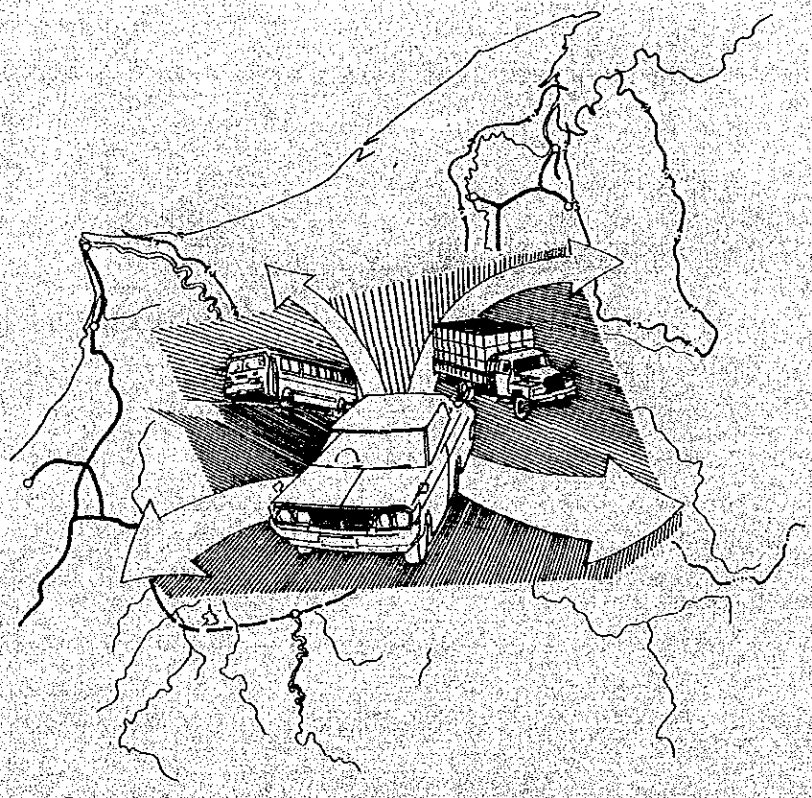
Chapter 3

PRESENT TRAFFIC CONDITION OF THE STUDY AREA



3-1 TRANSPORT NETWORK

3-1-1 General

Transport Network in the Study Area consists of road, river, air and coastal shipping. As is shown in Fig. 3-1 the roads at present serve only very limited parts of the area while the rivers provide the only real mode of transport in the remainder of the area. Although the main population centres in the Study Area are served by regular MAS air service, its capacity is very limited.

Coastal shipping plays an important role in transporting goods between the Study Area and other areas such as to Kuching, Sibu, Sabah and to foreign countries rather more than the three existing ports of Miri, Marudi and Limbang. A land linkage utilizing two ferries and a passenger ferry operating between Miri and Limbang via Brunei exists.

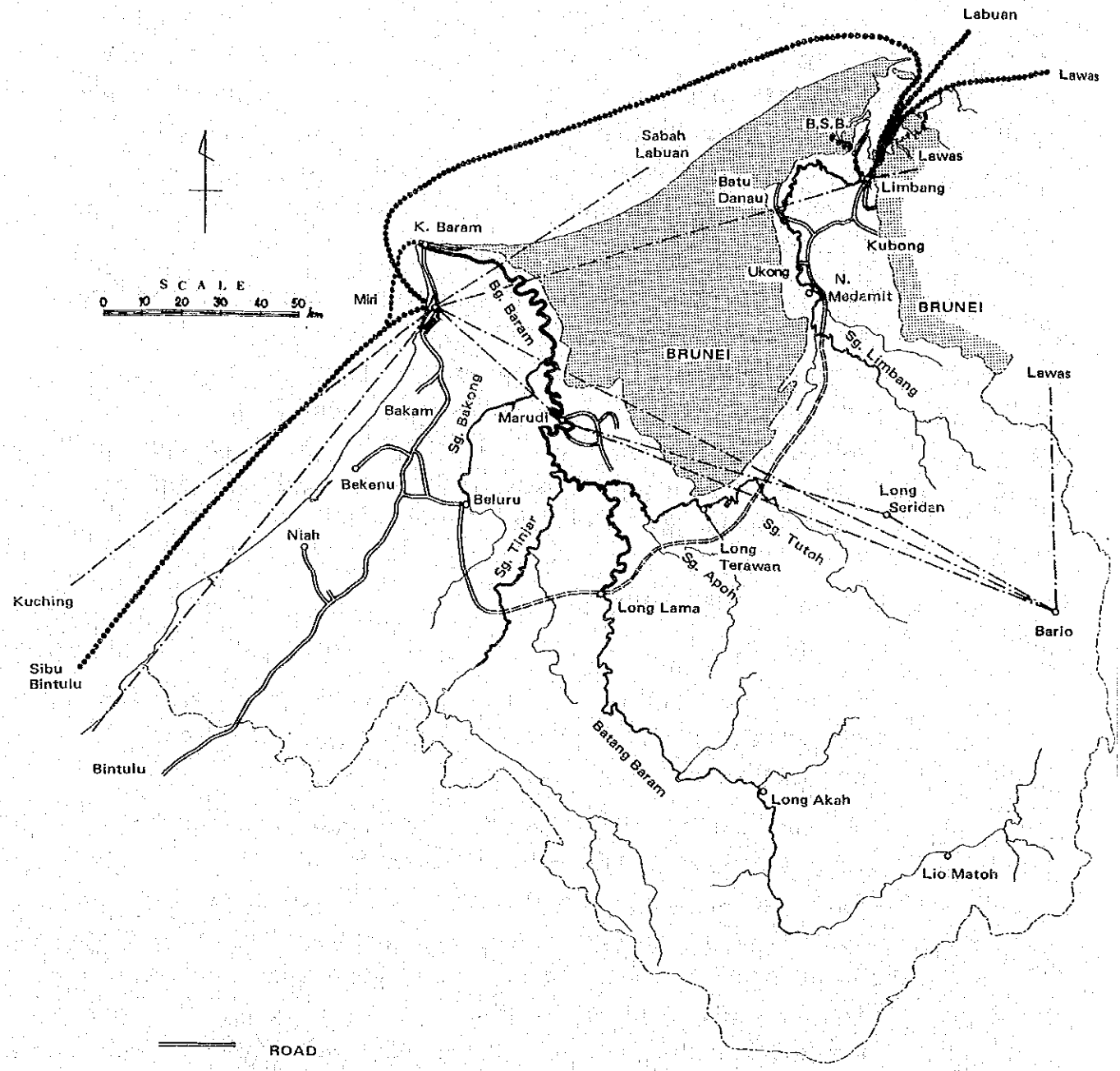
3-1-2 Present Conditions

(1) Roads

Roads serve most of the Miri Districts, the northern half of the Limbang District and the isolated Marudi area and its near vicinities.

The Miri-Bintulu Road having been completed in the early 1970s with the trunk road standard, is a 130 km (81.3 miles) long gravel road except for some 10 km (6.3 miles) from Miri which is surfaced.
The feeder roads branching from there link Bakamu, Niah, Beluru etc. This road further extends to Kuala Baram where the ferry operates from and then to the Brunei border where the road links with a trunk road in Brunei. Most of the road sections are bitumen surfaced with two lanes. The road section between Beluru and Sg. Tinjar is currently under construction using trunk road standards and at this time only a few miles remain before its completion. The Limbang - Ng. Medamit Road

Fig. 3-1 TRANSPORT NETWORK OF THE STUDY AREA



covering 41 km(25.6 miles) utilizing a feeder road standard has several feeder roads branching from it serving the major population centres of the Limbang District. Most of the sections of these roads are of gravel except those in Limbang town and its vicinity. Feeder roads of some 30 km(18.8 miles) exist in the Marudi areas of which the main link is between Marudi and Lubok Nibong with some sections in Marudi town being bitumen surfaced.

(2) River

The river system extensively covers most of the Study Area. The Bg. Baram and its major tributeries of Sg. Bakon, Sg. Tinjar, Sg. Apoh and Sg. Tutoh serve nearly the whole of the Baram District while Sg. Limbang and its tributeries serve the Limbang District. In these areas natural communities have been developed along these navigable water ways.

Bg. Baram, the second largest river in Sarawak, is abundant in water throughout the year and provides a reliable water transport channel for the maximum 400 ton motor vessels, barges etc. from Kuala Baram to Long Lama, 225 km(141 miles) upriver. The passenger express launches with capacities of 60-80 passengers are also operating daily on the K. Baram - Marudi - Long Lama section. Other major sections of the system are also navigable for smaller vessels with capacities of 10 to 30 tons depending on the water level. For long boats which are the most popular personal means of transport, most of the rivers are navigable all the year round. The Sg. Limbang is also a relatively sizable river system and plays an important role in transporting logs from Ng. Medamit to Limbang over 100 km(62.5 miles).

The Sg. Limbang system is navigable for longboats though some sections in the upper reaches have navigational difficulties during periods when the water level

is low as also occurs in the upper reaches of the Bg. Baram system as well.

(3) Coastal Shipping

The ports in the Study Area being located in Miri, Marudi and Limbang are the basis of external trade of which Miri is the most important. Shipping between Miri and destinations within the South China Sea is at present mainly served by 1,500 to 3,000 ton vessels employing literage service in transporting goods to and from Miri to the open anchorage outside Miri. Shallow draft vessels able to cross the Miri sand bar with 300 to 400 ton cargo goods at high tides are also being operated between Miri, Kuching, Sibu and neighbouring countries.

The small coasters having shallow draft can avoid the difficult stevedoring operation at Miri Roads therefore being able to compete with larger ships in economy even for the section between Singapore and Miri. Kuala Baram is better situated having a water depth at the Baram bar of about 2.7 m.(9feet) at high tide which can facilitate the use of shallow draft vessels with up to 1,500 tons loading capacity but however Kuala Baram is situated some 25 km(15.6 miles) from Miri, which necessitates the need for trucking to Miri at a cost of some M$5 to M$6 per ton.

Marudi is at present served by shipping services to Singapore and Peninsular Malaysia via trans-shipment Labuan with frequent launch services to/from Kuching, Sibu and Miri via Kuala Baram being also available. The Bg. Baram is sufficiently wide and deep at Marudi to facilitate calls of shallow draft vessels with loading capacity of up to about 1,000 to 1,500 tons. It would, however, be necessary to construct new and better port facilities to accomodate the larger vessels. Goods transport demand through Marudi port was approximately 24,000 tons in 1977, thus the most popular kind of

vessels are those with loading capacity of up to 200 tons.

Limbang is at present also served by shipping services as has been described for Marudi. The bar at the mouth of the Sg. Limbang restricts calls of vessels with loading capacities of more than 300 to 500 tons depending on the vessel type. During the "landas season" the vessels often face difficulties in crossing the bar with the result that ship calls are reduced to approximately 40 percent of normal operation.

(4) Air

At present, five airports exist in the Study Area, these being Miri, Marudi, Limbang, Long Seridan and Bario. Miri Airport has facilities to handle aircraft types up to that of the Boeing 737, which began utilizing the airport in 1977, but at the remainder of the airports only small aircraft such as the BN2 with a limited passenger capacity of only eight can be facilitated. Augmenting the regular service by MAS, frequent charter flights operated by other companies are available.

Expansion of Limbang Airport currently under study envisage facilities having the ability to handle aircraft of the Boeing 737 type.

3-2 OUTLINE OF THE TRAFFIC SURVEYS

At present comprehensive traffic data, covering the Study Area, is scarce in its availability. As of road traffic, however, the traffic count figures at major points have been adequatly prepared with traffic counts covering a complete week during each census period having been carried out twice a year since the early 1970s, although no origin and destination surveys have been conducted. Statistics of air passenger and cargo movements were available at the Department of Civil Aviation in each of the Districts. Statistics of imports and exports by port were compiled by the Statistical Department in the form of computer outputs. However the port statistics indicate only the external movements of goods. Information on river traffic and coastal shipping traffic in the Study Area was actually not at all available.

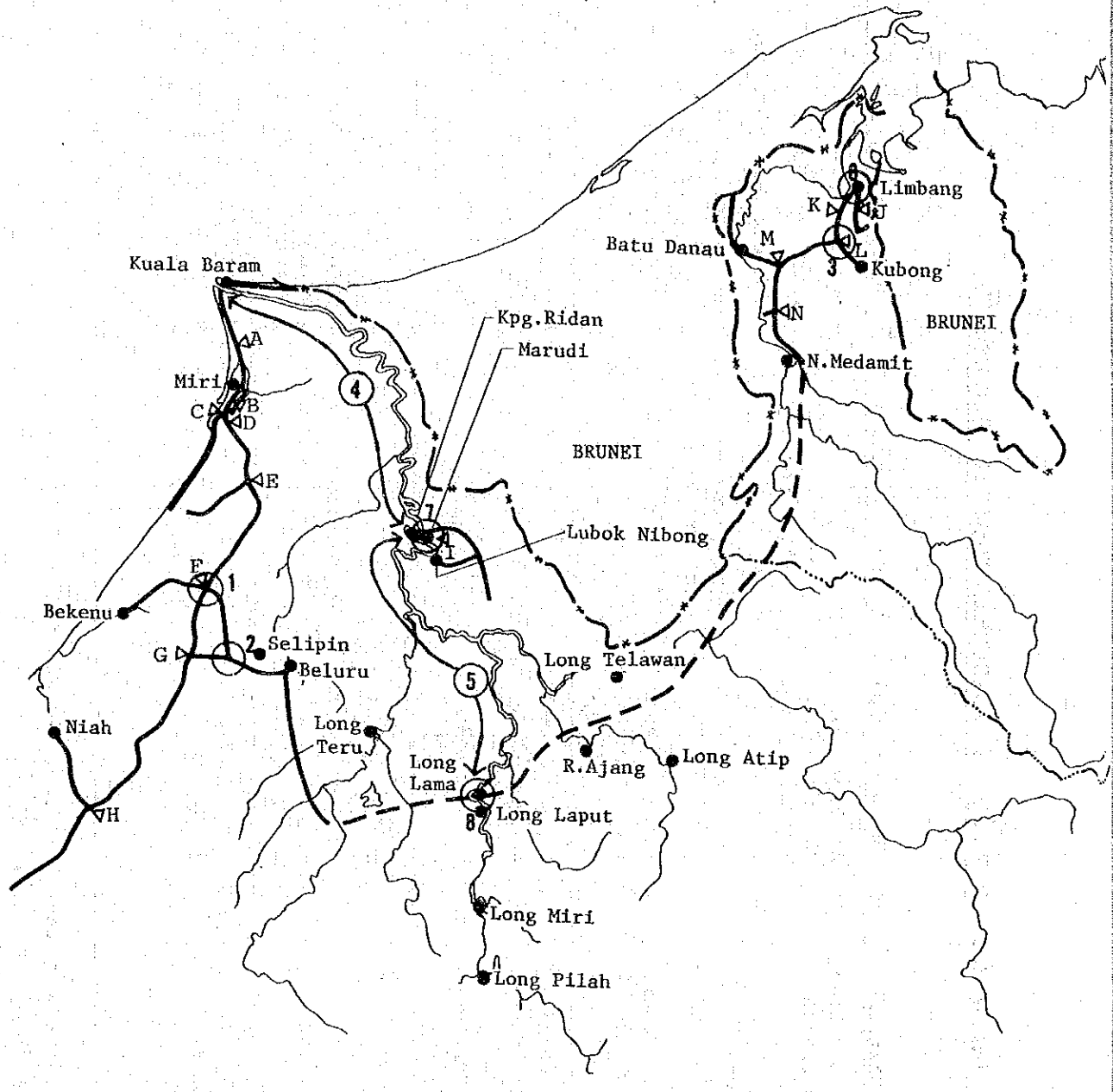
In order, therefore, to obtain characteristics and distribution of traffic particularly by river and road, different types of traffic surveys were conducted as shown in Table 3-1. The location of the survey stations is shown in Fig. 3-2.

