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REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS & HIGHWAYS

Feasibility Study
on
The Rural Road Network Development Project

FINAL REPORT (Volume 14)

PROJECT EVALUATION
IN
THE PROVINCE OF DAVAO DEL NORTE

OCTOBER, 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

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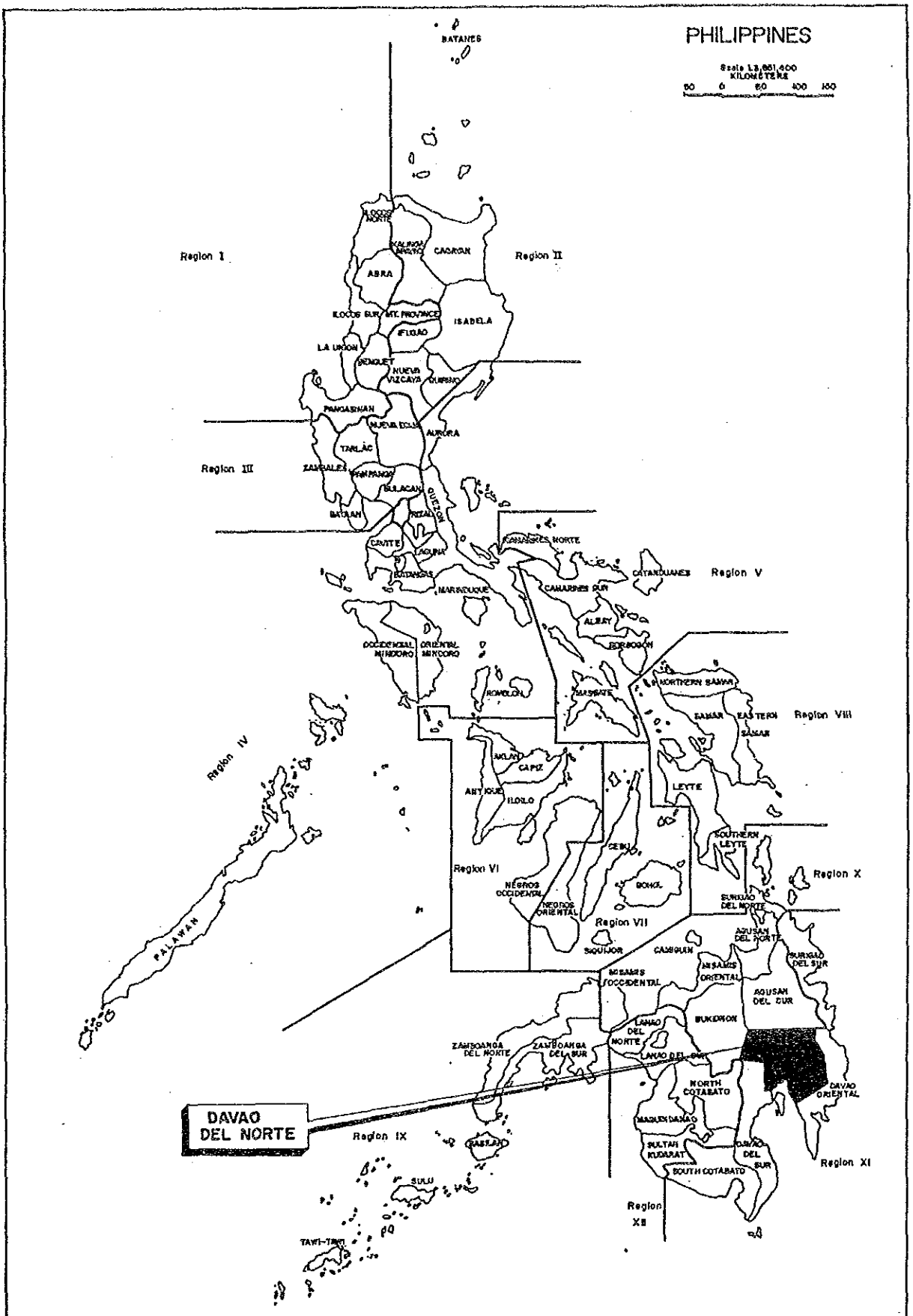

FEASIBILITY STUDY ON THE RURAL ROAD NETWORK DEVELOPMENT PROJECT	LOCATION MAP

VOLUME - 14
PROVINCE OF DAVAO DEL NORTE

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CHAPTER 1
SOCIO-ECONOMIC PROFILE OF THE PROVINCE

1.1 GENERAL

The Province of Davao del Norte was selected as one of the Study Provinces which represents the province of the following characteristics:

- Economically less developed
- Poor level in road development
- Topographically flat and mountainous

1.2 GEOGRAPHY AND TOPOGRAPHY

The province is located in the south-eastern portion of Mindanao Island and bounded on the north by Province of Agusan del Sur, on the east by Province of Davao Oriental, on the south by Davao Gulf and on the west by Davao City and Province of Bukidnon.

The Central areas of the Province (municipalities of Tagum, Carmen, Panabo, Kapalong and Sto. Tomas) are flat land and the rest of the Province are predominantly mountainous. Thus, the terrain of the Province is a combination of the seaside flat and the inland mountainous.

Slope map of the province is shown in Figure 1.2-1.

1.3 POPULATION

The province is composed of twenty-one (21) municipalities, however, three (3) municipalities located in Samal Island were excluded from the Study. Provincial capital is located at Tagum.

Population in 1990 is estimated at 908,000. The average annual population growth rate for the period of 10 years from 1980 to 1990 was estimated 2.2% which is lower than the national average of 2.4%. Population density of the province in 1990 is 111.8 persons per square kilometer which is lower than the national average of 205 persons per sq. km.

Population, the average annual population growth rate and population density by municipality are presented in Table 1.3-1. Distribution of municipal towns together with their population is shown in Figure 1.3-1.

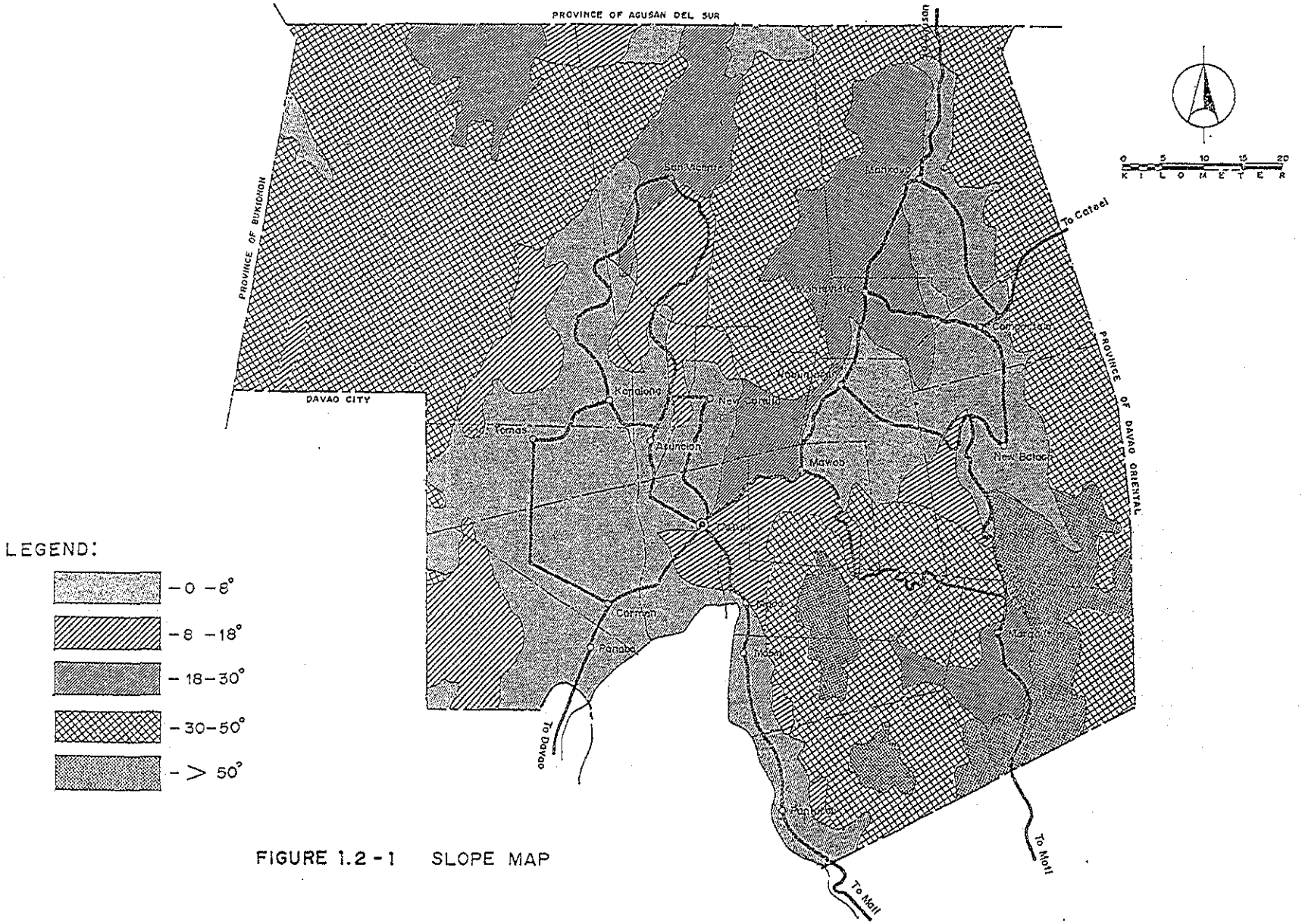


FIGURE 1.2 - 1 SLOPE MAP

Table 1.3-1

POPULATION, LAND AREA AND DENSITY (1990)
Province of Davao del Norte

	City/Municipality	Projected Population (1990)	Annual Growth Rate (%)	Land Area (km^2)	Density (p/km^2)
	1. Tagum	111,122	2.5	195.8	567.5
*	2. Babak	22,232	0.3	73.4	302.9
	3. Asuncion	50,631	1.6	362.6	139.6
	4. Carmen	41,039	2.9	282.5	145.3
	5. Compostela	38,738	2.4	172.5	224.6
	6. Kapalong	57,922	3.0	2,110.7	27.4
*	7. Kaputian	24,377	0.9	117.5	207.5
	8. Mabini	18,859	1.3	273.8	68.9
	9. Maco	51,124	2.2	303.8	168.3
	10. Mawab	26,011	2.1	135.9	191.4
	11. Monkayo	46,829	2.2	641.6	73.0
	12. Montevista	25,709	2.2	225.0	114.3
	13. Nabunturan	44,946	1.8	231.3	194.3
	14. New Bataan	41,036	2.2	630.0	65.1
	15. New Corella	23,931	1.0	201.2	118.9
	16. Panabo	88,617	2.2	193.4	458.2
	17. Pantukan	35,926	1.7	565.8	63.5
*	18. Samal	18,042	(0.5)	89.6	201.4
	19. Sto. Tomas	67,767	4.2	221.8	305.5
	20. San Mariano	37,800	6.4	333.5	113.3
	21. San Vicente	35,097	1.0	768.0	45.7
	T O T A L	907,755	2.2	8,129.8	111.76

Note: * - Island Municipality

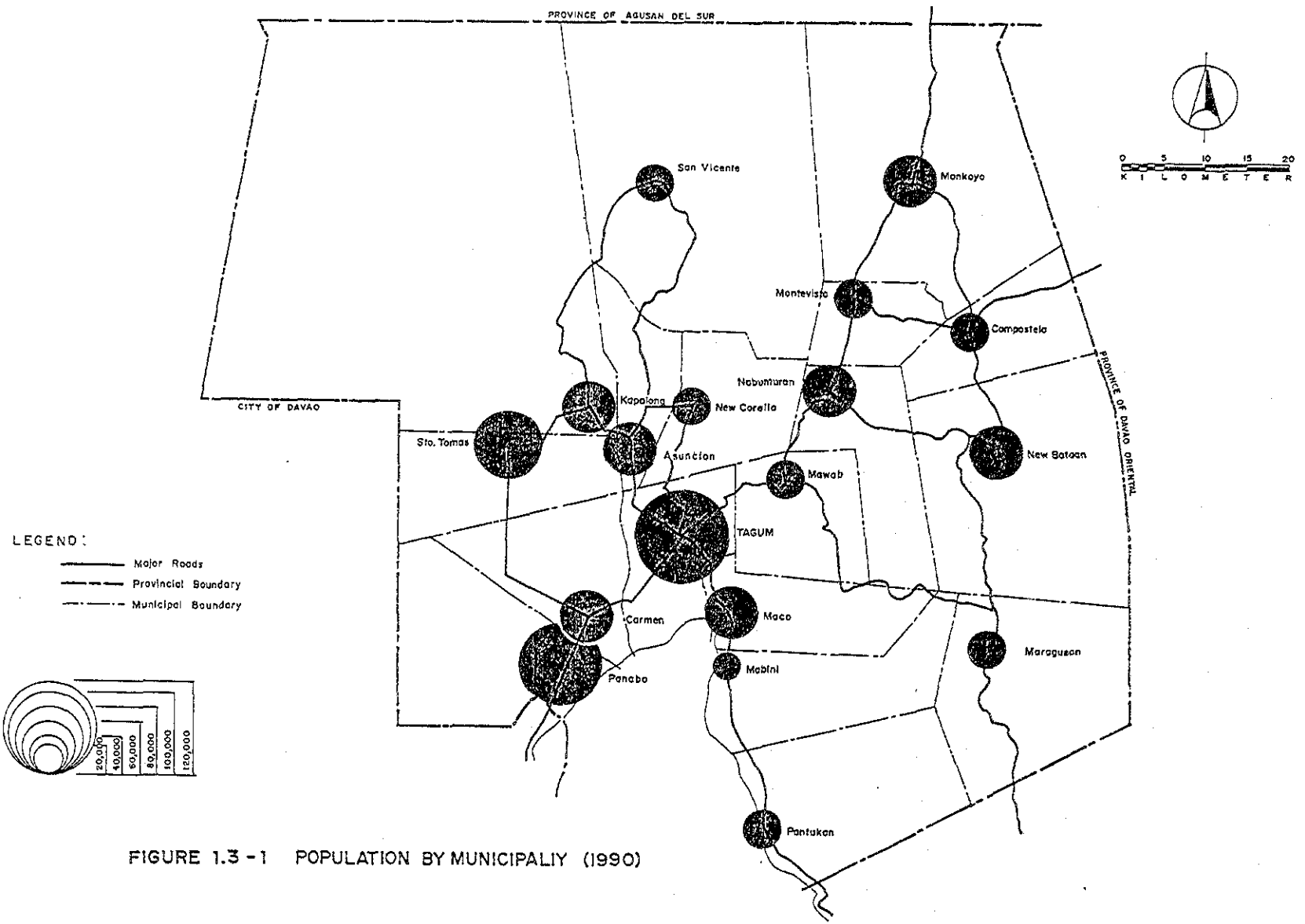


FIGURE 1.3 - 1 POPULATION BY MUNICIPALIY (1990)

1.4 SOCIO-ECONOMIC PROFILE

Table 1.4-1 shows major socio-economic data of the province in comparison with the national value.

Gross Regional Domestic Product which shows economic output of the province shares 1.4% of the total national output. In view of land area and population share of the province to the country, the province's economic output is slightly lower than the national average.

Per capita income of the province is much lower than the national average. Incidence of poverty shows the almost same level as the national average. Unemployment and underemployment rates show the lower level than the national average.
Agriculture is the predominant industry of the province and shares 77% in terms of number of workers.

Table 1.4-1
MAJOR SOCIO-ECONOMIC DATA OF PROVINCE OF DAVAO DEL NORTE

	Davao del Norte (A)	Philippines (B)	(A)/(B)
1. Total Land Area (sq.km.)	8,130	300,000	0.027
2. Population in 1990 (1000 persons)	908	61,483	0.015
3. Population Density (persons/sq.km.)	112	205	0.55
4. GRDP (Million ₱ at 1000 prices)	8,863	623,051	0.014
5. Per Capita Income in 1985 (₱/person)	4,956	5,593	0.89
6. Number of Workers by Industrial Sector in 1980 (1000 persons)			
* Agricultural	161.9 (77%)	7,303 (51%)	0.022
* Industry	11.3 (5%)	2,177 (15%)	0.005
* Service	35.2 (17%)	4,552 (32%)	0.008
* Total 1/	209.4 (100%)	14,197 (100%)	0.015
7. Incidence of Poverty in 1985 (%)	59.9	59.3	-
8. Unemployment Rate in 1988 (%)	2.4	8.3	-
9. Underemployment Rate in 1988 (%)	10.0	11.6	-

Note: 1/ Includes other workers who cannot be classified as any one of three (3) sectors.

1.5 AGRICULTURAL LAND USE AND MAJOR CROPS

Davao del Norte has a total land area of 8,130 square kilometers, representing 2.7% of the total land area of the Philippines. Table 1.5-1 shows general land use of the province. About 45% of the province are occupied by forest and about 30% by agricultural area.

Figure 1.5-1 illustrates the agricultural land use of the province. Table 1.5-2 shows major crops produced in the province. Five (5) major crops of the province are corn, palay, coconut, banana and abaca.

Table 1.5-1
LAND USE OF DAVAO DEL NORTE

Land Use	Area in sq.km.	%
Agricultural Area	2,390.2	29.4
Grass/Shrub Land	1,975.5	24.3
Forest	3,625.9	44.6
Wet Land	130.1	1.6
Built-up Area	8.1	0.1
Total	8,129.8	100.0

Source: Socio-Economic Profile of Davao del Norte

Table 1.5-2
MAJOR CROPS OF PROVINCE OF DAVAO DEL NORTE

Major Crops	Area Utilized (ha.)		Production (M.T.)	
	1985	1986	1985	1986
Corn	180,450	153,880	178,080	146,110
Palay	69,430	69,460	255,280	248,970
Coconut	-	106,535	-	162,281
Banana	26,688	26,691	833,498	873,311
Abaca	9,720	7,770	7,290	5,291

Source: Bureau of Agricultural Statistics

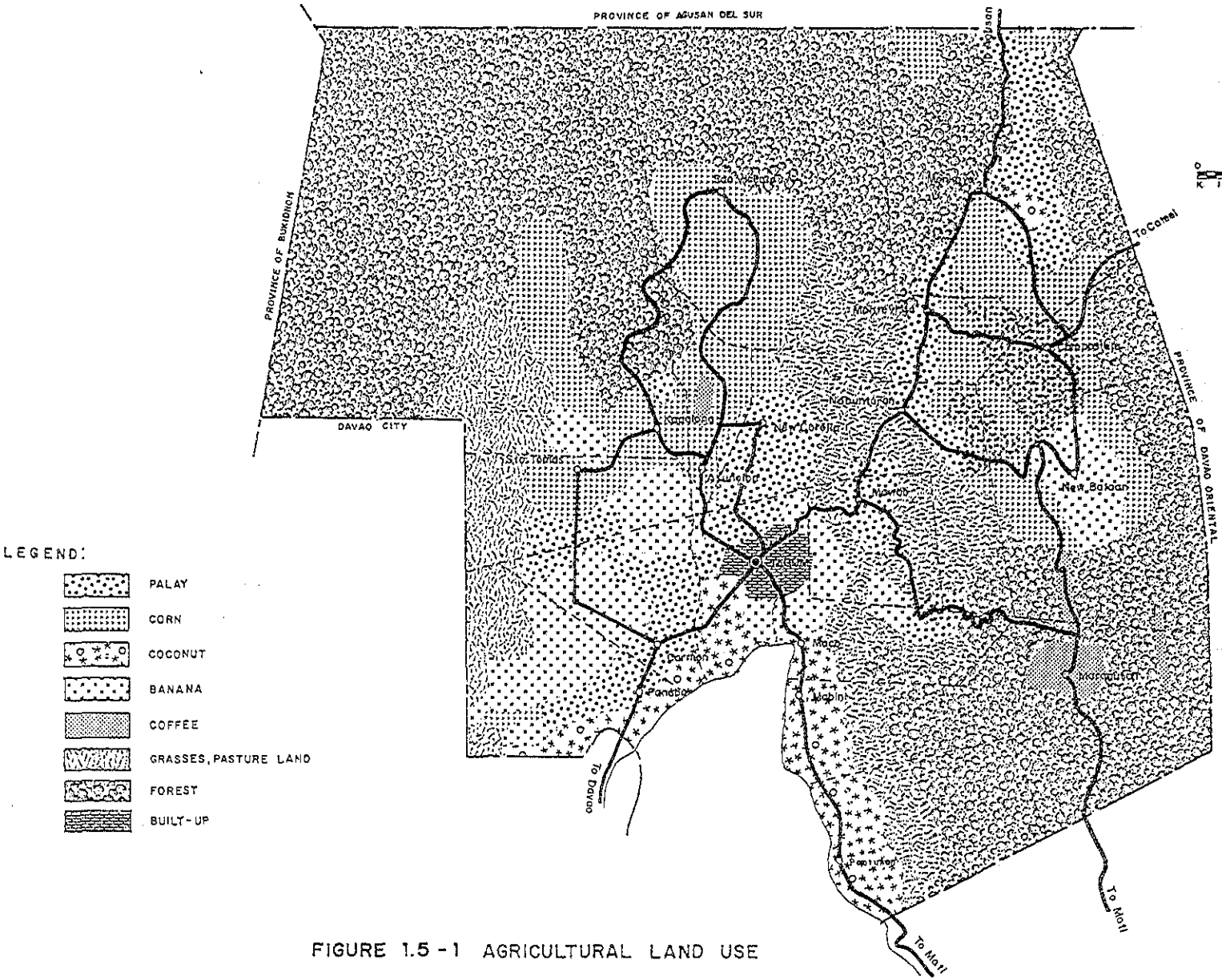


FIGURE 1.5 - 1 AGRICULTURAL LAND USE

CHAPTER 2
ROAD NETWORK OF THE PROVINCE

2.1 GENERAL

The province was classified as one of the provinces of which road network development represents the poor level in the Philippines. In this Chapter, present level of road network development is assessed more in details, then general direction of the future road network development is established. Based on the said assessment and the functional road classification criteria, the major road network for the Province is proposed.

2.2 PRESENT LEVEL OF ROAD NETWORK DEVELOPMENT

Present level of the road network development level is assessed in terms of road extension (quantity of roads), surface type and conditions (quality of roads) and road network pattern.

2.2.1 Present Level of Road Development in terms of Road Extension

Davao del Norte has a total of 3,228.4 kms. of roads, comprising 427.4 kms. of National, 697.6 kms. of Provincial, 39.6 kms. of City, 324.3 kms. of Municipal and 1,739.5 kms. of Barangay Roads in 1987.

Table 2.2-1 shows road density by class of road which is compared with national average. In comparison with the national average, road development level of the province in terms of road extension is summarized as follows:

National roads	low at 67% of the national average
Provincial roads	higher by 1.28
Barangay roads	almost same as the national average
All roads	almost same as the national average

In terms of road extension, national roads are in low level. Some of provincial roads which are in higher level will need to be upgraded to national roads. Development level of all roads in terms of road extension is in a standard level.

2.2.2 Present level of Road development in terms of surface type and surface condition

The Study Team conducted an extensive field survey on the existing road conditions of which results are summarized in Table 2.2-2.

Present level of road development in terms of surface condition (quality of roads) could be summarized as follows:

National Roads

- About 51% of national roads in the Province are paved with PCC or bituminous surfaces, which is in slightly higher level than the national average of 46%.
- About 76% of national roads were assessed in good/fair condition.
- In terms of road quality, national roads in the province are in a standard level.

Provincial Roads

- Only 2% of provincial roads are paved with PCC or bituminous surfaces, which is quite low level compared with the national average of 11%.
- About 71% of provincial roads were assessed in bad/very bad condition.
- Quality of provincial roads is still very low level.

TABLE 2.2-1
EXISTING ROAD LENGTH AND ROAD DENSITY
Province of Davao del Norte

Road Class	Road Length In 1987 (kms.)	Road Density (L/ PA)		
		Davao del Norte	Philippines	Davao del Norte/Phils
National Rd.	351.5 (11.6)	0.1335	0.1994	0.67
Prov'l. Rd.	743.7 (24.5)	0.2825	0.2211	1.28
Sub-Total	1,095.2 (36.1)	0.4160	0.4205	0.99
City Rd.	- -	-	0.0304	-
Municipal Rd	305.1 (10.0)	0.1159	0.0981	1.18
Barangay Rd.	1,641.1 (53.9)	0.6234	0.6536	0.95
TOTAL	3,041.4(100.0)	1.1553	1.2026	0.96

*SOURCE: DPWH Infrastructure Atlas, 1989

TABLE 2.2-2
EXISTING SURFACE CONDITION (SURVEYED ROADS ONLY)
Province of Davao del Norte

Road Class	Pavement Type	Surface Condition 1/			% of Pavement Type 2/	
		Good/Fair	Bad/Very Bad	Total (%)	Davao del Norte	Phils.
National Road	PCC	176.2 (95.8)	7.7 (4.2)	183.9 (100.0)	50.0	23.6
	Bituminous	- -	8.9 (100.0)	8.9 (100.0)	0.6	22.3
	Gravel	94.5 (57.1)	71.1 (42.9)	165.6 (100.0)	49.4	51.3
	Earth	- -	- -	- (100.0)	-	2.8
	Total:	270.7 (75.5)	87.7 (24.5)	358.4 (100.0)	100.0	100.0
Provincial Road	PCC	18.9 (99.5)	0.1 (0.5)	19.0 (100.0)	-	2.5
	Bituminous	- -	1.5 (100.0)	1.5 (100.0)	2.4	8.9
	Gravel	197.9 (27.3)	526.3 (72.7)	724.2 (100.0)	98.2	70.6
	Earth	- -	2.6 (100.0)	2.6 (100.0)	1.4	18.0
	Total:	216.8 (29.0)	530.5 (71.0)	747.3 (100.0)	102.0	100.0
National and Provincial Road	PCC	195.1 (96.2)	7.8 (3.8)	202.9 (100.0)	16.0	12.5
	Bituminous	- -	10.4 (100.0)	10.4 (100.0)	0.4	15.3
	Gravel	292.4 (32.9)	597.4 (67.1)	889.8 (100.0)	82.6	61.4
	Earth	- -	2.6 (100.0)	2.6 (100.0)	1.0	10.8
	Total:	487.5 (44.1)	618.2 (55.9)	1,105.7 (100.0)	100.0	100.0

SOURCE: 1/ Survey by Study Team in 1989
2/ DPWH Infrastructure Atlas, 1989

2.2.3 Present Road Network Pattern

Present road network is presented in Figure 2.2-1, which shows all existing national and provincial roads. Present road network of the Province is assessed as follows:

- The existing network pattern is a fish-bone type with Pan-Philippine Highway as a main axis.
- Tagum-Mati Road and Montevista-Compostela-New Bataan-Maragusan Road are another inter-provincial roads. The latter runs in mountainous area, therefore, is currently impassable.
- The central plain has a dense road network, however, the rest of mountainous areas have less developed road network.
- All municipal towns are accessed by a national or a provincial road.

2.3 GENERAL DIRECTION OF ROAD NETWORK DEVELOPMENT

Results of assessment of present road network development level are summarized as follows:

- Extension of national roads is in low level. Extension of other classes of roads is in a standard level.
- Quality of provincial roads is still in very poor level.
- Basic road network is formed.

Based on the above assessment, general direction of road network development of the Province will be as follows:

(1) Improvement of existing national and provincial roads, especially those which form a major road network, should be given priority.

(2) Some of provincial roads should be upgraded to a standard of national road.

