0	0	0	10	5	3.7%	0	0	0	16	8	IIIC
143	0	0	0	0	0	3.7%	0	0	0	0	0	IIIC
144	4	2	2	3	10	3.7%	6	3	3	5	16	IIIC
145	12	7	1	20	30	3.7%	19	11	2	32	48	IIIC
146	4	0	2	5	9	3.7%	6	0	3	8	14	IIIC
147	5	5	5	10	20	3.7%	8	8	8	16	32	IIIC
148	0	0	0	0	0	3.7%	0	0	0	0	0	IIIC
149	5	4	3	0	12	3.7%	8	6	5	0	19	IIIC
150	1	0	0	2	2	3.7%	2	0	0	3	3	IIIC

Table 2-1-2 (4) EXISTING AND FUTURE TRAFFIC VOLUME

PROV : SULAWESI UTARA KAB : MINAHASA

(SPD : 1/2)

	INVENTORY (1985)					RATE	AFTER 13 YEARS (1998)					CLASS
LINK NO	MBL	BUS	TRUK	SPD	TOTAL		MBL	BUS	TRUK	SPD	TOTAL	
151	9	4	1	2	15	3.7%	14	6	2	3	24	IIIC
152	1	0	1	0	2	3.7%	2	0	2	0	3	IIIC
153	0	0	0	0	0	3.7%	0	0	0	0	0	IIIC
154	0	0	0	5	3	3.7%	0	0	0	8	5	IIIC
155	10	0	4	15	22	3.7%	16	0	6	24	35	IIIC
156	0	0	0	0	0	3.7%	0	0	0	0	0	IIIC
157	3	5	2	10	15	3.7%	5	8	3	16	24	IIIC
158	0	0	3	4	5	3.7%	0	0	5	6	8	IIIC
159	15	3	5	10	28	3.7%	24	5	8	16	45	IIIC
160	50	15	10	20	85	3.7%	80	24	16	32	135	IIIB-2
PERCENT	34.12	14.67	14.55	36.66			34.12	14.67	14.55	36.66		

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 (1) FUTURE TRAFFIC VOLUME ESTIMATED BY THE PRODUCER'S SURPLUS

PROV : SULAWESI UTARA KAB : MINAHASA

(1998)

LINK NO	CLASS	SURFACE	MOBIL	BUS	TRUCK	SEPEDA	TOTAL
1	IIIB-2	KRK	41	18	18	45	100
2	IIIB-2	KRK	24	10	10	26	57
3	IIIC	KRK	10	4	4	11	24
4	IIIC	KRK	9	4	4	10	22
6	IIIC	KRK	11	5	5	12	27
7	IIIC	KRK	6	3	3	7	16
8	IIIC	KRK	19	8	8	21	46
9	IIIC	KRK	2	1	1	3	6
11	IIIB-2	KRK	24	10	10	26	57
12	IIIB-2	KRK	21	9	9	22	50
13	IIIB-2	KRK	27	12	12	30	66
14	IIIC	KRK	7	3	3	8	17
15	IIIC	KRK	10	4	4	11	24
16	IIIC	KRK	9	4	4	10	22
17	IIIB-2	KRK	21	9	9	23	51
18	IIIC	KRK	11	5	5	12	27
20	IIIC	KRK	11	5	5	12	27
21	IIIB-2	KRK	31	13	13	34	74
22	IIIB-2	KRK	23	10	10	25	56
23	IIIC	KRK	11	5	5	12	27
24	IIIC	KRK	17	7	7	18	40
26	IIIC	KRK	20	9	9	22	49
27	IIIC	KRK	6	2	2	6	13
29	IIIC	KRK	11	5	5	12	27
30	IIIC	KRK	5	2	2	5	12
33	IIIC	KRK	10	4	4	11	24
35	IIIC	KRK	7	3	3	8	17
37	IIIC	KRK	6	3	3	7	16
39	IIIC	KRK	20	9	8	21	48
40	IIIC	KRK	7	3	3	8	17
41	IIIB-2	KRK	26	11	11	28	62
42	IIIC	KRK	12	5	5	13	29
43	IIIC	KRK	7	3	3	8	17
47	IIIC	KRK	17	7	7	18	40
48	IIIB-2	KRK	39	17	17	42	94
50	IIIC	KRK	6	3	3	7	16
52	IIIC	KRK	9	4	4	9	22
53	IIIC	KRK	8	3	3	8	18
56	IIIB-2	KRK	61	26	26	66	146
58	IIIB-2	KRK	29	13	13	32	71
59	IIIC	KRK	10	4	4	11	24
60	IIIB-2	KRK	24	10	10	26	57
62	IIIB-2	KRK	26	11	11	28	62
63	IIIC	KRK	20	8	8	21	47
64	IIIC	KRK	17	7	7	19	41
66	IIIC	KRK	19	8	8	20	45
68	IIIC	KRK	19	8	8	20	45
69	IIIC	KRK	16	7	7	18	39
70	IIIB-2	KRK	36	16	15	39	87
71	IIIB-2	KRK	39	17	17	42	94
72	IIIB-2	KRK	30	13	13	32	72
73	IIIC	KRK	14	6	6	15	34
74	IIIC	KRK	9	4	4	9	22
75	IIIC	KRK	19	8	8	20	45
76	IIIC	KRK	16	7	7	17	39

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

PROV : SULAWESI UTARA KAB : MINAHASA

(1998)

LINK NO	CLASS	SURFACE	MOBIL	BUS	TRUCK	SEPEDA	TOTAL
79	IIIB-2	KRK	31	13	13	33	74
81	IIIB-2	KRK	39	17	17	42	94
83	IIIB-2	KRK	40	17	17	43	96
84	IIIC	KRK	14	6	6	15	34
86	IIIB-2	KRK	66	28	28	71	158
87	IIIC	KRK	20	8	8	21	47
88	IIIC	KRK	12	5	5	13	29
89	IIIB-2	KRK	63	27	27	68	151
91	IIIB-1	ASP	100	43	43	107	240
92	IIIB-2	KRK	35	15	15	37	84
93	IIIC	KRK	7	3	3	7	17
94	IIIC	KRK	8	3	3	9	19
96	IIIC	KRK	13	5	5	13	30
97	IIIB-2	KRK	24	10	10	26	57
98	IIIC	KRK	2	1	1	2	5
99	IIIC	KRK	12	5	5	13	29
100	IIIC	KRK	8	3	3	8	18
102	IIIC	KRK	3	1	1	3	7
103	IIIC	KRK	11	5	5	11	27
104	IIIC	KRK	11	5	5	11	27
105	IIIB-2	KRK	21	9	9	23	51
107	IIIC	KRK	6	3	3	7	16
108	IIIB-2	KRK	38	16	16	41	91
109	IIIC	KRK	3	1	1	3	7
133	IIIC	KRK	2	1	1	2	5
137	IIIC	KRK	5	2	2	5	12
139	IIIC	KRK	20	9	8	21	48
140	IIIB-2	KRK	25	11	10	26	59
141	IIIC	KRK	5	2	2	5	12
142	IIIC	KRK	5	2	2	6	12
144	IIIC	KRK	6	2	2	6	13
147	IIIC	KRK	4	2	2	4	10
148	IIIC	KRK	20	8	8	21	47
149	IIIB-2	KRK	21	9	9	23	51
150	IIIC	KRK	9	4	4	10	22
151	IIIB-2	KRK	35	15	15	37	84
152	IIIC	KRK	7	3	3	8	17
153	IIIC	KRK	2	1	1	2	5
154	IIIC	KRK	9	4	4	9	22
155	IIIC	KRK	8	3	3	8	18
156	IIIC	KRK	12	5	5	13	29
157	IIIB-2	KRK	37	16	16	39	89
158	IIIC	KRK	11	5	5	11	27
159	IIIC	KRK	11	5	5	11	27

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 : MINAHASA

(1000Rupiah)

	LINK 1	LINK 2	LINK 3	LINK 4	LINK 6	LINK 7	LINK 8	LINK 9	LINK 11	LINK 12
	18 Km	10 Km	5 Km	6 Km	5 Km	4 Km	11 Km	2 Km	8 Km	15 Km
	IIIB-2	IIIB-2	IIIC	IIIC	IIIC	IIIC	IIIC	IIIC	IIIB-2	IIIB-2
YEAR	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus
1988	0	0	0	0	0	0	0	0	0	0
1989	15282	5049	5465	306	3524	421	2086	46	630	10591
1990	15282	5049	5465	306	3524	421	2086	46	643	10591
1991	15282	5049	5465	306	3524	421	2086	46	659	10591
1992	15282	5049	5465	306	3524	421	2086	46	660	10591
1993	15282	5049	5465	306	3524	425	2086	46	660	10591
1994	15282	5049	5465	306	3524	425	2086	46	660	10591
1995	15282	5049	5465	306	3524	425	2086	46	676	10591
1996	15282	5049	5465	306	3524	425	2093	46	678	10591
1997	15282	5049	5465	306	3524	425	2093	46	678	10591
1998	15282	5049	5465	306	3524	425	2093	46	678	10591
SUM	152820	50490	54650	3060	35240	4234	20881	460	6622	105910
COST	29088	-4983	15576	-19724	3650	-11804	-26781	-6919	-24761	11066
/Km	1616	-498	3115	-3287	730	-2951	-2435	-3459	-3095	738

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.

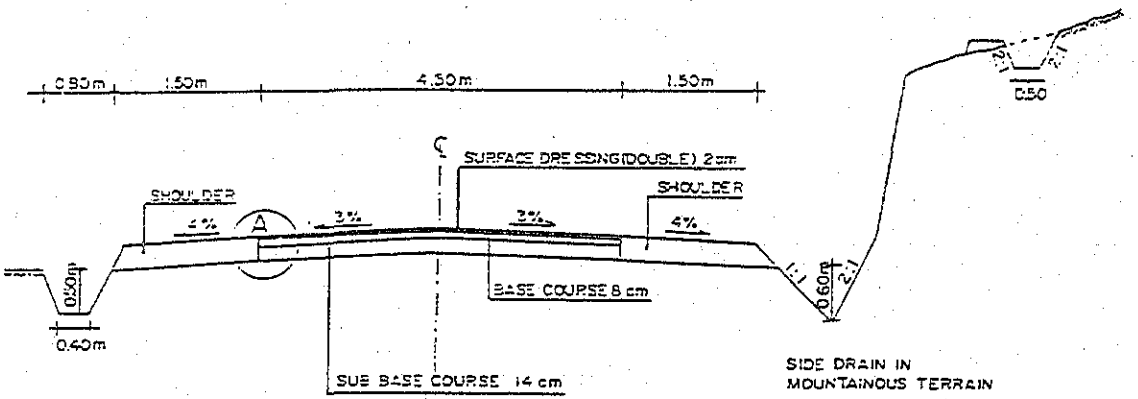
Table 3-1-1

DESIGN CRITERIA FOR KABUPATEN ROADS

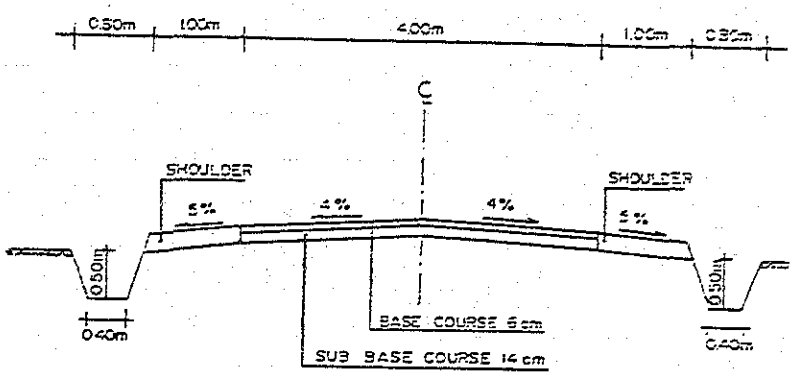
ROAD CLASSIFICATION		CLASS III A			CLASS III B-1			CLASS III B-2			CLASS III C		
SURFACE TYPE		ASPHALT SEAL (DOUBLE)			ASPHALT SEAL (SINGLE)			GRAVEL			GRAVEL		
TRAFFIC VOLUME : ADT (Forecast 10 th year average per day)		3000 - 500			500 - 200			200 - 50			50		
T E R R A I N		FLAT TO ROLLING	HILLY	MOUNT-AINOUS	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

