

**THE STUDY**  
**ON**  
**CONSTRUCTION OF THE BRIDGE OVER THE RIVER RUPSA**  
**IN KHULNA**  
**(Phase I)**

**FINAL REPORT**  
**Vol. II: APPENDIX**

**MARCH 1999**

**PACIFIC CONSULTANTS INTERNATIONAL**  
**JAPAN OVERSEAS CONSULTANTS**

JICA LIBRARY



J 1148046 [4]

SSF

JR

99 - 034 (2/2)







1148046 [4]

**JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)**

**MINISTRY OF COMMUNICATIONS**

**THE GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH**

**THE STUDY  
ON  
CONSTRUCTION OF THE BRIDGE OVER THE RIVER RUPSA  
IN KHULNA  
(Phase I)**

**FINAL REPORT  
Vol II: APPENDIX**

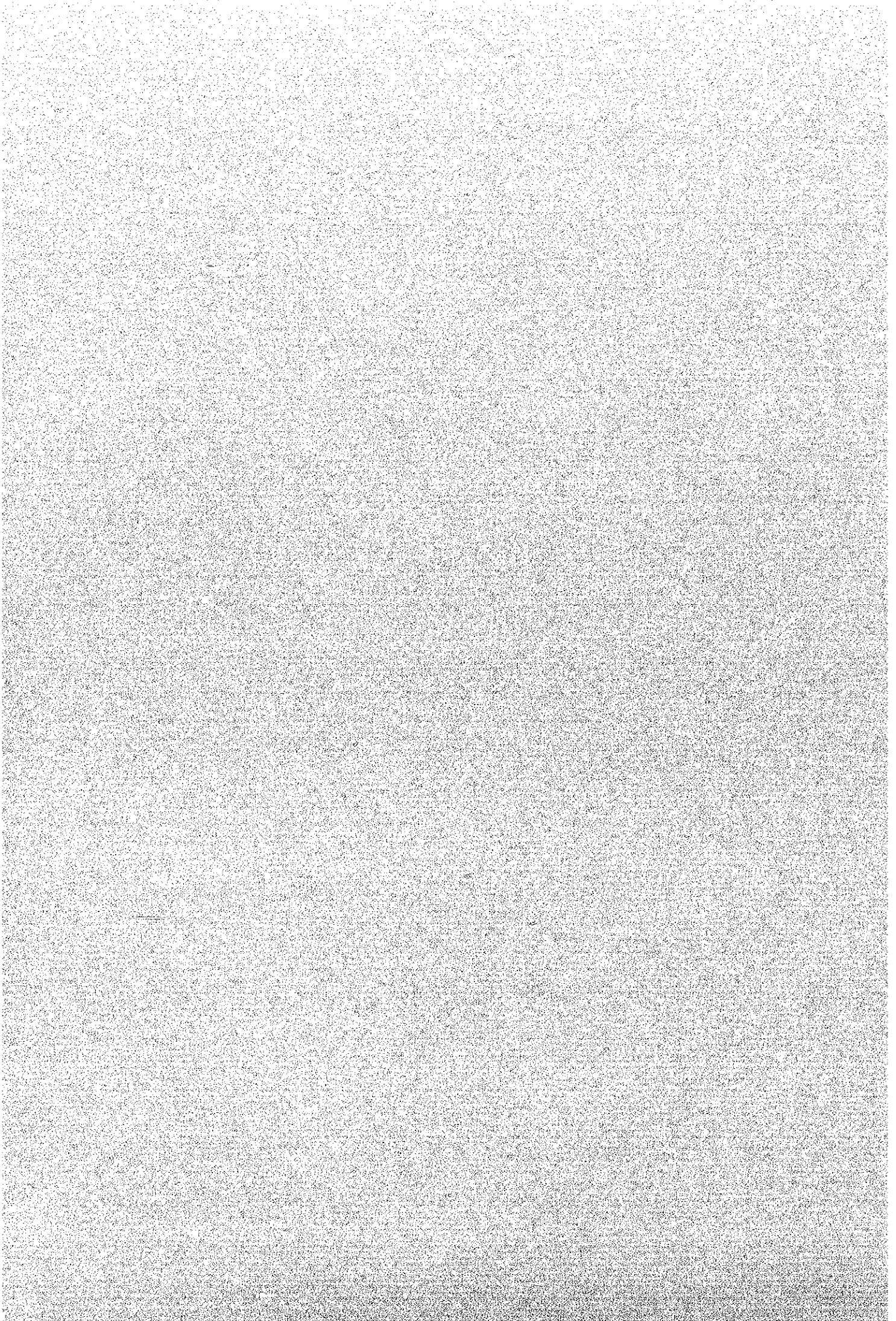
**MARCH 1999**

**PACIFIC CONSULTANTS INTERNATIONAL  
JAPAN OVERSEAS CONSULTANTS**

## **List of Appendixes**

Appendix A	Socio-Economy .....	A-1
Appendix B	Road Transport.....	B-1
Appendix C	Water Transport .....	C-1
Appendix D	Bridge Engineering .....	D-1
Appendix E	Mongla Port Demand Forecast .....	E-1
Appendix F	Traffic Demand Forecast .....	F-1
Appendix G	Natural Conditions.....	G-1
Appendix H	Cost Estimates.....	H-1
Appendix I	Economic and Financial Analysis.....	I-1
Appendix J	Institutional Aspects and Cross Border Trade Arrangements.....	J-1

**APPENDIX A**  
**SOCIO-ECONOMY**





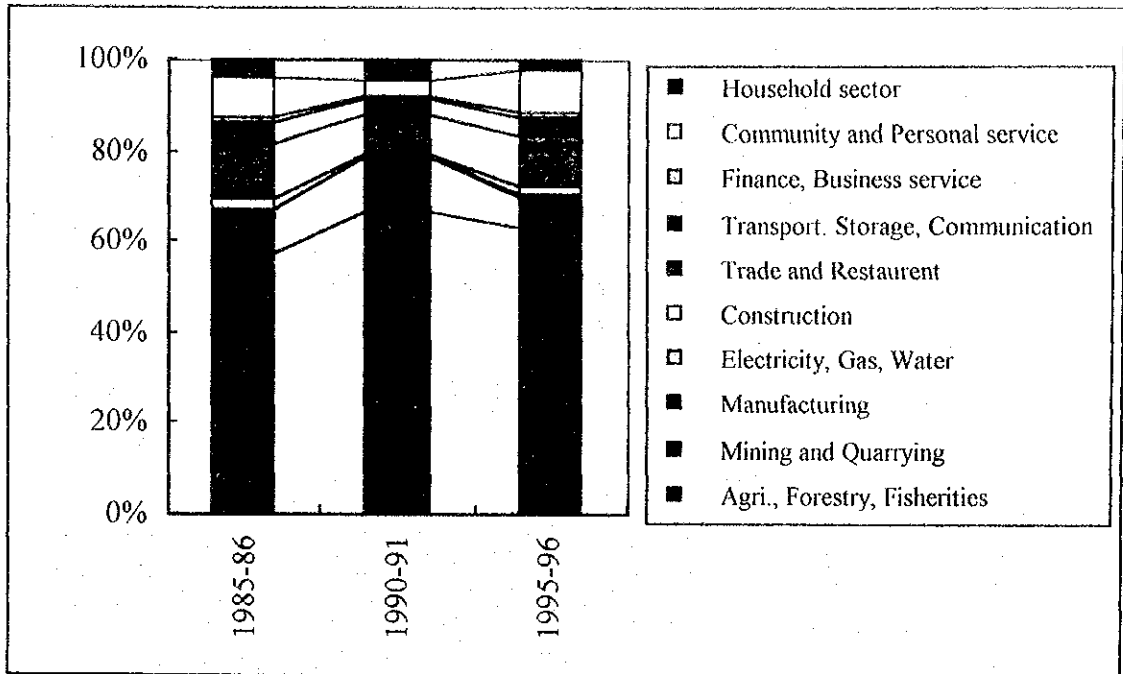


Fig A-2.2.1 Trend of Labour Force Composition by Industry

Source: 1996 Stastical Yearbook of Bangladesh

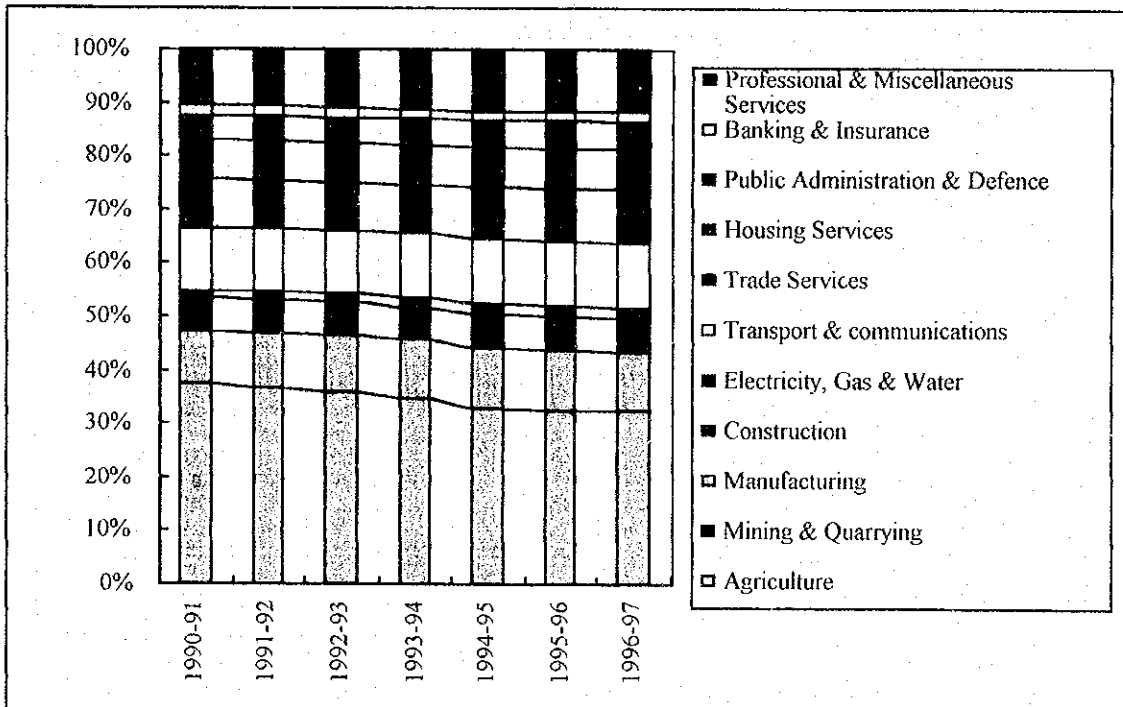


Fig. A-2.3.1 Trend of GDP Composition by Sector in Bangladesh

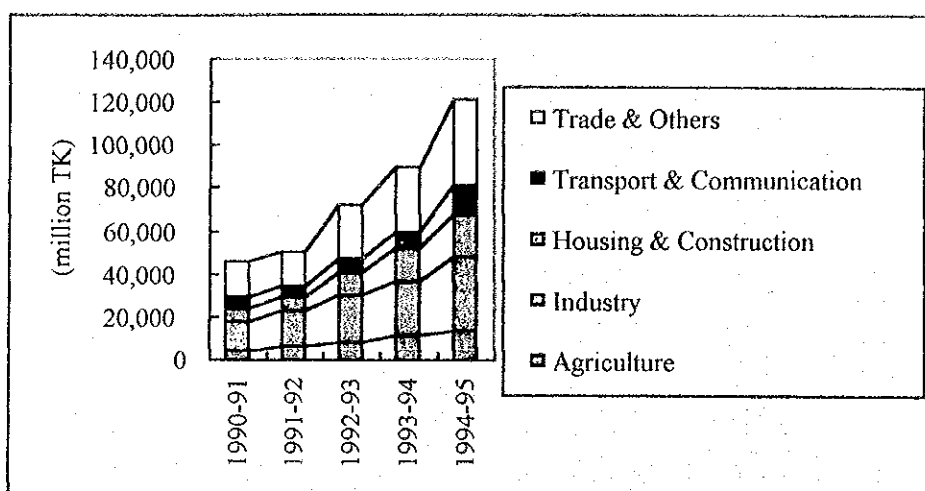


Fig. A-2.3.2 Private Investment by Sector during the Fourth Five Year Plan  
Source : The Fifth Five Year Plan, 1997-2002 (Draft)

Table A-3.1.1 Major Materials Targets of the 5FYP

Item	Unit	1996/97 (A)	2001/2002 (B)	(B)/(A)
<b>Agricultural Production</b>				
Food Grain	million ton	20.39	25.12	1.23
(Rice)	million ton	18.82	23.40	1.24
(Wheat)	million ton	1.45	1.60	1.10
(Others)	million ton	0.10	0.12	1.20
Jute (raw)	million bale	4.87	7.24	1.49
Cotton (raw)	million ton	0.18	0.26	1.44
Potato, Sweet Potato	million ton	2.90	3.09	1.07
Vegetables	million ton	2.32	1.82	0.78
Oil Seeds	million ton	0.58	0.76	1.31
Pulses	million ton	0.60	0.85	1.42
Fish	million ton	1.37	2.08	1.52
Tea	million ton	54.00	60.00	1.11
Livestock Population	million	227.06	294.50	1.30
<b>Industrial Output</b>				
Sugar	million MT	0.14	0.26	1.86
Yarn Production	million Kg	113.00	522.00	4.62
(Cotton Yarn)	million Kg	75.71	349.74	
(T.C & Others)	million Kg	37.29	172.26	
Total Fabrics Production	million m	1,163.00	3,651.00	3.14
(Cotton Yarn)	million m	779.21	2,446.17	
(T.C & Others)	million m	383.79	1,204.83	
Garments	million m	210.00	1,614.00	7.69
(Cotton Yarn)	million m	140.40	1,081.38	
(T.C & Others)	million m	69.30	538.62	
Jute Textiles	1000 MT	70.00	500.00	7.14
Paper & Pulp Newsprint	1000 MT	43.24	124.20	2.87
Fertilizer	1000 MT	2,153.99	2,583.00	1.20
Cement	1000 MT	160.00	233.00	1.46
Leather (Export quantity)	million sq. m	13.01	18.58	1.43
<b>Energy Supply</b>				
Electricity (generation)	MW	2,690.00	5,132.00	1.91
Natural Gas	BCF	285.00	365.00	1.28
POL Products	million MT	2.90	4.98	1.72
<b>Physical Infrastructure</b>				
National/Regional/Feeder Paved Roads	Km	11,500.00	14,000.00	1.22
Rural Paved Roads	Km	9,550.00	17,450.00	1.83

Source : The Fifth Five Year Plan 1997-2002

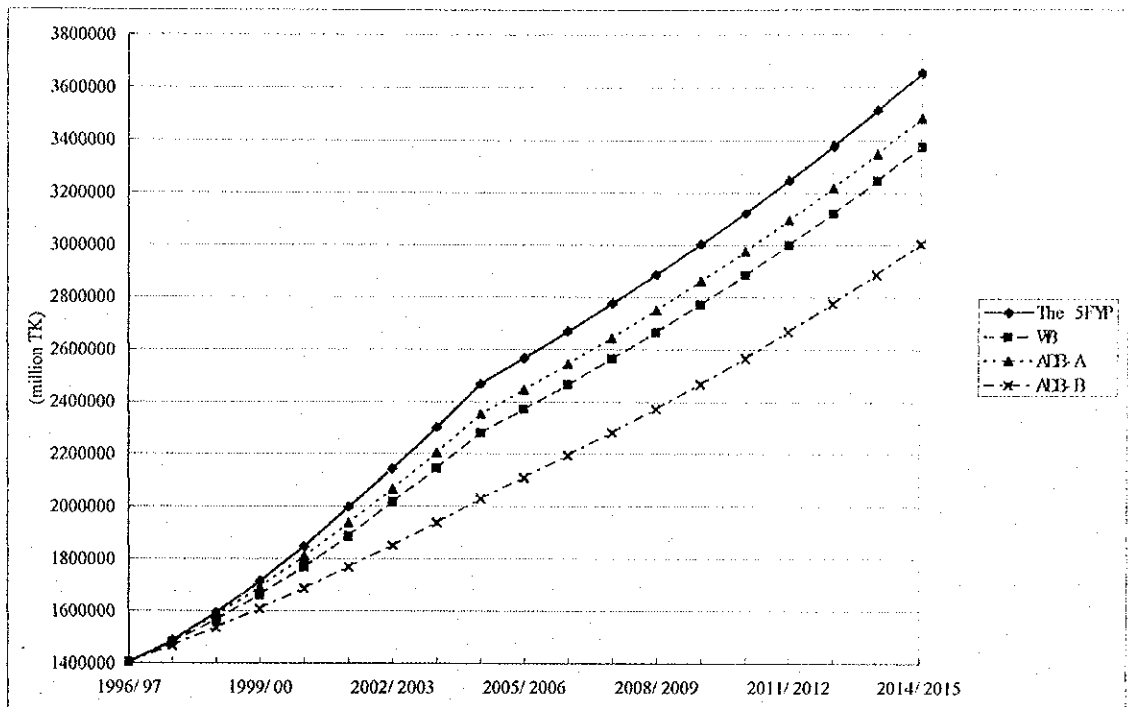


Fig. A-3.3.1 GDP Estimates

Table A-3.3.1 Socio-Economic Framework of India

<b>INDIA (Ninth Five Year Plan 1997 - 2002, Planning Commission)</b>				
<b>1. Population (million)</b>				
1996	934.22			
2001	1,012.39	(1.62% per annum)		
2006	1,094.13	(1.57% per annum)		
2011	1,178.89	(1.50% per annum)		
<b>2. GDP</b>				
	8FYP	9FYP	Share of GDP (%)	
	Growth Rate(%)	Growth Rate(%)	1996-97	2001-2002
Agriculture & Allied Sectors	3.7	4.5	27.0	24.0
Mining & Quarrying	4.1	7.7	1.9	1.9
Manufacturing	9.5	9.7	20.3	23.0
Electricity, Gas & Water	7.6	10.6	2.6	3.1
Construction	4.4	5.7	5.7	5.4
Trade	10.0	7.1	13.7	13.8
Rail Transport	2.4	3.4	1.3	1.1
Other Transport	7.5	7.9	5.2	5.5
Communications	13.9	11.2	1.4	1.7
Financial Services	8.9	10.1	5.8	6.7
Public Administration	4.3	4.9	5.3	4.8
Other Services	5.3	5.5	9.7	9.1
<b>Total</b>	<b>6.5</b>	<b>7.0</b>	<b>100.0</b>	<b>100.0</b>

