APPENDIX 9.2-2 TRAFFIC BENEFITS

APPENDIX 9.2-2 TRAFFIC BENEFITS

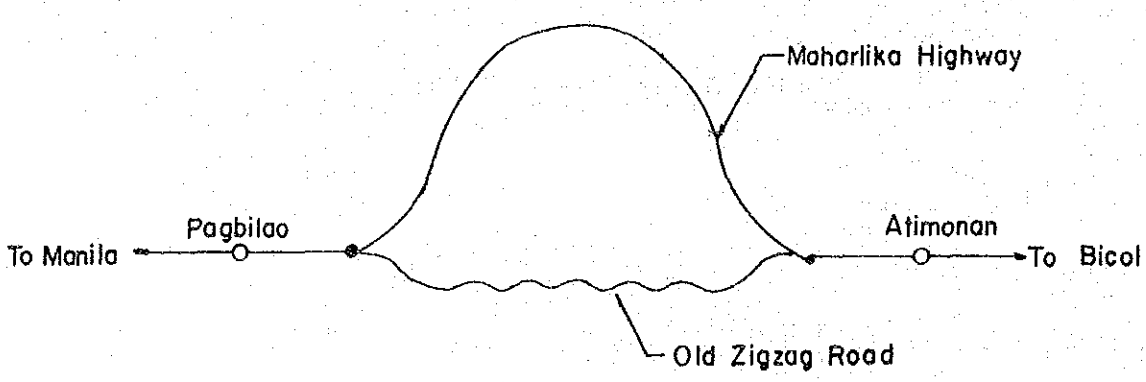
1) General

The quantified traffic benefits are savings in detour costs and savings in travel time costs. The Highway Planning Manual, Volume 5 "Road Traffic Costs for Actual Conditions" prepared by MPWH in October 1982 was main reference for the study.

2) Savings in Detour Costs (Lucena - Calauag Section)

a) Road Condition

The road conditions of the subject section, Maharlika Highway, and the alternative route, Old Zigzag Road are as follows:



APPENDIX 9.2-2 (1) ROAD CONDITION

	Subject Section	Alternative Route
Length of Section	10.0 km	5.8 km
Road Width	6.7 m	5.5 m
Shoulder	2.0 m (Unpaved)	-
Surface Type	Concrete Pavement	Concrete Pavement
Surface Condition	Fair	Fair
Gradient	3 - 5 %	6 - 10 %

APPENDIX 9.2-2 (1) (Cont'd.)

	Subject Section	Alternative Route
Roadside Friction	None	None
No. of Sharp Curve	0	9
Traffic Volume	See Appendix 9.2-2 (2)	
Volume - Capacity Ratio	See Appendix 9.2-2 (3)	

APPENDIX 9.2-2 (2) FUTURE TRAFFIC VOLUME
(LUCENA - CALAUAG SECTION)

Vehicle Type	1984	1990	2000	2010	2015
Car (Business)	354	465	834	1,497	2,000
Car (Private)	144	168	267	433	544
Jeepney	115	132	203	295	362
Bus	512	617	929	1,375	1,666
Truck	697	872	1,391	2,333	3,130
T o t a l	1,822	2,254	3,624	5,933	7,702

APPENDIX 9.2-2 (3) TRAFFIC VOLUME - CAPACITY RATIO

	Subject Section	Alternative Route	
		Two-Way	One-Way
At 1984	0.14	0.64	-
At 1990	0.18	0.78	-
At 2000	0.28	1.24	0.62
At 2010	0.45	2.01	1.00
At 2015	0.58	2.60	1.30

Note: Road capacities were calculated in accordance with the Highway Planning Manual, Volume 2 "Data Framework, Traffic Surveys, Traffic Assignment, Road Capacity".

b) Additional length due to detour

Additional length was computed by subtracting the road length of subject section from that of alternative route. The road length was calculated as follows:

$$\text{Road Length} = L + DL_1 + DL_2 + DL_3$$

Where, L : Actual road length

DL_1 : Surface type, condition and gradient DL

DL_2 : Roadside friction DL

DL_3 : Sharp curves DL

APPENDIX 9.2-2 (4) ADDITIONAL LENGTH DUE TO DETOUR

			Car, Jeepney		Bus, Truck	
			Subject Section	Alternative Route	Subject Section	Alternative Route
	L		10.0	5.8	10.0	5.8
DL	DL 1		3.00	5.22	3.50	12.47
	DL 2	1984	0.10	0.91	0.13	1.17
		1990	0.16	1.30	0.21	1.67
		2000	0.35	2.99 (0.86)	0.46	3.84 (1.10)
		2010	0.83	2.03	1.07	2.61
		2015	1.31	3.26	1.69	4.19
	DL 3		0	0.90	0	1.80
L + DL		1984	13.10	12.83	13.63	21.24
		1990	13.16	13.22	13.71	21.74
		2000	13.35	14.91 (12.78)	13.96	23.91 (21.17)
		2010	13.83	13.95	14.57	22.68
		2015	14.31	15.18	15.19	24.26
Add. Length		1984	-0.27		7.61	
		1990	0.06		8.03	
		2000	1.56 (-0.57)		9.95 (7.21)	
		2010	0.12		8.11	
		2015	0.87		9.07	

c) Additional travel time due to detour

Additional travel time was computed by subtracting the average travel time on subject section from that on alternative route. Average travel times were calculated from the road length and average travel speed shown in Appendix 9.2-2 (5).

After the year of 2,000, the alternative route will be one-way, and average waiting time will be assumed as 20 minutes.

APPENDIX 9.2-2 (5) AVERAGE TRAVEL SPEED

(in Kph)

	Subject Section	Alternative Route
Car	40	20
Jeepney	35	15
Bus	30	10
Truck	30	10

APPENDIX 9.2-2 (6) ADDITIONAL TRAVEL TIME

(in Hours)

	1984 - 1999	2000 - 1015
Car	0.040	0.373
Jeepney	0.101	0.434
Bus	0.247	0.580
Truck	0.247	0.580

d) Additional Traffic Cost

Additional traffic cost of each representative vehicle was computed by multiplying Basic Operating Cost by the additional length or additional travel time. (See Appendix 9.2-2 (7)).