Table 3-1 OUTLINE OF CONDUCTED TRAFFIC SURVEYS 1/

Traffic Type		Survey Station	Survey Period	Survey Method	Major Survey Items
Road Traffic	1	Miri-Bintulu Road, Bekenu Junction	27 July (Thu.), 28 July (Fri.) 7 a.m. - 5 p.m.	traffic count	- vehicle type - orig. and dest. - vehicle characteristics
	2	Beluru Road, B. Peninjau Junction	- do -	interviews with drivers by stopping the vehicles	- No. of passengers - tonnage and type of goods carried
	3	Limbang-N. Medamit Rd., Kubong Junction	1 Aug. (Tue.) 2 Aug. (Wed.) 7 a.m. - 5 p.m.		
Express Launch Passenger Traffic	4	On the launches, K. Baram - Marudi	5 Aug. (Sat.) -8 Aug. (Tue.)	traffic count	- orig. and dest. - trip purpose
	5	On the launches, Marudi - L. Lama	6 Aug. (Sun.) -12 Aug. (Sat.)	interviews with passengers	- passenger characteristics
River Goods Traffic	7	Marudi Wharf	6 Aug. (Sun.) -12 Aug. (Sat.)	interviews with vessel operators	- orig. and dest. - No. of passengers - tonnage and type of goods carried - average travel time
	8	L. Lama Wharf	7 Aug. (Mon.) -10 Aug. (Thu.)		
Speed Boat Passenger Traffic	9	Limbang Customs Wharf	1 Aug. (Tue.) 2 Aug. (Wed.)	interviews with passengers	- orig. and dest. - trip purpose - travel time - passenger characteristics

1/ samples of survey sheets used for the surveys above mentioned are contained in Appendix Fig. A-3-1 ∿ 4.

Fig. 3-2 LOCATION OF TRAFFIC SURVEY STATION



3-3 ROAD TRAFFIC

3-3-1 Road Traffic Volume

(1) Average Daily Traffic

The results of the traffic census being carried out by P.W.D. twice a year indicate fairly good ADT level on the major road sections in the Study Area as shown in Table 3-2. ADT on the Miri - Bintulu Road varies approximately from 300 to 5,000 and its annual increase rate becomes higher in the vicinity of Miri. ADT on the Limbang - Ng. Medamit Road is much lower and is only about 120 to 230 except the section near Limbang Town where the ADT reaches approximately 1,500.

Table 3-2 AVERAGE DAILY TRAFFIC AT CENSUS STATIONS ON EXISTING MAJOR ROADS IN THE STUDY AREA 1/

Survey Station 3/	Name of Road	1974	1975	1976	1977	1978 2/	Average Annual Growth Rate (%)
A	Miri - K. Baram road	1,066	1,053	823	1,002	891	Δ4.0
B	Lutong - Miri road	4,436	5,568	6,697	9,095	8,696	20.2
C	Miri - Tg. Lobang road	3,095	3,742	3,211	3,091	3,484	0.5
D	Miri - Bintulu road (Miri town)	1,852	2,206	2,294	3,333	5,363	28.9
E	Miri - Bintulu road (Bakam junction)	542	469	468	575	1,513	25.3
F	Miri - Bintulu road (Bekenu junction)	466	452	398	753	716	14.7
G	Miri - Bintulu road (Beluru junction)	307	342	299	515	356	7.3
H	Miri - Bintulu road (Batu Niah junction)	246	255	260	305	n.a.	6.9
I	Marudi - Ulu Linei road	1,036	588	706	537	984	Δ1.9
J	Limbang - Pandaruan road	731	810	854	981	1,241	13.3
K	Kubong - Limbang road	874	991	1,065	1,103	1,454	11.9
L	Limbang - N. Medamit road (Kubong junction)	201	186	232	235	227	4.9
M	Limbang - N. Medamit road (Batu Danan junction)	111	96	118	102	121	2.2
N	Limbang - N. Medamit road (Ukong junction)	81	73	83	73	71	Δ3.3

Source: P.W.D. traffic census

1/ 12-hour traffic for both directions excluding motor cycles

2/ First-half year data only

3/ Location of survey stations is shown in Fig. 3-2.

(2) Traffic Composition

Traffic composition by vehicle type is summarized in Table 3-3 which indicates that passenger cars generally have a share of nearly 70% in the immediate vicinity of towns like Miri and Limbang but with their shares being reduced to 30% to 50% in the suburban or rural areas while trucks share higher percentages.

Table 3-3 TRAFFIC COMPOSITION BY VEHICLE TYPE, 1978

(%)

Survey Station	Name of Road	Car/Taxi			Van and Trucks			Others
		Car	Taxi	Bus	Van	Truck Trailer	Truck	
A	Miri - K. Baram road	56.0	13.5	2.7	-	-	11.6	16.2
B	Miri - Lutong road	63.8	5.6	2.7	4.0	0.3	14.0	9.6
C	Miri - Tg. Lobang road	78.9	1.4	3.2	1.1	-	5.2	10.2
D	Miri - Bintulu road (Miri town)	36.0	7.4	4.8	8.4	0.7	24.9	17.8
E	Miri - Bintulu road (Bakam junc.)	32.7	17.4	3.1	0.3	6.9	29.3	10.3
F	Miri - Bintulu road (Bekenu junc.)	26.4	16.1	1.6	8.3	-	33.5	14.1
G	Miri - Bintulu road (Beluru junc.)	22.8	10.9	2.7	4.8	1.1	43.8	13.9
I	Marudi-Ulu Linei road	58.8	5.8	3.8	-	0.4	11.4	19.8
J	Limbang - Pandaruan road	46.5	7.8	2.8	6.1	0.2	15.9	20.7
K	Kubong - Limbang road	58.9	9.6	3.0	4.6	12.8	-	11.1
L	Limbang - N. Medamit road (Kubong junc.)	28.0	30.6	11.8	3.9	2.6	6.1	17.0
M	Limbang - N. Medamit road (Batu Danau junc.)	21.9	35.2	8.6	-	7.0	1.6	25.8

Source: PWD traffic census

(3) Traffic Variation

Daily variation of the road traffic at major census stations is illustrated in the Appendix Fig. A-3-5 and Table 3-4 shows the ratio of 12 hour traffic to 24 hour traffic. The ratio is higher in the vicinity of towns where the hours of activities are longer.

Table 3-4 DAYTIME TRAFFIC RATIO

Name of Road	Survey Station	Traffic Volume: Daytime 6 a.m.-6 p.m.	Traffic Volume: 24 Hours	Daytime Traffic Ratio
Miri - K. Baram road	A	893	1,011	1.13
Miri - Lutong road	B	8,697	11,841	1.36
Miri - Bintulu road (Miri town)	D	5,363	6,002	1.12
Miri - Bintulu road (Bakam June.)	E	1,513	1,584	1.05
Miri - Bintulu road (Bekenu June.)	F	717	1,003	1.40

The weekly variation of the road traffic does not necessarily show any distinctive patterns as shown in Appendix Fig. A-3-6.

(4) Estimated ADT on the Project Road Sections

Based on the results of PWD traffic census and those of the traffic surveys conducted by the Survey Team, the ADT on the existing sections of the Project Road was estimated as shown in the Table 3-5.

Table 3-5 ADT ON THE EXISTING PROJECT ROAD, 1978

Section	Length (km.)	Car	Van/ Pick up	Truck	Bus	Total
Miri/Bintulu Rd. - Beluru	18.0	60	17	97	2	176
N. Medamit - Ukong Junc.	10.7	35	5	22	7	69
Ukong Junc. - Batu Danau Junc.	8.3	46	6	30	6	88
Batu Danau Junc. - Kubong Junc.	13.4	96	13	65	9	183
Kubong Junc. - Limbang	8.6	565	42	200	25	832

3-3-2 Road Transport

(1) Bus Transport/Taxi

At present five bus companies are operating in the Study Area of which three are in Miri and one in Limbang and Marudi respectively. Of the three bus companies in Miri, two operate mostly in Miri Town. Table 3-6 summarizes the operating conditions of buses in the Study Area.

Table 3-6 BUS TRANSPORT IN THE STUDY AREA

Area	Year	No. of Buses	Total Kilometrage	Average Kilometrage per Bus	Total Passengers
Miri	1968	30	1,115,550	101.9	1,721,392
	1973	32	1,935,900	165.7	2,390,508
	1977	45	2,680,600	163.32	4,575,144
Limbang	1968	5	348,820	191.1	77,732
	1973	3	547,060	499.6	30,000
	1977	9	353,070	107.5	161,518
Marudi	1977	3	66,670	60.9	52,500

Source; Land Transport Department

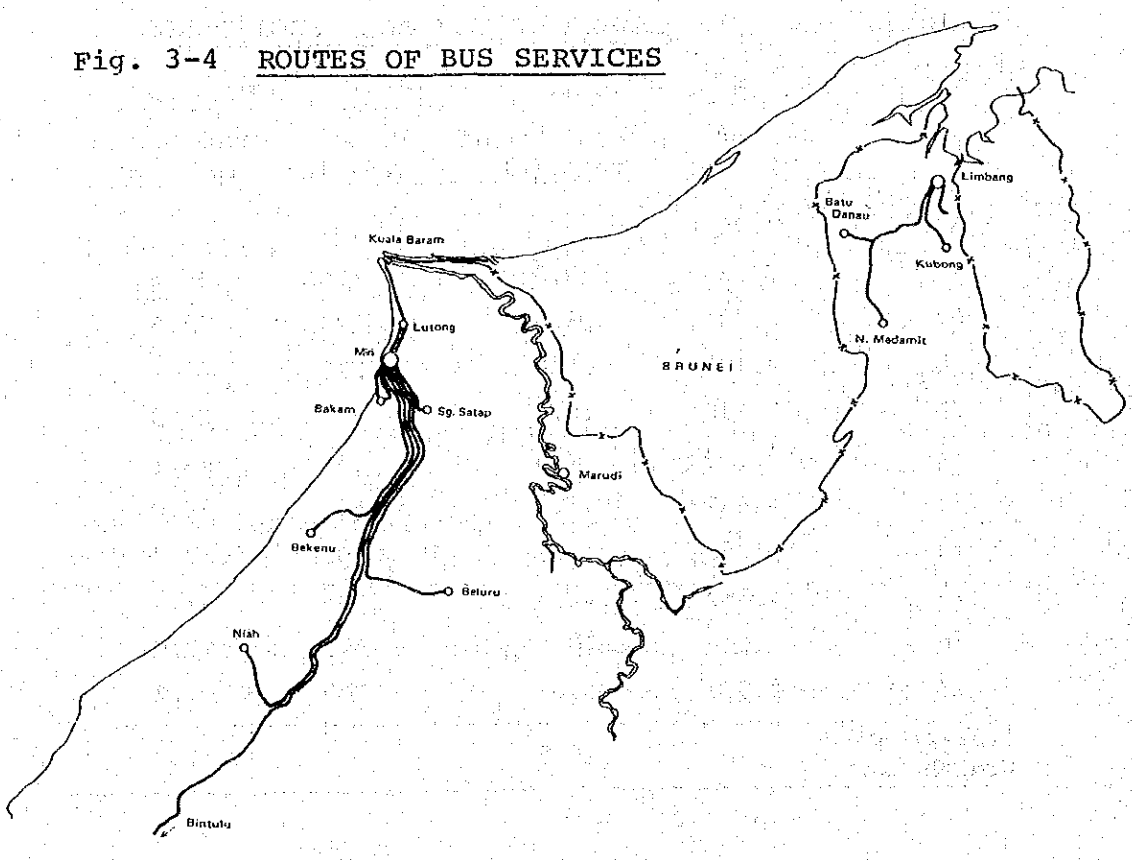
Bus fare is established in proportion to the distance travelled being M$0.1 per mile or M$0.062 per kilometer with a basic minimum fare of M$0.20. Bus routes and fares outside of towns are summarized in Table 3-7 and Fig. 3-4.

In the Study Area, the taxi service plays an important role not only in towns but also outside of them mainly due to the fact that the taxi fare per person with four to five passengers carried together equals the bus fare on longer distances and also partly due to the low frequency of bus services.

Table 3-7 BUS ROUTES AND FARE

Route	Distance km. (miles)	Fare (M$)	Frequency of Services (vehicle/day)
Miri ⟷ Lutong	11.3 (7)	0.70	60
Miri ⟷ Sungei Satap	48.3 (30)	3.00	4
Miri ⟷ Bakam	17.7 (11)	1.20	4
Miri ⟷ Batu Niah	112.6 (70)	7.00	8
Miri ⟷ Beluru	80.5 (50)	5.00	4
Miri ⟷ Bekenu	64.4 (40)	4.00	18
Miri ⟷ Bintulu	202.7 (126)	10.00	1
Limbang ⟷ Kubong	19.3 (12)	1.20	18
Limbang ⟷ N. Medamit	40.2 (25)	2.50	6

Fig. 3-4 ROUTES OF BUS SERVICES



(2) Truck Transport

Trucks in usage in the Study Area usually have only a loading capacity of five to six tons, although PWD along with some oil companies have a few truck-trailers with higher loading capacity while some timber companies have articulated vehicles with up to 20 ton loading capacities operating on their own timber roads but the number is very limited.

