ANNEX 9

Annex 9-1 Vehicle Operating Cost

MOPT has established a comprehensive model to estimate the vehicle operating cost (VOC) for a number of vehicle types under typical road conditions. The VOC determined for the respective prices of mid-1979 and mid-1980 are edited in the document of "Costos de Operacion de Vehiculos" (Ministerio de Obras Publicas y Transporte, Oficina de Planeacion, Document MOPT-OP-3-21-010, Agosto de 1980.) The above model of VOC is developed by applying the method developed by Quantification of Road User Savings (Jan de Wrille, World Bank Publication Series No.3, 1967) together with experiments and studies conducted in Colombia.

Since the vehicles running on the project road have different aspects than those of the above model of VOC, it is proposed that those characteristics should be considered in the VOCs on the project road. The followings are the detailed steps to estimate the VOCs on the project road [1] in the present level of traffic which is not congested and [2] in the estimated traffic for the year 1995. The estimate generally follows the procedure of the model but with new information. The cost per Km [1] differed little from that in [2].

The reason is that the traffic congestion in [1] and [2] are considered within the same service level C of the road, referring to HCM.

(1) Vehicle Operating Cost (for the traffic of 1980)

A. Basic Data

A representative vehicle make is selected for each of the four classifications by considering the production, import policy, market popularity, and the variation of the make in each classification. Of these representatives, the data such as the annual fixed cost, the purchase prices of complete vehicles and type are shown in Annex Tables 9-1 to 9-3.

B. Average Velocity and Average Annual Running Mileage

The running speeds of vehicles on the road were observed in September and October, 1980 with the results presented in Chapter 5. In the flow of traffic, approximately 2100 AADT, the average running speeds thus obtained are shown in Annex Table 9-4. With these average speeds, the annual running distances are calculated by the formula which has been applied by MOPT in other studies.

$$Ri = [0.5 + 0.5\ (Vi/Vo)]\ Ro$$

Where Ri : Running mileage on the road with the gradient i^{o}
Vi : Running speed on the road of Ri
Ro : Running mileage on the flat road
Vo : Running speed on the road of Ro

The average annual running mileages as determined by the formula are shown in Annex Table 9-5.

Annex Table 9-1 Basic Data for Annual Fixed Cost

(Pesos)

Vehicle	Wage Rate/ month Driver	Wage Rate/ month Assistant	Wage Rate & Tax	Insurance Year	Main-tenance	Garage	Amin.	Fixed Cost	Inflation Rate/79 (%)
Dodge Dart Auto				69,792				69,792	(55)
" P600 Bus	14,000	4,500	319,236	49,308	31,680	18,000	136,418	554,642	(44)
" D600 Truck	15,000		258,840	41,520	18,000	18,000	85,136	421,496	(54)
" CNT900 TM	22,000		379,632	136,900	18,000	24,000	171,741	730,273	(32)

- July, 1980-

Annex Table 9-2. Basic Data for Financial Capital Cost of Vehicle

(Pesos)

Vehicle	Al publico	Carroceria	Total	Tyres	Tyre	without Tyre	Financial	Inflation Rate /79 (%)
Dodge Dart Auto	1,115,000		1,150,000	9,040	2,260	1,105,960	884,768	(48)
" P600 Bus	824,161	584,925	1,409,086	32,400	5,400	1,376,686	1,101,349	(26)
" D600 Truck	1,067,522	180,000	1,247,522	44,400	7,400	1,203,122	962.498	(45)
" CNT900 TM	2,963,739	1,590,000	4,553,739	167,400	9,300	4,386,339	3,509,071	(45)

- July, 1980-

Annex Table 9-3. Basic Data for Economic Capital Cost of Vehicle

(Pesos)

Vehicle	Al publico sin impuestos	Carroceria sin impuestos	Total without Tax	Tyres	Tire	Price without Tire	Depre-ciation Cost	Inflation Rate/79 (%)
Dodge Dart Auto	626,369	-	626,369	9,040	2,260	617,329	493,863	(30)
" P600 Bus	575,803	551,818	1,127,621	32,400	5,400	1,095,221	876,177	(29)
" D600 Truck	857,190	169,812	1,027,002	44,400	7,400	982,602	786,082	(47)
" CNT900 TM	2,359,222	1,500,000	3,859,222	167,400	9,300	3,691,822	2,953,458	(50)

- July, 1980-

The price of gasoline and ACPM: P34/gal. Shadow price P47.80/gal, July 1980.
1 barril: 42 gal or 159 l, 1 gal: 3.785 l.

Source: MOPT Oficina de Planeacion, "Costos de Operacionde Vehiculos"
(MOPT-OP-3-21-010, Agosto de 1980)

Annex Table 9-4. Average Running Speed on the Project Road of the Representative Types - Km/H.

	Gradient 1%	3%	5%	7%	9%
Auto - Dart	69 (70)	48 (62)	40 (50)	35 (-)	31 (-)
Bus - P600	68 (70)	44 (62)	36 (50)	31 (-)	27 (-)
Truck - D600	66 (70)	38 (59)	29 (46)	25 (-)	21 (-)
Tractomula-CNT900	57 (46)	30 (33)	23 (19)	18 (-)	14 (-)

Source: 1) From Table 5-5 and Annex Fig.5-2 through 5-5
2) The figures in ( ) are from Table 8.2 in MOPT document (OP-3-21-010, Agosto de 1980)

Annex Table 9-5. Average Annual Running Mileage[1] of the Representative Types - '000 Km/Year

	Gradient 1%	3%	5%	7%	9%
Auto - Dart	20.0 (20.0)	16.9 (19.0)	15.7 (17.0)	15.0 (-)	14.4 (-)
Bus - P600	98.6 (100.0)	81.4 (94.0)	75.7 (86.0)	72.1 (-)	69.3 (-)
Truck-D600	63.1 (65.0)	50.1 (60.0)	46.0 (54.0)	44.1 (-)	42.3 (-)
Tractomula-CNT900	89.6 (80.0)	66.1 (68.0)	60.0 (45.0)	55.7 (-)	52.2 (-)

Notes: 1) The mileage in Km is calculated by applying the average speed in Ann. Table 9-4 to the formula of the MOPT document (OP-3-21-010, Agosto de 1980): $Ri=[0.5+0.5(Vi/Vo)] Ro$.
2) The figures in ( ) are from Table 8.4 in MOPT document (OP-3-21-010, Agosto de 1980)

C. Fixed Cost

The annual fixed cost which the vehicle owner has to pay for is shown in Annex Table 9-1. The cost is divided by annual running distance to obtain the fixed cost per Km which is presented in Annex Table 9-6.

C. Depreciation and Interest Cost

The vehicle life on the road was interviewed in February 1980 with the result shown in Annex Table 9-7. Based on these vehicle years the calculation of annualized depreciation cost is conducted and the result is shown in Annex Table 9-8.

It is found that the vehicle life used in the MOPT document is rather close to the average use in years on the road. It is the average year of the vehicles on the road including new vehicles and old vehicles. In estimating the VOC it is required to have the average of the usable (depreciable) years. They are determined as follows:

Auto	13 years	(9 years in the MOPT Document)
Bus	10 "	(6 " " " ")
Truck	18 "	(8 " " " ")
Tractomula	13 "	(8 " " " ")

E. Tyre Cost

The tyre cost per Km is calculated with the price of tyres and the tyre life in Km. Annex Table 9-9 presents the cost per Km together with the data applied.

F. Maintenance Cost

The maintenance cost is estimated by applying a certain percentage to the variable cost of vehicle operation. The percentage which is already determined by the MOPT method, is applied also in this study. Annex Table 9-10 presents the maintenance cost for each vehicle type.

G. Lubricant Oil Cost

In determining the cost of engine lubricant oil, the MOPT method uses a certain percentage to the cost of engine fuel. The same percentage is applied in this study. The cost is shown in Annex Table 9-10.

Annex Table 9-6. Fixed Cost Per KM, Financial & Economic.

	Fixed cost per year	gr %	Velo. K/H	Annual Km	Financial annual fixed cost pesos/km	Economic annual fixed cost 1) pesos/km
Auto	69792	1	69	20.000	.3.490	3.141
	"	3	48	16.900	4.130	3.717
	"	5	40	15.700	4.445	4.000
	"	7	35	15.000	4.653	4.188
	"	9	31	14.400	4.847	4.362
Bus	554642	1	68	98.600	5.625	5.062
	"	3	44	81.400	6.814	6.133
	"	5	36	75.700	7.327	6.594
	"	7	31	72.100	7.693	6.924
	"	9	27	69.300	8.003	7.203
Truck	421496	1	66	63.100	6.680	6.012
	"	3	38	50.100	8.413	7.572
	"	5	29	46.000	9.163	8.247
	"	7	25	44.100	9.558	8.602
	"	9	21	42.300	9.964	8.968
Tractomula	730273	1	57	89.600	8.150	7.335
	"	3	30	66.100	11.048	9.943
	"	5	23	60.000	12.171	10.954
	"	7	18	55.700	13.111	11.800
	"	9	14	52.200	13.990	12.591

Notes: 1) The economic cost is estimated at 90% of the financial cost.

Annex Table .9-7.. Vehicles with Years in Use: The Result of OD Survey in February 1980

Years on Roads	Range Mean	20 - 25	15 - 20 18	11 - 15 13	6 - 10 8	0 - 5 3	TOTAL	AVERAGE
	Location[1)]							
Auto	1	68	34	64	139	303	608	-
	2	20	17	22	68	154	281	-
	3	22	14	34	106	216	392	-
	Total	110	65	120	313	673	1281	7.4 Yrs.
Bus	1	3	0	10	35	56	104	-
	2	0	1	10	16	47	74	-
	3	3	5	32	31	52	123	-
	Total	6	6	52	82	155	301	7.3 Yrs.
Truck 2 axles	1	137	33	59	60	139	428	-
	2	54	43	46	71	226	440	-
	3	51	22	46	50	129	298	-
	Total	242	98	151	181	494	1166	10.5 Yrs.
Truck 3-5 axles	1	3	5	3	7	24	42	-
	2	1	1	10	22	58	92	-
	3	3	3	11	17	27	61	-
	Total	7	9	24	46	109	195	6.6 Yrs.

Note: 1) Location 1 is between Girardot and Espinal, 2 between Ibague and Calarca and 3 between Buga and Tulua.

Annex Table 9-8 Depreciation and Interest Cost (Financial and Economic)

	Annual Km	Fin. Dep. Cost/Year	Fin. Dep. Cost/Km	Eco. Dep. Cost/Year	Eco. Dep. Cost/Km	Remarks
Auto	20.000	226147	11.307	76.895	3.845	Depreciation 1)
	16.900	"	13.381	"	4.550	Fin. 884,768
	15.700	"	14.404	"	4.898	Econ. 493,863
	15.000	"	15.076	"	5.126	CRF Fin. n=13, i=24%, 0.25560
	14.400	"	15.705	"	5.340	Econ. n=13, i=12%, 0.15568
Bus	98.600	229148	3.034	155.066	1.573	Depreciation 1)
	81.400	"	3.675	"	1.905	Fin. 1,101,349
	75.700	"	3.952	"	2.048	Econ. 876,177
	72.100	"	4.149	"	2.151	CRF Fin. n=10, i=24%, 0.27162
	69.300	"	4.317	"	2.238	Econ. n=10, i=12%, 0.17698
Truck	63.100	235908	3.739	108.432	1.718	Depreciation 1)
	50.100	"	4.709	"	2.164	Fin. 1,203,122
	46.000	"	5.128	"	2.357	Econ. 786,082
	44.100	"	5.349	"	2.459	CRF Fin. n=18, i=24%, 0.24510
	42.300	"	5.577	"	2.563	Econ. n=18, i=12%, 0.13794
T-mula	89.600	896919	10.010	459.794	5.132	Depreciation 1)
	66.100	"	13.569	"	6.956	Fin. 3,509,071
	60.000	"	14.949	"	7.663	Econ. 2,953,458
	55.700	"	16.103	"	8.255	CRF Fin. n=13, i=24%, 0.25560
	52.200	"	17.182	"	8.808	Econ. n=13, i=12%, 0.15568

Notes: 1) Depreciable values from Annex Table 9-2 and 9-3. "n" means the years of vehicle life. "i" means the interest rate p.a.: 12% for the economic cost, 24% for the financial cost.

Annex Table 9-9 Tyre Cost, Financial & Economic

	1) Vel. Km/H	1) Life in Km	2) Cost of a set peso	3) Cost/Km peso
Automovil	69	20.000	9,040	0.452
	48	32.000	"	0.283
	40	40.000	"	0.226
	35	48.000	"	0.188
	31	55.000	"	0.164
Bus	68	21.000	32,400	1.543
	44	36.000	"	0.900
	36	46.000	"	0.704
	31	55.000	"	0.589
	27	69.000	"	0.470
Truck	66	22.000	44,400	2.018
	38	43.000	"	1.033
	29	58.000	"	0.766
	25	70.000	"	0.634
	21	82.000	"	0.542
Tractomula	57	26.000	44,400	6.439
	30	56.000	"	2.989
	23	76.000	"	2.203
	18	94.000	"	1.781
	14	113.000	"	1.481

Source: 1) The relationship between the speed and the tyre life is shown in Cuadro 8.7 of the MOPT document 09-3-21-010.

2) From Annex Table 9-2 and 9-3.

3) It has been treated by the above document that the economic cost is virtually equal to the financial cost in case of the domestic produce.