APPENDIX 9.2-2 (7) ADDITIONAL TRAFFIC COST/VEHICLE
(LUCENA - CALAUG SECTION)

		Unit	1984	1990	2000		2010	2015
Car (Business)	Add. Length	km.	-0.27	0.06	1.56	-0.57	0.12	0.87
	Add. Time	hour	0.040	0.040	0.040	0.373	0.373	0.373
	B. R. C.	₱km.	1.19	1.19	1.19	1.19	1.19	1.19
	B. F. C.	₱hour	4.78	4.78	4.78	4.78	4.78	4.78
	P. T. C.	₱hour	41.12	41.12	41.12	41.12	41.12	41.12
	Running Cost	₱/Veh.	-0.321	0.071	1.856	-0.678	0.143	1.035
	Fixed Cost	₱/Veh.	0.191	0.191	0.191	1.783	1.783	1.783
	Time Cost	₱/Veh.	1.645	1.645	1.645	15.338	15.338	15.338
	Total	₱/Veh.	1.515	1.907	3.692	16.443	17.264	18.156
Car (Private)	Add. Length	km.	-0.27	0.06	1.56	-0.57	0.12	0.87
	Add. Time	hour	0.040	0.040	0.040	0.373	0.373	0.373
	B. R. C.	₱km.	1.19	1.19	1.19	1.19	1.19	1.19
	B. F. C.	₱/hour	4.78	4.78	4.78	4.78	4.78	4.78
	Running Cost	₱/Veh.	-0.321	0.071	1.856	-0.678	0.143	1.035
	Fixed Cost	₱/Veh.	0.191	0.191	0.191	1.783	1.783	1.783
	Total	₱/Veh.	0.130	0.262	2.047	1.105	1.926	2.818
Jeepney	Add. Length	km.	-0.27	0.06	1.56	-1.57	0.12	0.87
	Add. Time	hour	0.101	0.101	0.101	0.434	0.434	0.434
	B. R. C.	₱/km.	1.15	1.15	1.15	1.15	1.15	1.15
	B. F. C.	₱/hour	20.21	20.21	20.21	20.21	20.21	20.21
	P. T. C	₱/hour	4.78	4.78	4.78	4.78	4.78	4.78
	Running Cost	₱/Veh.	-0.311	0.069	1.794	-1.806	0.138	1.001
	Fixed Cost	₱/Veh.	2.041	2.041	2.041	8.771	8.771	8.771
	Time Cost	₱/Veh.	0.483	0.483	0.483	2.075	2.075	2.075
	Total	₱/Veh.	2.213	2.593	4.318	9.040	10.984	11.847
Bus	Add. Length	km.	7.61	8.03	9.95	7.21	8.11	9.07
	Add. Time	hour	0.247	0.247	0.247	0.580	0.580	0.580
	B. R. C.	₱/km.	2.24	2.24	2.24	2.24	2.24	2.24
	B. F. C	₱/hour	27.36	27.36	27.36	27.36	27.36	27.36
	P. T. C.	₱/hour	34.65	34.65	34.65	34.65	34.65	34.65
	Running Cost	₱/Veh.	17.046	17.987	22.288	16.150	18.166	20.317
	Fixed Cost	₱/Veh.	6.758	6.758	6.758	15.869	15.869	15.869
	Time Cost	₱/Veh.	8.559	8.559	8.559	20.097	20.097	20.097
	Total	₱/Veh.	32.363	33.304	37.605	52.116	54.132	56.283
Truck	Add. Length	km.	7.61	8.03	9.95	7.21	8.11	9.07
	Add. Time	hour	0.247	0.247	0.247	0.580	0.580	0.580
	B. R. C.	₱/km	2.71	2.71	2.71	2.71	2.71	2.71
	B. F. C.	₱/hour	26.97	26.97	26.97	26.97	26.97	26.97
	Running Cost	₱/Veh.	20.623	21.761	26.965	19.539	21.978	24.580
	Fixed Cost	₱/Veh.	6.662	6.662	6.662	15.643	15.643	15.643
	Total	₱/Veh.	27.285	28.423	33.627	35.182	37.621	40.223

APPENDIX 9.2-2 (8) SAVING IN DETOUR COSTS
(LUCENA - CALAUAG SECTION)

	Vehicle Type	Traffic Vol. (Veh./Day)	Add. Cost (₱/Veh.)	No. of Day	Saving in Detour Cost (M₱)
1984	Car (Business)	354	1.515	7.5	0.0040
	(Private)	144	0.130	7.5	0.0001
	Jeepney	115	2.213	7.5	0.0019
	Bus	512	32.363	7.5	0.1243
	Truck	697	27.285	7.5	0.1426
	Total	1,822			0.2729
1990	Car (Business)	465	1.907	7.5	0.0067
	(Private)	168	0.262	7.5	0.0003
	Jeepney	132	2.593	7.5	0.0026
	Bus	617	33.304	7.5	0.1541
	Truck	872	28.423	7.5	0.1859
	Total	2,254			0.3496
2000	Car (Business)	834	3.692 16.443	7.5	0.0231 0.1029
	(Private)	267	2.047 1.105	7.5	0.0041 0.0022
	Jeepney	203	4.318 9.040	7.5	0.0066 0.0138
	Bus	929	37.605 52.116	7.5	0.2620 0.3631
	Truck	1,391	33.627 35.182	7.5	0.3508 0.3670
	Total	3,624			0.6466 0.8490
2010	Car (Business)	1,497	17.264	7.5	0.1938
	(Private)	433	1.926	7.5	0.0063
	Jeepney	295	10.984	7.5	0.0243
	Bus	1,375	54.132	7.5	0.5582
	Truck	2,333	37.621	7.5	0.6583
	Total	5,933			1.4409
2015	Car (Business)	2,000	18.156	7.5	0.2723
	(Private)	544	2.818	7.5	0.0115
	Jeepney	362	11.847	7.5	0.0322
	Bus	1,666	56.283	7.5	0.7033
	Truck	3,130	40.223	7.5	0.9442
	Total	7,702			1.9635

e) Saving in detour cosrs

Saving in detour costs were estimated by multiplying the additional traffic costs for each representative vehicle by traffic volume. Those are summarized in Appendix 9.2-2 (8).