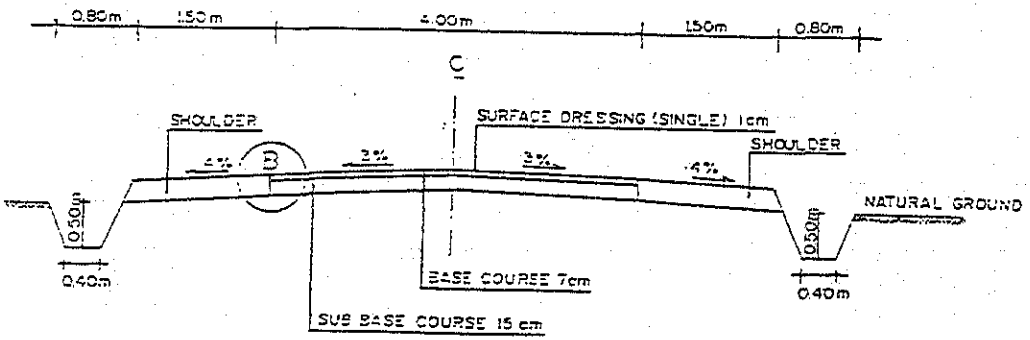
CLASS III A



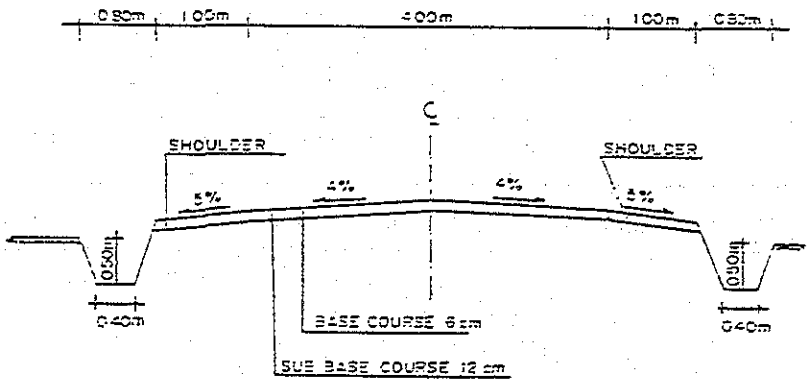
CLASS III B-2



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

(cm)

CBR	ROAD CLASSIFICATION			
	III A	III B-1	III B-2	III C
6	8 / 14 / 24	7 / 14 / 22	6 / 14 / 20	16

= SURFACE DRESSING (ASPHALT)

= BASE COURSE (CRUSHER-RUN)

= SUBBASE COURSE (SANDY GRAVEL)

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

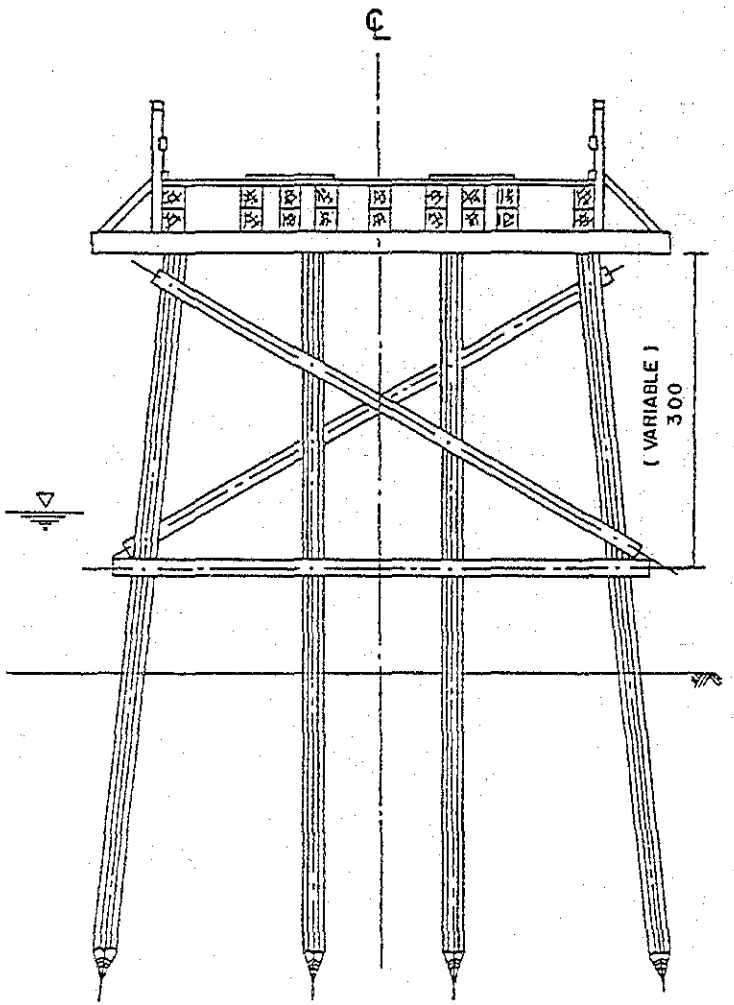
3) Foundation

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.

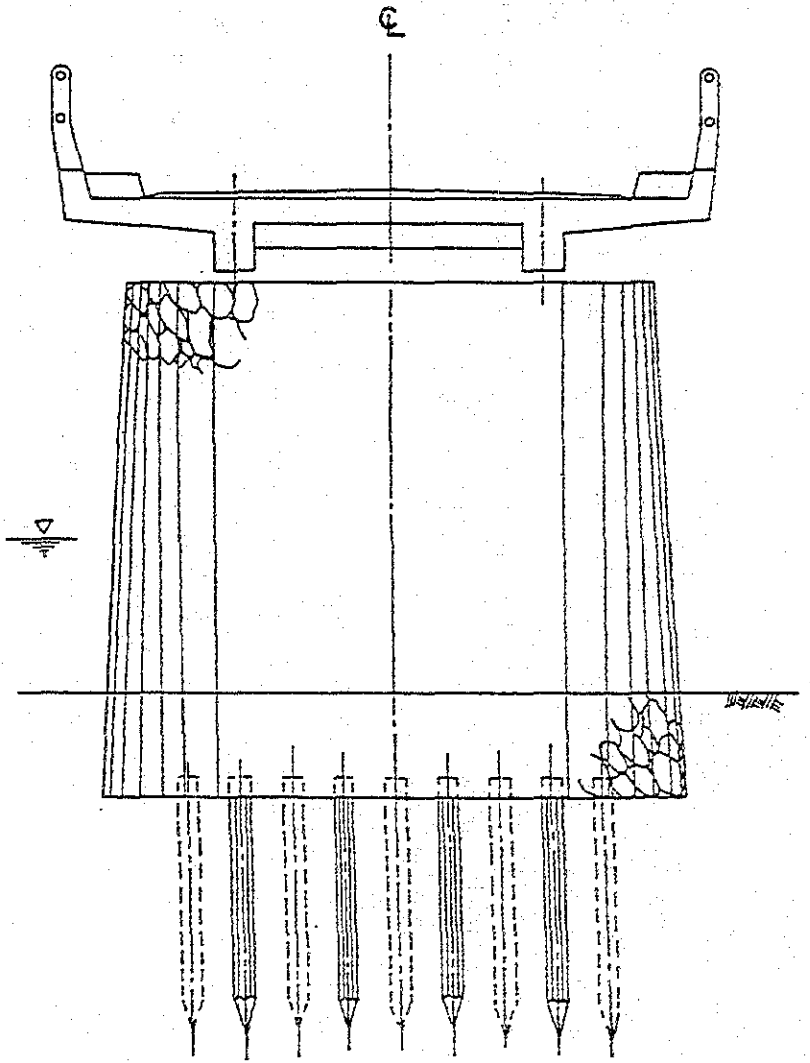
The pile length is suggested to be a minimum of 3 meters under the bottom of the foundation. The length and number of piles should be decided in order to be adequate for the condition of the foundation materials.