Table A-3.3.2 Nepal's Development Targets in Ninth Five Year Plan

Nepal (Approach to the Ninth Plan 1997 - 2002, National Planning Commission)						
1. Population (million)						
	1993	20.39				
	1994	21.36				
	1995	21.46 (85-95 Annual Average 2.5% per annum)				
		(to 1.8% per annum by the end of the 12FYP(2012))				
2. GDP (at constant 1996/97 prices. in Rs. 10 million)						
	1996/1997		2001/2002		Average Annual	
	Amount(Rs.)	Share(%)	Amount(Rs.)	Share(%)	Growth Rate(%)	
Agriculture, Irrigation & Forestry	11,116	41.7	13,655	37.4	4.2	
Industry(including Geology & Mining)	2,587	9.7	4,498	12.3	11.7	
Electricity, Gas & Water	397	1.5	636	1.7	9.9	
Construction	2,659	10.0	3,746	10.3	7.1	
Trade, Hotel & Restaurant	2,998	11.2	4,206	11.5	7.0	
Transport & Communications	1,802	6.8	2,722	7.4	8.6	
Finance & Real Estate	2,687	10.1	3,681	10.0	6.5	
Social Services	2,437	9.1	3,401	9.3	6.9	
Total (at factor cost)	26,682	100.0	36,546	100.0	6.5	

Table A-3.3.3 Socio-Economic Framework of Nepal

Nepali Socioeconomic Framework						
1. Population Estimates (in million persons)						
	1994/95	1999/2000	2004/2005	2009/2010	2011/2012	2014/2015
	21.46	23.50	25.87	27.85	28.55	30.12
2. GDP Estimates (at constant 1996/97 prices, in Rs 10 million)						
2-1. Estimates based on Targets of "Approach to the Ninth Plan 1997 - 2002, National Planning Commission"						
	1996/97	1999/2000	2001/2002	2004/2005	2009/2010	2014/2015
Agriculture, Irrigation & Forestry	11,116	12,479	13,655	15,479	19,410	24,263
Industry(including Geology & Mining)	2,587	3,524	4,498	6,281	11,151	19,730
Electricity, Gas & Water	397	517	636	846	1,385	2,260
Construction	2,659	3,222	3,746	4,611	6,634	9,513
Trade, Hotel & Restaurant	2,998	3,624	4,206	5,163	7,390	10,547
Transport & Communications	1,802	2,270	2,722	3,493	5,387	8,281
Finance & Real Estate	2,687	3,205	3,681	4,455	6,232	8,688
Social Services	2,437	2,937	3,401	4,163	5,933	8,430
Total (at factor cost)	26,682	31,778	36,546	44,491	63,523	91,713
2-2. Estimates based on Short-term Projections in "Country Economic Review Nepal, January 1998, Asian Development Bank"						
	1996/97	1999/2000	2001/2002	2004/2005	2009/2010	2014/2015
*** Agriculture	11,116	12,525		14,891	17,696	21,019
Agriculture, Irrigation & Forestry	11,116	12,525		14,891	17,696	21,019
*** Industry	5,643	6,451		7,857	9,564	11,637
Industry(including Geology & Mining)	2,587	3,144		4,205	5,563	7,289
Electricity, Gas & Water	397	459		566	691	834
Construction	2,659	2,848		3,086	3,310	3,514
*** Services	9,924	11,037		13,767	17,167	21,396
Trade, Hotel & Restaurant	2,998	3,322		4,113	5,087	6,278
Transport & Communications	1,802	2,087		2,784	3,707	4,928
Finance & Real Estate	2,687	2,936		3,552	4,290	5,173
Social Services	2,437	2,692		3,318	4,083	5,017
Total (at factor cost)	26,682	30,013		36,515	44,427	54,052

Table A-3.3.4 Socio-Economic Framework of Bhutan

<b>Bhutan (Eighth Five Year Plan 1997 - 2002, Ministry of Planning)</b>			
<b>1. Population (million)</b>			
	1997/1998	0.620	
	2002/2002	0.690	
	2004/2005	0.759	
	2009/2010	0.838	
	2014/2015	0.907	
<b>2. GDP (at constant 1980 prices, in million Nu.)</b>			
	1997/98	2001/2002	Average Annual Growth Rate(%)
Agriculture Sector	1,182.9	1,305.3	2.5
Agriculture	634.8	700.7	2.5
Livestock	263.3	296.4	3.0
Forestry & Logging	284.8	308.2	2.0
Mining & Quarrying	51.8	119.9	19.4
Manufacturing	327.8	540.5	12.0
Electricity & Gas	273.4	348.0	7.0
Construction	368.3	482.7	7.0
Transport & Communications	190.6	223.0	4.0
Trade, Hotel, etc.	273.6	400.6	10.0
Finance, Insurance & Real Estate	338.3	495.3	10.0
Government Services	355.4	448.6	6.0
<b>Total (at factor cost)</b>	<b>3,362.1</b>	<b>4,363.9</b>	<b>6.7</b>



**APPENDIX B**  
**ROAD TRANSPORT**

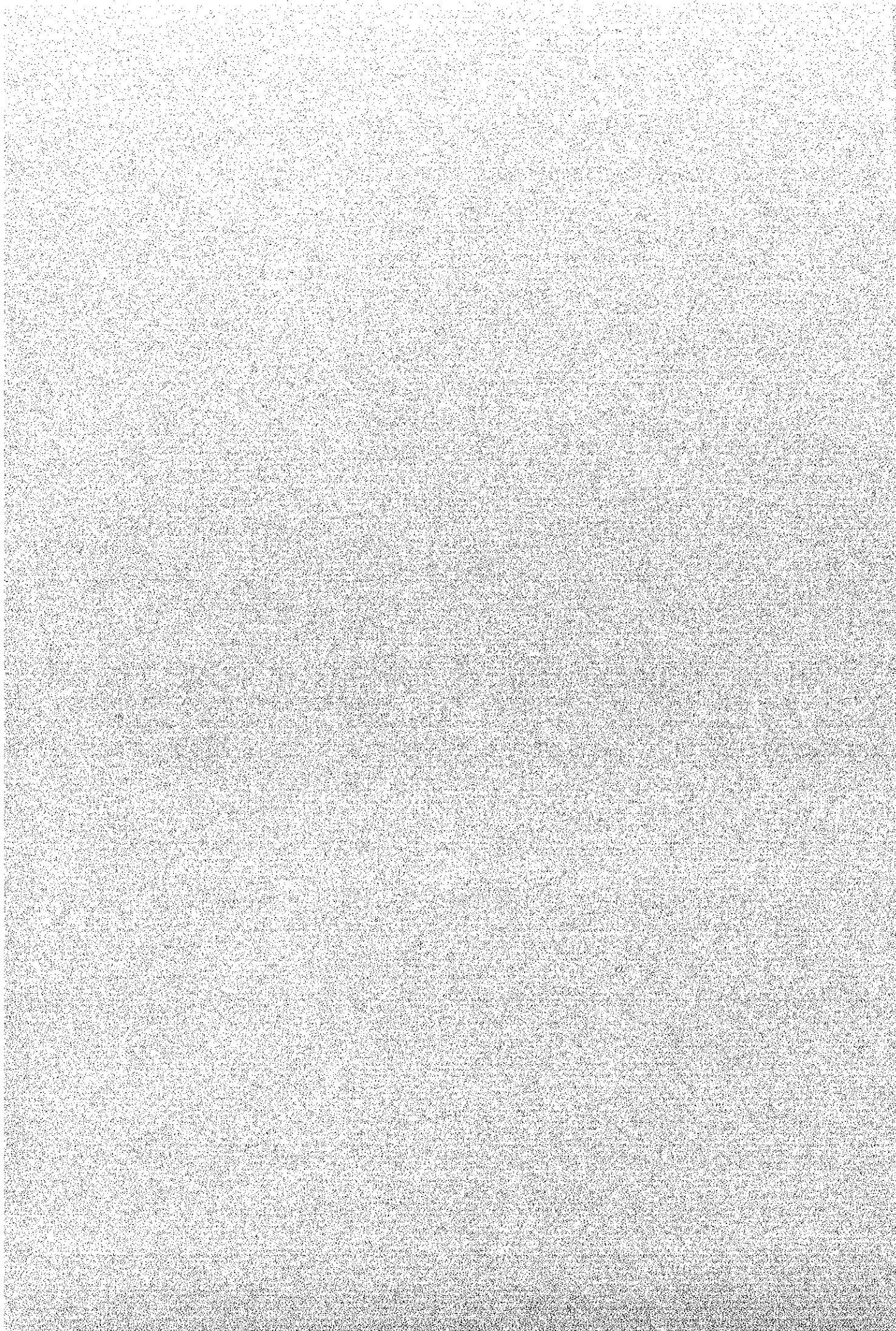




Table B-4.1.1 Length of RHD Roads by Circle in 1996/97

Circle	National Highway (%)	Regional Highway (%)	Feeder Road-A (%)	Total Length (%)
Dhaka	314 (11)	66 (4)	626+356* (6)	1,362 (7)
Mymensingh	216	194	1,312+565*	2,287
Comilla	215	111	939+500*	1,765
Sylhet	238	80	715+276*	1,309
Noakhali	120	29	529+240*	927
Chittagong	178	55	412+181*	826
Rangamati	27	34	297+206*	564
Chittagong(S)	147	6	739+422*	1,314
Rangpur	335	160	874+304*	1,673
Dinajpur	194	93	613+65*	965
Rajshahi	54	165	553+150*	922
Pabna	238	19	602+226*	1,085
Khulna	67 (2)	125 (8)	498+312* (4)	1,002 (5)
Jessore	267 (9)	228 (15)	656+179* (5)	1,330 (7)
Barisal	66	75	786+1,019*	1,946
Faridpur	186	125	349+348	1,008
TOTAL(km)	2,862 (100)	1,565 (100)	10,508+5,352*(100) =15,860	20,285 (100)

Note: Differences in length from other sources is inevitable and these will all be reconciled as divisional road maps are supplied and verified prior to entry into the network GIS.

\*: New addition of length as confirmed by divisional field Executive Engineers.