Annex Table 9-10. Vehicle Maintenance Cost: Financial & Economic

		Fuel Cons. (1)	Fuel Cost (2)	Lubricant (3)	Tyres (4)	Total (5)	Fina. Cost (6)	Econ. Cost[1] (7)
	Gr.	1/1000 Km	8.983/1	(0.20)			(0.668)	(0.90)
Auto	1%	152.11	1.366	0.273	0.452	2.091	1.397	1.257
	3	153.86	1.382	0.276	0.283	1.941	1.297	1.167
	5	159.37	1.432	0.286	0.226	1.944	1.299	1.169
	7	167.75	1.507	0.301	0.188	1.996	1.333	1.200
	9	178.32	1.602	0.320	0.164	2.086	1.393	1.254
Bus				(0.25)			(0.668)	(0.90)
	1%	571.03	5.130	1.283	1.543	7.956	5.315	4.784
	3	643.91	5.784	1.446	0.900	8.130	5.431	4.888
	5	733.97	6.593	1.648	0.704	8.945	5.975	5.378
	7	836.54	7.515	1.879	0.589	9.983	6.669	6.002
	9	948.20	8.518	2.130	0.470	11.118	7.427	6.684
Truck				(0.15)			(0.600)	(0.90)
	1	648.90	5.829	0.874	2.018	8.721	5.233	4.710
	3	731.72	6.573	0.986	1.033	8.592	5.155	4.640
	5	834.06	7.492	1.124	0.766	9.382	5.629	5.066
	7	950.61	8.539	1.281	0.634	10.454	6.272	5.645
	9	1.077.50	9.679	1.452	0.542	11.673	7.004	6.304
TM				(0.075)			(0.429)	(0.90)
	1%	1.375.67	12.358	0.927	6.439	19.724	8.462	7.616
	3	1.580.52	14.198	1.065	2.989	18.252	7.830	7.047
	5	1.834.93	16.483	1.236	2.203	19.922	8.547	7.692
	7	2.110.35	18.957	1.422	1.781	22.160	9.507	8.556
	9	2.413.60	21.681	1.626	1.481	24.788	10.634	9.571

Source: Cuadro 8.8 of the MOPT document 09-3-21-010 in which the percentage of the maintenance cost in the total of the variable costs (2) - (4) is shown.

Notes: 1) Economic cost is estimated at 90% of the financial cost.

H. Fuel Cost

The fuel consumption rates on different sections of the project road were tested as described in Chapter 5. The summary is shown in Annex Table 9-11. Of these classified data, the consumption rates on the road between 1,000m - 2,000m above the sea level are taken for the estimate of the VOC in this study since the Ibague - Calarca section lies mostly in this range. Based on these rates, the cost of fuel per Km is calculated and shown in Annex Table 9-10. The fuel costs (gasoline and diesel) are pesos 34.00 pesos/gal. for financial and pesos 47.80 pesos/gal. in terms of shodow priced economic cost in July 1980.

I. The Summary of the VOC

Annex Tables 9-12 and 9-13 present the summary of the VOC in the present traffic level (not congested) on the sections with different gradients. The cost per Km indicates the average of the uphill and downhill driving.

(2) Vehicle Operating Cost (for the traffic of 1995)

The speeds of the vehicles on the selected sections were observed in September and October, 1980, from which the average speed on a typical road of the respective gradient is calculated as shown in Annex Table 9-4. It is understood that these speeds reflect the normal running status on each level of the slope with traffic of 2100 AADT between Ibague and Calarca.

In order to find the changes in speed responding to the increase in traffic, the average speed is estimated for the forecasted traffic of 4100 in 1995. The estimate is conducted by taking into account the availability of passing sight distance on the sections with the application of the criteria in HCM (AASHO, 1965) and MOPT document (3-21-021). The applied method is stated in Chapter 5 and the simulated average speed for the traffic in 1995 is shown in Annex Table 9-14. It is likely that the speed will not be reduced considerably since the traffic in 1995 is still within the service level of C, less than the maximum capacity of the existing road.

Based on the average speeds on the road, the annual running distances and the cost items are calculated with the results shown in Annex Tables 9-15 through 9-19. In the calculation the methodology is same as that applied for VOC in 1980. The costs of tyres and maintenance are assumed to be the same as those in VOC of 1980. The result indicates that changes in VOC on the normal running conditions of the existing roads are quite modest, since the service level of the road associated with the traffic would be within the capacity.

Annex Table 9-11. Fuel Consumption Rates at the Average Speed 1)

(1/1000 Km)

	Gradient	1%		3%		5%		7%		9%	
	Above the sea lev. m.	Av Sp	Consu	Av Sp	Consu	Av Sp	Consu	Av Sp	Consu	Av Sp	Consu
Auto - Dart 2) (G)	- 1.000	69	106.33	48	111.47	40	119.23	35	128.99	31	140.26
	- 2.000	69	152.11	48	153.86	40	159.37	35	167.75	31	178.32
	2.000 -	69	199.90	48	199.82	40	205.20	35	226.86	31	250.76
Bus - P.600 3) (G)	- 1000	68	385.44	44	451.76	36	530.03	31	616.92	27	710.00
	- 2000	68	571.03	44	643.91	36	733.97	31	836.54	27	948.20
	2000 -	68	650.29	44	735.17	36	929.16	31	1130.98	27	1339.06
Truck - D.600 2) (G) (Loaded)	- 1000	66	438.00	38	513.36	29	602.31	25	701.05	21	806.82
	- 2000	66	648.90	38	731.72	29	834.06	25	950.61	21	1077.50
	2000 -	66	738.97	38	835.42	29	1055.86	25	1285.20	21	1521.66
Tractomula 3) (D) - CNT900 (Loaded)	- 1000	57	928.56	30	1108.86	23	1325.08	18	1556.33	14	1807.28
	- 2000	57	1375.67	30	1580.52	23	1834.93	18	2110.35	14	2413.60
	2000 -	57	1566.16	30	1804.51	23	2322.89	18	2853.14	14	3408.52

Notes: 1) Average speeds are from Annex Table 9-4.
2) Fuel consumption rates are from Tables in Chapter 5.
3) Those vehicle types are not included in the field test by the study team in September 1980. The consumption rates are determined by applying a ratio to that of D600 from Table 8.5 of the MOPT document (OP-3-21-010, Agosto de 1980). In case of bus, it is assumed the ratio of fuel consumption to that of D600 is 0.88 in all rises and falls. In case of CNT900, it is assumed its ratio to D600 is 2.12 at 1%, 2.16 at 3%, 2.20 at 5%, 2.22 at 7%, and 2.24 at 9%

Annex Table 9-12. Financial Cost of Vehicle Operation (1980)

(pesos/Km)

	Auto (DDA)	Bus (P600)	Truck (D600)	Tractomula (900 TM)
Gr=1%, (V)	(69)	(68)	(66)	(57)
Fuel	1.366	5.130	5.829	12.358
Eng. Oil	0.273	1.283	0.874	0.927
Tyres	0.452	1.543	2.018	6.439
Maintenance	1.397	5.315	5.233	8.462
Dep & Int	11.307	3.034	3.739	10.010
Overhead	3.490	5.625	6.680	9.128
Total	18.285	21.930	24.373	47.324
Gr=3%, (V)	(48)	(44)	(38)	(30)
Fuel	1.382	5.784	6.573	14.198
Eng. Oil	0.276	1.446	0.986	1.065
Tyres	0.283	0.900	1.033	2.989
Maintenance	1.297	5.431	5.155	7.830
Dep & Int	13.387	3.675	4.709	13.569
Overhead	4.130	6.814	8.413	11.048
Total	20.755	24.050	26.869	50.699
Gr=5%, (V)	(40)	(36)	(29)	(23)
Fuel	1.432	6.593	7.492	16.483
Eng. Oil	0.286	1.648	1.124	1.236
Tyres	0.226	0.704	0.766	2.203
Maintenance	1.299	5.975	5.629	8.547
Dep & Int	14.404	3.952	5.128	14.949
Overhead	4.445	7.327	9.163	12.171
Total	22.092	26.199	29.302	55.589
Gr=7%, (V)	(35)	(31)	(25)	(18)
Fuel	1.507	7.515	8.539	18.957
Eng. Oil	0.301	1.879	1.281	1.422
Tyres	0.188	0.589	0.634	1.781
Maintenance	1.333	6.669	6.272	9.507
Dep & Int	14.977	4.109	5.349	16.103
Overhead	4.622	7.619	9.558	13.111
Total	22.928	28.380	31.633	60.881
Gr=9%, (V)	(31)	(27)	(21)	(14)
Fuel	1.602	8.518	9.679	21.681
Eng. Oil	0.320	2.130	1.452	1.626
Tyres	0.164	0.470	0.542	1.481
Maintenance	1.393	7.427	7.004	10.634
Dep & Int	15.705	4.317	5.577	17.182
Overhead	4.847	8.003	9.964	13.990
Total	24.031	30.862	34.218	66.594

Annex Table 9-13. Economic Cost of Vehicle Operation (1980)

(pesos/Km)

	Auto (DDA)	Bus (P600)	Truck (D600)	Tractomula (900TM)
Gr=1%, (V)	(69)	(68)	(66)	(57)
Fuel	1.921	7.212	8.195	17.373
Eng. Oil	0.384	1.803	1.229	1.303
Tyres	0.452	1.543	2.018	6.439
Maintenance	1.257	4.784	4.710	7.616
Dep & Int. 12%	3.845	1.573	1.718	5.132
Overhead	3.141	5.062	6.012	7.335
Total	11.000	21.977	23.882	45.198
Gr=3%, (V)	(48)	(44)	(38)	(30)
Fuel	1.943	8.132	9.241	19.960
Eng. Oil	0.389	2.033	1.386	1.497
Tyres	0.283	0.900	1.033	2.989
Maintenance	1.167	4.888	4.640	7.047
Dep & Int	4.550	1.905	2.164	6.956
Overhead	3.717	6.133	7.572	9.943
Total	12.049	23.991	26.036	48.392
Gr=5%, (V)	(40)	(36)	(29)	(23)
Fuel	2.013	9.269	10.533	23.173
Eng. Oil	0.403	2.317	1.580	1.738
Tyres	0.226	0.704	0.766	2.203
Maintenance	1.169	5.378	5.066	7.692
Dep & Int	4.898	2.048	2.357	7.663
Overhead	4.000	6.594	8.247	10.954
Total	12.709	26.310	28.549	53.423
Gr=7%, (V)	(35)	(31)	(25)	(18)
Fuel	2.114	10.565	12.005	26.652
Eng. Oil	0.423	2.641	1.801	1.999
Tyres	0.188	0.589	0.634	1.781
Maintenance	1.200	6.002	5.645	8.556
Dep & Int	5.126	2.151	2.459	8.255
Overhead	4.188	6.924	8.602	11.800
Total	13.239	28.872	31.186	59.043
Gr=9%, (V)	(31)	(27)	(21)	(14)
Fuel	2.252	11.975	13.608	30.481
Eng. Oil	0.450	2.994	2.041	2.286
Tyres	0.164	0.470	0.542	1.481
Maintenance	1.254	6.684	6.304	9.571
Dep & Int	5.340	2.238	2.563	8.808
Overhead	4.362	7.203	8.968	12.591
Total	13.822	31.564	34.026	65.218

Annex Table 9-14 Average Running Speed on the Project Road of the Representative Types - Km/H in 1995

	Gradient				
	1%	3%	5%	7%	9%
Auto	67	45	36	30	24
Bus	66	41	32	27	22
Truck	65	36	28	23	19
Tractomula	56	29	22	17	13

Source: With the traffic of 4100 AADT in 1995 on the Section of Ibague - Calarca (See Chapter 4) and its length of the passing sight distances comprising 17.4% of the section, the speeds in Annex Table 9-4 are modified as above.

Annex Table 9-15 Average Annual Running Mileage of the Representative Types - 1995

	Gradient '000km/year				
	1%	3%	5%	7%	9%
Auto	19.5	16.4	15.1	14.3	13.4
Bus	97.1	79.3	72.9	69.3	65.7
Truck	62.7	49.2	45.5	43.2	41.3
Tractomula	88.7	65.2	59.1	54.8	51.3

Source: Calculated by applying the figures in Annex Table 9-14 into the same formulae of Annex Table 9-5..

Annex Table 9-16, Fixed Cost per Km, Financial & Economic - 1995 1)

	Fixed Cost per Year	Gr %	Velo. K/H	Annual Km	Finan. Ann. Fixed Cost pesos/ Km	Econ. Ann. Fixed Cost pesos/ Km 2)
Auto	69792	1	67	19.500	3.579	3.221
	"	3	45	16.400	4.256	3.830
	"	5	36	15.100	4.622	4.160
	"	7	30	14.300	4.881	4.393
	"	9	24	13.400	5.208	4.687
Bus	554642	1	66	97.100	5.712	5.141
	"	3	41	79.300	6.994	6.295
	"	5	32	72.900	7.608	6.847
	"	7	27	69.300	8.003	7.203
	"	9	22	65.700	8.442	7.598
Truck	421496	1	65	62.700	6.722	6.050
	"	3	36	49.200	8.567	7.710
	"	5	28	45.500	9.264	8.337
	"	7	23	43.200	9.757	8.781
	"	9	19	41.300	10.206	9.185
Tractomula	730273	1	56	88.700	8.233	7.410
	"	3	29	65.200	11.201	10.080
	"	5	22	59.100	12.357	11.121
	"	7	17	54.800	13.326	11.994
	"	9	13	51.300	14.235	12.812

Notes: 1) Assuming the annual running Km in 1995 as shown in Annex Table 9-15.
2) The economic cost is estimated at 90% of the financial cost.