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

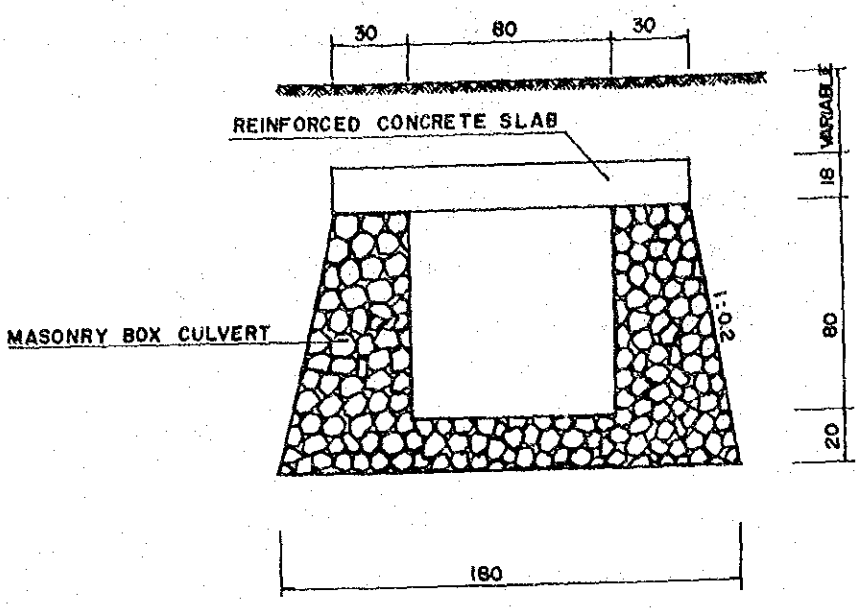
(2) Retaining Wall

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

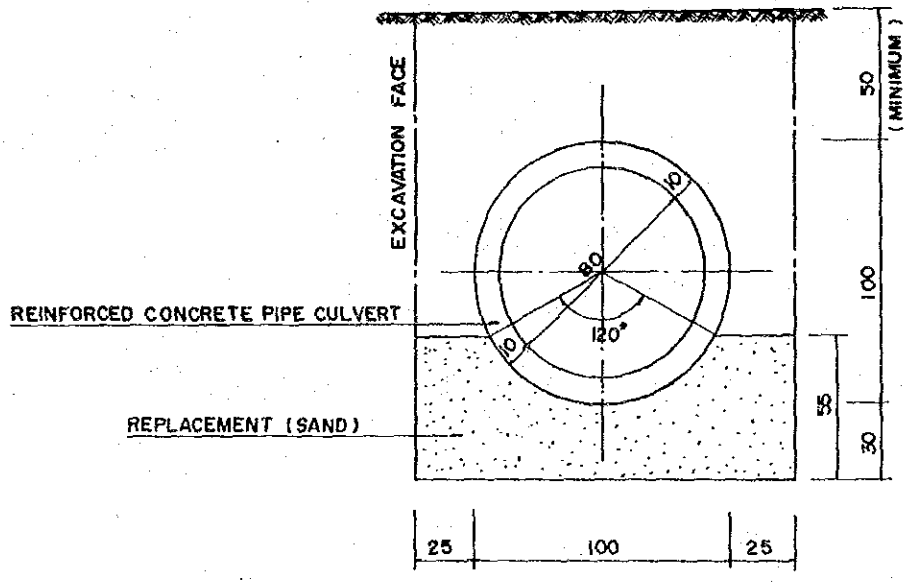
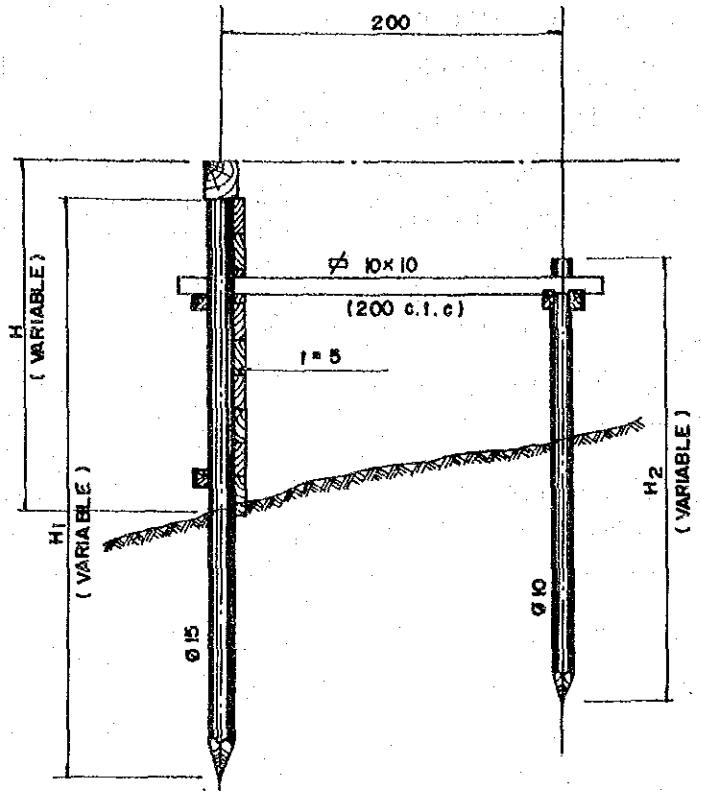
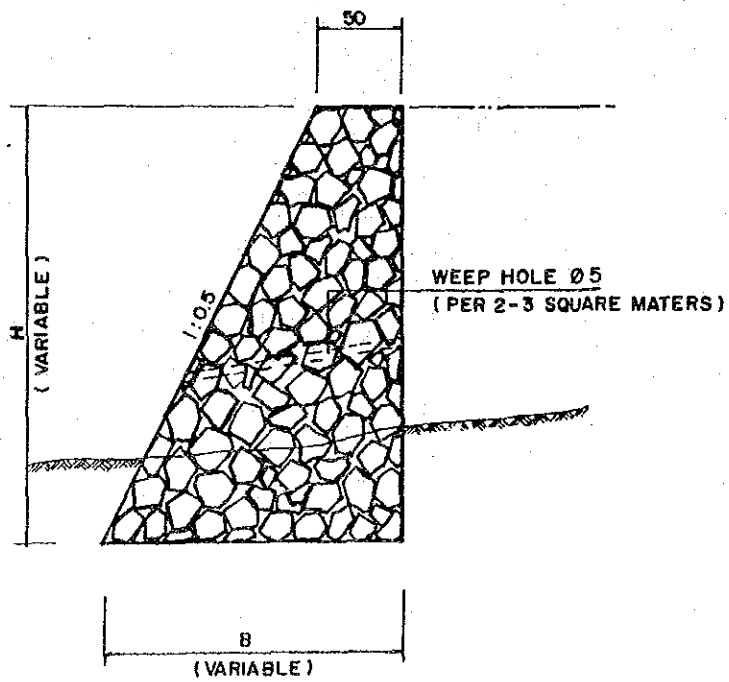


Fig. 3-3-3 STANDARD RETAINING WALLS

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.

The proposed laboratory equipment is listed in Table 3-5-2.

Table 3-5-2 LABORATORY TEST EQUIPMENT

DESCRIPTION	QUANTITY
Soil Moisture Test Set (JIS A1203)	1
Liquid Limit Set (JIS A1205)	1
Plastic Limit Set (JIS A1206)	1
Compaction Set (JIS A1210)	1
CBR Laboratory Set, Mechanical (JIS A1211)	1
Sand Density Apparatus (JIS A1214)	1
Aggregate Test Sieve Set	1
Portable Cone Penetrometer	1
Compression & Bending Test Machine	1
Cylinder Mould (JIS A1132, 1108)	9
Slump Test Apparatus (JIS A1101)	2

To conduct the surveys necessary for road and structure construction such as centering, profile leveling, cross section leveling etc., the surveying equipment listed in Table 3-5-3 recommended.

Table 3-5-3 SURVEYING EQUIPMENT

DESCRIPTION	QUANTITY
Transit	1
Level	1
Staff	3

Chapter 4 CONSTRUCTION AND MAINTENANCE COST ESTIMATIONS

4.1 Unit Price

With regard to the unit prices of materials and labor, the data were collected from each Kabupaten through Bina Marga. The collected data were compared with those of Jakarta using BAHAN BANGUNAN DKI-JAKARTA MAY & JUNE 1985 compiled by PUSAT INFORMASI TEHNIK PEMBANGUNAN, and then finalized.

4.1.1 Unit Labour Price

The unit labour prices of Kabupaten Minahasa and other Kabupatens in Sulawesi Utara Province are shown in Table 4-1-1.

Table 4-1-1 UNIT LABOUR PRICE

(Rp)

KABUPATEN	MAN	SKL LAB	CAP	MAS	LAB	DRIV	OPE
Minahasa	3,500	2,500	4,500	4,500	2,750	4,000	5,000
Average	3,500	2,500	4,500	4,500	2,750	4,000	5,000

Notes :

MAN	: Mandur
SKL LAB	: Skilled Labour
CAP	: Carpenter
MAS	: Mason
LAB	: Labourer
DRIV	: Driver
OPE	: Operater

4.1.2 Unit Price of Materials

Table 4-1-2 shows the unit price of materials for Kabupaten Minahasa together with for other Kabupatens in Sulawesi Utara Province.

Table 4-1-2 UNIT PRICE OF MATERIALS

(Rp)

MATERIAL	UNIT	MINAHASA	AVERAGE
Bitumen	L	350	350
Asphalt	L	800	800
Gasoline	L	250	250
Sand	M^3	3,500	3,500
Cement	bag	4,000	4,000
River Stone	M^3	5,000	5,000
Steel moulds	Set	8,000	8,000
Timber	M^3	170,000	170,000
Paint	L	1,500	1,500
Reinforcing Steel	Kg	900	900
tying Wire	Kg	1,100	1,100
Equivalent Royalty	M^3	250	250

4.1.3 Hourly Equipment Cost

The hourly equipment cost for Kabupaten is shown in Table 4-1-3.

Table 4-1-3

HOURLY EQUIPMENT COST

PROVINCE : SULAWESI UTARA
KABUPATEN : MINAHASA

(UNIT : Rp) (6'85)

CODE NO	EQUIPMENT NAME	CLASS	LOCAL COST OWNERSHIP	LOCAL COST OPERATION	LOCAL COST SUB-TOTAL	FOREIGN COST OWNERSHIP	FOREIGN COST OPERATION	FOREIGN COST SUB-TOTAL	TOTAL COST
	Bulldozer	120 HP	350	13,967	14,317	7,769	1,039	8,808	23,125
	Bulldozer/Ripper	120 HP	383	14,993	15,376	8,499	1,598	10,097	25,473
	Swamp Bulldozer	120 HP	400	15,238	15,638	8,879	1,670	10,549	26,187
	Bulldozer	90 HP	222	9,531	9,753	4,914	657	5,571	15,324
	Bulldozer/Ripper	90 HP	239	10,130	10,369	5,299	996	6,295	16,664
	Bulldozer	65 HP	158	6,929	7,087	3,499	467	3,966	11,053
	Bulldozer/Ripper	65 HP	172	7,384	7,556	3,819	718	4,537	12,093
	Swamp Bulldozer	90 HP	238	10,120	10,358	5,284	993	6,277	16,635
	Swamp Bulldozer	65 HP	183	7,214	7,397	4,049	761	4,810	12,207
	Motor Grader	110 HP	312	12,073	12,385	6,919	1,301	8,220	20,605
	Motor Grader	75 HP	216	8,271	8,487	4,779	898	5,677	14,164
	Motor Grader	65 HP	194	7,270	7,464	4,299	808	5,107	12,571
	Road Stabilizer	W=1850 mm	387	3,430	3,817	8,594	431	9,025	12,842
	Vibratory Roller	4 ton	131	3,635	3,766	2,899	387	3,286	7,052
	Hand-guide Vib. Roller	1000 Kg	98	652	750	849	30	879	1,629
	Tire Roller	8-15 ton	140	8,225	8,365	3,106	103	3,209	11,574
	Vibratory Roller (O&T)	4 ton	131	3,635	3,766	2,899	387	3,286	7,052
	Hand-guide Vib. Roller	600 Kg	69	445	514	600	21	621	1,135
	Rough Terrain Crane	10 ton	452	14,089	14,541	10,039	755	10,794	25,335
	Hydraulic Excavator; Wheel	0.3 m3	185	8,580	8,765	4,109	549	4,658	13,423
	Wheel Loader	1.2 m3	316	9,086	9,402	7,019	938	7,957	17,359
	Wheel Loader	0.3 m3	103	3,184	3,287	2,269	303	2,572	5,859
	Water Tank Truck	4000 ltr.	100	3,182	3,282	869	123	992	4,274
	Fuel Tank Truck	4000 ltr.	102	3,188	3,290	882	125	1,007	4,297
	Dump Truck	3.0 ton	170	3,940	4,110	1,469	209	1,678	5,788
	Flat Bed Truck with Crane	3.0 ton	78	3,425	3,503	1,716	129	1,845	5,348
	Dump Loader Truck	12 ton	173	21,395	21,568	3,838	128	3,966	25,534
	Dump Truck	5.0 ton	252	6,521	6,773	2,189	312	2,501	9,274
	Flat Bed Truck	3.0 ton	26	2,993	3,019	563	42	605	3,624
	Portable Crusher/Screening	30-40 t/h	846	23,521	24,367	18,800	2,514	21,314	45,681
	Concrete Mixer	0.5 m3	621	2,505	3,126	5,400	433	5,833	8,959
	Water Pump	200 l/min	22	292	314	188	6	194	508
	Concrete Vibrator	3.3 HP	9	254	263	73	2	75	338
	Asphalt Sprayer	850 ltr.	118	817	935	1,019	145	1,164	2,099

4.2 Unit Construction Cost by Work Type

4.2.1 All Works Except Bridges

The unit construction costs by work type, excluding bridge construction costs, have been estimated using the combination of equipment described in Clause 3.4 and the unit prices already listed. The results are summarized in Table 4-2-1.