The main reason for limiting trucks to five to six ton loading capacity is the existence of numerous temporary bridges, mostly of the Bailey-bridge type.

(3) Number of vehicles

Statistics on vehicle registration are available only by Division. Table 3-8 shows the trend of the number of vehicles in the 4th and 5th Divisions.

Table 3-8 THE NUMBER OF VEHICLES REGISTERED

	Fourth Division		Fifth Division	
	No. of Vehicles	Annual Growth rate (%)	No. of Vehicles	Annual Growth rate (%)
1967	1,709	-	137	-
68	2,188	28.0	179	30.6
69	2,704	23.6	223	24.6
70	3,191	18.0	313	40.4
71	3,720	16.6	389	24.3
72	4,000	7.5	436	12.1
73	4,452	11.3	462	6.0
74	5,241	17.7	500	8.2
75	5,887	12.3	538	7.6
76	7,686	30.6	690	28.3
77	8,879	15.5	719	4.2
Average Annual Growth Rate %		16.5		17.2

3-4 PASSENGER TRAFFIC BY RIVER/COASTAL SHIPPING

3-4-1 River Passenger Traffic in the Baram Areas

Passenger transport in the Baram Area totally rely on river traffic with the exception of a very small number of passengers utilizing air services. Transport of passengers is at present being done by express launches operated by the shipping companies and also with speed boats/long boats owned by individuals/long houses.

(1) River Passenger Traffic by Express Launches

Express launches are being operated twice a day per direction between K. Baram and Marudi and once a day per direction between Marudi and Long Lama. 4 launches owned by two companies are in service for K. Baram - Marudi section while 3 launches owned by three companies for Marudi - Long Lama section. Outline of the express launch operation is seen in the Table 3-9 below.

Table 3-9 OUTLINE OF EXPRESS LAUNCH OPERATION

	K. Baram-Marudi	Marudi-L. Lama
Distance (km.)	100 (64 miles)	120 (75 miles)
Average Travel Time (hr.)	3.0 ∿ 3.5	5.0 ∿ 5.5
Average Speed (km./hr.)	29 ∿ 33	22 ∿ 24
Fare per passenger (M$) 1/	10,5,3	9,8,7,6,5,4,3
Capacity (No. of passenger seats)	70 ∿ 80	60 ∿ 70
No. of ships in service	4	3
Average No. of passengers per trip in 1977	40	35

Source: Interviews with operators

1/ Fare varies depending on the travel distance.

Although the time table is stated as shown in the Table 3-10, delays of half an hour to one hour occur frequently mainly because of the fact that launches stop wherever the passenger want to embark or disembark.

Table 3-10 TIME SCHEDULE OF EXPRESS LAUNCHES

Direction	Departure	Arrival	Departure	Arrival
Kuala Baram ⟶ Marudi	7:30	10:30	13:00	16:00
Marudi ⟶ K. Baram	10:00	13:00	13:30	16.30
Marudi ⟶ Long Lama	7:30	12:30	-	-
Long Lama ⟶ Marudi	8:00	13:00	-	-

Table 3-11 shows the total number of passengers estimated by summarizing the records of shipping companies in Marudi. Average annual growth rate is as high as 18.9 percent.

Table 3-11 NUMBER OF PASSENGERS MOVING BY EXPRESS LAUNCHES

Year	No. of passengers	Growth
1974	50,400	-
1975	64,800	129
1976	72,000	111
1977	79,200	110
1978 1/	100,800	127

Source: Interviews with shipping companies

1/ Estimated based on the actual data of Jan. through July.

The distribution of the passenger traffic by express launch is summarized in the Table 3-12.

(2) River Passenger Traffic by Speed Boats/Long Boats

Beside the regular services of passenger express launches, numerous small vessels like speed boats and long boats are operating throughout the Bg. Baram system. Traffic surveys were carried out in Marudi and Long Lama in order to obtain the level of such traffic. As is shown in Table 3-12 which summarizes the interzonal traffic level by speed boats/long boats, trips are distributed quite extensively in spite of the considerably expensive operating cost, long travel time and inconviniences. During the survey period, it was often observed that people travel over long distances taking up to several days.

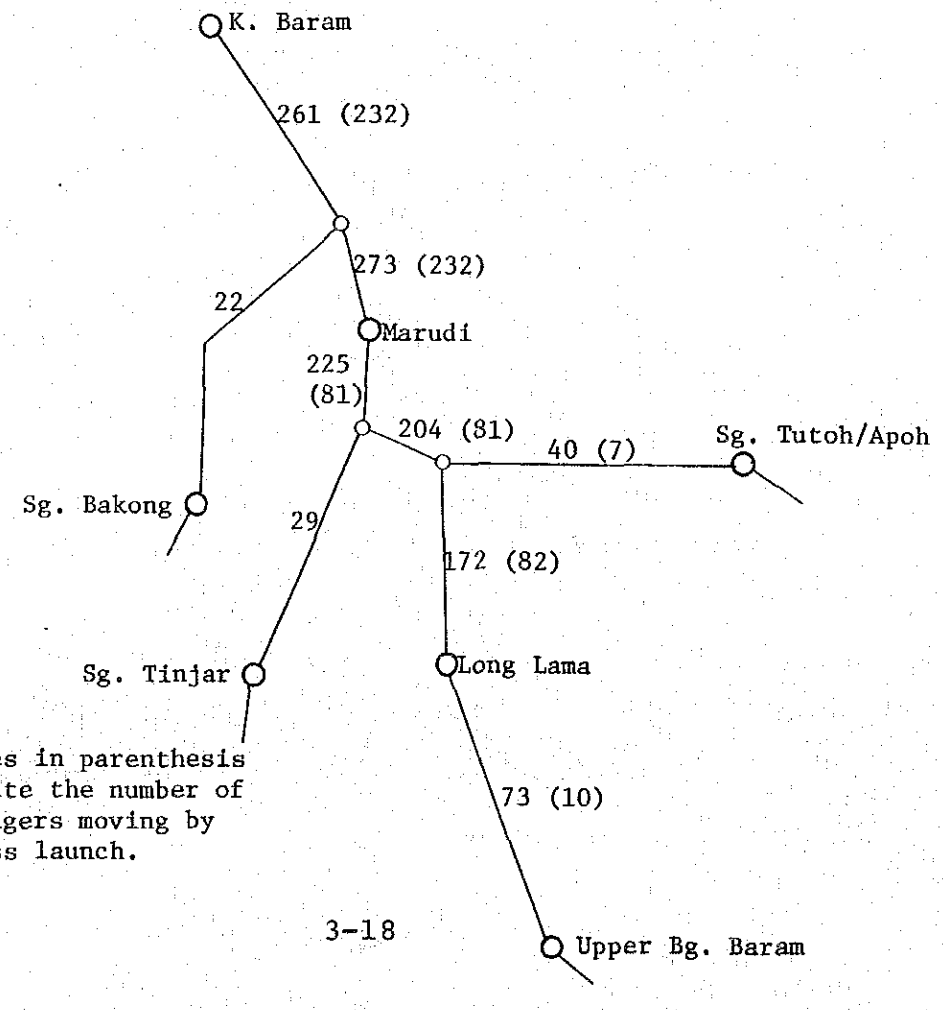
Table 3-12 DISTRIBUTION OF RIVER PASSENGER TRAFFIC IN THE STUDY AREA, 1978 1/

person/day

	Sg. Bakong	Sg. Tinjar	Marudi	Long Lama	Upper Baram	Tutoh/ Apoh	Total
K.Baram (Miri)	5	7	3 (204)	0 (28)	3	11	29 (232)
Sg. Bakong		2	10	3	0	2	22
Sg. Tinjar			16	3	1	0	29
Marudi				30 (68)	22 (10)	20 (3)	101 (285)
Long Lama					37	0 (4)	73 (100)
Upper Bg.Baram						0	63 (10)
Sg.Tutoh/ Apoh							33 (7)
							350 (634)

1/ Figures in parenthesis indicate the number of passengers moving by express launch, while others indicate that of long boats/speed boats.

Fig. 3-5 PASSENGER RIVER TRAFFIC IN THE BARAM AREA 1/



1/ Figures in parenthesis indicate the number of passengers moving by express launch.

3-4-2 Passenger Movement between Limbang and Brunei by SPEED BOAT

Frequent daily services by a number of small speed boats are available between Limbang and Brunei. Table 3-13 shows the number of passengers moving along the section.

Table 3-13 NUMBER OF PASSENGERS MOVING BY SPEED BOAT BETWEEN LIMBANG AND BRUNEI

Year	Out (to Brunei)		In (from Brunei)	
	Persons/ year	Average/day	Persons/ year	Average/day
1973	87,060	239	90,997	249
1974	41,792	114	43,170	118
1975	62,330	171	60,327	165
1976	88,952	244	93,981	257
1977	83,020	277	87,196	239
1978	n.a.	388 1/	n.a.	317 1/

Source: Immigration Office, Limbang

1/ Estimated based on the sample survey carried out on 1st. 2nd. Aug. at Customs Wharf, Limbang

The speed boats with an average capacity of 15 passengers are operating daily between 7a.m. and 6p.m., taking only about 20 minutes to reach the other side. According to the survey results, trip purposes of passengers are mainly shopping, recreation and visiting while those of bussiness are scarce.

Of these passengers, those who travel between Miri and Limbang via Brunei are included and are estimated to share 2.7 percent or 13 passengers per day in 1977 or 18 passengers per day in 1978.

3-5 RIVER GOODS TRAFFIC

Information concerning goods movement on the river system in the Study Area was difficult to discern even though interviews with the operators of vessels were carried out, the reasons being that the goods transported are diverse and operators often do not know how much tonnage they are actually carrying.

Table 3-14 shows the tonnage of goods handled at the Port of Marudi of which certain amounts are transported by smaller vessels/longboats between Marudi and other regions in the Baram Area. As is shown in Appendix Table A-3-1 most of the vessels calling at Marudi are those with a loading capacity of up to 30 tons while those with a loading capacity greater than 100 tons are scarcely seen.

Table 3-14 TONNAGE OF INCOMING CARGO HANDLED AT THE PORT OF MARUDI, 1977

Commodity Group/Item	EXTERNAL 1/	INTERNAL 2/
Food	262	1,600
Milled Wheat	132	110
Sugar	340	400
Beverages	89	150
Animal Feed	-	n.a.
Fertilizer	-	n.a.
Cement	844	1,100
Iron & Steel	301	400
Tobacco	3	
Crude Materials Inedible except Fuels	17	
Animal and Vegetable Oils	4	6,200
Chemicals and Products	30	
Other General Cargo	1,600	
Fuels	-	10,000
TOTAL	3,622	19,960

Source: 1/ Computer Output of external trade by port, Dept. of Statistics

2/ Consultant's estimate based on the results of interview survey etc.

3-6 AIR TRAFFIC

Table 3-15 shows the air traffic volume both of passengers and cargos for major airports in the Study Area. Significant growth rates in air passenger traffic both at the airports of Miri and Limbang have been experienced since 1973 or 1974. Air cargo traffic has been increasing at much higher growth rates for all airports with particular growth of air cargo traffic at Miri from 1976 to 1977.

Miri Airport, being one of the most busiest airports in Sarawak, handles about 170,000 passengers and 630,000 tons of cargo while Marudi and Limbang handles 8,000 passengers and 150 tons of cargo, and 14,000 passengers and 90 tons of cargo in 1977 respectively.

Table 3-15 AIR TRAFFIC OF MAJOR AIRPORTS IN THE STUDY AREA

Year		Miri		Marudi		Limbang	
		Passenger	Cargo (tons)	Passenger	Cargo (tons)	Passenger	Cargo (tons)
1973	Dep.	51,408	48,529	-	-	-	-
	Arriv.	52,180	93,199	-	-	-	-
	Total	103,588	141,728	-	-	-	-
1974	Dep.	60,276	61,066	3,251	51	4,444	17
	Arriv.	61,101	144,653	3,064	51	4,055	33
	Total	121,377	205,719	6,315	102	8,499	50
1975	Dep.	61,502	72,198	3,588	52	5,243	23
	Arriv.	66,477	171,324	3,291	60	5,020	38
	Total	127,979	243,522	6,879	112	10,263	61
1976	Dep.	78,819	72,238	3,747	79	6,629	25
	Arriv.	78,948	132,120	3,569	93	6,439	56
	Total	157,767	204,358	7,316	172	13,068	81
1977	Dep.	84,252	176,376	4,306	74	6,978	25
	Arriv.	83,844	455,556	3,808	80	6,786	64
	Total	168,096	631,932	8,114	154	13,764	89
Average Annual Growth Rate (%)	Total	13.1	34.8	8.5	18.1	18.4	22.3

Of the airway routes, those which relate with the Project Road are given in Table 3-16. Traffic for each of these routes has been increasing considerably, with its growth being greatly affected by its capacity. Types of aircraft are limited to those of up to the BN2 class with capacity of a maximum of 8 passengers depending upon the loading weights of cargo. Therefore the actual occupancy rates will be higher than those shown in Table 3-16.