Annex Table 9-17. Depreciation and Interest Cost (Financial and Economic) - 1995

	Annual Km	Fin. Dep. Cost/Year	Fin. Dep. Cost/Km	Econ. Dep. Cost/Year	Econ. Dep. Cost/Km	Remarks
	19,500	226147	11.597	76.895	3.943	Depreciation
	16,400	"	13.789	"	4.689	Fin. 884768
Auto	15,100	"	14.977	"	5.092	Eco. 493863
	14,300	"	15.814	"	5.377	CRF Fin. n=13, i=24%, 0.25560
	13,400	"	16.877	"	5.738	Eco. n=13, i=12%, 0.15568
	97,100	299148	3.081	155.066	1.597	Depreciation
	79,300	"	3.772	"	1.955	Fin. 1101349
Bus	72,900	"	4.104	"	2.127	Econ. 876177
	69,300	"	4.317	"	2.238	CRF. Fin. n=10, i=24%, 0.27162
	65,700	"	4.553	"	2.360	Econ. n=10, i=12%, 0.17698
	62,700	235908	3.762	108.432	1.729	Depreciation
	49,200	"	4.795	"	2.204	Fin. 1203122
Truck	45,500	"	5.185	"	2.383	Eco. 786082
	43,200	"	5.461	"	2.510	CRF Fin. n=18, i=24%, 0.24510
	41,300	"	5.712	"	2.625	Eco. n=18, i=12%, 0.13794
	88,700	896919	10.112	459.794	5.184	Depreciation
	65,200	"	13.756	"	7.052	Fin. 3509071
Tractomula	59,100	"	15.176	"	7.780	Eco. 2953458
	54,800	"	16.367	"	8.390	CRF. Fin. n=13, i=24%, 0.25560
	51,300	"	17.484	"	8.963	Eco. n=13, i=12%, 0.15568

Sources: Depreciable values from Annex Tables 9-2 and 9-3. The calculation method is same as in Annnex Table 9-8.

Annex Table 9-18. Financial Cost of Vehicle Operation (1995)

	Auto (DDA)	Bus (P600)	Truck (D600)	Tractomula (900TM)
Gr=1% (V)	(67)	(66)	(65)	(56)
Fuel	1.311	5.014	5.698	12.080
Eng. Oil	0.262	1.254	0.855	0.906
Tyres	0.452	1.543	2.018	6.439
Maintenance	1.397	5.315	5.233	8.462
Dep & Int	11.597	3.081	3.762	10.112
Overhead	3.579	5.712	6.722	8.233
Total	18.598	21.919	24.288	46.232
Gr=3% (V)	(45)	(41)	(36)	(29)
Fuel	1.377	5.819	6.612	14.282
Eng. Oil	0.275	1.445	0.992	1.071
Tyres	0.283	0.900	1.033	2.989
Maintenance	1.297	5.431	5.155	7.830
Dep & Int	13.789	3.772	4.795	13.756
Overhead	4.256	6.994	8.567	11.201
Total	21.277	24.361	27.154	51.129
Gr=5% (V)	(36)	(32)	(28)	(22)
Fuel	1.463	6.648	7.554	16.619
Eng. Oil	0.293	1.662	1.133	1.246
Tyres	0.226	0.704	0.766	2.203
Maintenance	1.299	5.975	5.629	8.547
Dep & Int	14.977	4.104	5.185	15.176
Overhead	4.622	7.608	9.264	12.357
Total	22.880	26.701	29.531	56.148
Gr=7% (V)	(30)	(27)	(23)	(17)
Fuel	1.573	7.653	8.697	19.307
Eng. Oil	0.315	1.913	1.305	1.448
Tyres	0.188	0.589	0.634	1.781
Maintenance	1.333	6.669	6.272	9.507
Dep & Int	15.814	4.317	5.461	16.367
Overhead	4.881	8.003	9.757	13.326
Total	24.104	29.144	32.126	61.736
Gr=9% (V)	(24)	(22)	(19)	(13)
Fuel	1.728	8.661	9.842	22.046
Eng. Oil	0.346	2.165	1.476	1.653
Tyres	0.164	0.470	0.542	1.481
Maintenance	1.393	7.427	7.004	10.634
Dep & Int	16.877	4.553	5.712	17.484
Overhead	5.208	8.442	10.206	14.235
Total	25.716	31.718	34.782	67.533

Annex Table 9-19 Economic Cost of Vehicle Operation - 1995

	Auto (DDA)	Bus (P600)	Truck (D600)	Tractomula (900TM)
Gr=1% (V)	(67)	(66)	(65)	(56)
Fuel	1.843	7.050	8.011	16.983
Eng. Oil	0.367	1.763	1.202	1.274
Tyres	0.452	1.543	2.018	6.439
Maintenance	1.257	4.784	4.710	7.616
Dep & Int 12%	3.943	1.579	1.729	5.184
Overhead	3.221	5.141	6.050	7.410
Total	11.083	21.860	23.720	44.906
Gr=3% (V)	(45)	(41)	(36)	(29)
Fuel	1.936	8.180	9.296	20.079
Eng. Oil	0.387	2.045	1.394	1.506
Tyres	0.283	0.900	1.033	2.989
Maintenance	1.167	4.888	4.640	7.047
Dep & Int	4.689	1.955	2.204	7.052
Overhead	3.830	6.295	7.710	10.080
Total	12.292	24.263	26.277	48.753
Gr=5% (V)	(36)	(32)	(28)	(22)
Fuel	2.057	9.346	10.620	23.364
Eng. Oil	0.411	2.337	1.593	1.752
Tyres	0.226	0.704	0.766	2.203
Maintenance	1.169	5.378	5.066	7.692
Dep & Int	5.092	2.127	2.380	7.780
Overhead	4.160	6.847	8.337	11.121
Total	13.115	26.739	28.762	53.912
Gr=7% (V)	(30)	(27)	(23)	(17)
Fuel	2.211	10.760	12.227	27.143
Eng. Oil	0.442	2.690	1.834	2.036
Tyres	0.188	0.589	0.634	1.781
Maintenance	1.200	6.002	5.645	8.556
Dep & Int	5.377	2.238	2.510	8.390
Overhead	4.393	7.203	8.781	11.994
Total	13.811	29.482	31.631	59.900
Gr=9% (V)	(24)	(22)	(19)	(13)
Fuel	2.429	12.176	13.836	30.993
Eng. Oil	0.486	3.044	2.075	2.324
Tyres	0.164	0.470	0.542	1.481
Maintenance	1.254	6.684	6.304	9.571
Dep & Int	5.738	2.360	2.625	8.963
Overhead	4.687	7.298	9.185	12.812
Total	14.758	32.032	34.567	66.144

Annex 9-2 Vehicle Cost of a "Stop and Go" and a "Slow Down"

Annex Table 9-20 presents the speed, running cost, speed change cost, and the cost ratio of a speed change cycle over the running of 1 Km. Based on these studies, it is determined that 30% of the vehicle running cost should be added to the traffic cost when a vehicle stops at one curve on flat road.

However, the project road runs through the mountain area with frequent curves, with changing gradients. On the project road, the fuel consumption rate is summarized as in Annex Table 9-21 from which it is found that the fuel consumption rises by 70% or by more than 150% when the gradient goes up to 5 - 9%. Accordingly, it is considered better to increase the 30% figure above by adjusting for the extra consumption rate of fuel. It is determined that a vehicle needs additional fuel by as much as 100% to return to the normal speed after stopping at a sharp curve with a gradient of 5 - 10%.

The percent of the cost of fuel consumption in the total VOC is obtained from Annex Table 9-13 and applied as follows to estimate the cost of "stop and go." The resultant ratio is used to estimate the cost of "stop and go" at a sharp curve which is the subject of the improvement plans.

Auto	0.30 x 1.16 = 0.348
Bus	0.30 x 1.37 = 0.411
Truck	0.30 x 1.39 = 0.417
Tractomula	0.30 x 1.45 = 0.435

The cost is high because of large gradient at the curve. Also it should be noted that the figure would cover actual situation of slowing down of the vehicle in the other lane and queuing movement, which are not quantified independently.

The same source referred to in the Annex Table 9-20 presents the tables of changes in vehicle operating cost responding to the speed change cycles. By reviewing the tables, it is determined that the ratio in cost of a cycle of speed change --- from the normal running to slow down to the half of the normal speed and to return to the normal running --- compared to the cost of "stop and go" is 60%. Accordingly, the ratio of a "slow down" cost to the VOC of 1 Km is as follows:

Auto	0.348 x 0.6 = 0.209
Bus	0.411 x 0.6 = 0.247
Truck	0.417 x 0.6 = 0.250
Tractomula	0.435 x 0.6 = 0.261

Annex Table 9-20. Running Cost and Excess Cost of Speed-Change Cycles

	(1) Speed		(2) Running Cost 1)	(3)	(4) Speed Ch. Cost.	(5) Ratio of 1 cy/Km	
	Km/h	M/h	US$/'000M	US$/'000Km	US$/'000 cy 1)	(4)/(3)	
Passenger Car (4 kips)	8	5	59.36	37.10	0.86	0.023	0.300
	16	10	44.93	28.08	1.84	0.065	
	32	20	37.09	23.18	4.95	0.214	
	48	30	34.91	21.82	9.36	0.429	
	64	40	35.03	21.89	15.76	0.720	
Truck (12 kips)	8	5	99.08	61.93	1.92	0.031	0.300
	16	10	77.68	48.55	4.73	0.097	
	32	20	65.90	41.19	12.57	0.305	
	48	30	65.11	40.69	23.76	0.584	
	64	40	68.87	43.04	39.92	0.928	
Trailer (50 kips)	8	5	166.72	104.20	9.08	0.087	0.300
	16	10	120.20	75.13	21.00	0.280	
	32	20	95.81	59.88	52.51	0.877	
	48	30	93.02	58.14	102.21	1.759	
	64	40	99.85	62.41	178.00	2.853	

Source: Robley Winfrev, Economic Analysis for Highways (International Textbook Co., Pen., 1969), Apendix A - - - Tables of the Running cost of Motor Vehicles.

Notes: The cost includes fuel, oil, tyres, maintenance and depreciation. It is shown in U.S. Dollars.

Annex Table 9-21. Fuel Consumption Rates by Gradient and by Speed. (l/'000 Km)

Average Speed on the Road. (1500 - 2500 above sea level)																				
Vehicles	Gradient	(69)	(59)	(49)	(48)	(40)	(39)	(38)	(35)	(31)	(30)	(29)	(28)	(25)	(21)	(20)	(18)	(15)	(10)	(8)
Auto	1 %	152.1	121.3	103.9			99.9					109.3				123.7				
	3				153.9			151.9					163.2				188.0			226.1
	5					159.4					168.1					190.2			225.6	
	7								167.8					182.5				210.6		
	9									178.3					198.4					231.9
Vehicles	Gradient	(68)	(58)	(48)	(44)	(38)	(36)	(34)	(31)	(28)	(27)	(26)	(24)	(21)	(18)	(16)	(11)	(8)		
Bus	1 %	571.0	442.8	370.5		354.0				393.4					426.5					
	3				643.9			663.1					749.5					903.3		
	5						734.0					794.6				947.6				
	7									836.5				913.7			1127.2			
	9								948.2					1027.9						
Vehicles	Gradient	(66)	(56)	(46)	(38)	(36)	(29)	(28)	(26)	(25)	(21)	(19)	(18)	(15)	(11)	(9)	(8)	(5)		
Truck	1 %	648.9	503.2	421.0		402.3			447.1			488.3								
	3				731.7			753.5					851.8				1026.4			
	5						834.1					902.9				1076.8				
	7									950.6				1038.3				1280.9		
	9										1077.5				1168.0					
Vehicles	Gradient	(57)	(47)	(37)	(30)	(27)	(23)	(20)	(18)	(17)	(14)	(13)	(10)	(5)						
Tr.mula	1 %	1375.7	1066.8	892.5		852.9				947.8										
	3				1580.5			1627.6					1839.8							
	5						1834.9					1986.4		2368.9						
	7								2110.4				2305.0							
	9										2413.6			2616.4						

Source: Summarized from the result of the traffic flow survey as presented in Chapter 5.

Notes: It is found that when the road has the gradient in the range of more than 5%, the rate of fuel consumption rises by approximately 70 - 120% from the road with 1%.

Annex 9-3 Estimates of Traffic Cost

The traffic cost is estimated for the sections as shown Table 9-5. The example of the steps are shown below. VOC per Km is shown in Annex Tables 9-13 and 9-19. Average ADT in 1983 and 1995 are shown below, as taken from Chapter 4. The ratio of increase per speed change cycle is estimated in Annex 9-2. The frequent times of "stop and go" by sebsection are shown in Annex Table 9-26, and are derived in Chapter 5. An example is shown afterwards.

	A D T	
Year	1983	1995
Auto	781	1,488
Bus	266	399
Truck	806	1,381
TMula	394	785
Total	2,247	4,053

	The ratio of increase in VOC per "stop and go" and "slow down"	
Auto	0.348	0.209
Bus	0.411	0.247
Truck	0.417	0.250
TMula	0.435	0.261

Annex Table 9-22 Vehicle Operation Economic Cost

	Vehicle Type	(Gradient) 1%	3%	5%	7%	9%
For the traffic in 1983	Auto	11.000	12.049	12.709	13.239	13.822
	Bus	21.977	23.991	26.310	28.872	31.564
	Truck	23.882	26.036	28.549	31.186	34.026
	Tractomula	45.198	48.392	53.423	59.043	65.218
For the traffic in 1995	Auto	11.083	12.292	13.115	13.811	14.758
	Bus	21.860	24.263	26.739	29.482	32.032
	Truck	23.720	26.277	28.762	31.631	34.567
	Tractomula	44.906	48.753	53.912	59.900	66.144

Source: Annex Tables 9-13 and 9-19

Example of Benefit Calculation in Subsection 4

Road Conditions of the Subsection 4

Existing route	:	Gradient	5%	0.4Km
			7%	0.4Km
		Total		0.8Km

Minimum Scale Improvement Plan (Plan-2)

Curves	:	Class A	1
		Class B	4
		Total	5

Medium Scale Improvement Plan (Plan-3)

		Gradient	7%	0.7Km
		Total		0.7Km

A. Traffic Cost for 1983 on the Subsection 4

VOC :	Auto	781 x (12.709 x 0.4 + 13.239 x 0.4)	= 8,106
	Bus	266 x (26.310 x 0.4 + 28.872 x 0.4)	= 5,871
	Truck	806 x (28.549 x 0.4 + 31.186 x 0.4)	= 19,258
	TMula	394 x (53.423 x 0.4 + 59.043 x 0.4)	= 17,724
		Total	50,959
		x	365
		=	18,600,035

(1) The Cost of "Stop and Go" and "Slow down"

There is only small difference between this VOC of a bus and that of a truck. Therefore, the VOC of buses are included in the VOC of trucks.