Table 4-2-1 UNIT COST BY WORK TYPE EXCEPT BRIDGE WORK

PROV : SULAWESI UTARA KAB : MINAHASA

(Rp)

ITEM	UNIT	LOCAL	FOREIGN	TOTAL
Site Clearance in Light Bush	m2	186	91	277
Subgrade Preparation	m2	24	11	35
Normal Fill	m3	1,921	865	2,786
Fill in Swamp	m3	2,860	1,055	3,915
Normal Excavation to Spoil	m3	1,119	524	1,643
Sub Base Course	m3	3,609	1,351	4,960
Base Course	m3	4,950	2,304	7,254
Shoulder	m2	340	146	486
Asphalt Patching	m2	4,447	1,447	5,894
Surface Dressing (Single)	m2	669	680	1,349
Surface Dressing (Double)	m2	838	1,071	1,909
Earth Drain	m	1,186	119	1,305
Earth Drain in Swamp (by machine)	m3	1,396	475	1,871
Pipe Culvert D80cm	m	50,919	45,715	96,634
Masonry Culvert (80x80cm)	m	72,228	37,567	109,795
Retaining Wall and Wing Wall (Timber)	m2	16,989	246	17,235
Retaining Wall and Wing Wall (Masonry)	m3	51,939	11,513	63,452
Gabion Protection	m3	11,203	121	11,324
Manual routine maintenance of road	Km	195,728	7,260	202,988
Routine maintenance of earth road	Km	109,484	37,964	147,448
Routine maintenance of gravel road	Km	217,962	88,227	306,189
Routine maintenance of asphalt road	Km	444,700	144,700	589,400

4.2.2 Bridges

The unit construction costs by bridge type including the cost of demolition of existing bridges are shown in Table 4-2-2.

Table 4-2-2 BRIDGE COST

PROV : SULAWESI UTARA KAB : MINAHASA

(Rp)

ITEM	UNIT	LOCAL	FOREIGN	TOTAL
Superstructure (Timber;Span 3m;10T)	m2	61,083	2,456	63,539
Superstructure (Timber;Span 5m;10T)	m2	67,659	2,713	70,372
Superstructure (Timber;Span 8m;10T)	m2	89,618	3,568	93,186
Superstructure (Timber;Span 3m;BM50)	m2	75,741	3,038	78,779
Superstructure (Timber;Span 5m;BM50)	m2	82,689	3,296	85,985
Superstructure (Timber;Span 8m;BM50)	m2	104,872	4,173	109,045
Superstructure (Concrete;Span 3m;BM50)	m2	65,155	95,353	160,508
Superstructure (Concrete;Span 5m;BM50)	m2	66,851	106,441	173,292
Superstructure (Concrete;Span 8m;BM50)	m2	68,459	116,207	184,666
Superstructure (Concrete;Span10m;BM50)	m2	74,742	132,062	206,804
Superstructure (Concrete;Span15m;BM50)	m2	80,157	155,660	235,817
Substructure (Pier;for Timber;10T)	NO	532,007	22,603	554,610
Substructure (Abut;for Timber;10T)	NO	1,447,247	119,304	1,566,551
Substructure (Pier;for Timber;BM50)	NO	782,414	33,422	815,836
Substructure (Abut;for Timber;BM50)	NO	1,635,943	130,625	1,766,568
Substructure (Pier;for Concrete;BM50)	NO	1,963,876	457,848	2,421,724
Substructure (Abut;for Concrete;BM50)	NO	4,170,765	967,543	5,138,308
Demolition of Bridge (Timber->Timber)	m2	16,898	1,018	17,916
Demolition of Bridge (Timber->Concrete)	m2	16,898	1,018	17,916
Demolition of Bridge (Concrete)	m2	99,288	73,210	172,498
Maintenance of Timber Bridge (New)	m2	10,927	898	11,825
Maintenance of Concrete Bridge (New)	m2	2,297	2,730	5,027
Maintenance of Timber Bridge (Exist)	m2	9,766	2,294	12,060
Maintenance of Concrete Bridge (Exist)	m2	4,762	2,391	7,153

Chapter 5 RESULTS OF ECONOMIC FEASIBILITY EVALUATION

5.1 Preliminary Screening

The road links to be improved should be effective for development of the Project Area. The road links where improvements were assumed to be inefficient for development of the Project Area were generally screened out using the following cut-off criteria.

(1) Very short roads, less than 2 Km long, which have no connection with the trunk road network.

(2) Roads not connected to the network at any point

(3) Unpreferred roads, due to poor suitability for transportation compared to other existing alternative roads serving the same purpose.

(4) Road in good condition according to the Bina Marga road inventory which lists improvement projects carried out in the last two or three years

(5) Roads with asphalt surface in good condition

(6) Urban roads, except those forming part of a longer route

(7) Roads serving single large organizations rather than the general public

(8) Roads with no inventory data

(9) Kabupaten roads also assigned as provincial roads

The road links to be screened out in Kabupaten Minahasa are shown in Table 5-1-1.

Table 5-1-1 ROAD LINKS TO BE SCREENED OUT

KABUPATEN : MINAHASA

CRITERIA NO	ROAD LINK NO
(6)	110,111,112,114,115,116,117,118,119,120,121,122, 123,124,125,126,127,128,129,130,131,134,136,145
(8)	10,77,78,80,90,132,138,143,146
(9)	05,31,36,45,46

5.2 Evaluation

5.2.1 Primary Analysis

The Kabupaten roads were classified by using the future traffic volume on the road links in 1998. The primary analysis of the IRR was carried out using the construction and maintenance costs. Road links where IRRs were more than 10% were defined as feasible links.

Results of primary analysis are shown in Table 5-2-1.

5.2.2 Secondary Analysis

From the infeasible road links evaluated by the primary analysis, road links where the IRRs were between 1% and 10%, i.e. road links which could become feasible if down graded by one rank, in classification were down graded and the costs re-estimated. Using these costs, a secondary analysis of IRR was carried out. Road links where these IRRs were then more than 10% were also defined as feasible links. This reflected that even though the road classification was rather low the road link should be improved.

Results of secondary analysis are shown in Table 5-2-2.

5.2.3 Ranking of Feasible Road Links

From the results of the primary and secondary analysis, road links where the IRRs were more than 10% were selected and their NPVs and B/Cs were estimated. The ranking of feasible road links from the economic evaluation are decided in the order of the NPVs, i.e. the larger the NPV the higher the road link priority as shown in Table 5-2-3.

Table 5-2-1 (1) RESULTS OF PRIMARY ANALYSIS

PROVINCE : SULAWESI UTARA KABUPATEN : MINAHASA

LINK NO	LENGTH	CLASS	IRR(%)	REMARK
28	6 Km	IIIB-2	42.870	VOC
95	19 Km	IIIB-1	41.344	VOC
89	12 Km	IIIB-2	32.684	Surplus
71	25 Km	IIIB-2	28.489	Surplus
108	27 Km	IIIB-2	27.261	Surplus
86	39 Km	IIIB-2	26.606	Surplus
51	15 Km	IIIB-2	25.613	VOC
72	18 Km	IIIB-2	23.239	Surplus
67	8 Km	IIIB-2	22.638	VOC
49	12 Km	IIIB-1	20.881	VOC
82	27 Km	IIIB-2	20.809	VOC
56	34 Km	IIIB-2	18.276	Surplus
157	15 Km	IIIB-2	17.572	Surplus
79	10 Km	IIIB-2	17.201	Surplus
58	12 Km	IIIB-2	16.783	Surplus
151	15 Km	IIIB-2	15.531	Surplus
91	19 Km	IIIB-1	15.347	Surplus
13	12 Km	IIIB-2	14.287	Surplus
47	7 Km	IIIC	13.629	Surplus
48	16 Km	IIIB-2	9.501	Surplus
97	15 Km	IIIB-2	7.721	Surplus
83	10 Km	IIIB-2	7.013	Surplus
160	12 Km	IIIB-2	6.577	VOC
139	20 Km	IIIC	5.882	Surplus
76	16 Km	IIIC	5.695	Surplus
81	22 Km	IIIB-2	5.297	Surplus
140	10 Km	IIIB-2	5.050	Surplus
26	14 Km	IIIC	4.540	Surplus
64	10 Km	IIIC	2.898	Surplus
156	5 Km	IIIC	2.266	Surplus
105	15 Km	IIIB-2	1.567	Surplus
3	5 Km	IIIC	1.444	Surplus
75	13 Km	IIIC	0.387	Surplus
38	11 Km	IIIB-2	0.078	VOC
39	9 Km	IIIC	0.078	Surplus
40	3 Km	IIIC	0.078	Surplus
41	12 Km	IIIB-2	0.078	Surplus
42	12 Km	IIIC	0.078	Surplus
43	4 Km	IIIC	0.078	Surplus
44	24 Km	IIIB-1	0.078	VOC
6	5 Km	IIIC	0.078	Surplus
7	4 Km	IIIC	0.078	Surplus
8	11 Km	IIIC	0.078	Surplus
50	5 Km	IIIC	0.078	Surplus
9	2 Km	IIIC	0.078	Surplus
52	9 Km	IIIC	0.078	Surplus
53	6 Km	IIIC	0.078	Surplus
54	14 Km	IIIB-2	0.078	VOC
55	8 Km	IIIB-2	0.078	VOC
11	8 Km	IIIB-2	0.078	Surplus