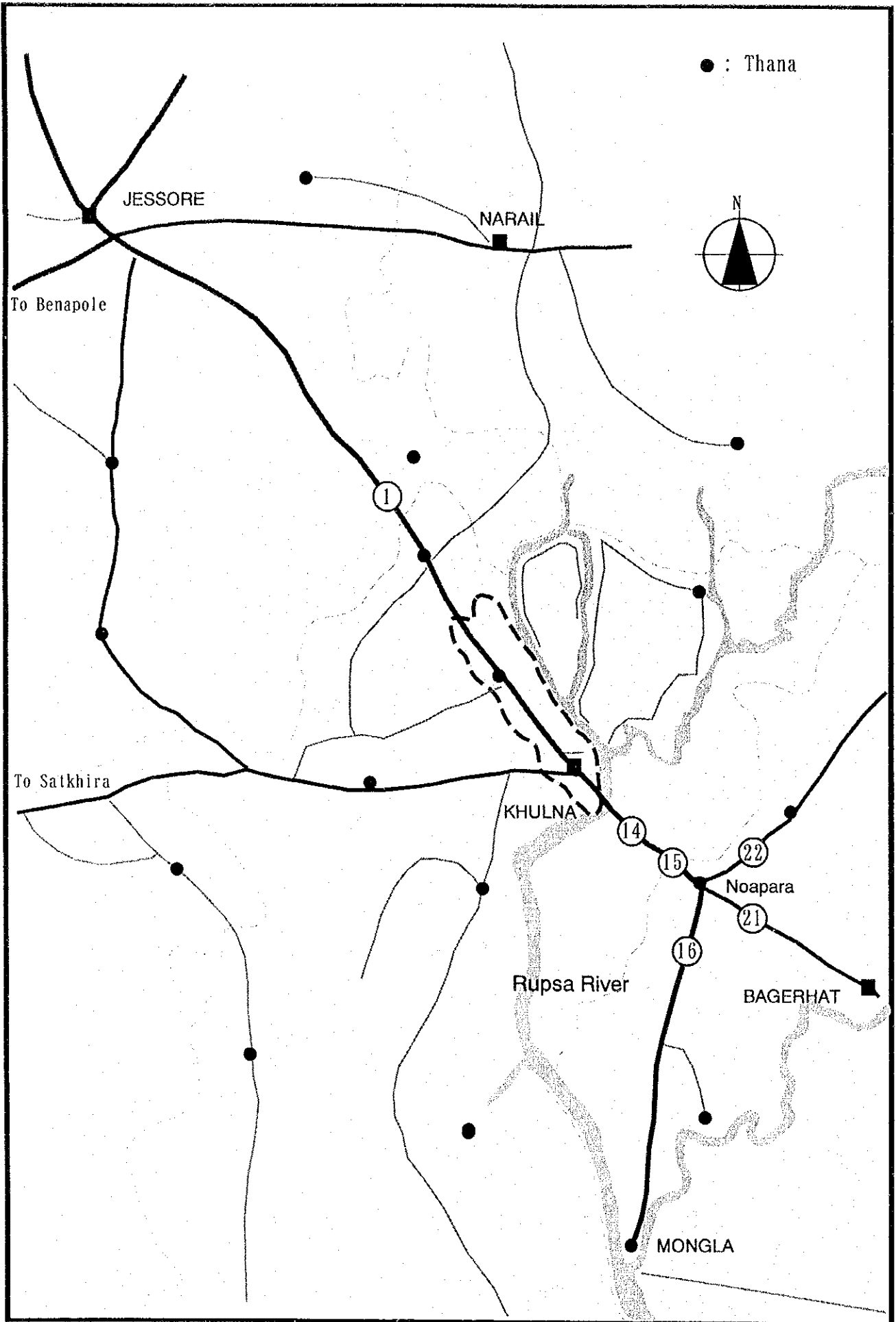


Fig B-4.2.1 Survey Locations in Khulna Surroundings

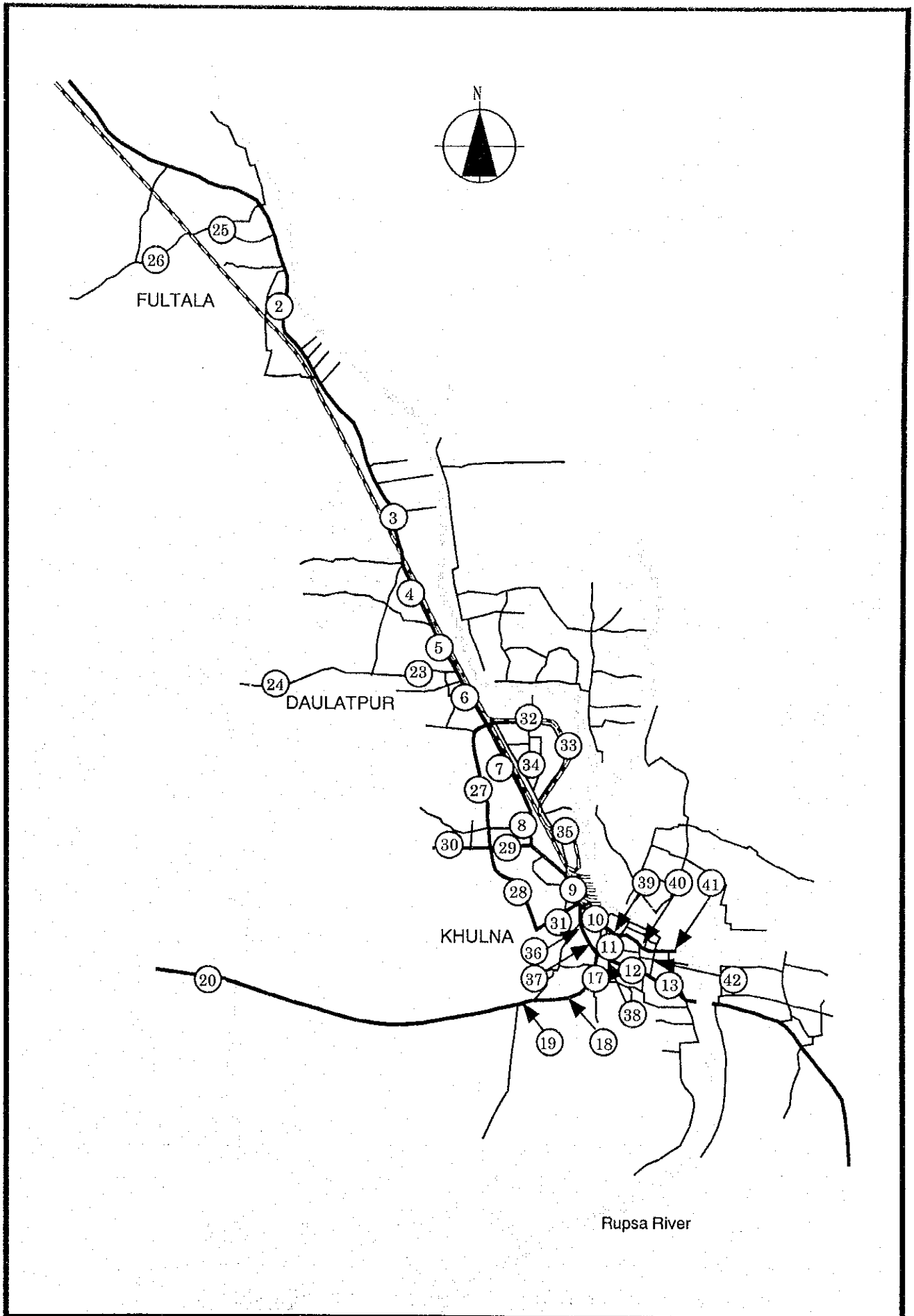


Fig B-4.2.2 Survey Locations in Khulna

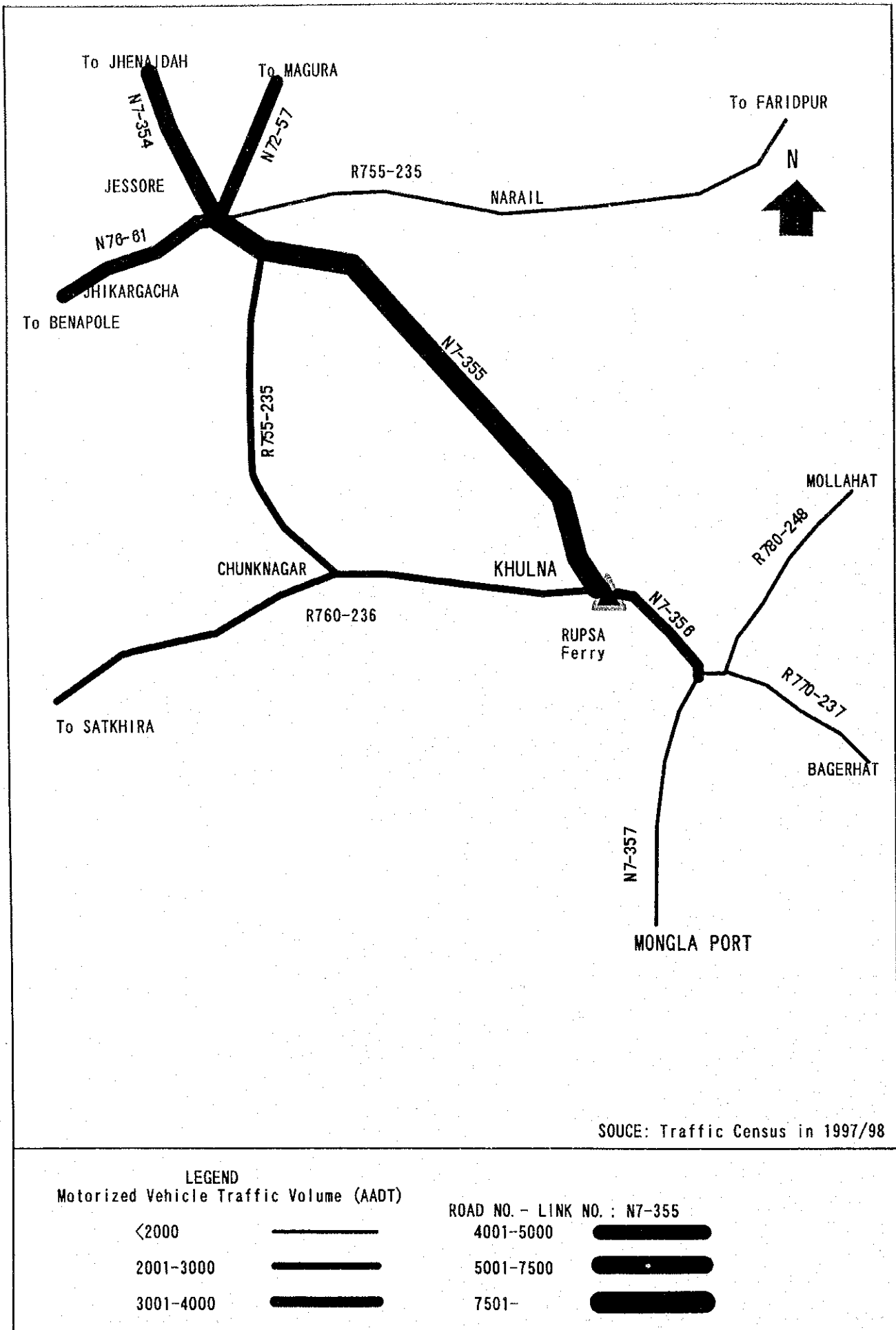


Fig B-4.3.1 Motorized Vehicle Traffic Volume (AADT) in 1997/98

Table B-4.3.1 Bus Route

BUS ROUTE			
Serial No:	via		
1	BAGERHAT	Khulna/ Jessore	BENAPOLE
2	KHULNA	Jiban nagar	ALAMDANGA
3	KHULNA		BAGERHAT
4	KHULNA		BARISHAL
5	KHULNA	Jessore	BENAPOLE
6	KHULNA	Jenidaho	CHUADANGA
7	KHULNA		DACOPE
8	KHULNA		DHAKA
9	KHULNA	Mawa	DHAKA
10	KHULNA		FAKIRHAT
11	KHULNA		FARIDPUR
12	KHULNA		FULTOLA
13	KHULNA		GOPALGANJ
14	KHULNA		JESSORE
15	KHULNA		JHENIDAHA
16	KHULNA	Koia	KALIGONJ
17	KHULNA	Jessore/Navaron	KALIGONJ
18	KHULNA	Jessor/Jhenaidah*	KUSTIA
19	KHULNA		LAXMIPASA
20	KHULNA		MADARIPUR
21	KHULNA	Arpara	MAGURA
22	KHULNA	Jhenaidha	MAGURA
23	KHULNA	kustia	MEHERPUR
24	KHULNA	Chuadanga	MEHERPUR
25	KHULNA	Karigonj/Chuadanga/Darsana	MEHERPUR
26	KHULNA		NARAIL
27	KHULNA		PAIKGACHA
28	KHULNA		SATKHIRA
29	RUPSA		BAGERHAT
30	RUPSA		BARISHAL
31	RUPSA		DHAKA
32	RUPSA	Fakirhat	MOLLAHAT
33	RUPSA		MONGLA
34	RUPSA		MOHISHPUR
35	RUPSA		RAMPAL

Source: BRTA

Table B-4.3.2 Daily Regularly Operated Passenger Ship Route

	Name of Route	Departure Time at BIWTA Ghat	Arrival Time at BIWTA Ghat	Name of Lanch Co.
1	KHULNA - MONGLA	2:30 3:30	17:40 19:10	JAMAN TRANSPORT CO. LTD. TALIM LTD.
2	KHULNA - MADINABAD	6:15 9:00 15:45 17:20	15:25 5:30 13:00 14:00	BASANTI WATER TRANSPORT/SK.KAWSAR ALI & CO. ABDULLAH NAVIGATION CO. JAMAN TRANSPORT CO. LTD. JAMAN TRANSPORT CO. LTD.
3	KHULNA - VATIAPARA	6:05 9:00 12:05 22:00	20:00 15:00 13:45 17:00	MALLIK WATER TRANSPORT A.K. ZALANI TRANSPORT CO. SADIN WATER TRANSPORT/A.RAZZAK SK.& JAMAN TRANSPORT CO. LTD.
4	KHULNA - BARDIA	14:20	11:30	SADIN WATER TRANSPORT/A.RAZZAK SK.& BARKATI WATERWAYS.
5	KHULNA - RUPGONG	14:45	11:00	A.HALIM & CO./AL-AMIN NAI-PARIBAHAN
6	KHULNA - KAPATAKHI	6:45	18:00	SK.KAWSAR ALI & CO./MAHAMADI AGENCY
7	KHULNA - ANGTIHARA	7:15	16:35	SHIPSHA PARIBAHAN
8	KHULNA - ZORESHING	10:30 14:10	7:05 11:45	PIRWALISTAN RIVER TRANSPORT M/S.KAZI MOYAZZEM HOSSAIN
9	KHULNA - KALABAGHI	12:00	11:00	TALIM LTD./SHIPSA PARAPBAHAN
10	KHULNA - CHARDOANT	16:00	10:15	M.S. JAMAM TRANSPORT LTD.
11	KHULNA - GANPARA	18:30	8:00	A.HALIM & CO./PIRWALISTAN RIVER TRANSPORT
12	KHULNA - MUNSHIGANJI	19:20	6:00	PIRWALISTAN RIVER TRANSPORT/A.HALIM & CO.
13	KHULNA - GHARILAL	20:20	18:00	PIRWALISTAN RIVER TRANSPORT/A.HALIM & CO.
14	KHULNA - NILDUMUR	22:00	3:30	PIRWALISTAN RIVER TRANSPORT/A.HALIM & CO.
15	KHULNA - DHAKA	3:00	21:30	BIWCT

Source: BIWTA

Table B-4.3.3 Summary of traffic Count Survey (1)

(1) Daily Traffic Volume at Survey Point No. 1 (Khalina Ghat) in September 1998

Date	M/Cycle	AutoRickshaw	P/Gar	Pickup	MicroBus	MiniBus	LargeBus	S/Truck	M/Truck	L/Truck	Rickshaw	Others	Total	M/Veh.	3&4W/Veh.	Non-M/Veh
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(1)~(12)	(1)~(10)	(2)~(10)	(11)~(12)
Sep. 4	534	2,475	235	64	151	26	29	49	269	0	9,380	1,483	14,695	3,832	3,298	10,863
Sep. 5	497	2,711	294	123	120	41	53	73	324	0	13,050	2,024	19,546	4,472	3,739	15,074
Sep. 6	537	2,072	234	121	106	46	37	57	323	0	9,072	1,351	13,956	3,533	2,996	10,423
Sep. 7	554	1,744	243	108	111	48	32	33	348	0	8,342	950	12,511	3,219	2,665	9,292
Sep. 8	304	1,358	204	84	136	36	19	36	319	0	6,038	608	9,142	2,496	2,192	6,646
Sep. 9	634	2,332	268	111	113	50	29	78	287	0	10,963	1,575	16,440	3,902	3,268	12,538
Sep. 10	490	2,145	245	75	157	37	25	75	303	0	9,319	1,247	14,118	3,552	3,062	10,568

(2) Daily Traffic Volume at Survey Point No. 2 (Rupsa Ghat) in September 1998

Date	M/Cycle	AutoRickshaw	P/Gar	Pickup	MicroBus	MiniBus	LargeBus	S/Truck	M/Truck	L/Truck	Rickshaw	Others	Total	M/Veh.	3&4W/Veh.	Non-M/Veh
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(1)~(12)	(1)~(10)	(2)~(10)	(11)~(12)
Sep. 4	438	917	176	51	140	487	158	55	382	0	1,095	1,536	5,435	2,804	2,366	2,631
Sep. 5	497	1,082	277	106	138	621	292	83	643	0	1,330	1,754	6,823	3,739	3,242	3,084
Sep. 6	325	928	221	107	157	590	240	58	390	0	882	1,032	4,930	3,016	2,691	1,914
Sep. 7	400	970	200	70	136	679	119	67	354	0	1,140	1,240	5,375	2,995	2,595	2,330
Sep. 8	299	837	169	115	274	327	117	58	299	0	1,103	689	4,287	2,495	2,196	1,792
Sep. 9	287	672	167	48	117	393	127	62	257	0	816	646	3,592	2,130	1,843	1,462
Sep. 10	367	1,092	202	84	128	609	179	85	318	0	1,153	1,073	5,290	3,034	2,697	2,225

(3) Daily Traffic Volume at Survey Point No. 3 (Fultara) in September 1998

Date	M/Cycle	AutoRickshaw	P/Gar	Pickup	MicroBus	MiniBus	LargeBus	S/Truck	M/Truck	L/Truck	Rickshaw	Others	Total	M/Veh.	3&4W/Veh.	Non-M/Veh
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(1)~(12)	(1)~(10)	(2)~(10)	(11)~(12)
Sep. 4	555	1,879	476	98	196	275	593	115	689	0	2,443	551	7,870	4,876	4,321	2,994
Sep. 5	543	1,855	524	129	219	255	702	284	1,005	0	2,409	976	8,901	5,516	4,973	3,385
Sep. 6	538	1,802	623	119	218	216	479	74	1,105	0	2,615	1,484	9,273	5,174	4,636	4,039
Sep. 7	521	1,797	475	111	239	277	501	93	1,153	0	2,171	1,114	8,452	5,167	4,646	3,285
Sep. 8	357	1,718	515	100	192	237	418	91	1,194	0	1,826	998	7,646	4,822	4,465	2,824
Sep. 9	422	1,810	499	83	196	238	406	127	1,137	0	2,198	1,001	8,117	4,918	4,496	3,199
Sep. 10	460	1,777	484	76	193	232	362	104	1,080	0	2,443	1,188	8,399	4,768	4,308	3,631

(4) Daily Traffic Volume at Survey Point No. 4 (To Sakthira) in September 1998

Date	M/Cycle	AutoRickshaw	P/Gar	Pickup	MicroBus	MiniBus	LargeBus	S/Truck	M/Truck	L/Truck	Rickshaw	Others	Total	M/Veh.	3&4W/Veh.	Non-M/Veh
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(1)~(12)	(1)~(10)	(2)~(10)	(11)~(12)
Sep. 4	771	56	196	32	141	7	6	68	125	0	2,863	3,853	8,118	1,402	631	6,716
Sep. 5	734	464	207	72	155	336	46	155	261	0	4,108	3,168	9,706	2,430	1,696	7,276
Sep. 6	658	517	261	112	178	349	70	188	305	0	4,609	2,252	9,499	2,638	1,980	6,861
Sep. 7	891	624	303	123	254	430	75	205	350	0	4,356	2,274	9,885	3,255	2,364	6,630
Sep. 8	466	536	264	93	174	474	42	210	298	0	3,325	1,633	7,325	2,557	2,091	4,788
Sep. 9	744	477	211	69	151	329	43	150	264	0	4,121	3,208	9,767	2,438	1,694	7,329
Sep. 10	880	624	321	118	252	434	75	204	342	0	4,358	2,282	9,890	3,250	2,370	6,640

Table B-4.3.3 Summary of traffic Count Survey (2)

(5) Daily Traffic Volume at Survey Point No. 5 (Mongla Port) in September 1998

Date	M/Cycle	Auto/Rickshaw	P/Car	Pickup	MicroBus	MiniBus	LargeBus	S/Truck	M/Truck	L/Truck	Rickshaw	Others	Total	M/Veh.	3&4W/Veh.	Non-M/Veh.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(1)~(12)	(1)~(10)	(2)~(10)	(11)~(12)
Sep. 4	177	37	95	33	90	230	38	59	245	0	452	51	1,507	1,004	827	503
Sep. 5	150	29	164	77	145	309	36	74	380	0	294	134	1,792	1,364	1,214	428
Sep. 6	93	2	91	36	121	273	37	42	273	0	222	74	1,204	908	815	296
Sep. 7	112	20	103	53	116	248	45	59	179	0	315	81	1,331	935	823	396
Sep. 8	104	37	127	54	166	293	59	84	209	0	271	86	1,490	1,133	1,029	357
Sep. 9	108	41	130	40	121	204	53	75	142	0	246	118	1,278	914	806	364
Sep. 10	117	37	135	54	215	252	53	84	219	0	338	183	1,687	1,166	1,049	521