VOC at gradient 7% is applied for all curves.

	"Stop and Go"	"Slow down"	Total
vs^{Truck}_{Truck}	31.186x0.417=13.005	31.186x0.250=7.797	20.802
vs^{TMula}_{TMula}	59.043x0.435=25.684	59.043x0.261=15.410	41.094

The cost of "Stop and Go" and "Slow down" is multiplied by the number of occurence in the subsection and then multiplied by 365. Each stage of the improvement will result in the savings in the above cost. For the two improvement plans, the traffic costs for 1983 are as follows, respectively. The traffic costs for 1995 are calculated in the same way and the results are shown afterwards.

(2) The minimum scale improvement plan will result in the savings of the cost as follows:

No. of encountings		: The total cost of "stop and go"&"slow down"
Truck vs Trucks	62 x 20.802	= 1,289.72
TMula vs Trucks	44 x 41.094	= 1,808.14
TMula vs TMula	16 x 41.094	= 657.50
		3,755.36
		x 365
		≒ 1,371 thousand pesos per year

(3) The medium scale improvement plan has an alignment of 0.7Km with the gradient 7%. The traffic cost which will be saved is as follows:

Auto	781 x 13.239 x 0.7 =	7,238
Bus	266 x 28.877 x 0.7 =	5,376
Truck	806 x 31.186 x 0.7 =	17,595
TMula	394 x 59.043 x 0.7 =	16,284
	Total	46,493
	x	365
	=	16,969,945

B. Traffic Cost for 1995 on the Subsection 4

VOC : Auto	1,488 x (12.709 x 0.4 + 13.239 x 0.4)	= 16.026
Bus	399 x (26.310 x 0.4 + 28.872 x 0.4)	= 8,973
Truck	1,381 x (28.549 x 0.4 + 31.186 x 0.4)	= 33,361
TMula	785 x (53.423 x 0.4 + 59.043 x 0.4)	= 35,737
	Total	94,097
	x	365
	=	34,345,405

The cost of "Stop and Go" and "Slow down"

Truck vs Trucks	223 x	21.098	=	4,705
TMula vs Trucks	165 x	41.691	=	6,879
TMula vs TMula	74 x	41.691	=	3,085
		Total		14,669
			x	365
			≒	5,354,000

The traffic cost in the medium scale improvement plan

VOC : Auto	1,488 x 13.239 x 0.7	=	7,238
Bus	399 x 28.872 x 0.7	=	5,376
Truck	1,381 x 31.186 x 0.7	=	17,595
TMula	785 x 59.043 x 0.7	=	16,284
	Total		46,493
		x	365
		=	16,969,945

C. Savings in VOC

(Year)	(1983) $'000	(1995) $'000
Existing Status :	18,600 + 1,371 = 19,971	34,345 + 5,354 = 39,699
After the Minimum Scale Improvement Plan :	18,600 + 0 = 18,600 (Savings 1,371)	34,345 + 0 = 34,345 (Savings 5,354)
After the Medium Scale Improvement Plan :	16,970 + 0 = 16,970 (Savings 3,001)	31,431 + 0 = 31,431 (Savings 8,268)

The cost of these cases for 1983 and 1995 for all subsections are shown in Table 9-5. From 1983 through 1995 to 2005 the cost of traffic is assumed to increase at a constant rate of increase. They are put in the cost streams which in turn, through the comparison, results in the savings (benefits) or net cost and B.C. ratio, PW, and internal rate of return.

Annex Table 9-23 Frequent Times of "Stop and Go" by Subsection between Ibague and Calarca

No.	1983				1995			
	a	b	b'	c	a	b	b'	c
1	19	33	19	14	76	140	75	65
2	10	16	9	7	36	67	35	32
3	91	61	41	22	309	244	169	75
4	62	60	44	16	223	239	165	74
5	16	24	15	9	62	102	61	41
6	13	18	13	5	49	70	48	22
7	0	0	0	0	0	0	0	0
7	13	18	13	5	49	70	48	22
8	-	5	-	5	-	22	-	22
9	6	8	4	4	18	34	18	16
10	12	30	12	18	35	103	35	68
11	6	9	6	3	23	33	23	10
11	24	52	23	29	76	191	75	116
12	14	19	14	5	51	74	51	23
13	6	22	5	17	19	95	19	76
14	40	69	40	29	160	300	159	141
15	-	7	-	7	-	32	-	32
16	-	3	-	3	-	13	-	13
17	24	17	16	5	81	62	62	24
18	20	49	19	30	74	222	83	139
18	110	80	45	35	411	393	190	203
18	101	60	32	28	370	279	136	143
18	8	58	8	50	31	291	31	260
18	27	46	27	19	60	126	61	65
18	128	133	87	46	468	536	328	208

Source: From Chapter 5.

Notes : a for buse and truck, b and c for tractomulas
b' is the balance between b and c

Annex Table 9-24 Summary of Benefit Cost Analysis

($'000 for Cost and Benefit)

Subsection / Alternative	01 P-2	01 P-3	02 P-2	02 P-3	03 P-2	03 P-3	04 P-2	04 P-3	05 P-2	05 P-3	06 P-2	06 P-3
PW Cost (i=12%)	4,387.0		8,134.0	23,378.2	45,415.1		26,356.5	37,238.1	7,359.7		2,811.7	59,718.2
PW Ben. (")	12,917.9		6,177.6	25,533.1	27,552.8		25,564.9	38,059.0	9,656.9		6,889.5	36,525.0
PW B-C (")	8,530.9		-1,956.4	2,155.1	-17,862.3		- 791.6	820.9	2,297.1		4,077.8	-23,193.2
B/C (")	2.945		0.759	1.092	0.607		0.970	1.022	1.312		2.45	0.612
IRR %	27.50		9.10	13.16	6.88		11.66	12.28	15.17		24.50	5.86

Subsection / Alternative	07 P-2	07 P-3	08 P-2	08 P-3	09 P-2	09 P-3	10 P-2	10 P-3	11 P-2	11 P-3	12 P-2	12 P-3
PW Cost (i=12%)		224,451.0	1,046.4	74,093.0	2,566.2	79,443.7	19,744.7	550,288.7	17,224.4	17,250.8	5,045.5	
PW Ben. (")		79,299.0	1,590.6	68,138.2	3,122.5	33,899.2	8,849.8	166,199.0	3,249.9	37,992.9	7,247.1	
W B-C (")		-145,152.0	544.2	-5,955.2	556.3	-45,544.5	-10,894.8	-384,029.7	-13,974.5	20,742.1	2,201.6	
B/C (")		0.35	1.52	0.92	1.217	0.427	0.448	0.302	0.189	2.202	1.436	
IRR %		1.10	16.98	10.84	14.26	3.69	3.99	1.58	0.10	25.20	16.40	

Subsection / Alternative	13 P-2	13 P-3	14 P-2	14 P-3	15 P-2	15 P-3	16 P-2	16 P-3	17 P-2	17 P-3	18 P-2	18 P-3
PW Cost (i=12%)	6,587.7	291,363.1	8,011.6		921.7	92,750.4	715.5		12,300.5	119,371.4	157,404.4	
PW Ben. (")	7,557.1	175,413.7	27,551.1		2,309.4	70,560.4	940.2		9,226.8	146,668.5	176,323.8	
W B-C (")	969.4	-115,949.4	19,539.4		1,387.7	-22,190.0	224.7		-3,073.7	27,297.2	18,919.4	
B/C (")	1.147	0.602	3.439		2.506	0.761	1.314		0.750	1.229	1.120	
IRR %	13.55	6.42	30.55		24.25	8.60	15.15		8.95	14.94	13.20	

Subsection / Alternative	Total(million) P-2 & P-3
PW Cost (i=12%)	462.1
PW Ben. (")	544.5
W B-C (")	82.4
B/C (")	1.178
IRR	14.06

Remarks:

- P-2 : Minimum scale improvement plan
  P-3 : Medium scale improvement plan
- P-2 and P-3 are recomendable from the economic viewpoint.
- The detailed engineering study is assumed to start after 1983 and the work after 1985, the timing is suggested by the Colombian MOPT.
- No residual value is assumed at the year 2005, the final year of the project cycle life. The benefit stream is estimated up to 2005 by applying the same average annual ratio of increase of the benefit during the years 1983 and 1995 for the years from 1996 to 2000. After 2001, no increase is assumed in calculation.
- P-3 does not include the savings in the cost of preventive work against slope failures along the existing road segment.

Annex Table 9-25 Results of B.C. Analysis: Large Scale Improvement Plans

(in $ million)

Subsection		Girardot Bypass	Ibague Bypass	Coello Bypass	La Linea Bypass
PW C	i=12%	557.1	312.7	1,109.4	1510.1
PW B	"	2,391.1	428.2	-	-
PW Net	"	1,834.0	115.5	-	-
B/C	"	4.29	1.37	-	-
IRR	%	36.5	16.5	-	-

Notes: For the cases of the Girardot and Ibague, the savings in the time value and traffic congestion cost on the road in the urban area are included (Referring to Annex 9-4) and 9-5. Coello and La Linea bypasses result in no savings in the traffic cost because the distance and the traffic cost are larger for the new bypasses than the existing roads.

Annex Table 9-26 Results of B.C Analysis : Sensitivity Test

Variation	01		02		03		04		05		06	
	P2	P3	P2	P3	P2	P3	P2	P3	P2	P3	P2	P3
Cx0.8 B/C i=12%	3.68		0.95	1.37	0.76		1.21	1.28	1.64		3.06	
IRR	32.15		11.43	16.37	9.07		14.25	15.28	18.07		28.75	
Cx1.2 B/C i=12%	2.45		0.63	0.91	0.51		0.81	0.85	1.09		2.04	
IRR	24.20		7.33	10.81	5.21		9.71	10.05	13.00		21.45	

Variation	07		08		09		10		11		12	
	P2	P3	P2	P3	P2	P3	P2	P3	P2	P3	P2	P3
Cx0.8 B/C i=12%			1.90		1.52		0.56		0.24	2.59	1.80	
IRR			20.50		17.07		6.00			29.75	19.51	
Cx1.2 B/C i=12%			1.27		1.01		0.37		0.16	1.73	1.20	
IRR			14.70		12.15		2.44			20.95	14.10	

Variation	13		14		15		16		17		18	
	P2	P3	P2	P3	P2	P3	P2	P3	P2	P3	P2	P3
Cx0.8 B/C i=12%	1.43		4.30		3.13		1.64		0.94	1.54	1.40	
IRR	16.28		35.65		28.25		18.03		11.29	18.49	17.00	
Cx1.2 B/C i=12%	0.96		2.87		2.09		1.10		0.63	1.02	0.93	
IRR	11.51		26.90		21.35		13.01		7.17	12.32	11.50	

Variation	Total 1		Total
	P2	P3	Selected P2 & P3
Cx0.8 B/C i=12%	1.29	1.57	1.473
IRR	15.03	18.78	17.12
Cx1.2 B/C i=12%	0.86	1.05	0.982
IRR	10.36	12.65	11.78

Annex Table 9-27 LARGE SCALE IMPROVEMENT PLANS : Economic Cost

(UNIT: $'000)

Section Item	Girardot-Espinal 1. (27.1 km)	Ibague 2. (6.6 km)	Coello 3. (24.0 km)	La Linea 4. (29.9 km)
a. Local Component	213,495	129,835	571,305	663,906
b. Foreign Component	285,534	131,346	536,946	651,884
c. Total (a + b)	499,029	261,181	1,108,251	1,315,790
d. w/Ovhd & Prof.	629,749	329,190	1,398,112	1,661,327
e. Supervision (d x 0.05)	32,680	17,002	72,465	86,385
f. Contingency (d + e)x0.10	66,243	34,619	147,057	174,772
g. Total (d + e + f)	728,672	380,811	1,617,634	1,922,484
h. Detail Eng. (d x 0.05)	32,680	17,002	72,465	86,385
i. Contingency (h x 0.10)	3,268	1,700	7,246	8,639
j. Total (h + i)	35,948	18,702	79,711	95,024
k. Land Acquisition	(48,780)	(11,290)	-	-
l. Grand Total (g + j)	764,620	399,513	1,697,345	2,017,508

Note: d. is with overhead and profit (e x 1.25)
Refer to Annex Table 8-3-4

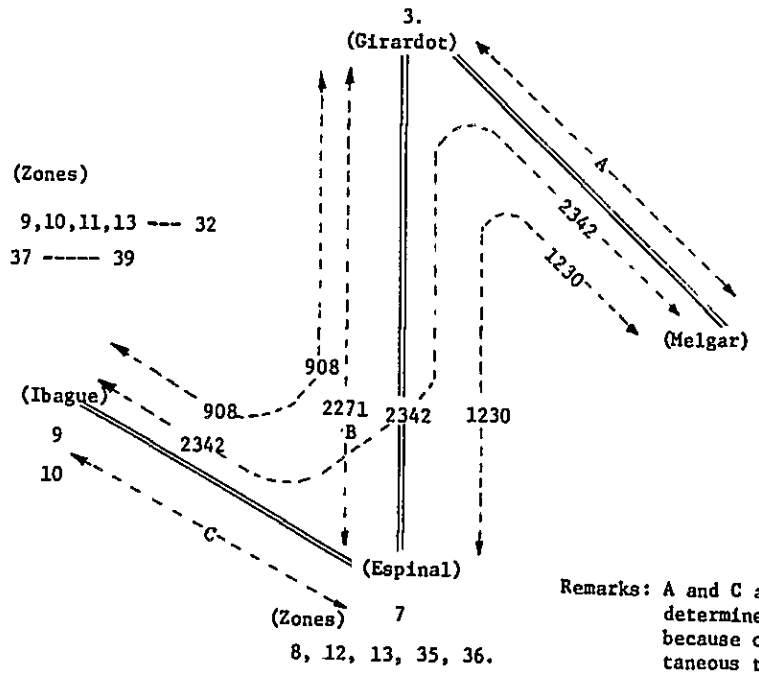
Annex 9-4 Girardot-Espinal Bypass Plans

(1) Traffic Diversion

Traffic diversion to the proposed bypass plan is estimated by studying the O-D distribution of the traffic flow on the existing road. The steps of the estimate is stated as follows:

1) The Origin and Destination Distribution by the Survey in 1980

The OD survey conducted in 1980 presents the trip distribution which is summarized as in the following Annex Fig.9-1.