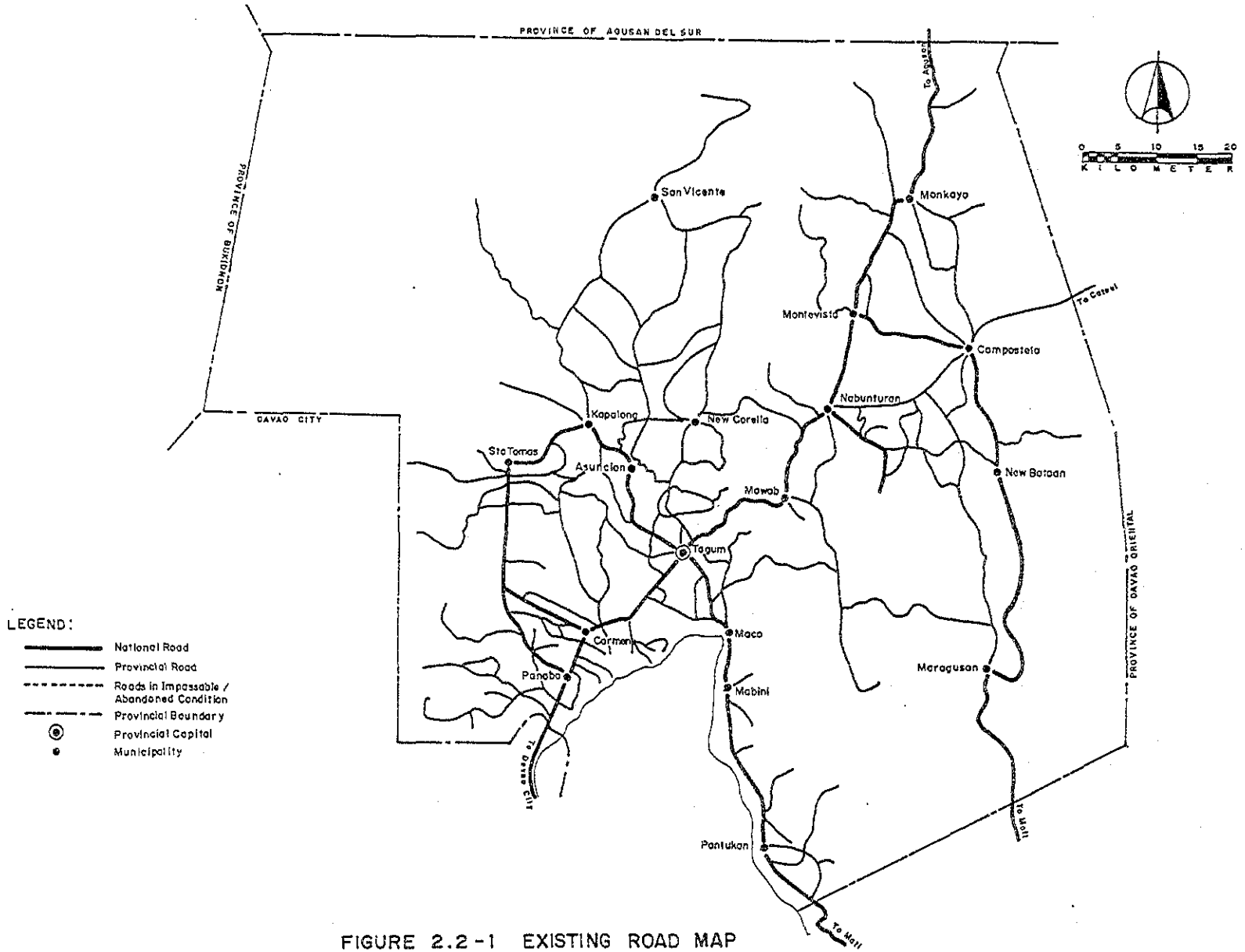


FIGURE 2.2-1 EXISTING ROAD MAP

2.4 PROPOSED MAJOR ROAD NETWORK

2.4.1 Procedure

To identify major roads, all existing roads are firstly classified in accordance with the functional road classification criteria which is shown in Table 2.4-1. Functional classification groups roads according to importance and quality of services they are intended to provide. Individual road links of similar importance and quality of services are organized into systems so that a road network in accordance with the hierarchy of functions can be planned and formed. They can be efficiently managed with consistent policies, design and operation.

After identification of existing major roads, necessity of additional new links is assessed. For example, if a certain municipal town has no access, a new major road is added to the existing major road network. Thus, the initial major road network is proposed and subjected to evaluation whether the proposed one is well-balanced or not. Evaluation is made by two (2) indicators as follows:

a) Network Value

$$Nv = \frac{L}{\sqrt{PA}}$$

Where: Nv = Network Value
L = Road length delineating a block
P = Population in a block
A = Land Area in a block
Block= Area delineated by major roads

b) Accessibility

Accessibility $AC = \sum pl$

Average Accessibility $A\ ave = \frac{\sum pl}{P}$

Where
p = Population of a Barangay
l = Distance from a barangay center to respective major road
P = Total population in a block

If indicators of some blocks show imbalanced value, additions or deletions of major road links are made until indicators show almost balanced values. After these adjustment, the major road network is finally proposed.

Table 2.4-1 Proposed Functional Road Classification Criteria for Rural Road Network

Functional Classification		General Definition	General Characteristics and Services Provided	Relationship with Administrative Classification				
				National Road	Provincial Road	City Road	Municipal Road	Barangay Road
Major Road	Primary Major Road	. Major inter-provincial roads. . Intra-provincial roads linking two (2) or more municipal towns to the Provincial Capital . Intra-provincial roads which form a skelton road network of a province	. Provides the highest level of service at the high speed for the long uninterrupted distance . Serves for long distance trips . Mobility is given the highest consideration	●				
	Secondary Major Road	. Roads linking municipal towns each other . Roads linking a municipal town to the Provincial Capital . Roads linking one (1) or more municipal towns to the primary major road network	. Provides high level of service . Serves for medium distance trips . Mobility is given high consideration	●	●	●		
Minor Road	Collector Road	. Roads linking secondary major roads each other or a primary road with a secondary road . Roads linking two (2) or more barangays to the municipal town or to the higher level network	. Provides rather low level of mobility . Serves for short distance trips . Collects traffic from feeder roads and connects them with major roads . Mobility and land access		●	●		●
	Feeder Road	. Roads linking one or more barangays centers to the higher level network . Roads linking farm areas to their respective barangay centers or to the higher level network	. Primarily provides access to abutting land with little or no through traffic . Serves for local traffic . Land access is given high			●		●
Street		. Roads within built-up population centers (Poblacion) with essentially urban rather than rural rural functions	. Primarily provides access to abutting land in urban areas . Through traffic usage discouraged			●	●	

NOTE: Relationship between functional classification and administrative classification gives only general guideline, therefore, some national roads may be classified as minor roads, or some barangay roads may be classified as major roads.

2.4.2 Proposed Major Road Network

The major road network for the Province of Davao del Norte was proposed as shown in Figure 2.4-1. For establishing the major road network, the following were taken into consideration:

- Based on the existing fish-bone type of road network with Pan-Philippine Highway as a main axis, a major road network was formulated.
- Though the basic pattern of proposed major road is a fish-bone type, development of mesh type network was proposed at the areas where considered practical.

Network value and accessibility of each block were computed to evaluate whether the proposed major road network is a balanced one. Based on these values, addition or deletion of road links was made and finally the major road network was proposed as shown in Figure 2.4-1.

Network value and accessibility of the proposed major road network are presented in Table 2.4-2.

Proposed major road network has a total length of 841.0 kms. and composed of the following roads.

National Road	269.2 kms.	(76% of all national roads)
Provincial Road	256.2 kms.	(34% of all national roads)
Total	525.4	

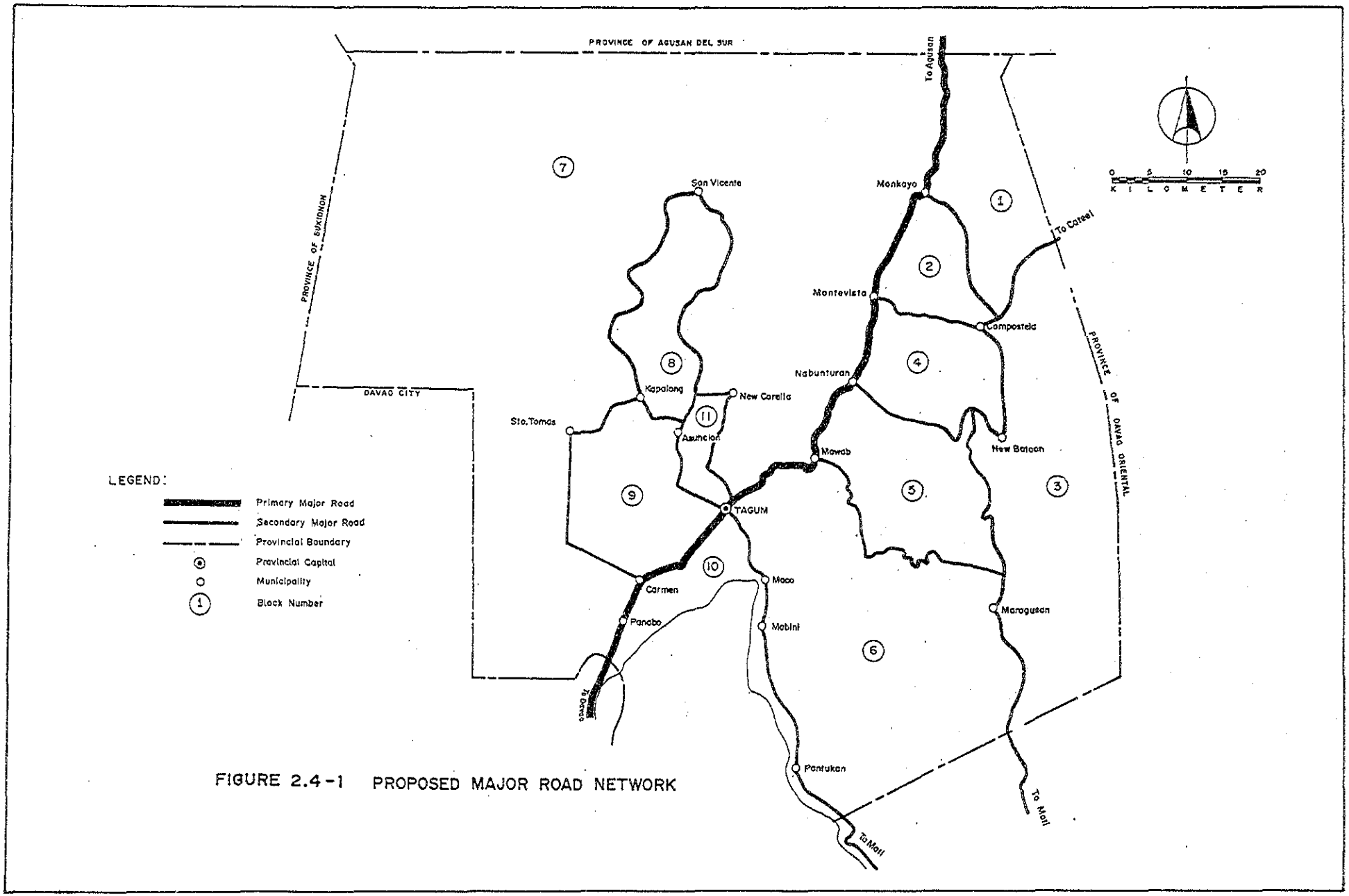


FIGURE 2.4-1 PROPOSED MAJOR ROAD NETWORK

Table 2.4-2

NETWORK VALUE/ACCESSIBILITY
Province of Davao del Norte

Block No.	Population (1990)	Land Area (km^2)	Road Length (km)	Network Value	Access (p.km)	Average Access. (km.)
1	10,293	368.47	63.50	1.031	6,216.5	0.604
2	36,112	152.12	56.60	0.764	47,782.0	1.323
3	36,495	721.93	94.20	0.580	12,316.0	0.337
4	46,420	205.41	67.20	0.688	65,234.0	1.405
5	57,197	475.47	143.60	0.871	149,437.0	2.613
6	129,274	1,047.33	132.60	0.360	367,170.0	2.840
7	277,295	3,564.79	229.50	0.231	962,428.0	3.471
8	36,715	245.71	87.00	0.916	39,399.0	1.073
9	100,767	324.90	77.30	0.427	188,751.0	1.873
10	75,243	130.29	123.80	0.386	100,558.0	1.336
11	28,962	73.69	46.30	1.002	2,064.0	0.071
Ave.	75,888	664.56	101.96	0.454	156,080	2.326

CHAPTER 3
TRAFFIC

3.1 TRAFFIC SURVEY RESULTS

Roadside traffic count survey was conducted on selected roads. Traffic counts were carried out on two (2) consecutive days for 12 hours from 6:00 AM to 6:00 PM each day. Traffic volume was counted by direction and by vehicle type every hour. The vehicle type was classified as follows:

- Car
- Jeep
- Van
- Jeepney
- Bus (mini bus & large bus)
- Truck (including trailer)
- Motor-tricycle
- Motorcycle
- Animal drawn
- Pedestrian
- Others

Figure 3.1-1 shows the location of traffic count stations. Traffic survey results are summarized in Table 3.1-1.

Survey results were converted to Average Daily Traffic (ADT) by using the hourly factors based on the data from the Nationwide Traffic Counts Program (NTCP). Considering other factors such as market days, harvest season, rainy season, etc., AADT were estimated by vehicle type.

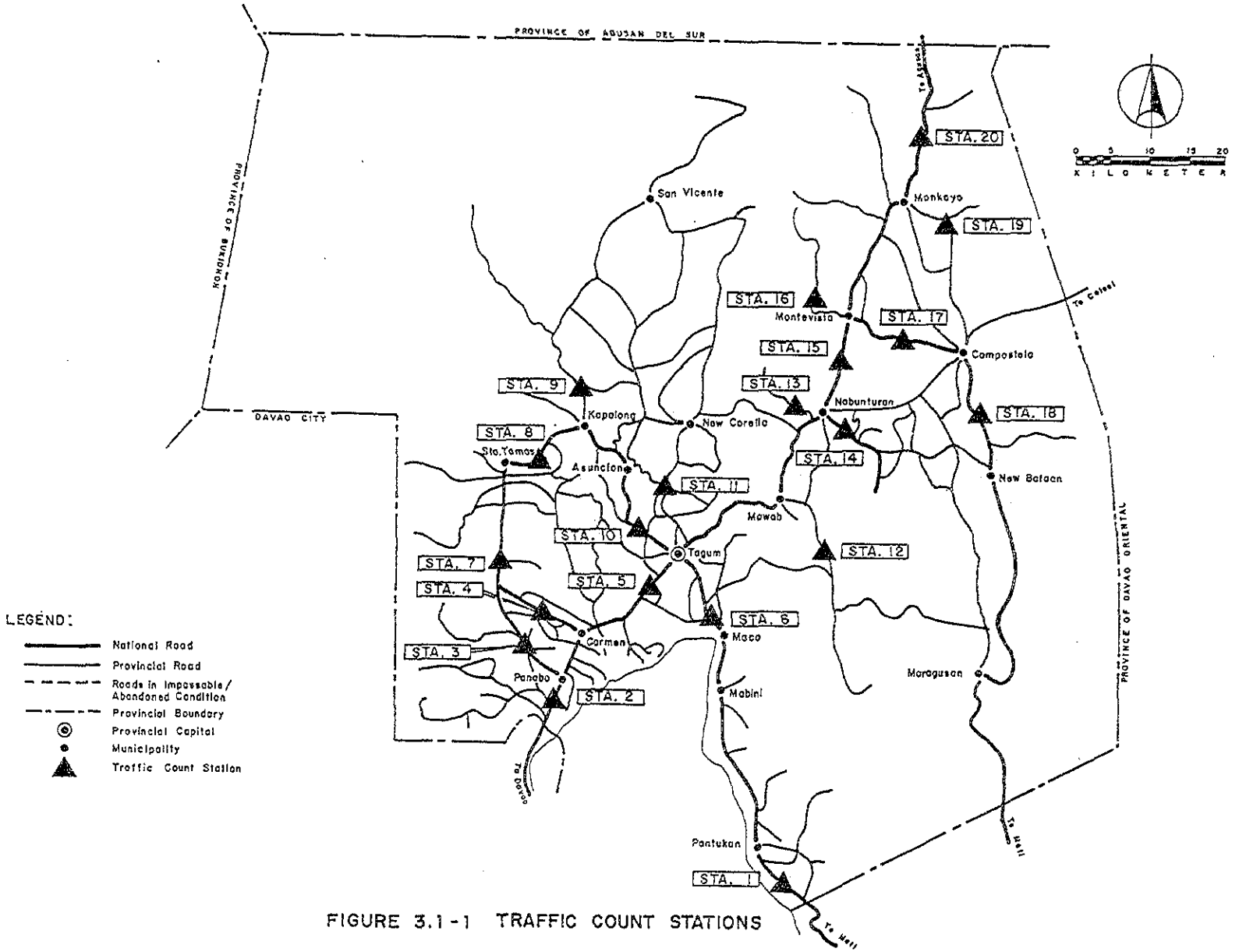


FIGURE 3.1-1 TRAFFIC COUNT STATIONS

TABLE 3.1-1 SUMMARY OF TRAFFIC SURVEY RESULTS
- DAVAO DEL NORTE -

(ADT as of May, 1990)

Station No.	Car	Jeep	Pickup /Van	Jeepney	Bus	Truck	Sub-Total	Tri-cycle	Motor-cycle	Animal Drawn	Total
1	23	29	72	143	79	109	455	185	454	0	1093
2	1045	510	1531	1829	522	1550	6987	1320	616	0	8923
3	73	29	316	132	32	312	894	145	557	7	1603
4	52	53	152	367	43	403	1071	118	199	0	1388
5	976	504	966	979	589	1018	5033	266	538	3	5839
6	177	208	135	847	82	335	1783	178	378	2	2341
7	61	68	213	331	41	539	1253	104	253	0	1611
8	35	58	117	37	11	259	518	564	316	1	1398
9	5	4	53	67	6	49	185	310	264	2	761
10	49	83	155	476	8	231	1003	329	367	1	1700
11	16	17	44	188	1	70	336	232	164	0	732
12	20	40	83	144	13	67	367	180	175	1	724
13	5	1	0	40	0	0	46	0	31	0	76
14	22	44	98	223	12	97	497	364	290	0	1151
15	133	151	252	329	263	518	1645	10	290	0	1945
16	0	2	1	9	0	0	12	0	254	0	267
17	29	27	91	48	125	221	541	11	137	0	689
18	2	2	13	4	6	2	30	6	207	2	245
19	1	12	34	120	4	97	267	106	556	0	928
20	103	153	225	211	234	455	1381	392	375	3	2151

Source: Traffic Survey by Study Team (May, 1990)

3.2 TRAFFIC ANALYSIS AND FORECAST: TRAFFIC PROJECTS.

3.2.1 Analysis of Present Traffic

1) General Procedure

Present traffic on each major road network was analyzed according to the procedure shown in Figure 3.2-1.

The analysis is divided into three major steps:

Step I : Analysis of Traffic Survey Results

The number of passengers and commodity tonnage were obtained from the results of the traffic survey. These data are, however, available only on the surveyed road links and used for calibration purposes for the traffic model described below.

Step II : Analysis by Traffic Model

Traffic generation and attraction, in terms of passengers and commodity tons, were estimated based on population and per capita traffic generation factors; traffic distribution (OD distribution) was estimated by the gravity model; then, OD distribution was assigned to the major road network expressed by the node and link system. In the analysis, since only traffic generation factors were unknown, assumed values were used in the first step.

Step III : Comparison of Both Figures

The number of passengers and commodity tonnage estimated by the traffic model were compared with those derived from the traffic survey. On the basis of the comparison, traffic generation factors were appropriately adjusted and the traffic model analysis was reiterated until the traffic model reflected the actual people and freight movements with a high accuracy.

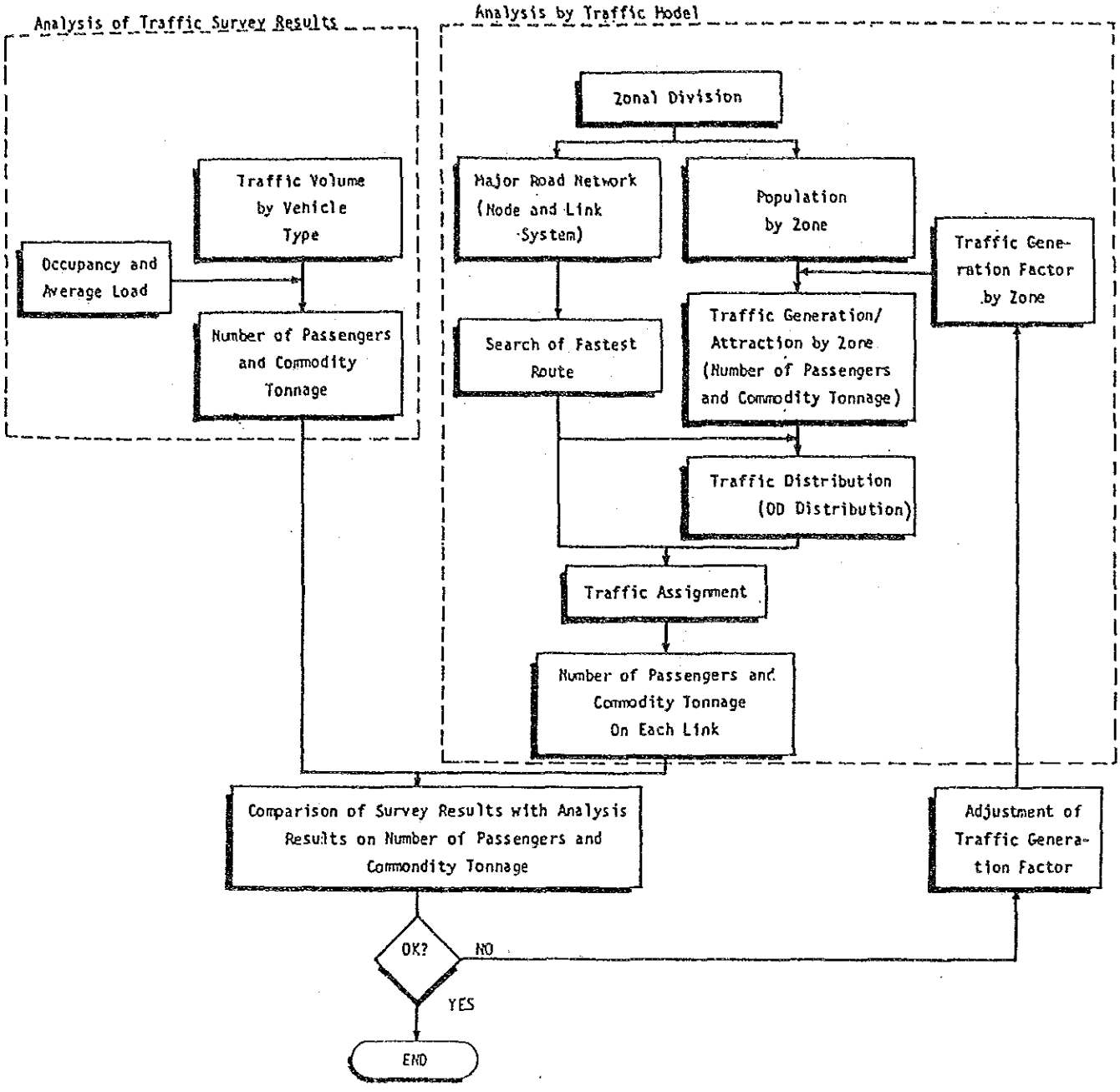


FIGURE 3.2-1
PROCEDURE OF ANALYSIS OF PRESENT TRAFFIC ON MAJOR ROAD NETWORK

2) Analysis of Traffic Survey Results

Traffic volume by vehicle type counted in the traffic survey was converted to number of passengers and commodity tonnage using the occupancy and average load shown in Table 3.2-1.

Table 3.2-1 OCCUPANCY AND AVERAGE LOAD
Province of Davao del Norte

	Average Number of Passenger per vehicle	Average Load (ton per vehicle)
Car/Taxi	3.40	1.00
Jeep	3.40	1.00
Van/Pickup	3.40	1.00
Jeepney	20.00	1.00
Bus	30.00	1.00
Truck	4.00	3.00
Motor-tricycle	2.90	0.30
Motorcycle	1.60	0.10
Animal Drawn	2.00	0.15

3) Analysis by Traffic Model

i) Zonal Division:
The province was divided into traffic zones corresponding to municipal divisions in principle.

ii) Major Road Network:
The major road network was expressed by a node and link system. Each link was given length and average speed according to the actual road condition. A node and link system of the Province is presented in Figure 3.2-2.

iii) Search for the Fastest Route:
The fastest route for each zone pair was calculated by Moore's Method.

iv) Traffic Generation Factor:
Per capita traffic generation factors (trip/person/day and ton/person/day) vary between zones even in the same province with many factors such as:

- Economic Activity
- Size of Population
- Distance from Provincial Capital
- Road Condition
- Other Physical Conditions

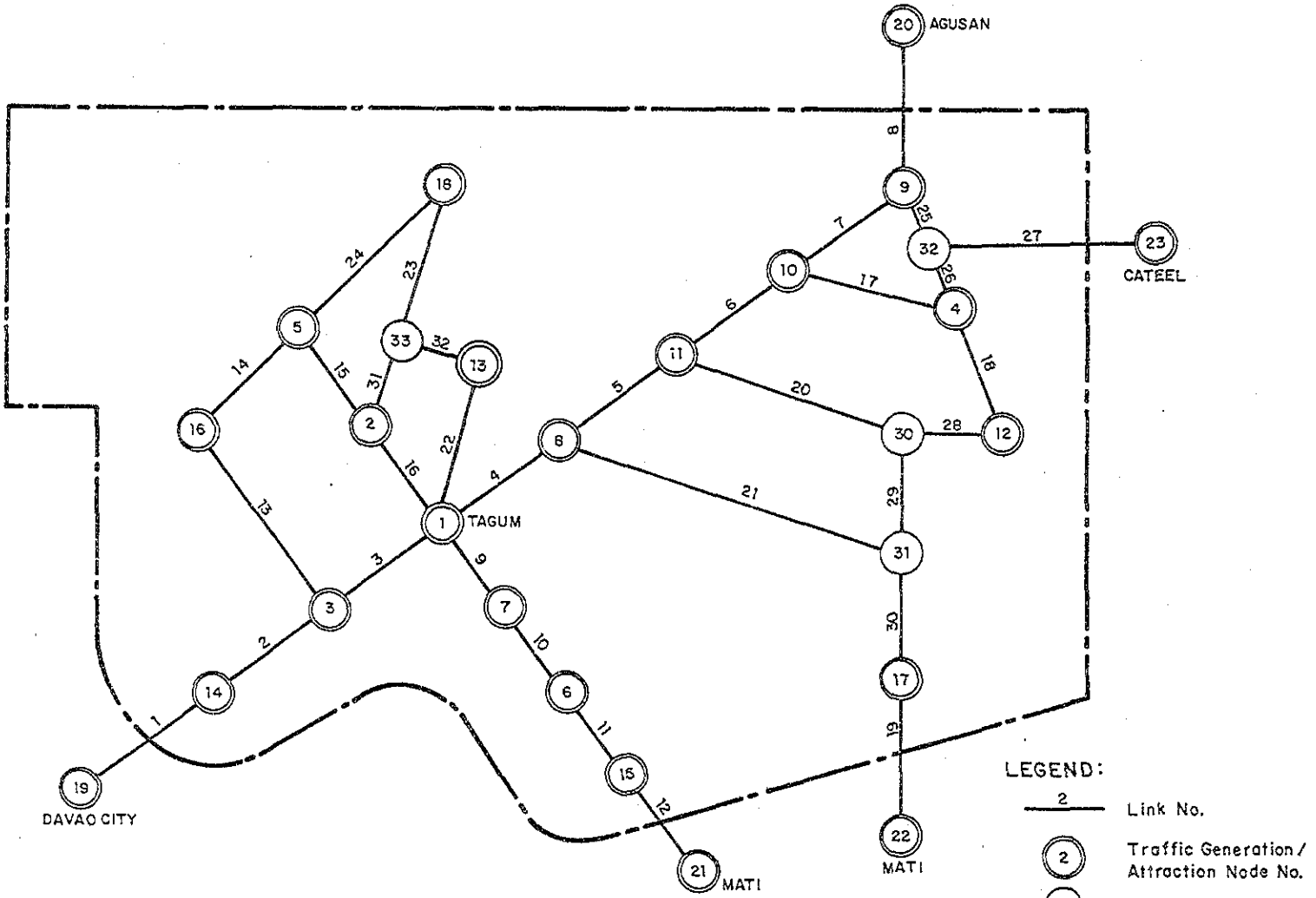


FIGURE 3.2-2 LINK / NODE SYSTEM
PROVINCE OF DAVAO DEL NORTE

The generation factors which best illustrate the observed people and freight movement were estimated by the iterative method. The traffic generation factors thus estimated are summarized in Table 3.2-2.