Table 3-16 OPERATING CHARACTERISTICS OF AIR ROUTES IN THE STUDY AREA

Air Route	No. of Passengers 1973	No. of Passengers 1977	Average Annual Growth Rate(%)	Frequency of Services	Occupancy Rate(%)
Miri - Marudi	5,728	6,302	2.4	24/week	81.7
Miri - Limbang	4,252	10,179	24.4	40/week	75.3
Marudi - Long Seridan	n.a.	205	n.a.	4/week	29.0

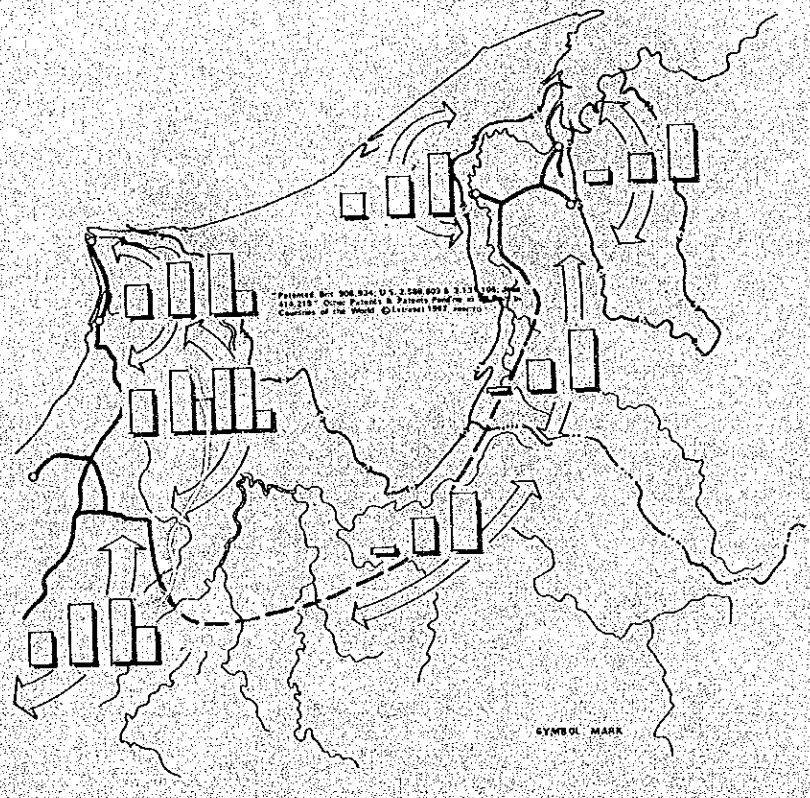
Source; Dept. of Civil Aviation

Distribution of air passenger traffic is estimated based on the statistics shown in Appendix Table A-3-2, A-3-3 as follows:

Routes	Daily Passenger Flow
Miri - Marudi:	20
Miri - Limbang:	30
Miri - Bario:	1
Marudi - Bario:	3
Marudi - Long Seridan:	1

Chapter 4

ESTIMATION OF FUTURE TRAFFIC DEMAND



4-1 METHODOLOGY

4-1-1 Traffic Forecast Methodology Outline

Future traffic volume on the Project Road is forecasted for each of four different types of traffic defined as follows:

(1) Normal Traffic; traffic existing and continuing to do so on the present roads regardless of the completion of the Project Road.

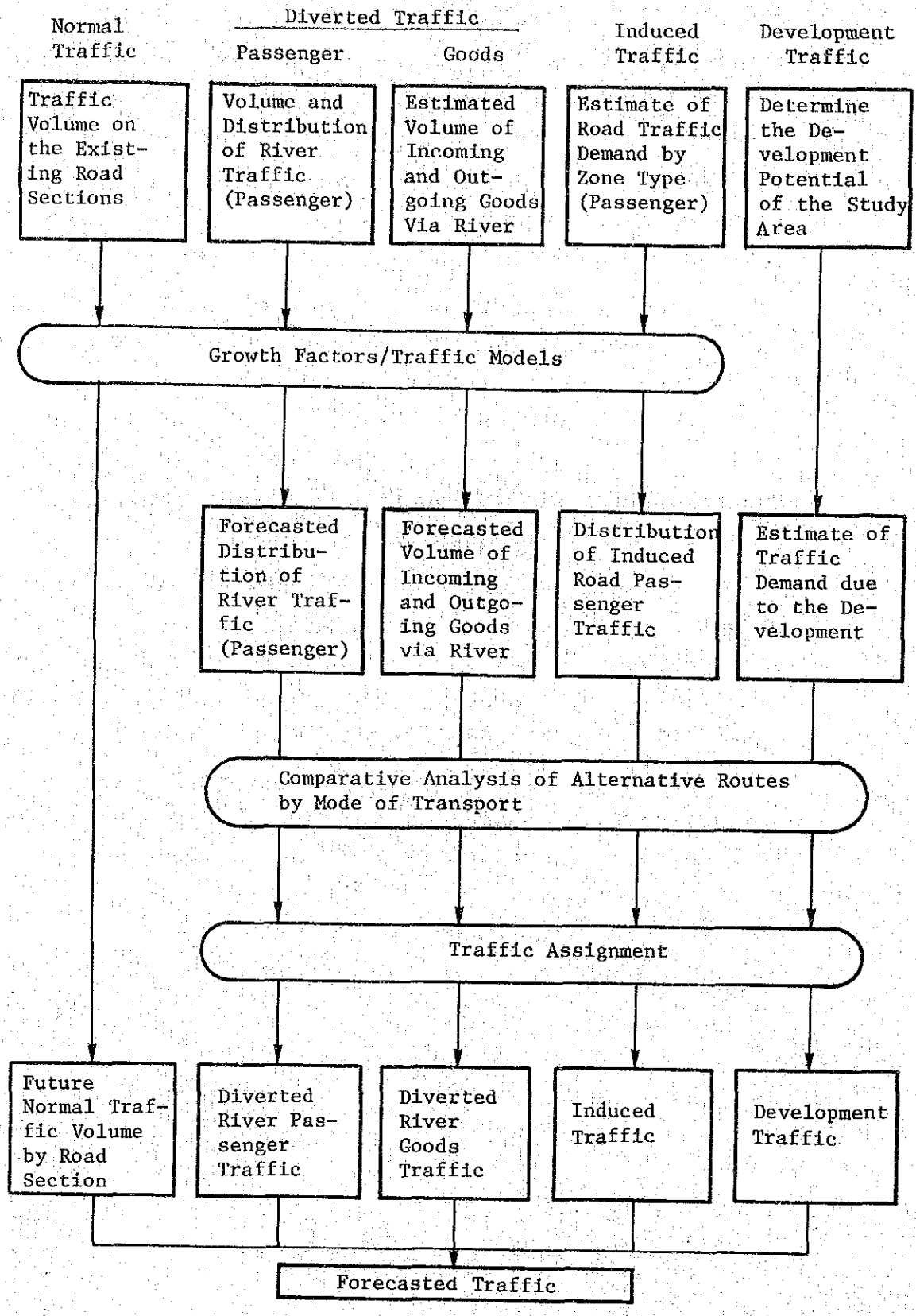
(2) Diverted Traffic; normal traffic existing on the present transport network but to divert to the Project Road on its completion due to the reduction in travel time and/or transportation cost.

(3) Induced Traffic; traffic not in existance before the completion of the Project Road but which will be generated after its completion.

(4) Development Traffic; traffic not in existance before the completion of the Project Road but which will be generated after its completion due to the development of any projects which will be realized with regard to the completion of the Project Road.

Although the details of forecast methods for the respective type of traffic are discribed in the following papers, the outline is presented in Fig. 4-1.

Fig. 4-1 OUTLINE OF THE TRAFFIC FORECAST METHOD



4-1-2 Zoning of the Study Area

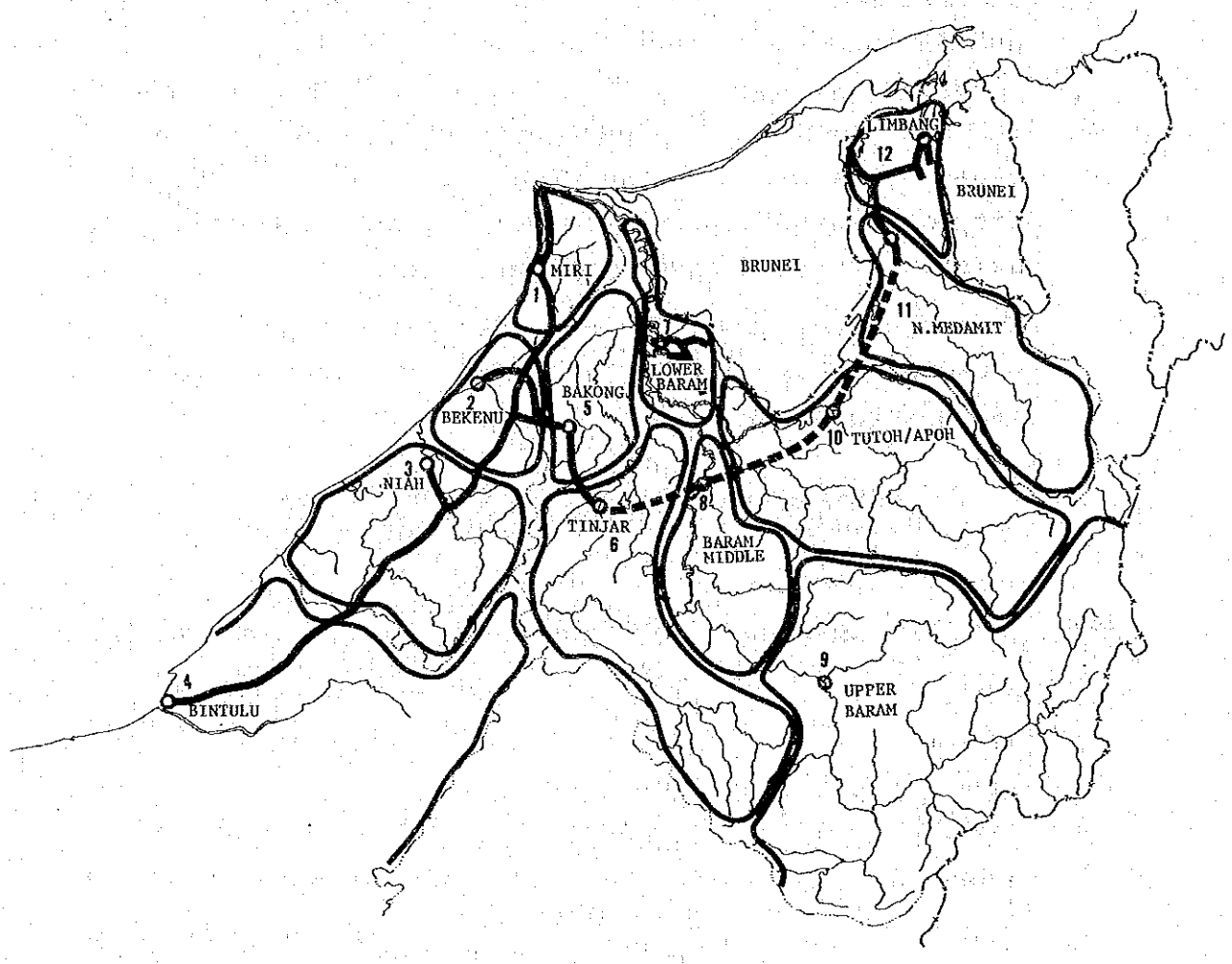
For the purpose of traffic analysis, the Study Area and its neighbouring areas were divided into twelve traffic zones as shown in Fig. 4-2. Niah sub-district and Bintulu sub-district were included in this study due to the fact that the proposed development of the Bintulu area is expected to strengthen the relations between it and the Study Area with the possibility of additional traffic being generated and/or the existing traffic flow undergoing change.

In zoning the areas the administrative boundary of the sub-districts, roads, rivers and their basins were taken into account.

Table 4-1 ZONING OF THE STUDY AREA

Zone	Name of Zone	Centre of Zone	River Basin/Road
1	Miri	Miri	Bg. Baram/ Miri-Bintulu Road
2	Bekenu	Bekenu	Miri-Bintulu Road
3	Niah	Niah	- do -
4	Bintulu	Bintulu	- do -
5	Bakong	Beluru	Sg. Bakong/Beluru Rd.
6	Tinjar	Crossing Point,of Bg. Tinjar and P.Road	Sg. Tinjar/Beluru Rd.
7	Lower Baram	Marudi	Bg. Baram
8	Baram Middle	Long Lama	Bg. Baram
9	Upper Baram	Long Akah	Bg. Baram
10	Tutoh/Apoh	Crossing point of Bg. Tutoh and P.Road	Sg. Tutoh/Apoh
11	N. Medamit	N. Medamit	Sg. Limbang/Limbang-Medamit Rd.
12	Limbang	Limbang	Limbang-Medamit Rd.

Fig. 4-2 ZONING MAP FOR TRAFFIC ANALYSIS



4-1-3 Population Estimates by Traffic Zone

As population is the most reliable economic indicator of which area-wise statistics are available, the population figures estimated by the administrative sub-districts as shown in Table 2-5 of Chapter 2, were modified based on the estimated population of major river basins as shown in Appendix Table A-4-7 and Appendix Figure A-4-1. The population of the Bintulu area was estimated based on the Bintulu Master Plan Study. The results being shown in Table 4-2 below.

Table 4-2 ESTIMATED POPULATION BY TRAFFIC ZONE

Traffic Zone	Name	1977	1982	1987	1992	2002
1	Miri	50,700	63,300	78,600	95,300	137,500
2	Bekenu	12,900	14,600	16,400	18,100	21,600
5	Sg. Bakong	5,780	6,750	7,800	8,800	11,100
6	Sg. Tinjar	10,220	11,750	13,500	15,300	19,200
7	Lower Bg. Baram	10,900	12,200	13,600	15,000	17,600
8	Bg. Baram Middle	6,500	7,400	8,400	9,300	11,400
9	Upper Bg. Baram	8,600	9,000	9,400	9,800	10,400
10	Sg. Tutoh/Apoh	6,200	7,100	8,000	8,900	11,000
11	N. Medamit	6,200	6,700	7,200	7,600	8,300
12	Limbang	18,000	20,400	23,000	25,500	30,800
Total	Study Area	136,000	159,200	185,900	213,600	278,900
3	B. Niah	14,200	16,100	18,100	20,000	23,900
4	Bintulu	18,200	24,200	32,300	43,000	76,300

4-2 NORMAL TRAFFIC

Future traffic volume on the existing road sections along the Project Road was forecasted by estimating the most likely growth rates of the road traffic in the project area and multiplying these rates by the present A.D.T.

As the past road traffic figures do not show a consistent trend and also as they vary by year considerably due to the low level of absolute amount of traffic, the future growth rates for different road sections were determined by comparing the growth rates of other economic parameters such as vehicle ownership, population and GDP with each other to gain their relationship with the traffic level. The following table summarizes the results of the forecast.

Table 4-3 FORECASTED NORMAL ROAD TRAFFIC (ADT) ON THE EXISTING PROJECT ROAD SECTIONS

Road Section	Base year (1978)	1982	1987	1992	2002	Average Annual Growth Rate (%) 1978-1982	1982-1992	1992-2002
Miri/Bintulu Rd. – Beluru (18km)	176	258	379	557	907	10.0	8.0	5.0
Beluru – Sg. Tinjar (38km)	10	12	14	17	23	4.0	3.8	2.9
N. Medamit – Ukong Junc. (10.7km)	69	77	86	96	115	2.7	2.3	1.8
Ukong Junc. – Batu Danau Junc. (8.3km)	88	97	107	118	137	2.4	2.0	1.5
Batu Danau Junc. – Kubong Junc. (13.4km)	183	202	224	249	301	2.5	2.1	1.9
Kubong Junc. – Limbang (8.6km)	832	1,162	1,540	2,041	2,935	8.7	5.8	3.7

Traffic composition by vehicle type was estimated based on its past trends on the existing road sections and with the forecasted future vehicle ownership figures. Table 4-4 shows the forecasted traffic composition by vehicle type and Table 4-5 shows the forecasted normal traffic by vehicle type.