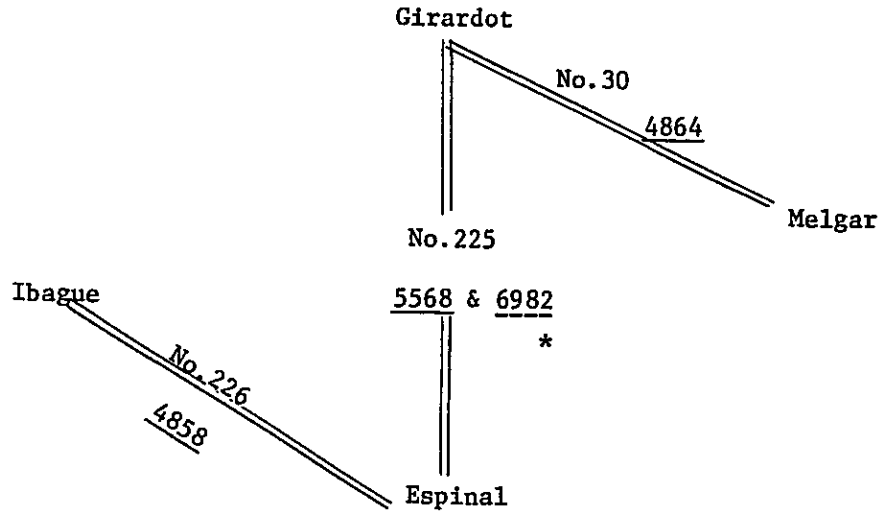
Remarks: A and C are not determined by OD tables because of no simultaneous traffic counting on the date of the OD interviewing at the Stations A and C. Buses are included for each figure.

(Unit: Vehicles/day)

Annex Fig. 9-1 O-D Distribution, 1980

2) Traffic Volumes by manual counting, 1980

According to the "Volumenes de Transito Conteos Manuales, 1980 (MOPT Direccion de Carreteras, Oficina de Programacion de Carreteras) the ADT (Transito promedio diario semanal) is registered as follows. The traffic volume for 24 hours when the OD interview survey was conducted was 6982 at the point between Girardot and Melgar.



Remarks: * 6982 is the volume counted on the day (24 hours) of O-D interviewing in 1980.

Unit vehicles/day in 1980

Annex Fig. 9-2 Traffic Volumes by Manual Counting: ADT

The ratio of 5568/6982=0.7975 indicates an adjustment coefficient which should be applied to the all O-D trips in order to adjust to the ADT as underlined above in Annex Fig.9-2. When the OD trips are modified after the adjustment, the balance between the ADT and the total of the adjusted OD trips is assumed to be the short distant trips which would remain on the existing road.

3) Diverting Traffic After Adjustment, 1980

i) Girardot Bypass

It is found from the OD Table in 1980 that the diverting traffic to the bypass is as follows:

Sm	1115
B	578
T2	1381
TM	498
Tot	3572

Adjusted by multiplying the ratio of 0.7975, the diverted traffic will be as follows. Also it is assumed that all buses will enter the urban area to let the passengers on and off.

The total of OD trips per day adjusted

Sm 1115x0.7975= 889
B 0x0.7975= 0
T2 1381x0.7975=1101
Tm 498x0.7975= 397
Tot 2994x0.7975=2387

The traffic which will divert to the new Bogota-Medellin Road is found as follows which is to be deducted from the ADT and above adjusted traffic, respectively.

	Bogota-Medellin	Adjusted OD Trips
Sm	17x0.7975= 13	889-13= 876
B	14x0.7975= 11	0
T2	89x0.7975= 71	1101-71=1030
Tm	66x0.7975= 53	397-53= 344
Tot	186x0.7975=148	2387-148=2250

(I) Melgar-Girardot:

	ADT Adjusted	Traffic Remaining on the Existing Road
Sm	2192-13=2179	2179-876=1303
B	681-11= 670	670- 0= 670
T2	1459-71=1388	1388-1030=358
Tm	532-53= 479	479-344= 135
Tot	4864-148=4716	4716-2250=2466

(II) Girordot-Espinal

	ADT Adjusted	Traffic Remaining on the Existing Road
Sm	2673-13=2660	2660- 876=1784
B	668-11= 657	657- 0= 657
T2	1670-71=1599	1599-1030= 569
Tm	557-53= 504	504- 344= 160
Tot	5568-148=5420	5420-2250=3170

ii) Espinal Bypass

The diverting traffic in 1980 is as follows according to the OD table in 1980:

Sm	1155
B	578
T2	1084
Tm	433
Tot	3250

Adjusted by multiplying the ratio of 0.7975, the diverted traffic will be as follows. Also it is assumed that all buses will enter the urban area to let the passengers on and off.

The total of OD trips adjusted

Sm	1155x0.7975= 921
B	- - = 0
T2	1084x0.7975= 864
Tm	433x0.7975= 345
Tot	3250x0.7975=2130

The traffic which will divert to the Bogota-Medellin Road is to be deducted from the above ADT adjusted traffic, respectively. The total of OD trips adjusted after the Medellin Bogota traffic deducted.

Sm	921-13= 908
B	= 0
T2	864-71= 793
Tm	345-53= 292
Tot	2130-148=1993

(III) Girardot-Espinal

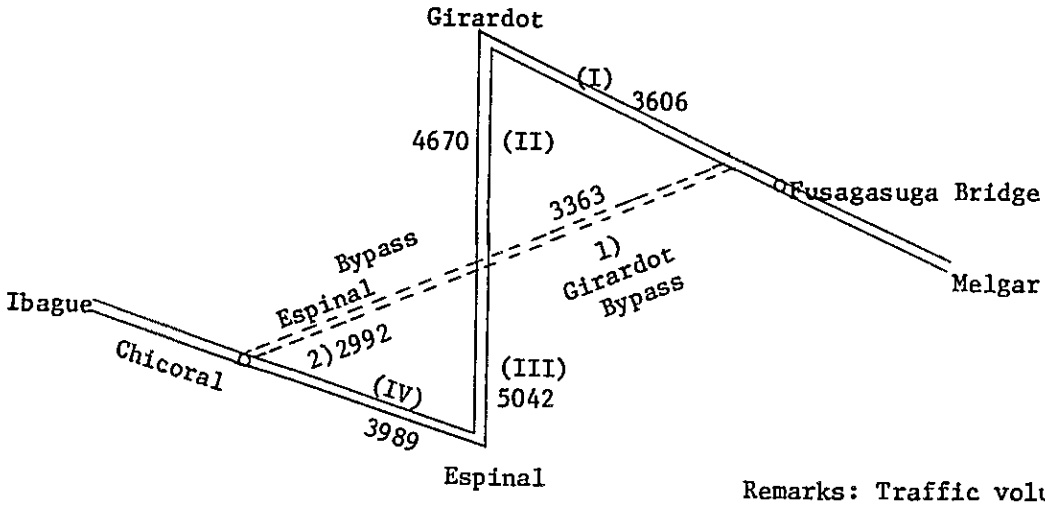
	ADT Adjusted	Traffic Remaining on the Existing Road
Sm	2673-13=2660	2660-908=1752
B	668-11= 657	657- 0= 657
T2	1670-71=1599	1599-793= 806
Tm	557-53= 504	504-292= 212
Tot	5568-148=5420	5420-1993=3427

(IV) Espinal-Ibague

	ADT Adjusted	Traffic Remaining on the Existing Road
Sm	2380-13=2367	2367-908=1459
B	632-11= 621	621- 0= 621
T2	1360-71=1289	1289-793= 496
Tm	486-53= 433	433-292= 141
Tot	4858-148=4710	4710-1993=2717

(2) Diverted Traffic Forecasted

By assuming the same growth rate of traffic as shown in 4-6 of Chart 4 and Annex Table 4-4, the traffic on each section is forecasted as in the following Annex Table 9-28. For the traffic in 1988, the following Annex Fig.9-3 is prepared.



Remarks: Traffic volume is ADT in 1988.

Annex Fig.9-3 Sections with Bypasses and Forecasted Traffic in 1988

(3) Bypass Alternatives and Cost

Alternative routes of the bypass plan for Girardot-EP inal area are shown in Annex Fig. 9-4 and Annex Table 9-29. In Annex Table 2 the construction cost is approximated by the average costs which are calculated from the estimated cost in Chapter 8.

(4) Savings in Traffic Cost Associated with Bypass Plans

The savings in traffic cost, which will be realized by the construction of a bypass are estimated. The diverted traffic is assumed to be equal for the three routes of A-1, A-2, and A-3 and the other three routes of B-1, B-2 and B-3, respectively. The magnitude of the Savings in VOC depends mostly on the savings in the road distance. The calculation is shown in Annex Tables 9-31 and 9-32.

(5) Economic Evaluation

Economic evaluation is conducted to find the priority order among the alternatives. The result is shown in Annex Table 9-33. For the Girardot Bypass plans of A-1, A-2 and A-3, the A-1 route is recommended since it will result in the largest distance reduction and net savings in VOC. For the Espinal Bypass plans of B-1, B-2 and B-3, the B-1 route is recommended by the same reason.

It is to be noted that B-2 presents the figures very close to those of B-1.

Annex Table 9-28 Forecasted Traffic on the Sections:

Section	Year	1980	1988	1990	('00/80)	2000
1) Melgar-Girardot Bypass	Sm	876	1347	1501	2.934	2570
	B	0	0	0		0
	T2	1030	1470	1607	2.435	2508
	Tm	344	546	613	3.171	1091
	Tot	2250	3363	3721		6169
2) Girardot-Espinal Bypass	Sm	908	1397	1555	2.934	2664
	B	0	0	0		0
	T2	793	1132	1237	2.435	1931
	Tm	292	463	520	3.171	926
	Tot	1993	2992	3312		5521
(I) Melgar-Girardot Existing Road	Sm	1303	2004	2232	2.934	3823
	B	670	877	939	1.963	1315
	T2	358	511	558	2.435	872
	Tm	135	214	240	3.171	428
	Tot	2466	3606	3969		6438
(II) Girardot-Espinal Existing Road	Sm	1784	2744	3056	2.934	5234
	B	657	860	920	1.963	1290
	T2	569	812	888	2.435	1386
	Tm	160	254	285	3.171	507
	Tot	3170	4670	5149		8417
(III) Girardot-Espinal Existing Road	Sm	1752	2695	3001	2.934	5140
	B	657	860	920	1.963	1290
	T2	806	1151	1257	2.435	1963
	Tm	212	336	378	3.171	672
	Tot	3427	5042	5556		9065
(IV) Espinal-Chicoral Existing Road	Sm	1459	2244	2499	2.934	4281
	B	621	813	870	1.963	1219
	T2	496	708	774	2.435	1208
	Tm	141	224	251	3.171	447
	Tot	2717	3989	4394		7155

Remarks: The total is the summation of four vehicle types. It is not controled by the growth rate of 5% p.a. since the buses are not included in the bypasses.

Buses are assumed to pass through the existing road to let the passengers on and off in the urban area.

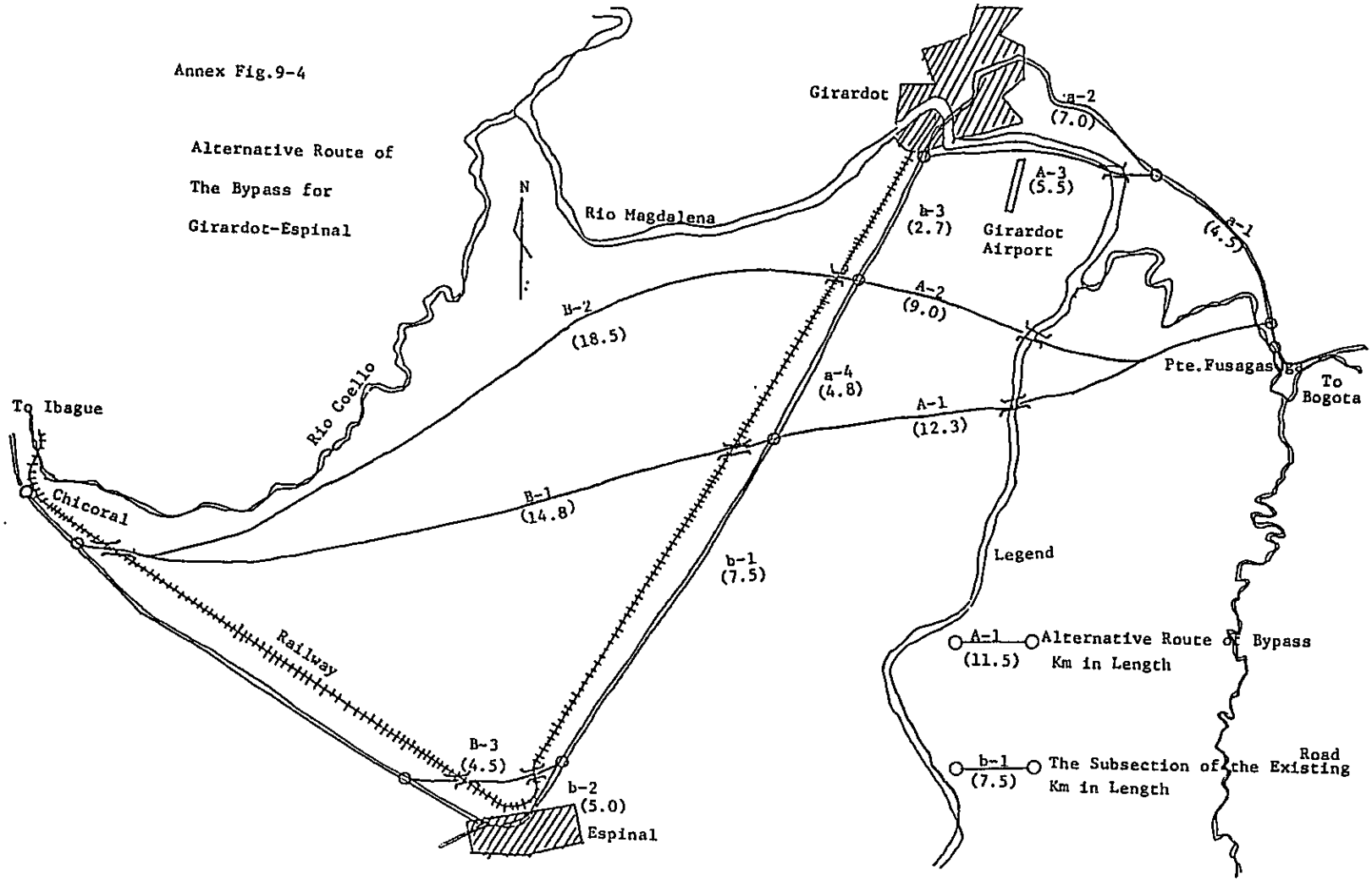
Annex Table 9-29 Length of the Bypass Plans and the Existing Road and Basic Criteria