Table 5-2-1 (2) RESULTS OF PRIMARY ANALYSIS

PROVINCE : SULAWESI UTARA KABUPATEN : MINAHASA

LINK NO	LENGTH	CLASS	IRR(%)	REMARK
57	6 Km	IIIB-2	0.078	VOC
12	15 Km	IIIB-2	0.078	Surplus
59	5 Km	IIIC	0.078	Surplus
60	14 Km	IIIB-2	0.078	Surplus
61	10 Km	IIIB-2	0.078	VOC
62	16 Km	IIIB-2	0.078	Surplus
63	11 Km	IIIC	0.078	Surplus
2	10 Km	IIIB-2	0.078	Surplus
65	3 Km	IIIB-2	0.078	VOC
66	10 Km	IIIC	0.078	Surplus
14	4 Km	IIIC	0.078	Surplus
68	7 Km	IIIC	0.078	Surplus
69	9 Km	IIIC	0.078	Surplus
70	24 Km	IIIB-2	0.078	Surplus
15	6 Km	IIIC	0.078	Surplus
16	6 Km	IIIC	0.078	Surplus
73	11 Km	IIIC	0.078	Surplus
74	7 Km	IIIC	0.078	Surplus
17	12 Km	IIIB-2	0.078	Surplus
18	8 Km	IIIC	0.078	Surplus
19	11 Km	IIIB-2	0.078	VOC
20	4 Km	IIIC	0.078	Surplus
21	17 Km	IIIB-2	0.078	Surplus
22	13 Km	IIIB-2	0.078	Surplus
84	11 Km	IIIC	0.078	Surplus
85	6 Km	IIIB-2	0.078	VOC
23	5 Km	IIIC	0.078	Surplus
87	11 Km	IIIC	0.078	Surplus
88	4 Km	IIIC	0.078	Surplus
24	10 Km	IIIC	0.078	Surplus
25	6 Km	IIIB-2	0.078	VOC
92	13 Km	IIIB-2	0.078	Surplus
93	5 Km	IIIC	0.078	Surplus
94	3 Km	IIIC	0.078	Surplus
1	18 Km	IIIB-2	0.078	Surplus
96	12 Km	IIIC	0.078	Surplus
27	4 Km	IIIC	0.078	Surplus
98	2 Km	IIIC	0.078	Surplus
99	5 Km	IIIC	0.078	Surplus
100	3 Km	IIIC	0.078	Surplus
101	15 Km	IIIB-2	0.078	VOC
102	3 Km	IIIC	0.078	Surplus
103	8 Km	IIIC	0.078	Surplus
104	8 Km	IIIC	0.078	Surplus
4	6 Km	IIIC	0.078	Surplus
106	3 Km	IIIB-2	0.078	VOC
107	27 Km	IIIC	0.078	Surplus
29	6 Km	IIIC	0.078	Surplus
109	2 Km	IIIC	0.078	Surplus
133	2 Km	IIIC	0.078	Surplus

Table 5-2-1 (3) RESULTS OF PRIMARY ANALYSIS

PROVINCE : SULAWESI UTARA KABUPATEN : MINAHASA

LINK NO	LENGTH	CLASS	IRR(%)	REMARK
135	7 Km	IIIB-2	0.078	VOC
137	3 Km	IIIC	0.078	Surplus
30	3 Km	IIIC	0.078	Surplus
32	25 Km	IIIB-2	0.078	VOC
141	8 Km	IIIC	0.078	Surplus
142	5 Km	IIIC	0.078	Surplus
144	4 Km	IIIC	0.078	Surplus
147	2 Km	IIIC	0.078	Surplus
148	10 Km	IIIC	0.078	Surplus
149	14 Km	IIIB-2	0.078	Surplus
150	4 Km	IIIC	0.078	Surplus
33	6 Km	IIIC	0.078	Surplus
152	3 Km	IIIC	0.078	Surplus
153	4 Km	IIIC	0.078	Surplus
154	5 Km	IIIC	0.078	Surplus
155	9 Km	IIIC	0.078	Surplus
34	5 Km	IIIB-2	0.078	VOC
35	9 Km	IIIC	0.078	Surplus
158	6 Km	IIIC	0.078	Surplus
159	6 Km	IIIC	0.078	Surplus
37	9 Km	IIIC	0.078	Surplus

Table 5-2-2 RESULTS OF SECONDARY ANALYSIS

PROVINCE : SULAWESI UTARA KABUPATEN : MINAHASA

LINK NO	LENGTH	CLASS	IRR(%)	REMARK
160	12 Km	IIIC	19.650	VOC
97	15 Km	IIIC	12.857	Surplus
140	10 Km	IIIC	10.004	Surplus
83	10 Km	IIIC	9.801	Surplus
48	16 Km	IIIC	9.524	Surplus
81	22 Km	IIIC	7.103	Surplus
105	15 Km	IIIC	6.016	Surplus
139	20 Km	IIIC	5.882	Surplus
76	16 Km	IIIC	5.695	Surplus
26	14 Km	IIIC	4.540	Surplus
64	10 Km	IIIC	2.898	Surplus
156	5 Km	IIIC	2.266	Surplus
3	5 Km	IIIC	1.444	Surplus

Table 5-2-3 RANKING OF FEASIBILITY ROAD LINKS

PROVINCE : SULAWESI UTARA KABUPATEN : MINAHASA

LINK NO	LENGTH	CLASS	NPV (1000Rp)	B/C	IRR (%)	REMARK
95	19 Km	IIIB-1	456249	2.344	41.344	VOC
71	25 Km	IIIB-2	244884	1.745	28.489	Surplus
86	39 Km	IIIB-2	231347	1.588	26.606	Surplus
89	12 Km	IIIB-2	193623	1.947	32.684	Surplus
108	27 Km	IIIB-2	171083	1.608	27.261	Surplus
72	18 Km	IIIB-2	117917	1.515	23.239	Surplus
82	27 Km	IIIB-2	114420	1.400	20.809	VOC
49	12 Km	IIIB-1	97541	1.417	20.881	VOC
51	15 Km	IIIB-2	78294	1.565	25.613	VOC
91	19 Km	IIIB-1	49093	1.170	15.347	Surplus
28	6 Km	IIIB-2	47577	2.102	42.870	VOC
157	15 Km	IIIB-2	44867	1.268	17.572	Surplus
67	8 Km	IIIB-2	41879	1.484	22.638	VOC
151	15 Km	IIIB-2	36501	1.193	15.531	Surplus
58	12 Km	IIIB-2	34939	1.247	16.783	Surplus
56	34 Km	IIIB-2	31917	1.170	18.276	Surplus
79	10 Km	IIIB-2	25826	1.250	17.201	Surplus
13	12 Km	IIIB-2	20529	1.148	14.287	Surplus
160	12 Km	IIIC	16956	1.239	19.650	VOC
97	15 Km	IIIC	15522	1.096	12.857	Surplus
47	7 Km	IIIC	7051	1.117	13.629	Surplus
140	10 Km	IIIC	11	1.000	10.004	Surplus
SUM	369 Km		2078026			

Chapter 6 IMPLEMENTATION PROGRAMME

6.1 Implementation Schedule

6.1.1 Project Cost

The total Project Cost for the Kabupaten is composed of the cost of construction and maintenance, supplementation as described later, and workshop, laboratory and survey equipment. The total Project Cost for the Kabupaten is summarized in Table 6-1-1.

Table 6-1-1 TOTAL PROJECT COST (1)

KABUPATEN: Minahasa

(Rpx10^6)

COST	FOREIGN CURRENCY	LOCAL CURRENCY	TOTAL
CONSTRUCTION	1,153	3,073	4,226
MAINTENANCE	339	1,433	1,772
SUPPLEMENTATION	742	-	742
WORKSHOP EQUIPMENT & TOOLS	28	-	28
LABORATORY EQUIPMENT	12	-	12
SURVEY EQUIPMENT	5	-	5
TOTAL	2,279	4,506	6,785

The total Project Cost can be divided into costs as shown in Table 6-1-2.

Table 6-1-2 TOTAL PROJECT COST (2)

(Rpx10^6)

COST	FOREIGN CURRENCY	LOCAL CURRENCY	TOTAL
CIVIL WORK	769	4,477	5,246
CONSTRUCTION & MAINTENANCE EQUIPMENT	1,350	-	1,350
SPARE PARTS	115	29	144
WORKSHOP/LABORATORY/SURVEY EQUIPMENT	45	-	45
TOTAL	2,279	4,506	6,785

The cost for civil work is composed of the cost of labour and materials, operation cost excluding spare parts, indirect cost and transportation cost of equipment, and ownership cost for existing equipment.

6.1.2 Proposed Road Links

(1) Road Link to be Improved

The road links to be improved were generally selected taking into consideration the following criteria:

(1) Feasible road links
- Feasible road links from the primary evaluation
- Feasible road links from the secondary evaluation

(2) Road links selected from the engineering points of view

(3) Road links selected because of basic human needs.

The road links finally proposed to be improved in the Kabupaten are the 38 links with the total length of 489 km which is 33% of the 1,470 km total length of Kabupaten roads studied. The proposed road links are shown in Table 6-1-3.

Table 6-1-3 ROAD LINKS TO BE IMPROVED

KABUPATEN : MINAHASA

REASON FOR SELECTION	ROAD LINK NO
Feasible	
- Primary	13,28,47,49,51,56,58,67,71,72,79, 82,86,89,91,95,108,151,157
- Secondary	97,140,160
Engineering Point of View	7,9,16,17,18,53,54,59,61,63,65,68, 76,100,137,148
Basic Human Needs	-

As the table shows all feasible road links are proposed to be improved.

Sixteen key road links which are located at the strategic point to complete the local road networks consisting of feasible road links are selected from the engineering points of view.