3) Saving in Detour Costs (Allen - Calbayog Section)

a) Detour routes

Detour routes of each trip types were considered as follows:

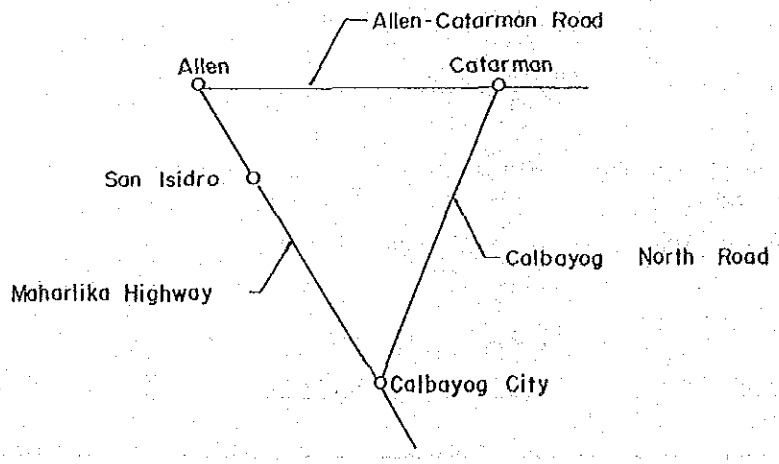
Type 1 ; Traffic between Calbayog (Western Samar, Leyte) and San Isidro (Luzon) ——— Calbayog North Road, Allen - Catarman Road and Allen - San Isidro Section of Maharlika Highway.

Type 2 ; Traffic between Calbayog (Western Samar, Leyte) and Allen ——— Calbayog North Road and Allen - Catarman Road.

Type 3 ; Traffic between Calbayog (Western Samar, Leyte) and Catarman ——— Calbayog North Road.

Since there are many temporary bridges which have narrow timbered plates and low loading capacities in the Calbayog North Road, the heavy vehicles can not pass through this road. It was assumed that the only light vehicles such as cars and jeepneys would be made detours.

b) Road condition



APPENDIX 9.2-2 (9) ROAD CONDITIONS

	Maharlika Highway	Calbayog North North	Allen-Catarman Road
Length of Section	Allen - San Isidro 22.7 km San Isidro - Calbayog 41.1 km	65.7 km	48.7 km
Road Width	6.7 m	6.0 m	7.2 m
Shoulder	2.5 m	-	-
Surface Type	Concrete Pavement	Gravel	Gravel
Surface Condition	Good	Bad	Good
Gradient	less than 3%	3 - 5 %	less than 3 %
Roadside Friction	None	None	None
No. of Sharp Curves	0	3	0
No. of Temporary Bridges	0	21	7
Traffic Volume	See Appendix 9.2-2 (10)		

APPENDIX 9.2-2 (10) FUTURE TRAFFIC VOLUME (ALLEN - CALBAYOG SECTION)

Type-1 (Calbayog - San Isidro)					(Veh./Day)
Vehicle Type	1984	1990	2000	2010	2015
Car (Business)	3	4	8	16	22
(Private)	7	8	12	18	22
Jeepney	2	2	3	4	5
Bus	34	42	64	95	114
Truck	14	18	30	53	70
T o t a l	60	74	117	186	233
Type-2 (Calbayog - Allen)					
Car (Business)	25	32	62	122	170
(Private)	27	34	58	100	134
Jeepney	59	73	115	179	224
Bus	7	12	20	32	40
Truck	14	18	30	53	70
T o t a l	132	169	285	486	638

Type-3 (Calbayog - Catarman)

Vehicle Type	1984	1990	2000	2010	2015
Car (Business)	34	46	89	175	244
(Private)	24	32	56	98	131
Jeepney	24	29	46	71	89
Bus	9	16	26	41	51
Truck	45	59	99	170	225
T o t a l	136	182	316	555	740
(All Traffic)					
Car (Business)	62	82	159	313	436
(Private)	58	74	126	216	287
Jeepney	85	104	164	254	318
Bus	50	70	110	168	205
Truck	73	95	159	276	365
T o t a l	328	425	718	1,227	1,611

c) Additional length due to detour

Additional length was computed by subtracting the road length of subject section from that of alternative route. Since traffic volumes on this section are very small, the DL values affected by volume - capacity ratio are ignored.

$$\text{Road Length} = L + DL_1 + DL_3$$

Where, L : Actual road length

DL_1 : Surface type, condition and gradient DL

DL_3 : Sharp curves and temporary bridges DL

APPENDIX 9.2-2 (11) ADDITIONAL LENGTH DUE TO DETOUR

(in km)

	Type 1		Type 2		Type 3	
	Subject Section	Alternative Route	Subject Section	Alternative Route	Subject Section	Alternative Route
L	41.1	137.1	63.8	114.4	112.5	65.7
DL 1	0	79.82	0	79.82	14.12	65.70
DL 3	0	3.10	0	3.10	0.70	2.40
L + DL	41.1	220.02	63.8	197.32	127.32	133.80
Add. Length	178.92		133.52		6.48	

d) Additional travel time due to detour

APPENDIX 9.2-2 (12) AVERAGE TRAVEL SPEED

(in km/hour)

	Maharlika Highway	Calbayog North Road	Allen - Catarman Road
C a r	55	30	40
Jeepney	50	25	35

Additional travel time was computed as follows:

For Type - 1 trips

$$ta = \frac{65.7}{V2} + \frac{48.7}{V3} + \frac{22.7}{V1} - \frac{41.1}{V1}$$

For Type - 2 trips

$$ta = \frac{65.7}{V2} + \frac{48.7}{V3} - \frac{63.8}{V1}$$

For Type - 3 trips

$$ta = \frac{65.7}{V2} - \frac{48.7}{V3} - \frac{63.8}{V1}$$

Where,

ta : Additional travel time

V_1 : Average travel speed on the Maharlika Highway

V_2 : Average travel speed on the Calbayog North Road

V_3 : Average travel speed on the Allen - Catarman Road

APPENDIX 9.2-2 (13) ADDITIONAL TRAVEL TIME

(hours)