Bypass Route		Eixsting Road	Savings in Distance	Basic Criteria
Alternative	Km	Km	Km	
A-1	12.3	19.0	6.7	1. Average height 0.8 m
A-2	9.0	14.2	5.2	2. Carriageway width 13.0 m
A-3	5.5	7.0	1.5	paved lanes 3.5 m x 2
B-1	14.8	21.0	6.2	3. Slope gradient 1:3
B-2	18.5	25.8	7.3	4. Transportation of
B-3	4.5	5.0	0.5	Embankment material 10 km
A-1 / B-1 1)	27.1	40.0	12.9	5. Pavement thickness
A-2 / B-2 2)	27.5	40.0	12.5	Subbase 20 cm
				Base 15 cm
				Asphalt Concrete 5 cm

Notes: 1) Combination of A-1 and B-1
2) Combination of A-2 and B-2

Annex Fig.9-4

Alternative Route of
The Bypass for
Girardot-Espinal



If the joint feature of As and Bs are considered, the combination of A-1 and B-1 is economically more viable than the combination of A-2 and B-2, although the difference is quite modest or that of A-3 and B-3.

Annex Table 9-30

CONSTRUCTION COST: Girardot Bypass Plans

Item	A1 - B1					A2 - B2					A3					B3				
	Q'ty Unit	FC	LC	TAX	TOTAL	Q'ty Unit	FC	LC	TAX	TOTAL	Q'ty Unit	FC	LC	TAX	TOTAL	Q'ty Unit	FC	LC	TAX	TOTAL
(1) Earth Work	266,660 m3	15,868	9,061	2,779	27,708	280,400 m3	16,689	9,531	2,922	29,142	54,100 m3	3,220	1,839	564	5,623	44,300 m3	2,636	1,506	461	4,603
(2) Pavement Work	189,700 m2	116,977	83,941	25,676	226,594	199,500 m2	123,017	88,275	27,002	238,294	38,500 m2	23,740	17,036	5,211	45,987	31,500 m2	19,424	13,938	4,263	37,625
(3) Structure	27.1 km	14,814	22,890	2,127	39,831	28.5 km	15,536	24,007	2,231	41,774	5.5 km	2,835	4,392	409	7,636	4.5 km	3,114	4,764	436	8,314
(4) Bridge Work	unit																			
L = 5 m	6 unit	1,758	2,759	261	4,778	3 unit	879	1,380	131	2,390	1 unit	293	460	43	796	1 unit	293	460	43	796
L = 10 m	2 "	1,161	1,861	183	3,205	2 unit	1,161	1,861	182	3,204	0	0	0	0	0	2 "	1,161	1,861	182	3,204
L = 40 m	1 "	5,208	5,757	1,268	12,233	1 unit	5,208	5,757	1,268	12,233	0	0	0	0	0	0	0	0	0	0
L = 110 m	1 "	27,003	20,866	5,235	53,104	1 unit	27,003	20,866	5,235	53,104	0	0	0	0	0	0	0	0	0	0
L = 260 m	1 "	102,745	66,360	13,840	182,945	1 unit	102,745	66,360	13,840	182,945	1 unit	102,745	66,360	13,840	182,945	0	0	0	0	0
(5) Sub-total		285,534	213,495	51,369	550,398		292,238	218,037	52,811	563,086		132,833	90,087	20,067	242,987		26,628	22,529	5,385	54,542
(6) w/Overhead & Profit	(5)x1.25	383,574	246,175	58,249	687,998		392,538	251,470	59,850	703,858		176,115	104,515	23,104	303,734		36,344	25,768	6,066	68,178
(7) Supervision	(6)x0.05	26,144	6,536	1,720	34,400		26,747	6,687	1,759	35,193		11,542	2,886	759	15,187		2,591	648	170	3,409
(8) Contingency	[(6)+(7)] x 0.10	40,972	25,271	5,997	72,240		41,928	25,816	6,161	73,905		18,766	10,740	2,386	31,892		3,894	2,642	624	7,159
(9) Total	(6)+(7) +(8)	450,690	277,982	65,966	794,638		461,213	283,973	67,770	812,956		206,423	118,141	26,249	350,813		42,829	29,058	6,859	78,746
(10) Detailed Eng. w/ Contingency	(7)x1.10	28,758	7,190	1,892	37,840		29,422	7,355	1,935	38,712		12,696	3,175	835	16,706		2,850	713	187	3,750
(11) Land Acquisition	27.1 km $600,000 /ha	-	47,780	-	48,780	28.5 km	-	51,300	-	51,300	5.5 km	-	9,900	-	9,900	4.5 km	-	8,100	-	8,100
(12) Grand Total		479,448	333,952	67,858	881,258		490,635	342,628	69,705	902,968		219,119	131,216	27,084	377,419		45,679	37,871	7,046	90,596
(13) Economic Cost		479,448	333,952	-	813,400		490,635	342,628	-	833,263		219,119	131,216	-	350,335		45,679	37,871	-	83,550

Annex Table 9-31

Girardot Bypass: Savings in VOC

1) Savings per day in 1988	A-1 Road Length Reduction 6.7Km	A-2 Road Length Reduction 5.2Km	A-3 Road Length Reduction 1.5Km	
(1) Diverted Traffic A 1,347 @11.000 T2 1,470 @23.882 Tm 546 @45.198 Total 3,363	6.7= 99,274 x6.7=235,214 x6.7=165,343 499,831/day	x5.2= 77,048 x5.2=182,554 x5.2=128,326 387,928/day	x1.5= 22,226 x1.5= 52,660 x1.5= 37,017 111,903/day	Refer to Table 9-3 and Annex 9-1.
(2) Additional VOC on the Road in the Urban Area A 1,347 @11.000 T2 1,470 @23.882 Tm 546 @49.356 Total 3,363	x2x0.3= 8,890 x2x0.3=21,064 x2x0.3=49,356 79,310/day	x2x0.3= 8,890 x2x0.3=21,064 x2x0.3=49,356 79,310/day	x2x0.3= 8,890 x2x0.3=21,064 x2x0.3=49,356 79,310/day	Additional VOC:30% The Road in the Urban Area 2.0 Km. (Refer to Annex 9-4)
(3) Savings in VOC for Intra-urban and Local Traffic Sm 2,000 L 1,000	x2x0.318=1,272 x2x0.488= 976 2,246/day	x2x0.318 x2x0.488 2,246/day	x2x0.318 x2x0.488 2,246/day	Reduced congestion will result in the increase of V=27 to V=30 on the road of 2 Km (Refer to Annex 9-4)
(4) Time Savings for Passengers of the Intra-urban Traffic Sm 2,000 x 0.37	= 740/day	740/day	740/day	V=27 to V=30 on the road of 2 Km. (Refer to Annex 9-4)
2) Savings in 1988				
(1) Diverted Traffic	499,831+79,310=579,141 579,141x365=211,386,000	387,928+79,310=467,238 467,238x365=170,541,000	111,903+79,310=191,213 191,213x365=69,792,745	
(2) Intra-urban Traffic	2,246+740=2,986 2,986x365=1,089,890	1,089,890	1,089,890	
(3) (1)+(2) Total in 1988	212,476,000	171,631,000	70,883,000	

Annex Table 9-32

Espinal Bypass: Savings in VOC

	B-1	B-2	B-3	
1) Savings per day in 1988	Road Length Reduction 6.2Km	Road Length Reduction 7.3Km	Road Length Reduction 0.5Km	
(1) Diverted Traffic				Refer to Table 9-3 and Annex 9-1.
A 1,397 @11.000	x6.2= 95,275	x7.3= 112,179	x0.5= 7,684	
T2 1,132 @23.882	x6.2=167,613	x7.3= 197,351	x0.5= 13,517	
Tm 463 @45.198	x6.2=129,745	x7.3= 152,765	x0.5= 10,463	
2,992	392,633/day	462,295/day	31,664/day	
(2) Additional VOC on the Road in the Urban Area				Additional VOC:30%
A 1,397 @11.000x1Km	x0.30= 4,610	4,610	4,610	The Road in the urban area = 1.0 Km
T2 1,132 @23.882x1Km	x0.30= 8,110	8,110	8,110	
Tm 463 @45.198x1Km	x0.30= 6,278	6,278	6,278	
2,992	18,998/day	18,998/day	18,998/day	(Refer to Annex 9-4)
(3) Savings in VOC for Intra-urban and Local Traffic				Reduced congestion will result in the increase of V=27 to V=30 on the road of 1 Km (Refer to Annex 9-4)
Sm 2,000 x1Km	x0.318= 636	636	636	
L 1,000 x1Km	x0.488= 488	488	488	
	1,124/day	1,124/day	1,124/day	
(4) Time Savings for Passengers of the Intra-urban Traffic				V=27 to V=30 on the road of 1 Km (Refer to Annex 9-4)
Sm 2,000	370/day	370/day	370/day	
2) Savings in 1988				
(1) Diverted Traffic	392,633+18,998=411,631	462,295+18,998=481,293	31,664+18,998=50,662	
	411,631x365=150,245,000	481,293x365=175,671,000	50,662x365=18,492,000	
(2) Intra-urban Traffic	1,124+370=1,494			
	1,494x365=545,310	545,000	545,000	
(3) (1)+(2) Total in 1988	150,245+545=150,795 ('000)	175,671+545=176,216 ('000)	18,492+545=19,037 ('000)	

Annex Table 9-33 Benefit Cost Analysis and Associated Factors

Route Plans	Plan A (A-1+B-1)	Plan B (A-2+B-2)	Plan C (A-3)	Plan D (A-3)
Economic Cost million Pesos	749.0	766.0	332.2	74.1
B/C Ratio, i=12%	4.29	4.02	2.03	2.20
PW in million, i=12%	1,834.0	1,719.8	299.3	86.3
IRR	36.5%	-	-	-
Economic Cost million Pesos/Km	27.6	27.9	60.4	16.5
Bypass Length Km	27.1	27.5	5.5	4.5
Existing Road Km	40.0	40.0	7.0	5.0
Reduced Length Km	12.9	12.5	1.5	0.5
Reduction in %	32%	31%	21.0%	10%

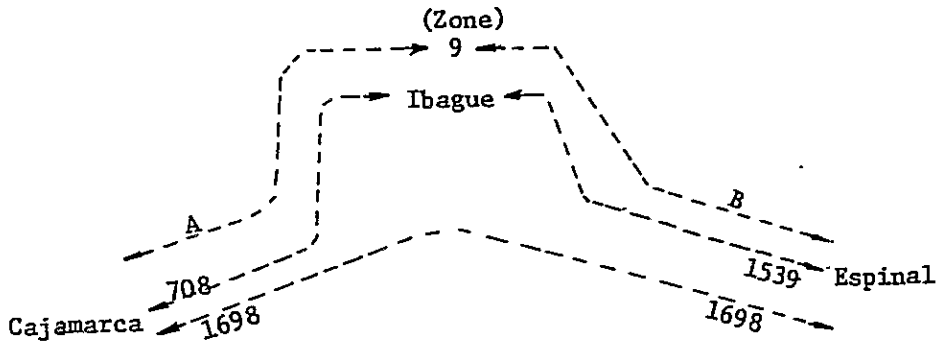
Annex 9-5 Ibague Bypass

(1) Traffic Diversion

Traffic diversion to the proposed bypass plan is estimated by studying the OD distribution of the traffic flow on the existing road. The steps of the estimate are stated as follows.

1) The Origin and Destination Distribution by the Survey in 1980

The OD survey conducted in 1980 presents the trip distribution which is summarized as in the following Annex Fig. 9-5.



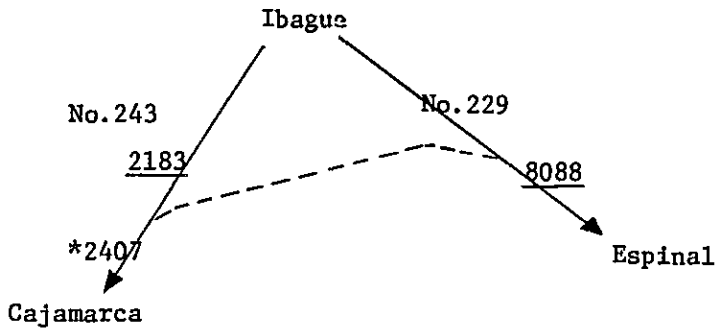
Remarks: Urban & local trips of A and B are not determined by OD Table because of no simultaneous traffic counting on Station A and B with the OD interviewing. Buses are included in each figure..

(Unit: vehicles/day)

Annex Fig. 9-5 OD Distribution, 1980

2) Traffic Volumes by manual counting, 1980

According to the "Volumenes de Transito Conteos Manuales, 1980 (MOPT Direction de Carreteras, Oficina de Programacion de Carreteras), the ADT (Transito promedio diario semanal) is registered as shown in the following Annex Fig. 9-6.