TABLE 3.2-2 PER CAPITA TRAFFIC GENERATION FACTORS (MAJOR ROAD, 1990 W/O)
Province of Davao del Norte

	Passenger Movement (trip/person/day)	Commodity (kg/person/day)
Range	0.060 - 0.160	10.6 - 33.6
Mean Value	0.107	21.7

v) Traffic Generation and Attraction by Zone:

Traffic generation and attraction were obtained in terms of passengers and commodity tonnage as the product by generation factors.

vi) Traffic Distribution:

Traffic distribution (OD distribution) was estimated by the gravity model:

$$Xij = k\frac{Gi.Aj}{tiJ^2}$$

Where, Xij = Traffic from zone i to zone j
k = Parameter
Gi = Traffic generation in zone i
Aj = Traffic attraction in zone j
tij = Travel time from zone i to zone j along the fastest route

OD distribution was adjusted so as to satisfy the following conditions by the Frator Method:

$$Gi = \sum_{j+1}^{n} Xj$$

$$Aj = \sum_{i+1}^{n} Xj$$

Where, n = Number of zones

vii) Traffic Assignment:

Each OD traffic was assigned to the major road network expressed by the node and link system on an all-or-nothing basis. Thus, the number of passengers and commodity tonnage for each link were calculated.

3.2.2 Traffic Forecast

Figure 3.2-3 illustrates the procedure of traffic forecast.

The traffic model prepared for the analysis of present traffic was basically used for forecasting future traffic on the major road network with the following additions/ modifications:

1) Major Road Network and Fastest Route Search

The node and link system for the "with" case was prepared by changing the characteristics of the links included under this feasibility study as well as the links committed to be improved.

The fastest route search was carried out both in the "w/o" and "with" case networks.

2) Traffic Generation/Attraction and Distribution

The future population was based on the NCSO 1980 Census of Population and Housing.

Per capita traffic generation factors in the "with" case were estimated referring to the generated transport demand/transport cost reduction elasticity shown in "Highway Planning Manual, Volume 3, MPWH" and also based on the results of the analysis of present traffic. For instance, a zone showing a small generation factor at present due to poor road conditions is expected to increase the factor to some extent by road improvement, and the degree of increase can be estimated referring to other zones in similar situations but with better road conditions.

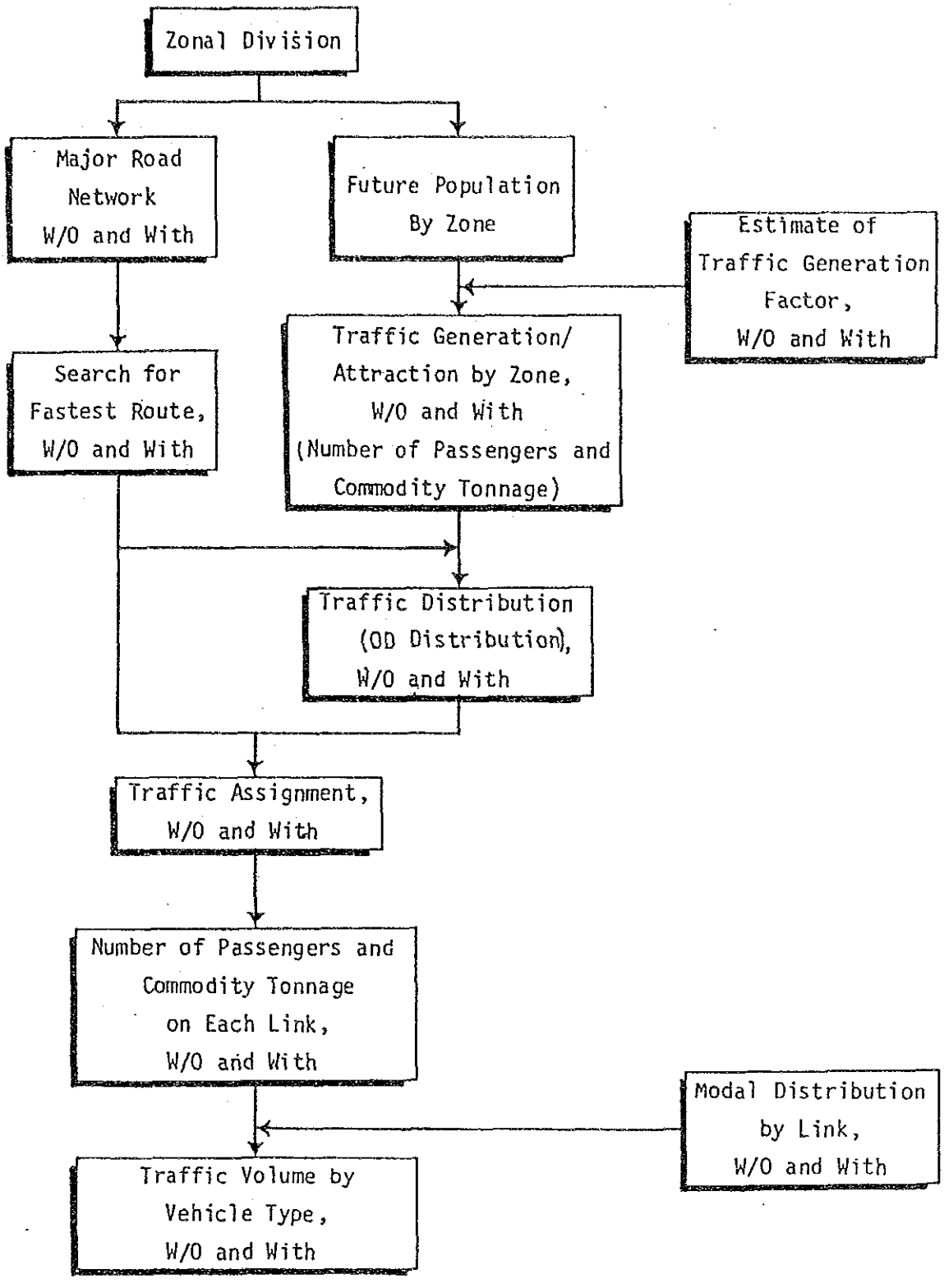


FIGURE 3.2-3
PROCEDURE OF FORECASTING TRAFFIC ON MAJOR ROAD NETWORK

The traffic generation factors thus estimated are summarized in Table 3.2-3.

TABLE 3.2-3 PER CAPITA TRAFFIC GENERATION FACTORS (MAJOR ROAD, 1990 WITH) Province of Davao del Norte

	Passenger Movement (trip/person/day)	Commodity (kg/person/day)
Range	0.060 - 0.160	10.6 - 33.6
Mean Value	0.108	21.9

The transition period, i.e., the period which will elapse after opening of the improved road before the full impact on generation will take place, was assumed to be three years.

Traffic distribution for the "with" case was estimated by the same method as used in the analysis of present traffic.

3) Traffic Assignment

The number of passengers and commodity tonnage on each link in the "with" case was estimated by assigning OD traffic to the major road network in the "with" case. They were converted to the number of vehicles using the modal distribution in the "with" case. Changes in modal distribution with changes in road condition were estimated reffering to the present distribution in other road links in a similar situation but in the road condition. The transition period of a complete change in modal distribution was assumed to be three years.

The traffic in the "with" case was broken down into following four categories for convenience of traffic benefit estimation:

Normal Traffic: Flow of passengers and freight which will occur even without road improvement. However, changes in the number of vehicles is possible due to changes in modal distribution.

Diverted Traffic-1: Traffic which diverts to a certain road from other routes as a consequence of road improvement. This is usually called simply diverted traffic.

Diverted Traffic-2: Traffic which changes destination as a consequence of road improvement but for the same trip purpose as in the "w/o" case. This is possible in the case of improvement of the access road to the nearest town which is at present barely accessible due to poor conditions. This traffic is called "Diverted Traffic-2" in this Study, distinguished from Diverted Traffic-1.

Generated Traffic: Increased traffic brought about by road improvement.

3.2.3 Estimated Present and Future Traffic

Estimated present and future traffic on the major road is illustrated in Figure 3.2-4 and Figure 3.2-5, respectively.

Estimated present and future movements of passengers and commodity by link are presented in Table 3.2-4, and estimated traffic volumes are presented in Table 3.2-5.

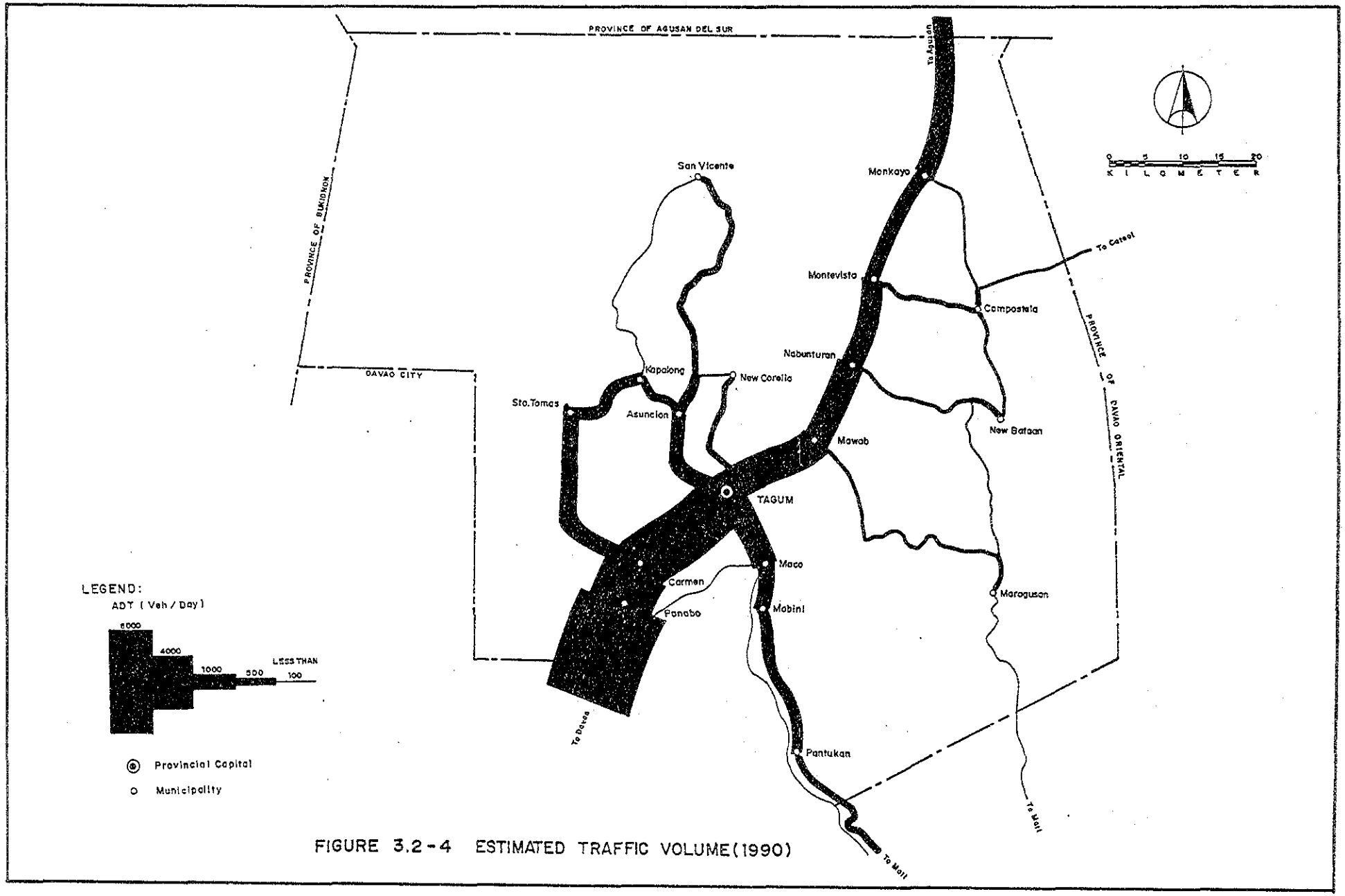


FIGURE 3.2-4 ESTIMATED TRAFFIC VOLUME(1990)

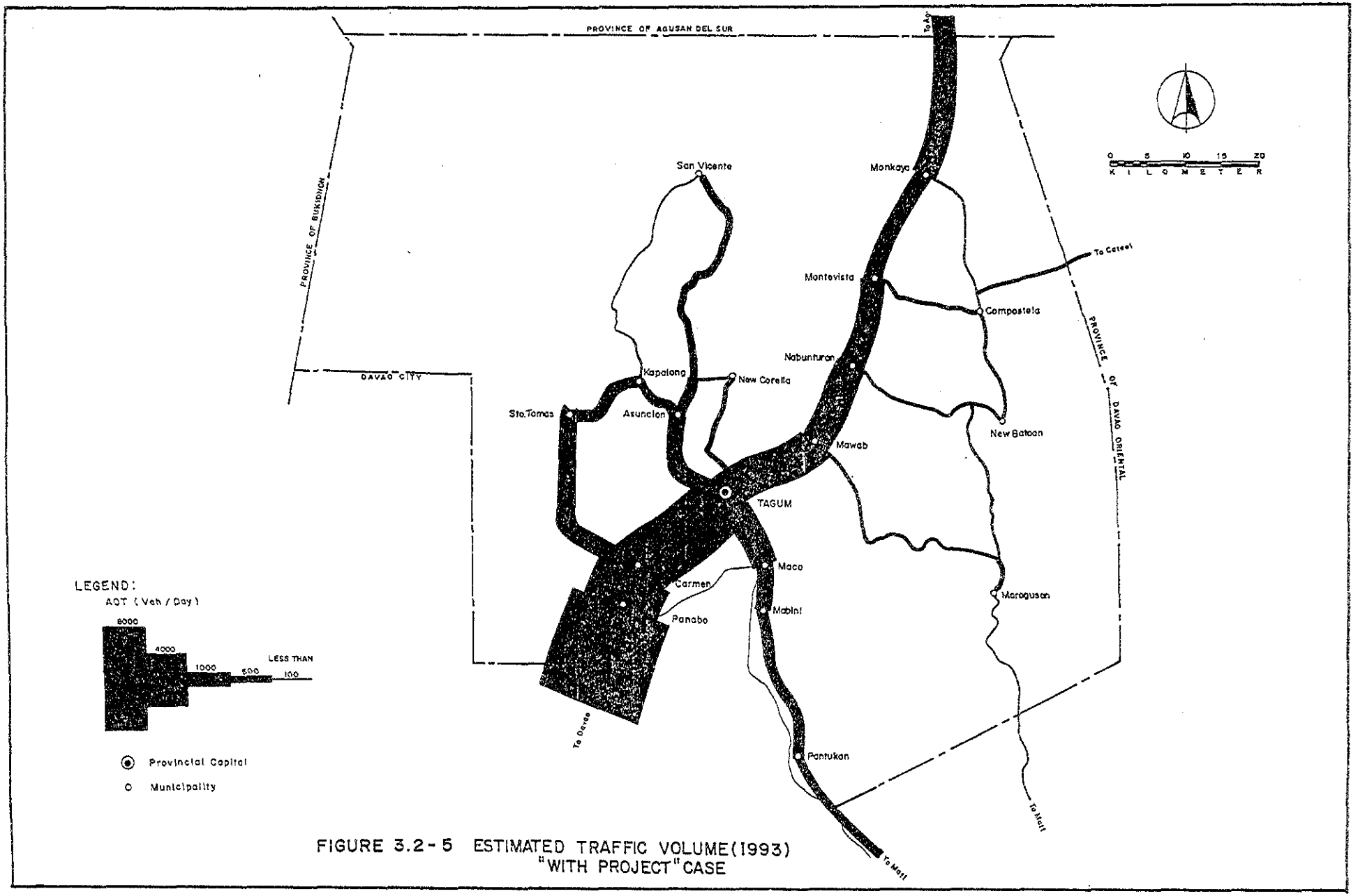


FIGURE 3.2-5 ESTIMATED TRAFFIC VOLUME(1993)
"WITH PROJECT" CASE

TRAFFIC PROJECTION DAVAO DEL NORTE

TABLE 3.2 - 4 (1)

Movement of Passengers and Commodity

Link	Year	Number of Passengers					Commodity Tonnage				
		Normal	Diverted-1	Diverted-2	Generated	Total	Normal	Diverted-1	Diverted-2	Generated	Total
1	1990	44805				44805	6868.86				6868.86
	1993	52503	-	76	-	52579	7818.42	-	11.11	-	7829.53
	1997	65131	-	94	-	65225	9331.12	-	12.99	-	9344.12
	2007	107892	-	153	-	108045	14032.44	-	-2.39	-	14030.04
	2017	172391	-	-24	-	172367	20352.36	-	-3.20	-	20349.16
2	1990	36252				36252	4295.51				4295.51
	1993	42498	-	85	-	42583	4902.11	-	5.32	-	4907.43
	1997	52870	-	105	-	52974	5896.25	-	6.43	-	5902.68
	2007	88223	-	170	-	88393	9040.38	-	-16.27	-	9024.11
	2017	141945	-	-57	-	141887	13344.98	-	-21.83	-	13323.14
3	1990	29270				29270	3581.81				3581.81
	1993	34158	-	-12	-	34146	4085.30	-	-18.03	-	4067.27
	1997	42239	-	-19	-	42221	4899.97	-	-22.52	-	4877.46
	2007	69605	-	-48	-	69558	7469.67	-	-50.54	-	7419.13
	2017	110960	-	-342	-	110618	10978.53	-	-76.16	-	10902.36
4	1990	15624				15624	2416.00				2416.00
	1993	18385	-	-308	133	18210	2763.70	-	-64.20	22.74	2722.23
	1997	22922	-	-380	470	23013	3316.76	-	-75.36	77.39	3318.79
	2007	38535	-	-617	696	38614	5069.67	-	-111.84	103.20	5061.03
	2017	62550	-	-1030	1006	62526	7481.57	-	-156.66	135.57	7460.48
5	1990	13326				13326	2081.71				2081.71
	1993	15537	-	-315	65	15287	2357.65	-	-63.65	11.03	2305.03
	1997	19104	-	-388	233	18949	2787.38	-	-74.75	38.18	2750.81
	2007	30952	-	-628	363	30687	4095.49	-	-110.38	52.61	4037.73
	2017	48442	-	-1027	541	47955	5813.77	-	-154.05	71.77	5731.48
6	1990	11023				11023	1784.32				1784.32
	1993	12934	-	-193	40	12780	2034.09	-	-38.96	6.73	2001.86
	1997	16031	-	-239	147	15938	2426.08	-	-45.95	24.07	2404.19
	2007	26507	-	-391	244	26361	3645.91	-	-67.95	35.68	3613.64
	2017	42302	-	-631	385	42056	5289.12	-	-94.76	51.26	5245.62
7	1990	7091				7091	1142.82				1142.82
	1993	8336	-	-25	-	8311	1305.62	-	-6.74	-	1298.88
	1997	10352	-	-31	-	10321	1561.74	-	-7.85	-	1553.89
	2007	17233	-	-53	-	17180	2368.09	-	-12.05	-	2356.04
	2017	27721	-	-95	-	27626	3469.69	-	-17.31	-	3452.38
8	1990	10033				10033	1731.60				1731.60
	1993	11804	-	-5	-	11799	1977.21	-	-.08	-	1977.14
	1997	14642	-	-6	-	14636	2359.22	-	-.09	-	2359.13
	2007	24252	-	-10	-	24242	3545.98	-	.15	-	3546.13
	2017	38743	-	2	-	38745	5140.74	-	.18	-	5140.92

TRAFFIC PROJECTION DAVAO DEL NORTE
TABLE 3.2 - 4 (2)
Movement of Passengers and Commodity

Link	Year	Number of Passengers					Commodity Tonnage				
		Normal	Diverted-1	Diverted-2	Generated	Total	Normal	Diverted-1	Diverted-2	Generated	Total
	1990	10966				10966	1652.60				1652.60
	1993	12791	-	-8	-	12784	1859.69	-	-5.16	-	1854.53
9	1997	15726	-	-9	-	15717	2177.96	-	-5.81	-	2172.14
	2007	25467	-	-14	-	25453	3129.32	-	-8.06	-	3121.26
	2017	39841	-	-35	-	39806	4357.29	-	-10.58	-	4346.71
	1990	5445				5445	1139.81				1139.81
	1993	6318	-	-9	-	6308	1272.26	-	-4.30	-	1267.96
10	1997	7718	-	-11	-	7707	1473.78	-	-4.89	-	1468.89
	2007	12372	-	-18	-	12354	2067.66	-	-6.79	-	2060.87
	2017	19282	-	-35	-	19246	2826.22	-	-9.08	-	2817.14
	1990	3872				3872	934.17				934.17
	1993	4524	-	-9	-	4515	1042.24	-	-3.31	-	1038.94
11	1997	5581	-	-11	-	5570	1206.44	-	-3.85	-	1202.59
	2007	9151	-	-17	-	9134	1690.07	-	-5.53	-	1684.54
	2017	14539	-	-35	-	14504	2308.08	-	-7.70	-	2300.37
	1990	4363				4363	456.80				456.80
	1993	5132	-	-1	-	5130	521.43	-	.03	-	521.46
12	1997	6366	-	-2	-	6364	622.24	-	.03	-	622.27
	2007	10546	-	-3	-	10543	935.43	-	-.03	-	935.40
	2017	16851	-	2	-	16853	1356.34	-	-.04	-	1356.30
	1990	6295				6295	1561.47				1561.47
	1993	7661	-	7	-	7668	1862.27	-	-6.03	-	1856.24
13	1997	9971	-	8	-	9979	2357.60	-	-7.97	-	2349.63
	2007	18277	-	10	-	18287	4019.51	-	-14.71	-	4004.80
	2017	31510	-	-3	-	31506	6413.94	-	-23.26	-	6390.68
	1990	3230				3230	969.64				969.64
	1993	3898	-	14	-	3912	1139.04	-	6.77	-	1145.81
14	1997	5007	-	18	-	5024	1408.26	-	8.69	-	1416.95
	2007	8882	-	31	-	8914	2265.84	-	16.67	-	2282.51
	2017	14862	-	54	-	14916	3430.68	-	26.12	-	3456.80
	1990	2901				2901	661.95				661.95
	1993	3406	-	-33	-	3373	748.00	-	1.30	-	749.29
15	1997	4204	-	-38	-	4166	879.02	-	2.09	-	881.11
	2007	6828	-	-54	-	6774	1267.42	-	5.05	-	1272.48
	2017	10640	-	-62	-	10578	1762.86	-	8.44	-	1771.30
	1990	6705				6705	1018.18				1018.18
	1993	7694	-	-216	133	7610	1131.65	-	-42.06	22.74	1112.33
16	1997	9244	-	-251	470	9463	1303.17	-	-46.82	77.39	1333.75
	2007	14213	-	-356	696	14553	1798.78	-	-61.22	103.20	1840.76
	2017	21306	-	-505	1006	21807	2419.02	-	-78.31	135.57	2476.29

TRAFFIC PROJECTION DAVAO DEL NORTE

TABLE 3.2 - 4 (3)

Movement of Passengers and Commodity

Link	Year	Number of Passengers					Commodity Tonnage				
		Normal	Diverted-1	Diverted-2	Generated	Total	Normal	Diverted-1	Diverted-2	Generated	Total
17	1990	2724				2724	456.50				456.50
	1993	3208	-	-189	40	3059	521.83	-	-34.99	6.73	493.58
	1997	3993	-	-234	147	3906	623.95	-	-41.55	24.07	606.47
	2007	6627	-	-382	244	6489	936.35	-	-61.26	35.68	910.77
	2017	10533	-	-601	385	10318	1346.30	-	-85.78	51.26	1311.77
18	1990	991				991	197.49				197.49
	1993	1172	-	106	73	1351	226.48	-	18.70	12.46	257.64
	1997	1462	-	126	291	1879	271.76	-	21.29	47.71	340.76
	2007	2462	-	186	553	3201	415.19	-	28.13	82.84	526.16
	2017	4011	-	266	984	5261	613.67	-	34.74	133.41	781.81
19	1990	476				476	83.58				83.58
	1993	555	-	-	185	740	94.72	-	.02	31.74	126.48
	1997	682	-	-	682	1364	111.99	-	.02	112.58	224.59
	2007	1104	-	1	1100	2205	164.76	-	-.01	166.65	331.40
	2017	1731	-	-	1733	3464	234.42	-	-.01	237.35	471.76
20	1990	2101				2101	352.56				352.56
	1993	2472	-	-74	25	2423	403.80	-	-11.66	4.30	396.44
	1997	3079	-	-83	86	3082	485.65	-	-12.18	14.11	487.59
	2007	5185	-	-103	118	5200	750.23	-	-11.90	16.93	755.26
	2017	8471	-	-112	156	8515	1124.71	-	-9.07	20.51	1136.14
21	1990	1361				1361	212.45				212.45
	1993	1753	-	2	68	1822	266.75	-	.12	11.71	278.58
	1997	2464	-	3	237	2704	362.44	-	.31	39.22	401.97
	2007	5371	-	6	334	5711	723.06	-	.76	50.58	774.40
	2017	10638	-	7	465	11109	1307.16	-	1.52	63.81	1372.49
22	1990	2370				2370	540.12				540.12
	1993	2590	-	-211	-	2379	572.09	-	-56.84	-	515.25
	1997	2914	-	-235	-	2679	617.75	-	-61.33	-	556.42
	2007	3881	-	-308	-	3573	742.08	-	-73.71	-	668.37
	2017	5188	-	-406	-	4782	895.05	-	-88.55	-	806.50
23	1990	3119				3119	488.28				488.28
	1993	3520	-	-67	133	3586	531.72	-	-15.54	22.74	538.92
	1997	4132	-	-83	470	4520	595.96	-	-18.37	77.39	654.99
	2007	6038	-	-131	696	6603	776.77	-	-27.14	103.20	852.83
	2017	8687	-	-200	1006	9493	999.94	-	-37.86	135.57	1097.66
24	1990	402				402	132.87				132.87
	1993	470	-	65	-	535	151.29	-	15.41	-	166.69
	1997	573	-	80	-	653	178.83	-	18.22	-	197.06
	2007	902	-	128	-	1030	260.25	-	27.06	-	287.31
	2017	1365	-	200	-	1565	363.11	-	37.74	-	400.85

TRAFFIC PROJECTION DAVAO DEL NORTE

TABLE 3.2 - 4 (4)