	Type - 1	Type - 2	Type - 3
C a r	3.073	2.248	-0.188
Jeepney	3.651	2.743	-0.039

e) Additional traffic cost

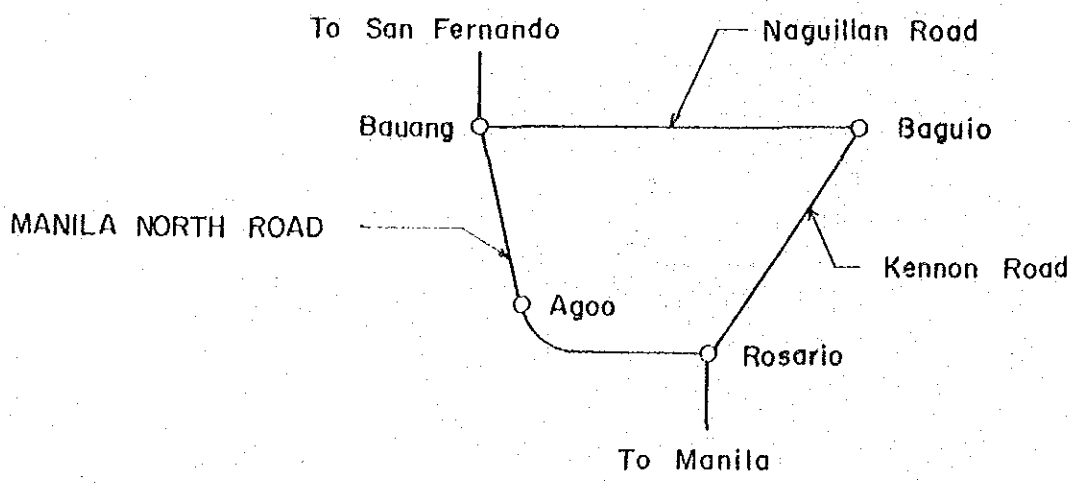
Additional traffic costs by each trip types are shown in Appendix 9.2-2 (14).

f) Saving in detour cost

Savin in detour costs are shown in Appendix 9.2-2 (15).

4) Saving in Detour Costs (Naguilian Road)

a) Road Condition



APPENDIX 9.2-2 (14) ADDITIONAL TRAFFIC COST/VEHICLE
(ALLEN - CALBAYOG SECTION)

		Unit	Type - 1	Type - 2	Type - 3
Car (Business)	Add. Length	km	178.92	133.52	6.48
	Add. Time	hour	3.073	2.248	-0.188
	B.R.C	₱/km	1.18	1.18	1.18
	B.F.C	₱/hour	3.50	3.50	3.50
	P.T.C	₱/hour	31.85	31.85	31.85
	Running Cost	₱/veh.	211.126	157.554	7.646
	Fixed Cost	₱/veh.	10.756	7.868	-0.658
	Time Cost	₱/veh.	97.875	71.599	-5.988
	Total	₱/veh.	319.757	237.021	1.000
Car (Private)	Add. Length	km	178.92	133.52	6.48
	Add. Time	hour	3.073	2.248	-0.188
	B.R.C	₱/km	1.18	1.18	1.18
	B.F.C	₱/hour	3.50	3.50	3.50
	Running Cost	₱/veh.	211.126	157.554	7.646
	Fixed Cost	₱/veh.	10.756	7.868	-0.658
	Total	₱/veh.	200.370	149.686	6.988
Jeepney	Add. Length	km	178.92	133.52	6.48
	Add. Time	hour	3.651	2.743	-0.039
	B.R.C	₱/km	1.15	1.15	1.15
	B.F.C	₱/hour	20.21	20.21	20.21
	P.T.C	₱/hour	17.85	17.85	17.85
	Running Cost	₱/veh.	205.758	153.548	7.452
	Fixed Cost	₱/veh.	73.787	55.436	-0.788
	Time Cost	₱/veh.	65.170	48.963	-0.696
	Total	₱/veh.	344.715	257.947	5.968

APPENDIX 9.2-2 (15) SAVING IN DETOUR COSTS
(ALLEN - CALBAYOG SECTION)

	Type	Traffic Vol. (Veh./Day)	Add. Cost (₱/Veh.)	No. of Day	Saving in Detour Cost (M₱)
1984	Car (Business)	3	319.757	8.5	0.0082
	1 (Private)	7	200.370	8.5	0.0119
	Jeepney	2	344.715	8.5	0.0059
	Car (Business)	25	237.021	8.5	0.0504
	2 (Private)	27	149.686	8.5	0.0344
	Jeepney	59	257.947	8.5	0.1294
	Car (Business)	34	1.000	8.5	0.0003
	3 (Private)	24	6.988	8.5	0.0014
	Jeepney	24	5.968	8.5	0.0012
	Total	205			0.2418
1990	Car (Business)	4	319.757	8.5	0.0109
	1 (Private)	8	200.370	8.5	0.0136
	Jeepney	2	344.715	8.5	0.0059
	Car (Business)	32	237.021	8.5	0.0645
	2 (Private)	34	149.686	8.5	0.0433
	Jeepney	73	257.947	8.5	0.1601
	Car (Business)	46	1.000	8.5	0.0004
	3 (Private)	32	6.988	8.5	0.0019
	Jeepney	29	5.968	8.5	0.0015
	Total	260			0.3021
2000	Car (Business)	8	319.757	8.5	0.0217
	1 (Private)	12	200.370	8.5	0.0204
	Jeepney	3	344.715	8.5	0.0088
	Car (Business)	62	237.021	8.5	0.1249
	2 (Private)	58	149.686	8.5	0.0738
	Jeepney	115	257.949	8.5	0.2521
	Car (Business)	89	1.000	8.5	0.0008
	3 (Private)	56	6.988	8.5	0.0033
	Jeepney	46	5.968	8.5	0.0023
	Total	449			0.5081

APPENDIX 9.2-2 (15) (Cont'd.)