(6) Daily Traffic Volume at Survey Point No. 6 (To Bagerhat) in September 1998

Date	M/Cycle	Auto/Rickshaw	P/Car	Pickup	MicroBus	MiniBus	LargeBus	S/Truck	M/Truck	L/Truck	Rickshaw	Others	Total	M/Veh.	3&4W/Veh.	Non-M/Veh.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(1)~(12)	(1)~(10)	(2)~(10)	(11)~(12)
Sep. 4	152	216	112	10	91	185	160	20	82	0	254	193	1,475	1,028	876	447
Sep. 5	168	252	78	24	75	206	187	36	145	0	227	135	1,533	1,171	1,003	392
Sep. 6	112	283	110	32	59	219	141	49	161	0	337	128	1,631	1,166	1,054	465
Sep. 7	241	232	146	45	99	220	198	37	285	0	290	181	1,974	1,503	1,262	471
Sep. 8	107	191	99	38	113	166	172	52	229	0	215	90	1,472	1,167	1,060	305
Sep. 9	91	174	95	53	62	160	111	82	166	21	91	75	1,181	1,015	924	166
Sep. 10	130	174	104	36	110	173	141	68	221	0	333	103	1,593	1,157	1,027	436

(7) Daily Traffic Volume at Survey Point No. 7 (To Mollahat) in September 1998

Date	M/Cycle	Auto/Rickshaw	P/Car	Pickup	MicroBus	MiniBus	LargeBus	S/Truck	M/Truck	L/Truck	Rickshaw	Others	Total	M/Veh.	3&4W/Veh.	Non-M/Veh.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(1)~(12)	(1)~(10)	(2)~(10)	(11)~(12)
Sep. 4	188	169	16	19	27	65	15	34	26	0	289	346	1,194	559	371	635
Sep. 5	342	292	39	54	84	179	108	112	147	0	442	470	2,269	1,357	1,015	912
Sep. 6	194	273	18	52	57	117	67	104	123	0	320	308	1,633	1,005	811	628
Sep. 7	161	176	17	27	54	89	24	46	68	0	315	236	1,213	662	501	551
Sep. 8	252	215	50	75	44	104	12	105	135	0	445	403	1,840	992	740	848
Sep. 9	241	230	44	59	63	132	17	80	91	5	380	408	1,750	962	721	788
Sep. 10	270	199	78	62	71	100	18	76	102	0	540	528	2,044	976	706	1,068

(8) Daily Traffic Volume at Survey Point No. 8 (to Benapole) in September 1998

Date	M/Cycle	Auto/Rickshaw	P/Car	Pickup	MicroBus	MiniBus	LargeBus	S/Truck	M/Truck	L/Truck	Rickshaw	Others	Total	M/Veh.	3&4W/Veh.	Non-M/Veh.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(1)~(12)	(1)~(10)	(2)~(10)	(11)~(12)
Sep. 4	645	30	362	47	117	113	461	42	441	0	571	1,053	3,882	2,258	1,613	1,624
Sep. 5	605	53	347	83	114	136	492	40	691	0	475	710	3,751	2,566	1,961	1,185
Sep. 6	373	34	448	80	126	244	265	82	875	0	464	653	3,644	2,527	2,154	1,117
Sep. 7	583	41	374	65	105	132	342	51	941	0	534	883	4,051	2,634	2,051	1,417
Sep. 8	455	61	415	47	123	337	152	57	966	0	841	967	4,421	2,613	2,158	1,808
Sep. 9	379	49	467	65	139	424	97	61	817	1	689	630	3,818	2,499	2,120	1,319
Sep. 10	440	45	345	48	210	327	189	83	619	0	423	773	3,502	2,306	1,566	1,195



Table B-4.3.3 Summary of traffic Count Survey (3)

(9) Daily Traffic Volume at Survey Point No. 9 (Rupsa Ferry) in September 1998

Date	Ferry Trips	M/Cycle	Auto Rickshaw	P/Car	Pickup	MicroBus	MiniBus	LargeBus	S/Truck	M/Truck	L/Truck	Rickshaw	Others	Total	M/Veh. (1)~(10)	3&4W/Veh (2)~(10)	Non-M/Veh (11)~(12)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Sep. 4	139	410	30	178	63	141	19	16	40	286	0	1,073	465	2,721	1,183	773	1,538
Sep. 5	150	428	44	171	105	101	38	34	65	333	0	1,715	2,011	5,045	1,319	891	3,726
Sep. 6	135	309	12	153	83	100	47	44	74	290	0	1,428	1,298	3,838	1,112	803	2,726
Sep. 7	139	513	34	163	100	138	45	53	83	374	0	1,667	1,723	4,893	1,503	990	3,390
Sep. 8	135	249	38	136	67	131	42	29	59	343	0	1,459	1,253	3,806	1,094	845	2,712
Sep. 9	134	382	16	190	76	133	39	26	93	269	0	1,059	681	2,964	1,224	842	1,740
Sep. 10	142	552	29	166	80	129	38	44	89	353	0	1,681	1,807	4,968	1,480	928	3,488

Date	Total Traffic	Moterized Vehicles	3&4Wheel Vehicles	Non-Motorized Veh.
Sep. 4	14,695	3,832	3,298	10,863
Sep. 5	19,546	4,472	3,739	15,074
Sep. 6	13,956	3,533	2,996	10,423
Sep. 7	12,511	3,219	2,665	9,292
Sep. 8	9,142	2,496	2,192	6,646
Sep. 9	16,440	3,902	3,268	12,538
Sep. 10	14,118	3,552	3,062	10,566

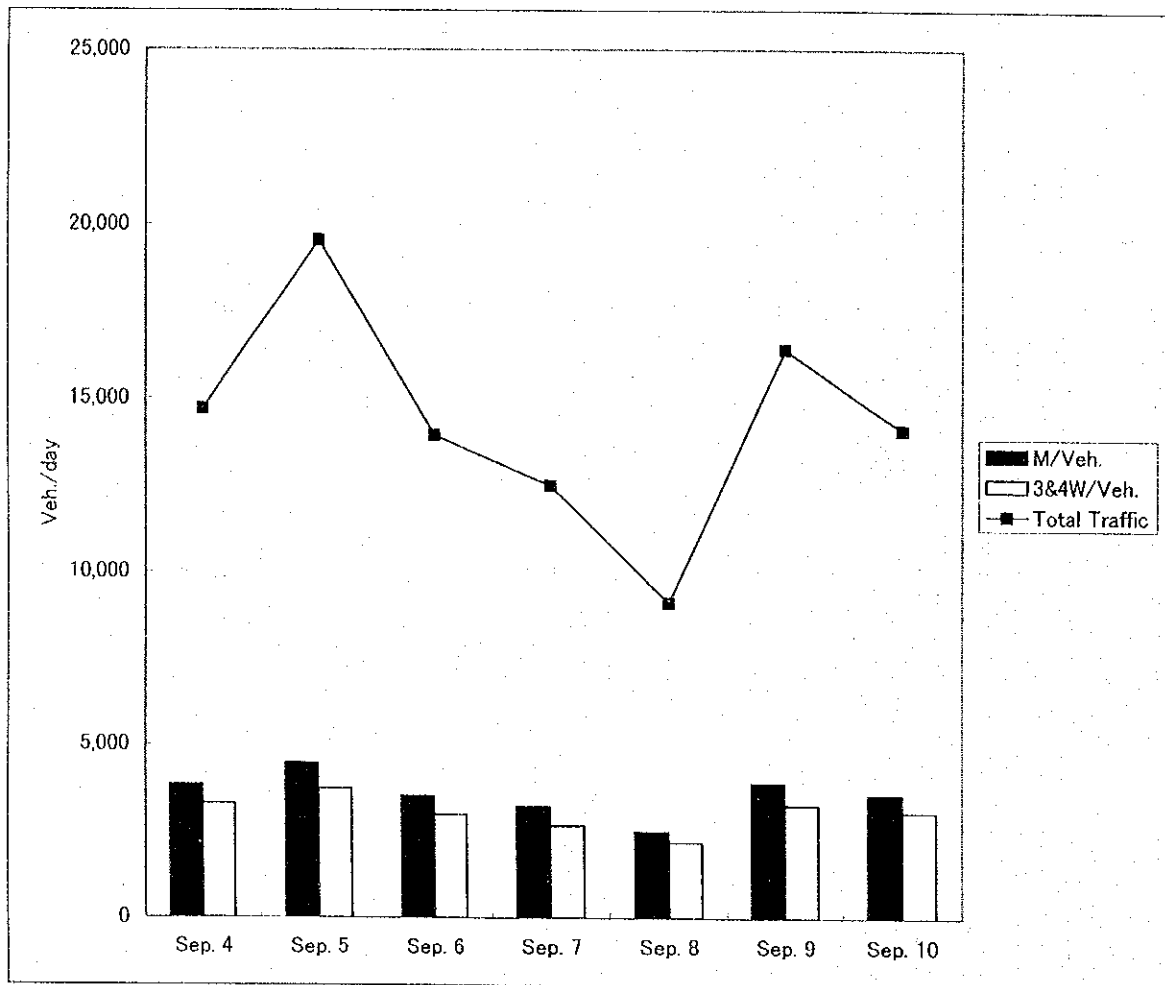


Fig B-4.3.2 Fluctuation of Daily Traffic Volume at Survey Point No. 1 (Khulna Ghat) in September 1998

Date	Veh./day			
	Total Traffic	Moterized Vehicles	3&4Wheel Vehicles	Non-Motorized Veh.
Sep. 4	5,435	2,804	2,366	2,631
Sep. 5	6,823	3,739	3,242	3,084
Sep. 6	4,930	3,016	2,691	1,914
Sep. 7	5,375	2,995	2,595	2,380
Sep. 8	4,287	2,495	2,196	1,792
Sep. 9	3,592	2,130	1,843	1,462
Sep. 10	5,290	3,064	2,697	2,226

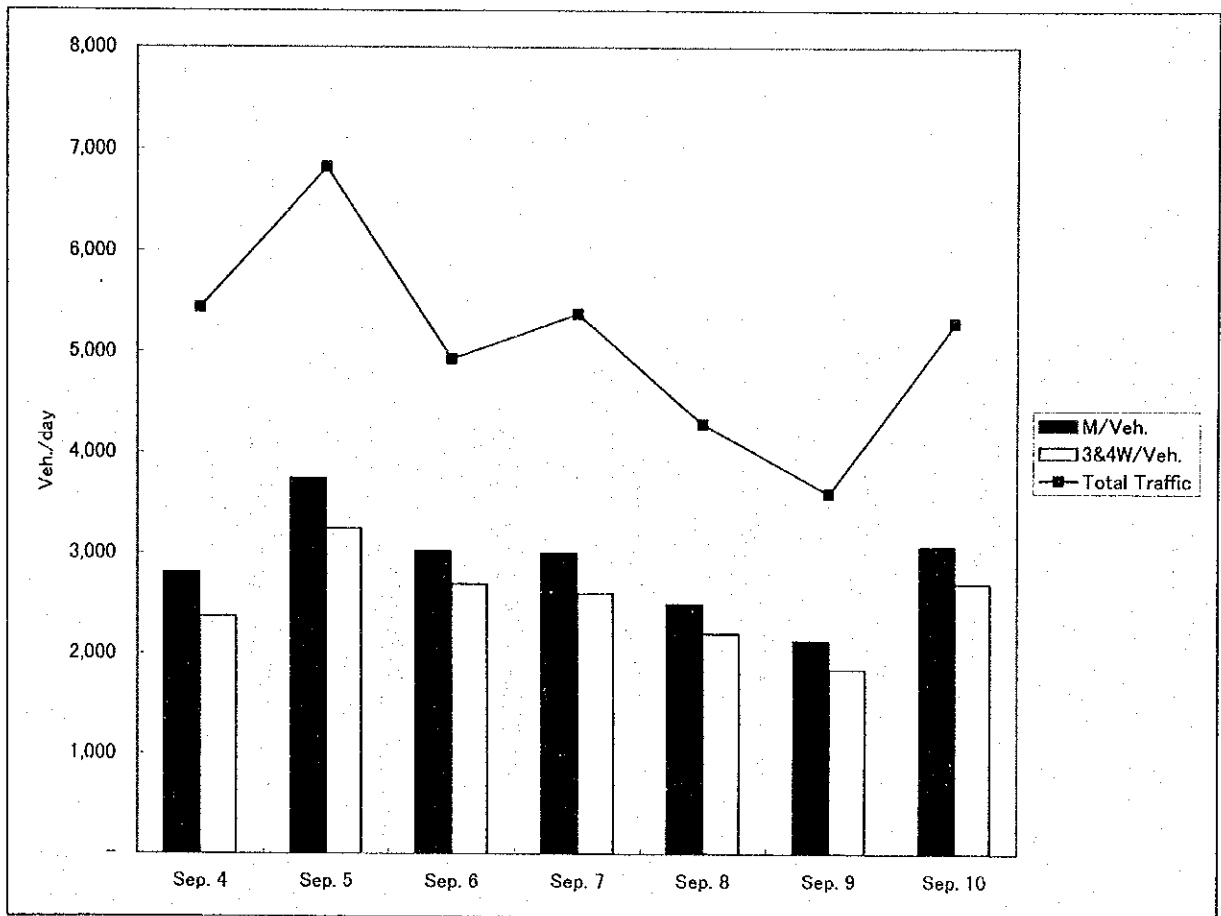


Fig B-4.3.3 Fluctuation of Daily Traffic Volume at Survey Point No. 2 (Rupsa Ghat) in September 1998

Date	Total Traffic	Moterized Vehicles	3&4Wheel Vehicles	Non-Motorized Veh.
Sep. 4	7,870	4,876	4,321	2,994
Sep. 5	8,901	5,516	4,973	3,385
Sep. 6	9,273	5,174	4,636	4,099
Sep. 7	8,452	5,167	4,646	3,285
Sep. 8	7,646	4,822	4,465	2,824
Sep. 9	8,117	4,918	4,496	3,199
Sep. 10	8,399	4,768	4,308	3,631

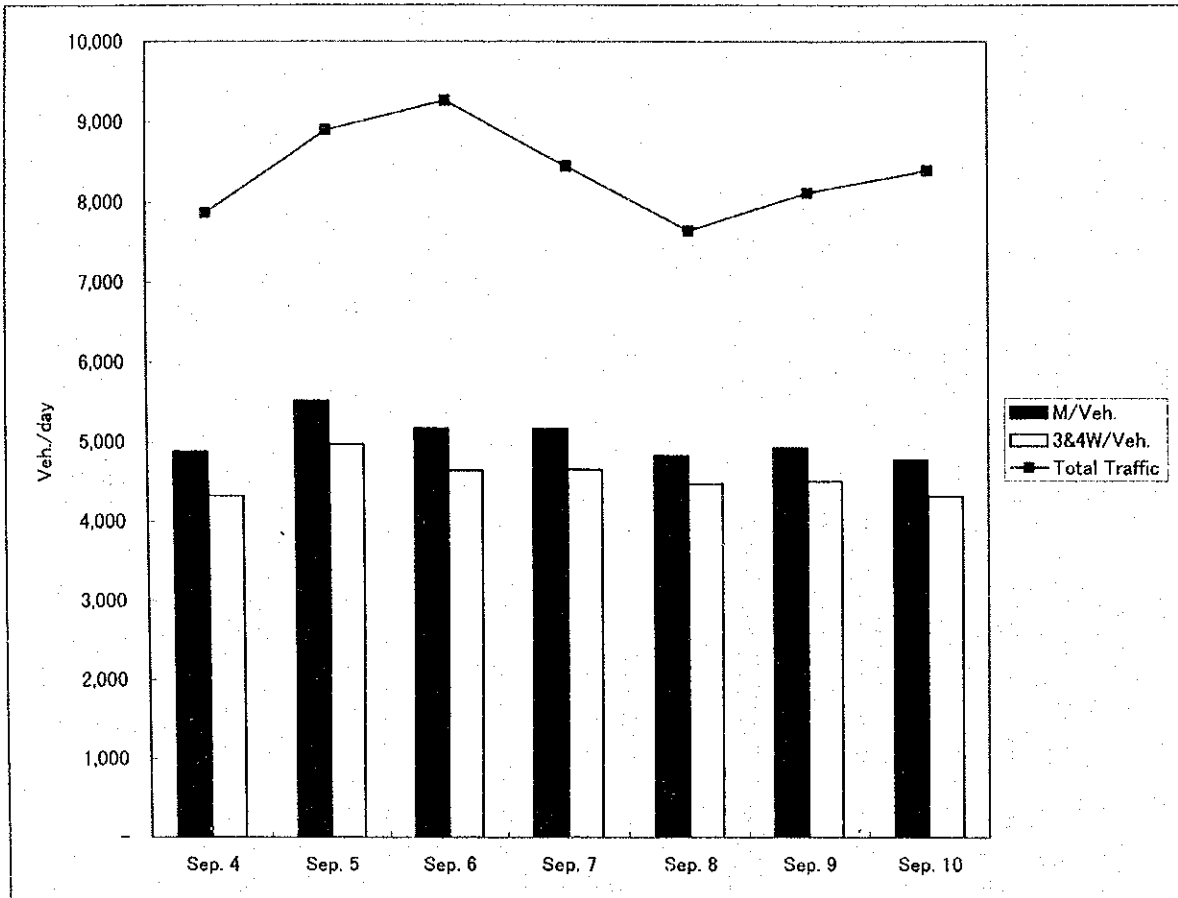


Fig B-4.3.4 Fluctuation of Daily Traffic Volume at Survey Point No. 3 (Fultara) in September 1998