Movement of Passengers and Commodity

Link	Year	Number of Passengers					Commodity Tonnage				
		Normal	Diverted-1	Diverted-2	Generated	Total	Normal	Diverted-1	Diverted-2	Generated	Total
25	1990	1083				1083	211.09				211.09
	1993	1276	-	62	-	1339	241.00	-	11.64	-	252.63
	1997	1579	-	79	-	1659	286.54	-	14.21	-	300.74
	2007	2583	-	140	-	2723	423.84	-	22.91	-	446.74
	2017	4052	-	243	-	4295	601.19	-	34.82	-	636.02
26	1990	1922				1922	351.36				351.36
	1993	2295	-	-35	113	2373	406.47	-	-7.19	19.19	418.48
	1997	2901	-	-47	438	3292	493.18	-	-9.21	71.78	555.75
	2007	4997	-	-90	797	5704	767.66	-	-15.85	118.52	870.34
	2017	8223	-	-157	1369	9434	1142.51	-	-25.71	184.67	1301.47
27	1990	1145				1145	202.22				202.22
	1993	1393	-	-1	113	1505	238.67	-	-.06	19.19	257.80
	1997	1805	-	-1	438	2242	297.49	-	-.07	71.78	369.20
	2007	3283	-	-2	797	4078	491.04	-	-.01	118.52	609.54
	2017	5636	-	-1	1369	7004	765.08	-	-.01	184.67	949.74
28	1990	2146				2146	364.38				364.38
	1993	2528	-	-129	142	2541	418.35	-	-23.53	24.33	419.15
	1997	3155	-	-161	532	3526	504.58	-	-28.21	87.47	563.83
	2007	5321	-	-269	885	5937	781.87	-	-43.09	132.99	871.77
	2017	8670	-	-435	1424	9659	1168.82	-	-63.44	194.05	1299.43
29	1990	688				688	141.62				141.62
	1993	898	-	-3	117	1012	179.50	-	-.50	20.03	199.03
	1997	1277	-	-4	445	1718	245.60	-	-.67	73.36	318.29
	2007	2833	-	-9	767	3591	494.13	-	-.71	116.06	609.49
	2017	5657	-	-	1268	6925	893.18	-	-1.16	173.55	1065.57
30	1990	2049				2049	354.07				354.07
	1993	2651	-	-2	185	2834	446.25	-	-.38	31.74	477.61
	1997	3741	-	-2	682	4422	608.04	-	-.36	112.58	720.26
	2007	8204	-	-2	1100	9301	1217.19	-	.05	166.65	1383.89
	2017	16295	-	6	1733	18034	2200.34	-	.36	237.35	2438.05
31	1990	3339				3339	582.81				582.81
	1993	3768	-	93	133	3994	635.81	-	30.54	22.74	689.08
	1997	4422	-	98	470	4990	713.77	-	31.82	77.39	822.98
	2007	6453	-	110	696	7259	932.94	-	34.47	103.20	1070.60
	2017	9270	-	123	1006	10399	1202.69	-	37.33	135.57	1375.60
32	1990	511				511	180.05				180.05
	1993	555	-	209	-	764	191.04	-	56.66	-	247.71
	1997	617	-	233	-	850	206.32	-	61.14	-	267.46
	2007	797	-	305	-	1103	248.83	-	73.58	-	322.41
	2017	1041	-	405	-	1445	302.06	-	88.39	-	390.46

TRAFFIC PROJECTION DAVAO DEL NORTE

TABLE 3.2 - 5 (1)

Traffic Volume

Link	Year	w/o								with							
		Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total	Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total
	1990	3077	1817	524	1543	6962	123	56	-	7141								
	1993	3552	2111	612	1757	8032	143	66	-	8240	3557	2114	613	1759	8043	143	66	-	8252
1	1997	4319	2590	756	2096	9762	175	81	-	10017	4325	2594	757	2099	9775	175	82	-	10032
	2007	6816	4178	1242	3153	15389	280	135	-	15803	6821	4182	1243	3152	15398	280	135	-	15813
	2017	10401	6512	1967	4572	23453	433	215	-	24101	10399	6511	1967	4572	23449	433	215	-	24098
	1990	2311	1180	520	965	4976	14	45	-	5035									
	1993	2676	1374	609	1101	5760	16	53	-	5829	2680	1376	610	1103	5769	16	53	-	5838
2	1997	3279	1695	755	1325	7054	20	66	-	7140	3285	1698	757	1326	7065	20	66	-	7151
	2007	5277	2772	1252	2031	11332	30	110	-	11472	5279	2775	1254	2027	11335	30	110	-	11476
	2017	8196	4376	2002	2998	17573	44	177	-	17795	8188	4373	2001	2993	17557	44	177	-	17778
	1990	2025	820	500	805	4149	-	37	-	4186									
	1993	2339	950	583	918	4790	-	43	-	4833	2334	949	582	914	4779	-	43	-	4822
3	1997	2855	1165	718	1101	5840	-	53	-	5893	2849	1164	718	1096	5826	-	53	-	5879
	2007	4555	1881	1176	1678	9290	-	87	-	9377	4540	1877	1175	1667	9259	-	87	-	9346
	2017	7031	2938	1863	2467	14298	-	139	-	14437	6998	2927	1856	2449	14231	-	138	-	14369
	1990	998	450	294	572	2313	-	20	-	2333									
	1993	1157	524	345	654	2680	-	23	-	2703	1142	518	342	644	2647	-	23	-	2670
4	1997	1414	646	429	785	3274	-	29	-	3303	1417	648	431	785	3281	-	29	-	3310
	2007	2268	1056	715	1200	5238	-	48	-	5286	2268	1057	716	1198	5238	-	48	-	5287
	2017	3518	1669	1150	1771	8108	-	78	-	8186	3513	1667	1150	1766	8095	-	78	-	8173
	1990	695	367	266	518	1847	-	25	-	1872									
	1993	797	424	310	587	2118	-	29	-	2147	782	416	305	574	2077	-	29	-	2105
5	1997	960	515	379	694	2548	-	36	-	2584	949	510	376	685	2521	-	36	-	2556
	2007	1477	812	609	1020	3918	-	58	-	3976	1460	804	604	1005	3873	-	58	-	3930
	2017	2201	1238	946	1448	5832	-	91	-	5923	2175	1224	936	1427	5762	-	90	-	5852
	1990	477	291	231	466	1466	-	28	-	1494									
	1993	551	339	270	532	1692	-	32	-	1724	543	335	267	523	1668	-	32	-	1700
6	1997	668	415	334	634	2052	-	40	-	2092	663	413	332	628	2036	-	40	-	2076
	2007	1049	669	547	953	3218	-	66	-	3284	1041	664	544	944	3194	-	66	-	3260
	2017	1593	1041	867	1382	4883	-	106	-	4989	1582	1034	862	1371	4848	-	105	-	4954
	1990	319	166	158	299	942	-	22	-	964									
	1993	369	193	185	342	1089	-	26	-	1115	368	193	184	340	1085	-	26	-	1111
7	1997	449	237	229	409	1324	-	32	-	1357	447	237	228	407	1319	-	32	-	1351
	2007	711	385	378	620	2094	-	54	-	2148	708	383	377	616	2086	-	54	-	2139
	2017	1091	604	604	908	3207	-	87	-	3293	1086	602	602	903	3193	-	86	-	3280
	1990	482	212	233	455	1383	-	38	-	1421									
	1993	558	247	274	520	1599	-	44	-	1643	558	247	273	520	1598	-	44	-	1643
8	1997	677	303	338	620	1939	-	55	-	1994	677	303	338	620	1939	-	55	-	1993
	2007	1063	489	555	933	3040	-	91	-	3131	1063	489	555	933	3039	-	91	-	3130
	2017	1614	762	880	1352	4608	-	145	-	4753	1614	762	880	1352	4608	-	145	-	4754

TRAFFIC PROJECTION DAVAO DEL NORTE

TABLE 3.2 - 5 (2)

Traffic Volume

Link	Year	w/o								with							
		Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total	Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total
9	1990	462	711	63	371	1607	-	27	-	1635									
	1993	529	818	73	417	1837	-	32	-	1869	528	816	73	416	1834	-	32	-	1866
	1997	634	987	90	489	2199	-	39	-	2238	633	985	90	487	2195	-	39	-	2235
	2007	967	1530	143	702	3342	-	64	-	3406	965	1528	143	700	3337	-	64	-	3400
	2017	1431	2302	220	977	4931	-	100	-	5031	1429	2299	220	975	4923	-	100	-	5023
10	1990	265	353	56	261	934	-	27	-	962									
	1993	299	402	64	291	1057	-	32	-	1088	298	401	64	290	1054	-	32	-	1085
	1997	352	480	78	337	1247	-	39	-	1286	351	479	77	336	1244	-	39	-	1283
	2007	518	727	122	473	1840	-	62	-	1902	517	725	122	472	1835	-	62	-	1897
	2017	744	1075	186	647	2653	-	96	-	2749	742	1072	186	645	2646	-	96	-	2742
11	1990	205	224	58	219	706	-	36	-	743									
	1993	232	256	67	244	799	-	42	-	842	231	256	67	243	797	-	42	-	839
	1997	273	307	81	283	944	-	52	-	996	272	306	81	282	941	-	52	-	993
	2007	400	468	130	396	1394	-	86	-	1480	399	467	130	395	1390	-	86	-	1476
	2017	573	699	202	541	2015	-	136	-	2151	572	697	202	539	2009	-	136	-	2145
12	1990	124	143	79	109	455	-	46	-	502									
	1993	144	167	93	124	527	-	55	-	582	144	167	92	124	527	-	55	-	582
	1997	174	205	114	148	641	-	68	-	709	174	205	114	148	641	-	68	-	709
	2007	271	330	188	223	1012	-	112	-	1124	271	330	188	223	1012	-	112	-	1124
	2017	409	514	298	323	1545	-	179	-	1724	409	514	298	323	1545	-	179	-	1724
13	1990	301	316	41	433	1090	-	24	-	1114									
	1993	362	382	49	516	1310	-	29	-	1339	362	382	49	514	1308	-	29	-	1337
	1997	464	494	64	653	1676	-	37	-	1713	463	494	64	651	1672	-	37	-	1710
	2007	816	890	117	1113	2937	-	69	-	3005	814	890	117	1109	2931	-	69	-	2999
	2017	1346	1509	201	1777	4833	-	118	-	4951	1344	1507	201	1770	4822	-	118	-	4940
14	1990	359	86	29	272	746	-	93	-	839									
	1993	429	104	35	319	887	-	112	-	999	431	104	36	321	892	-	112	-	1004
	1997	543	132	45	395	1115	-	144	-	1259	545	133	46	397	1121	-	144	-	1265
	2007	929	232	80	635	1877	-	255	-	2132	934	233	81	640	1887	-	256	-	2143
	2017	1502	384	134	962	2982	-	427	-	3409	1509	385	135	969	2998	-	429	-	3427
15	1990	190	127	5	186	508	-	36	-	545									
	1993	219	149	6	210	584	-	43	-	627	219	147	6	210	582	-	42	-	624
	1997	264	183	8	246	702	-	53	-	754	263	181	8	247	700	-	52	-	752
	2007	406	295	13	355	1069	-	85	-	1154	405	293	13	357	1067	-	85	-	1152
	2017	602	457	19	494	1573	-	133	-	1706	601	455	19	497	1572	-	132	-	1704
16	1990	278	449	8	231	965	-	34	-	999									
	1993	312	510	9	257	1088	-	38	-	1126	308	503	9	252	1072	-	38	-	1110
	1997	365	604	11	296	1276	-	46	-	1322	374	619	11	303	1306	-	47	-	1353
	2007	525	901	16	408	1850	-	71	-	1921	537	922	16	418	1894	-	73	-	1966
	2017	738	1311	24	549	2622	-	107	-	2728	755	1342	24	562	2684	-	109	-	2793

TRAFFIC PROJECTION DAVAO DEL NORTE

TABLE 3.2 - 5 (3)

Traffic Volume

Link	Year	w/o									with							
		Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total	Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total
	1990	88	30	79	128	326	-	9	-	335								
	1993	102	35	93	147	377	-	10	-	387	97	34	89	139	358	-	10	-	368
17	1997	124	44	116	176	459	-	12	-	471	120	43	113	171	447	-	12	-	459
	2007	193	70	191	263	718	-	21	-	738	188	69	187	256	700	-	20	-	720
	2017	290	109	301	379	1079	-	33	-	1112	283	107	294	369	1054	-	32	-	1086
	1990	139	22	26	19	206	-	78	-	284								
	1993	160	25	30	22	238	-	92	-	330	182	29	35	25	271	-	106	-	377
18	1997	193	31	38	27	288	-	115	-	403	242	39	48	33	363	-	148	-	511
	2007	298	50	62	41	450	-	194	-	644	379	64	80	51	575	-	252	-	827
	2017	447	78	99	60	683	-	316	-	999	571	101	129	76	878	-	414	-	1292
	1990	8	50	2	17	77	-	3	-	80								
	1993	10	57	2	19	88	-	3	-	91	15	70	7	25	117	-	5	-	122
19	1997	12	69	2	22	105	-	4	-	109	35	103	27	45	210	-	9	-	219
	2007	18	106	4	33	161	-	7	-	167	55	156	43	66	320	-	14	-	334
	2017	27	158	6	47	237	-	11	-	248	85	228	67	94	474	-	22	-	496
	1990	113	139	7	73	333	-	17	-	350								
	1993	131	162	8	83	385	-	20	-	405	131	141	20	82	374	-	18	-	392
20	1997	159	200	10	100	469	-	25	-	494	169	129	57	101	456	-	19	-	475
	2007	251	327	17	155	750	-	42	-	793	269	209	96	156	730	-	33	-	762
	2017	386	520	28	232	1167	-	69	-	1236	417	327	157	235	1136	-	53	-	1189
	1990	85	81	7	42	215	-	9	-	224								
	1993	108	103	9	53	272	-	12	-	284	117	99	15	55	285	-	12	-	297
21	1997	148	143	13	71	375	-	17	-	392	183	120	37	79	419	-	17	-	436
	2007	304	303	27	142	777	-	37	-	814	366	244	77	153	840	-	36	-	876
	2017	567	585	54	258	1463	-	73	-	1536	676	458	150	270	1553	-	69	-	1623
	1990	107	209	.8	120	437	-	13	-	450								
	1993	114	225	.9	127	467	-	15	-	482	116	187	11	115	429	-	14	-	443
22	1997	125	248	1	138	511	-	16	-	528	156	168	35	124	483	-	17	-	499
	2007	153	316	1	165	636	-	22	-	658	197	211	46	149	603	-	22	-	625
	2017	190	406	2	199	797	-	29	-	826	250	266	62	180	758	-	30	-	788
	1990	163	202	8	96	470	-	19	-	490								
	1993	179	226	9	105	519	-	22	-	541	203	206	22	106	538	-	22	-	560
23	1997	202	262	11	117	592	-	26	-	618	302	198	61	129	691	-	28	-	719
	2007	269	370	15	153	808	-	38	-	846	412	277	89	168	946	-	41	-	987
	2017	355	518	21	197	1091	-	54	-	1145	556	381	128	216	1282	-	59	-	1341
	1990	34	28	2	30	95	-	9	-	104								
	1993	39	33	3	34	109	-	10	-	119	44	35	4	38	121	-	12	-	133
24	1997	47	39	3	40	129	-	13	-	142	55	38	7	44	144	-	14	-	159
	2007	69	60	5	59	192	-	20	-	212	81	58	12	65	215	-	23	-	237
	2017	97	88	7	82	274	-	30	-	304	114	84	18	90	307	-	34	-	341

TRAFFIC PROJECTION DAVAO DEL NORTE

TABLE 3.2 - 5 (4)

Traffic Volume

Link	Year	w/o									with								
		Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total	Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total
	1990	27	68	2	56	154	-	32	-	186									
	1993	31	80	3	64	178	-	37	-	216	35	80	6	67	188	-	28	-	216
25	1997	38	98	3	76	215	-	46	-	261	47	88	15	80	230	-	5	-	235
	2007	57	155	5	113	331	-	76	-	407	73	140	24	119	356	-	9	-	364
	2017	83	237	8	160	489	-	119	-	608	108	213	38	169	529	-	13	-	542
	1990	46	119	4	94	263	-	55	-	318									
	1993	54	141	5	108	308	-	66	-	374	59	139	10	111	320	-	48	-	368
26	1997	66	176	6	131	380	-	83	-	463	90	170	29	148	437	-	10	-	448
	2007	105	296	10	204	616	-	144	-	759	147	286	50	232	715	-	18	-	732
	2017	161	475	16	304	957	-	236	-	1193	229	459	83	347	1117	-	29	-	1147
	1990	73	74	4	40	191	-	9	-	200									
	1993	86	89	5	47	228	-	11	-	239	93	97	5	51	246	-	12	-	258
27	1997	109	114	6	59	288	-	15	-	303	135	142	8	73	358	-	18	-	376
	2007	184	202	12	97	494	-	27	-	521	228	251	14	120	613	-	33	-	647
	2017	294	337	20	151	801	-	46	-	847	365	418	24	187	995	-	57	-	1052
	1990	74	172	26	69	341	-	169	-	510									
	1993	86	199	30	80	395	-	199	-	594	87	200	30	80	396	-	200	-	597
28	1997	106	244	37	96	482	-	248	-	731	118	272	41	107	539	-	278	-	817
	2007	171	391	60	149	771	-	419	-	1190	191	436	67	166	860	-	468	-	1327
	2017	268	606	95	222	1191	-	683	-	1874	298	674	105	247	1325	-	761	-	2086
	1990	34	115	8	10	160	-	21	-	182									
	1993	44	147	1	13	205	-	28	-	233	50	156	2	17	224	-	24	-	248
29	1997	61	203	1	18	283	-	40	-	323	84	229	6	34	353	-	14	-	367
	2007	125	420	3	36	584	-	89	-	672	165	452	13	65	695	-	29	-	724
	2017	233	782	5	65	1086	-	177	-	1263	298	817	25	113	1253	-	56	-	1310
	1990	60	332	2	26	419	-	64	-	483									
	1993	77	421	2	33	532	-	83	-	615	85	432	5	40	562	-	67	-	628
30	1997	106	579	3	44	733	-	117	-	850	137	603	15	77	832	-	36	-	868
	2007	221	1192	6	89	1508	-	256	-	1764	275	1192	31	147	1646	-	76	-	1722
	2017	416	2221	12	161	2809	-	509	-	3319	509	2171	60	259	2999	-	147	-	3145
	1990	153	242	11	130	536	-	21	-	557									
	1993	169	269	13	142	593	-	24	-	616	176	273	23	153	625	-	46	-	671
31	1997	194	310	15	159	678	-	28	-	705	199	297	52	183	732	-	109	-	841
	2007	266	433	22	208	929	-	40	-	969	271	409	76	238	995	-	159	-	1153
	2017	361	598	31	268	1258	-	58	-	1316	363	558	109	306	1337	-	227	-	1565
	1990	14	132	2	20	168	-	3	-	171									
	1993	14	141	2	22	179	-	3	-	183	21	164	5	34	223	-	9	-	232
32	1997	16	153	2	23	194	-	4	-	198	26	132	12	48	218	-	19	-	237
	2007	19	187	3	28	238	-	5	-	243	32	162	15	58	267	-	24	-	291
	2017	24	231	3	34	293	-	7	-	299	41	200	19	70	330	-	32	-	361

3.3 TRAFFIC ANALYSIS AND FORECAST: DEVELOPMENT PROJECT

Traffic on development project roads was forecasted separately for passenger traffic, non-agricultural traffic and agricultural traffic. The number of passengers and commodity tonnage were estimated first, and then they were converted to the number of vehicles assuming modal distribution and occupancy/average load. Figure 3.3.-1 shows the schematic diagram of traffic forecast for development project.

3.3.1 Passenger Traffic and Non-Agricultural Traffic

The population residing within the road influence area, which is defined as the area from which local existing or potential traffic using the road derives, was obtained mainly from distribution of barangays shown in 1:50,000 topographical maps and the NCSO 1980 Census of Population and Housing, and supplemented by information obtained from barangay interviews. The population forecasts were prepared using the NCSO report.

The number of passengers and non-agricultural commodity tonnage were obtained as the product of population by the per capita generation factor. Table 3.3-1 shows the generation factors commodity used in the analysis, which was derived mainly based on the traffic survey and referring to previous studies. In the case of particular roads where the common values were deemed inapplicale, specific values were used.

TABLE 3.3-1 PER CAPITA TRAFFIC GENERATION FACTORS (MINOR ROAD):Province of Davao del Norte

Existing Road Condition	Passenger Movement (trip/person/day)		Non-Agricultural Commodity (kg/person/day)	
	w/o	with	w/o	with
Paved/Gravel				
Good/Fair	0.12	0.12	2.0	2.0
Bad	0.10	0.11	1.6	1.8
Very Bad	0.08	0.11	0.6	1.0
Earth Road	0.03	0.06	0.5	1.0
Impassable to motoried vehicle	0.01	0.03	0.4	1.0

The modal distribution and the occupancy/average load used in the conversion to traffic volume by vehicle type were estimated individually for each road based on the road

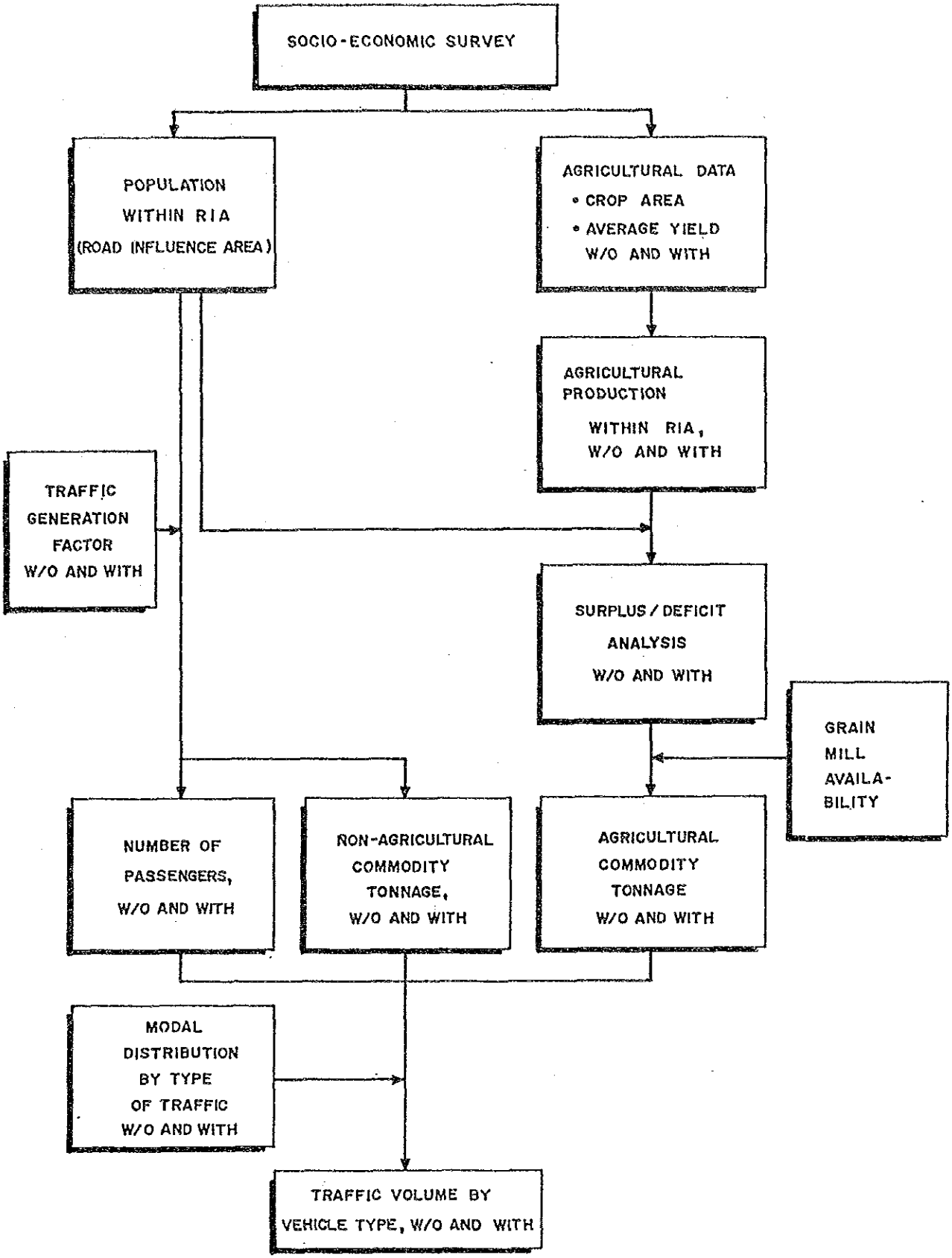


FIGURE 3.3-1
PROCEDURE OF TRAFFIC FORECAST FOR DEVELOPMENT PROJECTS

inventory survey and the traffic survey.

3.3.2 Agricultural Traffic

Agricultural commodity tonnage was estimated based on the agricultural production within the road influence area, taking into consideration i) home consuption and surplus/deficit and ii) availability of grain mill(s) in the road influence area, as regards food grain.

i) Home consumption of food grain was calculated as population times per capita grain consumption (assumed to be 130 kg in a milled form), and the surplus or deficit production was calculated based thereupon.

ii) In case of no mill in the road influence area, all net production is assumed to move out in the form of palay/unmilled corn. Milled grain products for home comsumption are then transported back. An eventual deficit moves into the road influence area in the form of milled products.

Provided one or more mills exist in the road influence area, the transport flows are assumed as follows:

- Home consumption remains in the road influence area (no transport movement assumed).
- Surplus production would be transported out, traditionally in the form of unmilled food grains.
- Deficit production would be moved into the road influence area in milled form.

Agricultural commodity tonnage was cnverted to number of vehicles using the modal distribution and average load, which were estimated individually for each road considering the transport circumstances.

3.3.3 Estimated Present and Future Traffic

Estimated present and future traffic is presented in Table 3.4-1 in the next Section.

3.4 SUMMARY OF TRAFFIC VOLUME ON STUDIED ROADS

Estimated present and future traffic volumes of the studied roads comprising of traffic and development projects are presented by each road project in Table 3.4-1.