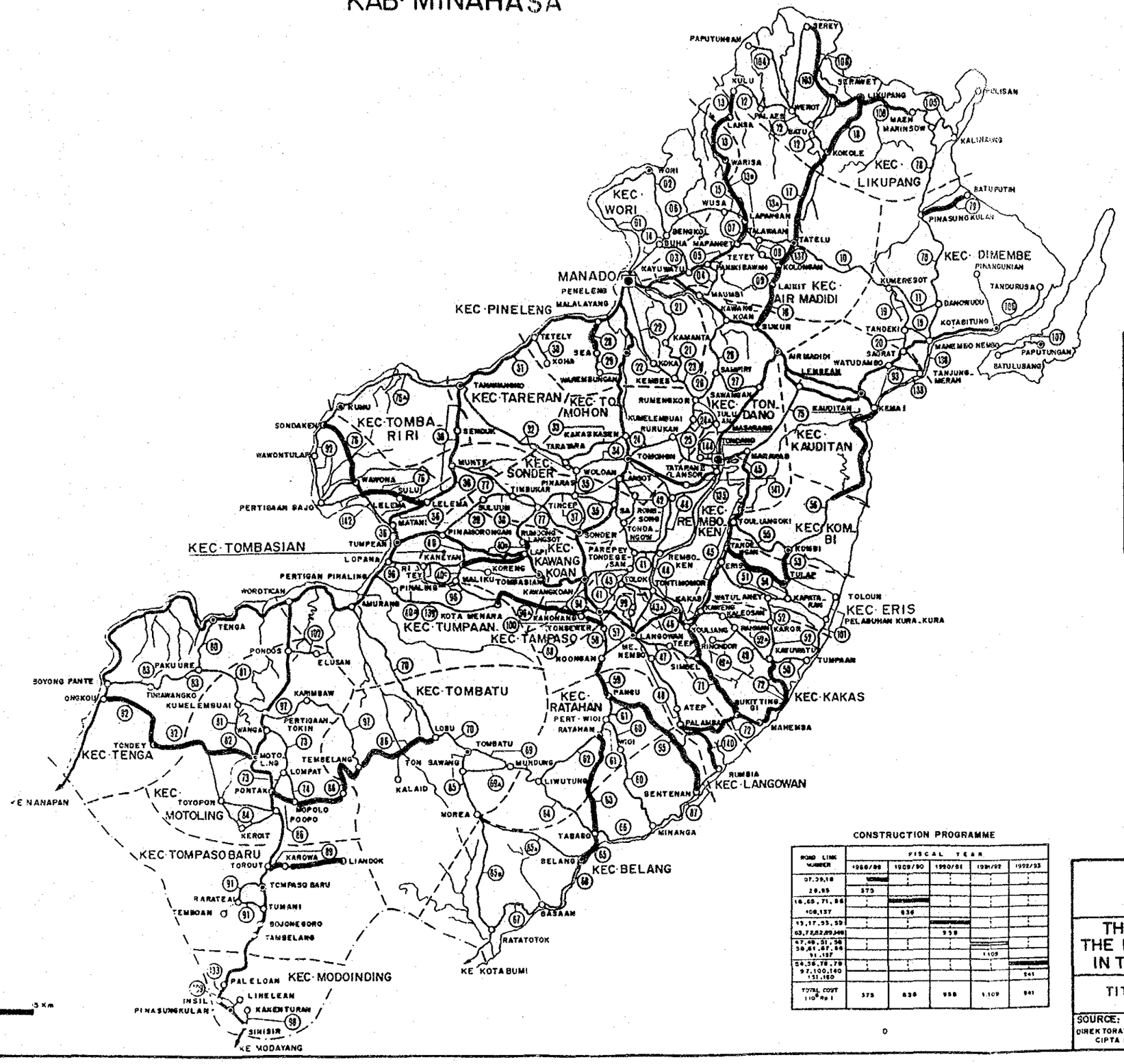
The order of proceeding with the improvement of the proposed road links are decided as shown in Table 6-1-4.

Table 6-1-4 ROAD LINKS TO BE IMPROVED BY YEAR

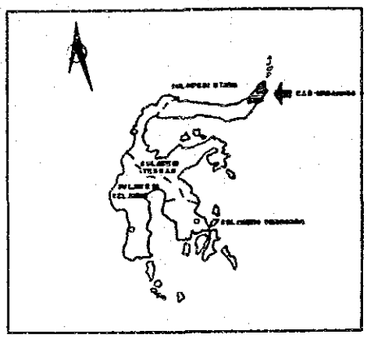
PROV : SULAWESI UTARA KAB : MINAHASA

YEAR	LINK NO ( ) : rate
1988	7, 9, 18, 20, 95
1989	16, 65, 71, 86, 108, 137
1990	13, 17, 53, 59, 63, 72, 82, 89, 148
1991	47, 49, 51, 56 (30%), 58, 61, 67, 68, 91, 157
1992	54, 56 (70%), 76, 79, 97, 100, 140, 151, 160

KAB. MINAHASA



LOCATION MAP



LEGEND :

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

CONSTRUCTION PROGRAMME

ROAD LINK NUMBER	FISCAL YEAR 1988/89	1989/90	1990/91	1991/92	1992/93
07,39,18					
20,95	575				
10,69,71,86					
108,137		636			
19,17,55,59					
63,75,82,89,148			958		
47,49,51,56 50,61,67,84 91,157				1109	
54,56,78,79 97,100,140 151,180					941
TOTAL COST 10^6 Rp.	575	636	958	1.109	941

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

TITLE : CONSTRUCTION PROGRAMME

SOURCE:	SCALE:	PROVINCE : SULAWESI UTARA
DIREKTORAT JENDERAL CIPTA KARYA	AS SHOWN	KABUPATEN : MINAHASA

(2) Road Links to Be Maintained

It is desirable that all Kabupaten roads are maintained. However, because of the limited budget it is inevitable that some road links in the Kabupatens will be left without maintenance for the time being. The budget should be used for those which are effective in producing more useful development of the Kabupaten through the road development project. The road links to be maintained are finally proposed as shown in Table 6-1-5.

Table 6-1-5 (1) ROAD LINKS TO BE MAINTAINED

PROV : SULAWESI UTARA KAB : MINAHASA

(1000Rp)

LINK NO	LENGTH (Km)	BA (%)	SD (%)	RU (%)	RB (%)	ASPHAL (Km)	GRAVEL (Km)	EARTH (Km)	TN NO	AREA (m2)	RC NO	AREA (m2)	BRIDGE COST	LOCAL COST	FOREIGN COST	TOTAL COST
1	18	48.9	23.6	19.4	8.1	6	12	0	0	0.00	0	0.00	0	8,807	2,058	10,865
2	10	54.1	0.0	43.9	2.0	6	4	0	0	0.00	2	71.25	510	5,837	1,464	7,301
4	6	74.8	18.5	6.7	0.0	5	1	0	0	0.00	2	67.20	481	3,936	1,016	4,952
8	11	54.6	29.9	15.5	0.0	11	0	0	0	0.00	0	0.00	0	7,045	1,672	8,717
9	2	60.0	20.0	20.0	0.0	2	0	0	0	0.00	0	0.00	0	1,281	304	1,585
11	8	82.9	12.1	5.0	0.0	8	0	0	0	0.00	0	0.00	0	5,123	1,216	6,339
12	15	52.0	9.3	24.0	14.7	6	6	3	0	0.00	0	0.00	0	7,240	1,620	8,860
14	4	92.5	4.5	3.0	0.0	3	1	0	1	92.00	0	0.00	1,110	3,233	762	3,995
15	6	65.0	35.0	0.0	0.0	2	4	0	0	0.00	0	0.00	0	2,936	686	3,622
16	6	75.8	19.2	5.0	0.0	6	0	0	0	0.00	0	0.00	0	3,843	912	4,755
17	12	25.0	40.0	34.9	0.1	12	0	0	0	0.00	0	0.00	0	7,685	1,824	9,509
19	11	85.2	14.8	0.0	0.0	11	0	0	0	0.00	0	0.00	0	7,045	1,672	8,717
22	13	83.1	16.9	0.0	0.0	13	0	0	0	0.00	0	0.00	0	8,326	1,975	10,301
24	10	65.0	0.0	35.0	0.0	10	0	0	0	0.00	0	0.00	0	6,404	1,520	7,924
25	6	23.3	35.0	41.7	0.0	6	0	0	0	0.00	0	0.00	0	3,843	912	4,755
30	3	16.7	73.3	10.0	0.0	3	0	0	0	0.00	0	0.00	0	1,921	456	2,377
32	25	54.8	26.9	18.3	0.0	25	0	0	0	0.00	0	0.00	0	16,011	3,799	19,810
34	5	93.4	1.0	5.6	0.0	5	0	0	0	0.00	0	0.00	0	3,202	760	3,962
38	11	15.9	76.4	7.7	0.0	11	0	0	0	0.00	0	0.00	0	7,045	1,672	8,717
39	9	12.8	50.0	37.2	0.0	9	0	0	2	121.50	1	40.50	1,755	7,143	1,743	8,886
43	4	78.8	7.5	13.8	0.0	4	0	0	0	0.00	0	0.00	0	2,562	608	3,170
44	24	71.5	27.9	0.6	0.0	24	0	0	0	0.00	1	8.40	60	15,410	3,667	19,077
54	14	35.0	61.4	3.6	0.0	12	2	0	0	0.00	0	0.00	0	8,513	2,014	10,527
55	8	72.5	27.5	0.0	0.0	8	0	0	0	0.00	0	0.00	0	5,123	1,216	6,339

Table 6-1-5 (2) ROAD LINKS TO BE MAINTAINED

PROV : SULAWESI UTARA KAB : MINAHASA

(1000Rp)

LINK NO	LENGTH (Km)	BA (%)	SD (%)	RU (%)	RB (%)	ASPHAL (Km)	GRAVEL (Km)	EARTH (Km)	TN NO	AREA (m2)	BC NO	AREA (m2)	BRIDGE COST	LOCAL COST	FOREIGN COST	TOTAL COST
56	34	12.6	63.2	24.1	0.0	34	0	0	0	0.00	0	0.00	0	21,775	5,167	26,942
57	6	99.0	1.0	0.0	0.0	6	0	0	0	0.00	0	0.00	0	3,843	912	4,755
59	5	15.0	60.0	25.0	0.0	5	0	0	0	0.00	0	0.00	0	3,202	760	3,962
60	14	15.7	47.9	27.9	8.6	14	0	0	0	0.00	0	0.00	0	8,966	2,127	11,093
61	10	48.5	22.5	29.0	0.0	9	1	0	0	0.00	0	0.00	0	6,178	1,463	7,641
62	16	50.9	7.2	32.8	9.1	16	0	0	0	0.00	0	0.00	0	10,247	2,431	12,678
65	3	31.7	48.3	20.0	0.0	3	0	0	0	0.00	0	0.00	0	1,921	456	2,377
68	7	20.0	45.0	35.0	0.0	7	0	0	0	0.00	0	0.00	0	4,483	1,064	5,547
73	11	78.6	0.0	13.2	8.2	11	0	0	0	0.00	0	0.00	0	7,045	1,672	8,717
85	6	53.3	8.3	38.3	0.0	6	0	0	0	0.00	0	0.00	0	3,843	912	4,755
94	3	83.3	0.0	16.7	0.0	3	0	0	0	0.00	0	0.00	0	1,921	456	2,377
101	15	38.7	25.3	36.0	0.0	15	0	0	0	0.00	0	0.00	0	9,606	2,279	11,885
102	3	92.7	0.0	7.3	0.0	3	0	0	0	0.00	0	0.00	0	1,921	456	2,377
106	3	90.0	0.0	10.0	0.0	3	0	0	0	0.00	0	0.00	0	1,921	456	2,377
135	7	83.6	15.0	1.4	0.0	7	0	0	0	0.00	0	0.00	0	4,483	1,064	5,547
147	2	40.0	20.0	25.0	15.0	2	0	0	0	0.00	0	0.00	0	1,281	304	1,585
160	12	20.8	34.2	45.0	0.0	12	0	0	0	0.00	0	0.00	0	7,685	1,824	9,509
SUM	398					364	31	3	3	213.50	6	187.35	3,915	249,835	59,351	309,186

6.1.3 Annual Construction and Maintenance Cost

The annual allocation of the total construction and maintenance cost in the five years programme for Kabupaten Minahasa is finally recommended as shown in Tables 6-1-6 (1), (2) and (3) for the construction, maintenance and total respectively.

The proposed construction cost is Rp 4,226 x 10^6 and maintenance cost is Rp 1,772 x 10^6 which is approximately 30% of the total expenditure.