	Type	Traffic Vo. (Veh./Day)	Add. Cost (₱/Veh.)	No. of Day	Saving in Detour Cost (M₱)
2010	Car (Business)	16	319.757	8.5	0.0435
	1 (Private)	18	200.370	8.5	0.0307
	Jeepney	4	344.715	8.5	0.0117
	Car (Business)	122	237.021	8.5	0.2458
	2 (Private)	100	149.686	8.5	0.1272
	Jeepney	179	257.947	8.5	0.3925
	Car (Business)	175	1.000	8.5	0.0015
	3 (Private)	98	6.988	8.5	0.0058
	Jeepney	71	5.968	8.5	0.0036
	Total	783			0.8623
2015	Car (Business)	22	319.757	8.5	0.0598
	1 (Private)	22	200.370	8.5	0.0375
	Jeepney	5	344.715	8.5	0.0147
	Car (Business)	170	237.021	8.5	0.3425
	2 (Private)	134	149.686	8.5	0.1705
	Jeepney	224	257.947	8.5	0.4911
	Car (Business)	244	1.000	8.5	0.0021
	3 (Private)	131	6.988	8.5	0.0078
	Jeepney	89	5.968	8.5	0.0045
	Total	1041			1.1305

APPENDIX 9.2-2 (16) ROAD CONDITION

	Naguilian Road	Manila North Road	Kennon Road
Road Length	47.2 km	Bauang - Agoo 22.3 km Agoo - Rosario 27.5 km	34.2 km
Road Width	6.0 m	6.7 m	6.0 m
Shoulder	0.5 - 1.0 m	2.5 m	0.5 - 1.0 m
Surface Type	Concrete Pavement	Concrete Pavement	Concrete Pavement
Surface Condition	Good/Fair	Good	Good/Fair
Gradient	6 - 7 %[1/]	Less than 3%	6 - 7 %
Roadside Friction	None	Light	None
Traffic Volume	Appendix 9.2-2 (17)	-	Appendix 9.2-2 (18)
Volume - Capacity Ratio	Appendix 9.2-2 (19)		Appendix 9.2-2 (19)

Note : [1/] For about 16 km from Bauang to point km 275 + 500, the gradient is less than 3%.

APPENDIX 9.2-2 (17) FUTURE TRAFFIC VOLUME (NAGUILIAN ROAD)

Type - 1 Baguio - Bauang (Veh./Day)

Vehicle Type	1984	1990	2000	2010	2015
Car (Business)	200	257	468	855	1,154
(Private)	201	260	455	780	1,019
Jeepney	318	406	642	993	1,229
Bus	85	108	172	265	327
Truck	250	336	593	1,051	1,398
T o t a l	1,054	1,367	2,330	3,944	5,127

APPENDIX 9.2-2 (17) (Cont'd.)

Vehicle Type	1984	1990	2000	2010	2015
Type - 2 Baguio - Agoo					
Car (Business)	1	1	2	4	5
(Private)	2	2	4	6	8
Jeepney	0	0	0	0	0
Bus	0	0	0	0	0
Truck	1	1	2	4	6
Total	4	4	8	14	19
Type - 3 Baguio - Rosario					
Car (Business)	10	11	21	39	51
(Private)	8	8	15	24	32
Jeepney	0	0	0	0	0
Bus	0	0	0	0	0
Truck	6	8	14	25	34
Total	24	27	50	88	117
Total Detour Traffic					
Car (Business)	211	269	491	898	1,210
(Private)	211	270	474	810	1,059
Jeepney	318	406	642	993	1,229
Bus	85	108	172	265	327
Truck	257	345	609	1,080	1,438
Total	1,082	1,398	2,388	4,046	5,263
Traffic not Detour					
Car (Business)	11	14	25	45	61
(Private)	32	42	74	127	166
Jeepney	97	120	199	308	380
Bus	0	0	0	0	0
Truck	17	23	40	71	95
Total	157	199	338	551	702

APPENDIX 9.2-2 (17) (Cont'd.)

All Traffic

Vehicle Type	1984	1990	2000	2010	2015
Car (Business)	222	283	516	943	1,271
(Private)	243	312	548	937	1,225
Jeepney	415	526	841	1,301	1,609
Bus	85	108	172	265	327
Truck	274	368	649	1,151	1,533
T o t a l	1,239	1,597	2,726	4,597	5,965

Source : The Study Team.

APPENDIX 9.2-2 (18) FUTURE TRAFFIC VOLUME (KENNON ROAD)

Vehicle Type	1984 1/	1990	2000	2010	2015 1/
Car (Business)	327	469	920	1,796	2,507
(Private)	597	819	1,503	2,623	3,477
Jeepney	177	232	381	591	736
Bus	485	638	1,045	1,621	2,020
Truck	324	443	789	1,420	1,909
T o t a l	1,910	2,601	4,638	8,051	10,649

Source : Stage - I Study

1/ Estimated by the Study Team.

APPENDIX 9.2-2 (19) TRAFFIC VOLUME - CAPACITY RATIO

Year	Naguilian Road	Kennon Road	
		Ordinary Traffic	Traffic Interruption on Naguilian Road
1984	0.13	0.19	0.31
1990	0.17	0.25	0.41
2000	0.29	0.44	0.70
2010	0.48	0.75	1.19
2015	0.63	0.99	1.55

b) Additional length due to detour

Road length = L + DL1 + DL2

Where, L : Actual road length
DL1 : Surface type, condition and gradient DL
DL2 : Roadside friction DL

Additional road length due to detour is shown in Appendix 9.8-2 (20).

c) Additional travel time due to detour

Average travel speeds on each sections are shown in Appendix 8.8-2 (21). Average travel speeds for ordinary traffic on the Kennon Road are almost same as those on the Naguilian Road. When the Kennon Road will be used as the detour route of the Naguilian Road, however, the average travel speeds on the Kennon Road will slow down.