Date	Veh./day			
	Total Traffic	Moterized Vehicles	3&4Wheel Vehicles	Non-Motorized Veh.
Sep. 4	8,118	1,402	631	6,716
Sep. 5	9,706	2,430	1,696	7,276
Sep. 6	9,499	2,638	1,980	6,861
Sep. 7	9,885	3,255	2,364	6,630
Sep. 8	7,325	2,557	2,091	4,768
Sep. 9	9,767	2,438	1,694	7,329
Sep. 10	9,890	3,250	2,370	6,640

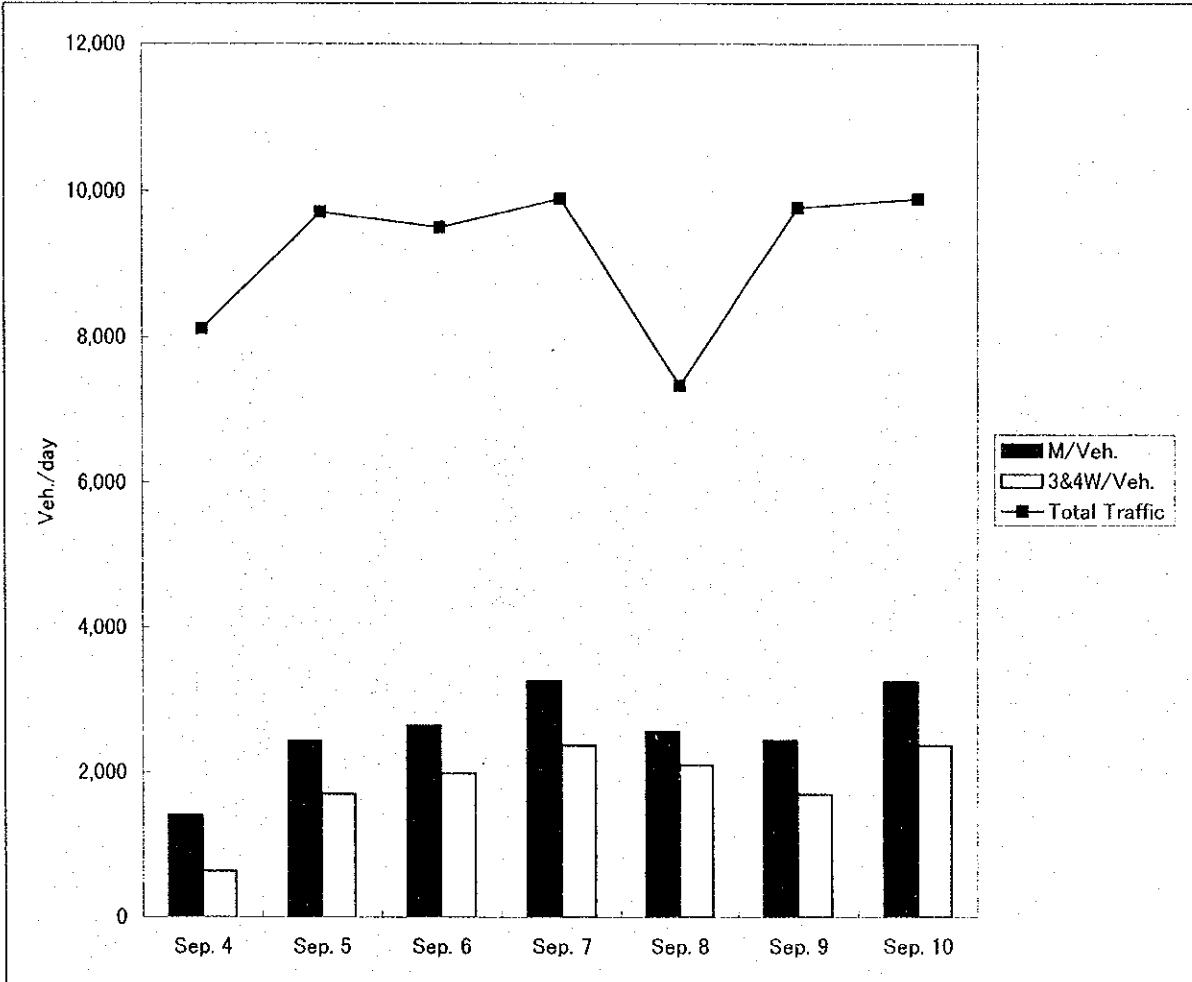


Fig B-4.3.5 Fluctuation of Daily Traffic Volume at Survey Point No. 4 (To Satkhira) in September 1998

Date	Total Traffic	Moterized Vehicles	3&4Wheel Vehicles	Non-Motorized Veh.
Sep. 4	1,507	1,004	827	503
Sep. 5	1,792	1,364	1,214	428
Sep. 6	1,204	908	815	296
Sep. 7	1,331	935	823	396
Sep. 8	1,490	1,133	1,029	357
Sep. 9	1,278	914	806	364
Sep. 10	1,687	1,166	1,049	521

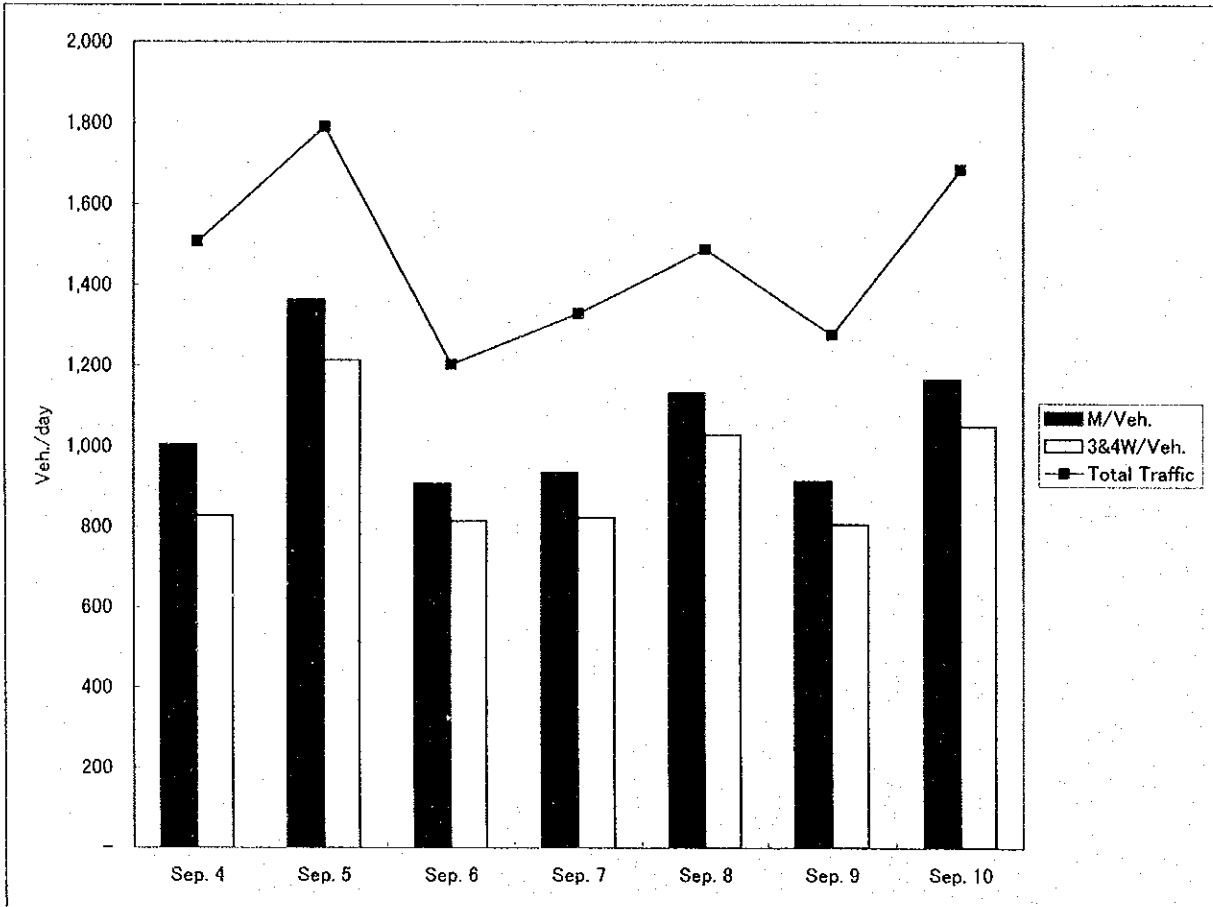


Fig B-4.3.6 Fluctuation of Daily Traffic Volume at Survey Point No. 5 (Mongla Port) in September 1998

Date	Total Traffic	Moterized Vehicles	3&4Wheel Vehicles	Non-Motorized Veh.
Sep. 4	1,475	1,028	876	447
Sep. 5	1,533	1,171	1,003	362
Sep. 6	1,631	1,166	1,054	465
Sep. 7	1,974	1,503	1,262	471
Sep. 8	1,472	1,167	1,060	305
Sep. 9	1,181	1,015	924	166
Sep. 10	1,593	1,157	1,027	436

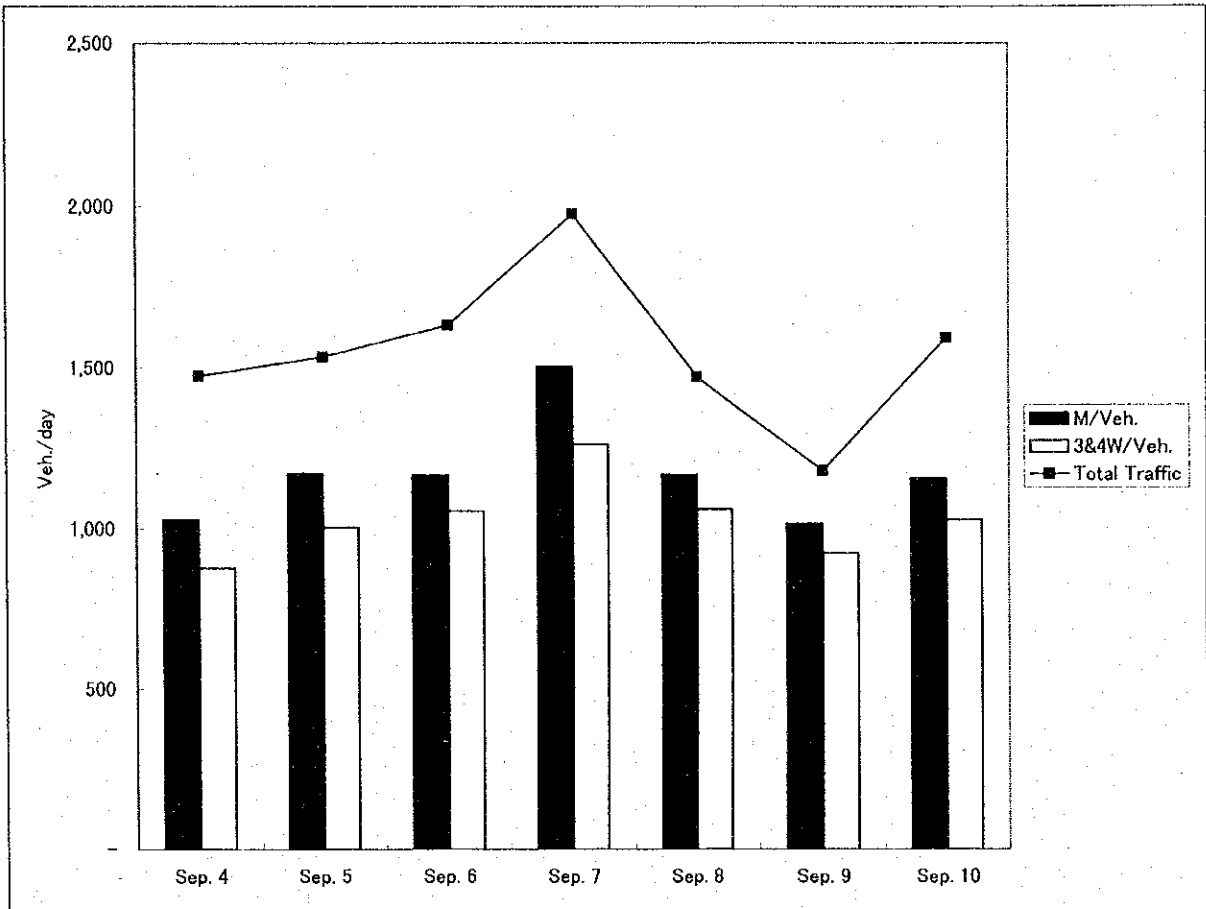


Fig B-4.3.7 Fluctuation of Daily Traffic Volume at Survey Point No. 6 (To Bagerhat) in September 1998

Date	Total Traffic	Moterized Vehicles	3&4Wheel Vehicles	Non-Motorized Veh.
Sep. 4	1,194	559	371	635
Sep. 5	2,269	1,357	1,015	912
Sep. 6	1,633	1,005	811	628
Sep. 7	1,213	662	501	551
Sep. 8	1,840	992	740	848
Sep. 9	1,750	962	721	788
Sep. 10	2,044	976	706	1,068

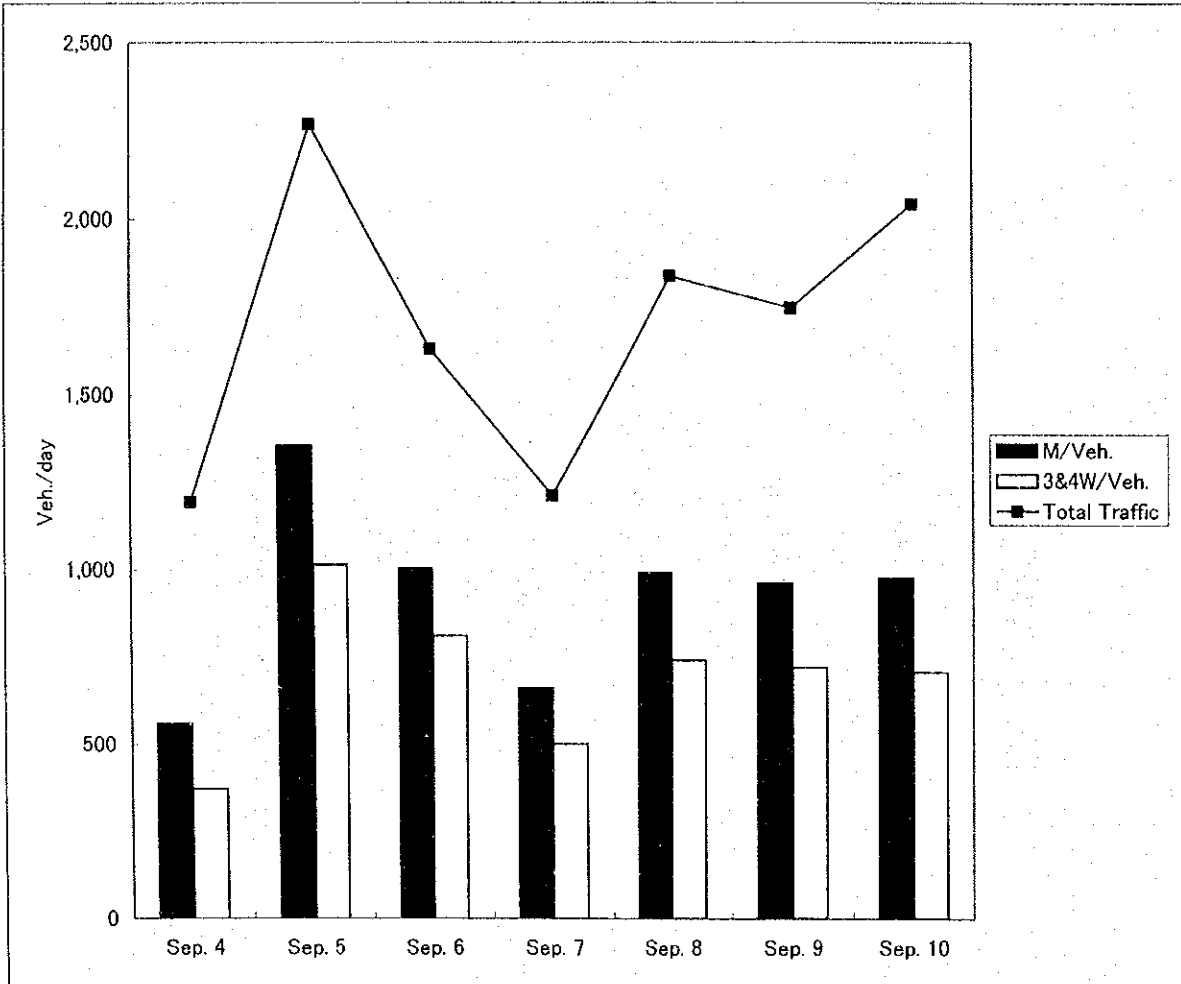


Fig B-4.3.8 Fluctuation of Daily Traffic Volume at Survey Point No. 7 (To Mollarhat) in September 1998