Table 6-1-6 (1) CONSTRUCTION AND MAINTENANCE COST
(CONSTRUCTION)

PROV : SULAWESI UTARA KAB : MINAHASA

(UNIT : 1000Rp)

ITEM	(1988)	(1989)	(1990)	(1991)	(1992)	(TOTAL)	
LOCAL CURRENCY :	235,456	594,432	660,498	709,287	630,673	2,830,346	(67.2%)
Ownership Cost	3,379	11,042	10,745	10,781	10,013	45,960	(1.6%)
Operation Cost	92,401	292,121	285,136	293,313	270,997	1,233,968	(43.5%)
Material Cost	49,172	39,969	80,415	132,828	95,485	397,869	(14.0%)
Labour Cost	59,792	173,765	205,007	179,849	171,916	790,329	(27.8%)
Contingency	30,712	77,535	87,195	92,516	82,262	370,220	(13.0%)
FOREIGN CURRENCY :	140,383	243,151	291,103	400,412	312,470	1,387,519	(32.8%)
Ownership Cost	46,113	147,985	142,085	145,815	133,777	615,775	(44.4%)
Operation Cost	6,281	21,498	20,349	20,352	19,036	87,516	(6.3%)
Material Cost	69,678	41,953	90,699	182,017	118,900	503,247	(36.3%)
Labour Cost	0	0	0	0	0	0	(0.0%)
Contingency	18,311	31,715	37,970	52,228	40,757	180,981	(13.0%)
TOTAL COST :	375,838	837,583	959,601	1,109,698	943,143	4,225,863	
Ownership Cost	49,492	159,027	152,830	156,596	143,790	661,735	(15.7%)
Operation Cost	98,682	313,619	305,485	313,665	290,033	1,321,484	(31.3%)
Material Cost	118,850	81,922	171,114	314,845	214,385	901,116	(21.3%)
Labour Cost	59,792	173,765	205,007	179,849	171,916	790,329	(18.7%)
Contingency	49,022	109,250	125,165	144,743	123,019	551,199	(13.0%)

(Contingency : 15%)

Table 6-1-6 (2) CONSTRUCTION AND MAINTENANCE COST

(MAINTENANCE)

PROV : SULAWESI UTARA KAB : MINAHASA

(UNIT : 1000Rp)

ITEM	(1988)	(1989)	(1990)	(1991)	(1992)	(TOTAL)	
LOCAL CURRENCY :	124,575	268,533	305,693	346,110	388,578	1,433,489	(80.9%)
Ownership Cost	1,720	3,700	4,134	4,623	5,152	19,329	(1.3%)
Operation Cost	43,194	93,530	111,106	129,038	145,128	521,996	(36.4%)
Material Cost	3,376	7,236	7,732	8,379	10,330	37,053	(2.6%)
Labour Cost	76,285	164,067	182,721	204,070	227,968	855,111	(59.7%)
FOREIGN CURRENCY :	29,606	63,816	72,434	81,818	91,483	339,157	(19.1%)
Ownership Cost	18,717	40,537	48,223	54,043	63,057	226,577	(66.8%)
Operation Cost	2,254	4,883	5,848	6,826	7,684	27,495	(8.1%)
Material Cost	8,635	18,396	18,363	18,949	20,742	85,085	(25.1%)
Labour Cost	0	0	0	0	0	0	(0.0%)
TOTAL COST :	154,181	332,349	378,127	427,928	480,061	1,772,646	
Ownership Cost	20,437	44,237	52,357	60,666	68,209	245,906	(13.9%)
Operation Cost	45,448	98,413	116,954	135,864	152,812	549,491	(31.0%)
Material Cost	12,011	25,632	26,095	27,328	31,072	122,138	(6.9%)
Labour Cost	76,285	164,067	182,721	204,070	227,968	855,111	(48.2%)

Table 6-1-6 (3) CONSTRUCTION AND MAINTENANCE COST

(TOTAL)

PROV : SULAWESI UTARA KAB : MINAHASA

(UNIT : 1000Rp)

ITEM	(1988)	(1989)	(1990)	(1991)	(1992)	(TOTAL)	
LOCAL CURRENCY :	360,031	862,965	974,191	1,055,397	1,019,251	4,271,835	(71.2%)
Ownership Cost	5,099	14,742	14,879	15,404	15,165	65,289	(1.5%)
Operation Cost	135,595	385,651	396,242	422,351	416,125	1,755,964	(41.1%)
Material Cost	52,548	47,205	88,147	141,207	105,815	434,922	(10.2%)
Labour Cost	136,077	337,832	387,728	383,919	399,884	1,645,440	(38.5%)
Contingency	30,712	77,535	87,195	92,516	82,262	370,220	(8.7%)
FOREIGN CURRENCY :	169,989	306,967	363,537	482,230	403,953	1,726,676	(28.8%)
Ownership Cost	64,830	188,522	190,308	201,858	196,834	842,352	(48.8%)
Operation Cost	8,535	26,381	26,197	27,178	26,720	115,011	(6.7%)
Material Cost	78,313	60,349	109,062	200,966	139,642	588,332	(34.1%)
Labour Cost	0	0	0	0	0	0	(0.0%)
Contingency	18,311	31,715	37,970	52,228	40,757	180,981	(10.5%)
TOTAL COST :	530,019	1,169,932	1,337,728	1,537,626	1,423,204	5,998,509	
Ownership Cost	69,929	203,264	205,187	217,262	211,999	907,641	(15.1%)
Operation Cost	144,130	412,032	422,439	449,529	442,845	1,870,975	(31.2%)
Material Cost	130,861	107,554	197,209	342,173	245,457	1,023,254	(17.1%)
Labour Cost	136,077	337,832	387,728	383,919	399,884	1,645,440	(27.4%)
Contingency	49,022	109,250	125,165	144,743	123,019	551,199	(9.2%)

(Contingency : 15%)

6.1.4 Construction and Maintenance Equipment Cost

(1) Required Number of Equipment

The required numbers of construction equipment for Kabupaten Minahasa are estimated from the annual proposed construction quantities as shown in Table 6-1-7.

The proposed numbers of equipment to be purchased are finally decided considering the following number of existing equipment in the Kabupaten which are available for the Project .

- 1-Bulldozer
- 2-Motor Grader
- 12-Dump Truck

The proposed numbers of maintenance equipment have been decided as shown below from the proposed annual maintenance volume taking into account the capacity of the proposed maintenance gangs.

a. Equipment for Road Maintenance

- 2-Motor Grader 75 HP
- 2-Tire Roller 8-15 Ton
- 2-Dump Truck 3 Ton
- 2-Hand Guided Vibratory Roller 1000 Kg
- 2-Flat Bed Truck 3 Ton

b. Equipment for Bridge Maintenance

- 2-Flat Bed Truck with Grane 3 Ton

(2) Equipment Cost

The proposed construction and maintenance equipment and their purchase costs are shown in Table 6-1-8. In the Project the supplementation cost or equipment cost supplemented is the difference between the purchase cost for newly supplied equipment and the depreciated value.

This comes about because full depreciation of the supplied equipment would not be completed within the Project Period of 5 years.

Table 6-1-7 REQUIRED NUMBER OF EQUIPMENT

PROV : SULAWESI UTARA KAB : MINAHASA

EQUIPMENT NAME	WORKABLE	EXISTING	(1988)	(1989)	(1990)	(1991)	(1992)
Bulldozer/Ripper	170	0	0.33	2.01	1.73	1.97	1.74
Swamp Bulldozer	170	0	0.01	0.04	0.01	0.01	0.01
Motor Grader	190	0	0.81	3.13	3.05	2.86	2.90
Hand-guide Vib. Roller	190	0	0.29	0.70	1.17	1.68	0.89
Tire Roller	170	0	0.91	0.40	1.00	2.29	1.48
Vibratory Roller (D&T)	190	0	0.57	2.57	2.35	2.20	2.33
Hydraulic Excavator; Wheel	170	0	0.07	0.21	0.01	0.12	0.29
Wheel Loader	190	0	1.12	4.19	3.76	3.80	3.54
Water Tank Truck	190	0	0.36	1.59	1.35	1.14	1.30
Dump Truck	190	0	10.00	34.70	34.21	32.14	31.14
Flat Bed Truck with Crane	190	0	0.06	0.36	0.47	0.31	0.30
Flat Bed Truck	190	0	1.00	0.60	1.21	2.58	1.71
Portable Crusher/Screening	190	0	0.32	0.61	0.57	0.59	0.41
Concrete Mixer	170	0	0.03	0.20	0.11	0.12	0.10
Water Pump	170	0	0.02	0.15	0.10	0.09	0.08
Concrete Vibrator	170	0	0.02	0.06	0.07	0.05	0.04
Asphalt Sprayer	170	0	0.91	0.40	1.00	2.29	1.48

NOTE WORKABLE : workable days in a year
EXISTING : number of existing equipment

Table 6-1-8 EQUIPMENT PURCHASE COST

PROV : SULAWESI UTARA KAB : MINAHASA

(1000 Rp)

EQUIPMENT NAME	CLASS	CIF (JAKARTA)	PURCHASE NO.	PURCHASE COST
Bulldozer	90 HP	49,150	-	-
Bulldozer/Ripper	90 HP	53,000	1	53,000
Swamp Bulldozer	90 HP	52,850	-	-
Swamp Bulldozer	65 HP	40,500	-	-
Motor Grader	75 HP	47,800	3	143,400
Road Stabilizer	W=1850 mm	85,950	-	-
Hand-guide Vib. Roller	1000 Kg	8,500	2	17,000
Tire Roller	8-15 ton	31,070	2	62,140
Vibratory Roller (D&T)	4 ton	29,000	3	87,000
Vibratory Roller	4 ton	29,000	-	-
Rough Terrain Crane	10 ton	100,400	-	-
Hydraulic Excavator; Wheel	0.3 m3	41,100	1	41,100
Wheel Loader	1.2 m3	70,200	4	280,800
Water Tank Truck	4000 ltr.	12,750	2	25,500
Dump Truck	3.0 ton	14,700	20	294,000
Dump Loader Truck	12 ton	56,300	1	56,300
Flat Bed Truck with Crane	3.0 ton	25,190	1	25,190
Flat Bed Truck	3.0 ton	11,275	3	33,825
Portable Crusher/Screening	30-40 t/h	188,000	1	188,000
Concrete Mixer	0.5 m3	18,000	-	-
Water Pump	200 l/min	630	-	-
Concrete Vibrator	3.3 HP	740	-	-
Asphalt Sprayer	850 ltr.	10,200	1	10,200
Service Car	3 ton	11,600	1	11,600
4 Wheel Drive Vehicle	70 HP	17,500	1	17,500
Motorcycle	100 cc	1,100	3	3,300

PURCHASE COST TOTAL	1,349,855
OWNERSHIP COST (FOREIGN)	607,545
EQUIPMENT COST SUPPLEMENTED	742,310

NOTE : OWNERSHIP COST (FOREIGN) for Existing Equipment

Bulldozer/Ripper	20,953
Motor Grader	41,775
Dump Truck	172,079
TOTAL	234,807

6.1.5 Other Costs

Cost other items includes the costs of workshop equipment and tools, laboratory test equipment and survey equipment which are recommended in Sub-Clause 3.5. These total costs are summarized in Table 6-1-1.