APPENDIX 9.2-2 (20) ADDITIONAL LENGTH DUE TO DETOUR

(in km)

			Type - 1				Type - 2			
			Car, Jeepney		Bus, Truck		Car, Jeepney		Bus, Truck	
			Ordinary Route	Alternative Route	Ordinary Route	Alternative Route	Ordinary Route	Alternative Route	Ordinary Route	Alternative Route
	L		47.2	84.0	47.2	84.0	69.5	61.7	69.5	61.7
DL	DL1		13.28	13.68	16.40	17.10	13.28	13.68	16.40	17.10
	DL2	1984	0.42	1.45	0.54	1.87	0.42	1.45	0.54	1.87
		1990	0.68	2.40	0.87	3.09	0.68	2.40	0.87	3.09
		2000	1.78	6.30	2.29	8.10	1.78	6.30	2.29	8.10
		2010	4.41	16.37	5.67	21.05	4.41	16.37	5.67	21.05
		2015	7.19	19.20	9.25	24.68	7.19	19.20	9.25	24.68
L + DL		1984	60.90	99.13	64.14	102.97	83.20	76.83	86.44	80.67
		1990	61.16	100.08	64.47	104.19	83.46	77.78	86.77	81.89
		2000	62.26	103.98	65.89	109.20	84.56	81.68	88.19	86.90
		2010	64.89	114.05	69.27	122.15	87.19	91.75	91.57	99.85
		2015	67.67	116.88	72.85	125.78	89.97	94.58	95.15	103.48
Add. Length		1984	38.23		38.83		-6.37		-5.77	
		1990	38.92		39.72		-5.68		-4.88	
		2000	41.72		43.31		-2.88		-1.29	
		2010	49.16		52.88		4.56		8.28	
		2015	49.21		52.93		4.61		8.33	

APPENDIX 9.2-2 (21) AVERAGE TRAVEL SPEED

(km/hour)

	Naguilian Road	Manila North Road	Kennon Road
Car	45	60	30
Jeepney	35	55	25
Bus	30	50	20
Truck	30	50	20

APPENDIX 9.2-2 (22) ADDITIONAL TRAVEL TIME

(in hour)

	Type - 1	Type - 2
Car	0.921	0.178
Jeepney	0.925	0.114
Bus	1.133	0.241
Truck	1.133	0.241

d) Additional traffic cost

See Appendix 9.2-2 (23)

e) Saving in detour cost

See Appendix 9.2-2 (24)

5) Savings in Travel Time Cost

Even after urgent restoration work to make a road passable, one-lane traffic operation remains and road surface as well remains in bad condition. Under such circumstances, drivers tend to reduce speed, resulting in loss of travel time. These benefits were estimated based on travel time survey results, some simulation results and duration of restoration work.

APPENDIX 9.2-2 (23) ADDITIONAL TRAFFIC COST/VEHICLE
(NAGUILIAN ROAD)

Type - 1

		Unit	1984	1990	2000	2010	2015
Car (Business)	Add. Length	km	38.23	38.92	41.72	49.16	49.21
	Add. Time	hour	0.921	0.921	0.921	0.921	0.921
	B.R.C	₱/km	1.22	1.22	1.22	1.22	1.22
	B.F.C	₱/hour	4.26	4.26	4.26	4.26	4.26
	P.T.C	₱/hour	32.35	32.35	32.35	32.35	32.35
	Running Cost	₱/veh.	46.641	47.482	50.898	59.975	60.036
	Fixed Cost	₱/veh.	3.923	3.923	3.923	3.923	3.923
	Time Cost	₱/veh.	29.794	29.794	29.794	29.794	29.794
	Total	₱/veh.	80.358	81.199	84.615	93.692	93.753
Car (Private)	Add. Length	km	38,23	38.92	41.72	49.16	49.21
	Add. Time	hour	0.921	0.921	0.921	0.921	0.921
	B.R.C	₱/km	1.22	1.22	1.22	1.22	1.22
	B.F.C	₱/hour	4.26	4.26	4.26	4.26	4.26
	Running Cost	₱/veh.	46.641	47.482	50.898	59.975	60.036
	Fixed Cost	₱/veh.	3.923	3.923	3.923	3.923	3.923
	Total	₱/veh.	50.564	51.405	54.821	63.898	63.959
Jeepney	Add. Length	km	38.23	38.92	41.72	49.16	49.21
	Add. Time	hour	0.925	0.925	0.925	0.925	0.925
	B.R.C	₱/km	1.15	1.15	1.15	1.15	1.15
	B.F.C	₱/hour	20.21	20.21	20.21	20.21	20.21
	P.T.C	₱/hour	14.70	14.70	14.70	14.70	14.70
	Running Cost	₱/veh.	43.965	44.758	47.978	56.534	56.592
	Fixed Cost	₱/veh.	18.694	18.694	18.694	18.694	18.694
	Time Cost	₱/veh.	13.598	13.598	13.598	13.598	13.598
	Total	₱/veh.	76.257	77.050	80.270	88.826	88.884
Bus	Add. Length	km	38.83	39.72	43.31	52.88	52.93
	Add. Time	hour	1.133	1.133	1.133	1.133	1.133
	B.R.C	₱/km	2.87	2.87	2.87	2.87	2.87
	B.F.C	₱/hour	28.75	28.75	28.75	28.75	28.75
	P.T.C	₱/hour	46.61	46.61	46.61	46.61	46.641
	Running Cost	₱/veh.	111.442	113.996	124.300	151.766	151.909
	Fixed Cost	₱/veh.	32.574	32.574	32.574	32.574	32.574
	Time Cost	₱/veh.	52.809	52.809	52.809	52.809	52.809
	Total	₱/veh.	196.825	199.379	209.683	237.149	237.292
Truck	Add. Length	km	38.83	39.72	43.31	52.88	52.93
	Add. Time	hour	1.133	1.133	1.133	1.133	1.133
	B.R.C	₱/km	2.65	2.65	2.65	2.65	2.65
	B.F.C	₱/hour	27.58	27.58	27.58	27.58	27.58
	Running Cost	₱/veh.	102.900	105.258	114.772	140.132	140.265
	Fixed Cost	₱/veh.	31.248	31.248	31.248	31.248	31.248
	Total	₱/veh.	134.148	136.506	146.020	171.380	171.513

APPENDIX 9.2-2 (23) (Cont'd.)