Table 4-4 FORECASTED VEHICLE COMPOSITION ON THE EXISTING ROAD SECTIONS IN THE STUDY AREA

Road Section	1982, 1987				1992, 2002			
	Car/ Taxi	Van/ Pick-up	Truck	Bus	Car/ Taxi	Van/ Pick-up	Truck	Bus
Miri/Bintulu Rd.- Beluru	35.0	10.0	52.0	3.0	50.0	10.0	35.0	5.0
Beluru - Sg. Tinjar	35.0	10.0	55.0	0	50.0	10.0	37.0	3.0
N. Medamit - Ukong Junc.	51.0	7.0	32.0	10.0	55.0	7.0	30.0	7.0
Ukong Junc.-Kubong Junc.	52.0	7.0	34.0	7.0	55.0	7.0	30.0	7.0
Kubong Junc. -Limbang	68.0	5.0	24.0	3.0	70.0	4.0	23.0	3.0

Table 4-5 FORECASTED TRAFFIC ON THE EXISTING ROAD SECTIONS

1982

Road Section	Car/ Taxi	Van/ Pick-up	Truck	Bus	Total
Miri/Bintulu Rd. - Beluru	90	26	134	8	258
Beluru - Sg. Tinjar	5	1	6	0	12
N. Medamit - Ukong Junc.	40	5	24	8	77
Ukong Junc. - Batu Danau Junc.	50	7	33	7	97
Batu Danau Junc.- Kubong Junc.	105	14	69	14	202
Kubong Junc. - Limbang	790	58	279	35	1,162

1987

Road Section	Car/ Taxi	Van/ Pick-up	Truck	Bus	Total
Miri/Bintulu Rd. - Beluru	133	38	197	11	379
Beluru - Sg. Tinjar	5	1	8	0	14
N. Medamit - Ukong Junc.	44	6	28	8	86
Ukong Junc. - Batu Danau Junc.	57	7	36	7	107
Batu Danau Junc.- Kubong Junc.	116	16	76	16	224
Kubong Junc. - Limbang	1,048	77	369	46	1,540

1992

Road Section	Car/ Taxi	Van/ Pick-up	Truck	Bus	Total
Miri/Bintulu Rd. - Beluru	279	56	195	27	557
Beluru - Sg. Tinjar	9	2	6	0	17
N. Medamit - Ukong Junc.	53	7	30	6	96
Ukong Junc. - Batu Danau Junc.	66	8	36	8	118
Batu Danau Junc.- Kubong Junc.	137	17	78	17	249
Kubong Junc. - Limbang	1,428	82	470	61	2,041

2002

Road Section	Car/ Taxi	Van/ Pick-up	Truck	Bus	Total
Miri/Bintulu Rd. - Beluru	454	91	317	45	907
Beluru - Sg. Tinjar	11	2	9	1	23
N. Medamit - Ukong Junc.	65	8	34	8	115
Ukong Junc. - Batu Danau Junc.	75	10	42	10	137
Batu Danau Junc.- Kubong Junc.	169	21	90	21	301
Kubong Junc. - Limbang	2,055	117	675	88	2,935

4-3 DIVERTED TRAFFIC

4-3-1 Diverted River Passenger Traffic

(1) Future Demand of River Passenger Traffic

The past trend of the number of passengers transported by express launches is the most reliable indicator as a basis of computing future traffic demand.

As can be seen in 3-4-1 of Chapter 3, the growth rates for the last several years are very high appearing at first sight to be unrealistic. However, considering that the recent high growth was brought about partly by accelerated timber activities which have and are expected to continue to provide additional employment opportunities and partly by the general increment of income level in the internal areas, the growth rates assumed as shown in Table 4-6 below can be viewed as not being over optimistic.

Table 4-6 FUTURE GROWTH RATE OF PASSENGER RIVER TRAFFIC IN THE BARAM AREA

	1974/75-1977/78	1978-1982	1982-1992	1992-2002
Annual Average Growth Rate (%)	19.7	10.0	8.0	5.0

Table 4-7 shows the future demand and distribution patterns of river passenger traffic estimated by applying the growth rates determined in Table 4-6.

Table 4-7 DISTRIBUTION OF FORECASTED RIVER PASSENGER TRAFFIC IN THE BARAM AREA 1/

	5 Sg. Bakong	6 Sg. Tinjar	7 Marudi	8 Long Lama	9 Upper Baram	10 Sg. Tutoh/Apoh	Total
1. K. Baram (Miri)	7	10	4(299)	0 (41)	4	16	31(340)
Sg. Bakong	3	15	4	0	3	32	
Sg. Tinjar	23	4	1	0	41		
Marudi	44(100)	32(15)	29(4)	147(418)			
Long Lama	54	0(6)	106(147)				
Upper Baram	0	91 (15)					
Sg. Tutoh/Apoh	48 (10)						
							496(930)

1982

	5 Sg. Bakong	6 Sg. Tinjar	7 Marudi	8 Long Lama	9 Upper Baram	10 Sg. Tutoh/Apoh	Total
1. K. Baram (Miri)	10	15	6(439)	0 (60)	6	24	61 (499)
Sg. Bakong	4	22	6	0	4	46	
Sg. Tinjar	34	6	1	0	60		
Marudi	65(147)	47(22)	43(6)	217 (614)			
Long Lama	79	0(9)	156 (216)				
Upper Baram	0	133 (22)					
Sg. Tutoh/Apoh	71 (15)						
							744(1,366)

1987

	5 Sg. Bakong	6 Sg. Tinjar	7 Marudi	8 Long Lama	9 Upper Baram	10 Sg. Tutoh/ Apoh	Total
1. K. Baram (Miri)	15	22	9(645)	0 (88)	9	35	80 (733)
Sg. Bakong	6	32	9	0	6	68	
Sg. Tinjar	50	9	2	0	89		
Marudi	96(216)	69(32)	63 (9)	319 (902)			
Long Lama	116	0(13)	230 (317)				
Upper Baram	0	196 (32)					
Sg. Tutoh/Apoh	104 (22)						
							1,086(2,006)

1992

	5 Sg. Bakong	6 Sg. Tinjar	7 Marudi	8 Long Lama	9 Upper Baram	10 Sg. Tutoh/Apoh	Total
1. K. Baram (Miri)	24	36	15(1,051)	0(143)	15	57	147(1,194)
Sg. Bakong	10	52	15	0	10	111	
Sg. Tinjar	81	15	3	0	145		
Marudi	156(352)	112(52)	103(15)	519(1,470)			
Long Lama	119	0(21)	305 (516)				
Upper Baram	0	249 (52)					
Sg. Tutoh/Apoh	170 (36)						

2002

1/ Figures in parenthesis are those of passenger express launches

(2) Comparison of Competitive Routes

With the completion of the Project Road, the present areas where the river is the only mode of transport will also be served by road as well. Comparative analysis of passenger movement between those using river and those using road forms of transportation was made as of distance, estimated travel time and estimated fares/transportation cost for the respective pairs of zones. Table 4-8 shows the characteristics of river and road between major traffic zones.

As is shown in Table 4-9 the comparative ratio of time distance and of cost of those using the route via the Project Road is distinctively superior than those utilizing the existing route. It is therefore expected that the river passenger traffic will be diverted to the Project Road from most of the internal areas. Table 4-10 shows the estimated diversion rate for the respective zone pairs.

Table 4-8 CHARACTERISTICS OF COMPETITIVE TRANSPORT MODE BETWEEN MAJOR ZONES FOR PASSENGER MOVEMENT

Traffic Zone Pair	RIVER												ROAD											
	Distance (km.)				Average Travel Time (hr.) 1/				Fare (M$) 1/				Distance (km.)				Average Travel Time (hr.) 1/				Fare (M$) 1/			
	Road	Express	Long Boat	Total	Bus 2/	Express	Long Boat	Total	Bus 2/	Express	Long Boat	Total	Road	Express	Long Boat	Total	Bus 2/	Express	Long Boat	Total	Bus 2/	Express	Long Boat	Total
1. Miri - 5. Sg. Bakong	25	75	52	25+127	0.78	2.50	3.47	6.75	1.50	6.75	12.48	20.73	69	–	–	69	2.16	–	–	2.16	4.14	–	–	4.14
- 6. Sg. Tinjar	25	148	66	25+214	0.78	5.50	4.40	10.68	1.50	12.88	15.84	30.22	107	–	–	107	3.34	–	–	3.34	6.42	–	–	6.42
- 7. Lower Baram (Marudi)	25	112	–	25+112	0.78	3.70	–	4.48	1.50	10.00	–	11.50	69	37	52	158	2.16	1.23	3.47	6.86	4.14	3.33	12.48	19.95
- 8. Baram Middle (L/Lama)	25	220	–	25+220	0.78	9.10	–	9.88	1.50	19.00	–	20.50	132	–	–	132	4.13	–	–	4.13	7.92	–	–	7.92
- 9. Upper Baram	25	220	123	25+343	0.78	9.10	8.20	18.08	1.50	19.00	29.52	50.02	132	–	123	255	4.13	–	8.20	12.33	7.92	–	29.52	37.44
- 10. Sg. Tutoh/Apoh	25	168	86	25+254	0.78	6.50	5.73	13.01	1.50	14.84	20.62	36.96	187	–	–	187	5.84	–	–	5.84	11.22	–	–	11.22
5. Sg. Bakong - 6. Sg. Tinjar	–	73	118	191	–	3.03	7.87	10.93	–	6.21	28.32	34.53	38	–	–	38	1.19	–	–	1.19	2.28	–	–	2.28
- 7. Marudi	–	37	52	89	–	1.23	3.47	4.70	–	3.33	12.48	15.81	63	108	–	171	1.97	5.40	–	7.37	3.78	9.00	–	12.78
- 8. Long Lama	–	145	52	197	–	6.63	3.47	10.10	–	12.33	12.48	24.81	63	–	–	63	1.97	–	–	1.97	3.78	–	–	3.78
- 9. Upper Baram	–	145	175	320	–	6.33	11.67	18.30	–	12.33	42.00	54.33	63	–	123	186	1.97	–	8.20	10.17	3.78	–	29.52	33.30
- 10. Tutoh/Apoh	–	93	86	179	–	4.03	5.73	9.76	–	7.81	20.64	28.45	118	–	–	118	3.69	–	–	3.69	7.08	–	–	7.08
6. Sg. Tinjar - 8. Long Lama	–	72	66	138	–	3.60	4.40	8.00	–	5.76	15.84	21.60	25	–	–	25	0.78	–	–	0.78	1.50	–	–	1.50
- 9. Upper Baram	–	72	189	261	–	3.60	12.60	16.12	–	5.76	45.36	51.12	25	–	123	148	0.78	–	8.20	8.98	1.50	–	29.52	31.02
- 10. Tutoh/Apoh	–	20	152	172	–	1.00	10.13	11.13	–	1.60	36.48	38.08	80	–	–	80	2.50	–	–	2.50	4.80	–	–	4.80
8. Long Lama - 10. Tutoh/Apoh	–	52	86	138	–	2.60	5.73	8.33	–	4.16	20.64	24.80	55	–	–	55	1.72	–	–	1.72	3.30	–	–	3.30
9. Upper Baram - 10. Tutoh/Apoh	–	52	209	261	–	2.60	13.93	16.53	–	4.16	50.16	54.32	55	–	123	178	1.72	–	8.20	9.92	3.30	–	29.52	32.82

1/ Average travel speed and fares/costs were assumed as follows:

K. Baram – Marudi ; 30 km/hr., M$0.09/km/person
Marudi - L. Lama ; 20 km/hr., M$0.08/km/person
Long Boat ; 15 km/hr., M$0.24/km/person

2/ Between K. Baram and Miri by Bus

Average travel speed and bus fares were assumed as follows:

32 km/hr., M$0.06/km/person

Table 4-9 COMPARATIVE RATIO OF TRAVEL TIME AND FARE BETWEEN RIVER AND ROAD

	5. Bakong	6. Tinjar	7. Marudi	8. L/Lama	9. Upper Baram	10. Tutoh/ Apoh
1. Miri	3.13 / 5.01	3.20 / 4.71	0.65 / 0.58	2.39 / 2.59	1.47 / 1.34	2.23 / 3.29
Bakong		9.18 / 15.14	0.64 / 1.24	5.13 / 6.56	1.80 / 1.63	2.64 / 4.02
Tinjar				10.26 / 14.40	1.80 / 1.65	4.45 / 7.93
Marudi						
L/Lama						4.84 / 7.52
Upper Baram						1.67 / 1.66
Tutoh/ Apoh						

upper: ratio of time ; River / Road

below: ratio of cost ; River / Road

Table 4-10 MODAL SPLIT

(%)

	RIVER	ROAD
1. Miri - 5. Bakong	-	100
6. Tinjar	-	100
7. Marudi	100	-
8. Long Lama	-	100
9. Upper Baram	-	100
10. Totoh/Apoh	-	100
5. Bakong - 6. Tinjar	-	100
7. Marudi	100	-
8. Long Lama	-	100
9. Upper Baram	-	100
10. Tutoh/Apoh	-	100
6. Tinjar - 8. Long Lama	-	100
9. Upper Baram	-	100
10. Tutoh/Apoh	-	100
8. Long Lama - 10. Totoh/Apoh	-	100
9. Upper Baram - 10. Tutoh/Apoh	-	100

(3) Diverted Passenger Traffic from River Transport

Based on the figures shown in Table 4-7 and Table 4-10, the passenger traffic expected to divert to the Project Road from the existing river system was calculated as is shown in Table 4-11. This traffic was then assigned to the Project Road of which results are shown in Table 4-12.