TABLE 3.4 - 1 (1)

Traffic Volume by Vehicle Type DAVAO DEL NORTE

Class of Road	Type of Impr't	Road Number	w/o										with									
			Car	Jeep-ney	Bus	Truck	Total	Tri-cycle	Motor cycle	Ani-mal	Walk-ing	Boat	Car	Jeep-ney	Bus	Truck	Total	Tri-cycle	Motor cycle	Ani-mal	Walk-ing	Boat
Second'y Major	Rehab/Imp-1	P96-1	77	421	2	33	532	-	83	-	-	-	85	432	5	40	562	-	67	-	-	-
		P92-1	179	226	9	105	519	0	22	-	-	-	203	206	22	106	538	0	22	-	-	-
		P96-2	44	147	1	13	205	-	28	-	-	-	50	156	2	17	224	-	24	-	-	-
		P109	86	199	30	80	395	-	199	-	-	-	87	200	30	80	396	-	200	-	-	-
		P89	108	103	9	53	272	-	12	-	-	-	117	99	15	55	285	-	12	-	-	-
		P104	108	103	9	53	272	-	12	-	-	-	117	99	15	55	285	-	12	-	-	-
		P7-3	44	147	1	13	205	-	28	-	-	-	50	156	2	17	224	-	24	-	-	-
		P17-1	31	80	3	64	178	-	37	-	-	-	35	80	6	67	188	-	28	-	-	-
		P93-2	39	33	3	34	109	-	10	-	-	-	44	35	4	38	121	-	12	-	-	-
		B14-21	14	141	2	22	179	-	3	-	-	-	21	164	5	34	223	-	9	-	-	-
		P17-2	31	80	3	64	178	-	37	-	-	-	35	80	6	67	188	-	28	-	-	-
		P121	39	33	3	34	109	-	10	-	-	-	44	35	4	38	121	-	12	-	-	-
		P93-1	39	33	3	34	109	-	10	-	-	-	44	35	4	38	121	-	12	-	-	-
		N5-4	10	57	2	19	88	-	3	-	-	-	15	70	7	25	117	-	5	-	-	-
		P134	39	33	3	34	109	-	10	-	-	-	44	35	4	38	121	-	12	-	-	-
	Imp-2/Widen	P86-1	169	269	13	142	593	-	24	-	-	-	176	273	23	153	625	-	46	-	-	-
		P91-1	179	226	9	105	519	0	22	-	-	-	203	206	22	106	538	0	22	-	-	-
		P86-2	179	226	9	105	519	0	22	-	-	-	203	206	22	106	538	0	22	-	-	-
		P92-2	179	226	9	105	519	0	22	-	-	-	203	206	22	106	538	0	22	-	-	-
		N5-2	160	25	30	22	238	-	92	-	-	-	182	29	35	25	271	-	106	-	-	-
		P103	108	103	9	53	272	-	12	-	-	-	117	99	15	55	285	-	12	-	-	-
		P126-2	131	162	8	83	385	-	20	-	-	-	131	141	20	82	374	-	18	-	-	-
		P88	131	162	8	83	385	-	20	-	-	-	131	141	20	82	374	-	18	-	-	-
		P85-1	39	33	3	34	109	-	10	-	-	-	44	35	4	38	121	-	12	-	-	-

TABLE 3.4 - 1 (2)

Traffic Volume by Vehicle Type DAVAO DEL NORTE

Class of Road	Type of Impr't	Road Number	w/o										with									
			Car	Jeep-ney	Bus	Truck	Total	Tri-cycle	Motor cycle	Ani-mal	Walk-ing	Boat	Car	Jeep-ney	Bus	Truck	Total	Tri-cycle	Motor cycle	Ani-mal	Walk-ing	Boat
Minor (Nat'l/ Prov'l)	Rehab/ Imp-1	P79-2	1	11	-	-	12	18	205	12	276	-	19	33	-	-	52	77	53	-	-	-
		N5-3	26	94	-	4	125	-	330	21	774	-	30	87	10	3	130	180	277	11	-	-
		P120	6	16	-	-	21	5	114	3	243	-	7	20	2	1	30	44	60	-	-	-
		P128	0	5	-	-	5	24	241	25	315	-	20	34	-	0	55	77	50	2	-	-
		P18	33	56	-	3	92	111	65	8	-	-	67	68	3	1	139	42	42	-	-	-
		P118-1	4	15	-	-	20	-	74	-	224	-	4	17	3	-	24	29	53	-	-	-
		P98	-	2	-	-	2	21	178	11	291	-	8	20	-	-	29	45	36	-	-	-
		P10-1	41	70	-	3	114	138	81	10	-	-	42	72	-	-	114	168	114	-	-	-
		P78	8	26	-	-	34	-	133	-	371	-	9	27	4	-	40	63	110	-	-	-
		P126-1	7	20	-	0	28	-	93	1	217	-	8	20	3	0	31	49	77	-	-	-
		N8	1	6	-	1	8	30	262	15	305	-	11	30	4	1	46	69	109	-	-	-
		P129	7	17	-	1	24	-	83	4	193	-	7	19	3	-	29	45	73	-	-	-
		P4-2	12	22	-	1	35	48	28	2	-	-	14	25	-	1	39	53	33	2	-	-
		P124	21	51	-	81	152	-	219	31	113	-	44	59	-	143	246	-	-	-	-	-
		P140	9	26	-	-	34	-	102	18	293	-	17	30	-	1	49	64	42	-	-	-
		P95	7	27	-	1	36	-	89	7	206	-	9	28	3	2	41	38	56	-	-	-
		P27	12	24	-	0	36	24	-	2	124	-	7	22	2	0	31	33	49	-	-	-
		P11-2	28	48	-	-	76	113	76	-	-	-	15	40	5	1	61	92	145	-	-	-
		P146	5	13	-	19	37	-	56	8	31	-	10	18	-	1	29	37	24	-	-	-
		P87	3	11	-	0	14	-	32	6	36	-	6	10	-	0	17	22	14	1	-	-
		P67	0	0	-	0	1	3	27	4	31	-	2	4	-	0	7	8	6	-	-	-
		P91-2	15	28	-	2	45	25	26	4	118	-	17	29	-	32	77	18	8	11	-	-
	Imp-2/ Widen	P85-2	48	95	-	4	148	168	102	29	-	-	52	87	-	7	146	168	102	-	-	-
		P54	16	42	-	-	58	-	209	-	519	-	17	54	5	-	75	90	120	-	-	-
		P40	44	99	-	-	143	219	173	-	-	-	45	100	-	-	145	223	175	-	-	-
		P74	37	107	17	-	160	257	436	-	-	-	38	107	13	6	164	227	363	-	-	-
		P4-1	23	43	-	1	68	95	54	4	-	-	24	42	-	1	66	87	56	4	-	-
		P36	39	86	9	-	134	197	255	-	-	-	41	88	7	3	139	184	217	-	-	-
		P14	76	133	-	7	215	276	182	-	-	-	76	133	-	7	215	276	182	-	-	-
		P79-1	26	51	-	1	78	102	67	8	-	-	28	50	-	-	79	117	81	-	-	-
		P10-2	17	38	-	4	59	54	29	12	-	-	17	38	-	-	55	85	66	-	-	-
		P2	24	42	-	1	67	91	59	3	-	-	12	42	5	-	60	69	109	-	-	-

TABLE 3.4 - 1 (3)

Traffic Volume by Vehicle Type DAVAO DEL NORTE

Class of Road	Type of Impr't	Road Number	w/o										with									
			Car	Jeep-ney	Bus	Truck	Total	Tri-cycle	Motor cycle	Ani-mal	Walk-ing	Boat	Car	Jeep-ney	Bus	Truck	Total	Tri-cycle	Motor cycle	Ani-mal	Walk-ing	Boat
Minor (Baran-gay)	Rehab/ Imp-1	B05-30	35	65	-	74	174	20	37	35	31	-	75	77	2	2	157	61	57	-	-	-
		B20-4	-	2	-	-	2	13	116	7	159	-	4	17	1	1	24	26	38	8	-	-
		B14-19	1	7	-	1	9	16	167	12	157	-	8	26	2	1	37	37	51	3	-	-
		B08-23	5	14	-	20	40	-	63	9	35	-	11	17	-	37	64	-	-	-	-	-
		B10-12	1	7	-	1	9	-	17	3	40	-	2	8	1	0	11	10	14	1	-	-
		B13-11	-	1	-	-	1	6	51	10	113	-	5	9	-	0	14	18	12	-	-	-
	New Const.	B19-1	-	-	-	-	-	-	-	22	153	-	2	5	-	1	8	5	4	-	-	-
		B20-10	-	-	-	-	-	-	-	13	86	-	1	4	0	0	5	4	5	1	-	-

CHAPTER 4
PROJECT IDENTIFICATION AND SCREENING

4.1 PROJECT IDENTIFICATION

4.1.1 Field Surveys

Field survey was conducted by the Study Team to assess present condition of all major roads and some other typical minor roads (these are referred to as "Surveyed Roads").

Road projects (mostly minor roads) proposed by the local officials were also collected and road conditions of these roads were obtained by the interview survey (these are referred to as " Road Projects proposed by local officials").

Road projects surveyed by the Study Team and proposed by the local officials were combined and integrated, because some road projects were both surveyed by the Study Team and also proposed by the local officials, and a list of Studied Roads was prepared.

Summaries of "Surveyed Roads", "Road Projects proposed by Local officials "and" Studied Roads" are shown in Table 4.1-1.

TABLE 4.1-1 SUMMARY OF SURVEYED ROADS
Road Projects Proposed by Local Officials and Studied Roads
Province of Davao del Norte

	Road Class	National Roads	Prov'l/City Roads	Barangay Roads	Total
Surveyed Road	Major Rd.	269.2	227.4	-	496.6
	Minor Rd.	89.2	521.3	-	610.5
	Total	358.4	748.7	-	1,107.1
Rd. Proj. Proposed by Local Officials	Major Rd.	16.3	150.1	-	166.4
	Minor Rd.	43.0	325.5	453.0	821.5
	Total	59.3	475.6	453.0	987.9
Studied Road	Major Rd.	269.2	256.2	-	525.4
	Minor Rd.	89.2	779.0	453.0	1,321.2
	Total	358.4	1,035.2	453.0	1,846.6

4.1.2 Project Identification

1) Project Identification Criteria

Project identification criteria are shown in Table 4.1-2.

TABLE 4.1-2 PROJECT IDENTIFICATION CRITERIA

Item	Condition of Identification	
	Major Roads	Minor Roads
(1) Existing Links		
* Carriageway Width	Less than 6.0 meter	Less than 4.0 meters
* Pavement Type	Inferior to recommended type in the engineering Standards	Inferior to gravel
* Surface Condition	Bad or very bad 1/	Bad or very bad2/
(2) New Links	Impassable Abandoned Non-existing	
(3) Bridges	Ford crossing Spillway Timber bridge Bailey bridge	Ford crossing Spillway in structurally unsound condition Bailey bridge for AADT more than 300

Notes: 1/ Gravel road which is proposed for improvement by local officials shall be identified, even though surface condition is "fair".

2/ Gravel road of which surface condition is "fair" shall be identified, as the surface condition of gravel minor roads is easily deteriorated.

2) Identified Road Projects

All studied Roads, except those of the national primary roads and committed roads, were evaluated in accordance with the identification criteria. Road projects identified are summarized in Table 4.1-3.

TABLE 4.1-3 SUMMARY OF IDENTIFIED ROAD PROJECTS
Province of Davao del Norte

Road Class		National Road	Prov'l/City Road	Barangay Road	Total
Major Road	Length (kms.)	63.8	229.7	-	293.5
	(% to Studied Roads)	(24%)	(90%)	-	(56%)
Minor Road	Length (kms.)	71.6	779.0	453.0	1,303.6
	(% to Studied Roads)	(80%)	(100%)	(100%)	(99%)
Total	Length (kms.)	135.4	1,008.7	453.0	1,597.1
	(% to Studied Roads)	(38%)	(97%)	(100%)	(86%)

4.2 PROJECT SCREENING

4.2.1 Categorization

Road projects are categorized by the following factors in order to establish comprehensive prioritization criteria:

(1) Class of Roads

Major Roads	Minor Roads
* Primary major roads	*National/provincial/city roads
* Secondary major roads	* Barangay roads

(2) Urgency of work

Improvement criteria for roads and bridges are established as shown in Tables 4.2-1 and 4.2-2, respectively. Improvement works are classified into five (5) types as shown in Table 4.2-3. In view of the urgency of work to be implemented, the types of improvement are grouped into two (2) as follows:

Type A (Urgent Projects)

* Rehabilitation: Improvement of deteriorated road surface, but standard or superior class pavement, to acceptable condition.
* Improvement -1: Improvement of deteriorated road surface and substandard class pavement, to acceptable and standard pavement.
* New Construction: Construction of new road including re-construction of abandoned road.

Type B (Less Urgent Projects)

* Improvement -2: Upgrading of substandard pavement class to standard pavement class, though existing road surface condition is acceptable.
* Widening : Widening of roads with substandard carriageway width, other conditions meet engineering standards.

Note: Road projects which include only improvement of bridges are classified as "Rehabilitation".

(3) Economic Viability

Major Roads

Simplified economic evaluation is conducted for major roads. Internal Rate of Return (IRR) is calculated based on roughly estimated construction cost and traffic cost savings. Categorization is made as follows:

Improvment Type A:

* IRR of 7.5% or more
* IRR of less than 7.5%

Improvement Type B:

* IRR of 15% or more
* IRR of less than 15.0%

Minor Roads

Minor road Pre-evaluation Indicator (MPI) is developed based on Phase-1 Study results. Categorization of minor roads is made based on calculated MPI as follows:

* MPI of 7.5 or more
* MPI of less than 7.5

TABLE 4.2-1 IMPROVEMENT CRITERIA FOR ROAD

Road Class	Major Road		Minor Road	
	Standard/ Superior	Substandard	Standard/ Superior	Substandard
Good/Fair	No improvement or widening (widening)	Upgrading of pavement type (improvement-2)	No improvement	No improvement
Bad/Very bad	Improvement of surface condition (Rehabilitation)	Upgrading of pavement type (improvement-1)	Improvement surface con (Rehabilitation)	Upgrading of pavement type (Improvement-1)
Abandoned/ Non-existing	Construction of new road (New Construction)			

Note: 1) In case of carriageway width less than 6.0 meters.

TABLE 4.2-2 IMPROVEMENT CRITERIA FOR BRIDGES

Existing Bridge Type	Proposed Improvement		
	Major Road	Minor Road	
Ford Crossing	2-lane permanent bridge	Carriageway width 4.0 m: 1-lane spillway Carriageway width 6.0 m: 2-lane spillway	
Spillway	2-lane permanent bridge	No improvement	
Timber Bridge	2-lane permanent bridge	AADT less than 200	1-lane permanent bridge
		AADT more than 200	2-lane permanent bridge
Bailey Brridge	2-lane permanent bridge	AADT less than 300	No improvement
		AADT more than 300	2-lane permannet bridge

Note: 1) Where the site condition is not favorable for a spillway, a permanent bridge should be planned in accordance with the criteria for a timber bridge.

2) When the existing spillway is structurally sound and traffic disturbance is estimated less, the existing one can be utilized. Under other conditions, a permanent bridge should be planned in accordance with the criteria for a timber bridge.

TABLE 4.2-3 TYPES OF IMPROVEMENT

Type	Existing Pavement Type	Existing Surface Condition	Proposed Improvement Work
Rehabilitation	Standard or superior	Bad/ very bad	Improvement of surface condition
Improvement-1	Substandard	Bad/ very bad	Upgrading of surface type
Improvement-2	Substandard	Good/Fair	Upgrading of surface type
Widening	Standard (carriageway is narrowed than standard)	Good/Fair	Widening of existing road
New Construction	Impassable/abandoned non-existing		Construction of new road

Note: Improvement-2 and widening are not applied to minor roads.

4.2.2 Prioritization and Selection Criteria

Prioritization and selection criteria of road projects for feasibility studies are established as shown in Tables 4.2-4 and 4.2-5.

TABLE 4.2-4 PRIORITIZATION AND SELECTION OF ROAD PROJECTS
- Major Roads -

Category	Road Class	Type of Improvement	IRR	Priority Criteria	Selection Criteria
1	Primary	A	7.5 ≦ IRR	MA-1	↑
2	Secondary	A	7.5 ≦ IRR		
3	Primary	B	15.0 ≦ IRR	MA-2	To be selected for F/S
4	Secondary	B	15.0 ≦ IRR		
5	Primary	A	IRR < 7.5		
6	Secondary	A	IRR < 7.5		
7	Primary	B	IRR <15.0	MA-3	
8	Secondary	B	IRR <15.0		

TABLE 4.2-5 PRIORITIZATION AND SELECTION OF ROAD PROJECTS
- Minor Roads -

Category	Road Class	Type of Improvement	MPI	Priority Criteria	Selection Criteria
1	National/Provincial/ City	A	7.5 ≦ MPI	MI-1	↑ To be selected for F/S
2	Barangay	A	7.5 ≦ MPI		
3	National/Provincial/ City	A	MPI < 7.5	MI-2	
4	Barangay	A	MPI < 7.5		

Note: Improvement Type A: Rehabilitation, Improvement-1, New Construction
Improvement Type B: Improvement-2, Widening

4.2.3 Priority of Identified Road Projects

Identified projects were evaluated and prioritized in accordance with criteria discussed and summarized in Tables 4.2-6 and 4.2-7.

TABLE 4.2-6 PRIORITY OF IDENTIFIED MAJOR ROADS
Province of Davao del Norte

Category	Road Class	Type of Improvement	IRR	Priority Group	Road Length	No. of Road Links
1	Primary	A	7.5 ≤ IRR	MA-1	-	-
2	Secondary	A	7.5 ≤ IRR	MA-1	128.9	13
3	Primary	B	15.0 ≤ IRR	MA-2	-	-
4	Secondary	B	15.0 ≤ IRR	MA-2	-	-
5	Primary	A	IRR<7.5	MA-2	-	-
6	Secondary	A	IRR<7.5	MA-2	118.1	12
7	Primary	B	IRR<15.0	MA-3	-	-
8	Secondary	B	IRR<15.0	MA-3	46.5	4
	Total				293.5	29

Table 4.2-7 PRIORITY OF IDENTIFIED MINOR ROADS
Province of Davao del Norte

Category	Road Class	Type of Improvement	MPI	Priority Group	Road Length	No. of Rd.Links
1	Nat'l/Provi/ City	A	7.5 ≤ MPI	MI-1	456.6	64
2	Barangay	A	7.5 ≤ MPI	MI-1	144.0	12
3	Nat'l/Provi/	A	MPI < 7.5	MI-2	394.0	59
4	Barangay	A	MPI < 7.5	MI-2	309.0	27
	Total				1,303.6	162

4.2.4 Selection of Road Projects For Feasibility Studies

In accordance with selection criteria discussed above, road projects under priority groups MA-1 and MA-2 for major roads and priority groups MI-1 for minor roads were initially selected, and these were plotted on 1:100,000 map to evaluate the following:

- Distribution of initially selected road projects (when these are concentrated in certain area, some minor roads were deleted, and where road projects are scarce, some minor roads were added.)

- Linkage of road projects
  (There is a case that a selected lower class road is connected with a higher class road, however, the latter is not selected due to lower priority. Such a case, a higher class road is also selected to maintain similar condition of road after implementation.)

After adjustment mentioned above, road projects were finally selected and summarized as follows:

Major Road	237.9 kms.	(24 projects)
Minor Road	360.9 kms.	(40 projects)
Total	598.8 kms.	(64 projects)

CHARTER 5
PROJECT EVALUATION

5.1 PRELIMINARY DESIGN AND COST ESTIMATE

5.1.1 Preliminary Design

1) Design Concept

There are two options in design concept for rural road improvement, as follows :

* Designing rural roads with optimum standards aimed at improving all aspects including horizontal and vertical alignments, which sometimes require massive earth works and is costly.

* Designing rural roads by basically concentrating on improving surface conditions, thus improving horizontal and vertical alignments is limited to the required minimum.

Rural roads are extensive in the number of road links as well as in length, and their present conditions are still at a poor level. Thus, requirements for rural road improvement are quite huge, while financial resources are limited. Under these circumstances, the Study Team placed priority on improving surface conditions of more roads. The preliminary design was undertaken in line with the concept of the second option.

2) Preliminary Design

On the basis of the findings of the road inventory survey, the type of improvement was determined for each subsection of road in accordance with the engineering standards and the improvement criteria.

Typical road sections for each type of improvement/rehabilitation are summarized as shown in Table 5.1-1.

Special considerations were given to steep gradient sections and flood section.

"PCC pavement for steep gradient section" was applied to sections with steep gradients where otherwise gravel surfacing might be applied, as a countermeasure against excessive gravel losses during heavy rains and impossibility for vehicles to climb. "Grade raising in flood area", was applied to sections located in flood areas.

Table 5.1-2 shows the proposed improvement for each road project subjected to the feasibility study.

TABLE 5.1-1 EXISTING CONDITION VS PROPOSED IMPROVEMENT/REHABILITATION

Type of Improvement	Road Section Type	Existing Pavement Type	Existing Pavement Condition	Proposed Pavement Type	Pavement Structure (cm) Surface Course	Base	Subbase
Rehabilitation	1 - 1	PCC	Bad/Very Bad	PCC	20 - 23	-	10
	1 - 2	PCC	Bad/Very Bad	AC Overlay	5	-	-
	1 - 3	Bituminous	- do -	AC	5	20	10
	1 - 4	Bituminous	- do -	AC Overlay	5	-	-
	1 - 5	Bituminous	- do -	BMP/DBST	5.5/1.6	15	5
	1 - 6	Gravel	- do -	Gravel	15	-	10
Improvement - 1	2 - 1	Bituminous	Bad/Very Bad	PCC	20 - 23	-	10
	2 - 2	Gravel	- do -	PCC	20 - 23	-	20
	2 - 3	Gravel	- do -	AC	5	20	20
	2 - 4	Gravel	- do -	BMP/DBST	5.5/1.6	15	15
	2 - 5	Earth	Any Condition	PCC	20 - 23	-	20
	2 - 6	Earth	- do -	AC	5	20	20
	2 - 7	Earth	- do -	BMP/DBST	5.5/1.6	15	15
	2 - 8	Earth	- do -	Gravel	15	-	10
Improvement - 2	3 - 1	Bituminous	Good/fair	PCC	20 - 23	-	10
	3 - 2	Gravel	- do -	PCC	20 - 23	-	10
	3 - 3	Gravel	- do -	AC	5	20	10
	3 - 4	Gravel	- do -	BMP/DBST	5.5/1.6	15	5
Widening	4 - 1	PCC	Good/fair	Widening w/PCC	20 - 23	-	20
	4 - 2	Bituminous	- do -	Widening w/AC	5	20	20
	4 - 3	Bituminous	- do -	Widening w/BMP/DBST	5.5/1.6	15	15
	4 - 4	Gravel	- do -	Widening w/Gravel	15	-	10
New Construction	5 - 1	-	-	PCC	20 - 23	-	20
	5 - 2	-	-	AC	5	20	20
	5 - 3	-	-	BMP/DBST	5.5/1.6	15	15
	5 - 4	-	-	Gravel	15	-	10
Special Treatment	6	PCC pavement for steep gradient section					
	7	Grade raising in flood area					

TABLE 5.1 - 2 (I)

Summary of Proposed Improvement DAVAO DEL NORTE

Secondary Major

Type of Impr't	Road Number	Length (km)	1993 AADT w/o	1993 AADT with	Existing Condition L	Width	Type	Condition	Proposed Improvement	Proposed Bridge (Number/Total Length)	Cost (Million Peso) Road	Bridge	Total	IRR (%)
Rehab/ Imp-1	P96-1	7.2	532	562	7.2	4.0-4.5	GRV	Bad	Imp-1(6.0-AC)	2-lane Br (n= 3,L= 42m)	17.30	4.19	21.48	28.7 (T)
	P92-1	14.5	519	538	4.0	3.6-4.5	GRV	Fair	Imp-2(6.0-AC)		38.61	.00	38.61	21.4 (T)
					10.5	4.0-4.5	GRV	Bad	Imp-1(6.0-AC)					
	P96-2	20.1	205	224	20.1	3.2-5.0	GRV	Bad/V.Bad	Imp-1(6.0-BMP)	2-lane Br (n= 3,L= 45m) 2-cell BC (n= 3,L= 30m)	44.16	6.15	50.31	13.9 (T)
	P109	5.6	395	396	4.7	4.0-4.9	GRV	Bad	Imp-1(6.0-BMP)		13.47	.00	13.47	13.8 (T)
					.9	4.0	GRV	Fair	Imp-2(6.0-BMP)					
	P89	7.5	272	285	5.9	4.5	GRV	Bad	Imp-1(6.0-BMP)	2-lane Br (n= 2,L= 32m)	13.07	2.98	16.06	12.9 (T)
					1.6	4.0	GRV	Fair	Imp-2(6.0-BMP)					
	P104	13.5	272	285	13.5	1.6-4.0	GRV	Bad/V.Bad	Imp-1(6.0-BMP)	2-lane Br (n= 4,L= 66m)	38.23	6.35	44.58	12.5 (T)
	P7-3	8.2	205	224	8.2	3.2-4.3	GRV	Bad	Imp-1(6.0-BMP)	2-lane Br (n= 1,L= 16m)	14.26	1.49	15.75	11.3 (T)
	P17-1	6.3	178	188	6.3	5.0-6.0	GRV	Bad	Rehab(6.0-GRV)	2-lane Br (n= 1,L= 22m)	4.57	1.78	6.34	9.8 (T)
	P93-2	7.9	109	121	5.8	3.4-4.5	GRV	Bad/V.Bad	Rehab(6.0-GRV)	2-lane Br (n= 1,L= 40m)	8.28	2.95	11.23	9.2 (T)
					2.1	3.7-4.0	EAR	Bad	Imp-1(6.0-GRV)					
	B14-21	7.9	179	223	3.6	2.4-4.0	GRV	Fair	Imp-2(6.0-BMP)	2-lane Br (n= 1,L= 80m)	19.26	5.49	24.75	8.4 (T)
					1.9	2.0-2.4	GRV	Bad	Imp-1(6.0-BMP)					
					2.4	2.0	EAR	Bad/V.Bad	Imp-1(6.0-BMP)					
	P17-2	15.8	178	188	9.5	3.2-6.0	GRV	Fair/V.Bad	Rehab(6.0-GRV)	2-lane Br (n= 3,L=100m)	25.18	7.59	32.77	7.0 (T)
					5.1	4.3-5.3	GRV	Fair	Widen(6.0-GRV)					
					1.2	3.2-5.0	EAR	Bad	Imp-1(6.0-GRV)					
	P121	9.7	109	121	9.5	2.2-4.0	GRV	Bad/V.Bad	Rehab(6.0-GRV)	2-lane Br (n= 2,L= 43m)	10.45	3.51	13.96	5.3 (T)
					.2	2.4	EAR	Bad	Imp-1(6.0-GRV)					
	P93-1	5.0	109	121	2.0	3.2-4.0	GRV	Bad/V.Bad	Rehab(6.0-GRV)	2-lane Br (n= 1,L= 20m)	5.64	1.68	7.33	4.8 (T)
					2.3	3.8-4.8	GRV	Fair	Widen(6.0-GRV)					
					.7	4.0	EAR	Bad	Imp-1(6.0-GRV)					
	N5-4	15.0	88	117	9.9	2.8-6.0	GRV	Fair/V.Bad	Rehab(6.0-GRV)	2-lane Br (n= 4,L= 51m)	12.58	5.34	17.92	2.5 (T)
					5.1	2.7-4.0	GRV	Fair	Widen(6.0-GRV)					
	P134	7.2	109	121	1.0	4.0	GRV	Fair	Widen(6.0-GRV)		10.64	.00	10.64	.0 (T)
					5.2	3.2-3.4	GRV	Bad/V.Bad	Rehab(6.0-GRV)					
Imp-2/ Widen	P86-1	4.7	593	625	4.7	4.5	GRV	Fair	Imp-2(6.0-AC)		11.37	.00	11.37	30.4 (T)
	P91-1	5.0	519	538	.9	4.5	GRV	Bad/V.Bad	Imp-1(6.0-AC)		11.92	.00	11.92	25.0 (T)
					4.1	4.0-4.5	GRV	Fair	Imp-2(6.0-AC)					
	P86-2	7.3	519	538	4.4	4.0-4.5	GRV	Fair	Imp-2(6.0-AC)	2-lane Br (n= 2,L= 50m)	17.88	4.16	22.03	23.3 (T)
					2.9	4.5	GRV	Bad	Imp-1(6.0-AC)					
	P92-2	7.4	519	538	4.3	4.5	GRV	Good/Fair	Imp-2(6.0-AC)		19.01	.00	19.01	22.1 (T)
					3.1	3.2-4.0	GRV	Bad	Imp-1(6.0-AC)					
	N5-2	16.3	238	271	3.4	4.0-6.0	GRV	Bad	Imp-1(6.0-BMP)	2-lane Br (n= 2,L=118m)	32.42	8.04	40.45	11.9 (T)

				12.9	5.2-5.9	GRV Fair	Imp-2(6.0-BMP)				
P103	24.0	272	285	19.0	4.5-5.5	GRV Fair	Imp-2(6.0-BMP)	2-lane Br (n= 4,L= 68m)	49.40	6.16	55.55	11.1 (T)
				5.0	4.0	GRV Bad	Imp-1(6.0-BMP)					
P126-2	5.3	385	374	5.3	4.0-4.5	GRV Fair	Imp-2(6.0-BMP)		9.66	.00	9.66	10.9 (T)
P88	6.0	385	374	3.1	3.4-4.0	GRV Fair	Imp-2(6.0-BMP)		14.52	.00	14.52	10.6 (T)
				2.9	4.0	GRV Bad/V.Bad	Imp-1(6.0-BMP)					
P85-1	10.5	109	121	.4	6.7	PCC Good	-	2-lane Br (n= 1,L= 10m)	6.62	1.18	7.80	4.8 (T)
				8.9	3.4-5.5	GRV Fair	Widen(6.0-GRV)					
				1.2	4.5	EAR Fair	Imp-1(6.0-GRV)					

(T):Traffic Project
(D):Development Project

TABLE 5.1 - 2 (2)

Summary of Proposed Improvement DAVAO DEL NORTE

Minor(National/Provincial)