Remarks: *2407 is the volume counted on the day (24 hours) of OD interviewing in February 1980.

(Unit: Vehicles/day, 1980)

Annex Fig. 9-6 Traffic Volume by Manual Counting: ADT, 1980

The ratio of 2183/2407=0.907 indicates an adjustment coefficient which should be applied to the all OD trips in order to adjust to the ADT as underlined above in Annex Fig.9-b. When the OD trips are modified after the adjustment, the balance between the ADT and the total of the adjusted OD trips is assumed to be the short distant trips which would remain on the existing road.

3) Diverting Traffic After Adjustment, 1980

From the OD table

Sm	310
B	179
T2	843
Tm	366
Tot	1698

Adjusted by multiplying the ratio of 0.7975, the diverting traffic will be as follows. Also it is assumed that all buses will enter the urban area to let the passengers on and off.

The total of OD trips per day adjusted:

Sm	310x0.907=281
B	= 0
T2	843x0.907=765
Tm	366x0.907=332
Tot	1519x0.907=1378

The traffic which will divert to the new Bogota-Medellin Road is found as follows which is to be adjusted from the above adjusted traffic and ADT, respectively. (Refer to Annex 9-5 Girardot-Espinal Bypass)

Bogota-Medellin Traffic	Adjusted OD Trips Diverting
Sm 17x0.7975= 13	281-13= 268
B 14x0.7975= 11	= 0
T2 89x0.7975= 71	765-71= 694
Tm 66x0.7975= 53	332-53= 279
Tot 186x0.7975= 148	1378-137=1241

Ibague-Cajamarca

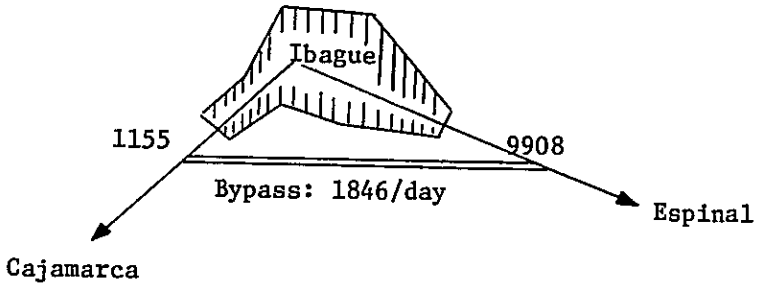
ADT adjusted	Traffic Remaining on the Existing Road
Sm 699-13= 686	686-268= 418
B 240-11= 229	229 = 229
T2 896-71= 825	825-694= 131
Tm 348-53= 295	295-279= 16
Tot 2183-148=2035	2035-1241=794

Ibague-Espinal:

ADT adjusted	Traffic Remaining on the Existing Road
Sm 4772-13= 4759	4759-268= 4491
B 1375-11= 1364	1364- 0= 1364
T2 1553-71= 1482	1484-294= 788
Tm 388-53= 335	335-279= 56
Tot 8088-148= 7940	7940-1241=6699

(2) Diverted Traffic Forecasted

By assuming the same growth rate of traffic as shown in 4-6 of Chapter 4 and Annex Table 4-4, the traffic on each section is forecasted as in the following Annex Table 9-34. For the traffic in 1988 Annex Fig.9-7 is prepared. For this proposed bypass lan, the traffic volume as estimated here is assumed to be equal for all by ass alternatives.



Remarks: Traffic volume is ADT in 1988

Annex Fig. 9-7 Sections with the Bypass and Forecasted Traffic in 1988

(3) Bypass Alternatives and Construction Cost

Alternative routes of the bypass plan for Ibague are shown in Annex Fig. 9-8 and Annex Table 9-35.

Plan A : Length 6.6 Km starting from Km 50.2 to Km 59.0 of the existing road. A long bridge of 110 m. Maximum gradient 8%. (Slightly different from Plan A)

Plan B : Length 5.5 Km starting from Km 50.2 to Km 57.5 of the existing road. A long bridge of 270 m.

Plan C : Length 9.0 Km starting from Km 47.4 to Km 59.0 of the existing road. A long bridge of 110 m. Maximum gradient 6%.

The construction cost was estimated by using the average costs which were obtained from the case of C. The cost of the case C was estimated by the engineering study using the map with a scale of 1/2000. The cost for each alternative is shown in Annex Table 9-36.

(4) Savings in Traffic Cost Associated with the Bypass Plan

Among the various benefits realized by the construction of a bypass, the following savings in traffic cost were estimated.

1) Savings in traffic cost of the diverted traffic mainly resulted from the reduction of road distance.

2) Savings in additional VOC of the diverted traffic in the urban area. (The additional VOC is resulted from the conjestion in the urban area.)

3) Savings in VOC of the intra-urban traffic resulted from the improvement of running condition in the urban area accompanied by the traffic diversion.

4) Time Savings of passengers in the intra-urban traffic.

The diverted traffic is assumed equal for all cases of the alternatives. However, the magnitude of the savings in the traffic cost varies because of the changes in reduced road distance and in gradient component.

The intra-city traffic on the existing route is ADT 5,500, composed of 3,900 and 1,600 small and large vehicles, respectively. VOC on the urban streets is assumed to increase by 30% from that on the inter-city road. The ratio of 1.30 is obtained by studying the MOPT document (OP-3-21-010). It is assumed that the average vehicle speed of 27 Km will increase to 30 km in the urban area if the through traffic diverts to the bypass. The unit VOC for the intra-urban traffic is determined as in the following 1) Traffic Cost Data.

Time value of passengers in small vehicles is assumed in the following way. Average income per month is $20,000 from which hourly value is 20,000÷(24x30)=27.78. 1.5 persons per vehicle are economically active. Savings in time for the runnig of the urban street of 5.5 km is 5.5/27 - 5.5/30 = 0.021 hrs. The small vehicles in intra-urban traffic has the share of 70%.

-1) Traffic Cost Data

The basic vehicle running cost data used in the calculation for intra-urban traffic are determined by refering to Annex 9-1. They are shown below:

Annual running distance in Km.

		Small		Truck
Without Bypass	(V=27)	13,900	(V=25)	55,700
With Bypass	(V=30)	14,300	(V=27)	57,600

Engine oil cost is 20% and 15% of the fuel cost for the above vehicles respectively. Tyres and maintenance costs are assumed to have no change although the speed (V) changes slightly. The VOCs are shown as follows:

VOC :	Small vehicle		Large (D-600)	
	V=27	V=30	V=25	V=27
Fuel	1.477	0.289	6.945	6.769
Oil	0.295	0.289	1.042	1.015
Tyres	0.164	0.164	0.634	0.634
Maintenance	1.254	1.254	5.645	5.645
Dep & int	5.532	5.377	1.946	1.883
Overhead	4.519	4.393	6.809	6.587
	13.241	12.923	23.021	22.533
Difference in pesos/km	0.318		0.488	

Annex Table 9-34 Forecasted Traffic on the Sections

Vehicles/day

Section	Year	1980	1988	1990	'00/80	2000
Ibague Bypass	Sm	268	412	459	2.933	786
	B	0	0	0	0	0
	T2	694	991	1083	2.435	1690
	Tm	279	443	497	3.172	885
	Tot	1241	1846	2042	2.708	3361
Existing Road Cajamarca-Ibague	Sm	418	643	716	2.935	1227
	B	229	300	321	1.965	450
	T2	131	187	204	2.435	319
	Tm	16	25	28	3.188	51
	Tot	794	1155	1269	2.578	2047
Existing Road Ibague-Espinal	Sm	4491	6908	7693	2.934	13178
	B	1364	1786	1911	1.963	2678
	T2	788	1125	1229	2.435	1919
	Tm	56	89	100	3.179	178
	Tot	6699	9908	10933	2.680	17953

Remarks: The total is the summation of four vehicle types. It is not controled by the growth rate of 5% p.a. since the buses are not included in the bypasses.
Buses are assumed to pass through the existing road to let the passengers on and off in the urban area.

Annex Table 9-35 CONSTRUCTION COST: Ibague Bypass Plans (UNIT: $'000)

Item	A					B					C				
	Q'ty Unit	FC	LC	TAX	TOTAL	Q'ty Unit	FC	LC	TAX	TOTAL	Q'ty Unit	FC	LC	TAX	TOTAL
(1) Earth Work	6.55 km	32,408	24,319	6,778	63,505	5.6 km	28,550	21,172	5,985	55,707	8.95 km	109,848	77,931	24,373	212,152
(2) Pavement Work	6.55 km	16,826	11,434	3,130	31,390	5.6 km	14,385	9,776	2,676	26,837	8.95 km	22,991	15,624	4,277	42,892
(3) Structure	6.55 km	27,507	41,829	3,382	72,718	5.6 km	25,244	38,175	3,119	66,538	8.95 km	60,400	101,935	6,127	168,462
(4)Bridge Work L = 10 m	1 unit	580	931	91	1,602	1 uni	580	931	91	1,602	1 unit	580	931	91	1,602
L = 20 m	2 unit	4,787	5,881	1,146	11,814	1 unit	2,394	2,940	573	5,907	4 unit	9,575	11,762	2,291	23,628
L = 40 m	0	0	0	0	0	1 unit	5,208	5,757	1,268	12,233	0	0	0	0	0
L = 80 m	2 unit	22,235	24,575	5,412	52,222	2 unit	22,235	24,575	5,412	52,222	2 unit	22,235	24,575	5,412	52,222
L = 110 m	1 uni	27,003	20,866	5,235	53,104	1 unit	27,003	20,866	5,235	53,104	1 unit	27,003	20,866	5,235	53,104
(5) Sub-total		131,346	129,835	25,174	286,355		125,599	124,192	24,359	274,150		252,632	253,624	47,806	554,062
(6) w/Overhead & Profit	(5) x 1.25	182,353	146,837	28,754	357,944		174,432	140,470	27,786	342,688		351,325	286,521	54,732	692,578
(7) Supervision	(6) x 0.05	13,602	3,400	895	17,897		13,022	3,255	857	17,134		26,318	6,580	1,731	34,629
(8) Contingency	[(6)+(7)]x0.10	19,595	15,024	2,965	37,584		18,745	14,373	2,864	35,982		37,764	29,310	5,646	72,720
(9) Total	(6)+(7)+(8)	215,550	165,261	32,614	413,425		206,199	158,098	31,507	395,804		415,408	322,411	62,109	799,928
(10) Detailed Eng. w/Contingency	(7)x1.10	14,962	3,740	985	19,687		14,324	3,581	942	18,847		28,950	7,238	1,904	38,092
(11) Land Acquisition	6.55 km $600,000/ha	-	11,790	-	11,790	5.6 km	-	10,080	-	10,080	8.95 km	-	16,110	-	16,110
(12) Grand Total		230,512	180,791	33,599	444,902		220,523	171,759	32,449	424,731		444,358	345,759	64,013	854,130
Economic Cost		230,512	180,791	-	411,303		220,523	171,759	-	392,282		444,358	345,759	-	790,117

Annex Table 9-36 Ibague Bypass: Savings in Traffic Cost

Savings per day in 1988	Plan A Road Length of New Rd. 6.6kmx4% Road Length of Existing 8.2kmx3%			Plan B Road Length of New Rd. 5.5kmx5% Road Length of Existing 6.7kmx3%			Plan C Road Length of New Rd. 9.0kmx4% Road Length of Existing 11.0kmx3%		
1) Diverted Traffic									
3% 4%									
A 12,049 12,379	x6.6x412	33,661	40.706	x5.5x412	28,799	33,260	x9x412	45,901	54,606
T2 26,036 27,293	x6.6x991	178,513	211,574	x5.5x991	155,606	172,871	x9x991	243,426	283,818
Tm 48,392 50,906	x6.6x443	148,839	179,789	x5.5x443	130,165	143,732	x9x443	202,962	235,814
Total			67,056		314,570	349,763 35,193			81,949
2) Additional VOC in the Urban Area									
1%									
A 11,000							412x5.5x0.3 = 7,478		
T2 23,882							991x5.5x0.3 = 39,051		
Tm 45,198			79,556			79,556	443x5.5x0.3 = 33,037*		79,556
Total 1) + 2)			146,612			114,749			161,505
	146,612x365	=	53,513,380 /year	114,749x365	=	41,883,385 /year	161,505x365	=	58,949,325 /year
3) Savings in VOC for intra-urban traffic									
Sm 3,900x5.5x0.318									
L 1,600x5.5x0.488			11,115			11,115			11,115
4) Time Savings for Passengers									
Sm 3,900x0.37			1,443						1,443
Total 3) + 4)			12,558			12,558			12,558
	12,558x365	=	4,583,670 /year	12,558x365	=	4,583,670	12,558x365	=	4,583,670 /year

VOC for inter-urban traffic is estimated by using the figures in Table 9-3 and Annex 9-1.

Accident reduction cost and other associated benefits are not estimated because of no supporting data. Average annual traffic growth ratio of 5.0% is applied for the savings of the through traffic. That of 7.0% is applied to the savings of intra-city traffic and time value since the congestion cost increases progressively in the urban streets.

-2) Savings in the Traffic Cost Resulted from the Bypass Alternatives

Savings in the traffic cost estimated for each alternative case are calculated and shown in Annex Table 9-37.

(5) Economic Evaluation

Economic evaluation is roughly conducted to find out the project viability from the alternatives. The result is shown in Annex Table 9-38. Amoung the alternatives, the plan A has the highest internal rate of return, 16.5%.