Date	Total Traffic	Moterized Vehicles	3&4Wheel Vehicles	Non-Motorized Veh.
Sep. 4	3,882	2,258	1,613	1,624
Sep. 5	3,751	2,566	1,961	1,185
Sep. 6	3,644	2,527	2,154	1,117
Sep. 7	4,051	2,634	2,051	1,417
Sep. 8	4,421	2,613	2,158	1,808
Sep. 9	3,818	2,499	2,120	1,319
Sep. 10	3,502	2,306	1,866	1,196

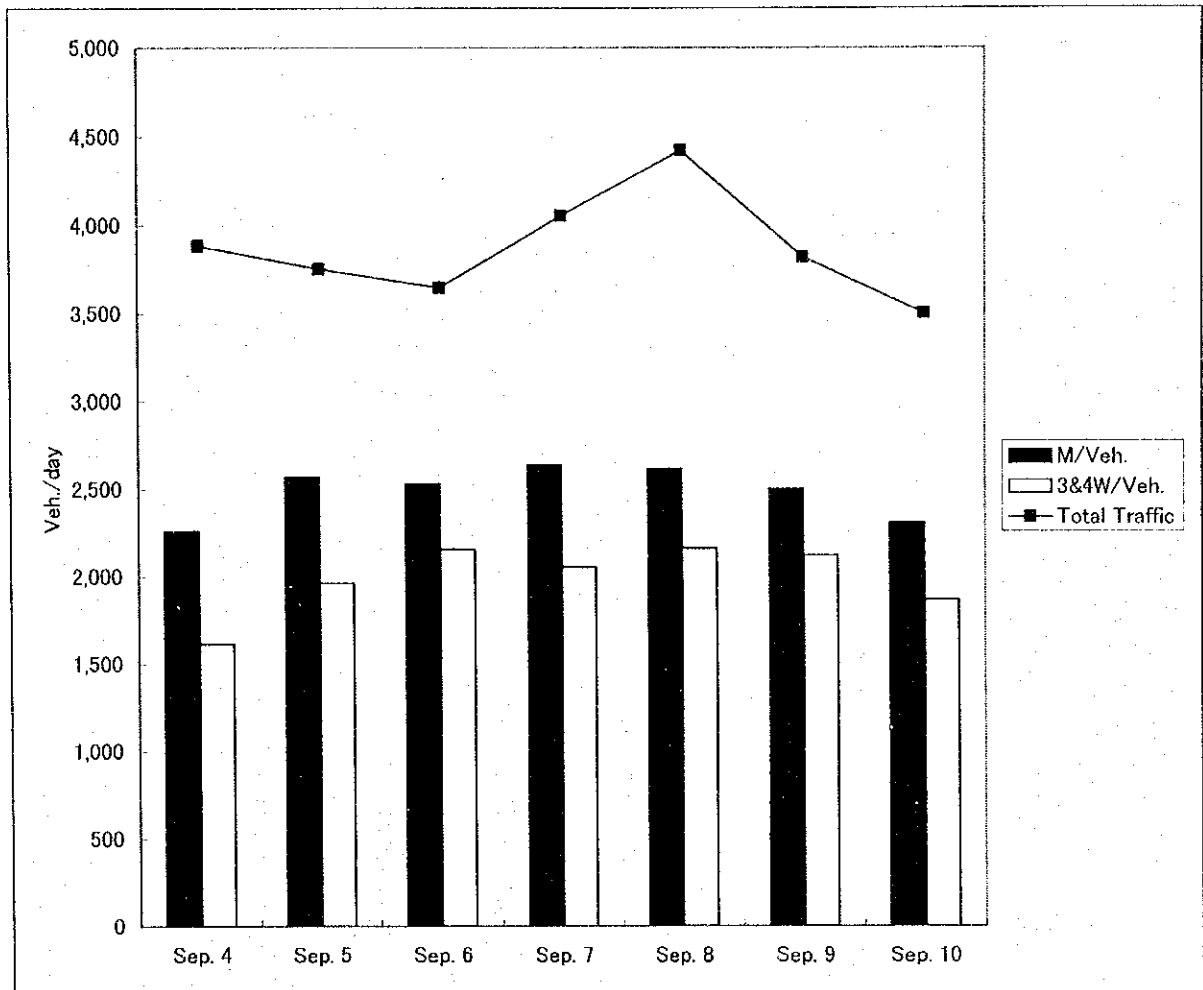


Fig B-4.3.9 Fluctuation of Daily Traffic Volume at Survey Point No. 8 (To Benapole) in September 1998

Date	No. of Ferry Trips	Total Traffic	Moterized Vehicles	3&4Wheel Vehicles	Non-Motorized Veh.
Sep. 4	139	2,721	1,183	773	1,538
Sep. 5	150	5,045	1,319	891	3,726
Sep. 6	135	3,838	1,112	803	2,726
Sep. 7	139	4,893	1,503	990	3,390
Sep. 8	135	3,806	1,094	845	2,712
Sep. 9	134	2,964	1,224	842	1,740
Sep. 10	142	4,968	1,480	928	3,488

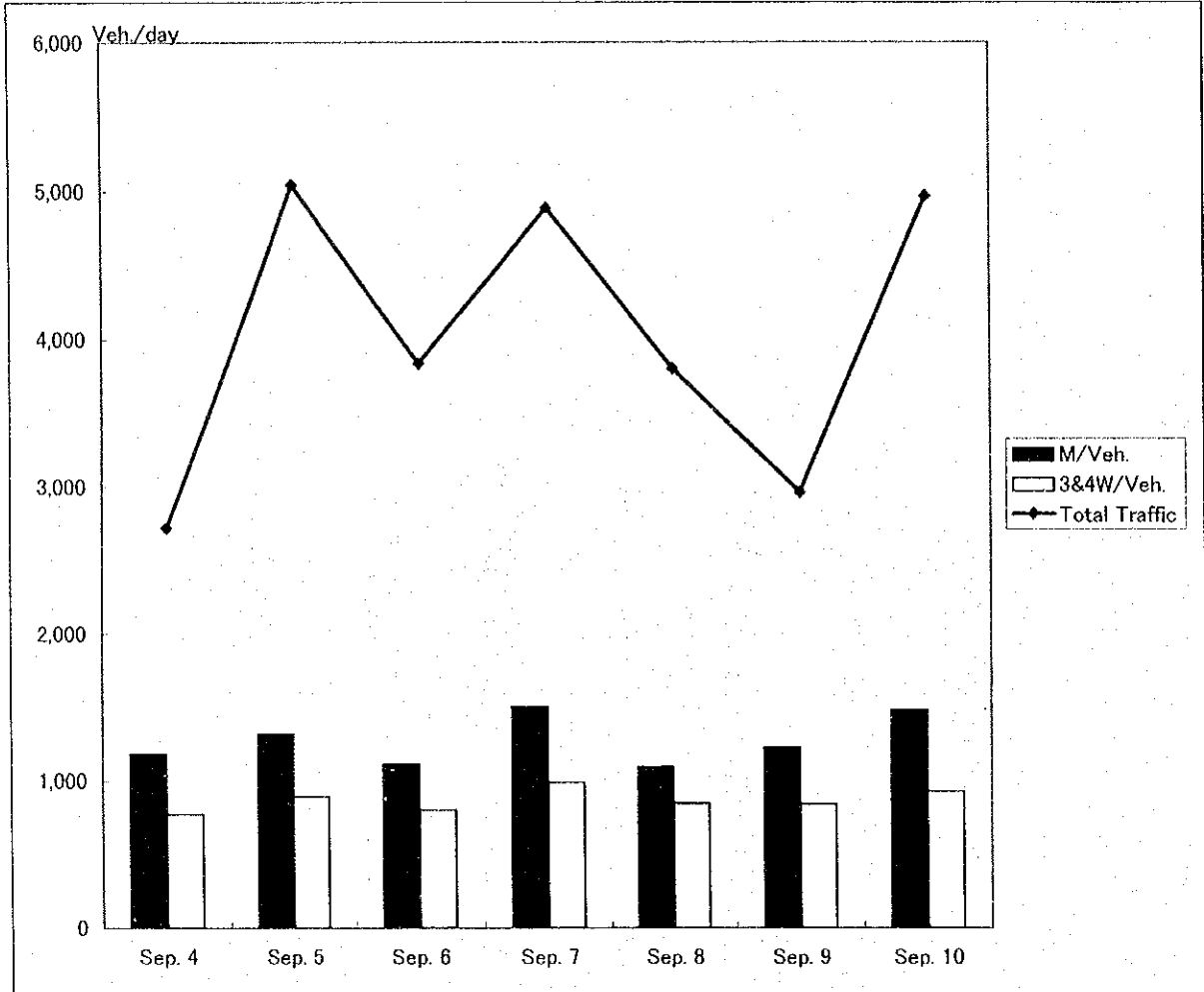


Fig B-4.3.10 Fluctuation of Daily Traffic Volume at Survey Point No. 9 (Rupsa Ferry) in September 1998

Date	Fishing	Cargo Engine	Cargo Oar	Passenger Ship	Tanker	Barge	Others	Total
1-Sep	149	136	17	25	4	7	2	340
2-Sep	106	122	24	23	1	7	4	287
3-Sep	94	123	23	21	5	3	5	274
4-Sep	76	81	37	19	1	11	7	232
5-Sep	162	99	38	27	0	14	0	340
6-Sep	161	73	38	17	2	7	1	299
7-Sep	121	116	31	24	4	4	3	303

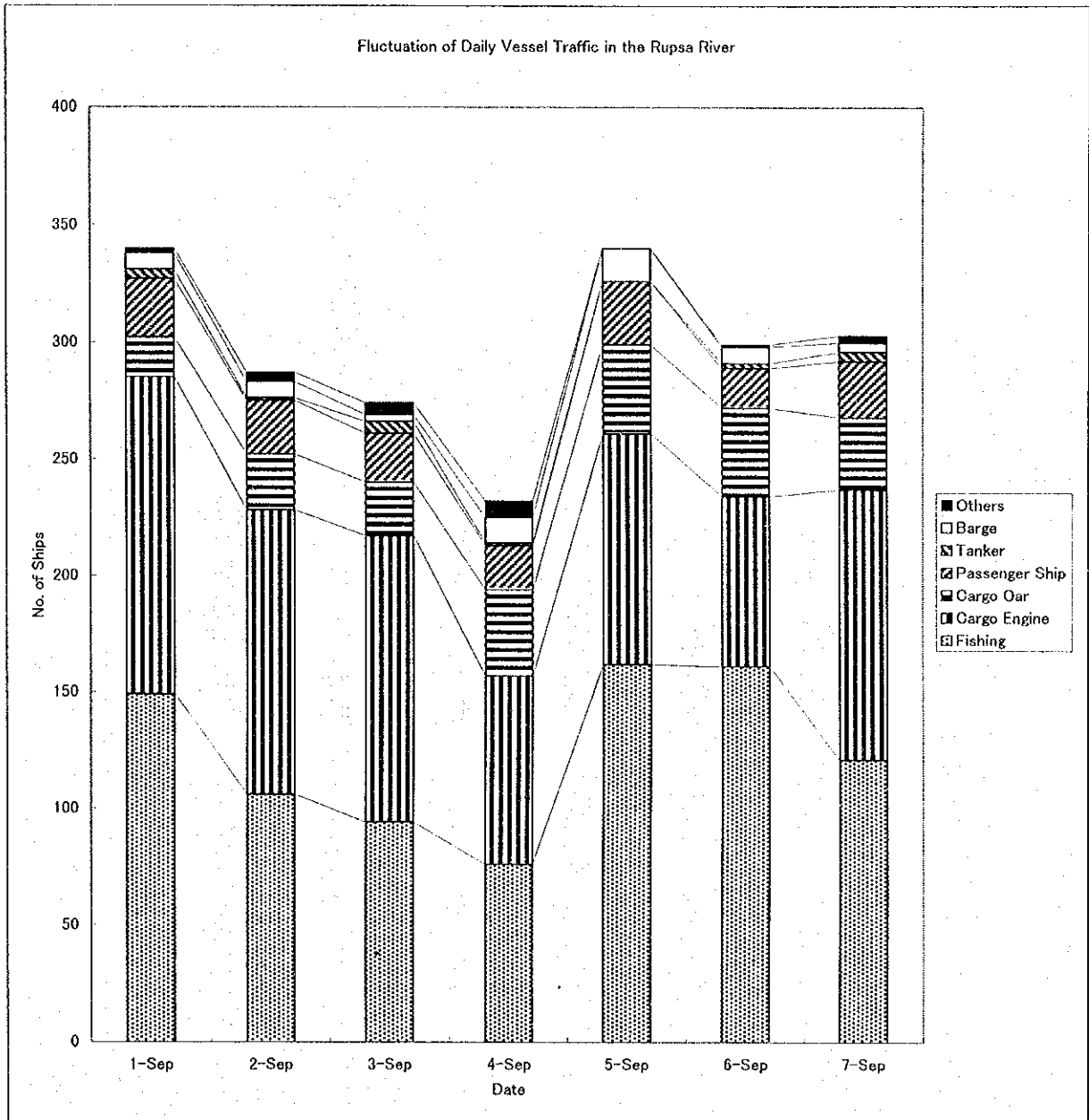


Fig B-4.3.11 Fluctuation of Daily Vessel Traffic in the Rupsa River

Date	Fishing	Cargo Engine	Cargo Oar	Passenger Ship	Tanker	Barge	Others	Total
1-Sep	79	4	95	0	0	0	2	180
2-Sep	83	1	115	0	0	0	58	257
3-Sep	79	0	127	0	0	0	61	267
4-Sep	89	5	142	0	0	0	106	342
5-Sep	73	4	149	0	0	0	83	309
6-Sep	155	5	226	0	0	0	183	569
7-Sep	107	1	147	0	0	0	95	350

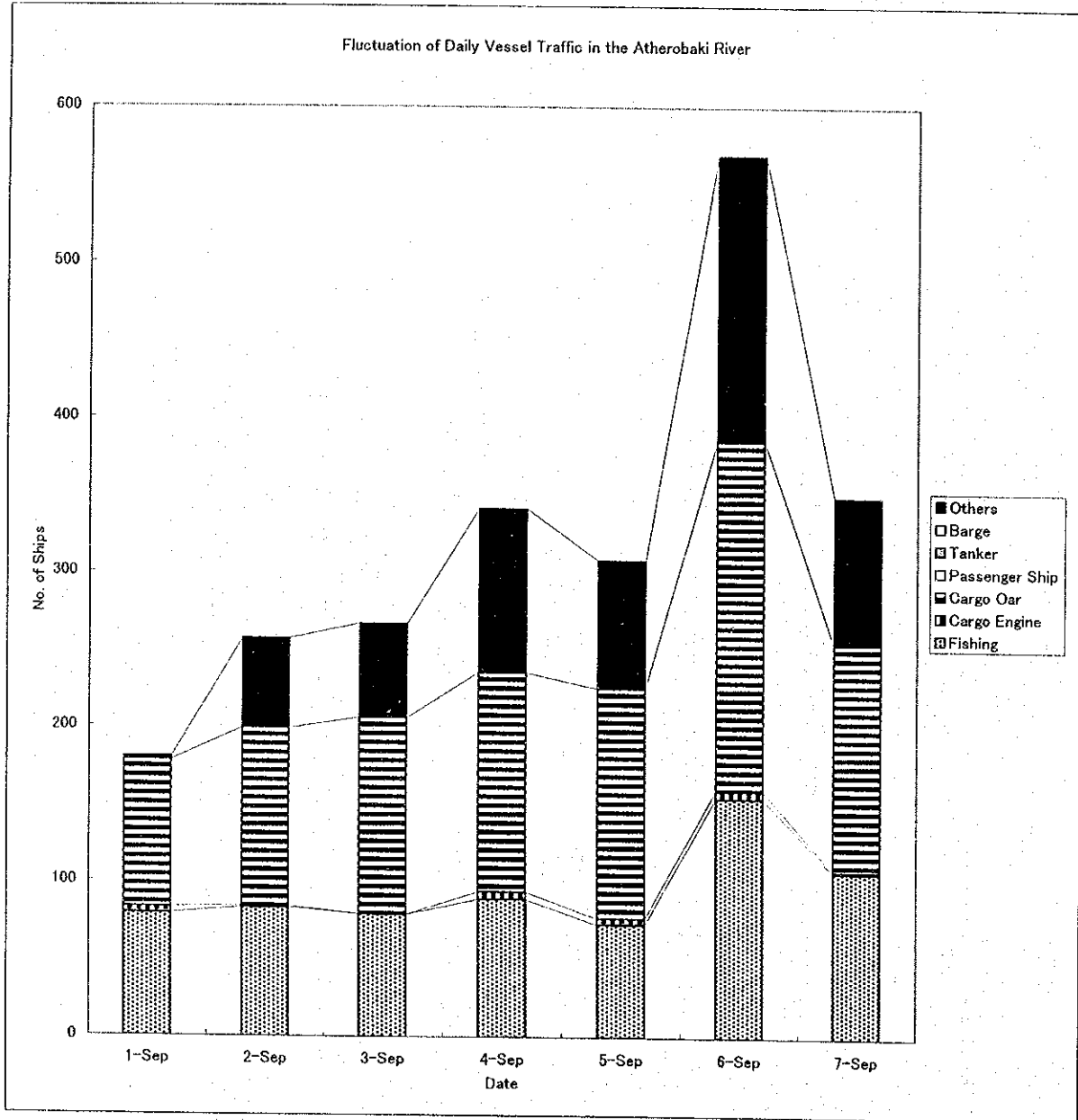


Fig B-4.3.12 Fluctuation of Daily Vessel Traffic in the Atherobaki River

Date	Fishing	Cargo Engine	Cargo Oar	Passenger Ship	Tanker	Barge	Others	Total
1-Sep	847	7	33	2	0	0	6	895
2-Sep	821	5	34	1	0	0	1	862
3-Sep	803	4	40	1	0	0	7	855
4-Sep	959	3	36	1	0	0	1	1000
5-Sep	865	4	53	2	0	0	9	933
6-Sep	928	4	41	1	0	0	4	978
7-Sep	934	5	42	2	0	0	3	986