Type - 2

		Unit	1984	1990	2000	2010	2015
Car (Business)	Add. Length	km	-6.37	-5.68	-2.88	4.56	4.61
	Add. Time	hour	0.178	0.178	0.178	0.178	0.178
	B.R.C	₱/km	1.22	1.22	1.22	1.22	1.22
	B.F.C	₱/hour	4.26	4.26	4.26	4.26	4.26
	P.T.C.	₱/hour	32.35	32.35	32.35	32.35	32.35
	Running Cost	₱/veh.	-7.771	-6.930	-3.514	5.563	5.624
	Fixed Cost	₱/veh.	0.758	0.758	0.758	0.758	0.758
	Time Cost	₱/veh.	5.758	5.758	5.758	5.758	5.758
	Total	₱/veh.	-1.255	-0.414	3.002	12.079	12.140
Car (Private)	Add. Length	km	-6.37	-5.68	-2.88	4.56	4.61
	Add. Time	hour	0.178	0.178	0.178	0.178	0.178
	B.R.C	₱/km	1.22	1.22	1.22	1.22	1.22
	B.F.C	₱/hour	4.26	4.26	4.26	4.26	4.26
	Running Cost	₱/veh.	-7.771	-6.930	-3.514	5.563	5.624
	Fixed Cost	₱/veh.	0.758	0.758	0.758	0.758	0.758
	Total	₱/veh.	-7.013	-6.172	-2.756	6.321	6.382
Jeepney	Add. Length	km	-6.37	-5.58	-2.88	4.56	4.61
	Add. Time	hour	0.114	0.114	0.114	0.114	0.114
	B.R.C	₱/km	1.15	1.15	1.15	1.15	1.15
	B.F.C	₱/hour	20.21	20.21	20.21	20.21	20.21
	P.T.C.	₱/hour	14.70	14.70	14.70	14.70	14.70
	Running Cost	₱/veh.	-7.326	-6.532	-3.312	5.244	5.302
	Fixed Cost	₱/veh.	2.304	2.304	2.304	2.304	2.304
	Time Cost	₱/veh.	1.676	1.676	1.676	1.676	1.676
	Total	₱/veh.	-3.346	-2.552	0.668	9.224	9.282
Bus	Add. Length	km	-5.77	-4.88	-1.29	8.28	8.33
	Add. Time	hour	0.241	0.241	0.241	0.241	0.241
	B.R.C	₱/km	2.87	2.87	2.87	2.87	2.87
	B.F.C	₱/hour	28.75	28.75	28.75	28.75	28.75
	P.T.C	₱/hour	46.61	46.61	46.61	46.61	46.61
	Running Cost	₱/veh.	-16.560	-14.006	-3.702	23.764	23.907
	Fixed Cost	₱/veh.	6.929	6.929	6.929	6.929	6.929
	Time Cost	₱/veh.	11.233	11.233	11.233	11.233	11.233
	Total	₱/veh.	1.602	4.156	14.460	41.926	42.069
Truck	Add. Length	km	-5.77	-4.88	-1.29	8.28	8.33
	Add. Time	hour	0.241	0.241	0.241	0.241	0.241
	B.R.C	₱/km	2.65	2.65	2.65	2.65	2.65
	B.F.C	₱/hour	27.58	27.58	27.58	27.58	27.58
	Running Cost	₱/veh.	-16.291	-12.932	-3.419	21.942	22.075
	Fixed Cost	₱/veh.	6.647	6.647	6.647	6.647	6.647
	Total	₱/veh.	-8.644	-6.285	3.228	28.589	28.722

APPENDIX 9.2-2 (24) SAVING IN DETOUR COSTS
(NAGUILIAN ROAD)

	Type	Traffic Vol. (Veh./Day)	Add. Cost (₱/Veh.)	No. of Day	Saving in Detour Cost (M₱)
1984	1 Car (Business)	200	80.358	4	0.0643
	(Private)	201	50.564	4	0.0407
	Jeepney	318	76.257	4	0.0970
	Bus	85	196.825	4	0.0669
	Truck	250	134.148	4	0.1341
	2 Car (Business)	1	0	4	0
	(Private)	2	0	4	0
	Jeepney	0	0	4	0
	Bus	0	1.602	4	0
	Truck	1	0	4	0
	Total	1,058			0.4030
1990	1 Car (Business)	257	81.199	4	0.0835
	(Private)	260	51.405	4	0.0535
	Jeepney	406	77.050	4	0.1251
	Bus	108	199.379	4	0.0861
	Truck	336	136.506	4	0.1835
	2 Car (Business)	1	0	4	0
	(Private)	2	0	4	0
	Jeepney	0	0	4	0
	Bus	0	4.156	4	0
	Truck	1	0	4	0
	Total	1,371			0.5317
2000	1 Car (Business)	468	84.615	4	0.1584
	(Private)	455	54.821	4	0.0998
	Jeepney	642	80.270	4	0.2061
	Bus	172	209.683	4	0.1443
	Truck	593	146.020	4	0.3464
	2 Car (Business)	2	3.002	4	0.0000
	(Private)	4	0	4	0
	Jeepney	0	0.668	4	0
	Bus	0	14.460	4	0
	Truck	2	3.228	4	0.0000
	Total	2,338			0.9550

APPENDIX 9.2-2 (24) (Cont'd.)

		Type	Traffic Vol. (Veh./Day)	Add. Cost (₱/Veh.)	No. of Day	Saving in Detour Cost (M₱)
2010	1	Car (Business)	855	93.692	4	0.3204
		(Private)	780	63.898	4	0.1994
		Jeepney	993	88.826	4	0.3528
		Bus	265	237.149	4	0.2514
		Truck	1,051	171.380	4	0.7205
	2	Car (Business)	4	12.079	4	0.0002
		(Private)	6	6.321	4	0.0002
		Jeepney	0	9.224	4	0
		Bus	0	41.926	4	0
		Truck	4	28.589	4	0.0005
		Total	3,958			1.8454
2015	1	Car (Business)	1,154	93.753	4	0.4328
		(Private)	1,019	63.959	4	0.2607
		Jeepney	1,229	88.884	4	0.4370
		Bus	327	237.292	4	0.3104
		Truck	1,398	171.513	4	0.9591
	2	Car (Business)	5	12.140	4	0.0002
		(Private)	8	6.382	4	0.0002
		Jeepney	0	9.282	4	0
		Bus	0	42.069	4	0
		Truck	6	28.722	4	0.0007
		Total	5,146			2.4011

The following assumptions were made:

- These benefits will be generated at the embankment slope failures.
- The affected period will be 60 days.
- The loss time at one disaster spot will be 0.009 hours per vehicle.