Type of Impr't	Road Number	Length (km)	1993 AADT w/o	1993 AADT with	Existing Condition L	Width	Type Condition	Proposed Improvement	Proposed Bridge (Number/Total Length)	Cost (Million Peso) Road	Bridge	Total	IRR (%)
Rehab/ Imp-1	P79-2	7.4	12	52	1.3	3.2	GRV Fair	Widen(6.0-GRV)		7.56	.00	7.56	25.6 (D)
					2.2	2.4-2.8	GRV Bad/V.Bad	Rehab(6.0-GRV)					
					3.9	2.4-2.8	EAR V.Bad	Imp-1(6.0-GRV)					
	N5-3	43.0	125	130	23.1	2.4-4.0	GRV Bad	Rehab(6.0-GRV)	2-lane Sp (n= 4,L= 70m)	39.25	1.27	40.52	22.0 (D)
					7.6	3.2-4.0	GRV Fair	Widen(6.0-GRV)					
					12.3	.8	EAR Impas	Imp-1(6.0-GRV)					
	P120	14.8	21	30	3.8	3.2-3.6	GRV Fair	Widen(4.0-GRV)	2-lane Sp (n= 2,L= 32m)	6.92	.58	7.50	20.6 (D)
					11.0	.8-3.2	GRV V.Bad/Impa	Rehab(4.0-GRV)					
	P128	6.2	5	55	6.2	2.4-3.2	GRV Bad	Rehab(6.0-GRV)	2-lane Br (n= 1,L= 8m)	4.23	1.11	5.34	19.0 (D)
	P18	1.6	92	139	1.6	4.5-5.0	GRV Bad	Rehab(6.0-GRV)		1.07	.00	1.07	16.5 (D)
	P118-1	7.5	20	24	.9	3.6	GRV Fair	Widen(6.0-GRV)		6.66	.00	6.66	15.2 (D)
					6.5	.8-3.2	GRV Bad/V.Bad	Rehab(6.0-GRV)					
					.1	5.5	PCC Fair	Rehab(6.0-PCC)					
	P98	7.0	2	29	2.1	1.6-4.0	GRV Fair	Widen(6.0-GRV)		5.87	.00	5.87	14.6 (D)
					4.9	.8-3.2	GRV Bad/Impas	Rehab(6.0-GRV)					
	P10-1	8.3	114	114	1.7	4.5	GRV Fair	Widen(6.0-GRV)		5.53	.00	5.53	13.7 (D)
					6.6	3.6-4.5	GRV Bad	Rehab(6.0-GRV)					
	P78	13.2	34	40	.4	5.5	GRV Fair	Widen(6.0-GRV)		14.25	.00	14.25	11.3 (D)
					12.8	3.2-4.5	GRV Bad	Rehab(6.0-GRV)					
	P126-1	7.7	28	31	.1	4.0	PCC Good	Widen(6.0-PCC)	2-lane Sp (n= 1,L= 20m)	9.04	.36	9.40	10.7 (D)
					7.6	3.2-4.5	GRV Bad	Rehab(6.0-GRV)					
	N8	17.8	8	46	14.3	2.8-3.4	GRV Bad	Rehab(6.0-GRV)	2-lane Sp (n= 1,L= 40m)	27.98	.73	28.70	9.6 (D)
					3.5	4.0	EAR V.Bad	Imp-1(6.0-GRV)					
	P129	3.8	24	29	3.8	2.8-3.6	GRV Bad	Rehab(6.0-GRV)		2.90	.00	2.90	9.3 (D)
	P4-2	2.6	35	39	1.6	2.4-4.0	GRV Bad/V.Bad	Rehab(6.0-GRV)	2-lane Br (n= 1,L= 50m)	1.79	3.43	5.22	8.1 (D)
					1.0	1.6	EAR Impas	Imp-1(6.0-GRV)					
	P124	15.9	152	246	13.7	2.8-4.0	GRV Bad/V.Bad	Rehab(6.0-GRV)	2-lane Br (n= 3,L= 43m)	18.52	4.24	22.75	7.4 (D)
					2.2	3.6	GRV Fair	Widen(6.0-GRV)					
	P140	10.3	34	49	3.5	2.4-4.0	GRV Fair	Widen(6.0-GRV)	2-lane Sp (n= 2,L= 45m)	10.05	2.74	12.79	6.9 (D)
					5.0	2.4-3.7	GRV Bad	Rehab(6.0-GRV)	2-lane Br (n= 1,L= 25m)				
					1.8	2.4-3.2	EAR Bad/V.Bad	Imp-1(6.0-GRV)					
	P95	10.7	36	41	4.9	2.4-3.6	GRV Bad/V.Bad	Rehab(6.0-GRV)	2-lane Br (n= 1,L= 15m)	10.22	1.44	11.67	6.7 (D)
					3.8	2.1-3.2	EAR Bad	Imp-1(6.0-GRV)					
					2.0	3.6	GRV Fair	Widen(6.0-GRV)					

(T):Traffic Project

TABLE 5.1 - 2 (3)

Summary of Proposed Improvement DAVAO DEL NORTE

Minor(National/Provincial)(Continued)

Type of Impr't	Road Number	Length (km)	1993 AADT w/o	1993 AADT with	Existing Condition L	Existing Condition Width	Existing Condition Type Condition	Proposed Improvement	Proposed Bridge (Number/Total Length)	Cost (Million Peso) Road	Cost (Million Peso) Bridge	Cost (Million Peso) Total	IRR (%)
Rehab/ Imp-1	P27	3.2	36	31	.6	2.8	GRV Fair	Widen(6.0-GRV)		2.61	.00	2.61	6.4 (D)
					2.6	2.8-3.2	GRV Bad	Rehab(6.0-GRV)					
	P11-2	3.9	76	61	3.9	3.2-4.0	GRV Bad	Rehab(6.0-GRV)		3.01	.00	3.01	5.6 (D)
	P146	16.2	37	29	1.1	3.2-4.0	GRV Fair	Widen(6.0-GRV)		19.74	.00	19.74	2.1 (D)
					15.1	2.4-4.0	GRV Bad/V.Bad	Rehab(6.0-GRV)					
	P87	4.3	14	17	.2	3.4	GRV Fair	Widen(6.0-GRV)		7.77	.00	7.77	.0 (D)
					4.1	2.4-3.4	GRV Bad/V.Bad	Rehab(6.0-GRV)					
	P67	2.5	1	7	2.5	3.2-4.0	GRV Bad	Rehab(6.0-GRV)		3.76	.00	3.76	.0 (D)
	P91-2	8.7	45	77	.4	4.0	GRV Fair	Widen(6.0-GRV)		7.28	.00	7.28	.0 (D)
					8.3	4.0-4.5	GRV Bad/V.Bad	Rehab(6.0-GRV)					
Imp-2/ Widen	P85-2	2.7	148	146	2.7	3.2-3.6	GRV Fair	Widen(6.0-GRV)		2.24	.00	2.24	37.0 (D)
	P54	3.2	58	75	1.7	4.5	GRV Fair	Widen(6.0-GRV)		1.99	.00	1.99	35.9 (D)
					1.5	2.4-3.2	GRV Bad	Rehab(6.0-GRV)					
	P40	2.8	143	145	2.1	4.5	GRV Fair	Widen(6.0-GRV)		1.65	.00	1.65	19.7 (D)
					.7	4.0	GRV Bad	Rehab(6.0-GRV)					
	P74	3.3	160	164	1.2	6.7	PCC Good	-		4.83	.00	4.83	15.3 (D)
					2.1	4.5	GRV Fair	Imp-2(6.0-AC)					
	P4-1	4.8	68	66	2.0	4.0-4.5	GRV Bad/V.Bad	Rehab(6.0-GRV)		2.95	.00	2.95	15.1 (D)
					2.8	4.5	GRV Fair	Widen(6.0-GRV)					
	P36	6.4	134	139	1.6	6.0	GRV Fair	-	2-lane Br (n= 1,L= 45m)	3.00	3.19	6.19	9.3 (D)
					2.7	4.5	GRV Fair	Widen(6.0-GRV)					
					2.1	4.0	GRV Bad	Rehab(6.0-GRV)					
	P14	7.6	215	215	3.5	4.5-5.5	GRV Fair	Imp-2(6.0-BMP)	1-cell BC (n= 1,L= 5m)	6.27	5.99	12.25	8.2 (D)
					3.8	6.0	PCC Good	-	2-lane Br (n= 1,L= 75m)				
					.3	6.0	BT Bad	Rehab(6.0-BMP)					
	P79-1	5.7	78	79	3.6	3.2-4.0	GRV Fair	Widen(6.0-GRV)	2-lane Br (n= 1,L= 32m)	4.17	2.57	6.74	7.8 (D)
					2.1	2.4-3.2	GRV Bad	Rehab(6.0-GRV)					
	P10-2	3.4	59	55	3.4	4.0	GRV Fair	Widen(6.0-GRV)		1.98	.00	1.98	3.6 (D)
	P2	7.0	67	60	4.0	3.7-4.0	GRV Fair	Widen(6.0-GRV)		9.76	.00	9.76	1.8 (D)
					3.0	2.4-4.5	GRV Bad	Rehab(6.0-GRV)					

(T):Traffic Project
(D):Development Project

TABLE 5.1 - 2 (4)

Summary of Proposed Improvement DAVAO DEL NORTE

Minor(Barangay)

Type of Impr't	Road Number	Length (km)	1993 AADT w/o	1993 AADT with	Existing Condition L	Width	Type Condition	Proposed Improvement	Proposed Bridge (Number/Total Length)	Cost (Million Peso) Road	Bridge	Total	IRR (%)
Rehab/ Imp-1	B05-30	7.1	174	157	7.1	2.4-4.0	GRV Bad	Rehab(4.0-GRV)		4.25	.00	4.25	49.5 (D)
	B20-4	9.5	2	24	9.5	.8-2.4	GRV Bad/Impas	Rehab(4.0-GRV)	1-lane Sp (n= 1,L= 20m)	4.79	.26	5.06	48.7 (D)
	B14-19	5.8	9	37	.6	2.4-3.2	GRV Fair	Widen(4.0-GRV)	1-lane Sp (n= 1,L= 15m)	2.92	.20	3.12	25.5 (D)
					4.9	2.4-3.2	GRV Bad	Rehab(4.0-GRV)					
					.3	.8	EAR Impas	Imp-1(4.0-GRV)					
	B08-23	14.2	40	64	11.2	2.0-3.2	GRV Bad/V.Bad	Rehab(4.0-GRV)	1-lane Br (n= 1,L= 10m)	6.91	.86	7.77	5.9 (D)
					3.0	2.0	EAR Impas	Imp-1(4.0-GRV)					
	B10-12	14.2	9	11	.5	3.3	GRV Bad	Rehab(4.0-GRV)	1-lane Br (n= 1,L= 18m)	8.45	1.14	9.59	4.5 (D)
					12.3	2.8-4.0	EAR Bad/V.Bad	Imp-1(4.0-GRV)					
					1.4		None	New-C(4.0-GRV)					
	B13-11	15.0	1	14	7.7	2.8-4.0	GRV Bad/V.Bad	Rehab(4.0-GRV)	1-lane Br (n= 2,L= 17m)	16.52	2.53	19.06	2.0 (D)
					7.3	2.4	EAR Impas	Imp-1(4.0-GRV)	1-lane Sp (n= 3,L= 45m)				
									1-cell BC (n= 1,L= 5m)				
New Const.	B19-1	24.2	0	8	24.2		None	New-C(4.0-GRV)	1-lane Sp (n= 4,L= 65m)	16.16	.86	17.02	10.9 (D)
	B20-10	7.4	0	5	1.2	3.2	EAR V.Bad	Imp-1(4.0-GRV)		5.04	.00	5.04	5.4 (D)
					6.2		None	New-C(4.0-GRV)					

(T):Traffic Project
(D):Development Project

5.1.2 Cost Estimate

1) Unit Cost

Unit prices for construction equipment, materials and labor were obtained from Associated Construction Equipment Lessors, Inc. (ACEL), the Price Monitoring Section of DPWH, market price survey by the Study Team and relevant studies. Based on the data collected, unit prices at April 1990 prices were developed. Exchange rates used were : P22.50 = US$1.00 = Y155.

Unit costs for major construction items are presented in Table 5.1-3.

2) Construction Cost Estimate

Based on the results of the road inventory survey and proposed type of improvement, the quantity of each construction item was computed for each road project. Then the constuction cost was estimated.
Table 5.1-4 presents estimated quantities and construction cost of each road project.

TABLE 5.1-3 UNIT COST OF MAJOR CONSTRUCTION ITEMS

Unit: Pesos at April 1990 Prices

Item No.	Description	Unit	Unit Price
100	Clearing nad Grubbing	sq.m.	2.10
102	Stripping	cu.m.	52.00
106	Roadway and Drainage Excavation	cu.m.	58.00
107	Borrow	cu.m.	110.00
108	Aggregate Subbase	cu.m.	225.00
118-1	Preparation Of Previously Constructed Road (Gravel)	sq.m.	7.00
118-2	Preparation Of Previously Constructed Road (Asphalt)	sq.m.	8.00
118-3	Preparation of Existing Pavement Surface (PCC)	sq.m.	22.50
118-4	Preparation of Existing Pavement Surface (AC)	sq.m.	17.00
200	Crushed Aggregate Base Course	cu.m.	305.00
300	Crushed Aggregate Surface Course	cu.m.	305.00
302	Bituminous Prime Coat	MT	11,100.00
303	Bituminous Tact Coat	MT	11,500.00
306	Bituminous Macadam Pavement	sq.m.	95.00
310	Bituminous Concrete Surface Course	MT	1,350.00
314	Double Bituminous Surface Treatment	sq.m.	45.00
316-1	PCC Pavement (t = 23cm)	sq.m.	320.00
316-2	PCC Pavement (t = 20cm)	sq.m.	280.00
316-3	PCC Pavement (t = 18cm)	sq.m.	250.00
413-1	RCPC (Ø 910mm)	sq.m.	1,550.00
413-2	Headwal T for RCPC (Ø 910mm)	set	2,900.00
500	Grouted Riprap	sq.m.	625.00
517	Side Ditch (Grouted Riprap)	m	360.00
Bridge Cost			
	2-lane Superstructure	m	43,500.00
	Abutment for 2-lane bridge	each	330,000.00
	Pier for 2-lane bridge	each	285,000.00
	1-lane Superstructure	m	32,000.00
	Abutment for 1-lane bridge	each	230,000.00
	Pier for 1-lane bridge	each	200,000.00
Reinforced Concrete Box Culvert			
	1-Cell RCBC	m	20,600.00
	2-Cell RCBC	m	36,000.00
	Wing wall and Apron for 1-Cell RCBC	set	132,000.00
	Wing wall and Apron for 2-Cell RCBC	set	155,000.00
Spillway			
	2-lane Spillway	m	16,500.00
	1-lane Spillway	m	12,000.00
Slope Protection Cost			
	Cut Slope Protection	m	23,000.00
	Embankment Slope Protection	m	25,000.00

TABLE 5.1 - 4 (1)

Quantity and Construction Cost DAVAO DEL NORTE

		Unit	P96-1	P92-1	P96-2	P109	P89	P104	P7-3	P17-1	P93-2	B14-21	P17-2
Total Road Length		km	7.2	14.5	20.1	5.6	7.5	13.5	8.2	6.3	7.9	7.9	15.8
Improvement Length		km	7.2	14.5	20.1	5.6	7.5	13.5	8.2	6.3	7.9	7.9	15.8
Proposed Pavement Type			6.0-AC	6.0-AC	6.0-BMP	6.0-BMP	6.0-BMP	6.0-BMP	6.0-BMP	6.0-GRV	6.0-GRV	6.0-BMP	6.0-GRV
Quantity													
100	Clearing & Grubbing	m2	-	-	-	-	-	-	-	-	-	-	-
	Stripping	m3	-	-	-	-	-	-	-	-	-	-	-
102	Roadway & Drainage Excavation	m3	5400	36356	122180	4967	7148	142430	6150	4050	33823	43176	17491
104	Borrow	m3	-	-	-	15876	-	-	-	5630	2039	11642	63199
200	Aggregate Subbase	m3	20196	39361	33861	11047	15065	22165	16497	4158	5214	13788	7165
	Preparation of Prev.Road(Grvl)	m2	77760	110440	144060	52574	67878	61848	83544	41580	44240	32172	92210
	Preparation of Prev.Road(Asph)	m2	-	-	-	-	-	-	-	-	-	-	-
	Preparation of Pave.Surf.(PCC)	m2	-	-	-	-	-	-	-	-	-	-	-
	Preparation of Pave.Surf.(AC)	m2	-	-	-	-	-	-	-	-	-	-	-
202	Crushed Aggregate Base Course	m3	9720	19575	19846	5729	7673	12777	8389	-	-	8082	-
300	Crushed Aggr. Surface Course	m3	-	-	-	-	-	-	-	5670	6705	-	14220
301	Bituminous Prime Coat	M.T.	52	104	140	40	54	90	59	-	-	57	-
302	Bituminous Tack Coat	M.T.	-	-	-	-	-	-	-	-	-	-	-
305	Bituminous Macadam Pavement	m2	-	-	116400	33600	45000	74940	49200	-	-	47400	-
310	Bitum.Concrete Surface Course	M.T.	4752	9570	-	-	-	-	-	-	-	-	-
304	Double Bitum.Surface Treatment	m2	-	-	-	-	-	-	-	-	-	-	-
311-1	PCC Pavement (t=23 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
311-2	PCC Pavement (t=20 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
311-3	PCC Pavement (t=18 cm)	m2	-	-	4200	-	-	6060	-	-	2700	-	-
500	RCPC (dia.910mm)	m	210	435	600	255	225	405	240	195	240	300	825
	Headwall for RCPC (dia.910mm)	Set	14	29	40	17	15	27	16	13	16	20	55
504	Grouted Riprap	m3	-	-	-	2445	-	-	-	-	-	1793	8936
	Side Ditch (Grouted Riprap)	m	-	7100	10200	-	-	12600	-	-	2000	3200	150
	Slope Protection (Cut Slope)	m	-	-	-	-	-	100	-	-	-	-	-
	Slope Protection (Embank't Sl)	m	-	-	-	-	-	-	-	-	-	-	50
	2-lane Bridge,Superstructure	m	42	-	45	-	32	66	16	22	40	80	100
	1-lane Bridge,Superstructure	m	-	-	-	-	-	-	-	-	-	-	-
	2-lane Bridge,Abutment	Each	6	-	6	-	4	8	2	2	2	2	6
	1-lane Bridge,Abutment	Each	-	-	-	-	-	-	-	-	-	-	-
	2-lane Bridge,Pier	Each	-	-	-	-	-	1	-	-	1	3	2
	1-lane Bridge,Pier	Each	-	-	-	-	-	-	-	-	-	-	-
	2-lane Spillway	m	-	-	-	-	-	-	-	-	-	-	-
	1-lane Spillway	m	-	-	-	-	-	-	-	-	-	-	-
	1-cell RCBC	m	-	-	-	-	-	-	-	-	-	-	-
	2-cell RCBC	m	-	-	33	-	-	-	-	-	-	-	-
	Wingwall for 1-cell RCBC	Set	-	-	-	-	-	-	-	-	-	-	-
	Wingwall for 2-cell RCBC	Set	-	-	3	-	-	-	-	-	-	-	-
	Miscellaneous	l.s.	1	1	1	1	1	1	1	1	1	1	1
Road Construction Cost		M.p.	17.30	38.61	44.16	13.47	13.07	38.23	14.26	4.57	8.28	19.26	25.18
Bridge Construction Cost		M.p.	4.19	.00	6.15	.00	2.98	6.35	1.49	1.78	2.95	5.49	7.59
Total Construction Cost		M.p.	21.48	38.61	50.31	13.47	16.06	44.58	15.75	6.34	11.23	24.75	32.77
Road Construction Cost/Impr't km		M.p.	2.40	2.66	2.20	2.41	1.74	2.83	1.74	.72	1.05	2.44	1.59
Total Construction Cost/Total km		M.p.	2.98	2.66	2.50	2.41	2.14	3.30	1.92	1.01	1.42	3.13	2.07

TABLE 5.1 - 4 (2)

Quantity and Construction Cost DAVAO DEL NORTE

	Unit	P121	P93-1	N5-4	P134	P86-1	P91-1	P86-2	P92-2	N5-2	P103	P126-2
Total Road Length	km	9.7	5.0	15.0	7.2	4.7	5.0	7.3	7.4	16.3	24.0	5.3
Improvement Length	km	9.7	5.0	15.0	7.2	4.7	5.0	7.3	7.4	16.3	24.0	5.3
Proposed Pavement Type		6.0-GRV	6.0-GRV	6.0-GRV	6.0-GRV	6.0-AC	6.0-AC	6.0-AC	6.0-AC	6.0-BMP	6.0-BMP	6.0-BMP
Quantity												
100 Clearing & Grubbing	m2	-	-	-	-	-	-	-	-	-	-	-
Stripping	m3	-	-	-	-	-	-	-	-	-	-	-
102 Roadway & Drainage Excavation	m3	56209	29441	47404	73099	8413	7809	9996	27442	22523	140250	17514
104 Borrow	m3	2764	863	4245	1353	-	-	-	-	23212	-	-
200 Aggregate Subbase	m3	6402	2311	7932	4352	13183	13385	21377	18478	26990	33076	8446
Preparation of Prev.Road(Grvl)	m2	44820	23018	70450	24820	21150	28720	53570	42970	106860	126300	22200
Preparation of Prev.Road(Asph)	m2	-	-	-	-	-	-	-	-	-	-	-
Preparation of Pave.Surf.(PCC)	m2	-	-	-	-	-	-	-	-	-	-	-
Preparation of Pave.Surf.(AC)	m2	-	-	-	-	-	-	-	-	-	-	-
202 Crushed Aggregate Base Course	m3	-	-	-	-	6345	6750	9855	9990	16675	24143	5422
300 Crushed Aggr. Surface Course	m3	8730	4311	13410	6120	-	-	-	-	-	-	-
301 Bituminous Prime Coat	M.T.	-	-	-	-	34	36	53	53	117	170	38
302 Bituminous Tack Coat	M.T.	-	-	-	-	-	-	-	-	-	-	-
305 Bituminous Macadam Pavement	m2	-	-	-	-	-	-	-	-	97800	141600	31800
310 Bitum.Concrete Surface Course	M.T.	-	-	-	-	3102	3300	4818	4884	-	-	-
304 Double Bitum.Surface Treatment	m2	-	-	-	-	-	-	-	-	-	-	-
311-1 PCC Pavement (t=23 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
311-2 PCC Pavement (t=20 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
311-3 PCC Pavement (t=18 cm)	m2	-	1260	600	2400	-	-	-	-	-	2400	-
500 RCPC (dia.910mm)	m	285	150	450	210	135	150	225	225	615	720	165
Headwall for RCPC (dia.910mm)	Set	19	10	30	14	9	10	15	15	41	48	11
504 Grouted Riprap	m3	-	-	-	-	-	-	-	-	3260	-	-
Side Ditch (Grouted Riprap)	m	2850	2100	2550	3600	-	-	-	1700	-	10800	900
Slope Protection (Cut Slope)	m	-	-	-	-	-	-	-	-	-	-	-
Slope Protection (Embank't Sl)	m	-	-	-	-	-	-	-	-	-	-	-
2-lane Bridge,Superstructure	m	43	20	51	-	-	-	50	-	118	68	-
1-lane Bridge,Superstructure	m	-	-	-	-	-	-	-	-	-	-	-
2-lane Bridge,Abutment	Each	4	2	8	-	-	-	4	-	4	8	-
1-lane Bridge,Abutment	Each	-	-	-	-	-	-	-	-	-	-	-
2-lane Bridge,Pier	Each	-	-	-	-	-	-	1	-	3	-	-
1-lane Bridge,Pier	Each	-	-	-	-	-	-	-	-	-	-	-
2-lane Spillway	m	-	-	-	-	-	-	-	-	-	-	-
1-lane Spillway	m	-	-	-	-	-	-	-	-	-	-	-
1-cell RCBC	m	-	-	-	-	-	-	-	-	-	-	-
2-cell RCBC	m	-	-	-	-	-	-	-	-	-	-	-
Wingwall for 1-cell RCBC	Set	-	-	-	-	-	-	-	-	-	-	-
Wingwall for 2-cell RCBC	Set	-	-	-	-	-	-	-	-	-	-	-
Miscellaneous	l.s.	1	1	1	1	1	1	1	1	1	1	1
Road Construction Cost	M.p.	10.45	5.64	12.58	10.64	11.37	11.92	17.88	19.01	32.42	49.40	9.66
Bridge Construction Cost	M.p.	3.51	1.68	5.34	.00	.00	.00	4.16	.00	8.04	6.16	.00
Total Construction Cost	M.p.	13.96	7.33	17.92	10.64	11.37	11.92	22.03	19.01	40.46	55.55	9.66
Road Construction Cost/Impr't km	M.p.	1.08	1.13	.84	1.48	2.42	2.38	2.45	2.57	1.99	2.06	1.82
Total Construction Cost/Total km	M.p.	1.44	1.47	1.19	1.48	2.42	2.38	3.02	2.57	2.48	2.31	1.82

TABLE 5.1 - 4 (3)

Quantity and Construction Cost DAVAO DEL NORTE

	Unit	P88	P85-1	P79-2	N5-3	P120	P128	P18	P118-1	P98	P10-1	P78
Total Road Length	km	6.0	10.5	7.4	43.0	14.8	6.2	1.6	7.5	7.0	8.3	13.2
Improvement Length	km	6.0	10.1	7.4	43.0	14.8	6.2	1.6	7.5	7.0	8.3	13.2
Proposed Pavement Type		6.0-BMP	6.0-GRV	6.0-GRV	6.0-GRV	4.0-GRV	6.0-GRV	6.0-GRV	6.0-GRV 6.0-PCC	6.0-GRV	6.0-GRV	6.0-GRV
Quantity												
100 Clearing & Grubbing	m2	-	-	-	-	-	-	-	-	-	-	-
Stripping	m3	-	-	-	-	-	-	-	-	-	-	-
102 Roadway & Drainage Excavation	m3	49491	12281	32746	151450	16868	4650	1200	22474	19538	7143	72176
104 Borrow	m3	-	6242	2481	16707	3801	3203	704	2663	2229	4316	3385
200 Aggregate Subbase	m3	8751	2561	4468	25740	5524	4092	1056	4777	4004	4713	8492
Preparation of Prev.Road(Grvl)	m2	26176	48966	28650	170650	56960	40920	10560	33420	28430	51210	57920
Preparation of Prev.Road(Asph)	m2	-	-	-	-	-	-	-	550	-	-	-
Preparation of Pave.Surf.(PCC)	m2	-	-	-	-	-	-	-	-	-	-	-
Preparation of Pave.Surf.(AC)	m2	-	-	-	-	-	-	-	-	-	-	-
202 Crushed Aggregate Base Course	m3	5729	-	-	-	-	-	-	-	-	-	-
300 Crushed Aggr. Surface Course	m3	-	9090	6390	38700	8820	5580	1440	6570	6129	7470	11790
301 Bituminous Prime Coat	M.T.	40	-	-	-	-	-	-	-	-	-	-
302 Bituminous Tack Coat	M.T.	-	-	-	-	-	-	-	-	-	-	-
305 Bituminous Macadam Pavement	m2	33600	-	-	-	-	-	-	-	-	-	-
310 Bitum.Concrete Surface Course	M.T.	-	-	-	-	-	-	-	-	-	-	-
304 Double Bitum.Surface Treatment	m2	-	-	-	-	-	-	-	-	-	-	-
311-1 PCC Pavement (t=23 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
311-2 PCC Pavement (t=20 cm)	m2	-	-	-	-	-	-	-	600	-	-	-
311-3 PCC Pavement (t=18 cm)	m2	2400	-	1800	-	400	-	-	600	1140	-	600
500 RCPC (dia.910mm)	m	180	330	225	1350	240	180	45	225	210	255	390
Headwall for RCPC (dia.910mm)	Set	12	22	15	90	30	12	3	15	14	17	26
504 Grouted Riprap	m3	-	558	-	1228	-	-	-	-	-	-	-
Side Ditch (Grouted Riprap)	m	5200	-	1950	8750	-	-	-	1200	950	-	4600
Slope Protection (Cut Slope)	m	-	-	-	-	-	-	-	-	-	-	-
Slope Protection (Embank't Sl)	m	-	-	-	-	-	-	-	-	-	-	-
2-lane Bridge,Superstructure	m	-	10	-	-	-	8	-	-	-	-	-
1-lane Bridge,Superstructure	m	-	-	-	-	-	-	-	-	-	-	-
2-lane Bridge,Abutment	Each	-	2	-	-	-	2	-	-	-	-	-
1-lane Bridge,Abutment	Each	-	-	-	-	-	-	-	-	-	-	-
2-lane Bridge,Pier	Each	-	-	-	-	-	-	-	-	-	-	-
1-lane Bridge,Pier	Each	-	-	-	-	-	-	-	-	-	-	-
2-lane Spillway	m	-	-	-	70	32	-	-	-	-	-	-
1-lane Spillway	m	-	-	-	-	-	-	-	-	-	-	-
1-cell RCBC	m	-	-	-	-	-	-	-	-	-	-	-
2-cell RCBC	m	-	-	-	-	-	-	-	-	-	-	-
Wingwall for 1-cell RCBC	Set	-	-	-	-	-	-	-	-	-	-	-
Wingwall for 2-cell RCBC	Set	-	-	-	-	-	-	-	-	-	-	-
Miscellaneous	l.s.	1	1	1	1	1	1	1	1	1	1	1
Road Construction Cost	M.p.	14.52	6.62	7.56	39.25	6.92	4.23	1.07	6.66	5.87	5.53	14.25
Bridge Construction Cost	M.p.	.00	1.18	.00	1.27	.58	1.11	.00	.00	.00	.00	.00
Total Construction Cost	M.p.	14.52	7.80	7.56	40.52	7.50	5.34	1.07	6.66	5.87	5.53	14.25
Road Construction Cost/Impr't km	M.p.	2.42	.66	1.02	.91	.47	.68	.67	.89	.84	.67	1.08
Total Construction Cost/Total km	M.p.	2.42	.74	1.02	.94	.51	.86	.67	.89	.84	.67	1.08