Annex Table 9-37 Benefit Cost Analysis and Factors Associated for Ibague Bypass

	Alternatives		
	A	B	C
Econ. Cost in million pesos	407.1	388.2	782.0
B/C Ratio	1.369	1.149	0.779
P.W. in million pesos	115.5	44.3	-132.5
I.R.R. (%)	16.5	-	-
Econ. Cost in million pesos per Km	61.7	70.6	86.9
Length of Bypass Km	6.6	5.5	9.0
Existing Road Km	8.2	6.7	11.0
Reduced Length Km	1.6	1.2	2.0

Annes Table 9-38 *** COST BENEFIT ANALYSIS TABLE ***

	Subsection 1 P-2			Subsection 2 P-3			Subsection 3 P-2		
	- - - - - DISC=12% - - - - -			*- - - - - DISC=12% - - - - -*			*- - - - - DISC=12% - - - - -*		
YEAR	INVEST.	MAINT.	TRAFFIC	INVEST	MAINT.	TRAFFIC	INVEST.	MAINT.	TRAFFIC
1983	173.6	0	0	924.0	0	0	1871.1	0	0
1984	66.4	0	0	353.6	0	0	716.0	0	0
1985	4147.0	0	0	22100.6	0	0	26847.4	0	0
1986	0	0	653.4	0	8.8	2016.5	15980.6	0	0
1987	0	0	657.8	0	7.8	1916.1	0	0	1611.7
1988	0	0	662.2	0	7.0	1822.6	0	0	1605.8
1989	0	0	667.7	0	6.2	1734.2	0	0	1599.4
1990	0	0	672.2	0	5.6	1649.3	0	0	1593.2
1991	0	0	677.3	0	5.0	1567.9	0	0	1587.7
1992	0	0	681.9	0	77.5	1491.1	0	0	1581.6
1993	0	0	687.1	0	4.8	1418.3	0	0	1575.4
1994	0	0	692.2	0	4.3	1349.9	0	0	1569.9
1995	0	0	697.1	0	3.8	1283.1	0	0	1563.9
1996	0	0	702.2	0	3.4	1220.6	0	0	1557.9
1997	0	0	707.4	0	3.0	1160.6	0	0	1552.2
1998	0	0	712.5	0	2.7	1104.0	0	0	1546.5
1999	0	0	717.7	0	2.4	1049.9	0	0	1540.7
2000	0	0	723.0	0	2.2	998.5	0	0	1534.7
2001	0	0	645.5	0	1.9	891.6	0	0	1370.2
2002	0	0	576.4	0	1.7	796.0	0	0	1223.4
2003	0	0	514.6	0	1.5	710.7	0	0	1092.3
2004	0	0	459.5	0	1.4	634.6	0	0	975.3
2005	0	0	410.2	0	1.2	566.6	0	0	870.8
TOTAL	4387.0	0	12917.9	23378.2	152.1	25381.2	45415.1	0	27552.8
G. TOT			17305.0			48911.5			72967.9
P.W			8530.9			2155.1			-17862.3
B/C			2.945			1.092			0.607
* I R			27.500 %			13.160 %			6.880 %

	Subsection 4 P-3			Subsection 5 P-2			Subsection 6 P-2		
	- - - - - DISC=12% - - - - -			*- - - - - DISC=12% - - - - -*			*- - - - - DISC=12% - - - - -*		
YEAR	INVEST.	MAINT.	TRAFFIC	INVEST.	MAINT.	TRAFFIC	INVEST.	MAINT.	TRAFFIC
1983	1638.0	0	0	291.2	0	0	111.3	0	0
1984	626.8	0	0	111.4	0	0	42.6	0	0
1985	0	0	0	6957.1	0	0	2657.8	0	0
1986	34973.3	0	0	0	0	490.4	0	0	369.4
1987	0	7.8	2673.6	0	0	493.8	0	0	369.2
1988	0	7.0	2597.1	0	0	497.1	0	0	369.4
1989	0	6.2	2524.0	0	0	500.6	0	0	369.8
1990	0	5.6	2451.7	0	0	503.9	0	0	370.0
1991	0	5.0	2381.7	0	0	507.3	0	0	370.0
1992	0	588.6	2313.7	0	0	511.0	0	0	370.0
1993	0	-446.0	2248.3	0	0	514.2	0	0	370.3
1994	0	4.3	2184.5	0	0	517.5	0	0	370.3
1995	0	3.8	2122.2	0	0	521.1	0	0	370.4
1996	0	3.4	2061.9	0	0	524.6	0	0	370.6
1997	0	3.0	2003.0	0	0	528.1	0	0	370.6
1998	0	2.7	1945.9	0	0	531.6	0	0	370.7
1999	0	2.4	1890.6	0	0	535.0	0	0	370.8
2000	0	2.2	1836.6	0	0	538.7	0	0	371.0
2001	0	1.9	1639.8	0	0	481.0	0	0	331.2
2002	0	1.7	1464.1	0	0	429.5	0	0	295.7
2003	0	1.5	1307.2	0	0	383.5	0	0	264.0
2004	0	1.4	1167.2	0	0	342.4	0	0	235.7
2005	0	1.2	1042.1	0	0	305.7	0	0	210.5
TOTAL	37238.1	203.7	37855.3	7359.7	0	9656.9	2811.7	0	6889.5
G. TOT			75297.1			17016.6			9701.3
P.W.			820.9			2297.1			4077.8
B/C			1.022			1.312			2.450
* I R			12.280 %			15.170 %			24.500 %

	Subsection 8 P-2			Subsection 9 P-2			Subsection 10 P-2		
	- - - - - DISC=12% - - - - -			*- - - - - DISC=12% - - - - -*			*- - - - - DISC=12% - - - - -*		
YEAR	INVEST.	MAINT.	TRAFFIC	INVEST.	MAINT.	TRAFFIC	INVEST.	MAINT.	TRAFFIC
1983	41.3	0	0	101.5	0	0	780.5	0	0
1984	15.8	0	0	38.8	0	0	298.7	0	0
1985	989.3	0	0	2425.9	0	0	18665.5	0	0
1986	0	0	77.6	0	0	160.2	0	0	522.4
1987	0	0	78.8	0	0	161.4	0	0	516.7
1988	0	0	79.4	0	0	162.3	0	0	510.7
1989	0	0	80.0	0	0	163.1	0	0	505.1
1990	0	0	81.4	0	0	163.8	0	0	499.4
1991	0	0	82.0	0	0	164.8	0	0	493.5
1992	0	0	82.9	0	0	165.9	0	0	487.9
1993	0	0	84.0	0	0	166.5	0	0	482.6
1994	0	0	85.1	0	0	167.6	0	0	476.9
1995	0	0	86.0	0	0	168.4	0	0	471.5
1996	0	0	87.1	0	0	169.4	0	0	466.1
1997	0	0	88.0	0	0	170.2	0	0	460.8
1998	0	0	89.0	0	0	171.0	0	0	455.5
1999	0	0	90.0	0	0	171.9	0	0	450.4
2000	0	0	91.0	0	0	172.9	0	0	445.2
2001	0	0	81.3	0	0	154.4	0	0	397.5
2002	0	0	72.6	0	0	137.8	0	0	354.9
2003	0	0	64.8	0	0	123.1	0	0	316.9
2004	0	0	57.8	0	0	109.9	0	0	283.0
2005	0	0	51.7	0	0	98.1	0	0	252.6
TOTAL	1046.4	0	1590.6	2566.2	0	3122.5	19744.7	0	8849.8
G.TOT			2637.0			5688.7			28594.5
P.W			544.2			556.3			-10894.8
B/C			1.520			1.217			0.448
* I R			16.980%			14.260 %			3.990 %

	Subsection			Subsection			Subsection		
	- - - - - DISC=12% - - - - -			*- - - - - DISC=12% - - - - -*			*- - - - - DISC=12% - - - - -*		
YEAR	INVEST.	MAINT.	TRAFFIC	INVEST.	MAINT.	TRAFFIC	INVEST.	MAINT.	TRAFFIC
1983	983.5	0	0	199.5	0	0	260.4	0	0
1984	376.3	0	0	76.3	0	0	99.6	0	0
1985	0	0	0	4769.6	0	0	6227.7	0	0
1986	0	0	0	0	0	390.8	0	0	383.6
1987	18743.3	0	0	0	0	390.8	0	0	386.4
1988	0	14.0	3705.3	0	0	390.4	0	0	389.3
1989	0	12.5	3494.2	0	0	390.6	0	0	376.4
1990	0	11.1	3297.2	0	0	390.4	0	0	394.9
1991	0	9.9	3110.3	0	0	390.2	0	0	397.4
1992	0	374.0	2932.8	0	0	390.2	0	0	400.3
1993	0	11.9	2767.0	0	0	389.9	0	0	403.1
1994	0	10.7	2610.3	0	0	389.8	0	0	405.9
1995	0	-146.4	2461.8	0	0	389.9	0	0	408.6
1996	0	6.8	2322.0	0	0	389.8	0	0	411.4
1997	0	6.1	2190.0	0	0	389.8	0	0	414.4
1998	0	5.4	2065.9	0	0	389.7	0	0	417.1
1999	0	4.8	1949.0	0	0	389.5	0	0	420.0
2000	0	4.3	1838.5	0	0	387.7	0	0	423.1
2001	0	3.8	1641.5	0	0	346.2	0	0	377.8
2002	0	3.4	1465.6	0	0	309.1	0	0	337.3
2003	0	3.1	1308.7	0	0	276.0	0	0	301.2
2004	0	2.7	1168.4	0	0	246.4	0	0	268.9
2005	0	2.4	1043.2	0	0	220.0	0	0	240.1
TOTAL	20103.2	340.6	41371.6	5045.5	0	7247.1	6587.7	0	7557.1
G. TOT			61815.4			12292.5			14144.8
P.W			21609.1			2201.6			969.4
B/C			2.075			1.436			1.147
* I R			24.650 %			16.400 %			13.550 %

	Subsection 14 P-2			Subsection 15 P-2			Subsection 16 P-2		
	- - - - DISC=12% - - - - -			*- - - - - DISC=12% - - - - -*			*- - - - - DISC=12% - - - - -*		
YEAR	INVEST.	MAINT.	TRAFFIC	INVEST.	MAINT.	TRAFFIC	INVEST.	MAINT.	TRAFFIC
1983	316.4	0	0	36.4	0	0	28.0	0	0
1984	121.1	0	0	13.9	0	0	10.7	0	0
1985	7574.1	0	0	871.3	0	0	676.8	0	0
1986	0	0	1374.4	0	0	109.6	0	0	46.3
1987	0	0	1387.3	0	0	111.2	0	0	47.0
1988	0	0	1399.3	0	0	112.9	0	0	47.1
1989	0	0	1411.5	0	0	114.5	0	0	47.6
1990	0	0	1424.0	0	0	116.3	0	0	48.4
1991	0	0	1436.2	0	0	117.9	0	0	48.9
1992	0	0	1448.9	0	0	119.7	0	0	49.4
1993	0	0	1462.1	0	0	121.4	0	0	49.9
1994	0	0	1475.0	0	0	123.3	0	0	50.3
1995	0	0	1487.9	0	0	125.0	0	0	50.8
1996	0	0	1501.1	0	0	126.7	0	0	51.3
1997	0	0	1514.4	0	0	128.7	0	0	51.8
1998	0	0	1527.7	0	0	130.6	0	0	52.4
1999	0	0	1541.2	0	0	132.5	0	0	52.9
2000	0	0	1554.9	0	0	134.4	0	0	53.5
2001	0	0	1388.3	0	0	120.0	0	0	47.7
2002	0	0	1239.6	0	0	107.2	0	0	42.6
2003	0	0	1106.7	0	0	95.7	0	0	38.0
2004	0	0	988.2	0	0	85.4	0	0	34.0
2005	0	0	882.3	0	0	76.3	0	0	30.3
TOTAL	8011.6	0	27551.1	0	0	2309.4	715.5	0	940.2
G. TOT			35562.7			3231.1			1655.8
P.W.			19539.4			1387.7			224.7
B/C			3.439			2.506			1.314
* I R			30.550 %			24.250 %			15.150 %

	Subsection 17 P-3			Subsection 18 P18 P-2			Selected Total		
	- - - - - DISC=12% - - - - -			*- - - - - DISC=12% - - - - -*			*- - - - - DISC=12% - - - - -*		
YEAR	INVEST.	MAINT.	TRAFFIC	INVEST.	MAINT.	TRAFFIC	INVEST.	MAINT.	TRAFFIC
1983	5647.6	0	0	6834.1	0		20.2	0	0
1984	2161.1	0	0	2615.1			7.7	0	0
1985	0	0	0	18803.6			123.7	0	0
1986	36182.5	0	0	129151.7			216.3	0	6.6
1987	75380.2	0	0		0	9562.7	94.1	0	20.4
1988	0	48.9	13076.4		0	9611.0	0	0.1	37.0
1989	0	43.6	12333.9		0	9663.5	0	0.1	36.0
1990	0	38.9	11624.5		0	9717.9	0	0.1	35.0
1991	0	34.8	10960.6		0	9771.6	0	0.1	34.1
1992	0	1053.4	10331.1		0	9828.4	0	2.1	33.2
1993	0	39.0	9738.7		0	9886.8	0	-0.4	32.4
1994	0	34.8	9180.0		0	9947.1	0	0.1	31.6
1995	0	31.1	8655.6		0	10009.2	0	-0.1	30.9
1996	0	-297.1	8159.5		0	10073.0	0	-0.3	30.2
1997	0	21.2	7691.5		0	10138.1	0	0.0	29.6
1998	0	18.9	7252.5		0	10205.1	0	0.0	29.0
1999	0	16.9	6836.4		0	10274.2	0	0.0	28.4
2000	0	15.1	6444.2		0	10344.6	0	0.0	27.9
2001	0	13.5	5753.7		0	9736.3	0	0.0	24.9
2002	0	12.0	5137.3		0	8246.8	0	0.0	22.2
2003	0	10.7	4586.8		0	7363.2	0	0.0	19.9
2004	0	9.6	4095.4		0	6574.2	0	0.0	17.7
2005	0	8.6	3656.6		0	5869.8	0	0.0	15.8
TOTAL	119371.4	1153.9	145514.6		462.1	176323.8	462.1	1.9	542.6
G. TOT			266039.9			333728.2			1006.6
P.W			27297.2			18919.4			82.4
B/C			1.229			1.120			1.178
* I R			14.940 %			13.20 %			14.060 %

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