Table 4-11 DISTRIBUTION OF DIVERTED TRAFFIC

persons/day

1982

	Bakong	Tinjar	Marudi	Long Lama	Upper Baram	Tutoh/ Apoh	Total
K. Baram (Miri)	7	10	-	0 (41)	4	16	37 (41)
Bakong		3	-	4	0	3	17
Tinjar			-	4	1	0	18
Marudi				-	-	-	-
Long Lama					-	0 (6)	8 (47)
Upper Baram						0	5
Tutoh/ Apoh							19 ((6)

1987

	Bakong	Tinjar	Marudi	Long Lama	Upper Baram	Tutoh/ Apoh	Total
K. Baram (Miri)	10	15	-	0 (60)	6	24	55 (60)
Bakong		4	-	6	0	4	24
Tinjar			-	6	1	0	26
Marudi				-	-	-	-
Long Lama					-	0 (9)	12 (69)
Upper Baram						0	7
Tutoh/ Apoh							28 (9)

1992

	Bakong	Tinjar	Marudi	Long Lama	Upper Baram	Tutoh/ Apoh	Total
K. Baram (Miri)	15	22	-	0 (88)	9	35	81 (88)
Bakong		6	-	9	0	6	36
Tinjar			-	9	2	0	39
Marudi				-	-	-	-
Long Lama					-	0(13)	18(101)
Upper Baram						0	11
Tutoh/Apoh							41(13)

2002

	Bakong	Tinjar	Marudi	Long Lama	Upper Baram	Tutoh/ Apoh	Total
K. Baram (Miri)	24	36	-	0(143)	15	57	132(143)
Bakong		10	-	15	0	10	59
Tinjar			-	15	3	0	64
Marudi				-	-	-	-
Long Lama					-	0(21)	30(164)
Upper Baram						0	18
Tutoh/ Apoh							67 (21)

Table 4-12 DIVERTED RIVER PASSENGER TRAFFIC IN NO. OF PASSENGERS

persons/day

Road Section	1982	1987	1992	2002
1. Miri/Bintulu Rd. - Beluru	78	115	169	275
2. Beluru - Sg. Tinjar	81	119	175	286
3. N. Medamit - Ukong Junc.	73	107	158	258
4. Ukong Junc. - Batu Danau Junc.	30	44	65	106
5. Batu Danau Junc. - Kubong Junc.	-	-	-	-
6. Kubong Junc. - Limbang	-	-	-	-

These passengers were then split into those utilizing buses and those utilizing cars. It was assummed that 30% of them are for cars and 70% for buses with an average number of passengers being 3.4 and 25 respectively. Table 4-13 shows the vehicular traffic volume by road section.

Table 4-13 DIVERTED PASSENGER TRAFFIC IN NO. OF VEHICLES

vehicles/day

Road Section	1982			1987			1992			2002		
	Car	Bus	Total	Car	Bus	Total	Car	Bus	Total	Car	Bus	Total
1. Miri/Bintulu Rd. – Beluru	7	2	9	10	3	13	15	5	20	24	8	32
2. Beluru – Sg. Tinjar	7	2	9	10	3	13	15	5	20	25	8	33
3. N. Medamit – Ukong Junc.	6	2	8	9	3	12	14	4	18	23	7	30
4. Ukong Junc. – Batu Danau Junc.	3	1	4	4	1	5	6	2	8	9	3	12
5. Batu Danau Junc. – Kubong Junc.	–	–	–	–	–	–	–	–	–	–	–	–
6. Kubong Junc. – Limbang	–	–	–	–	–	–	–	–	–	–	–	–

4-3-2 Diverted River Goods Traffic

(1) Estimate of Goods Traffic Demand by River

Goods movement to and from the Study Area consists mainly of exports of agricultural products, timber and stones while imports are general consumer goods, construction materials, fertilizer, animal feed and fuels. The goods movement which relate to the Project Road will be mainly those transported to and from the Baram

District and partly of those to and from the Limbang District.

1) Estimate of Goods Requirement in the Baram and Limbang Districts.

Most of the goods required for consumption in the Baram and Limbang Districts are those needing to be imported. In order therefore to estimate the amount of goods to these Districts the per capita consumption level of food, milled wheat, sugar, beverages, cement, iron and steel, fuels and other general goods was determined based on the available statistics and the results of the field survey as is shown in Table 4-14. Table 4-15 shows the assumed consumption of animal feed and fertilizer usage in terms of per livestock head and per ha. respectively. Appendix Table A-4-2 shows the comparative figures of per capita consumption of major import items for Sarawak, Miri, Marudi and Limbang. Table 4-16 summarizes the estimated consumption of goods in the Baram and Limbang Districts.

Table 4-14 ESTIMATED PER CAPITA CONSUMPTION BY COMMODITY ITEM/GROUP FOR BARAM AND LIMBANG DISTRICTS 1/

kg/person

Commodity Group/ Item	Baram					Limbang				
	1977	1982	1987	1992	2002	1977	1982	1987	1992	2002
Food	40	44.2	48.8	53.8	65.6	40	44.2	48.8	53.8	65.6
Milled Wheat	5	5.5	6.1	6.7	8.2	7	7.7	8.5	9.4	11.5
Sugar	15	16.6	18.3	20.2	24.6	17	18.8	20.7	22.9	27.9
Beverages	5	5.5	6.1	6.7	8.2	6	6.6	7.3	8.1	9.8
Cement	40	48.7	59.2	72.0	106.6	70	85.2	103.6	126.1	186.6
Iron and Steel	15	18.2	22.2	27.0	40.0	17	20.7	25.2	30.6	45.3
Others	130	143.5	158.5	175.0	213.3	200	220.8	243.8	269.2	328.1
Fuel	210	243.4	282.2	327.2	439.7	180	208.7	241.9	280.4	376.9
Total	460	525.6	601.4	688.6	906.2	537	612.7	699.8	800.5	1,051.7

1/ Annual growth rate for commodity group/item is assumed as follows; 2% for food, milled wheat, sugar, beverages and others, 3% for fuel and 4% for cement and iron & steel.

Table 4-15 ESTIMATED PER HEAD ANIMAL FEED REQUIREMENTS, AND PER HECTARE FERTILIZER REQUIREMENTS

		1977	1982	1987	1992	2002	
Animal Feed (kg/head)		50	50	50	50	50	(Limbang)
		20	20	20	20	20	(Baram)
Fertilizer: (kg/ha)							
	Paddy	n.a.	200	200	200	200	
	Rubber	n.a.	165	165	165	165	
	Pepper	n.a.	280	280	280	280	

Table 4-16 SUMMARIZES THE ESTIMATED AMOUNT OF IMPORT GOODS REQUIRED IN THE BARAM AND LIMBANG DISTRICTS

Tons

Commodity Group/Item	Baram					Limbang				
	1977	1982	1987	1992	2002	1977	1982	1987	1992	2002
Food	1,928	2,396	2,962	3,610	5,294	968	1,198	1,474	1,781	2,565
Milled Wheat	241	298	370	450	662	169	209	257	311	450
Sugar	723	900	1,111	1,355	1,985	411	509	625	756	1,091
Beverages	241	298	370	450	662	145	179	220	268	383
Animal Feed 1/	189	209	230	254	310	261	288	318	351	428
Fertilizer	3,196	3,243	3,293	3,345	3,457	1,843	1,866	1,891	1,917	1,973
Cement	1,928	2,640	3,593	4,831	8,603	1,694	2,309	3,129	4,174	7,296
Iron and Steel	723	986	1,348	1,812	3,228	411	561	761	1,013	1,771
Petroleum Products	10,122	13,192	17,130	21,955	35,484	4,356	5,656	7,305	9,281	14,737
Miscellaneous Cargo	6,266	7,778	9,621	11,743	17,213	4,840	5,984	7,363	8,911	12,829
Total	25,557	31,940	40,028	49,805	76,898	15,098	18,759	23,343	28,763	43,523
Per Capita Consumption (tons)	530	589	659	742	953	624	692	773	869	1,113

1/ Annual growth rate of 2% throughout the years is assumed.

2) Estimate of Outgoing Agricultural Products

Major agricultural products in the areas are rice, rubber and pepper. Nearly all the production of rubber and pepper is exported mainly via Miri, Marudi or Limbang and partly via Kuching. The surplus of rice in Baram District is transported to Miri.

Table 4-17 shows the estimated future deficit/surplus balance of rice in the Study Area. The surplus tonnage of Baram and Limbang Districts will be transported to the Miri area where a deficit of rice is expected to continue.

Table 4-17 ESTIMATED FUTURE DEFICIT/SURPLUS BALANCE OF RICE IN THE STUDY AREA

tons

		1977	1982	1987	1992	2002
Miri 1/	Production	2,646	2,787	3,044	3,253	3,526
	Demand 2/	7,632	9,348	10,925	13,041	17,501
	Balance	Δ4,986	Δ6,561	Δ7,881	Δ9,788	Δ13,975
Baram	Production	10,013	10,471	11,312	12,012	13,227
	Demand 2/	7,712	8,672	9,105	10,065	11,702
	Balance	2,301	1,799	2,207	1,947	1,525
Limbang	Production	4,777	4,988	5,371	5,698	6,427
	Demand 2/	3,751	4,201	4,379	4,800	5,474
	Balance	1,026	787	992	898	953
Study Area	Production	17,436	18,246	19,727	20,963	23,180
	Demand	19,095	22,221	24,409	27,906	34,677
	Balance	Δ1,659	Δ3,975	Δ4,682	Δ6,943	Δ11,497

1/ Includes Miri and Sibuti sub-districts

2/ Per capita consumption is assumed as follows:

Miri : 120 kg. for 1977 and 1982, 115 kg. for 1987 and 1992 and 110 kg. for 2002.

Baram : 160 kg. for 1977 and 1982, 150 kg. for 1987 and 1992 and 145 kg. for 2002.

Limbang: 155 kg. for 1977 and 1982, 145 kg. for 1987 and 1992 and 140 kg. for 2002.

Table 4-18 shows the tonnage of rubber and pepper to be exported by export point. Export amount tonnage by port were determined with consideration to the present amount levels of the ports.

Table 4-18 PRODUCTION AND EXPORTS OF RUBBER AND PEPPER OF BARAM AND LIMBANG DISTRICTS

tons

Area		Rubber					Pepper				
		1977	1982	1987	1992	2002	1977	1982	1987	1992	2002
Baram	Production:	2,500	2,760	3,047	3,365	4,102	565	671	797	947	1,335
	Export:										
	Marudi	750	828	914	1,010	1,231	170	201	239	284	401
	Miri	750	828	914	1,010	1,231	170	201	239	284	401
	Kuching	1,000	1,104	1,219	1,345	1,640	225	269	319	379	533
Limbang	Production:	1,750	1,932	2,133	2,355	2,871	85	392	466	553	780
	Export:										
	Limbang	788	869	960	1,060	1,292	60	274	326	387	546
	Kuching	962	1,063	1,173	1,295	1,579	25	118	140	166	234

3) Transport of Stones

At present stones are being produced in Batu Gadin near Long Lama. Current production is approximately 150,000 tons per year and nearly all are transported in 300 to 400 ton barges down to Marudi, Miri and Brunei. Roughly 15,000 tons are utilized in Marudi, while the rest are transported mostly to the Miri areas and partly to Brunei. It has been confirmed that the reserves are large enough to supply stones for the next 20 years at the present production level and it is expected that even after this period stones will be readily available. Production and export of stones were estimated as shown in Table 4-19.

Table 4-19 PRODUCTION AND EXPORT OF STONES FROM BATU GADING

	1978	1982	1987	1992	000tons 2002
Production 1/ :	150	168.8	195.7	226.9	304.9
Export:					
Marudi 2/	15	15.9	17.2	18.5	21.4
Miri/Brunei	135	152.9	178.5	208.4	283.5

1/ Annual growth rate of 3% is assumed.

2/ Annual growth rate of 1.5% is assumed.

4) Transport of Timber

Of the whole timber production of the Baram District, the tonnage produced uprivers of the Project Road will be affected by the implementation of the Project Road as shown in Table 4-20. Production of hill timber in the upriver areas of the Project Road is assumed to increase.

Table 4-20 PRODUCTION AND EXPORT OF HILL TIMBER OF THE BARAM DISTRICT

Area	1977	1982	1987	1992	H/T 2002
Whole of Baram	600	600	625	650	700
Area upriver of the Project Road	150	180	219	260	350
(% of whole of Baram)	(25)	(30)	(35)	(40)	(50)

5) Summary of Potential Tonnage of Outgoing and Incoming Goods

Table 4-21 summarizes the potential tonnage of outgoing and incoming goods that might be transported to/from the Miri areas. Table 4-22 and Table 4-23 show the estimated tonnage of imcomming goods by traffic zone.

Table 4-21 SUMMARY OF TRANSPORT DEMANDS

000tons

		Baram					Limbang				
		1977	1982	1987	1992	2002	1977	1982	1987	1992	2002
Incoming	Total	25.6	31.9	40.0	49.8	76.9	15.1	18.8	23.3	28.8	43.5
	Fuel	10.1	13.2	17.1	22.0	35.5	4.4	5.7	7.3	9.3	14.7
	Cement, Iron	2.7	3.6	4.9	6.6	11.8	2.1	2.9	3.9	5.2	9.1
	Others	12.8	15.1	18.0	21.2	29.6	8.6	10.2	12.1	14.3	19.7
Outgoing	Total	290.8	338.2	403.4	474.4	639.6	1.7	1.3	1.5	1.4	1.5
	Paddy	3.7	2.9	3.4	3.0	2.3	1.7	1.3	1.5	1.4	1.5
	Agricultural Products	2.1	2.4	2.7	3.0	3.8	-	-	-	-	-
	Stones	135.0	152.9	178.5	208.4	283.5	-	-	-	-	-
	Timber	150.0	180.0	218.8	260.0	350.0	-	-	-	-	-

Table 4-22 CONSUMPTION OF IMPORT COMMODITIES BY ZONE IN 1977

Zone	Population	Per Capita Consumption (kg.)	Consumption (tons)	Transport Route
5. Bakong	5,780	487.5	2,818	Bg. Baram-Sg. Bakong/ Beluru Road
6. Tinjar	10,220	487.5	4,982	Bg. Baram-Sg. Tinjar
7. Lower Baram	10,900	795 1/	8,666	Bg. Baram
8. Baram Middle	6,500	583 1/	3,790	Bg. Baram
9. Upper Baram	8,600	265 1/	2,279	Bg. Baram
10. Tutoh/Apoh	6,200	487.5	3,022	Bg. Baram-Sg. Tutoh/Apoh
Baram Dist.	48,200	530	25,557	
11. N. Medamit	6,200	480	2,976	Road-Bg. Limbang

1/ Average of Baram Dist. x 1.5 for Lower Baram, x 1.1 for Baram Middle and x 0.5 for Upper Baram are assumed.