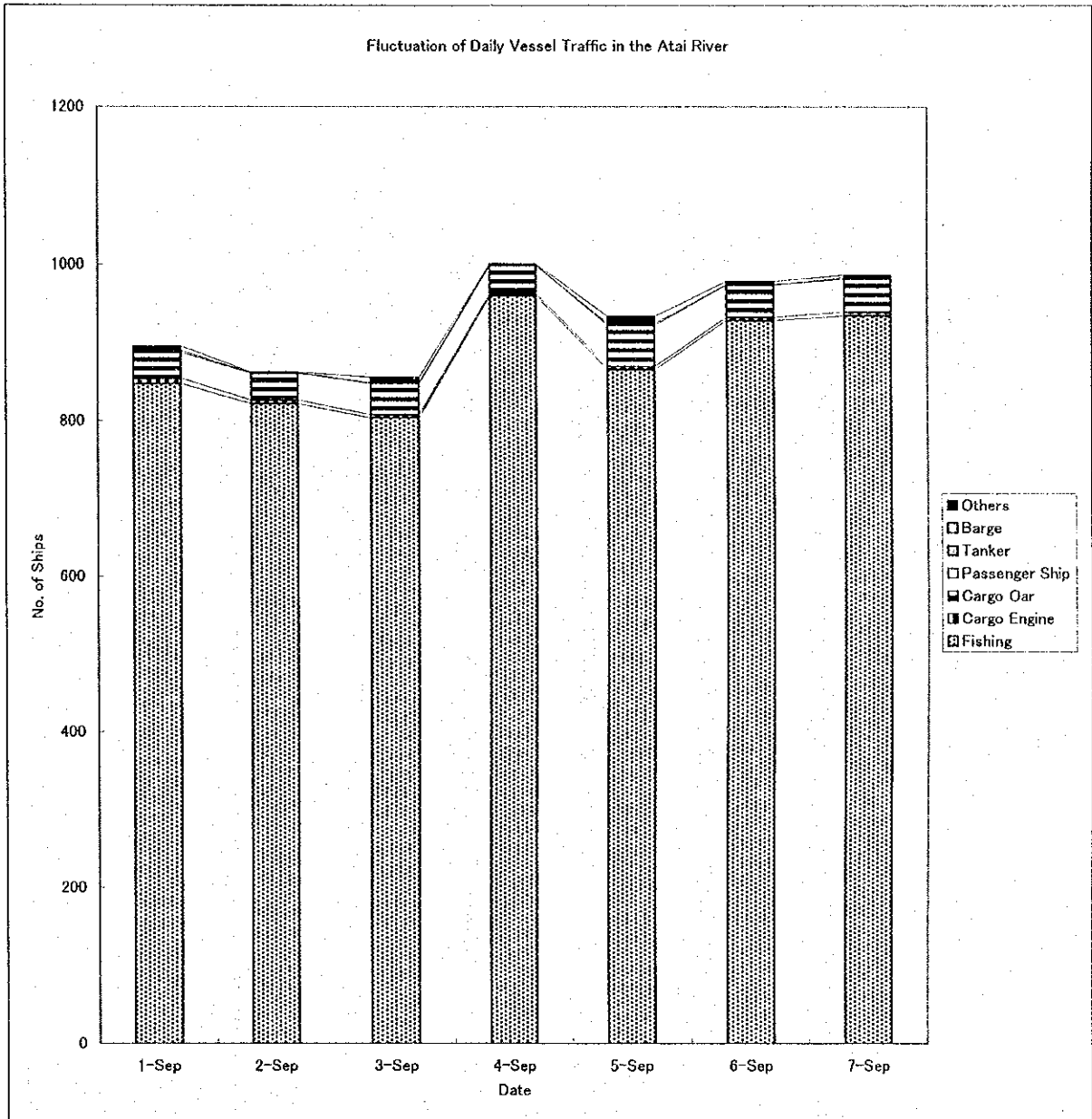


Fig B-3. 3.13 Fluctuation of Daily Vessel Traffic in the Atai River

Date	Fishing	Cargo Engine	Cargo Oar	Passenger Ship	Tanker	Bargo	Others	Total
1-Sep	27	84	8	8	0	2	32	161
2-Sep	34	83	13	10	0	2	27	169
3-Sep	22	85	22	10	0	8	10	157
4-Sep	21	75	19	9	0	2	6	132
5-Sep	18	84	24	9	0	3	15	153
6-Sep	22	97	21	7	0	4	15	166
7-Sep	34	90	20	7	0	3	15	169

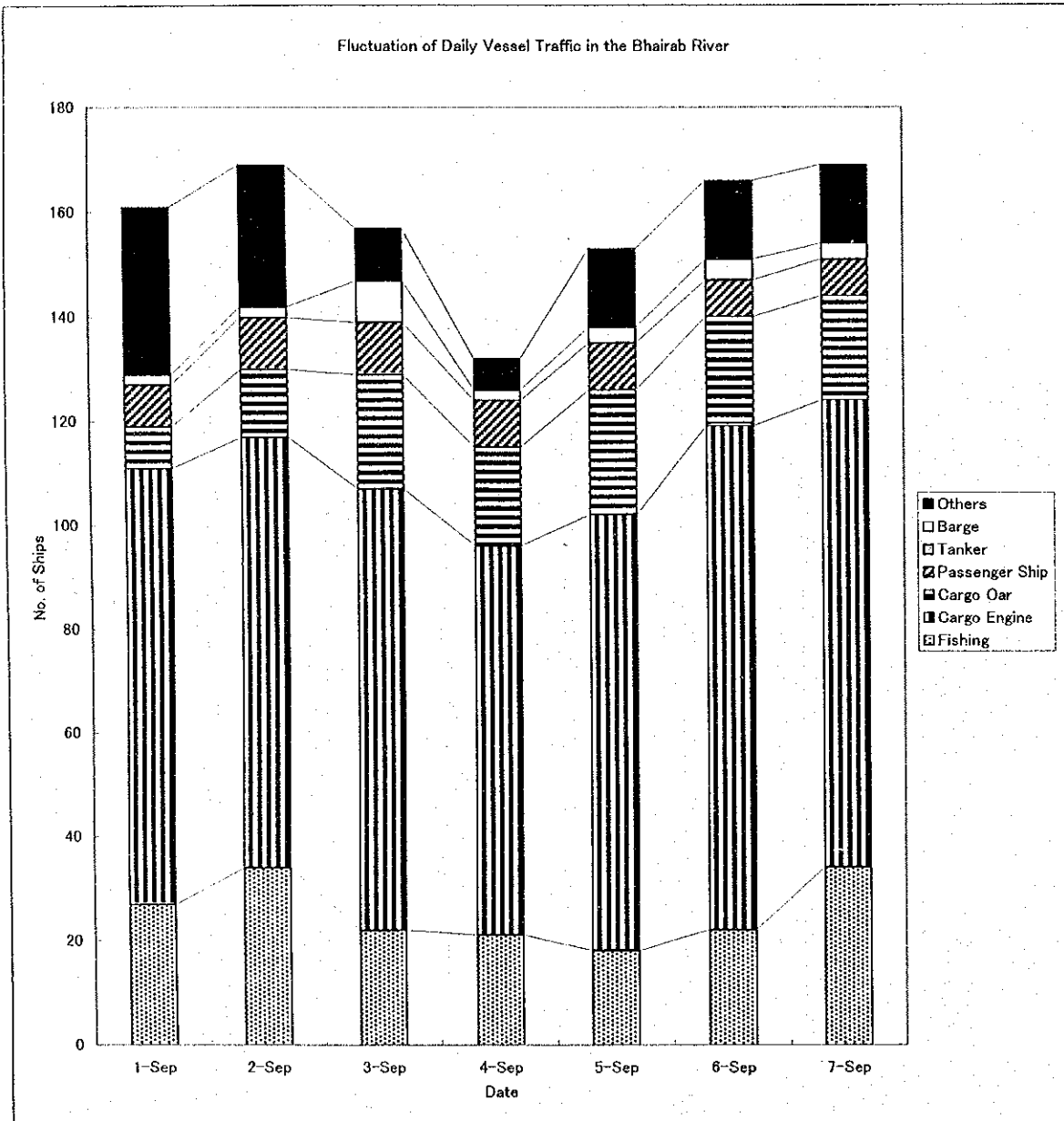


Fig B-4.3.14 Fluctuation of Daily Vessel Traffic in the Bhairab River

## Engineering Site Survey for Highway

### 1. Existing Road Conditions

#### (1) Existing Road Conditions

It is obvious that considerable investment have been made for a long of time by RHD Khulna Zone and local governments in order to secure the hub of regional commerce and administration as well.

However, although uninterrupted efforts still continue, road conditions are far from satisfactory level due to mixed traffic with non-motorized vehicles and limited number of arterial roads, and troublesome roadside vendors are deemed one of major traffic problems which accrue from, for example, lack of facilities, network deficiency or road user's behavior. Fig. B-5.1.1 shows the location of divided 4-lane arterial roads in Khulna.

In this sub-section, analysis begins with categorization of road conditions that brought about traffic problems.

#### 1) Road Traffic

Salient features of road traffic in the study area are predominant non-motorized traffic, consisting of rickshaws and carts. These slow-moving vehicles transport passengers and cargoes considerably, and motorized vehicles manage to pass among such movements. Even among motorized vehicles, trucks of quite an old vintage prevail and they also move slowly due to overloaded and shortage of horsepower.

These features may affect geometric design of roads and bridges, and it is often observed that flatter slope on approach road is applied before and after bridge.

Since such slow-moving traffic may be replaced by usual motorized vehicles gradually as full motorization will take place in near future, it is necessary for the Study to take into consideration road traffic characteristics.

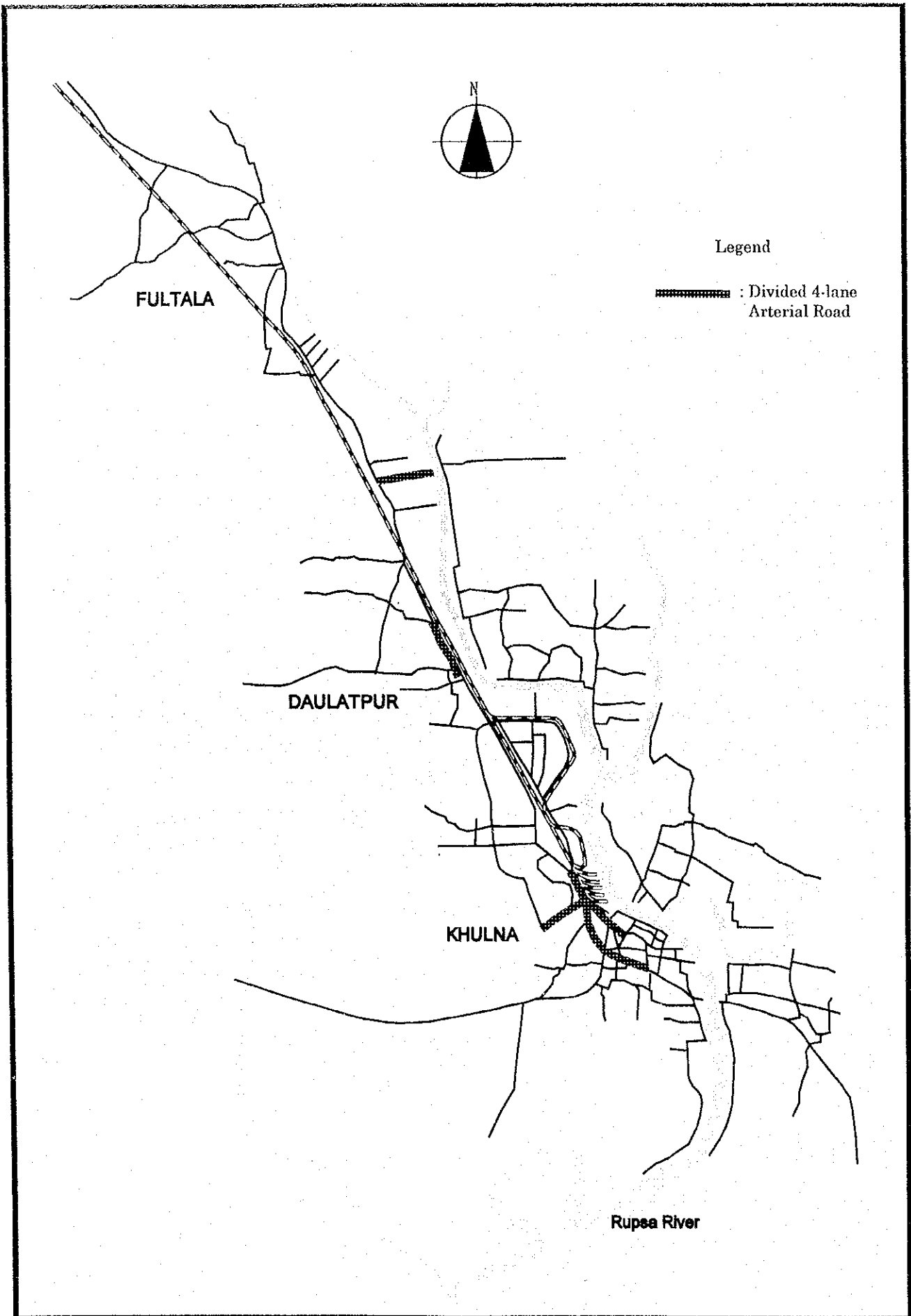


Fig. B-5.1.1 Location of Divided 4-Lane Arterial Roads in Khulna



## 2) Traffic Obstacles

Through traveled traffic is disturbed by many kinds of obstacles such as the existence of facilities, physical constraints, multipurpose use of road, road user's behavior, etc.

Roadside vendors, stockyard of adjacent factories, on-road parking, animal carts parking are major obstacles. Especially on-road loading/unloading of trucks has become a serious traffic obstacle.

Deep potholes, uneven cracks and eroded shoulder with significantly vertical gaps, which are often observed in the study area, are major physical constraints. Reduction of lateral clearance by electric poles, traffic sign boards, street trees, etc. are also found. On the other hand, one of remarkable engineering constraints is small radius roundabouts at intersections.

Traffic congestion occurs at such traffic bottleneck sections.

## 3) Lack of Facilities

Lack of traffic signals, pedestrian sidewalks, guardrails, traffic islands/markings, drainage, and median traffic signs also cause disorder and disturbance to traffic flows. Traffic capacity decreases considerably by various side friction, especially for occupation of pedestrian sidewalk or shoulder.

## 4) Road Network

Road traffic needs mobility and accessibility. Arterial roads have high mobility by certain degree of access control, while local roads require high level of access to destination or egress from origin. Predominant ribbon development as well as limited number of motorized vehicles seem to discourage development of collectors/distributors.

Many narrow roads which enable only one vehicle to pass are found in the study area. Road Network Density<sup>\*1)</sup> as well as Road Area Occupancy<sup>\*2)</sup> still remains low in the study area from the viewpoints of road transport planning.

Since only two ferry services accommodate vehicular traffic to cross the Bhairab/Rupsa river, east-westward traffic converges on Rupsa ferry. Number of ferry services for vehicular traffic seems to be too small, compared with population and traffic demand in the eastern side of the Bhairab/Rupsa river.

**\*1) Road Network Density (RND)**

This index, which is computed by a certain district area (ha) and accumulated length (m) of roads and usually expressed in unit of m/ha, has implication in the level of mobility. Accordingly, the index becomes necessary higher in business and commercial area and lower in residential area.

**\*2) Road Area Occupancy (RAO)**

This index, which is calculated by a certain district area and accumulated area of roads and usually expressed in unit of %, has relationship to the level of accessibility and open space.

Fig. B-5.1.2 shows traffic congestion prone locations and areas in Khulna and its surroundings due to above-mentioned factors.