TABLE 5.1 - 4 (4)

Quantity and Construction Cost DAVAO DEL NORTE

	Unit	P126-1	N8	P129	P4-2	P124	P140	P95	P27	P11-2	P146	P87
Total Road Length	km	7.7	17.8	3.8	2.6	15.9	10.3	10.7	3.2	3.9	16.2	4.3
Improvement Length	km	7.7	17.8	3.8	2.6	15.9	10.3	10.7	3.2	3.9	16.2	4.3
Proposed Pavement Type		6.0-PCC 6.0-GRV	6.0-GRV	6.0-GRV	6.0-GRV	6.0-GRV	6.0-GRV	6.0-GRV	6.0-GRV	6.0-GRV	6.0-GRV	6.0-GRV
Quantity												
100 Clearing & Grubbing	m2	-	-	-	-	-	-	-	-	-	-	-
Stripping	m3	-	-	-	-	-	-	-	-	-	-	-
102 Roadway & Drainage Excavation	m3	27199	109650	5550	1950	102380	18331	45271	6876	6975	101940	29550
104 Borrow	m3	2680	4190	1707	1469	3420	13947	3109	1459	1761	4126	875
200 Aggregate Subbase	m3	5132	11748	2508	1716	9702	5810	6342	1944	2574	10292	2771
Preparation of Prev.Road(Grvl)	m2	41290	70940	24240	17160	68480	53640	47700	16860	24060	56900	13452
Preparation of Prev.Road(Asph)	m2	-	-	-	-	-	-	-	-	-	-	-
Preparation of Pave.Surf.(PCC)	m2	-	-	-	-	-	-	-	-	-	-	-
Preparation of Pave.Surf.(AC)	m2	-	-	-	-	-	-	-	-	-	-	-
202 Crushed Aggregate Base Course	m3	-	-	-	-	-	-	-	-	-	-	-
300 Crushed Aggr. Surface Course	m3	6462	14751	3420	2340	14130	9270	9630	2799	3510	13698	3303
301 Bituminous Prime Coat	M.T.	-	-	-	-	-	-	-	-	-	-	-
302 Bituminous Tack Coat	M.T.	-	-	-	-	-	-	-	-	-	-	-
305 Bituminous Macadam Pavement	m2	-	-	-	-	-	-	-	-	-	-	-
310 Bitum.Concrete Surface Course	M.T.	-	-	-	-	-	-	-	-	-	-	-
304 Double Bitum.Surface Treatment	m2	-	-	-	-	-	-	-	-	-	-	-
311-1 PCC Pavement (t=23 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
311-2 PCC Pavement (t=20 cm)	m2	200	-	-	-	-	-	-	-	-	-	-
311-3 PCC Pavement (t=18 cm)	m2	2520	8460	-	-	1200	-	-	540	-	5880	3780
500 RCPC (dia.910mm)	m	225	540	120	75	480	375	315	90	120	480	135
Headwall for RCPC (dia.910mm)	Set	15	36	8	5	32	25	21	6	8	32	9
504 Grouted Riprap	m3	-	-	-	-	-	1652	-	-	-	-	-
Side Ditch (Grouted Riprap)	m	1950	7300	400	-	6700	950	3000	300	300	6600	2050
Slope Protection (Cut Slope)	m	50	230	-	-	-	-	-	-	-	-	70
Slope Protection (Embank't Sl)	m	-	-	-	-	-	-	-	-	-	-	-
2-lane Bridge,Superstructure	m	-	-	-	50	43	25	15	-	-	-	-
1-lane Bridge,Superstructure	m	-	-	-	-	-	-	-	-	-	-	-
2-lane Bridge,Abutment	Each	-	-	-	2	6	2	2	-	-	-	-
1-lane Bridge,Abutment	Each	-	-	-	-	-	-	-	-	-	-	-
2-lane Bridge,Pier	Each	-	-	-	1	-	-	-	-	-	-	-
1-lane Bridge,Pier	Each	-	-	-	-	-	-	-	-	-	-	-
2-lane Spillway	m	20	40	-	-	-	45	-	-	-	-	-
1-lane Spillway	m	-	-	-	-	-	-	-	-	-	-	-
1-cell RCBC	m	-	-	-	-	-	-	-	-	-	-	-
2-cell RCBC	m	-	-	-	-	-	-	-	-	-	-	-
Wingwall for 1-cell RCBC	Set	-	-	-	-	-	-	-	-	-	-	-
Wingwall for 2-cell RCBC	Set	-	-	-	-	-	-	-	-	-	-	-
Miscellaneous	l.s.	1	1	1	1	1	1	1	1	1	1	1
Road Construction Cost	M.p.	9.04	27.98	2.90	1.79	18.52	10.05	10.22	2.61	3.01	19.74	7.77
Bridge Construction Cost	M.p.	.36	.73	.00	3.43	4.24	2.74	1.44	.00	.00	.00	.00
Total Construction Cost	M.p.	9.40	28.70	2.90	5.22	22.75	12.79	11.67	2.61	3.01	19.74	7.77
Road Construction Cost/Impr't Km	M.p.	1.17	1.57	.76	.69	1.16	.98	.96	.81	.77	1.22	1.81
Total Construction Cost/Total km	M.p.	1.22	1.61	.76	2.01	1.43	1.24	1.09	.81	.77	1.22	1.81

TABLE 5.1 - 4 (5)

Quantity and Construction Cost DAVAO DEL NORTE

	Unit	P67	P91-2	P85-2	P54	P40	P74	P4-1	P36	P14	P79-1	P10-2
Total Road Length	km	2.5	8.7	2.7	3.2	2.8	3.3	4.8	6.4	7.6	5.7	3.4
Improvement Length	km	2.5	8.7	2.7	3.2	2.8	2.1	4.8	4.8	3.8	5.7	3.4
Proposed Pavement Type		6.0-GRV	6.0-GRV	6.0-GRV	6.0-GRV	6.0-GRV	6.0-AC	6.0-GRV	6.0-GRV	6.0-BMP	6.0-GRV	6.0-GRV
Quantity												
100 Clearing & Grubbing	m2	-	-	-	-	-	-	-	-	-	-	-
Stripping	m3	-	-	-	-	-	-	-	-	-	-	-
102 Roadway & Drainage Excavation	m3	1575	22961	11130	3318	3234	3549	5112	5058	6002	13912	4556
104 Borrow	m3	16788	2423	410	1434	805	-	1796	2118	-	2030	1173
200 Aggregate Subbase	m3	1650	5582	870	1347	903	4946	1908	1953	5971	2410	884
Preparation of Prev.Road(Grvl)	m2	15460	53260	9120	17550	14070	9450	25800	26010	18060	23750	13600
Preparation of Prev.Road(Asph)	m2	-	-	-	-	-	-	-	-	1800	-	-
Preparation of Pave.Surf.(PCC)	m2	-	-	-	-	-	-	-	-	-	-	-
Preparation of Pave.Surf.(AC)	m2	-	-	-	-	-	-	-	-	-	-	-
202 Crushed Aggregate Base Course	m3	-	-	-	-	-	2835	-	-	3887	-	-
300 Crushed Aggr. Surface Course	m3	2115	7740	2430	2880	2520	-	4320	4320	-	5130	3060
301 Bituminous Prime Coat	M.T.	-	-	-	-	-	15	-	-	27	-	-
302 Bituminous Tack Coat	M.T.	-	-	-	-	-	-	-	-	-	-	-
305 Bituminous Macadam Pavement	m2	-	-	-	-	-	-	-	-	22800	-	-
310 Bitum.Concrete Surface Course	M.T.	-	-	-	-	-	1386	-	-	-	-	-
304 Double Bitum.Surface Treatment	m2	-	-	-	-	-	-	-	-	-	-	-
311-1 PCC Pavement (t=23 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
311-2 PCC Pavement (t=20 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
311-3 PCC Pavement (t=18 cm)	m2	900	600	-	-	-	-	-	-	-	-	-
500 RCPC (dia.910mm)	m	75	255	75	90	90	60	150	150	120	165	105
Headwall for RCPC (dia.910mm)	Set	5	17	5	6	6	4	10	10	8	11	7
504 Grouted Riprap	m3	-	-	-	-	-	-	-	-	-	-	-
Side Ditch (Grouted Riprap)	m	-	1200	600	-	-	-	-	-	-	550	-
Slope Protection (Cut Slope)	m	-	-	-	-	-	-	-	-	-	-	-
Slope Protection (Embank't Sl)	m	-	-	-	-	-	-	-	-	-	-	-
2-lane Bridge,Superstructure	m	-	-	-	-	-	-	-	45	75	32	-
1-lane Bridge,Superstructure	m	-	-	-	-	-	-	-	-	-	-	-
2-lane Bridge,Abutment	Each	-	-	-	-	-	-	-	2	2	2	-
1-lane Bridge,Abutment	Each	-	-	-	-	-	-	-	-	-	-	-
2-lane Bridge,Pier	Each	-	-	-	-	-	-	-	1	4	1	-
1-lane Bridge,Pier	Each	-	-	-	-	-	-	-	-	-	-	-
2-lane Spillway	m	-	-	-	-	-	-	-	-	-	-	-
1-lane Spillway	m	-	-	-	-	-	-	-	-	-	-	-
1-cell RCBC	m	-	-	-	-	-	-	-	-	12	-	-
2-cell RCBC	m	-	-	-	-	-	-	-	-	-	-	-
Wingwall for 1-cell RCBC	Set	-	-	-	-	-	-	-	-	1	-	-
Wingwall for 2-cell RCBC	Set	-	-	-	-	-	-	-	-	-	-	-
Miscellaneous	l.s.	1	1	1	1	1	1	1	1	1	1	1
Road Construction Cost	M.p.	3.76	7.28	2.24	1.99	1.65	4.83	2.95	3.00	6.27	4.17	1.98
Bridge Construction Cost	M.p.	.00	.00	.00	.00	.00	.00	.00	3.19	5.99	2.57	.00
Total Construction Cost	M.p.	3.76	7.28	2.24	1.99	1.65	4.83	2.95	6.19	12.25	6.74	1.98
Road Construction Cost/Impr't km	M.p.	1.50	.84	.83	.62	.59	2.30	.61	.62	1.65	.73	.58
Total Construction Cost/Total km.	M.p.	1.50	.84	.83	.62	.59	1.46	.61	.97	1.61	1.18	.58

TABLE 5.1 - 4 (6)

Quantity and Construction Cost DAVAO DEL NORTE

	Unit	P2	B05-30	B20-4	B14-19	B08-23	B10-12	B13-11	B19-1	B20-10
Total Road Length	km	7.0	7.1	9.5	5.8	14.2	14.2	15.0	24.2	7.4
Improvement Length	km	7.0	7.1	9.5	5.8	14.2	14.2	15.0	24.2	7.4
Proposed Pavement Type		6.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV
Quantity										
100 Clearing & Grubbing	m2	-	-	-	-	-	21000	-	307300	93000
Stripping	m3	-	-	-	-	-	2100	-	30730	9300
102 Roadway & Drainage Excavation	m3	7719	10725	17700	8377	15825	26825	16875	35110	17750
104 Borrow	m3	20538	1947	1935	1949	4431	3241	9300	19388	2815
200 Aggregate Subbase	m3	3129	3266	4370	2508	6532	6532	6900	11132	3404
Preparation of Prev.Road(Grvl)	m2	34712	23320	3280	20330	54740	46420	64000	-	3960
Preparation of Prev.Road(Asph)	m2	-	-	-	-	-	-	-	-	-
Preparation of Pave.Surf.(PCC)	m2	-	-	-	-	-	-	-	-	-
Preparation of Pave.Surf.(AC)	m2	-	-	-	-	-	-	-	-	-
202 Crushed Aggregate Base Course	m3	-	-	-	-	-	-	-	-	-
300 Crushed Aggr. Surface Course	m3	6300	3810	5640	3480	8520	7980	8076	14520	4440
301 Bituminous Prime Coat	M.T.	-	-	-	-	-	-	-	-	-
302 Bituminous Tack Coat	M.T.	-	-	-	-	-	-	-	-	-
305 Bituminous Macadam Pavement	m2	-	-	-	-	-	-	-	-	-
310 Bitum.Concrete Surface Course	M.T.	-	-	-	-	-	-	-	-	-
304 Double Bitum.Surface Treatment	m2	-	-	-	-	-	-	-	-	-
311-1 PCC Pavement (t=23 cm)	m2	-	-	-	-	-	-	-	-	-
311-2 PCC Pavement (t=20 cm)	m2	-	-	-	-	-	-	-	-	-
311-3 PCC Pavement (t=18 cm)	m2	-	3000	400	-	-	3600	6160	-	-
500 RCPC (dia.910mm)	m	420	112	152	96	224	256	256	704	216
Headwall for RCPC (dia.910mm)	Set	28	14	19	12	28	32	32	88	27
504 Grouted Riprap	m3	4104	-	-	-	-	-	924	-	-
Side Ditch (Grouted Riprap)	m	-	-	-	-	-	-	-	-	-
Slope Protection (Cut Slope)	m	-	-	-	-	-	-	150	-	-
Slope Protection (Embank't Sl)	m	-	-	-	-	-	-	100	-	-
2-lane Bridge,Superstructure	m	-	-	-	-	-	-	-	-	-
1-lane Bridge,Superstructure	m	-	-	-	-	10	18	17	-	-
2-lane Bridge,Abutment	Each	-	-	-	-	-	-	-	-	-
1-lane Bridge,Abutment	Each	-	-	-	-	2	2	4	-	-
2-lane Bridge,Pier	Each	-	-	-	-	-	-	-	-	-
1-lane Bridge,Pier	Each	-	-	-	-	-	-	-	-	-
2-lane Spillway	m	-	-	-	-	-	-	-	-	-
1-lane Spillway	m	-	-	20	15	-	-	45	65	-
1-cell RCBC	m	-	-	-	-	-	-	8	-	-
2-cell RCBC	m	-	-	-	-	-	-	-	-	-
Wingwall for 1-cell RCBC	Set	-	-	-	-	-	-	1	-	-
Wingwall for 2-cell RCBC	Set	-	-	-	-	-	-	-	-	-
Miscellaneous	l.s.	1	1	1	1	1	1	1	1	1
Road Construction Cost	M.p.	9.76	4.25	4.79	2.92	6.91	8.45	16.52	16.16	5.04
Bridge Construction Cost	M.p.	.00	.00	.26	.20	.86	1.14	2.53	.86	.00
Total Construction Cost	M.p.	9.76	4.25	5.06	3.12	7.77	9.59	19.06	17.02	5.04
Road Construction Cost/Impr't km	M.p.	1.39	.60	.50	.50	.49	.60	1.10	.67	.68
Total Construction Cost/Total km	M.p.	1.39	.60	.53	.54	.55	.68	1.27	.70	.68

5.1.3 Summary of Preliminary Design

Results of preliminary design were summarized in Tables 5.1-5 and 5.1-6 for major and minor roads, respectively.

TABLE 5.1-5 SUMMARY OF PRELIMINARY DESIGN :
Province of Davao del Norte
- Major Roads -

	Type of Improvement			
	Rehabilitation/ Improvement - 1	Improvement-2/ Widening	New Construction	Total
Primary Major Roads				
1. No. of Links	-	-	-	-
2. Total Length (km)	-	-	-	-
3. Improvement Length (km)	-	-	-	-
4. Construction Cost (million P)	-	-	-	-
5. Const. Cost/Imp. Length (MP/km)	-	-	-	-
Secondary Major Roads				
1. No. of Links	15	9	-	24
2. Total Length (km)	151.4	86.5	-	237.9
3. Improvement Length (km)	151.4	86.1	-	237.5
4. Construction Cost (million P)	325.2	192.3	-	517.5
5. Const. Cost/Imp. Length (MP/km)	2.15	2.23	-	2.18
Major Roads Total				
1. No. of Links	15	9	-	24
2. Total Length (km)	151.4	86.5	-	237.9
3. Improvement Length (km)	151.4	86.1	-	237.5
4. Construction Cost (million P)	325.2	192.3	-	517.5
5. Const. Cost/Imp. Length (MP/km)	2.15	2.23	-	2.18

TABLE 5.1-6 SUMMARY OF PRELIMINARY DESIGN
Province of Davao del Norte
- Minor Roads -

	Type of Improvement		
	Rehabilitation/ Improvement-1&2/ Widening	New Construction	Total
Minor Roads (National/ Provincial/City)			
1. No. of Links	32	-	32
2. Total Length (km)	263.5	-	263.5
3. Improvement Length (km)	256.9	-	256.9
4. Construction Cost (million P)	282.5	-	282.5
5. Const. Cost/Imp. Length (MP/km)	1.10	-	1.10
Minor Roads (Barangay)			
1. No. of Links	6	2	8
2. Total Length (km)	65.8	31.6	97.4
3. Improvement Length (km)	65.8	31.6	97.4
4. Construction Cost (million P)	48.8	22.1	70.9
5. Const. Cost/Imp. Length (MP/km)	0.74	0.70	0.73
Minor Roads Total			
1. No. of Links	38	2	40
2. Total Length (km)	329.3	31.6	360.9
3. Improvement Length (km)	322.7	31.6	354.3
4. Construction Cost (million P)	331.3	22.1	353.4
5. Const. Cost/Imp. Length (MP/km)	1.03	0.70	1.00

5.2 ECONOMIC EVALUATION

5.2.1 Basic Assumptions

The commonly used cost-benefit analysis was applied under the following basic assumptions:

i) Analysis Period

1991 - Detailed design
1992 - Construction
1993 ┐
     │
     │ -Project life (25 years)
     │
2017 ┘

ii) Discount Rate: 15% pa

iii) Quantified Cost

Initial construction/improvement costs
Periodic maintenance costs

iv) Quantified Benefit

Traffic benefit
Development benefit (only for development projects)
Maintenance cost savings

The periodic maintenance costs, or rehabilitation costs, such as overlay, reconstruction and regravelling which will be needed after completion of the project to prolong the pavement life, were treated as project costs in this study, while the difference between routine maintenance costs and total maintenance costs in the "w/o" case was taken into account as a project benefit. In the case where the routine maintenance costs are higher than the "w/o" maintenance costs, the difference is considered as a negative benefit.

5.2.2 Economic Costs

1) Initial Construction/Improvement Costs

The construction costs discussed in Section 5.2.1 are the financial costs and do not include the costs for detailed design and construction supervision. In the cost-benefit analysis, the following economic cost was used:

Construction Cost	100%
-Tax	-15%
+Detailed Design Cost	4%
+Construction Supervision Cost	6%
Total Economic Cost	95%

In the cost-benefit stream, 4% for detailed design cost was assumed to be spent in 1991 and the remaining 91% in 1992.

2) Periodic Maintenance Costs

Periodic maintenance, or rehabilitation, will be necessary when the riding quality of a pavement decreases to a certain minimum level of acceptability. Table 5.2-1 shows the periodic maintenance assumed in this Study.

TABLE 5.2-1 PERIODIC MAINTENANCE COST ASSUMED IN THE ANALYSIS

Surface Type	Periodic Maintenance Work	Timing	Financial Cost 1) (million₱/Km)	Economic Cost
Gravel	10cm Regravelling	When thickness of gravel is reduced by 10cm, assuming 1.5cm loss annually from rainfall and 1.5cm loss every 100,000 vehicles (2-6 years)	4.0 m Gravel: ₱ 0.210 M 6.0 m Gravel: ₱ 0.320 M	85% of Cost
BMP	5.5cm BMP Overlay	When pavement serviceability decreases to 2.0, assuming 85,000 ESAL or 350,000 vehicle repetitions (4-10 years)	₱ 0.830 M	85% of Cost
AC	5 cm AC Overlay	When pavement serviceability decreases to 2.0, assuming 800,000 ESAL or 2,300,000 vehicle repetitions (8-20 years)	₱ 1.170 M	85% of Cost
PCC	5 cm AC Overlay	When pavement serviceability decreases to 2.0, assuming 2,000,000 ESAL or 5,700,000 vehicle repetitions (10-25 years)	₱ 1.200 M	85% of Cost

Note: 1) As of April 1990

5.2.3 Benefits

1) Traffic Benefits

a) Traffic Cost

Basic Traffic Costs

The basic traffic costs were provided by PMO-FS, as shown in Table 5.2-2.

TABLE 5.2-2 BASIC TRAFFIC COSTS EXCLUDING TAX (AS OF DECEMBER 1989)

	Running Cost (₱/km)	Fixed Cost (₱/hour)	Time Cost (₱/hour)
Car/Van	1.75	6.30	17.70
Jeepney	1.12	23.76	26.40
Bus	2.81	35.64	95.04
Truck	3.48	38.88	0
Motor-tricycle	0.36	8.76	4.98
Motorcycle	0.31	0.72	8.34

Actual Traffic Costs

The actual traffic costs were estimated according to the dl-system concerning running costs and the dt-system with regard to fixed and time costs. The dl-values and operating speed for different surface conditions are shown in Tables 5.2-3 and 5.2-4, respectively.

TABLE 5.2-3 DL-VALUES IN KM PER ACTUAL KM

Surface Type / Surface Condition	PCC/AC	BMP/DBST	Gravel	Earth
Good	0	0.14	0.29	-
Fair	0.17	0.38	0.60	-
Bad	0.43	0.65	0.87	1.20
Very Bad	0.89	1.04	1.20	1.56
Impassable	1.73	1.73	1.73	1.73

TABLE 5.2-4 OPERATING SPEED IN KM/HOUR

Surface Condition	Surface Type: PCC/AC OV	PCC/AC TR	PCC/AC MC	BMP/DBST OV	BMP/DBST TR	BMP/DBST MC	Gravel OV	Gravel TR	Gravel MC	Earth OV	Earth TR	Earth MC
Good	65	40	60	63	38	55	60	35	50	-	-	-
Fair	55	35	50	53	33	45	50	30	40	-	-	-
Bad	30	20	20	30	20	20	30	20	20	20	10	10
Very Bad	20	10	10	20	10	10	20	10	10	10	5	5
Impassable	10	5	5	10	5	5	10	5	5	10	5	5

Note: OV = Car/Jeepney/Bus/Truck
TR = Motor-tricycle
MC = Motorcycle

Traffic Costs of Other Transport Modes

In addition to the land-based motorized vehicles, the traffic costs of other modes were estimated as shown in Table 5.2-5.

TABLE 5.2-5 TRAFFIC COST OF OTHER MODES (COMMON TO ALL SURFACE TYPES AND CONDITIONS)

Mode	Traffic Cost in ₱/Km
Animal Drawn	4.0
Walking (head loading)	1.2
Banca Boat	2.25

b) Traffic Benefits in Traffic Projects

Traffic on the project roads wwas broken down into four categories: normal traffic, diverted traffic-1, diverted traffic-2 and generated traffic.

The traffic benefits were estimated as follows:

i) Normal Traffic : Difference in traffic costs between "w/o" and "with" cases. The change in traffic costs results not only from the improvement of surface type and condition but also from consequent change in modal distribution.

ii) Diverted Traffic-1 : Difference between traffic costs along the "w/o" route and those along the "with" route. Where diverted traffic passes through two or more project roads, the benefits were allocated to each road in proportion to length.

iii) Diverted Traffic-2 and Generated Traffic: Half of the difference in traffic costs between "w/o" and "with" cases. This is the commonly used approximation.

Traffic costs were calculated assuming the following surface conditions:

"W/O" Case : Present surface condition is maintained.
"With" Case: Gravel/BMP are maintained in a fair condition.
AC/PCC are maintained in a good condition

c) Traffic Benefits in Development Projects

No diverted traffic is expected in most development projects. The benefits from normal traffic generated traffic were estimated in the same way as used for the traffic projects paying attention to the following:

i) The travel distance considered in the benefit calculation is the distrance from the average gravity point of transport (gravity of population for passenger traffic and non-agricultural traffic and gravity of agricultural production for agricultural traffic) to the connecting point with a higher road.

ii) The benefit from generated agricultural traffic is not considered as a traffic benefit because it is included in the development benefit. Therefore, the generated traffic benefits are only from passenger traffic and non-agricultural traffic.

2) Development Benefits

Development benefits were assessed using the producer surplus approach, under the hypothesis that substantial road improvement which removes constraints on development will permit and encourage farmers to adopt modern agricultural techniques and inputs. The development benefit consists of the difference in the

net value of total production (farmgate value less production costs) between the "w/o" and "with" cases. Changes in the volume and value of agricultural production will be achieved by one or more of the following:

i) Increase in cultivated area
ii) Increase in yield
iii) Increase in intensity of land use through increasing the number of harvest or intercropping
iv) Changes in the type of crop

Using the data obtained from the socio-economic survey, development benefits were calculated from the following equation:

Benefit = PRODw(FGPw-CPw)-(FGPw-CPw/o)

where, PRODw = Production in metric tons, with
PRODw/o= Production in metric tons, w/o
FGPw = Farmgate price in pesos per metric ton, with
CPw = Production cost in pesos per metric ton, with
CPw/o = Production cost in pesos per metric ton, w/o

The increase in farmgate price resulting from reduction in traffic cost is not included in the development benefits, because it is considered a part of the traffic benefits.

Table 5.2-6 presents the summary of demographic and agricultural data.