Table 4-23 CONSUMPTION OF IMPORT COMMODITIES BY ZONE IN 1982, 1987, 1992 AND 2002

	Zone	Population				Per Capita Consumption (Kg./person)				Consumption (tons)			
		1982	1987	1992	2002	1982	1987	1992	2002	1982	1987	1992	2002
5.	Bakong	6,750	7,800	8,800	11,100	535	593	663	843	3,614	4,628	5,836	9,359
6.	Tinjar	11,750	13,500	15,300	19,200	535	593	663	843	6,290	8,011	10,147	16,188
7.	Lower Baram	12,200	13,600	15,000	17,600	884	989	1,113	1,430	10,785	13,450	16,695	25,168
8.	Baram Middle	7,400	8,400	9,300	11,400	648	725	816	1,048	4,795	6,090	7,589	11,947
9.	Upper Baram	9,000	9,400	9,800	10,400	295	330	371	477	2,655	3,102	3,636	4,961
10.	Tutoh/Apoh	7,100	8,000	8,900	11,000	535	593	663	843	3,801	4,747	5,902	9,275
	Baram Dist.	54,200	60,700	67,100	80,700	589	659	742	953	31,940	40,028	49,805	76,898
11.	N. Medamit	6,700	7,200	7,600	8,300	530	585	646	827	3,551	4,212	4,910	6,864

(2) Comparison of Transportation Cost between Road and River/Coastal Shipping for Major Sections

Transportation costs between road and river/coastal shipping were compared for major sections in order to know the advantages and disadvantages in transporting goods to and from the Study Area via the Project Road. Table 4-24 through Table 4-29 show the results of comparative analysis made, based on the operating costs of various types of vessels and vehicles estimated as shown in the Appendix A-4-5 through Appendix A-4-6. Time value is not taken into consideration in the analysis at all. The outlined results for the major sections are summarized as follows:

Long Lama - Miri

a) In transporting general goods even 6 ton trucks are advantageous.

b) 20 ton truck-trailers are able to compete with river transport in the movement of sinkers or

sawn timbers only if the goods are for local consumption in Miri and not for export.

c) Roads are unable to compete with log rafting at all.

Long Lama - Bintulu

a) The transporting of logs or sawn timbers by barge is approximately 20 per cent less in transportation cost than by utilizing 20 ton truck-trailers.

b) General goods can be transported at less cost by truck than by motor vessel.

Limbang - Miri

Transportation cost of general goods by coastal shipping (motor vessel) is approximately half of that by 20 ton truck-trailer. Therefore coastal shipping will be very advantageous even if the influence of "landas" is taken into consideration.

Limbang - Bintulu

Same results derived as explained for Limbang - Miri.

N. Medamit - Miri

Larger trucks such as 20 ton truck-trailer can compete with coastal shipping due to the necessity of trucking at both ends.

Table 4-24 COMPARISON OF TRANSPORTATION COSTS
(Long Lama-Miri, General Goods)

Section	Long Lama - Miri	
Commodity Type	General Goods	
Mode	Road vs.	River
Vessel/vehicle Type	6 ton Truck	40ton/150ton Motor Vessel
Route: Distance(km.) Conditions	132 gradient 0-3% ($1/_2$), 3-5% ($1/_2$),paved road	River + Road (K. Baram-Miri) 220 + 25 Sg. Baram, flat paved road
Transportation Cost (M$/ton)	full load Line Haul: M$0.6611/km x 132km x $1/_6$ tons = M$14.54/ton Handling: M$3.9/ton Total M$18.44	full load 40 ton Motor Vessel Line Haul, River: M$266.01/day x 2 days (110km/day) x 1/40 tons = M$13.30/ton Line Haul, Road: M$0.5226/km (6 ton truck) x 25km x $1/_6$ ton = M$2.18/ton Handling Cost: M$5.5 + M$3.9/2 = M$7.45/ton Total M$22.93/ton 150 ton Motor Vessel Line Haul, River: M$1,517.89/day x $\frac{220km}{300km/day \times 0.8}$ x $1/_{150}$ tons = M$9.28/ton Line Haul, Road: M$1.83/ton Handling Cost : M$7.45/ton Total M$18.56/ton
Comments	Road is advantageous	Average Transport Cost in use of fifty-fifty basis: (M$22.93 + M$18.56) x $1/_2$ = M$20.75/ton

Table 4-25 COMPARISON OF TRANSPORTATION COSTS
(Long Lama-Miri, Log (Sinker)/Stones)

Section	Long Lama - Miri	
Commodity Type	Log (Sinker)/Stones	
Mode	Road vs.	River
Vessel/vehicle Type	20 ton Truck - trailer	2 x 300ton Barge + 500HP Tug
Route: Distance(km.) Conditions	132 gradient 0-3% ($1/_2$), 3-5% ($1/_2$),paved road	River + Road (K. Baram-Miri) 220 + 25 Sg. Baram, flat paved road
Transportation Cost (M$/ton)	full load Line Haul: M$1.3912 x 132km x $1/_{20}$tons = M$9.18/ton Handling Cost: M$3.90/ton Total M$13.08/ton	full load Line Haul, River: (M$355.40 x 2 x 220km/112km + M$664.96 x 220km/90km) x $1/_{600}$ tons = M$5.04/ton Line Haul, Road: (Stones only, 6 ton Truck) M$2.18/ton Handling Cost, (Log): M$5.50/ton Handling Cost (Stones): M$7.45/ton Total Log for Export: M$10.54/ton Stones and log: M$14.67/ton for local market
Comments	20 ton truck trailer can compete with barges in transporting stones and logs for consumption of local market in Miri if road transport from K. Baram to Miri is necessitated.	

Cf. Cost of log (floster) rafting: two rachets (200logs or 700tons) + 500HP Tug + rafting + tug + handling cost = M$1.31/ton + M$2.32 (M$664.96/day x 220kmx $1/_{90}$km x $1/_{700}$tons) + M$5.5/2 = M$6.38/ton

Table 4-26 COMPARISON OF TRANSPORTATION COSTS

(Long Lama-Bintulu, Log (Sinker), Sawn Timber)

Section	Long Lama - Bintulu	
Commodity Type	Log (Sinker), Sawn Timber	
Mode	Road vs.	River + Coastal Shipping
Vessel/vehicle Type	20 ton truck - trailer	2 x 500 barges + 800HP Tug
Route: Distance (km.) Conditions	230 gradient 0-3%, paved road	River + Sea 220 + 220
Transportation Cost (M$/ton)	full load Line Haul: M$1.2098 x 230km x $1/_{20}$tons = M$13.91/ton Handling Cost = M$3.90/ton Total M$17.81/ton	full load Line Haul: (M$582.79 x 2 x 440km/112km + M$831.03 x 440km/90km) x $1/_{1000}$tons = M$8.64/ton Handling Cost: M$5.50/ton Total M$14.14/ton
Comments	20 ton truck-trailer cannot compete with barges unless the goods carried by barge necessitate unloading at Bintulu and subsequent transportation in the Bintulu area for local use.	

Table 4-27 COMPARISON OF TRANSPORTATION COSTS

(Limbang-Miri, General Goods)

Section	Limbang - Miri	
Commodity Type	General Goods	
Mode	Road vs.	Coastal Shipping
Vessel/Vehicle Type	20 ton Truck - Trailer	200 ton Motor Vessel
Route: Distance(km.) Conditions	285 gradient 0-3% ($1/_2$), 3-5% ($1/_2$), paved road	Sea + Road (K. Baram-Miri) 210 + 25 difficulties during "landas" season
Transportation Cost (M$/ton)	full load Line Haul: M$1.3912 x 285km x $1/_{20}$ tons = M$19.82/ton Handling Cost: M$3.90/ton Total M$23.72/ton	full load Line Haul, Sea: M$2,242.52/day x 210km/324km x $1/_{200}$tons = M$7.27/ton Line Haul, road (5 ton truck) = M$2.18/ton Handling Cost: M$7.45/ton Total M$16.90/ton
Comments	Shipping is advantageous in any situation	

Table 4-28 COMPARISON OF TRANSPORTATION COSTS

(Limbang-Bintulu, General Goods)

Section	Limbang - Bintulu	
Commodity Type	General Goods	
Mode	Road vs.	Coastal Shipping
Vessel/vehicle Type	20 ton Truck - trailer	200 ton Motor Vessel
Route: Distance(km.) Conditions	355 gradient 0-3% (1/2), 3-5% (1/2), paved road	Sea 400
Transportation Cost (M$/ton)	full load Line Haul: M$1.3912 x 355km x 1/20tons = M$24.69/ton Handling Cost: M$3.90/ton Total M$28.59/ton	full load Line Haul: M$2,242.52/day x 400km/324km x 1/200tons = M$13.84/ton Handling Cost: M$5.50/ton Total M$19.34/ton
Comments	Shipping is advantageous in any situation	

Table 4-29 COMPARISON OF TRANSPORTATION COSTS

(N. Medamit-Miri, General Goods)

Section	N. Medamit - Miri	
Commodity Type	General Goods	
Mode	Road vs.	Coastal Shipping
Vessel/vehicle Type	6 ton Truck 20 ton Truck - trailer	200 ton Motor Vessel + 6 ton Truck
Route: Distance(km.) Conditions	244 gradient 0-3% (1/2), 3-5% (1/2) paved road	Road + Sea + Road 4 + 210 + 25
Transportation Cost (M$/ton)	full load 20 ton truck trailer = M$23.72/ton 6 ton truck: M$0.6611 x 244km x 1/6tons = M$26.88/ton + M$3.90/ton (Handling Cost) = M$30.78/ton	full load Line Haul, Sea = M$7.27/ton Line Haul, Road: M$0.5226 x (41 + 25)km x 1/6tons = M$5.75/ton Handling Costs: M$5.50 + M$3.90 = M$9.40/ton Total M$22.42/ton
Comments	6 ton truck cannot compete with motor vessel plus 6 ton truck, while 20 ton tuck-trailer can compete fairly well.	

(3) Estimate of Diverted Traffic

Based on the analysis made in the previous section, it was concluded that the goods being transported at present either from Miri or via Marudi into the zones of 6(Tinjar), 8(Baram Middle), 9(Upper Baram) and 10(Tutoh/Apoh) will totally divert to the Project Road, with all agricultural goods being brought out from zone 6, 8, 9 and 10 with approximately 10 per cent of timber transport diverting to the Project Road. Table 4-30 summarizes the tonnage and the number of vehicles as to the diverted goods traffic.

Table 4-30 DIVERTED RIVER GOODS TRAFFIC

Item	1982	1987	1992	2002	Vehicle Type
					tons
Incoming Goods	17,541	21,950	27,274	42,371	6 ton truck
Outgoing Goods					
Agri. products	3,180	3,660	3,600	3,660	6 ton truck
Timber	18,000	21,880	26,000	35,000	20 ton truck-trailer
					Vehicle/day
Incoming	16	20	25	39	6 ton truck
Agri. products	3	3	3	3	6 ton truck
Timber	5	6	7	10	20 ton truck-trailer
Total	24	29	35	52	

4-4 ESTIMATE OF INDUCED TRAFFIC

The implementation of the Project Road will definitely induce a certain volume of traffic due to the drastically improved accessibility in the areas where the only mode of transport is by river. Though great difficulties were met, the induced traffic has been estimated as follows:

4-4-1 Estimate of Tripends of Interzonal Road Passenger Traffic

In order to estimate the level of generating road passenger trips for each of the zones which currently are not served by roads, typical communities or areas being served by roads in the Study Area were selected. Since most of these selected communities/areas are connected with other areas by a rather simple road network, the interzonal passenger traffic volume to and from each of the areas can be estimated with reasonable accuracy based on the vehicular traffic volumes by vehicle type counted at zone boundary and by the average number of passengers aboard by vehicle type. The former was obtained from the PWD traffic census while the latter being gained from the results of field surveys. Table 4-31 here following shows the results of the analysis.

Table 4-31 TRIPENDS OF INTERZONAL ROAD PASSENGER TRAFFIC PER 1000 POPULATION, 1978

Traffic Zone	Population	Interzonal Passenger Trips	Tripends per 1,000 Population
Miri	50,700	7,638	150.7
Bekenu	12,900	1,616	125.3
Limbang	18,000	610	33.9
N. Medamit	6,200	207	33.4
Beluru	5,780	139	24.0
Niah	14,200	846	59.6

Though it is considered that close relations will exist between the size of population and the magnitude of traffic generated, other factors such as the level of economic activities, availability of alternative transport modes, existence and the size of population centres etc. will also show the co-relationships. Type of areas were classified as shown in the Table 4-32, although the number of samples are limited.

Table 4-32 TRIPENDS OF INTERZONAL ROAD PASSENGER TRAFFIC PER 1,000 POPULATION BY TYPE OF ZONE

Type of Zone	Characteristics	Zone	Tripends per 1000 Population per Day
A	- existence of cities population centres - high dependency on cars	Miri Bekenu	140
B	- existence of population centres	Niah	60
C	- existence of population centres - existence of river as alternative transport mode - limited extent of driving areas	Limbang N. Medamit Beluru	30
D	- no population centres - existence of river as alternative transport mode	-	15 1/

1/ Assumed

With the Project Road to be constructed, the area type for each traffic zone in the Study Area was determined as follows:

Table 4-33 THE AREA TYPE FOR EACH TRAFFIC ZONE

Zone No.	Name of Zone	Area Type
1	Miri	A
2	Bekenu	A
5	Sg. Bakong	C
6	Sg. Tinjar	D
8	Bg. Baram Middle	C
10	Sg. Tutoh/Apoh	D
11	N. Medamit	C
12	Limbang	C
3	Niah	B
4	Bintulu	B

* Upper Baram was excluded as it seems the Project Road will induce very little traffic

The tripends of future interzonal passenger traffic can be calculated by multiplying the population of each zone by the estimated tripends per 1,000 population. Table 4-34 shows the results.

Table 4-34 FORECASTED TRIPENDS OF INTERZONAL PASSENGER TRAFFIC

Zone No.	Zone Name	1982	1987	1992	2002
1	Miri	10,761	16,270	24,016	40,150
2	Bekenu	2,482	3,395	4,561	6,307
5	Sg. Bakong	243	343	475	699
6	Sg. Tinjar	212	297	413	595
8	Bg. Baram Middle	266	370	502	718
10	Sg. Tutoh/Apoh	128	176	240	341
11	N. Medamit	241	317	410	523
12	Limbang	734	1,012	1,377	1,940
3	Niah	1,175	1,611	2,160	2,988
4	Bintulu	1,767	2,875	4,644	9,538

4-4-2 Estimate of Distribution Pattern of Induced Interzonal Road Passenger Traffic

Based on the results of O-D survey conducted during the field survey period, a gravity model has been developed as follows:

$$Tij = K\frac{(Pi \cdot Pj)^{\alpha}}{Dij^{\beta}}$$

where; Tij = Distribution traffic between 'i' and 'j' zones
Pi = Population of 'i' zone
Pj = Population of 'j' zone
Dij = Time distance between 'i' and 'j' zones
K = 0.03295
α = 1.73253 R = 0.92301
β = 2.59915

By applying this model, the distribution patterns of interzonal road passenger traffic in the Study Area including Niah and Bintulu zones are able to be estimated. Population figures of each zone and time distance for each pair of zones used as inputs of this model are shown in Table 4-2 and Appendix Table A-4-3 respectively. Table 4-35 shows the forecasted distribution of interzonal road passenger traffic and indicates that considerable volume of traffic will be induced between Miri and each of the zones.