In the Study, one point in the Lucena - Calauag Section, two points in the Allen - Calbayog Section and five points in the Naguilian Road are identified as the embankment slope failure spots classified heavy or medium.

Traffic costs were computed as follows:

$$Ct = (B.F.C. + P.T.C.) \times n \times 0.09$$

Where,
- Ct : Loss of the travel time cost per vehicle
- B.F.C. : Basic fixed cost
- P.T.C. : Passenger time cost
- n : No. of spots

APPENDIX 9.2-2 (25) LOSS OF TRAVEL TIME COSTS PER VEHICLE

(Unit : ₱/Veh. - Day)

	Lucena - Calauag Section	Allen - Calbayog Section	Naguilian Road
Car (Business)	0.413	0.636	1.647
(Private)	0.043	0.063	0.192
Jeepney	0.225	0.685	1.571
Bus	0.558	1.101	3.391
Truck	0.243	0.441	1.241

Savings in travel time cost were estimated by multiplying loss of the travel time costs for each representative vehicle by traffic volumes and affected days.

APPENDIX 9.2-2 (26) SAVINGS IN TRAVEL TIME COST

		1984	1990	2000	2010	2015
Lucena - Calauag Section	Car (Business)	0.0088	0.0115	0.0207	0.0371	0.0496
	(Private)	0.0004	0.0004	0.0007	0.0011	0.0014
	Jeepney	0.0016	0.0018	0.0027	0.0040	0.0049
	Bus	0.0171	0.0207	0.0311	0.0460	0.0558
	Truck	0.0102	0.0127	0.0203	0.0340	0.0456
	Total	0.0381	0.0471	0.0755	0.1222	0.1573
Allen - Calbayog Section	Car (Business)	0.0024	0.0031	0.0061	0.0119	0.0166
	(Private)	0.0002	0.0003	0.0005	0.0008	0.0011
	Jeepney	0.0035	0.0043	0.0067	0.0104	0.0131
	Bus	0.0033	0.0046	0.0073	0.0111	0.0135
	Truck	0.0019	0.0025	0.0042	0.0073	0.0097
	Total	0.0113	0.0148	0.0248	0.0415	0.0540
Naguilian Road	Car (Business)	0.0219	0.0280	0.0510	0.0932	0.1256
	(Private)	0.0028	0.0036	0.0063	0.0108	0.0141
	Jeepney	0.0391	0.0496	0.0793	0.1226	0.1517
	Bus	0.0173	0.0220	0.0350	0.0539	0.0665
	Truck	0.0204	0.0274	0.0483	0.0857	0.1141
	Total	0.1015	0.1306	0.2199	0.3662	0.4720

APPENDIX 9.2-3 ESTIMATION OF RESTORATION COST

ESTIMATION OF RESTORATION COST : LUCENA - CALAUAG SECTION
(Large Scale Typhoon)

Type of Disaster	No. of Spot	Total Length (m)	Quantity of Restoration Work	Unit Price	Estimated Cost (Million ₱)
			Removal of Slides		
C-SF/DF	(H) 1	120	89 m^3/m x 120 m = 10,700m^3	55 ₱/m^3	0.59
E-D.F	(M) 1	20	Stone Masonry = 130m^3	560 ₱/m^3	0.07
			Re-filling = 295m^3	95 ₱/m^3	0.03
			Re-pavement = 67m^2	370 ₱/m^3	0.03
					0.13
			Removal of Rocks		
C-F	(H) 2	650	26 x 650 = 16,900m^3		
	(M) 2	230	13 x 230 = 3,000m^3		
			19,900m^3	115 ₱/m^3	2.29
			Removal of Slides		
Landslides	(M) 1	150	1/2 x 6.9 x 2.0 x 150m = 1,000m^3	55 ₱/m^3	0.06
				T O T A L	₱ 3.07 Million
				Excluding E-D.F	₱ 2.94 Million

ESTIMATION OF RESTORATION COST : ALLEN - CALBAYOG SECTION

(Large Scale Typhoon)

Type of Disaster	No. of Spot	Total Length (m)	Quantity of Restoration Work	Unit Price	Estimated Cost (Million ₱)
			Removal of Slides		
C-DF	(M) 1	120	58 x 120 = 7,000	55 ₱/m^3	0.39
E-DF	(M) 2	40	Stone Masonry = 480m^3	560 ₱/m^3	0.27
			Re-filling = 1,930m^3	95 ₱/m^3	0.18
			Re-pavement = 134m^2	370 ₱/m^2	0.05
					0.50
C-F	(H) 2	300	26m^3 x 300 = 7,800m^3		
	(M) 7	1,320	13 x 1,320 =17,200m^3		
			25,000m^3	115 ₱/m^3	2.88
D.F	(M) 2	170	1/2 (12 + 18) x 2.0 x 150m = 4,500m^3		
			1/2 (12 + 18) x 1.0 x 20m = 300m^3		
			4,800m^3	55 ₱/m^3	0.26
				T O T A L	₱ 4.03 Million
				Excluding E-DF	₱ 3.53 Million

ESTIMATION OF RESTORATION COST : NAGUILIAN ROAD
(Super-large Scale Typhoon)

Type of Disaster	No. of Spot	Total Length (m)	Quantity of Restoration Work	Unit Price	Estimated Cost (Million ₱)
			Removal of Slides		
C-SF/DF	(H) 2	100	40 m^3 x 100 m = 4,000m^3		
	(M) 3	140	40 m^3 x 140 m = 5,600m^3		
			9,600m^3	55 ₱/m^3	0.53
E-D.F	(M) 5	101	Stone Masonry = 940m^3	560 ₱/m^3	0.53
			Re-filling = 1,600m^3	95 ₱/m^3	0.15
			Re-pavement = 300m^2	370 ₱/m^2	0.11
					0.79
			Removal of Slides		
C-F	(H) 1	50	40 x 50 = 2,000m^3		
	(M) 4	160	10.5 x 160 = 1,700m^3		
			3,700m^3	115 ₱/m^3	0.43
				T O T A L	₱ 1.75 Million
				Excluding E-D.F	₱ 0.96 Million

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