TABLE 5.2 - 6 (1)

Summary of Demographic and Agricultural Data DAVAO DEL NORTE

Class of Road	Type of Impr't	Road Number	Road Length (km)	1990 Population Total	1990 Population /km	1990 Crop Area (ha) Total	1990 Crop Area (ha) Major Crop	1993 AADT w/o	1993 AADT with	IRR (%)
Minor (Nat'l/ Prov'l)	Rehab/ Imp-1	P79-2	7.4	6626	895	1312	526(Coco.) 353(Banan) 247(Corn) 176(Coff.) 10(Vege.)	12	52	25.6
		N5-3	43.0	18811	437	7999	2255(Coff.) 1990(Coco.) 1857(Palay) 1459(Corn) 398(Banan)	125	130	22.0
		P120	14.8	3371	228	1660	864(Coco.) 426(Banan) 370(Corn)	21	30	20.6
		P128	6.2	5390	869	873	480(Coco.) 152(Coff.) 144(Banan) 87(Corn) 10(Palay)	5	55	19.0
		P18	1.6	8960	5600	470	200(Coco.) 90(Banan) 80(Root) 50(Palay) 50(Corn)	92	139	16.5
		P118-1	7.5	2283	304	2015	982(Coco.) 610(Banan) 294(Corn) 119(Palay) 10(Vege.)	20	24	15.2
		P98	7.0	2073	296	846	312(Coco.) 270(Banan) 152(Palay) 62(Corn) 50(Root)	2	29	14.6
		P10-1	8.3	10597	1277	1069	394(Banan) 319(Palay) 215(Coco.) 141(Corn)	114	114	13.7
		P78	13.2	4131	313	1744	950(Coco.) 594(Banan) 150(Corn) 50(Palay)	34	40	11.3
		P126-1	7.7	4154	539	836	568(Coco.) 125(Coff.) 112(Corn) 31(Palay)	28	31	10.7
		N8	17.8	6486	364	831	329(Coco.) 313(Corn) 179(Banan) 10(Palay)	8	46	9.6
		P129	3.8	3665	964	846	547(Coco.) 224(Corn) 75(Banan)	24	29	9.3
		P4-2	2.6	6521	2508	1113	593(Coco.) 279(Corn) 201(Banan) 20(Palay) 20(Vege.)	35	39	8.1
		P124	15.9	12375	778	1965	782(Coco.) 459(Coff.) 440(Banan) 254(Corn) 30(Vege.)	152	246	7.4
		P140	10.3	4986	484	1904	1165(Corn) 338(Coco.) 202(Banan) 159(Palay) 40(Vege.)	34	49	6.9
		P95	10.7	5070	474	1603	674(Coco.) 471(Banan) 360(Palay) 58(Coff.) 34(Corn)	36	41	6.7
		P27	3.2	3542	1107	472	390(Coco.) 61(Corn) 21(Banan)	36	31	6.4
		P11-2	3.9	7770	1992	489	256(Coco.) 113(Banan) 80(Root) 40(Vege.)	76	61	5.6
		P146	16.2	3115	192	972	498(Corn) 255(Coco.) 119(Banan) 100(Coff.)	37	29	2.1
		P87	4.3	1780	414	405	218(Coco.) 89(Banan) 58(Corn) 40(Root)	14	17	.0
		P67	2.5	603	241	333	239(Coco.) 58(Banan) 36(Corn)	1	7	.0
		P91-2	8.7	4718	542	1166	386(Coco.) 313(Banan) 200(Palay) 186(Root) 81(Coff.)	45	77	.0
	Imp-2/ Widen	P85-2	2.7	11513	4264	2003	730(Banan) 495(Coco.) 438(Corn) 300(Coff.) 40(Vege.)	148	146	37.0
		P54	3.2	7730	2416	565	280(Coco.) 225(Banan) 60(Palay)	58	75	35.9
		P40	2.8	8993	3212	2560	1092(Banan) 1091(Coco.) 297(Corn) 50(Palay) 30(Vege.)	143	145	19.7
		P74	3.3	14858	4351	1625	686(Coco.) 500(Palay) 439(Banan)	160	164	15.3
		P4-1	4.8	5663	1180	1974	1256(Coco.) 339(Banan) 244(Corn) 100(Root) 35(Coff.)	68	66	15.1
		P36	6.4	8777	1371	1039	989(Banan) 50(Palay)	134	139	9.3
		P14	7.6	14956	1968	1375	833(Coco.) 487(Banan) 55(Corn)	215	215	8.2
		P79-1	5.7	6783	1190	2225	866(Coco.) 582(Banan) 430(Corn) 216(Coff.) 91(Palay)	78	79	7.8
		P10-2	3.4	3175	934	690	372(Banan) 192(Corn) 126(Palay)	59	55	3.6
		P2	7.0	5313	759	765	600(Coco.) 100(Banan) 25(Corn) 20(Vege.) 20(Root)	67	60	1.8
Minor (Baran-gay)	Rehab/ Imp-1	B05-30	7.1	9971	1404	1772	581(Banan) 483(Coco.) 368(Corn) 300(Coff.) 40(Vege.)	174	157	49.5
		B20-4	9.5	9586	1009	245	135(Banan) 100(Coff.) 10(Coco.)	2	24	48.7
		B14-19	5.8	4254	733	985	408(Coco.) 264(Palay) 163(Banan) 120(Corn) 30(Vege.)	9	37	25.5
		B08-23	14.2	3902	275	910	344(Coco.) 251(Banan) 244(Corn) 31(Coff.) 30(Palay)	40	64	5.9
		B10-12	14.2	2511	177	1394	750(Corn) 513(Coco.) 111(Banan) 20(Vege.)	9	11	4.5
		B13-11	15.0	2316	154	586	178(Palay) 171(Coco.) 107(Corn) 67(Banan) 53(Coff.)	1	14	2.0
	New Const.	B19-1	24.2	2000	83	1320	400(Coff.) 300(Coco.) 240(Corn) 180(Palay) 180(Banan)	0	8	10.9
		B20-10	7.4	1905	257	656	404(Coco.) 202(Corn) 50(Banan)	0	5	5.4

3) Maintenance Cost Savings

The difference in maintenance costs between the "w/o" and "with" cases is considered one of the benefits. Maintenance costs in the "w/o" case were estimated based on the current EMK system, while maintenance costs in the "with" case were estimated as shown in b) below. It is noted that periodic maintenance cost in the "with" case is not included in the calculation of maintenance cost savings, because it is treated as a part of project costs.

In the case where the routine maintenance costs in the "with" case are higher than the maintenance costs in the "w/o" case (especially in the case of new construction, the maintenance cost in the "w/o" case in zero), the difference is considered as a negative benefit).

a) Maintenance Cost in "w/o" Case

According to the current EMK system, the annual maintenance cost per km was estimated as basic maintenance cost of ₱17,143.00/km times the EMK factor as shown in Table 5.2-7.

TABLE 5.2-7
EMK FACTOR FOR DIFFERENT SURFACING AND AADT

AADT / Surface Type	25	50	75	100	150	200	300	400
Earth	0.35	0.40	0.50					
Gravel	0.40	0.60	0.90	1.40	1.90	2.20	2.40	2.50	2.60

AADT / Surface Type	400	600	1000	1500	2000	3000	5000	10000
Bituminous	1.10	1.55	2.10	2.50	2.60			
Gravel	0.50	0.60	0.80	0.85	0.90	0.95	1.00	1.05	1.10

b) Routine Maintenance Costs in "with" Case

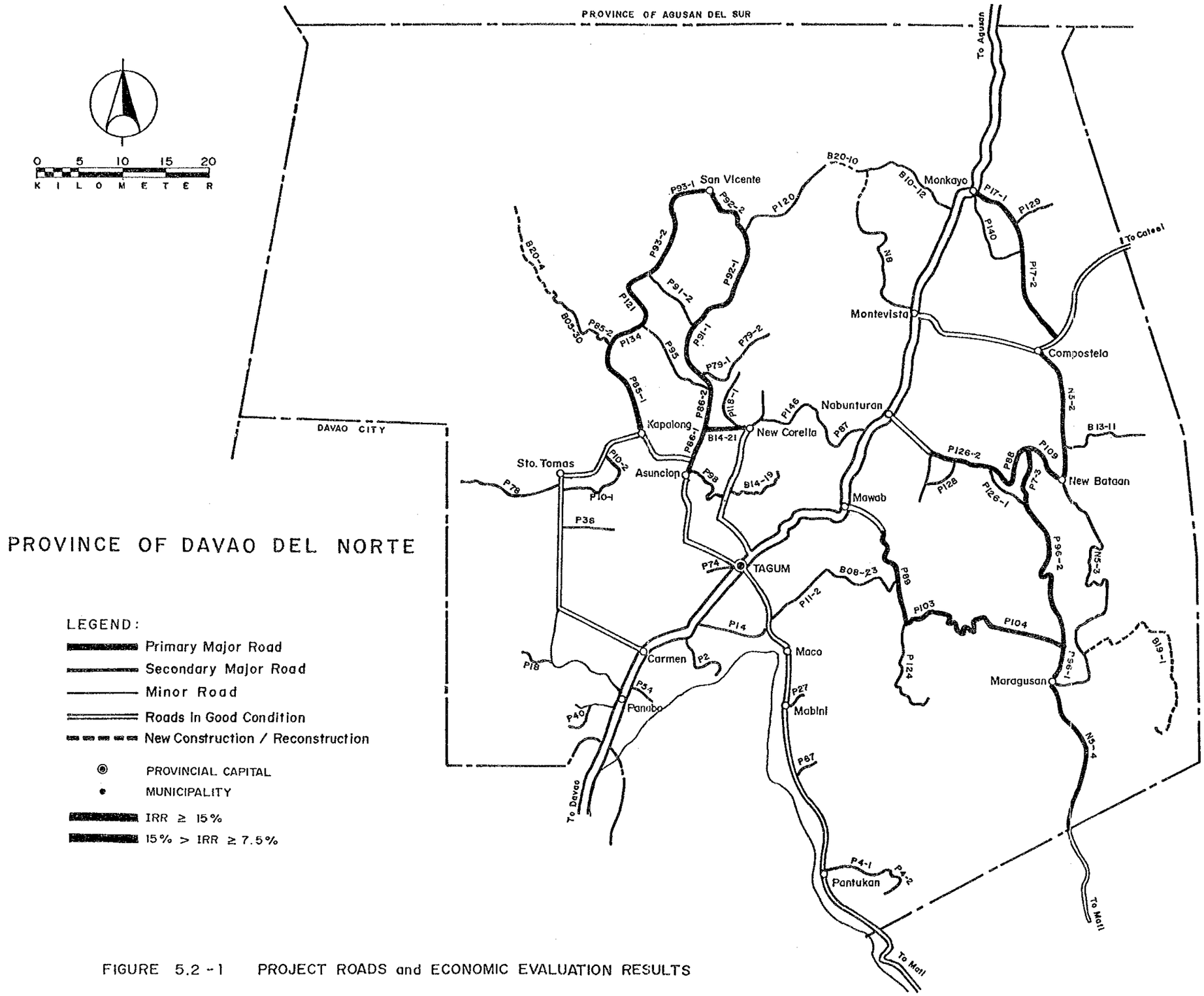
The costs deemed necessary to maintain the improved roads in a fair condition were estimated as shown in Table 5.2-8.

TABLE 5.2-8
ESTIMATED ROUTINE MAINTENANCE COSTS

Surface Type	Operation	Annual Cost (peso/km)
Gravel	Vegetation Control	1,150
	Ditch Cleaning	4.0 m Gravel: 2,650 + 40 AADT
	Grading	6.0 m Gravel: 3,000 + 45 AADT
	Pothole Repair	
	Total	4.0 m Gravel: 3,800 + 45 AADT
		6.0 m Gravel: 4,150 + 45 AADT
BMP	Vegetation Control	1,150
	Ditch Cleaning	1,100
	Shoulder Repair	2,150
	Patching	8,000 + 7.5 AADT
	Regravelling Shoulder	8,600
	Total	21,000 + 7.5 AADT
AC	Vegetation Control	1,150
	Ditch Cleaning	1,100
	Shoulder Repair	2,150
	Crack and Joint Sealing	9,300
	Regravelling Shoulder	8,600
	Total	20,400
PCC	Vegetation Control	1,150
	Ditch Cleaning	1,100
	Shoulder Repair	2,150
	Crack and Joint Sealing	5,600
	Regravelling Shoulder	8,600
	Total	18,600

5.2.4 Economic Evaluation

Results of economic evaluation are summarized in Table 5.2-9 and illustrated in Figure 5.2-1. Results of economic evaluation of each project road is presented in Table 5.2-10.



PROVINCE OF DAVAO DEL NORTE

LEGEND:

- Primary Major Road
- Secondary Major Road
- Minor Road
- Roads in Good Condition
- New Construction / Reconstruction
- PROVINCIAL CAPITAL
- MUNICIPALITY
- IRR ≥ 15%
- 15% > IRR ≥ 7.5%

FIGURE 5.2 - 1 PROJECT ROADS and ECONOMIC EVALUATION RESULTS

TABLE 5.2 - 9 (1)

Road Length and Construction Cost DAVAO DEL NORTE

Class of Road	Range of IRR	Rehabilitation/Improvement-1						Improvement-2/Widening						New Construction					
		No.	Total Length	Improv Length	Road Cost	Bridge Cost	Total Cost	No.	Total Length	Improv Length	Road Cost	Bridge Cost	Total Cost	No.	Total Length	Improv Length	Road Cost	Bridge Cost	Total Cost
Primary Major	15<	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7.5-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	<7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Second'y Major	15<	2	21.7	21.7	55.9	4.2	60.1	4	24.4	24.4	60.2	4.2	64.3	-	-	-	-	-	-
	10-15	5	54.9	54.9	123.2	17.0	140.2	4	51.6	51.6	106.0	14.2	120.2	-	-	-	-	-	-
	7.5-10	3	22.1	22.1	32.1	10.2	42.3	-	-	-	-	-	-	-	-	-	-	-	-
	<7.5	5	52.7	52.7	64.5	18.1	82.6	1	10.5	10.1	6.6	1.2	7.8	-	-	-	-	-	-
	Total	15	151.4	151.4	275.7	49.5	325.2	9	86.5	86.1	172.8	19.5	192.3	-	-	-	-	-	-
Minor (Nat'l/ Prov'l)	15<	6	80.5	80.5	65.7	3.0	68.7	5	16.8	15.6	13.7	-	13.7	-	-	-	-	-	-
	10-15	4	36.2	36.2	34.7	.4	35.1	-	-	-	-	-	-	-	-	-	-	-	-
	7.5-10	3	24.2	24.2	32.7	4.2	36.8	3	19.7	14.3	13.4	11.7	25.2	-	-	-	-	-	-
	<7.5	9	75.7	75.7	82.9	8.4	91.4	2	10.4	10.4	11.7	-	11.7	-	-	-	-	-	-
	Total	22	216.6	216.6	216.0	15.9	231.9	10	46.9	40.3	38.8	11.7	50.6	-	-	-	-	-	-
Minor (Baran-gay)	15<	3	22.4	22.4	12.0	.5	12.4	-	-	-	-	-	-	-	-	-	-	-	-
	10-15	-	-	-	-	-	-	-	-	-	-	-	-	1	24.2	24.2	16.2	.9	17.0
	7.5-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	<7.5	3	43.4	43.4	31.9	4.5	36.4	-	-	-	-	-	-	1	7.4	7.4	5.0	-	5.0
	Total	6	65.8	65.8	43.8	5.0	48.8	-	-	-	-	-	-	2	31.6	31.6	21.2	.9	22.1
Total	15<	11	124.6	124.6	133.6	7.6	141.2	9	41.2	40.0	73.9	4.2	78.0	-	-	-	-	-	-
	10-15	9	91.1	91.1	157.9	17.3	175.2	4	51.6	51.6	106.0	14.2	120.2	1	24.2	24.2	16.2	.9	17.0
	7.5-10	6	46.3	46.3	64.8	14.4	79.2	3	19.7	14.3	13.4	11.7	25.2	-	-	-	-	-	-
	<7.5	17	171.8	171.8	179.3	31.1	210.4	3	20.9	20.5	18.4	1.2	19.5	1	7.4	7.4	5.0	-	5.0
	Total	43	433.8	433.8	535.5	70.4	605.9	19	133.4	126.4	211.6	31.3	242.9	2	31.6	31.6	21.2	.9	22.1

TABLE 5.2 - 9 (2)

Road Length and Construction Cost DAVAO DEL NORTE

Class of Road	Range of IRR	Total					
		No.	Total Length	Improv Length	Road Cost	Bridge Cost	Total Cost
Primary Major	15<	-	-	-	-	-	-
	10-15	-	-	-	-	-	-
	7.5-10	-	-	-	-	-	-
	<7.5	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Second'y Major	15<	6	46.1	46.1	116.1	8.3	124.4
	10-15	9	106.5	106.5	229.2	31.2	260.3
	7.5-10	3	22.1	22.1	32.1	10.2	42.3
	<7.5	6	63.2	62.8	71.1	19.3	90.4
	Total	24	237.9	237.5	448.5	69.1	517.5
Minor (Nat'l/ Prov'l)	15<	11	97.3	96.1	79.4	3.0	82.3
	10-15	4	36.2	36.2	34.7	.4	35.1
	7.5-10	6	43.9	38.5	46.1	15.9	62.0
	<7.5	11	86.1	86.1	94.7	8.4	103.1
	Total	32	263.5	256.9	254.9	27.7	282.5
Minor (Baran-gay)	15<	3	22.4	22.4	12.0	.5	12.4
	10-15	1	24.2	24.2	16.2	.9	17.0
	7.5-10	-	-	-	-	-	-
	<7.5	4	50.8	50.8	36.9	4.5	41.5
	Total	8	97.4	97.4	65.0	5.8	70.9
Total	15<	20	165.8	164.6	207.4	11.8	219.2
	10-15	14	166.9	166.9	280.0	32.4	312.4
	7.5-10	9	66.0	60.6	78.2	26.1	104.3
	<7.5	21	200.1	199.7	202.7	32.3	235.0
	Total	64	598.8	591.8	768.4	102.6	870.9

TABLE 5.2 - 10 (1)

Summary of Economic Analysis DAVAO DEL NORTE

Cost/Benefit:1991-2017 Discounted Total

Class of Road	Type of Impr't	Road Number	1993 AADT w/o	1993 AADT with	Length (km) Total	Length (km) Improvement	Economic Cost (Mp/km) Construct.	Economic Cost (Mp/km) Period Maint.	Economic Cost (Mp/km) Total	Benefit (Mp/km) Normal	Benefit (Mp/km) Diverted	Benefit (Mp/km) Generated	Benefit (Mp/km) Develop't	Benefit (Mp/km) Maint sav'g	Benefit (Mp/km) Total	Econom. Indicator NPV (Mp)	B/C	IRR (%)
Second'y	Rehab/	P96-1	532	562	7.2	7.2(6.0-AC)	2.48	.14	2.62	5.35	-	.39	-	.10	5.84	23.2	2.2	28.7
Major	Imp-1	P92-1	519	538	14.5	14.5(6.0-AC)	2.21	.08	2.29	3.03	-	.13	-	.10	3.26	14.0	1.4	21.4
		P96-2	205	224	20.1	20.1(6.0-BMP)	2.08	.37	2.45	1.94	-	.25	-	.07	2.25	-4.1	.9	13.9
		P109	395	396	5.6	5.6(6.0-BMP)	2.00	.67	2.67	2.30	-	.12	-	.07	2.48	-1.0	.9	13.8
		P89	272	285	7.5	7.5(6.0-BMP)	1.78	.48	2.26	1.81	-	.07	-	.07	1.95	-2.3	.9	12.9
		P104	272	285	13.5	13.5(6.0-BMP)	2.75	.48	3.22	2.50	-	.10	-	.07	2.67	-7.4	.8	12.5
		P7-3	205	224	8.2	8.2(6.0-BMP)	1.60	.37	1.97	1.28	-	.16	-	.07	1.51	-3.8	.8	11.3
		P17-1	178	188	6.3	6.3(6.0-GRV)	.84	.35	1.19	.79	-	.02	-	.11	.92	-1.7	.8	9.8
		P93-2	109	121	7.9	7.9(6.0-GRV)	1.18	.27	1.45	.89	-	.05	-	.07	1.01	-3.5	.7	9.2
		B14-21	179	223	7.9	7.9(6.0-BMP)	2.60	.22	2.83	1.55	-	.24	-	.02	1.80	-8.1	.6	8.4
		P17-2	178	188	15.8	15.8(6.0-GRV)	1.72	.35	2.08	1.10	-	.03	-	.09	1.22	-13.5	.6	7.0
		P121	109	121	9.7	9.7(6.0-GRV)	1.20	.27	1.46	.65	-	.04	-	.10	.78	-6.6	.5	5.3
		P93-1	109	121	5.0	5.0(6.0-GRV)	1.22	.27	1.49	.65	-	.04	-	.09	.77	-3.6	.5	4.8
		N5-4	88	117	15.0	15.0(6.0-GRV)	.99	.31	1.30	.38	-	.17	-	.07	.62	-10.2	.5	2.5
		P134	109	121	7.2	7.2(6.0-GRV)	1.23	.27	1.50	.36	-	.02	-	.10	.48	-7.3	.3	.0
	Imp-2/	P86-1	593	625	4.7	4.7(6.0-AC)	2.01	.08	2.09	4.00	-	.26	-	.10	4.36	10.7	2.1	30.4
	Widen	P91-1	519	538	5.0	5.0(6.0-AC)	1.98	.08	2.06	3.21	-	.13	-	.10	3.44	6.9	1.7	25.0
		P86-2	519	538	7.3	7.3(6.0-AC)	2.51	.08	2.59	3.79	-	.16	-	.10	4.05	10.6	1.6	23.3
		P92-2	519	538	7.4	7.4(6.0-AC)	2.14	.08	2.22	3.03	-	.13	-	.10	3.26	7.7	1.5	22.1
		N5-2	238	271	16.3	16.3(6.0-BMP)	2.06	.44	2.50	1.74	-	.22	-	.07	2.03	-7.6	.8	11.9
		P103	272	285	24.0	24.0(6.0-BMP)	1.92	.48	2.40	1.69	-	.07	-	.07	1.82	-13.9	.8	11.1
		P126-2	385	374	5.3	5.3(6.0-BMP)	1.52	.58	2.10	1.60	-	.00	-	.07	1.67	-2.2	.8	10.9
		P88	385	374	6.0	6.0(6.0-BMP)	2.01	.58	2.59	1.91	-	.00	-	.07	1.99	-3.6	.8	10.6
		P85-1	109	121	10.5	10.1(6.0-GRV)	.64	.27	.91	.43	-	.02	-	.09	.54	-3.7	.6	4.8

TABLE 5.2 - 10 (2)

Summary of Economic Analysis DAVAO DEL NORTE

Cost/Benefit:1991-2017 Discounted Total

Class of Road	Type of Impr't	Road Number	1993 AADT w/o	1993 AADT with	Length (km) Total	Length (km) Improvement	Economic Cost (Mp/km) Construct.	Economic Cost (Mp/km) Period Maint.	Economic Cost (Mp/km) Total	Benefit (Mp/km) Normal	Diverted	Generated	Develop't	Maint sav'g	Benefit (Mp/km) Total	Econom. Indicator NPV (Mp)	B/C	IRR (%)
Minor (Nat'l/ Prov'l)	Rehab/ Imp-1	P79-2	12	52	7.4	7.4(6.0-GRV)	.85	.20	1.05	1.46	-	.17	.11	-.01	1.73	5.0	1.7	25.6
		N5-3	125	130	43.0	43.0(6.0-GRV)	.78	.27	1.05	1.21	-	.08	.08	.07	1.44	16.7	1.4	22.0
		P120	21	30	14.8	14.8(4.0-GRV)	.42	.12	.54	.59	-	.04	.08	.01	.72	2.7	1.3	20.6
		P128	5	55	6.2	6.2(6.0-GRV)	.72	.20	.91	1.01	-	.04	.08	-.01	1.12	1.3	1.2	19.0
		P18	92	139	1.6	1.6(6.0-GRV)	.56	.29	.85	.31	-	.01	.53	.07	.92	.1	1.1	16.5
		P118-1	20	24	7.5	7.4(6.0-GRV) .1(6.0-PCC)	.74	.17	.91	.61	-	.03	.28	.00	.92	.1	1.0	15.2
		P98	2	29	7.0	7.0(6.0-GRV)	.70	.17	.87	.78	-	.02	.05	.00	.85	-.1	1.0	14.6
		P10-1	114	114	8.3	8.3(6.0-GRV)	.55	.28	.84	.50	-	.02	.15	.10	.78	-.5	.9	13.7
		P78	34	40	13.2	13.2(6.0-GRV)	.90	.18	1.08	.71	-	.03	.08	.03	.83	-3.2	.8	11.3
		P126-1	28	31	7.7	.1(6.0-PCC) 7.6(6.0-GRV)	1.02	.17	1.19	.77	-	.04	.06	.02	.89	-2.3	.7	10.7
		N8	8	46	17.8	17.8(6.0-GRV)	1.34	.19	1.53	.96	-	.05	.03	-.01	1.04	-8.7	.7	9.6
		P129	24	29	3.8	3.8(6.0-GRV)	.64	.18	.81	.44	-	.02	.08	.02	.56	-1.0	.7	9.3
		P4-2	35	39	2.6	2.6(6.0-GRV)	1.67	.19	1.86	.75	-	.20	.11	.01	1.07	-2.0	.6	8.1
		P124	152	246	15.9	15.9(6.0-GRV)	1.19	.42	1.61	.82	-	.07	.09	.07	1.06	-8.9	.7	7.4
		P140	34	49	10.3	10.3(6.0-GRV)	1.03	.19	1.22	.57	-	.02	.08	.01	.68	-5.6	.6	6.9
		P95	36	41	10.7	10.7(6.0-GRV)	.91	.18	1.09	.54	-	.03	.03	.01	.62	-5.0	.6	6.7
		P27	36	31	3.2	3.2(6.0-GRV)	.68	.18	.85	.42	-	.02	.03	.02	.49	-1.2	.6	6.4
		P11-2	76	61	3.9	3.9(6.0-GRV)	.64	.20	.84	.26	-	.01	.10	.09	.46	-1.5	.5	5.6
		P146	37	29	16.2	16.2(6.0-GRV)	1.01	.17	1.19	.36	-	.03	.05	.02	.46	-11.7	.4	2.1
		P87	14	17	4.3	4.3(6.0-GRV)	1.50	.17	1.68	.20	-	.02	.12	.00	.34	-5.7	.2	.0
		P67	1	7	2.5	2.5(6.0-GRV)	1.25	.17	1.42	.11	-	.00	.06	.01	.19	-3.1	.1	.0
		P91-2	45	77	8.7	8.7(6.0-GRV)	.70	.23	.93	.11	-	.01	.10	.02	.23	-6.0	.3	.0
	Imp-2/ Widen	P85-2	148	146	2.7	2.7(6.0-GRV)	.69	.29	.98	.91	-	.00	2.16	.11	3.18	5.9	3.2	37.0
		P54	58	75	3.2	3.2(6.0-GRV)	.52	.22	.73	.84	-	.03	.55	.05	1.46	2.3	2.0	35.9
		P40	143	145	2.8	2.8(6.0-GRV)	.49	.27	.76	.60	-	.02	.22	.11	.94	.5	1.2	19.7
		P74	160	164	3.3	2.1(6.0-AC)	1.91	.03	1.94	1.82	-	.00	.06	.08	1.97	.1	1.0	15.3
		P4-1	68	66	4.8	4.8(6.0-GRV)	.51	.20	.72	.46	-	.02	.17	.06	.72	.0	1.0	15.1
		P36	134	139	6.4	4.8(6.0-GRV)	1.07	.29	1.36	.81	-	.02	.04	.10	.97	-1.9	.7	9.3
		P14	215	215	7.6	3.8(6.0-BMP)	2.68	.30	2.98	1.54	-	.00	.07	.06	1.67	-4.9	.6	8.2
		P79-1	78	79	5.7	5.7(6.0-GRV)	.98	.22	1.20	.49	-	.01	.14	.08	.72	-2.7	.6	7.8
		P10-2	59	55	3.4	3.4(6.0-GRV)	.49	.20	.68	.26	-	.00	.04	.06	.36	-1.1	.5	3.6
		P2	67	60	7.0	7.0(6.0-GRV)	1.16	.22	1.38	.24	-	.01	.13	.08	.46	-6.5	.3	1.8

TABLE 5.2 - 10 (3)

Summary of Economic Analysis DAVAO DEL NORTE

Cost/Benefit:1991-2017 Discounted Total

Class of Road	Type of Impr't	Road Number	1993 AADT w/o	1993 AADT with	Length (km) Total	Length (km) Improvement	Economic Cost (Mp/km) Construct.	Economic Cost (Mp/km) Period Maint.	Economic Cost (Mp/km) Total	Benefit (Mp/km) Normal	Diverted	Generated	Develop't	Maint'g saving	Benefit (Mp/km) Total	Econom. Indicator NPV (Mp)	B/C	IRR (%)
Minor (Barangay)	Rehab/Imp-1	B05-30	174	157	7.1	7.1(4.0-GRV)	.50	.21	.71	1.72	-	.08	.39	.12	2.31	11.4	3.3	49.5
		B20-4	2	24	9.5	9.5(4.0-GRV)	.44	.12	.56	.89	-	.39	.74	.00	2.02	13.8	3.6	48.7
		B14-19	9	37	5.8	5.8(4.0-GRV)	.45	.11	.56	.74	-	.03	.14	.00	.92	2.1	1.6	25.5
		B08-23	40	64	14.2	14.2(4.0-GRV)	.45	.14	.59	.22	-	.02	.07	.01	.32	-3.8	.5	5.9
		B10-12	9	11	14.2	14.2(4.0-GRV)	.56	.11	.68	.20	-	.08	.04	.00	.31	-5.2	.5	4.5
		B13-11	1	14	15.0	15.0(4.0-GRV)	1.06	.11	1.17	.33	-	.03	.04	.00	.41	-11.4	.3	2.0
	New Const.	B19-1	0	8	24.2	24.2(4.0-GRV)	.58	.11	.70	.40	-	.07	.09	-.02	.53	-4.0	.8	10.9
		B20-10	0	5	7.4	7.4(4.0-GRV)	.57	.11	.68	.16	-	.06	.11	-.02	.31	-2.7	.5	5.4