6.1.6 Quantities by Work Type

The annual construction and maintenance quantities for all proposed road links are shown in Table 6-1-9.

Table 6-1-9 CONSTRUCTION QUANTITIES FOR ALL PROPOSED LINKS

PROV : SULAWESI UTARA KAB : MINAHASA

I T E M	UNIT	(1988)	(1989)	(1990)	(1991)	(1992)	(TOTAL)
Site Clearance in Light Bush	m2	1500.00	95150.00	80500.00	94600.00	80500.00	352250.00
Subgrade Preparation	m2	34215.00	373186.00	357621.50	275106.00	331765.00	1371893.50
Normal Fill	m3	10.00	3915.00	30.00	715.00	400.00	5070.00
Fill in Swamp	m3	64.10	1162.60	3.10	180.50	166.10	1576.40
Normal Excavation to Spoil	m3	818.00	14998.00	8607.00	9475.00	9869.00	43767.00
Sub Base Course	m3	6913.80	34479.20	31435.00	28344.50	34966.30	136138.80
Base Course	m3	7120.00	18060.00	13985.00	9785.00	7660.00	56610.00
Shoulder	m2	72500.00	237000.00	273000.00	303000.00	264500.00	1150000.00
Asphalt Patching	m2	1609.00	971.00	5898.00	9898.10	3873.90	22250.00
Surface Dressing (Single)	m2	111000.00	49000.00	121500.00	279200.00	180300.00	740000.00
Surface Dressing (Double)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Earth Drain	m	25680.00	83100.00	98480.00	53840.00	71240.00	332340.00
Earth Drain in Swamp (by machine)	m3	900.00	2730.00	90.00	1560.00	3900.00	9180.00
Pipe Culvert D80cm	m	65.00	321.00	374.00	254.70	221.30	1236.00
Masonry Culvert (80x80cm)	m	0.00	0.00	0.00	5.00	5.00	10.00
Retaining Wall and Wing Wall (Timber)	m2	0.00	0.00	30.00	80.00	0.00	110.00
Retaining Wall and Wing Wall (Masonry)	m3	22.80	243.60	80.00	109.16	99.44	555.00
Gabion Protection	m3	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Timber;Span 3m;10T)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Timber;Span 5m;10T)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Timber;Span 8m;10T)	m2	0.00	0.00	200.00	60.00	88.00	348.00
Superstructure (Timber;Span 3m;BM50)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Timber;Span 5m;BM50)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Timber;Span 8m;BM50)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Concrete;Span 3m;BM50)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Concrete;Span 5m;BM50)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Concrete;Span 8m;BM50)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Concrete;Span10m;BM50)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Concrete;Span15m;BM50)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Substructure (Pier;for Timber;10T)	NO	0.00	0.00	6.00	1.00	1.00	8.00
Substructure (Abut;for Timber;10T)	NO	0.00	0.00	2.00	2.00	4.00	8.00
Substructure (Pier;for Timber;BM50)	NO	0.00	0.00	0.00	0.00	0.00	0.00
Substructure (Abut;for Timber;BM50)	NO	0.00	0.00	0.00	0.00	0.00	0.00
Substructure (Pier;for Concrete;BM50)	NO	0.00	0.00	0.00	0.00	0.00	0.00
Substructure (Abut;for Concrete;BM50)	NO	0.00	0.00	0.00	0.00	0.00	0.00
Demolition of Bridge (Timber->Timber)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Demolition of Bridge (Timber->Concrete)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Demolition of Bridge (Concrete)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Manual routine maintenance of road	Km	198.50	430.50	520.50	611.40	688.10	2449.00
Routine maintenance of earth road	Km	1.50	3.00	3.00	3.00	3.00	13.50
Routine maintenance of gravel road	Km	15.50	41.00	132.00	210.50	251.00	650.00
Routine maintenance of asphalt road	Km	181.50	386.50	385.50	397.90	434.10	1785.50
Maintenance of Timber Bridge (New)	m2	0.00	0.00	0.00	0.00	200.00	200.00
Maintenance of Concrete Bridge (New)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Maintenance of Timber Bridge (Exist)	m2	106.75	213.50	213.50	213.50	237.50	984.75
Maintenance of Concrete Bridge (Exist)	m2	93.67	217.35	249.35	249.35	273.35	1083.08

6.2 Organization and Construction System

6.2.1 Organization

The Bupati as head of the Kabupaten has been authorized by Law No. 13, 1980 as an official responsible for the Local Road Development Project implementation. This means that the DPUK is considered as a responsible agency for the actual execution of the Project.

According to instruction letter dated June 24, 1982 Ref. No. 620/975-/BANGDA, the Project Manager appointed by the Bupati will be responsible for the operation and maintenance of the equipment. Accordingly the Equipment Coordinator appointed from the staff of the Regional Public Works (Kantor Wilayah) by Bina Marga as a coordinator between the Governor and the Bupati will be responsible for delivery, effectual utilization and maintenance of the equipment.

The standard organization of DPUK consists of a minimum of four sections, i.e. Road Section, Housing and City Planning Section, Irrigation Section and Administration Section. For execution of the Project it is strongly recommended that the structural organization of DPUK is established. It will be necessary not only to organize new sections but also to reorganize the current structure through a review of the roles and responsibilities of each inter-related section.

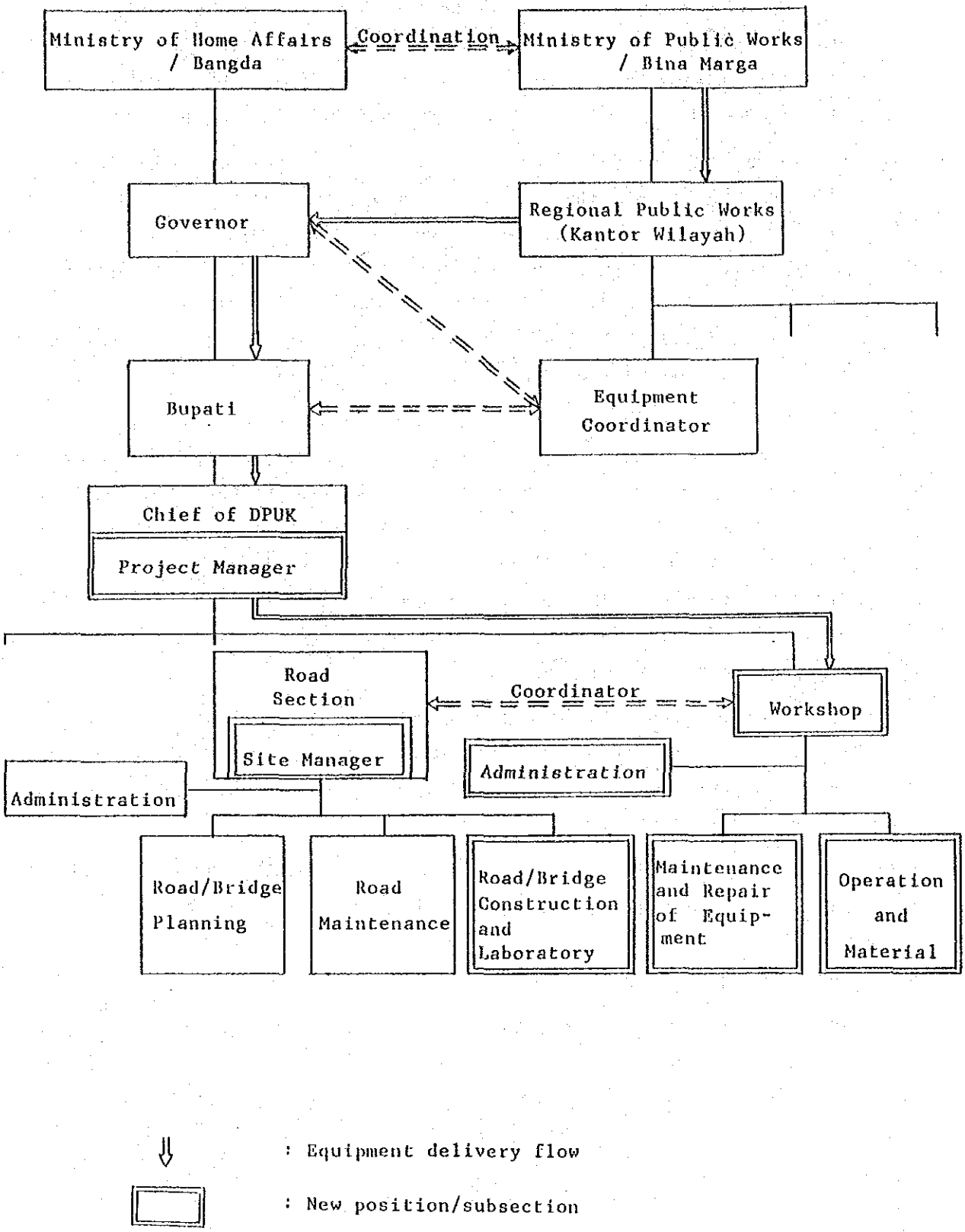
It is recommended that the workshop is newly organized to consist of three sub-sections, i.e. maintenance and repair of equipment, operation and materials, and administration to execute the main tasks described in Clause 3.5.

The sub-section of laboratory would be under the relevant Road Section. The proposed organization is shown in Fig. 6-2-1.

6.2.2 Construction System

For the construction of Kabupaten roads with a ten year effective design life, it has been recommended in Clause 3.4 that the equipment intensive method should be adopted for earth work and pavement work with the exception of surface dressing.

Fig. 6-2-1 PROPOSED ORGANIZATION



Current road construction in the Kabupatens is obliged to rely upon the traditional labour intensive method. It is therefore assumed that both the DPUK and the local contractors in the Kabupatens do not have sufficient experience and technique for the equipment intensive method of road construction.

For realization of the Local Road Development Project the GOI has ensured availability of the required human resources of DPUK and intends to conduct training programmes for those human resources as described in Clause 8.3 of the Main Report. This means that the GOI intends the Kabupatens to have the ability to execute the Project by force account (Swakelola).

It should be recognized from the experiences in the first local road project, which was assisted by OECF, ADB and IBRD, that because of their poor construction management and traditional labour intensive methods most of the road construction by local contractors could not be completed within the contract periods. Therefore execution of the road improvement by force account is desirable as recommended from their experience by the consultants for the first local road project.

It is strongly recommended that except for labourers the staff of the force account team should not be hired by the day as it would then not be able to consolidate the foundations for development of self reliability.

However, it will be very difficult to execute all the Projects by force account because of the need for many Kabupaten staff. The GOI has emphasized the need to promote the employment of local weak contractors in order to up-grade their capability in the road project schemes within the Fourth Five-Year Plan (REPELITA)

Taking into consideration the conditions mentioned above it is strongly recommended that the DPUK is obliged to lend some equipment with skilled operators to the local contractors in the Kabupatens for the execution of a part of the road improvement works.

The types of work executed only by force account are recommended as follows:

- Routine maintenance work for the Kabupaten roads
- Laboratory tests
- Production of crushed stone
- Technical service for the equipment