Table 4-35 DISTRIBUTION OF INDUCED INTER-ZONAL ROAD PASSENGER TRAFFIC

	5. Bakong	6. Tinjar	8. Bg. Baram Middle	10. Tutoh/Apoh	11. N. Medamit	12. Limbang	Tripends
1. Miri	-	158	193	74	15	420	(860)
2. Bekenu	5	2	3	1	0	5	(16)
3. Niah	4	3	4	1	0	7	(19)
4. Bintulu	7	10	11	4	2	29	(63)
Bakong	1	1	0	0	1	19	
Tinjar	32	1	0	5	212		
Bg. Baram Middle	9	1	12	266			
Tutoh/Apoh	3	35	128				
N. Medamit	-	21					
Limbang	514						

1982

	5. Bakong	6. Tinjar	8. Bg. Baram Middle	10. Tutoh/Apoh	11. N. Medamit	12. Limbang	Tripends
1. Miri	-	231	279	92	22	590	(1,214)
2. Bekenu	5	2	3	1	0	6	(17)
3. Niah	4	3	4	2	0	8	(21)
4. Bintulu	9	13	15	7	2	42	(88)
Bakong	1	1	0	0	1	21	
Tinjar	38	2	0	7	297		
Bg. Baram Middle	13	1	16	370			
Tutoh/Apoh	5	55	176				
N. Medamit	-	30					
Limbang	725						

1987

	5. Bakong	6. Tinjar	8. Bg. Baram Middle	10. Tutoh/Apoh	11. N. Medamit	12. Limbang	Tripends
1. Miri	-	332	389	131	32	829	(1,713)
2. Bekenu	5	2	4	1	0	7	(19)
3. Niah	4	3	4	2	0	10	(23)
4. Bintulu	12	17	20	10	3	61	(123)
Bakong	1	2	0	0	2	26	
Tinjar	46	3	0	9	413		
Bg. Baram Middle	16	1	20	502			
Tutoh/Apoh	6	71	240				
N. Medamit	-	42					
Limbang	1,009						

1992

	5. Bakong	6. Tinjar	8. Bg. Baram Middle	10. Tutoh/Apoh	11. N. Medamit	12. Limbang	Tripends
1. Miri	-	500	581	205	51	1,230	(2,567)
2. Bekenu	5	2	4	1	0	8	(20)
3. Niah	4	3	4	2	0	12	(25)
4. Bintulu	14	23	29	16	4	103	(189)
Bakong	1	2	0	0	2	28	
Tinjar	52	3	0	11	595		
Bg. Baram Middle	19	1	26	718			
Tutoh/Apoh	7	88	341				
N. Medamit	-	63					
Limbang	1,480						

2002

4-4-3 Induced Traffic on the Project Road Sections

Table 4-36 shows the number of induced passengers assigned on the Project Road sections and Table 4-37 shows the vehicular traffic volume by vehicle type. The number of passengers was converted into buses and cars. It was assumed that 70% of the passengers utilizing buses have an average number of passengers of 25, while 30% of the passengers utilizing cars have an average number of passengers of 3.4.

Table 4-36 INDUCED INTERZONAL ROAD PASSENGER TRAFFIC IN NO. OF PASSENGERS

Road Section	1982	1987	1992	2002
1. Beluru Junc. - Sg. Bakong	961	1,340	1,878	2,801
2. Sg. Bakong - Sg. Tinjar	948	1,325	1,862	2,783
3. Sg. Tinjar - L. Lama	812	1,122	1,565	2,320
4. L. Lama - Sg. Tutoh/Apoh	590	812	1,137	1,694
5. Sg. Tutoh/Apoh - N. Medamit	538	755	1,051	1,543
6. N. Medamit - Limbang	517	725	1,009	1,480

Table 4-37 INDUCED INTERZONAL ROAD PASSENGER TRAFFIC IN NO. OF VEHICLES

Road Section	1982			1987			1992			2002		
	Car	Bus	Total	Car	Bus	Total	Car	Bus	Total	Car	Bus	Total
1. Beluru Junc. - Sg. Bakong	85	27	112	118	38	156	166	53	219	247	78	325
2. Sg. Bakong - Sg. Tinjar	84	27	111	117	37	154	164	52	216	246	78	324
3. Sg. Tinjar - L. Lama	72	23	95	99	31	130	138	44	182	205	65	270
4. L. Lama - Sg. Tutoh/Apoh	52	17	69	72	23	95	100	32	132	149	47	196
5. Sg. Tutoh/Apoh - N. Medamit	47	15	62	67	21	88	93	29	122	136	43	179
6. N. Medamit - Limbang	46	14	60	64	20	84	89	28	117	131	41	172

4-5 ESTIMATE OF DEVELOPMENT TRAFFIC

Types of development traffic considered in the Phase I study stage consist of;

(1) Traffic being generated due to the development of agricultural development potential blocks as described in 2-3-2 of Chapter 2.

(2) Traffic being generated due to the tourism development of G. Mulu National Park.

The former type of development traffic was estimated by converting the agricultural production forecasted in the Table 2-17 of Chapter 2 into the number of trucks. All the products expected in the Long Lama and Tutoh/Apoh areas will be transported to Miri while approximately 66,000 tons of surplus paddy will be more economically transported through the port of Limbang because the major deficit areas will be the First and Third Divisions. Assuming that the necessary inputs for agriculture development are carried by returning truck, their number on the major road section of the Project Road can be forecasted as shown in the Table 4-38.

The latter tourism development traffic was estimated based on the fact that the present number of visitors is approximately 3,000 to 4,000 a year. Development of G. Mulu into a first class tourism area will not only attract international tourists but also provide recreational opportunities for the local people particularly for those living in the isolated Limbang Area. With the opening to the public of G. Mulu in 1992 a figure of roughly 10,000 visitors can be expected to use the necessary facilities provisioned. It was assumed that approximately 3,000 tourists and 7,000 tourists will visit G. Mulu from Limbang and from Miri respectively. These visitors were converted into terms of the number of vehicles as shown in Table 4-38.

Table 4-38 ESTIMATED DEVELOPMENT TRAFFIC

Section	Type of Traffic	1987	1992	2002	Vehicle Type
Miri - L. Lama	Agriculture	2	3	3	6 ton truck
Miri - Apoh/Tutoh	- do -	-	2	3	6 ton truck
Miri - G. Mulu	Tourism	-	8+1	21+3	Car + Bus 1/
G. Mulu - Limbang	- do -	-	4+1	10+3	Car + Bus 1/
Total		2	19	43	

1/ It was assumed that 70% of visitors will utilize cars while 30% buses with the annual growth rate being 10% after 1992.

Although the development of the Limbang Valley Project, which covers an area of approximately 27,000ha. is expected to generate considerable traffic particularly on most of the sections of the Limbang - N. Medamit Road, it has not been taken into consideration in the Phase I Study, due to the fact that the Project necessitates the need of approximately 20,000 families for agricultural production but depending on the cultivation methods, it is unlikely to expect that such a population will move to the Limbang Area. Therefore the matter has been put aside for further study.

4-6 SUMMARY OF FORECASTED TRAFFIC

Table 4-39 summarizes the forecasted traffic volume on the Project Road by section for the years of 1982, 1987, 1992 and 2002. Though the sections between Long Lama and N. Medamit particularly would not be completed by 1982 according to the construction schedule tentatively proposed, the traffic was forecasted in order to have an indication for the purpose of this study. This table shows the traffic volume and its growth rates will vary considerably by road section.

Table 4-39 SUMMARY OF FORECASTED TRAFFIC ON THE PROJECT ROAD

Road Section	Vehicles/Day				Growth rate (%)		
	1982	1987	1992	2002	82-87	87-92	92-02
1. Miri/Bintulu Road - Beluru	403	579	845	1,346	7.52	7.85	4.77
2. Beluru - Sg. Tinjar	156	212	302	447	6.33	7.33	4.00
3. Sg. Tinjar - Long Lama	127	173	249	367	6.38	7.56	3.96
4. Long Lama - Sg. Tutoh/Apoh	84	113	167	244	6.11	8.13	3.86
5. Sg. Tutoh/Apoh - N. Medamit	62	88	127	192	7.26	7.61	4.22
6. N. Medamit - Ukong junc.	137	170	218	300	4.41	5.10	3.24
7. Ukong junc. - Batu Danau junc.	157	191	240	322	4.00	4.67	2.98
8. Batu Danau junc. - Kubong junc.	262	308	371	486	3.29	3.79	2.74
9. Kubong junc. - Limbang	1,222	1,624	2,163	3,120	5.85	5.90	3.73

Breakdown figures of traffic are shown in Table 4-40 by type of traffic and by type of vehicle. The forecasted traffic on the road sections which are presently not in existence is composed of mainly induced traffic, partly diverted traffic and development traffic to the least extent.

Table 4-40 SUMMARY OF FORECASTED TRAFFIC ON THE PROJECT ROAD

	Road Section	Distance (km)	1982 Type of Traffic: Normal Traffic	Diverted Traffic	Induced Traffic	Development Traffic	1982 Type of Vehicle: Car	Medium Truck	Truck Trailer	Bus	Total
1	Miri/Bintulu Road - Beluru	18.0	258	33	112	-	208	153	5	37	403
2	Beluru - Sg. Tinjar	38.0	12	33	111	-	97	25	5	29	156
3	Sg. Tinjar - Long Lama	25.0	-	32	95	-	78	19	5	25	127
4	Long Lama - Sg. Tutoh/Apoh	55.0	-	15	69	-	55	9	2	18	84
5	Sg. Tutoh/Apoh - N. Medamit	57.0	-	-	62	-	47	-	-	15	62
6	N. Medamit - Ukong junc.	10.7	77	-	60	-	91	24	-	22	137
7	Ukong junc. - Batu Danau junc.	8.3	97	-	60	-	103	33	-	21	157
8	Batu Danau junc. - Kubong junc.	13.4	202	-	60	-	165	69	-	28	262
9	Kubong junc. - Limbang	8.6	1,162	-	60	-	894	279	-	49	1,222

	Road Section	Distance (km)	1987 Type of Traffic: Normal Traffic	Diverted Traffic	Induced Traffic	Development Traffic	1987 Type of Vehicle: Car	Medium Truck	Truck Trailer	Bus	Total
1	Miri/Bintulu Road - Beluru	18.0	379	42	156	2	299	222	6	52	579
2	Beluru - Sg. Tinjar	38.0	14	42	154	2	133	33	6	40	212
3	Sg. Tinjar - Long Lama	25.0	-	41	130	2	108	25	6	34	173
4	Long Lama - Sg. Tutoh/Apoh	55.0	-	18	95	-	76	10	3	24	113
5	Sg. Tutoh/Apoh - N. Medamit	57.0	-	-	88	-	67	-	-	21	88
6	N. Medamit - Ukong junc.	10.7	86	-	84	-	114	28	-	28	170
7	Ukong junc. - Batu Danau junc.	8.3	107	-	84	-	128	36	-	27	191
8	Batu Danau junc. - Kubong junc.	13.4	224	-	84	-	196	76	-	36	308
9	Kubong junc. - Limbang	8.6	1,540	-	84	-	1,189	369	-	66	1,624

1992

	Road Section	Distance (km)	Type of Traffic				Type of Vehicle				Total
			Normal Traffic	Diverted Traffic	Induced Traffic	Development Traffic	Car	Medium Truck	Truck Trailer	Bus	
1	Miri/Bintulu Road - Beluru	18.0	557	55	219	14	522	228	7	88	845
2	Beluru - Sg. Tinjar	38.0	17	55	216	14	196	39	7	60	302
3	Sg. Tinjar - Long Lama	25.0	-	53	182	14	158	33	7	51	249
4	Long Lama - Sg. Tutoh/Apoh	55.0	-	24	132	11	112	15	3	37	167
5	Sg. Tutoh/Apoh - N. Medamit	57.0	-	-	122	5	96	-	-	31	127
6	N. Medamit - Ukong junc.	10.7	96	-	117	5	152	30	-	36	218
7	Ukong junc. - Batu Danau junc.	8.3	118	-	117	5	166	36	-	38	240
8	Batu Danau junc. - Kubong junc.	13.4	249	-	117	5	246	78	-	47	371
9	Kubong junc. - Limbang	8.6	2,041	-	117	5	1,602	470	-	91	2,163

2002

	Road Section	Distance (km)	Type of Traffic				Type of Vehicle				Total
			Normal Traffic	Diverted Traffic	Induced Traffic	Development Traffic	Car	Medium Truck	Truck Trailer	Bus	
1	Miri/Bintulu Road - Beluru	18.0	907	84	325	30	835	365	10	136	1,346
2	Beluru - Sg. Tinjar	38.0	23	85	324	30	290	57	10	90	447
3	Sg. Tinjar - Long Lama	25.0	-	82	270	30	234	48	10	75	367
4	Long Lama - Sg. Tutoh/Apoh	55.0	-	36	196	27	164	22	5	53	244
5	Sg. Tutoh/Apoh - N. Medamit	57.0	-	-	179	13	145	-	-	47	192
6	N. Medamit - Ukong junc.	10.7	115	-	172	13	213	34	-	53	300
7	Ukong junc. - Batu Danau junc.	8.3	137	-	172	13	225	42	-	55	322
8	Batu Danau junc. - Kubong junc.	13.4	301	-	172	13	330	90	-	66	486
9	Kubong junc. - Limbang	8.6	2,935	-	172	13	2,312	675	-	133	3,120

These forecasted traffic volumes worked out in the Phase I Study stage will be further analysed to refine the figures. It is considered that the refinement work in the Phase II Study stage will mainly cover the following aspects.

a) to refine the development traffic by determining the development programs or at least the more realistic assumptions on which the traffic analysis depends based on further discussions with relevant Government Departments. Particular attention will be placed on agriculture development, timber based industry development and the development of new community centres/sub-regional centres.

b) comparative case study on the changes of transport activities and regional socio-economic activities due to the construction of trunk road on a "before" and "after" completion basis.

c) forecast of induced traffic on the existing road sections due to their upgrading and improvement.