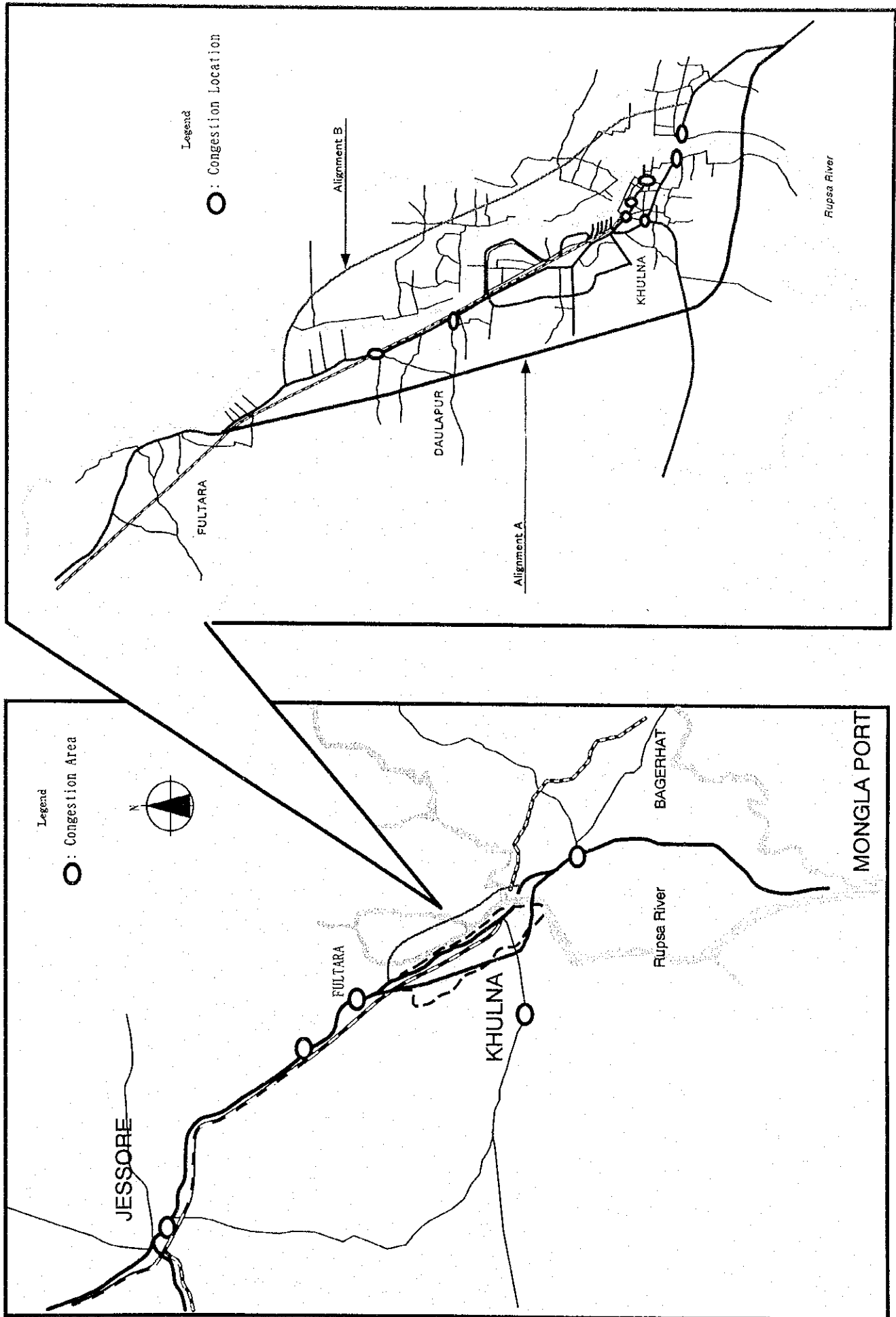


Fig. B-5.1.2 Traffic Congestions Prone Locations and Areas in Khulna and its Surroundings

## 2. Accomplishment and Development Direction

### (1) Accomplishment

Since such financial problems as land acquisition/property compensation and resettlement have caused delay in new road and bridge construction, road development, in the study area is accomplished to a limited extent, compared with planned road length. Table 10.1.1 shows road development in the study area.

Table B-5.1.1 Road Development Plan in the Study Area

Items	From	To	Length (km)
<b>Planned Projects</b>			
Khulna City Bypass Road	Fultala	Satkira	17.35
Widening of Improvement Road	Jatil Swarani	Kaya Bazar	6.90
Road	Inter District Bus Terminal	Embank,ment Road of WDB	2.00
<b>On going Projects</b>			
Outer Bypass Road Phase II Road	Shiromoni Market	Bhairab River	1.00

### (2) Development Direction

Recent road projects converge to increase capacity in certain corridors such as Khulna - Sathkira and Noapara - Mawa to provide non-river interruption road linkage between Khulna and other district growth poles as well as between Khulna and Dhaka.

These trends of regional road bridge development may direct traffic demand to rely upon road transport on certain routes, and will lead to facilitating cargo traffic diversion from rail and inland water transport.

Fig. B-5.1.3 shows development direction and development locations in Khulna and its surroundings.

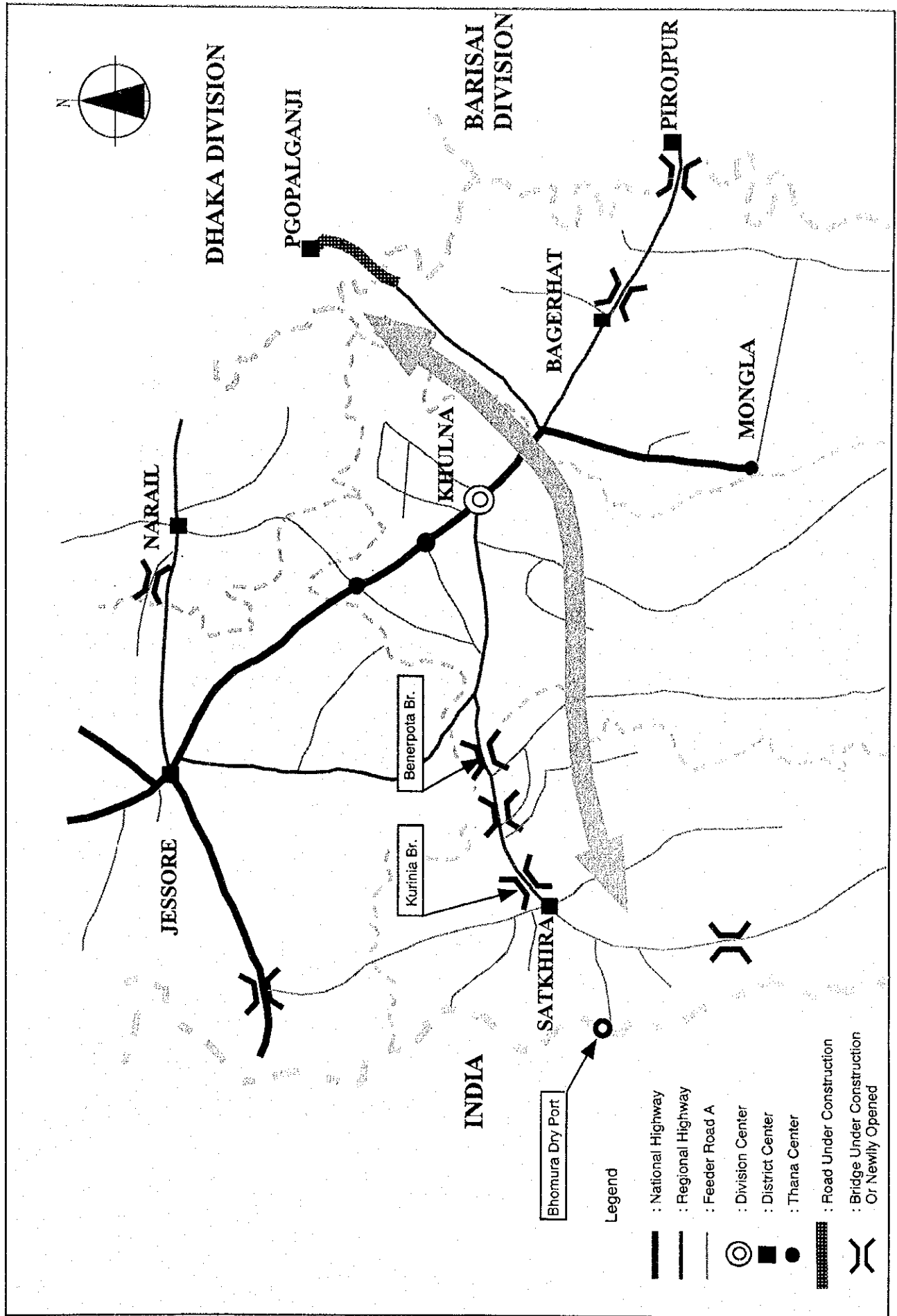


Fig. B-5.1.3 Development Direction in Khulna Surroundings

### 3. Future Road Network Proposed by Khulna Master Plan

The future road network proposed by Khulna Development Master Plan is to strengthen existing roads to cover planned urbanized area as shown in Fig. B-5.1.4. Khulna Bypass is planned to strengthen present road network to the north-south direction, and new streets in association with seven (7) ferry services are planned to accommodate east-westward traffic movement. It aims to increase the road network density as well as road area occupancy, which represent the level of road improvement, up to two times as high as it is. It will contribute to improve land accessibility to develop residential and commercial areas from undeveloped lands due to no access or physical constraints such as undrained lowland and swamps. Fig. B-5.1.5 shows relation of RAO and RND, and RAO and RND at the major cities is tabulated in Table B-5.1.2.

The route location of Khulna Bypass developed by the KDA is controlled at two points. One is the beginning point at Siramoni on Khulna - Jessore Road, and another is the crossing point with Khulna - Satkhira Road which is 150 ft far from the western end of the premise of Khulna University.

The route location of Khulna Bypass developed by the RHD is also shown in the Master Plan to extend from the crossing point with Khulna - Satkhira Road to Khulna - Mongla Road, passing the west of Labanchora University and the south of Khulna Shipyard and crossing the Rupsa river at 2.5 km downstream of Existing Rupsa Ferry.

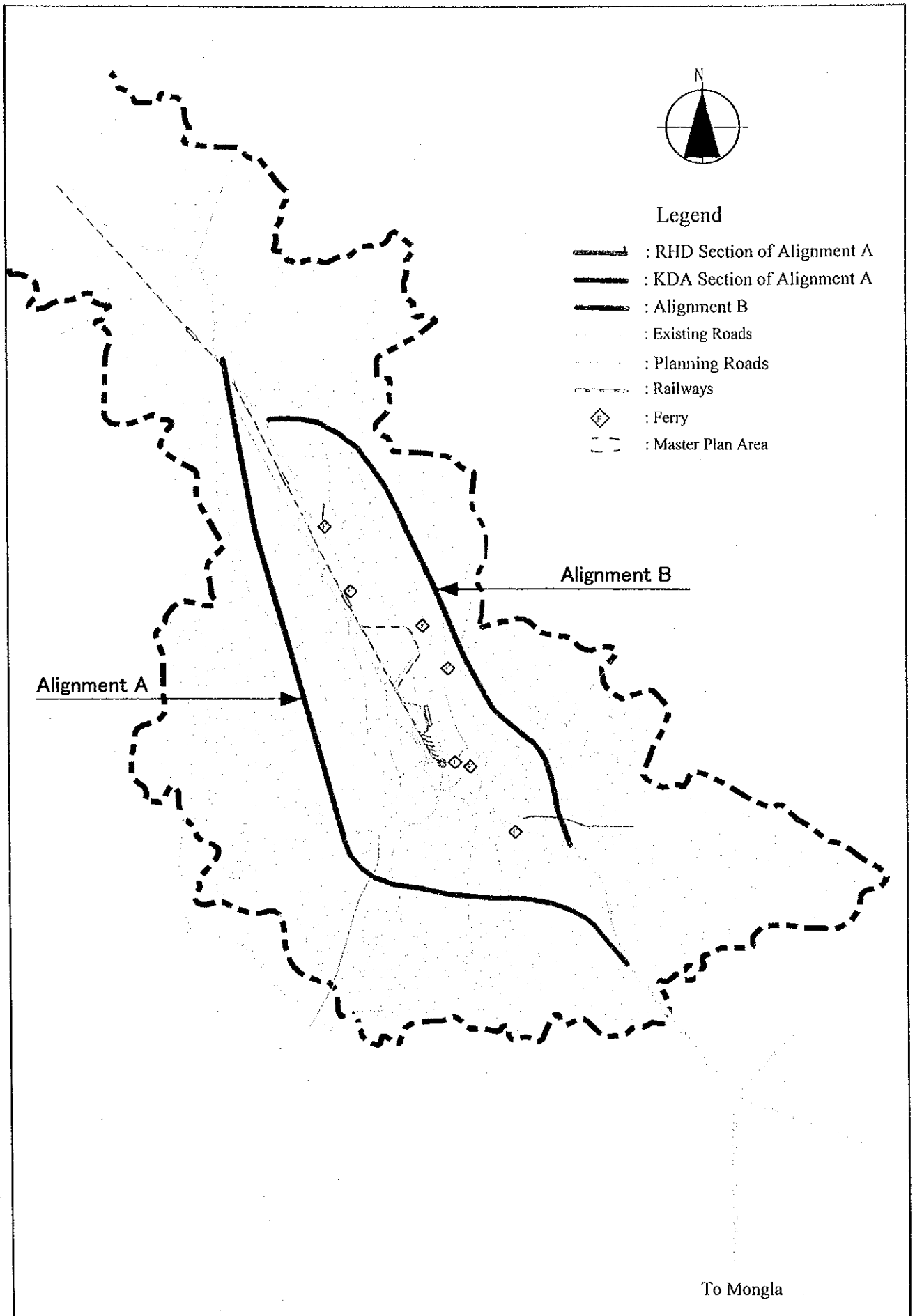


Fig. B-5.1.4 Future Road Network in Khulna

Table B-5.1.2 List of RAO and RND at the Major Cities

Country	Location	RAO (%)	RND (m/ha)
Bangladesh	Khulna	0.3(0.6)	2.3(5.0)
Japan	Tokyo Pref.	7.3	106.4
	Tokyo	15.1	
	Kyoto	3.6	
	Osaka	17.6	
	Hiroshima	3.7	50.5
U.S.	New York	30.0	
	Manhattan	37.6	
France	Paris	24.7	
British	London	14.9	
Germany	Berlin	8.5	
Spain	Balserona	15.9	
Korea	Seoul	11.7	

Note: Figures in parenthesis show value of KDA Master Plan.

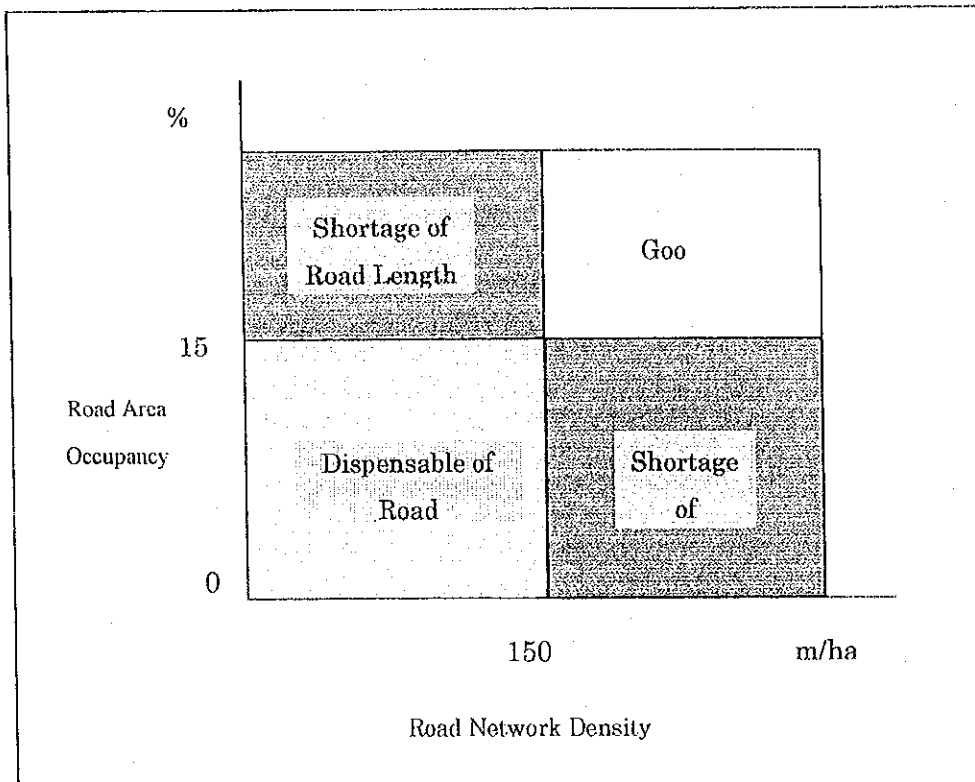


Fig. B-5.1.5 Relation of RAO and RND